CITY OF REDMOND, OREGON

2010 STANDARD SPECIFICATIONS

DIVISION III – SANITARY & STORM SEWER FACILITIES

301 TRENCH EXCAVATION, BEDDING AND BACKFILL

301.1.00 DESCRIPTION

Minimum general standards for sewer facilities shall conform to the ***Oregon Standard Specifications for Construction,*** latest edition. This section covers trench excavation, trench foundation, pipe bedding, pipe zone, trench backfill.

301.1.01 TRENCH EXCAVATION, BEDDING, AND BACKFILL

See Division I Trenches

301.3.00 CONSTRUCTION

301.3.01 TRENCH EXCAVATION

301.3.01A General

The Contractor shall secure and comply with applicable State, County, or City street cutting permits. The Contractor shall comply with all City, County, State and Federal Highway Construction Safety and Health Standards. Prior to installing a sewer facility in an unimproved street, the street shall be brought to subgrade to assure that adequate bury, depth of cover, and utility separation is achieved.

301.3.02 TRENCH BACKFILL

See Division I Trenches

301.4.00 MEASUREMENT AND PAYMENT

301.4.01 LINEAR FOOT BASIS

The length of trench shall be measured horizontally from centerline to centerline of manholes or to the end of the pipe, whichever is applicable. Measurement of the various depth classes, as stated in the Schedule of Bid Items, will be from the pipe invert elevation as constructed to the design subgrade elevation at the point of measurement.

Payment for TRENCH EXCAVATION will be at the unit price bid per lineal foot at the specified diameter for the depth class as measured. Payment shall include all materials, tools, labor, equipment, bedding, backfill and incidentals required to excavate and backfill the trench as specified. There will be no separate payment for rock excavation unless specifically called for in the Schedule of Bid Items.

301.4.02 INCIDENTAL BASIS

When not listed in the Schedule of Bid Items as a separate pay item, TRENCH EXCAVATION shall be considered incidental to the price bid for pipe.

303 PIPE AND FITTINGS (SANITARY SEWER)

303.1.00 DESCRIPTION

This section covers all work necessary for the installation of sanitary sewer pipe and fittings.

303.2.00 MATERIALS

303.2.01 GENERAL

Sanitary sewer pipe shall be designated as either gravity main or pressure main for purposes of this specification. Unless otherwise specified, all gravity sewer and pressure pipe in the project shall be polyvinyl chloride (PVC) of the size and pressure class called for on the plans. Where more than one type of material is considered appropriate, the type required will be designated on the plans.

At the sole discretion of the City, the Contractor and/or material supplier shall provide certified manufacture date of any PVC pipe with visible cracking, discoloration, or fading due to ultraviolet light exposure. Pipe which is one year or older from the date of manufacture may be rejected. The City reserves the right to reject pipe material for cause regardless of the age of pipe.

303.2.02 POLYVINYL CHLORIDE PIPE

303.2.02A Gravity Sewer Pipe

1. Rigid PVC pipe compounds used in gravity sewer pipe shall conform to ASTM D1784, Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (PVC) Compounds.

2. PVC pipe shall conform to ASTM D3034, standard dimensions ratio not to exceed 35, or to ASTM F679, minimum pipe stiffness (F/Δy) at 5% deflection of 46 psi or 115 psi for all sizes when tested in accordance with ASTM D2412. Provide manufacturer's certification, including test results, for all materials supplied under these Specifications.

3. All piping system components of a pipe class shall be the products of one manufacturer.

4. Where minimum cover cannot be maintained, or where directed by the Engineer, pipe shall be PVC water pipe meeting the requirements of AWWA C900 specifications, ***Polyvinyl Chloride (PVC) Pressure Pipe.***

303.2.02B Pressure Sewer Pipe

1. Pipe shall be Class 160 (160 psi) rigid PVC Class 12454-B, conforming to ASTM D1784 and ASTM D2241 or ASTM D1785 and ASTM D2241; or

2. Pipe shall be Class 150- PVC C900 and have a minimum DR of 18 unless otherwise specified.

3. All piping system components of a class shall be the products of one manufacturer.

4. Where minimum cover cannot be maintained, or where directed by the Engineer, Pipe shall be PVC water pipe meeting the requirements of AWWA C900 specifications, ***Polyvinyl Chloride (PVC) Pressure Pipe.***

5. Purple non-metallic tape shall be laid 12inches above the pipe when using white or blue plastic pipe in pressure sewer installation.

303.2.03 JOINTING MATERIALS

303.2.03A Polyvinyl Chloride Pipe

1. GRAVITY SEWER PIPE

Joints shall be rubber gasketed conforming to ASTM D3212 for gravity sewers. Gaskets shall conform to ASTM F477. All bells shall be formed integrally with the pipe and shall contain a factory installed elastomeric gasket. Lubricant for jointing shall be as recommended by the pipe manufacturer.

2. PRESSURE SEWER PIPE

Joints shall be rubber gasketed conforming to the manufacturers recommendations for the pressure class specified. Gaskets shall conform to ASTM F477. Lubricant for jointing shall be as recommended by the pipe manufacturer.

303.2.04 FITTINGS

303.2.04A Poly Vinyl Chloride Pipe

1. GRAVITY SERVICE FITTINGS

a. PVC pipe fittings shall conform to ASTM D3034, standard dimensions ratio not to exceed 35 or to ASTM F679. Provide manufacturer's certification, including test results, for all materials supplied under this Specification.

b. All fittings shall be the same as the joints used on the sewer pipe. Caps or plugs shall be furnished with each tee outlet or stub with the same type gasket and joint as furnished with the service connection pipe specified for future service connections. The plug or cap shall be banded or otherwise secured to withstand all test pressures involved without leakage.

c. Lateral connections to the main shall be made with Tee-Wyes.

2. PRESSURE SEWER FITTINGS

a. Gate Valves (Isolation Valves)

Gate valves shall be iron-body, resilient-seated gate valves conforming to AWWA C509, "Ken-seal" valves as manufactured by Kennedy Valve Co. or equal. Gate valves shall be polymer coated inside and out, have flanged or threaded ends, and a non-rising stem. Unless otherwise specified, gate valves shall be supplied with a 2 inch operating nut and 0-ring joints. Gate valves installed in vaults or above ground shall be supplied with hand wheels.

b. Check Valves

Check valves on pressure sewers, except for service lines, shall be spring loaded, external lever actuated, iron-body, flanged end, resilient seat check valves, Kennedy model 106 ALS or equal. APCO model 104P3 with backflow device may be used in certain applications as approved by the Engineer. Commercially available PVC check valves may be used for individual 3" diameter service lines where the total head at the check valve does not exceed 25 feet.

c. Valve Enclosures

Valve enclosures for check valves and gate valves shall be concrete in traffic areas, and may be plastic elsewhere. Covers shall have the word "SEWER" in raised letters. Top section and base section shall have minimum overlap of 4 inches.

d. Pressure Pipe Cleanouts

Cleanouts shall be constructed as indicated on the Standard Drawings. Box shall be a standard valve box.

e. Pressure Pipe Air-release Valves

Air-release valves shall be installed as indicated on Standard Drawing 3-5, complete with 2"

shut-off valve, 1" blow-off valve, quick disconnect coupling and backflushing apparatus, APCO Model 400, or approved equal. Valve shall provide for an operating pressure range of 0-50 psi.

f. Saddles

Saddles shall be nylon coated, ductile iron body saddles with double stainless steel straps equivalent to Type 357 service saddles as manufactured by Smith-Blair.

g. Valve Boxes

Valve boxes subject to traffic loading shall be a two piece grade adjustable box. The valve box shall be 5" I.D. with a slip top section without a dirt flange on the bottom as shown in the Standard Drawing. Valve boxes shall be Rich 926 (c) or equal. The extension piece shall be of the proper length for depth of cover. The word "SEWER" shall be cast into the top of the lid, and lid shall be filled with concrete.

h. Bends, Tees and Other Fittings

Pressure sewer fittings shall be ductile iron meeting the requirements of AWWA C110 or AWWA C153 and shall have a minimum working pressure of 250 psi. Fittings shall be restrained to meet the anticipated loading using grip ring gaskets or mechanical joint restraint.

303.2.05 Detection Tape and Detection Wire

Detection tape shall be installed on all non-metallic gravity sewer mains. Detection tape shall be 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 only 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, UF bury, solid copper wire. The wire shall be attached to the top of the pipe. Where a splice is necessary, the wire shall be joined with a King KWC 100 tan watertight connector, or equivalent as approved by the Engineer. For service connections, detection wire shall be brought to the ground surface within the cleanout access box, allowing for adequate length (approximately 6 inches) for locator connection.

303.2.06 Insulation

Pipe insulation when required shall be a minimum of 2-inch thickness, CPR Upjohn-Trymer bun material, Manville Micro-Lok, or equivalent, covered with an aluminum roll jacketing, 0.016-inch minimum thickness, PABCO Surefit Aluminum Jacketing, Manville Micro-Lok, or equivalent. Insulation shall have a maximum conductivity ("K") of 0.40. Insulation at pipe supports shall be calcium silicate or other approved rigid insulation adequate to support the pipe. Jacketing joints shall be sealed within silicone caulk. Pipe supports and hangers shall be plated or hot dipped galvanized after fabrication.

303.2.07 Concrete

Concrete for thrust blocking and support structures shall conform to ASTM C 94, Alternate 2, and shall be proportioned to obtain a 28-day compressive strength of 2500 pounds per square inch or approved equal. Sacrete mix type products are not allowed.

303.3.00 CONSTRUCTION

303.3.01 LINE AND GRADE

Project shall be staked according to General Specifications and City Standards for street construction.

Line and grade may not vary more than 1/32 inch per inch of pipe diameter subject to the following limitations:

a) Variance may not exceed ½ inch regardless of pipe diameter
b) Variance must not result in level or adverse slope

303.3.02 PIPE DISTRIBUTION AND HANDLING

303.3.02A Pipe and Fitting Storage
Material shall be stored on the job from cars, trucks, or storage yard no sooner than can be used to good advantage. Pipe and fittings shall be stored and covered in such a manner as to prevent damage or contamination.

303.3.02B Handling Material
Proper implements, tools, and facilities shall be provided by the Contractor for the safe and convenient prosecution of the work. The Contractor shall protect pipe and fittings from contamination or damage at all times. All pipe, fittings, and valves shall be transported and handled in a manner to prevent damage to the pipeline materials and protective coatings and linings. Under no circumstances shall pipeline materials be dropped or dumped off trucks or into the trench. No more pipe shall be laid out along open ditch prior to installation than can be installed and backfilled in one work shift. Pipeline materials shall be removed from storage area as needed for installation,

303.3.02C Cleaning Pipe and Fittings
All foreign material shall be removed from the bell-and-spigot ends of each pipe as installation proceeds. When deemed necessary by the City Inspector, the outside of the spigot and the inside of the bell shall be wiped clean, dry, and free from oil, grease, or ice before the pipe is laid. The ends of solvent weld pipe and fittings, and of rubber gasket joint pipe and fittings, shall be wiped clean of all dirt, grease and foreign matter.

303.3.03 LAYING PIPE ON CURVES
The Contractor shall lay pipe on horizontal or vertical curves in accordance with the manufacturer's recommendations. Pipelines intended to be aligned straight between manholes shall be so laid, and in no case shall the deviation from the straight line at any joint exceed 1/2-inch.

303.3.05 PIPE PLACING AND JOINTING
Trench excavation, bedding, and backfill shall be in accordance with Division I - Trenches.

303.3.05A Placing Pipe in the Trench
Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed into the trench. If the pipe laying crew cannot place the pipe in the trench and install it without getting dirt in the pipe, the Inspector may require that, before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe. Between each shift, pipe end shall be plugged to prevent any objects or animals from entering.

303.3.05B Unsuitable Conditions for Installing Pipe
Pipe shall not be installed when there is water in the trench bottom, or when, in the opinion of the Inspector, trench conditions are otherwise unsuitable.

303.3.05C Pipe Cutting
Pipe shall be cut in a neat and professional manner with proper tools intended for that purpose and without damaging the ends of the pipe. The pipe shall be cut so as to leave a smooth end at right angles to the axis of the pipe. The cut end shall be dressed in conformance with the pipe manufacturer's recommendation.

303.3.05D Solvent Welded Joints
After a length of Solvent Weld pipe is placed in the trench, both the spigot end and the receiving bell shall receive a thorough application of primer and glue as per the manufacturer's specifications. Precaution shall be taken to prevent dirt from entering the joint space. The pipe (spigot end) shall be centered, inserted, seated, and rotated at least 90 degrees. The pipe shall be brought to correct line and grade along its length, and secured in place with approved backfill material. Pipe and fittings which do not allow a sufficient and uniform space for jointing shall be removed and replaced with pipe and fittings of proper dimensions to assure such uniform space.

303.3.05E Number of Pipes Laid before Jointing
Solvent weld and rubber gasket joint pipe shall be connected immediately as they are placed in the trench.

303.3.05F Prevention of Trench Water from Entering Pipe
When pipe installation is not immediately progressing, the open ends of pipe in the trench shall be sealed with a watertight plug, or other means approved by the Inspector, and no trench water shall be permitted to enter the pipe. These provisions shall apply during midday breaks and at the end of each shift. If water is present in the trench, the seal shall remain in place until the trench is pumped completely dry.

303.3.05G Bell End Direction
Pipe shall be laid with bell ends facing upgrade/upstream unless otherwise directed by Engineer.

303.3.05H Seating Rubber Gasket Joint
After a length of pipe with rubber gasket joint is placed in the trench, the plain end shall be centered in the bell, and the pipe properly seated and brought to correct line and grade along the entire length. Pipe and fittings which do not allow a sufficient and uniform space for jointing shall be removed and replaced with pipe and fittings of proper dimensions to provide for such space. Precautions shall be taken to prevent dirt or contaminants from entering the joint space.

303.3.05I Jointing Rubber Gasket Fittings
PVC fittings with rubber gasket type joint shall be laid and jointed in strict accordance with the manufacturer's recommendations as approved by the Inspector and in accordance with the requirements of the Special Specifications (if applicable). The Contractor shall provide all special tools and devices such as special reamers, rasps, and similar items required for the installation. Lubricant for the pipe gaskets shall be of the type recommended by the pipe manufacturer, and no substitutions will be permitted under any circumstances.

Fittings, plugs, and caps shall be set and jointed to pipe in the manner prescribed by these specifications, or as otherwise approved by the City Engineer or City Representative. MJ Style couplings, such as Romac RC501 or XR501, shall be used for dissimilar pipe materials. Special conditions encountered for which suitable adapter couplings are not available, such as rare or discontinued pipe materials, shall be referred to the City Engineer for consideration of an approved method.

303.3.05J Joints For Dissimilar Pipe
Adaptors for transitioning between ASTM D3034 PVC sewer pipe and AWWA C900 pressure pipe shall meet the requirements of AWWA C907. Concrete pipe to PVC pipe shall be joined with properly sized transition couplings meeting the requirements of AWWA C219. For 8” to 24” pipe, use Romac RC501 Reducing Coupling or approved equal. For pipe larger than 24”, use Romac RC400 Steel Reducing Coupling or approved equal.

303.3.05K Pressure Service Connections and Fittings
Service connections shall be designed and approved on an individual basis. Materials required will be specified and designated on approved plans. Pressure service pipe shall be no larger than 3" diameter and shall be connected to the City system by City crews with a gate valve and check valve assembly.

303.3.05L Bridge Crossing Pipe
Pipe for bridge crossing shall be ductile iron as specified herein, except that restrained joint pipe may be used and deflected within the limits of the manufacturer's recommendations to facilitate wingwall penetration and overall alignment. Flanged fittings may be used for the wing wall penetrations. Bridge crossing pipe shall be insulated with a urethane or fiberglass pipe wrap system specifically designed for pipe insulation purposes.

303.3.06 DEFLECTION AT JOINTS
Wherever it is necessary to deflect pipe from a straight line, either in a vertical or horizontal plane, a manhole shall be required. Where long-radius curves are permitted by the Engineer, the amount of deflection allowed at each joint shall be uniform and not exceed that indicated in the manufacturer's specifications.

Variation in invert elevations between ends of jointed pipes must not exceed 1/64 inch per inch of pipe diameter to a maximum of ½ inch regardless of pipe diameter.

303.3.07 REQUIREMENTS PRIOR TO TESTS

303.3.07A General
All gravity systems and appurtenances shall successfully pass a hydrostatic or air test prior to acceptance, and shall be free of visible leakage. Information regarding air testing may be obtained from the Engineer.

On pipe 54" diameter and larger, individual joints may be tested by an approved joint testing device. All details of testing procedure shall be subject to approval of the Engineer.

303.3.07B Plugging of Tees, Wyes, Stubs and Service Connections
The Contractor shall plug all wyes, tees, stubs, and service connections with gasketed caps or plugs securely fastened or blocked to withstand the internal test pressure. Such plugs or caps shall be removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

303.3.07D Time of Test
The Contractor shall perform system testing during the normal work day, scheduling the plugging, capping and other preparatory work so as to complete the testing during daylight hours.

303.3.07E Lines Not Passing Requiring Testing and Inspection
The Contractor shall repair or replace any portion of the system not passing the air or hydrostatic test In a manner conforming to these specifications. Infiltration of ground water in an amount greater than allowed by specifications following a successful hydrostatic or air test shall be considered as evidence that the original test was in error or that partial failure of the system has occurred. The Contractor shall correct such failures occurring within the warranty period in a manner approved by the Engineer, and at no additional expense to the Owner.

303.3.08 REPAIRS

All repair or replacement of existing sewer pipe must conform to City Standards and Specifications. The City's Wastewater Division must be notified of any damage to existing sewer pipe. The pipe must remain exposed until it is inspected by a City representative. Repair method must be approved by the City and repairs must be inspected prior to backfill. After trench backfill is placed and compacted, the City will conduct a video inspection and any work not meeting City standards will be corrected by the Contractor. Video inspection fees will be charged to the party that damaged the line in accordance with the fee schedule in effect at the time.

303.3.09 HYDROSTATIC TESTING (PRESSURE PIPE)

303.3.09A General

Pressure sewer lines shall be tested by hydrostatic methods. The Contractor shall furnish all necessary equipment and material, and make all taps in the pipe as required for testing purposes. The City Engineer or City Inspector will monitor the tests. The test pressure shall be two times the calculated operating pressure, but not less than 50 psi for the low end of the pipe. For high pressure lines, the test pressure shall not exceed the manufacturer's maximum operating pressure recommendation.

303.3.09B Equipment

Furnish the following equipment and materials for the tests:

Amount	Description
2	Approved Graduated Containers
2	Pressure Gauges
1	Hydraulic Force Pump Approved by the Engineer Suitable Hose and Suction Pipe as Required

303.3.09C Backfilling and Thrust Blocks

Perform the testing after the trench has been completely backfilled. The Contractor may conduct an initial test, if field conditions permit as determined by the Engineer, by partially backfilling the trench and leaving the joints open for inspection. The acceptance test shall not, however, be performed until all backfilling to subgrade has been completed. Where any section of pipe is provided with concrete thrust blocking, the pressure test shall not be conducted until five days after the concrete blocking was placed. If high-early strength cement is used for the concrete thrust blocking, the curing time may be reduced to two days.

303.3.09D Procedure

After backfilling the trench, fill pipe with water. Expel all air from pipe prior to test. Make up any water lost by absorption, and then apply test pressure with suitable pump. Valve off line when test pressure is determined to be stabilized, and conduct pressure test for two hours. At the end of the test period, add water with the pump to raise system back up to test pressure. Measure the quantity of water required to restore test pressure. The pipe shall be deemed to have passed if this makeup water is less than that calculated for allowable leakage.

Allowable leakage shall be determined by the formula -

$$L = \frac{ND(P)^{0.5}}{7400}$$

L= Allowable leakage (gal./hr.)
N = Number of joints in the section tested (pipe and fittings)
In 1000' there are 50 pipe joints. Each fitting has 2 joints
D = Nominal diameter of pipe (in.)
P = Average test pressure. Equal to gage pressure less ½ static head where gage is located at the low point of the line. Where gage is located at the high point, add 1/2 static head.

Allowable Leakage per 1,000 feet for Mechanical Joint or Push-On Joint Pipe in 20 Foot Nominal Lengths Not Including Fittings (gallons per hour)

Nominal Pipe Size	Average Test Pressure in Line (psi)				
Inches	50	100	150	200	250
4	0.19	0.27	0.33	0.38	0.43
6	0.29	0.41	0.50	0.57	0.64
8	0.38	0.54	0.66	0.76	0.85
10	0.48	0.68	0.83	0.96	1.07
12	0.57	0.81	0.99	1.15	1.28
14	0.67	0.95	1.16	1.34	1.50
16	0.76	1.08	1.32	1.53	1.71
18	0.86	1.22	1.49	1.72	1.92
20	0.96	1.35	1.66	1.91	2.14
24	1.15	1.62	1.99	2.29	2.56
30	1.43	2.03	2.48	2.87	3.20
36	1.72	2.43	2.98	3.44	3.85

303.3.10 AIR TESTING (GRAVITY PIPE)

303.3.10A General

The Contractor has the option after completing installation of the system, including all service connections, backfilling and compaction, of conducting a low pressure air test in lieu of the hydrostatic test. The Owner may require testing of manhole to manhole sections as they are completed for the purpose of expediting acceptance of the system and to allow connections to be made before the entire system is complete.

The test shall be performed at no additional expense to the City. The Contractor shall provide all equipment and personnel for the test. The method, equipment, and personnel shall be subject to the approval of the Engineer. The Engineer may, at any time, require a calibration check of the instrumentation used. The pressure gauge shall have minimum divisions of 0.10 psi and have an accuracy of 0.0625 psi (one ounce per square inch). All air used shall pass through a single control panel.

The Air Test described in this section shall be used for plastic pipe. The Air Test indicated in the APWA Standard Specifications shall be used for all other materials. Where a question exists as to the appropriateness of the method to be used, the method resulting in the longest test period shall be used.

303.3.10B 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 as necessary.

All air testing equipment must be placed above ground, and no person shall be permitted to enter a manhole or trench where a plugged line is under pressure. All pressure must be released before plugs are removed. The testing equipment used 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 of the test pressures in order to avoid excessive pressure. The Contractor shall use care to avoid flooding of the air inlet by ground water. The Contractor shall inject the air at the upper plug if possible. Only qualified personnel shall be permitted to conduct the test.

303.3.10C Ground Water
The presence of ground water will affect results of the test. The average height of ground water over the pipelines must be determined immediately before starting the test. The method of checking the ground water height shall be as approved by the Engineer.

303.3.10D Method
All air testing shall be by the Time Pressure Drop Method. The test procedures are described as follows:

1. Clean the lines to be tested and remove all debris where noted.
2. The Contractor has the option of wetting the lines prior to testing.
3. Plug all open ends with suitable test plugs. Brace each plug securely.
4. Check the average height of the ground water over the pipe. The test pressures required below shall be increased 0.433 psi for each foot of average water depth over the line.
5. Add air slowly to the section of system being tested until the internal air pressure is raised to 4.0 psig greater than the average back pressure of any ground water that may submerge the pipe.
6. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize adding only the amount of air required to maintain pressure.
7. After the temperature stabilization period disconnect the air supply.
8. At any convenient observed pressure reading between 3.5 and 4.0 pisg greater than the average external pressure of any groundwater above the pipe, begin timing the pressure loss. If the time shown in the table below for the designated pipe size and length elapses before the air pressure drops 0.5 psig, the section is considered to have passed the test. The test may be discontinued once the prescribed time has elapsed, even though 0.5 psig loss has not occurred.
9. Technical data
    a. Allowable air loss rate (Q) - The value for Q is 0.0015 cubic feet per minute per square foot of internal surface.
    b. Testing main sewers with services - If lateral sewers such as services are included in the test because of the difficulty in isolating such lateral sewer, their lengths may be ignored for computing test times. Ignoring the laterals results in a slightly more severe test.
    c. Rounding off pipe lengths - Rounding off pipe lengths shall always be to the next higher length value shown, i.e., the test time for 201' shall be the times shown for 250'. At the discretion of the Inspector, test times for a unique pipe length may be linearly interpolated from the next higher and lower times indicated.

Specification Time for Length (L) Shown
(min:sec)

Pipe Dia.(in)	Min. Time Min:Sec	Length For Min. Time (ft)	Time For Longer Length (sec)	100ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft
6	2:50	398	0.427L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12	3:33
8	3:47	298	0.760L	3:47	3:47	3:47	3:47	3:47	4:26	5:04	5:42	6:20
10	4:43	239	1.187L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	9:54
12	5:40	199	1.709L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	14:16
15	7:05	159	2.671L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	22:16
18	8:30	133	3.846L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51	32:04
21	9:55	114	5.235L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16	43:38
24	11:20	996	837L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	56:59

303.3.11 CLOSED CIRCUIT TELEVISION INSPECTION OF SANITARY AND STORM SEWERS

The City shall televise all lines before the placement of street base material and paving. Charge for this service is listed in the fee schedule.

Prior to CCTV inspection the following conditions need to be met:

1) All sewer trenches are to be completely backfilled and compacted as specified in Division 1 Trenches.
2) All manholes to be in place with covers exposed.
3) All grouting of pipes and channels in manholes are to be finished.
4) All curbs in place.
5) Streets clear of materials and debris to allow inspection equipment access to point(s) of inspection.
6) Manholes are to be constructed to grade. If manhole is more than one foot above surrounding grade, ramping is required.
7) The Contractor must remove all large, construction debris from the line prior to inspection. The City will clean and flush sediment from all pipelines just prior to CCTV Inspection.
8) CCTV inspection should be performed prior to base rock placement.

Findings will be recorded, and the Contractor will be required to correct all deficiencies at no additional expense to the City. Deficiencies include, but are not limited to;

1) Horizontal offsets at joints or fittings in excess of 1/32 inch per inch of pipe diameter (Ex. ¼" for 8" pipe)
2) Vertical offsets at joints or fittings in excess of 1/32 inch per inch of pipe diameter (Ex. ¼" for 8" pipe) if drop is in direction of flow. No offset is allowed if it will create a step up in the direction of flow.
3) Standing water in excess of 3/8 inch
4) Fittings protruding into pipe in excess of ½ inch if above spring line. No protrusion permitted below spring line.
5) Damage to pipe or fittings

Upon correction of deficiencies revealed by television inspections, the Contractor shall notify the Engineer. If the pipe has been cut and repaired or opened in any way, the pressure test must be repeated along with mandrel testing and CCTV inspection. If the corrective work is limited to exposing the pipe and making minor changes to the grade, only mandrel testing and CCTV inspection are required. Additional CCTV inspection testing services will be conducted by the City with cost for

inspection charged to the Contractor or developer in accordance with the current fee schedule.

If at any time during the one year warranty period an examination of the sewer line discloses a deficiency from construction, that deficiency shall be corrected by the Contractor, Developer, Property Owner or other responsible party at no additional expense to the City. Pavement, sidewalk, landscaping or other incidental repairs are the responsibility of the Contractor Developer or Property Owner. The City will consider trenchless repair methods provided they can be shown to provide acceptable corrective action. A CCTV inspection will be completed by the City following all repairs.

303.3.12 MANDREL TESTING

PVC sanitary sewer mains shall be deflection tested by pulling an approved mandrel 95 percent of the inside pipe diameter having at least 6 vanes through the pipe from manhole to manhole. Conduct test after pipe has been flushed and cleaned and no less than 30 days after trench has been backfilled and compacted, but prior to paving.

303.3.13 SERVICE CONNECTION INSPECTION

All Insert-a-tee connections for service lines shall be inspected by the City Inspector prior to backfilling.

303.4.00 MEASUREMENT AND PAYMENT

303.4.01 SEWER PIPE

Payment for stormwater and sanitary sewer pipelines will be made on a lineal foot basis for the various classes, types, and size of pipe listed and installed. The pipeline will be measured horizontally from center-to-center of manholes, or to the end of the pipe, whichever is applicable.

No final payment for sewer pipe in place will be made until the pipeline has successfully passed the air or hydrostatic test and video inspection.

303.4.02 TEE AND WYE FITTINGS

Payment for tee and wye fittings will be made at the unit price for each size and type as listed and installed. Payment for tee and wye fittings will be in addition to payment for sewer from manhole to manhole.

303.4.03 CONCRETE TEE AND WYE ENCASEMENT

Payment for concrete tee and wye encasement will be made at the unit price each for the various sizes of pipe as listed and installed.

303.4.04 INCIDENTAL BASIS

When neither specified nor listed in the proposal for separate payment, Pipe and Fittings (Sanitary Sewer) shall be considered incidental work for which no separate payment will be made.

304 SERVICE LINE SEWERS

304.1.00 DESCRIPTION

This section covers the work necessary for the installation of sewer service lines, service taps, and connections. In general, service lines will extend from the sewer main to the street or alley right of way line.

At the sole discretion of the City, the Contractor and/or material supplier shall provide certified manufacture date for any PVC pipe with visible cracking, discoloration and/or fading due to ultraviolet light exposure. Pipe which is one year or older may be rejected. The City also reserves the right to reject pipe material for cause regardless of age of pipe.

304.2.00 MATERIAL

304.2.03 PIPE AND FITTINGS FOR SERVICE LINES

Sewer service connection lines shall conform to the same specifications as sanitary sewer lines unless otherwise modified by these specifications.

304.2.04 SEWER SERVICE MARKERS

Service connection markers shall be new, one piece Douglas Fir or cedar, 2x4's, utility grade or better, or 2” PVC Schedule 40 pipe. All markers shall be painted green.

304.2.05 SERVICE SADDLES

Service saddles shall be Romac "CB" type saddles or equivalent. The type shall conform to style 101S with painted saddle and stainless steel strap. On sewer pipe with a diameter of 12” or larger, INSERTA TEE® service connections will be acceptable. No other type shall be permitted.

304.2.06 SWING CHECK VALVES

Swing valves shall be APCO series 100 or equivalent. The check valve shall be capable of passing a 3" diameter solid.

304.2.07 GATE VALVES

Iron body, resilient seated gate valves shall be "Kennedy Ken-Seal" type 1561x or equal. Gate valves will meet AWWA standards (C-500), have non-rising stems, be rated at 200 lbs. working pressure and 350 lbs. hydrostatic pressure, open left with 2" square operating nuts, with brass fittings, "0" ring stem pressure seals, non-directional, mechanical joints; as manufactured by Kennedy, Mueller, Waterous, or American Darling.

304.3.00 CONSTRUCTION

Sewer service lines shall not have less than 3.0 feet of cover under roadway area and shall not have less than 2.0 feet of cover to natural ground in the right-of-way. Services shall be extended at minimum grade or as required to provide gravity services to each property or building.

Each property shall be connected to the sewer main or lateral by an independent sewer service. Sewer services to adjacent properties may share the same trench.

Where a sewer service is to be connected to an existing sewer main and no connection fitting is available, the connection must be made by the City of Redmond Wastewater Department. Inspection by the City Engineering Division is required for work in the public right-of-way. Sewer services in new construction areas shall extend to the property line and be marked with material described in 304.2.04

extending a minimum of 6" above the natural ground surface. The distance from natural ground surface to the top of the service connection in feet and inches shall be neatly written in permanent ink on the sewer service marker.

304.3.01 SEWER TAPS

All taps on existing sewer mains shall be performed by City of Redmond Wastewater Division personnel. Contractor shall provide 72 hour advance notice to the City for all taps.

304.3.02 CITY SEWER TAP PREPARATION REQUIREMENTS

The Contractor shall provide a finished trench with appropriate safety shoring meeting OSHA requirements to allow City staff to tap active or existing main lines for service laterals. The full circumference of sewer main shall be exposed and accessible, and wiped free of dirt and foreign material prior to the scheduled arrival of the City tapping crew. When crossing streets, or when required by the City, traffic control shall be provided and maintained by the Contractor. Damage to existing pipe or other utilities in the ground is the responsibility of the excavator.

304.3.03 SEWER SERVICE ABANDONMENT

Sewer services are to be abandoned by cutting and capping service at edge of pavement or back of curb when possible. If sidewalk is curb-tight, cut and cap at back of sidewalk. Remove the cleanout and service line on property side. When converting split services to a single service, remove the 6x4 wye and replace/restore cleanout. Obtain plumbing permit for service abandonment on property.

304.4.00 MEASUREMENT AND PAYMENT

304.4.01 TRENCH EXCAVATION AND BACKFILL

Trench excavation and backfill shall be paid for under the provisions of Sec. 301.4.01.

Where no separate item exists in the Schedule of Bid Items, work for sewer service trench excavation and backfill shall be considered incidental to the work required to provide and install sewer services.

304.4.02 SEWER SERVICE LINE PIPE

Payment for sewer service line pipe will be made on a lineal foot basis for the size and type of pipe shown. Measurement will be made horizontally along the centerline of the service pipe from the main line fitting to the cap or termination of the service line.

No final payment for sewer service line pipe will be made until the section of sewer to which the services are connected has successfully passed the applicable internal pressure test as described in Section 303.

304.4.03 SEWER TAPS

Payment for sewer taps will be made on a per each basis for the type, kind, and size specified, and shall constitute full compensation for constructing the sewer tap complete and in place.

304.4.04 INCIDENTAL BASIS

When neither specified nor listed in the proposal for separate payment, sewer service lines shall be considered incidental work for which no separate payment will be made.

305 PIPE AND FITTINGS (STORM SEWERS)

305.1.00 DESCRIPTION

This section covers the work necessary for the construction of storm sewers. Except as amended or modified herein, the provisions of Section 303 shall apply.

At the sole discretion of the City, the Contractor and/or material supplier shall provide certified manufacture date of any PVC pipe with visible cracking, discoloration and/or fading due to ultraviolet light exposure. Pipe which is one year or older may be rejected. City also reserves the right to reject pipe material for cause regardless of age of pipe.

305.2.00 MATERIALS

305.2.01 GENERAL

Unless otherwise specified, all storm sewer pipe with less than 24 inches of cover to finish grade shall be AWWA C900, 8" thru 12", or AWWA C905, 14" through 24", DR 25 water pipe meeting the requirements of AWWA specifications for ***Poly Vinyl Chloride (PVC) Water Transmission and Distribution Pipe.*** Pipes with more than 24 inches of cover to finish grade may be PVC meeting the requirements of ASTM D3034 SDR 35 for diameters up to and including 15 inch. Pipes larger than 15 inch with more than 24 inches of cover shall meet the requirements of ASTM F679 PS46.

305.3.00 CONSTRUCTION

305.3.01 TRENCH BACKFILL

Trench backfill shall be placed in accordance with the requirements of Division I – TRENCHES, except that the finished backfill shall be water jetted under the direction of the Engineer to demonstrate that all rock crevices that may have been opened up during excavation are sealed.

305.3.02 INSTALLATION

All storm sewer not located under paved roadway shall be provided with one layer of detection tape as required in Standard Drawing 3-1.

305.3.03 CLOSED CIRCUIT TELEVISION INSPECTION

All storm sewers shall be inspected in accordance with Section 303.3.11.

305.4.00 MEASUREMENT AND PAYMENT

305.4.01 TRENCH EXCAVATION AND BACKFILL

Trench excavation and backfill shall be paid for under the provisions of Sec. 301.4.01. Where no separate item exists in the Schedule of Bid Items, work for storm sewer trench excavation and backfill shall be considered incidental to the work required to construct storm sewers.

305.4.02 STORM SEWERS

Payment for storm sewers will be made on a lineal foot basis. Measurement will be made horizontally along the pipe centerline from the finished end to end of the pipe.

305.4.03 INCIDENTAL BASIS

When neither specified nor listed in the proposal for separate payment, storm drains shall be considered incidental work for which no separate payment will be made.

306 MANHOLES

306.1.00 DESCRIPTION

This section covers the work necessary for the construction of sanitary and stormwater sewer manholes. Except as modified or supplemented herein, the provisions of Section 00470 of the ***APWA Oregon Standard Specifications for Construction,*** current edition shall apply.

Manholes shall be located as shown on the Plans or as directed by the City Engineer, or City representative.

306.2.00 MATERIALS

306.2.01 CONCRETE

Concrete shall conform to the requirements of ASTM C94 Alternate 2. Compressive strength for manhole bases and miscellaneous concrete structures shall be not less than 3000 psi at 28 days. Maximum size of aggregate shall be 1 1/2 ". Slump shall be between 2" and 4".

306.2.02 METAL CASTINGS

Covers for sanitary sewer manholes shall comply with Standard Drawing 3-7. Storm sewer manhole covers shall comply with Standard Drawing 3-9. Locking and sealed manhole covers may be required in some locations.

306.2.03 RIM ADJUSTMENT

An adjustment system such as East Jordan Iron Works Infra-Riser or approved equal, shall be used to adjust manhole frame and cover to finish grade. Flexible sealant between manhole frame, Infra-Risers and grade rings suitable for metal concrete and rubber such as Hi-Tec Project 1 4000 Series Modified Poly Sealant or equal.

306.2.04 MANHOLES

306.2.04A Pre-cast Manhole Sections

Materials shall conform to the requirements of ASTM C478. Minimum wall thickness shall be 4 inches. Cones shall have the same wall thickness and reinforcement as riser sections. Joints shall be tongue-and- groove or keylock type. Cone shall be eccentric unless otherwise specified. Flat top manholes shall be used where depth is less than 6 feet.

Minimum manhole diameter shall be as 48" unless otherwise approved by the Engineer

306.2.04B Pre-cast Bases

At the option of the Contractor, pre-cast base sections or manhole bases maybe used provided all details of construction are approved by the City Engineer prior to construction.

306.2.04C Cast In Place Bases

Cast-in-place bases shall be formed prior to setting wall sections, i.e. blocking up walls and casting base beneath will not be acceptable. Options include using block outs in first wall section (over pipe) to use as form or casting base with form ring.

306.2.04D Mortar
Mortar shall conform to the requirements of ASTM C387, or be proportioned 1 part Portland cement to 2 parts clean, well graded sand passing a 1/8-inch screen. Admixtures may be used not exceeding the following percentages by weight of cement: hydrated lime, 10 percent; diatomaceous earth, or other inert materials, 5 percent. Consistency of the mortar shall be such that it will readily adhere to the pre-cast concrete.

306.2.04E Coatings
When required due to corrosion concerns, manholes shall be spray lined with Polyshield HT Elastomeric Polyurea or approved equal.

306.2.05 PIPE FITTINGS
Pipe and fittings shall conform to the applicable portions of Section 303. Tees, ells, and other fittings for drop manholes shall be of the same material as the pipe in the adjacent mains unless specified otherwise.

306.2.06 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 specified for adjacent pipelines. Where there are two different classes of pipe at a manhole, the higher strength pipe shall govern strength classification. Rubber-gasketed water tight plugs shall be furnished with each stub-out and shall be adequately braced for hydrostatic or air test pressure.

306.3.00 CONSTRUCTION

306.3.01 GENERAL

306.1.01A Foundation Stabilization
If in the opinion of the Engineer, unstable material exists that will not support the manhole or other structure, the Contractor shall excavate to suitable supporting material and backfill with compacted foundation stabilization material to the design grade as directed by the Engineer.

306.3.01B Pipe Connections
All pipes entering or leaving the manhole or vault shall be provided with flexible joints within 18 inches of the manhole structure, and shall be placed on firmly compacted bedding. Special care shall be taken to see that the openings through which the pipes enter the structure are completely watertight. Flexible joints shall be constructed with rigid PVC repair couplings or the bell end of a PVC pipe section. Flexible rubber couplings are not an acceptable flexible joint.

306.3.02 PRECAST CONCRETE MANHOLES

306.3.02A Bases
If bases are cast-in-place, the concrete shall be consolidated by mechanical vibration. The concrete shall be screed off so that the first manhole section to be placed has a level uniform bearing for the full circumference.

Pre-cast base sections shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment, and assuring that all entering pipes can be inserted on the proper grade.

The minimum open channel length thru the manhole shall not be less than the diameter of the manhole less 12", i.e., 48" manhole requires a 36" minimum channel length. All pipes entering or leaving shall be provided with flexible joints within 18" of the exterior wall of the manhole structure.

306.3.02B Frames and Covers

The final elevation for each manhole shall be within 1/4" of the finished street grade. It is permissible to adjust the manhole frame to final grade after street paving provided that the structure is low enough so as not to interfere with the street paving operation. Patching material shall be asphalt concrete or Portland Cement Concrete with a maximum patch diameter of 6 feet.

Manhole cover shall have two holes. A cut out at the rim should be provided for raising the lid.

Concrete grade rings may be used to bring the manhole frame and cover to grade, but the distance from the top of the flat top or cone section to the bottom of the manhole cover cannot exceed 18 inches. Grade rings shall be set in a bed of mortar that covers the full surface of the grade ring at a depth of ½ inch or less. Minimum grade ring thickness is 3 inches. Infra-risers or equal shall be used between the manhole frame and concrete with beveled risers used to adjust to the slope of the pavement. Apply a mastic between the grade ring, cone or flattop and the Infra-riser, between layers of Infra-risers and between the Infra-riser and manhole frame.

306.3.02C Cleanouts

Cleanouts are not acceptable on gravity sanitary or storm sewer lines in lieu of a manhole. Sanitary sewer cleanouts on pressure systems shall be located as shown on the plans.

306.3.03 MANHOLE TESTING

Manholes shall be tested using either hydrostatic or vacuum methods as specified by APWA Oregon Standard Specifications Section 00470.71.

306.4.00 MEASUREMENT AND PAYMENT

306.4.01 MANHOLES

Payment for manholes will be made on a per each basis as listed in the Bid Schedule for the type and size shown. Payment shall include all materials, labor, equipment, and incidentals necessary to construct and test manholes complete and in place as shown.

306.4.02 INCIDENTAL BASIS

When neither specified nor listed in the proposal for separate payment, Manholes shall be considered incidental work for which no separate payment will be made.

307 CATCH BASINS AND INLETS

307.1.00 DESCRIPTION

This section covers the work necessary to construct catch basins at the locations shown on the plans and Standard Drawings. Except as modified or supplemented herein, the provisions of Section 00470 of the ***APWA Oregon Standard Specifications for Construction,*** current edition shall apply.

Construction of City standard double and single or curb inlet catch basins, frames and grates shall conform to Standard Drawings 3-10, 3-11 and 3-12.

307.2.00 MATERIALS

307.2.01 EXCAVATION AND BACKFILL

Excavation and backfill shall conform to the requirements of Section 301.

307.2.02 WELDED FRAMES AND GRATES

The Contractor shall furnish grates conforming to Standard Drawings. The Owner has the option to supply grates, which will be listed in the Special Provisions. Ductile iron grates matching the dimensions in Standard Drawing 3-12 may be substituted for steel grates.

307.3.00 CONSTRUCTION

307.3.01 EXCAVATION AND BACKFILL

After backfilling and mechanical compaction is complete, the backfill around catch basins shall be water jetted if directed by the Engineer. Water jetting shall continue until all evidence of subsidence disappears. When dry, subsided areas shall be backfilled with appropriate material. The Engineer may then require water jetting of the entire backfill to be repeated. Other techniques include mechanical compaction.

307.3.02 FORMING, POURING, AND CURING

Pipe connections shall be grouted on the interior and exterior of all stormwater structures.

307.3.03 FRAMES AND GRATES

The grate frame shall be set into the concrete structure. The dimensions of the various grate frames are shown on the standard drawings.

Catch basin grates shall be placed after street paving has been completed. In the interim, 2" wood planking shall be substituted to protect the structure during street construction.

307.4.00 MEASUREMENT AND PAYMENT

307.4.01 CATCH BASINS AND INLETS

Measurement and payment for catch basins will be made on a per each basis for the number and type constructed. Payment shall constitute full compensation for all tools, materials, work and incidentals required to complete the work.

307.4.02 EXCAVATION

Where not listed as a separate item, excavation for any drainage structure will be considered incidental to the price bid to construct the structure. Where listed as a separate item, excavation will

be measured by the cubic yard to the nearest 1 cubic yard. The dimensions for measuring excavation will be the exterior dimensions of the drainage structure as designed and specified by the Engineer. Payment for excavation will be at the contract unit price bid for excavation.

307.4.03 INCIDENTAL BASIS

When neither specified nor listed in the proposal for separate payment, Catch Basins and Inlets shall be considered incidental work for which no separate payment will be made.

308 DRYWELLS, SWALES AND PONDS

308.1.00 DESCRIPTION

This section covers the work necessary to construct drywells, swales, ponds and other storm water disposal facilities at the locations shown on the plans and in accordance with the Standard Drawings. Except as modified or supplemented herein, the provisions of the Central Oregon Stormwater Manual and Section 00470 of the ***APWA Oregon Standard Specifications for Construction,*** current edition shall apply.

308.1.01 DRYWELL LOCATION

No portion of a drywell shall be located within 10 feet of a waterline. Drywells shall be located no closer than 25 feet from a fire hydrant. Drywells and infiltration swales must be located at least 50 feet from a sewer wetwell. Drywells shall be spaced at least 40 feet center to center, or twice the depth of the drywell, whichever is greater.

308.2.00 MATERIALS

308.2.01 EXCAVATION AND BACKFILL

Excavation and backfill shall conform to the requirements of Section 301.

308.2.02 DRYWELL FRAME AND COVER

The Contractor shall furnish frame and cover conforming to Standard Drawings. The Owner has the option to supply grates, which will be listed in the Special Provisions.

308.2.03 DRAIN ROCK

Drain rock shall consist of clean 6"-2" hard cinder, river rock, crushed, or pit run aggregate containing little or no fines.

308.2.04 DRYWELL FABRIC LINER

A fabric liner is specified for the inside of the drywell barrel. This fabric shall have a smooth finish surface to promote cleaning by washing down. Felted materials are not acceptable. Fabric liner shall have sufficient tensile strength to be hung without undue sagging, and to resist tearing and raveling.

Fullflow Vinyl screen (a0706) or approved equal, available locally, is an acceptable fabric liner.

308.2.05 GEOTEXTILE

When required to protect the drain rock from contamination, geotextile fabric shall be placed against, and to 24" beyond gravel or soil at the limits of the excavation for drain rock, to prevent fine soil particles from migrating into the drain rock. Material shall be equivalent to a Type 1 or Type 2 riprap geotextile fabric per ODOT Spec 02320-1 (8-10 oz. nonwoven).

308.2.06 SWALE SOIL LAYER

The treatment zone soil layer in swales and ponds shall meet the requirements of Section 6.5.1.2 of the Central Oregon Stormwater Manual with a minimum infiltration rate of 0.25 inches per hour and at least 2 percent organic content.

308.3.00 CONSTRUCTION

308.3.01 FORMING, POURING, AND CURING

The concrete cap required by the Standard Drawing 3-8 need not be formed. It may be placed directly on the moisture barrier. In earth or granular material, the outside two feet (2') of the concrete cap shall be placed over undisturbed earth. In rock excavation, the cap may be placed directly to the rock sidewall, provided that the rock wall is stable.

Pipe connections shall be grouted on the interior and exterior of all stormwater structures.

308.3.02 DRYWELL FRAMES AND GRATES

The grate frame shall be set into the concrete structure. The dimensions of the various grate frames are shown on the standard drawings.

308.3.04 DRYWELLS

Drywells construction details are shown in Standard Drawing 3-8. Drywells are subject to DEQ regulations. Drywells shall comply with standards and facility requirements as specified in the Central Oregon Stormwater Manual, current edition with City amendments.

Drywells shall be protected from and not used for sediment collection during construction. Drywells installed prior to final site stabilization shall be protected from construction site runoff by routing storm runoff to an appropriate sediment control facility and erosion control measures.

308.3.05 DRYWELL TESTING AND ACCEPTANCE CRITERIA

Prior to acceptance and certification, all drywells shall pass a performance test conducted by a City Representative if they are in the right of way and observed by a City Representative if they are on private property. Drywell testing consists of three components; confirmation of storage volume, verification of infiltration rate and ability to drain within 72 hours.

1. The testing process starts during construction. Track the quantity of drain rock placed using load tickets. Record on the testing form and calculate the volume of drain rock storage.
2. Measure the diameter and depth of the drywell. Calculate interior volume of the drywell from the base to the bottom of the lowest pipe and record on the testing form. Verify that total volume exceeds design volume shown on the construction plans.
3. Inspect the drywell for compliance with construction drawings and City Standard Drawings and Specifications.
4. Field check the accuracy of the flow meter to be used for the test.
5. Introduce clean water into the drywell. Monitor flow using an in-line flowmeter.
6. If possible, raise the water level in the structure until it reaches the top of the active barrel section. In the case of structures interconnected by pipes, raise the water level to the invert elevation of the connecting pipe, or use an expandable plug to seal the connecting pipe.
7. Monitor and record the flow rate required to maintain the constant head level in the drywell at 10 minute intervals.
8. If a hydrant is available, it shall be used for the test. 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.
    a. For drywells in the right of way, maintain the flow rate necessary to keep the water level 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.

b. For drywells on private property, maintain the flow rate necessary to keep the water level at the top of the barrel section or pipe invert for one hour or until the design volume has been reached. At this time, 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 or when the design volume is reached and measure and record the depth to the water surface every 10 minutes for one hour.

9. If a hydrant is not readily available, a water truck may be used. Place four water truck loads (3,500 to 4,000 gallons) 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.
10. Fill out all of the information on the drywell testing form including a sketch of the installation. Take photos of the installation during construction and after completion. Note any other pertinent data in the comments section

308.3.06 SWALE, POND AND INFILTRATION GALLERY TESTING AND ACCEPTANCE CRITERIA
Prior to acceptance and certification, the storage volume, infiltration rate and ability to drain within 72 hours shall be confirmed.

308.3.06A 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.

308.3.06B 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.

308.3.06C 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 for infiltration galleries.

308.4.00 MEASUREMENT AND PAYMENT

308.8.01 DRY WELLS
Measurement and payment for dry wells will be made on a per each basis for the number and type constructed. Payment shall constitute full compensation for all tools, materials, work and incidentals required to complete the work.

308.4.02 EXCAVATION
Where not listed as a separate item, excavation for any drainage structure will be considered incidental to the price bid to construct the structure. Where listed as a separate item, excavation will be measured by the cubic yard to the nearest 1 cubic yard. The dimensions for measuring excavation will be the exterior dimensions of the drainage structure as designed and specified by the Engineer. Payment for excavation will be at the contract unit price bid for excavation.

308.4.03 INCIDENTAL BASIS

When neither specified nor listed in the proposal for separate payment, drainage facilities shall be considered incidental work for which no separate payment will be made.

310 SEWAGE LIFT STATION

310.1.00 DESCRIPTION

These specifications describe a sewage lift station as manufactured for the City of Redmond, Oregon. These specifications indicate the type, function, standard design, efficiency and quality required, and are not to be construed as eliminating from competition other manufacturers with comparable and equal equipment. The Pump Station Package shall include fiberglass wet well and valve vault, pumps, controls, telemetry, instrumentation, odor control equipment as required, emergency generator as required, piping, valves, flowmeter and meter vault, safety equipment, and all other appurtenances as described by the following specifications. Lift stations shall be designed and approved on an individual basis. The station manufacturer shall be required to affix an UNDERWRITER'S LABORATORIES (UL) LABEL attesting to the compliance of that assembled equipment under the PACKAGED PUMP SYSTEMS (QCZJ) UL Listing Category. This label shall be inclusive of the entire station with enclosure so as to demonstrate compliance with the National Electrical Code requirements for working clearances and wiring procedures. Equipment manufactured without this third party certification label or equipment manufactured by an outside source or brokered equipment defined as systems not assembled on the premises of the named manufacturer by that company's employees **WILL NOT** be considered as equal and will not be accepted by the City of Redmond. All lift station designs are subject to submittal to D.E.Q. for approval.

City maintained lift stations shall be located in dedicated tracts of land owned by the City. All lift stations not on City owned land will remain the responsibility of the homeowner or homeowner group. Developed subdivisions utilizing pressure systems shall discharge at a single manhole location approved by the City of Redmond Wastewater Division and Engineering staff.

310.2.0 TESTING

The completed pump station shall be given an operational test of all equipment at the factory to check for excessive vibration, leaks in all piping and seals, correct operation of the automatic control system and all auxiliary equipment. The automatic control will be adjusted to start and stop the pumps at approximately the levels required by the job conditions. All irregularities will be corrected at the factory. After delivery and installation the completed system shall be given a thorough performance test by certified manufacturer representatives to assure that all components and systems meet the design and performance criteria. The City shall have sole discretion as to adequacy of performance testing and acceptance.

310.3.00 STRUCTURES

310.3.01 FIBERGLASS WET WELL / VALVE VAULT

The wet well and valve vault shall be fiberglass or other approved material, of sufficient size, diameter and depth in accordance with the approved design criteria. Unless otherwise indicated, the plastic terminology used in this specification shall be in accordance with the definitions given in American Society for Testing and Materials (ASTM) designations ASTM D3753-99. This specification is for the hand lay-up, chopped spray technique for manufacturing of vertical underground fiberglass basins. Other methods of manufacturing may be approved upon written request and review by the City Public Works Wastewater Division. All valve vaults must include a drain allowing water discharge into the wet-well, with a check valve. Drain valve cover must be flush to the floor in the valve vault.

The resin used shall be of a commercial grade and shall be evaluated as a laminate by test or determined by previous service to be acceptable for the environment. The resins used may contain the minimum amount of fillers or additives required to improve handling properties. Up to 5% by weight of thixotropic agent that will not interfere with visual inspection may be added to the resin for viscosity control. Resins may contain pigments and dyes by agreement between fabricator and engineer, recognizing that such additions may interfere with visual inspection of laminate quality.

The reinforcing material shall be a commercial grade of glass fiber having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin.

The laminate shall consist of an inner surface, an interior layer, and an exterior layer of laminate body. The inner surface shall be free of cracks and crazing with a smooth finish and with an average of not over two pits per square foot, providing the pits are less than 1/8" in diameter with not over 1/32" deep and are covered with sufficient resin to avoid exposure of inner surface fabric. Some waviness shall be permissible as long as the surface is smooth and free of pits. A white GelCoat shall be the finishing surface for the interior of the wet well/valve vault. Other coatings or colors are not acceptable.

The Interior Layer, described as a minimum of 0.100 inch of the laminate next to the inner surface, shall be reinforced with not less than 20 percent nor more than 30 percent by weight of non-continuous glass strands having fiber lengths from 0.5 to 2.0 inches.

The Exterior Layer, or the body of laminate, shall be of construction suitable for the service intended and contain sufficient glass by weight to provide the aggregate strength necessary to meet the tensile and flexural requirements anticipated during construction and service life. The exterior surface shall be relatively smooth with no exposed fibers or sharp projections. Handwork finish is acceptable, but enough resin shall be present on the surface to prevent fiber show.

The wet well and valve vault must be designed to withstand wall collapse based on the assumption of hydrostatic type loading by backfill with a density of 120 lb./ft.^{3}. The tank wall laminate must be constructed to withstand or exceed two times the actual imposed loading on any depth of basin. Stress calculations must be submitted verifying the results obtained using 120lb./cu. Ft. hydrostatic pressure and the actual imposed loading on any depth basin.

The wet well shall incorporate an integral hopper bottom design that directs solids to the center of the wet well and into the suction of the pumps. Sloping requirements shall be verified by the City prior to construction.

The tank bottom of 6 foot diameter or smaller wet wells shall be constructed of 0.37" minimum A36 steel plate. The steel base shall be completely encapsulated in fiberglass resin to prevent corrosion. Tank bottom must be constructed suitable for the service designated by the project engineer. Under total water submergence conditions, the center deflection of the empty tank bottom must be less than 3/8 inch as not to interfere with bottom pump mounting requirements and rail systems. A minimum of 8 hold down ears shall be provided to secure tank to the Anti Floatation Concrete Pad provided by the contractor.

The tank bottom of wet wells larger than 6 foot diameter shall be constructed of 0.5" minimum A36 steel plate. 6-inch I-beams shall be welded to the bottom steel plate to add structural integrity and reduce the possible deflection caused by ground water hydrostatic forces. The I-beams shall protrude from under the plate in 4 places, which are used to anchor the station to a concrete pad of sufficient mass to prevent uplift. Foam board shall be cut to fit in between the I-beams and the outer edge of the 0.5" steel plate to prevent potential voids between the concrete pad and the station bottom, which can cause ground

settling and sink holes. The steel base plate, I-beams and foam board shall be completely encapsulated in fiberglass resin to prevent corrosion. The tank bottom must be constructed suitable for the service designated by the project engineer. Center deflection shall not exceed 3/8 inch under any conditions. The width of the first layer of joint overlay shall be 12" inch minimum. Successive layers shall uniformly increase in width to form a smooth contour laminate that is centered on the joint ± ½". A highly filled resin paste may be placed in the crevices between joined pieces leaving a smooth surface for lay-up. The cured resin surface of the parts to be joined shall be roughened to expose glass fiber. This roughened area shall extend beyond the lay-up areas so that no reinforcement is applied to an unprepared surface. Surfaces shall be clean and dry before lay-up. The entire roughened area shall be coated with resin after joint overlay is made.

The finished laminate shall be free from visual defects such as foreign inclusions, dry spots, air bubbles, pinhole, dimples, and de-lamination. The surfaces shall be relatively smooth; hand finish is acceptable, with no exposed fibers or sharp projections.

310.3.02 WET WELL INLET PIPE

The wet well inlet pipe shall be made using a bolt on fiberglass invert. The flange of the bolt on invert must be the curved with the same radius as the outside of the wetwell. The flange shall be connected to the wetwell using stainless steel bolts and seaming materials. The pipe side of the bolt on invert shall be the same size as the PVC sewer main. The connection between the sewer main and bolt on invert shall be made using a mechanical coupling such as a Romac 501 straight coupler or approved equal.

310.3.03 WET WELL TOP FLANGE

The top flange and cover O.D. shall assure a tight fit and afford ease of access not possible with recessed covers.

310.3.04 COVER

Cover shall be of 0.375" galvanized steel construction with an outside diameter equal to the outside diameter of the top flange of the wet well/valve vault. The cover shall be secured to the basin with stainless steel bolts, washers and nuts. Two rows of ¼" x ½" Butyl Tape shall be applied, one on each side of the cover bolts and between the basin and galvanized cover, to prevent foreign materials from entering the wet well/valve vault. A six-inch diameter hole shall be cut in the cover directly beneath the control panel to allow the pump cords, transducer, and float cords to be easily brought out of wet well and into the control panel bottom. The location of the control panel will be determined during the design phase of the project.

310.3.05 CORROSION PROTECTION

After fabrication, the wet well and valve vault cover shall be slagged to remove weld splatter and flux. The steel shall then be cleaned with a hot alkaline cleaner to remove oil and grease. The complete unit shall then be placed in a hot acid bath "pickling" solution to remove surface rust, mill scale, and similar deposits for a pure metallic surface.

After "pickling," the steel cover shall be immersed into molten zinc at approximately 850^0 Fahrenheit to achieve a minimum thickness coating of 2.0 ounces of zinc per square foot of surface area. Hot-dipped galvanizing will be done in accordance with American Hot-Dip Galvanizers Association (AHDGA), and ASTM A123 standards.

Painted steel covers requiring periodic painting and maintenance costs for the Owner are not acceptable and shall not be considered as "equal" to hot-dipped galvanizing.

310.3.06 ACCESS HATCHES
Access hatches shall be provided for entrance into the wet well and valve vault. The hatches shall have aluminum diamond plate tops with no cross bar, 300 psf load rating, 316SS hardware and pad lock, pin,and lockable hinged OSHA approved safety grating panel and 300 psf load rating. The safety grating panel shall be powder coated “safety orange” color. Hatches shall be appropriately sized to safely and easily remove pumps from the wet well and allow access into the valve vault. Safety grating is only required on the wet well hatch. Hatches shall open opposite each other to the sides of the wet well.

310.3.07 VALVE VAULT LADDER
In valve vaults 5 feet or more deep, provide an OSHA approved round rung ladder with “Ladder Up” safety extension.

310.3.08 ALTERNATE MATERIALS
If fiberglass wet well basins and valve vaults are not available because of size or depth requirements, alternate materials may be substituted subject to approval by the City . Alternate wet well/valve vault materials must be resistant to the corrosive effects of municipal wastewater. Concrete wet wells/valve vaults shall be lined or coated with an approved protective coating system by a certified applicator.

310.4.00 PUMPS AND GUIDE RAILS

310.4.01 PUMPS
Pumps shall be manufactured by Flygt as described in the following section. If Flygt pumps are not available for installation, then alternate manufacturers will be considered on a case by case basis.

310.4.02 OPERATING CONDITIONS:
Pumps shall be rated at the horsepower, TDH, and gpm required for the design conditions, and be suitable for the service requirements. All pumps must be three-phase, 460/480 Volt and operational efficiency must be specified. The pump shall be capable of handling a 3" spherical solid or be fitted with an N-impeller. The pump shall be non-overloading throughout the entire range of operation without employing service factor. The pump shall reserve a minimum service factor of 1.15. The performance curve submitted for approval shall state in addition to head and capacity performance, the pump efficiency, solids handling capacity, and reflect motor service factor.

310.4.03 PUMP DESIGN
The pump shall be supplied with a mating cast iron discharge connection. The pump shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor. Each pump shall be fitted with a stainless steel lifting chain. The working load of the lifting system shall be 50% greater than the pump unit weight.

310.4.04 PUMP CONSTRUCTION
The pump shall be a centrifugal, non-clog, solids handling, Flygt submersible sewage pump with an N impeller as manufactured by Flygt, or approved equal. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be of stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray

coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

310.4.05 IMPELLER

The impeller shall be of ASTM A-48, Class 35B gray iron dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the gray iron impeller shall be hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impellers shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

310.4.06 VOLUTE/SUCTION COVER

The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove. The spiral groove shall provide trash release pathways and sharp edge across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of ASTM A-48, Class 35B gray iron and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

310.4.07 SHAFT

Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be stainless steel – ASTM A479 S43100-T.

If a shaft material of lower quality than stainless steel – ASTM A479 S43100-T is used, a shaft sleeve of stainless steel – ASTM A479 S43100-T is used to protect the shaft material. However, shaft sleeves only protect the shaft around the lower mechanical seal. No protection is provided for in the oil housing and above. Therefore, the use of stainless steel sleeves will not be considered equal to stainless steel shafts.

310.4.08 MECHANICAL SEALS

Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.

The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

Seal lubricant shall be FDA Approved, nontoxic.

310.4.09 BEARINGS

The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable. B-10 bearing life shall be a minimum of 50,000 hours at any usable point of the pump curve.

310.4.10 MOTOR:

The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of no less than 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board, shall be hermetically sealed from the motor by an elastomer compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. The motor and the pump shall be produced by the same manufacturer.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous

submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

310.4.11 PROTECTION:
All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. The thermal switches shall open at 125°C (260°F), stop the motor and activate an alarm.

A leakage sensor shall be available as an option to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and send an alarm both local and/or remote. This alarm shall energize a warning light on the control panel and send an alarm signal to SCADA. Use of voltage sensitive solid state sensors and trip temperature above 125°C (260°F) shall not be allowed.

The thermal switches and FLS shall be connected to a Mini CAS (Control and Status) monitoring unit. The Mini CAS shall be designed to be mounted in any control panel.

310.4.12 CABLE ENTRY SEAL:
The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable. The power cord shall be equipped with a “quick-coupler” plug for the power connection to the Control Panel.

310.4.17 SPARK-PROOF GUIDE RAIL SYSTEM
Provide a non-sparking guide rail system consisting of two stainless steel guide rails, cast bronze pump guide bracket, cast ductile iron discharge elbow with mounting feet and 125 lb. flanges, upper guide rail mounting bracket, and intermediate guide brackets every 10 feet. The upper guide bracket shall align and support the two guide rails at the top of the sump. It shall bolt directly to the hatch frame and incorporate an expandable rubber grommet for secure rail installation. System design shall prevent spark ignition of explosive gases during pump installation and removal.

310.4.18 SEALING FLANGE WITH RAIL GUIDE
A sealing flange/rail guide bracket shall be mounted on each pump discharge. It shall have a machined mating flange that matches the base elbow discharge connection. Sealing of this discharge connection shall be accomplished by a simple linear downward motion of the pump culminating with the weight of the pumping unit supported entirely by the base elbow.

310.4.19 LIFTING CHAIN
The submersible pump station shall be provided with a Chain Grabber Lifting System. The Chain Grabber link shall be made of alloy steel and sized to fit the lifting chain. Each pump shall be equipped with 300 series stainless steel chain. The lifting chain and the Chain Grabber shall be rated for a minimum working load limit 50 percent greater than the pump unit weight.

310.4.20 CABLE HANGERS
All cables entering the wet well shall be supported by stainless steel strain relief straps connected to a stainless steel hanger. Hangers shall be mounted in a location where cables and devices suspended from them will not interfere with pump operation or installation/removal of pumps.

310.5.00 PIPING

310.5.01 CAST IRON PIPE
All pipe and fittings shall be either cast or ductile iron pipe meeting ASTM A48 material specifications. Each pump discharge pipe shall be the same diameter as the discharge of the pump through the exit of the tank. A common flanged discharge line, properly sized for the discharge capacity, shall exit the valve box at an elevation specified on the engineered drawings.

310.5.02 DISCHARGE BASE ELBOW
A discharge base elbow designed to mount directly on the sump floor shall be supplied for each pump. It shall have a standard 125 lb. flange faced and drilled on the outlet side with a machined mating inlet connection. The design shall be such that the pump to discharge connection is made without the need for any nuts, bolts or gaskets. The base elbow shall also anchor and align the two guide rails.

310.5.03 PLUG VALVE
Plug valves shall be located on the discharge pipe for each pump following the check valve and before the cross. A third plug valve shall be located on the common discharge line before the flow meter and within 36 inches outside of the valve vault.

Valves shall be of the non-lubricated eccentric type with an elastomer covering all seating surfaces. The elastomer shall be suitable for the service intended. Flanged valves shall be manufactured in accordance with ANSI B16.1 including facing, drilling and flange thickness.

Valve bodies shall be ASTM A-126 Class B cast iron. Valves 3" and larger shall be furnished with a welded-in overlay seat of not less than 90% nickel in accordance with AWWA C507-73. Sprayed, plated or screwed-in seats are not acceptable.

Plugs shall be of ASTM A-536 Grade 65-45-12 in compliance with AWWA C-504 Section 2.2. The plugs shall be of one-piece construction with PTFE thrust bearings on the upper and lower bearing journals to reduce torque and prevent dirt and grit from entering the bearing and seal area.

310.5.04 CHECK VALVES
Check valves shall be located on the discharge pipe for each pump after entering the valve vault and before the plug valve.

Check valves shall be all iron body, bronze mounted, full opening swing type. Valve clapper shall swing completely clear of the waterway when valve is full open, permitting a "full flow" through the valve equal to the nominal pipe diameter. They shall comply with AWWA standard C-508 latest revision. Check valves shall be rated at 175-PSI water working pressure, 350-PSI hydrostatic test for structural soundness (2" through 12"). Seat tightness at rated working pressure shall be in accordance with values shown in AWWA standard C-500 for gate valves and fully conform to AWWA C-508. Check valves shall be furnished with 125# ANSI flanged ends.

All cast iron shall conform to ASTM-A-126 Class B. Castings shall be clean and sound without defects

that will impair their service. No plugging or welding of such defects will be allowed. Check valve clappers shall be all bronze in sizes 2" through 4" and cast iron in 6" through 30". Seat facing for all sizes shall be neoprene rubber. The neoprene rubber ring shall be securely held in position by a bronze clamp ring mechanically attached to clapper assembly. Hinge pins shall be 18-8 stainless steel rotating in bronze plugs.
Check valves shall be constructed to permit top entry for complete removal of internal components without removing the valve from the line. Glands shall be O-rings in valves sizes 2" through 12". When specified for application conditions of rapid flow reversal, vertical installation or back flushing the check valves shall be equipped with adjustable outside manual operation lever and spring to accomplish faster closing and to minimize slamming effect. Bosses shall be provided on check valves that may be tapped for draining or used for by-pass.

310.5.05 CROSS
A cast iron cross shall be installed in the valve vault of equal size as the discharge piping to incorporate a pig launch/bypass system. A 45 deg. fitting pointed upward followed by a plug valve and male cam loc fitting shall be installed on the backside of the cross. This shall allow for “pigging” the entire discharge main during routine maintenance or bypass pumping in emergency situations.

310.5.06 DISCHARGE PRESSURE GAUGE
A discharge pressure gauge (Ashcroft Duralife® Pressure Gauge Type 1009 PLUS) with a petcock shall be mounted at a 45° angle to the common discharge piping after the cross within in the valve vault.

310.5.07 BOLTS & FASTENERS
All nuts, washers, bolts and fasteners of any type shall be constructed of 304 stainless steel, all inclusive of the entire station. Never Seize shall be applied to the threads of all nuts and bolts to prevent galling and aid in the removal process.

310.5.08 FLOWMETER
Each sewer lift station shall have an in-line, electro magnetic flowmeter installed on the station discharge main after the valve unit in a separate vault. The flow meter shall have no moving parts or obstructions in the flow path. The flowmeter can utilize A.C. or D.C. model signal, using a 120-volt A.C. power source. The meter must be designed and approved for wastewater applications with an accuracy of 1%. The meter shall have field replaceable sensors. The meter shall be programmable with a built-in keypad, with data storage. The transmitter is to be mounted in the station enclosure. There shall be 4-20 mA inputs and outputs, with an interface capable of communicating with the City’s RTUs. The meter shall be installed according to the manufacturers’ specifications and recommendations. The specifications will be included in the O and M manuals. A shut off valve shall be installed downstream of the meter at a distance as required by the manufacturer. All necessary conduit and wires for electrical power and communications shall be installed and connected by the contractor.

Meters shall be as manufactured by Siemens or Advanced Flow Technology, Uni Mag meter, or approved equal.

A non-contact, digital pressure sensor will be mounted on the discharge main such as manufactured by Ashcroft and Valvematic. This will either have a recording capability or communicate and log historical data with the City’s SCADA system.

310.6.00 ELECTRICAL

310.6.01 GENERAL

The Controller is intended for use in a wastewater application and may require the use of intrinsically safe components. All signaling devices located in the wastewater sump must be interfaced to the Controller through an intrinsically safety barrier unless the device is classified for use in a Class I Division I environment. The control system must be designed and manufactured to meet UL698A specifications.

310.6.02 CONTROL PANEL

The Controller will be housed in two 30"x30"x12" NEMA4 enclosures mounted side-by-side with one enclosure containing the equipment required for 3-phase motor operation and voltages above 24 volts nominal control (Motor Panel), and the other containing the equipment required to provide for operator interface, 24VDC input/output control circuitry and for executing control sequencing (24VDC Panel). In addition, a Federal Signal Model# TERRA 3 SCADA RTU unit shall be mounted on the back of the Controller (SCADA panel).

Each panel will be lockable, dead front with intrusion detection alarms and swing-out internal panels for mounting of control operators and indicators. The enclosure motor panel will be fitted with a separate, external, weather proof, lockable housing for a convenience outlet and light switch. Panel exteriors will be painted bright white using UTEK SIKKENS Polyurethane paint specification number WA5111 in order to minimize component heat rise due to direct sunlight exposure. Enclosures will be Hoffman or approved equivalent. All exterior penetrations shall be gasketed and made rain tight, or in bottom of enclosures, or both.

Control operators and indicators mounted to the swing-out panel doors will be corrosion resistant and rated for heavy-duty industrial application. Operators will be 30MM Cutler-Hammer 10250T series or approved equivalent. Internal condensation and corrosion control will be accomplished by the inclusion (at a minimum) of a 200Watt/120VAC space heater (mounted in both the 24VDC and SCADA panels) and corrosion inhibitors (mounted in both the Motor and 24VDC panels).

All serial communication, analog and/or frequency signal wiring inside the control panel will be 18AWG UL508A twisted, shielded-pair cabling unless otherwise specified on the schematic diagram(s). All analog signal loops will be routed through centrally located terminal groups to allow for easy access and modification(s) as necessary. All discrete control wiring inside the control panel will be 16AWG MTW UL508A approved hook-up wire and sized according to NEC unless otherwise specified on the schematic diagram(s). Color-coding of panel wiring should be as follows:

AC Power (Unswitched)	Black
AC Neutral	White
AC Control (Switched)	Red
Ground	Green/Yellow
Foreign (External) Power	Yellow
DC Power	Blue
DC Common	Blue/White
DC Control	Blue

The operation of the control system will be field-configurable based around a Programmable Logic Controller (PLC) (model ELC-PA10AADR processor with ELC-EXO8NNDR expansion module) and Human Machine Interface (HMI) (model ELC-GPO4). The controller will operate a pair of 4860 VAC 3-phase 60Hz.appropriately sized motors in an alternating-duplex configuration. The operational

mode of each pump will be field-selectable between “Hand”, “Off” and “Auto” using a pair of illuminated H-O-A switches mounted on the swing-out panel door of the 24VDC panel. In “Auto” mode, the pumps will be field-selectable to operate as “Lead” pump, or “Lag” pump, and “Alternate” at the completion of each pumping cycle. In addition they will both run when a high float condition exists and can be individually selected through the SCADA system.

The pump motors will be protected against short-circuit by Cutler Hammer type HMCP circuit breakers sized appropriately for the HP rating of the motors with individual disconnect mechanisms mounted through the swing-out panel door of the Motor Panel. The pump motors are also protected by a contactor/overload relay assembly

Cutler Hammer style IT type E04N (contactor) and E05N (O.L.) sized for motor HP with overload reset operators mounted on the swing-out panel door of the 24VDC panel.

Three-phase power, seal failure and thermal protection connections from the control system to the pump motors will be made using pin and sleeve type quick disconnect plugs and sockets. The current draw of each pump will be monitored by passing one leg of the 3-phase power output to the motor through a current transformer (CT) and will be continuously displayed locally by digital ammeters mounted on the swing-out panel of the 24VDC panel, and transmitted remotely via analog (4-20mA) signal to the SCADA unit mounted on the back of the control system. The operational run-time of each pump will be tracked by hour meters mounted on the swing-out panel of the 24VDC panel.

Control circuitry will be protected against short circuit by (at a minimum) the following small-frame circuit breakers: Panel Heater, 1P/5A/UL1077, Control Power Transformer (Primary) 2P/15A/UL489, Control Power Transformer (Secondary), 1P/15A/UL489, 24VDC/5A Power Supply, 1P/5A/UL1077, External Station Lighting, 1P/15A/UL1077, SCADA RTU, 1P1A/UL1077, Convenience Outlet, 1P/15A/UL489. In addition, the power circuitry in the system will be protected (at a minimum) by the following devices: Motor Saver / Phase Monitor, model MS-201-A and Transient Voltage Surge Suppressor Square D model SDSA3650.

310.6.03 TRANSFER SWITCH

Station shall be equipped with a NEMA 3R, fused transfer switch with high visibility handle and nameplate with on/off/on indication, clear line terminal shields, generous wiring room that meets or exceeds NEC wire bending space requirements, side hinges and rated for $60/70^0$ C wire connection through 200 amps.

310.6.04 GENERATOR RECEPTACLE

Stations equipped with a transfer switch will also come equipped with a user specified heavy duty circuit breaking receptacle. Receptacle shall be mounted on the outside of the pump station and will be equipped with a weatherproof spring door. It shall be placed at a 45deg angle. Appleton part number ADR1034P4RS.

310.6.05 EMERGENCY GENERATOR

An appropriately sized emergency generator shall be provided for lift stations with a designed flow rate exceeding 400gpm. Generator specifications shall be obtained from the City. An automatic transfer switch integrated with the City’s SCADA system is required.

310.6.06 SCADA RTU

The control system will include a Federal Signal Model # TERRA 3 SCADA RTU in the provided NEMA 4X enclosure mounted to the back of the 24VDC panel. The RTU shall include a 12V valve-

regulated sealed lead acid (SLA) battery for power backup, sized to provide more than 12 hours of uninterrupted standby operation in the event of AC power loss. The SCADA system will be used to monitor the following control signals (at a minimum):

Analog (4-20mA): Wastewater Sump Level AI-01),
Pump #1 Motor Current (AI-02),
Pump #2 Motor Current (AI-03)
Control Circuitry Cabinet Temperature (AI-04)
RTU Cabinet Temperature (AI-05)

Discrete: RTUIntrusion Alarm (DI-01)
Motor Control Cabinet Intrusion Alarm (DI-02)
Control Circuitry Cabinet Intrusion Alarm (DI-02)
Pump #1 Run Status (DI-03)
Pump #2 Run Status (DI-04)
Pump #1 Seal Fail Alarm (DI-05)
Pump #2 Seal Fail Alarm(DI-06)
Pump #1 Over-Temperature Alarm (DI-07)
Pump #2 Over-Temperature Alarm (DI-08)
High Level Float (DI-09)
Low Level Float (DI-10)
3 Phase Power Loss (DI-11).

In addition, the SCADA system will be configured to provide remote Start/Stop control capability for each pump unit that is selected for "Auto" mode operation with the H-O-A switch mounted on the swing-out panel door of the 24VDC panel.

Prior to design approval a radio frequency (RF) survey is required to be completed at the site to assure that communications with the City's server are adequate. The survey report shall be submitted to the City for approval. The pump supplier shall coordinate with the city on integration of the SCADA System with the City's existing system.

310.6.07 RTU COMMUNICATIONS HARDWARE

The RTU shall utilize a wireless licensed VHF transceiver, using the frequency provided by the City of Redmond, with modem and cables as required for a complete operating system. The transceiver shall be a Motorola CDM750. Each RTU shall utilize a properly grounded inline surge protector by Polyphaser, or approved equal, to guard against lightning intrusion. Each remote site shall utilize properly grounded, high quality antenna cable, Time Microwave LMR-400 or approved equal, for data transmission to the antenna. Each remote site shall utilize a properly grounded, omni-directional, fiberglass antenna with a minimum gain of 3dB, installed on a corrosion-resistant mast at a minimum height of ten (10) feet. The antenna for SCADA shall be an Antenex FG1563 or approved equal. The antenna is to be mounted to the mast by a certified RF specialist. The antenna and communication hardware shall be adjusted by the RF Specialist in accordance with the manufacturer's recommendations to assure optimal communications with the base station. Optimization of the communication hardware is the responsibility of the Contractor and shall be coordinated through the City's Wastewater Department.

310.6.08 SUMP LEVEL CONTROL, PRIMARY

The wastewater sump level will be monitored using a hydrostatic pressure sensor located at or near

the bottom of the sump. It shall be supplied with 40 feet of shielded and vented cable, able to withstand 200 pounds of tensile stress allowing the transducer to be suspended directly by its own cable. The device shall be the Endress-Hauser Waterpilot FMX167 hydrostatic pressure sensor. A stainless steel hook shall be provided to allow the sensor to be suspended with a stainless steel strain relief device. The hook shall be located at a location in the wet well which will minimize turbulence from the incoming flow and pumps. Easy access shall be provided through the wet well cover in order to install, remove, or service the sensor.

The analog (4-20mA) signal produced by the transducer will be directly routed through an intrinsic safety barrier to the PLC and SCADA RTU with no intervening junction box or calibration device required. During normal operation, the primary means of level control will be accomplished by comparison of the transducer output to field adjustable control set points entered into the PLC via the HMI terminal mounted on the swing-out panel door in the 24VDC cabinet.

There will be five (5) set points designated for the level transducer. Primary sump level control sequencing will be as follows:

HIGH LEVEL
When the sump level rises to this set point, a High Level Alarm is SET (local indication only). *This has no effect on the operation of the pump units.*

LAG PUMP START LEVEL
When the sump level rises to this set point, the LAG pump is brought on-line to supplement the LEAD pump (which should already be in operation). Both pumps will continue to run until the sump level drops to the Stop Level set point.

LEAD PUMP START LEVEL
When the sump level rises to this set point, the LEAD pump is brought on line. This pump will continue to run until the sump level drops to the Stop Level set point.

PUMP(S) STOP LEVEL
When the sump level drops to this set point, any pump that is currently in operation will be shut-off. During normal (alternating) operation, the LEAD and LAG pump designations are reversed in preparation for the next operational cycle (i.e., the current LEAD pump becomes designated as the LAG pump and the current LAG pump becomes designated as the LEAD pump).

LOW LEVEL
When the sump level drops to this set point, a Low Level Alarm is SET (local indication only). *This has no effect on the operation of the pump units.*

310.6.09 SUMP LEVEL CONTROL, SECONDARY

In addition, there will be two (2) level float switches submerged in the wastewater sump to provide backup level control in the event of a transducer failure. Float switches shall be of a weighted design, which do not require tying off in order to tip and operate properly. Floats with mercury activated switches are not acceptable. Floats shall be hung, at a distance no less than 8 inches apart from each other, from stainless steel hangers attached to the wet well cover and installed in such a manner as not to interfere with pulling pumps for maintenance and free of water turbulence. The connection from the control system to the floats will be made using pin and sleeve type quick disconnect plugs

and sockets. The output signals from these floats are routed through intrinsic safety barrier relays to the controller. The function of these floats is as follows:

HIGH FLOAT
This float is suspended in the sump at a level above the High Level set point described above. When the sump level rises to the level of this switch, a High Float Alarm is SET to the SCADA system and BOTH pump units are brought on-line. Both pumps will remain on-line until the sump level drops below the Low Float switch.

LOW FLOAT
This float is suspended in the sump at a level below the Low Level set point described above. When the sump level drops to the level of this switch, a Low Float Alarm is SET to the SCADA system and any pump units that are currently on-line are shut off (in this application, the low float does not prevent the pump units from operating in HAND).

310.6.10 PANEL STAND

The control panel, meter base, manual transfer switch, SCADA system, and an Antenna as supplied by Federal Signal Corporation, 16x16x612 weatherized tool and O&M storage box, Hoffman CSD16166 or approved equal with lever opening latch, shall be mounted on a stand constructed of 2", 304 stainless steel square tubing. The panel stand is to be mounted on the cover of the wet well or on a concrete slab poured by the contractor. It is to be centered over the 6" cord hole in the galvanized station cover, this allows the pump, transducer and float cords to be brought out of the wet well and plug into the bottom of the control panel eliminating the need for conduit and seal offs. A stainless steel, expanded metal cage will protect the cords from being damaged or inadvertently disconnected. The cage shall be hinged and pad lockable.

310.7.00 ACCESSORIES

310.7.01 SPARE PARTS:

One complete set of Gaskets, O-rings and lower mechanical seal shall be provided with each station.

310.7.02 OTHER ACCESSORIES:

An outdoor convenience GFI outlet shall be mounted to the side of the control panel.
An awning shall be mounted over the control panel. The awning shall be of sufficient size to provide protection from weather when the doors are open and shall not interfere with equipment used to pull the pumps from the wet well. Each station will have exterior lighting beneath the awning activated by a switch on the side of the control panel. The light will provide sufficient light to read while standing at the panel, and illuminate the panel, wet well , and valve vault area.

A 16x16x126 Weatherized Storage box (Hoffman CSD16166 or approved equal with lever opening latch) to house operating manuals and tools shall be mounted on panel stand between the transfer switch and SCADA RTU.

A stainless steel or galvanized cord hanger shall be mounted under the cover within arms reach from the wet well access hatch, and located as far from the invert as possible. Stainless steel hooks shall be welded to the back side of the cord cage to provide a place to hang the cord strain reliefs. A frost free yard hydrant with approved backflow device shall be provided within the fenced enclosure.

Prior to installation, the City shall be provided two draft copies of the Operations and Maintenance manual for the lift station for review and approval. Six hard copies and one electronic copy of the final operations and maintenance manual shall be provided to the City following the acceptance of the

sewage lift station installation.

310.8.00 EQUIPMENT MANUFACTURER:

In these specifications and accompanying drawings specific equipment and materials are deemed most suitable for the service anticipated and of the type and manufacture preferred by the City. Other equipment of equal or better quality meeting industry standards and the intent of these specifications may be substituted on a case-by-case basis when approved by the City of Redmond Wastewater Division Engineering staff. The lift station shall be the product of a manufacturer with a minimum of thirty years experience in the design and manufacturing of package pump stations. For the purpose of customer service the equipment manufacturer shall be regional and located no further then 400 miles from the job site and have an authorized representative with in 100 miles.

310.9.00 WARRANTY:

The manufacturer of the lift station shall warrant it to be of quality construction, and free from defects in material and factory workmanship. The pump station chamber and cover shall be warranted for a period of five (5) years to be free from defects and resistant to rust, corrosion, or physical failures occurring in normal service conditions, and when properly installed in accordance with the manufacturer's recommendations.

The interior equipment (pumps, motors, and apparatus) as well as installation of said equipment shall be warranted for at least a period of one (1) year excepting only those items normally consumed in service such as light bulbs, oil, grease, packing, gaskets, and O-rings. The pump station manufacturer shall be solely responsible for the pump station and all related components. Warranties and guarantees by the suppliers of various components used to manufacture the pump station will not be valid.

Major components that fail to perform as specified by the Engineer, or as represented by the manufacturer, or prove defective in service during the warranty period shall be replaced, repaired, or satisfactorily modified by the manufacturer without additional cost to the City for parts and labor. After start-up service has been performed, labor to replace accessory items such as blowers, heaters, or other accessible and easily serviced parts shall be the responsibility of the Owner. Such components, parts, or repairs determined by the manufacturer to have failed because of defects in workmanship or materials will be replaced or repaired F.O.B. factory or other designated location.

The warranty does not imply that the manufacturer assumes liability for consequential damages or contingent liabilities arising from the failure of any product (or parts thereof) to operate properly be it caused by, resulting from, or arising out of defect, replacement, delay in delivery, or warrants all products of its manufacture to be free from defects in material and factory workmanship for a period of one year from date of shipment provided the product is properly installed, serviced and operated under normal conditions according to the manufacturer’s instructions. Other warranties, as put forth by original equipment manufacturers, shall prevail when such equipment is used and overrides the contractor's warranty.

Major components which fail to perform or prove defective in service during the warranty period and are determined by the manufacturer to have failed because of defect in workmanship or materials shall be replaced, repaired or satisfactorily modified by the manufacturer F.O.B. factory or authorized warranty service station. The warranty shall not assume responsibility for removal, reinstallation or freight.

310.10.00 CONSTRUCTION

310.10.01 SAFETY
The Contractor shall comply with all City, County, State, and Federal construction safety and health Standards, Regulations, laws, and permits. Contractor shall be solely and completely responsible for trench and excavation safety.

310.10.02 TRENCHING, EXCAVATION, BEDDING and BACKFILL
Refer to Division I TRENCHES.

310.10.03 BEDDING
Bedding for Wet Well and Valve Vault shall be in accordance with the recommendations of the manufacturer and subject to review and approval by the City of Redmond Wastewater Engineering Manager and/or City Engineer. Bedding for structures shall be Class B backfill or as directed by the Engineer.

310.10.04 BACKFILL
The Contractor shall place granular backfill around Wet Well and Valve Vault above the concrete base or footings that will achieve compaction requirements without causing excessive pressures against fiberglass walls of the Wet Well or vault. Material shall be 1/2" -1/4" clean, graded, rounded particle rock fill or "pea gravel". The fill shall be placed for at least two feet outside of wall diameter.

At the location of the inlet sewer piping, the trench zone above the pipe bedding will be lined with a geotextile filter fabric to isolate the pea-gravel structure fill from the pipe zone fill. The pipe zone will be backfilled with Class B backfill, properly compacted in lifts, or other material as approved by the Engineer.

310.10.05 STATION ACCESS
Paved access shall be provided to the station at all times. The access shall allow a vehicle, including the City's Jet Rodder Combination Truck (23-foot wheel base, 8-foot overhang front, and 7 foot overhang rear) to park adjacent to the wet well without blocking any traffic lanes or pedestrian walkways. Access shall be as level as possible, but shaped to drain away from wet well. All paving shall be shown on construction plans and approved by the Engineering Division prior to construction. A 10 foot clear space shall be required between existing, proposed, or future equipment (including 12 foot by 20 foot designated generator area) within the fencing on all sides of the lift station.

310.10.06 FENCING
The lift station shall be enclosed with 6 foot high chain link fencing. Two 6 foot swing gates in 12 foot clear opening shall provide access to the lift station. The fence and gates will be fitted with beige privacy fence slats set in a bottom locking slat. Fencing shall be at the tract property line. The entire area within the fenced enclosure shall be paved with asphalt and sloped to drain away from the wet well.

Fence materials shall be in conformance with Division V, Section 512 Railing, Fencing, and Gates.