DESIGN GUIDELINES:

Stormwater, Sanitary Sewer, Water, and Irrigation Systems

Stormwater, Sanitary Sewer, Water and Irrigation Systems

University at Albany (Uptown Campus)

SUCF Project No. 01834

Prepared for:

The State University Construction Fund and the University at Albany

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November 14, 2008

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TABLE OF CONTENTS

1. INTRODUCTION

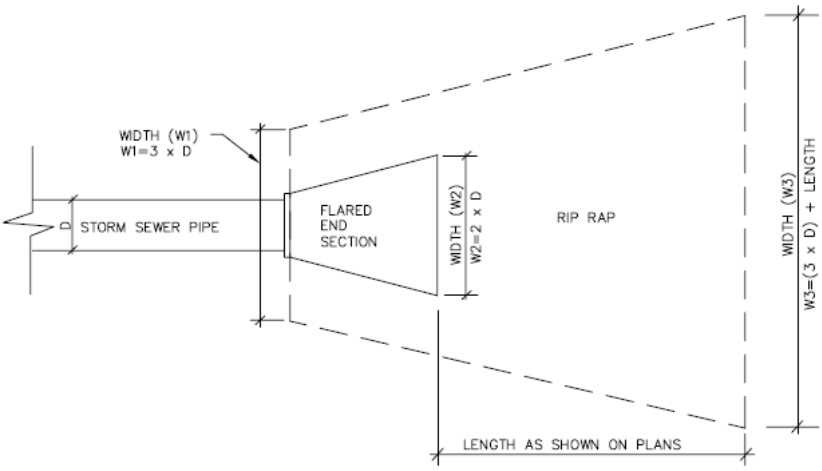
This Design Manual is intended to provide a set of standards for use in managing the underground water, sanitary sewer, storm sewer, and irrigation infrastructure. Specifications and standard detail drawings are provided for the major infrastructure elements. These specifications and standard details are not intended to be used directly for construction or contracting purposes, but instead are intended to provide a consistent basis for utility management and construction.

2. STORM SEWER OUTFALL

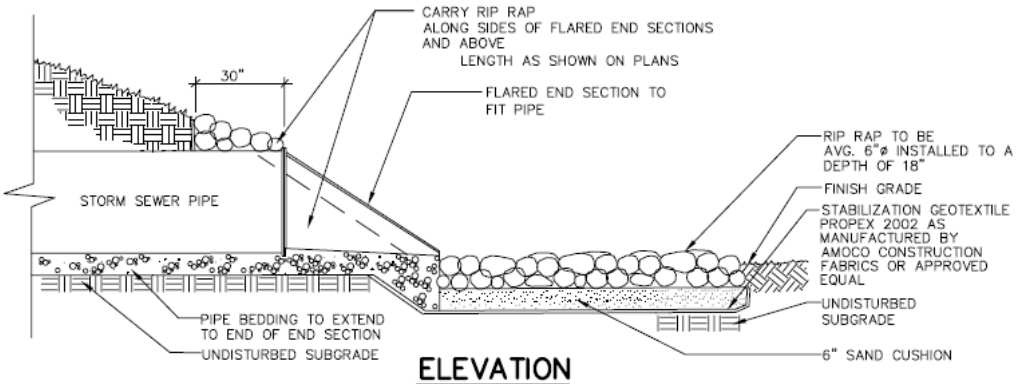
2.1 RIPRAP

Riprap shall consist of clean, sound, hard, dense, durable rock, free of decomposed stone or other defects impairing its durability. The stone shall have a minimum density of 162 pounds per cubic foot. No stone shall be used in which the least principal dimension is less than one-third of the greatest dimension. Stones shall be angular in shape. Stone size d-50 of 6-inches: Riprap shall be stone with a d-50 size of six inches and conform to the following gradation:

Size of Stone	Percent of Total Weight Smaller Than the Given Size
50 lb.	100
10 lb.	50
2 lb.	10



PLAN



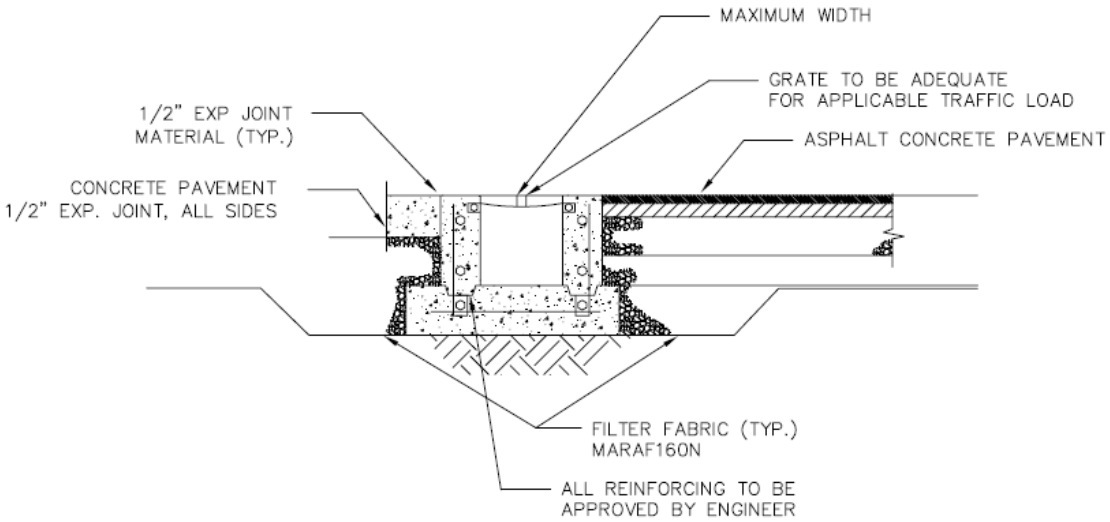
ELEVATION

WOODARD & CURRAN 709 WESTCHESTER AVENUE, SUITE L2 WHITE PLAINS, NEW YORK 10604 800.807.4980 | www.woodardcurran.com COMMITMENT & INTEGRITY DRIVE RESULTS	STORM SEWER OUTFALL DESIGNED BY: MW CHECKED BY: JS DRAWN BY: SH WC_SUNY PIPING DETAILS.dwg	Tthe University of Albany Uptown Campus Standard Details for Environmental Utilities	JOB NO: 213534 DATE:JANUARY 2008 SCALE: NTS STORM SEWER

3. CONCRETE TRENCH DRAIN

3.1 TRAFFIC LOADING

Grates and trench structures which will be exposed to traffic loads such as maintenance vehicle traffic or equipment delivery traffic shall be capable of supporting AASHTO H20 loading.



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4. SANITARY SEWER SERVICE

4.1 NEW SEWER SERVICES

New services are to connect to existing or new sewer mains at manholes.

All building sewers shall discharge by gravity to the University's sewer. In all new or substantially rehabilitated buildings in which the building sewer is too low to permit gravity discharge, wastewater shall be lifted by an approved means and allowed to discharge by gravity (i.e., not under pressure) to the sewer.

Building sewer and building storm drain connections shall be laid at least 10 feet apart from any new or existing water service connection.

4.2 PIPE AND FITTINGS

Provide fittings of same type and class of materials as pipe, unless otherwise stated. Provide commercially manufactured wyes or tee/wyes for service connections. Fitting must have single piece gasket. Gaskets are to be nitrile in contaminated soils areas.

4.2.1 PVC Non-Pressure Pipe Less Than 16-feet Deep

For pipe up to 16-feet deep, pipe shall be ASTM D3034, SDR 35; push-on joints ASTM D3212; gaskets ASTM F477, elastomeric seals. Pipe shall be clearly stamped with the manufacturer's name.

4.2.2 Other Conditions

Where sewers and building sewer services are to be installed 16 feet deep or deeper, where the sewer/water line (including sewer and water services) separation requirements as specified herein cannot be met, and where otherwise indicated, the sewer main and building sewer services shall be pressure rated AWWA C900/C905, DR18, pressure class 150; or ASTM D2241, SDR21, pressure rating 200; or as otherwise noted on plans; joints ASTM D3139.

4.3 INSTALLATION OF GRAVITY PIPE AND FITTINGS

4.3.1 Methods

A. Install in accordance with manufacturer's recommendations. Use a laser beam for line and grade unless otherwise permitted.
B. Secure each length of pipe with bedding before placing next length. Plug open ends when Work is suspended. Bed pipe as shown on the drawing.
C. A 30-inch minimum cover over the top of pipe should be provided before the trench is wheel-loaded.

4.3.2 Conditions

Lay pipe in the dry. Do not use installed pipe to remove water from work area.

4.3.3 Flushing

Flush all pipes and remove debris. Gravity flushing is not acceptable.

4.3.4 Sewers Greater than 16 Feet Deep

Where sewers are to be installed 16 feet deep or deeper, upgraded sewer main shall be installed complete from manhole to manhole. Mixing of pipe class, splicing or couplings shall not be allowed.

4.3.5 Vertical Separation from Water and Storm Sewer

Whenever sewers must cross water or storm drain lines, the line shall be laid at such an elevation that the top of the sewer is at least 18-inches below the bottom of the water or drain line. When the elevation of the sewer cannot be buried to meet the above requirements, protection shall be provided as follows:

A. Adequate structural support for the sewers to prevent excessive deflection of joints.
B. That one full length of water pipe be centered at the point of crossing so that the joints will be equal distance and as far as possible from the sewer.

4.3.6 Parallel Separation from Sanitary and Storm Sewer

Sewer lines, sewer services and sewer manholes shall be laid at least 10 feet horizontally, edge to edge, from water and drain lines. When conditions do not permit a horizontal separation of 10 feet, a sewer line may be laid closer to a water or drain line provided that:

A. The bottom of the water or drain line is at least 18 inches above the top of the sewer wherever possible.
B. Where this 18-inch vertical separation cannot be obtained, the sewer shall be constructed of upgraded materials as specified herein.

4.3.7 Detectable Tracer Tape

Install directly over the pipe to be identified approximately 18-inches below the proposed ground surface. The tape shall be a minimum of three (3") inches wide. The upper face of the tape shall be of a highly visible color easily detectable when exposed by digging. The upper face shall carry the warning of the buried sewer below. The tape shall have a metallic core locatable at a depth of 18-inches by metal or pipe locators. It shall be used over all non-metallic pipes. Warning Tape Color Code: Green: Drain and Sanitary Sewer Systems.

4.3.8 Pipe Connections to New Manholes

Pipe connections to new manholes shall be constructed with a compression type flexible connector cast into the manhole wall.

4.3.9 Pipe Connections to Existing Manholes

Pipe connections to existing manholes shall be made by coring the existing manhole and installing a boot type flexible connector consisting of a rubber gasket or boot, metal expansion ring and double metal take-up clamps. Rubber boots and gasket material shall meet or exceed ASTM C-923

4.4 TESTING OF SANITARY SEWERS

Test all sanitary sewer pipes after backfilling. Install all service leads on main pipe before testing. A maximum of 1000 feet of pipe may be installed but not tested at any time.

Prior to activating water service, every new building sewer shall be dye tested to establish that the building sewer is properly connected to the wastewater system. Dye tests may also be required to establish that the building storm drain is properly connected to the storm drainage system.

4.4.1 Gravity Sewer - Leakage Test for PVC Pipe

Use low pressure air test in accordance with UNI-BELL PVC Pipe Association UNI-B-6, Table 1, latest revision.

4.4.2 Gravity Sewer - Deflection Test for PVC Pipe

Within 30 days of completion of the PVC pipe installation, test 100% of pipe with a "Go/No-Go" mandrel. The mandrel outside dimension shall be sized to permit no more than a 7.5% deflection. Mandrel dimensions shall be based on a base pipe ID from ASTM 3034 DR35/SDR21 or AWWA C900 DR18 as appropriate and calculation provided in UNI-TR-1:

Mandrel O.D. = ((100-7.5)/100) * base pipe ID

4.4.3 Repairs

Repair or replace all pipes not passing tests using approved materials and methods, and retest.

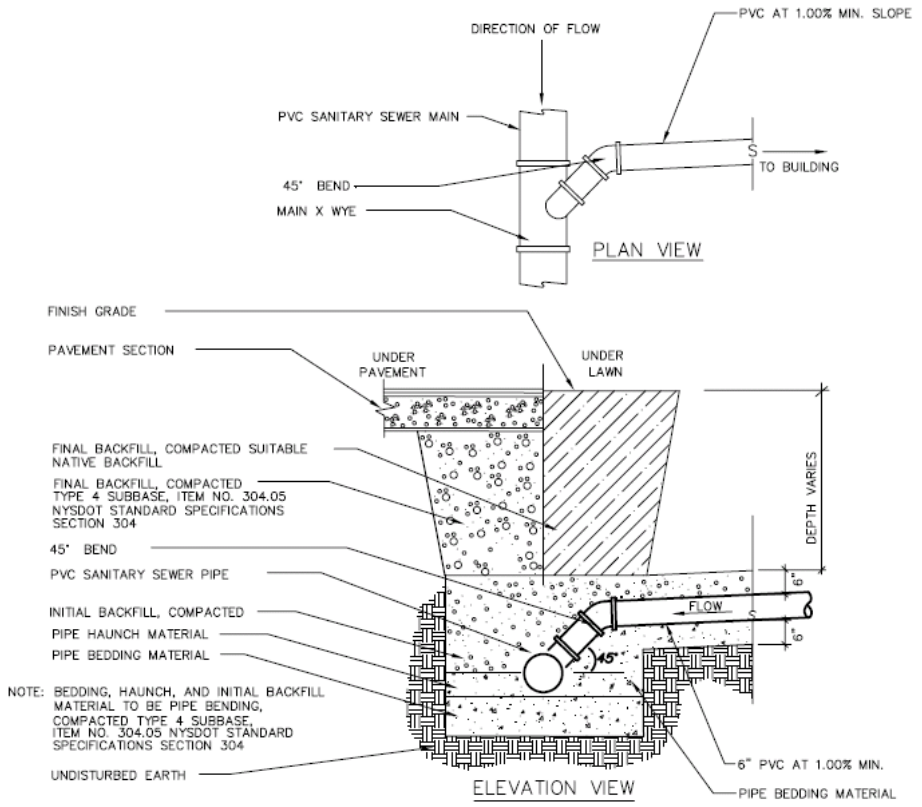
4.5 CLEANING

Clean and flush all sewer and drain piping after Work is completed and before final acceptance.

4.6 MISCELLANEOUS

4.6.1 Flexible Couplings

ASTM 1173. Use and location shall be approved.



NOTE: 1) SANITARY SEWER SERVICE CONNECTIONS TO BE LOCATED AT MANHOLES WHERE POSSIBLE.

2) IF UNSUITABLE SOILS ARE ENCOUNTERED AS DETERMINED BY THE ENGINEER, ADDITIONAL PIPE BEDDING AND/OR A STABILIZING GEOSYNTHETIC FABRIC, ITEM 207.02 NYSDOT STANDARD SPECIFICATIONS SECTION 207, MAY BE REQUIRED A.O.B.E.

3) FILL IS TO BE PLACED AND COMPACTED PER NYSDOT STANDARD SPECIFICATIONS SECTION 203.

4) PROVIDE SAFE OPERATION SHEETING IF NEEDED IN ACCORDANCE WITH NYSDOT SECTION 552.

N.T.S.

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COMMITMENT & INTEGRITY DRIVE RESULTS

SANITARY SEWER SERVICE		The University at Albany Uptown Campus	JOB NO: 213534.90
			DATEDECEMBER 2007
DESIGNED BY: MW	CHECKED BY: JS	Standard Details for Environmental Utilities	SCALE: NTS
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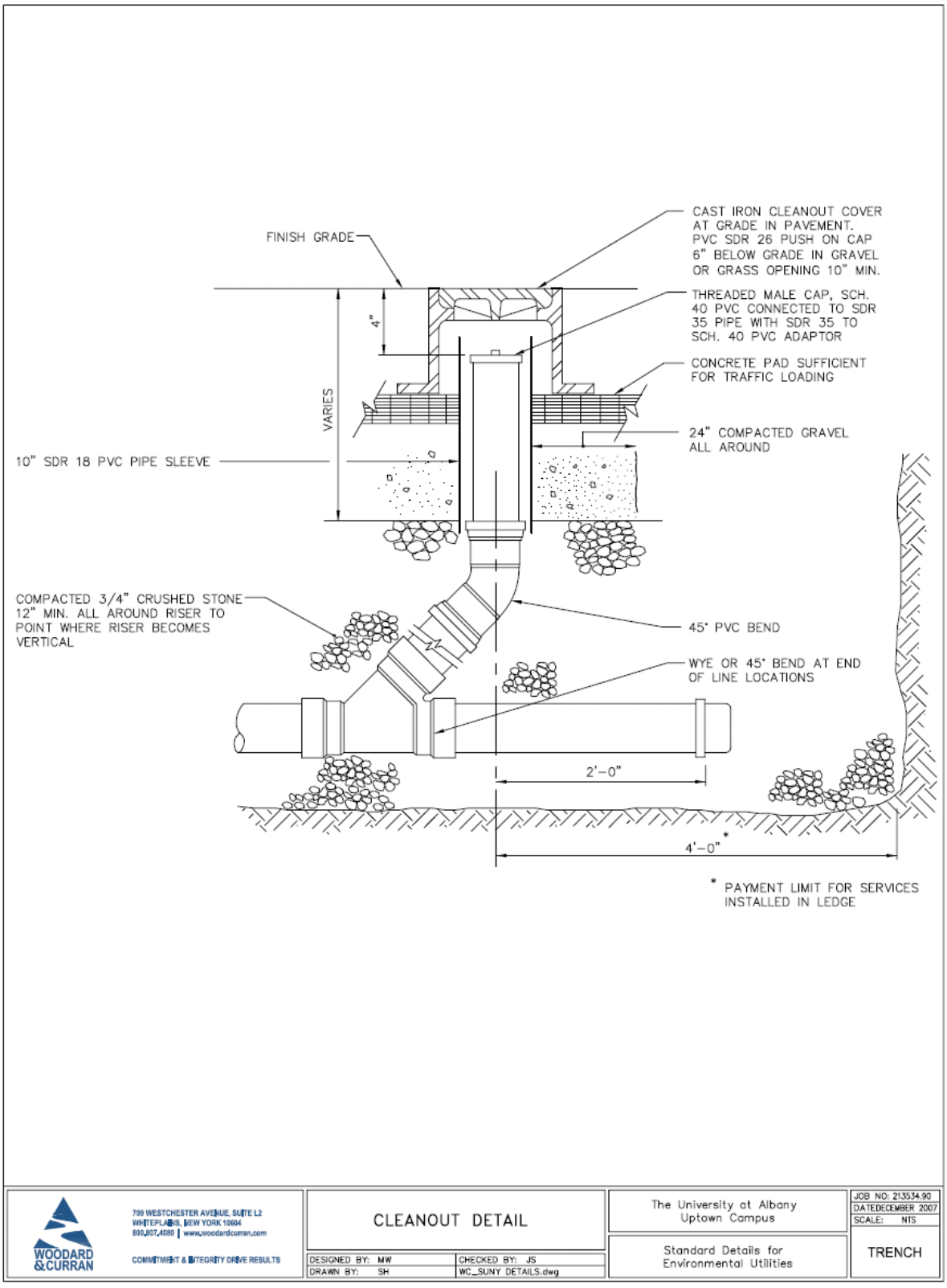
5. SANITARY SEWER CLEANOUT

5.1 COVER

The cleanout cover shall be at minimum 10" in diameter. It shall be a push on cast iron cap at grade with pavement. A concrete pad sufficient for support of the cover under traffic loading shall be provided if appropriate. The cleanout shall have a threaded male PVC cap 4" below grade.


FINISH GRADE
CAST IRON CLEANOUT COVER AT GRADE IN PAVEMENT. PVC SDR 26 PUSH ON CAP 6" BELOW GRADE IN GRAVEL OR GRASS OPENING 10" MIN.
4"
THREADED MALE CAP, SCH. 40 PVC CONNECTED TO SDR 35 PIPE WITH SDR 35 TO SCH. 40 PVC ADAPTOR
CONCRETE PAD SUFFICIENT FOR TRAFFIC LOADING
VARIES
24" COMPACTED GRAVEL ALL AROUND
10" SDR 18 PVC PIPE SLEEVE
COMPACTED 3/4" CRUSHED STONE 12" MIN. ALL AROUND RISER TO POINT WHERE RISER BECOMES VERTICAL
45° PVC BEND
WYE OR 45° BEND AT END OF LINE LOCATIONS
2'-0"
4'-0"*
* PAYMENT LIMIT FOR SERVICES INSTALLED IN LEDGE
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Environmental Utilities
JOB NO: 213534.90
DATEDECEMBER 2007
SCALE: NTS
TRENCH

6. WATER PIPING

All products used in the construction that come in contact with drinking water shall meet the National Sanitation Foundation Standard 61 for Drinking Water System Components - Health Effects. The primary focus of the standard is on contaminants or impurities which may be imparted indirectly to drinking water. The products and/or materials covered include, but are not limited to, protective materials (coatings, linings, liners, etc.), joining and sealing materials (solvent cements, welding materials, gaskets, etc.), and mechanical devices used in transmission/distribution systems, (valves, etc.).

6.1 PIPING

Pipes shall be required to be capped when delivered to prevent contamination. Backfilling and compaction shall follow immediately behind pipe laying. No excavation shall be left open or unprotected for any period of time when work is not in progress.

6.2 WATERMAINS- DUCTILE IRON PIPING AND FIXTURES

All products used in the construction that come in contact with drinking water shall meet the National Sanitation Foundation Standard 61 for Drinking Water System Components - Health Effects. The primary focus of the standard is on contaminants or impurities which may be imparted indirectly to drinking water. The products and/or materials covered include, but are not limited to, protective materials (coatings, linings, liners, etc.), joining and sealing materials (solvent cements, welding materials, gaskets, etc.), and mechanical devices used in transmission/distribution systems, (valves, etc.).

A. Ductile iron pipe used for exterior piping shall be Class 52, 60-42-10 grade and shall be designed for Type 2 laying condition, as defined in the latest revision of AWWA Standard C150. The pipe shall have push-on joints conforming to ANSI Specification A21.51 of latest revision except at fittings and for above-grade piping systems, which shall be mechanical joints.
B. Ductile iron pipe shall be centrifugally cast, bituminous coated, cement lined, seal-coated and manufactured in accordance with the latest revision of AWWA Standards C150 and C151. Note that the cement lining called for above shall be twice the thickness specified in the latest revision of AWWA Standard C104 and the interior shall be asphalt seal-coated twice.
C. Pipe fittings shall be ductile iron, cement lined, mechanical joint in conformance with AWWA C110 – Standards for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch for Water. The exterior of pipe fittings shall be bituminous coated.
D. Gasket material for all jointing requirements shall be neoprene unless otherwise required due to field conditions or joint restraint requirements and shall conform to the requirements of AWWA C111 – Standards for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
E. Flexible pipe couplings for use on plain ended pipe for pipe repairs, specified herein or where required for relief of pipe line strain shall be mechanical compression joint type with a pressure rating equal to that of the ductile iron pipe. Flexible pipe couplings shall be included under the related pipe unit prices.
F. In general, all new water mains shall be a minimum of 8” in diameter. Water mains that will supply hydrants must be at least 8” in diameter.
G. Laying line will normally be 5’-6’ off the curb line in the roadway. Line assignment for the proposed main shall be coordinated with University officials especially in cases where storm drains and catch basins are proposed.
H. Water mains should not be installed less than six feet (6’) from the street.

6.3 WATER LINE REPAIR

A. Repairs to existing pipe and fittings and valves cut in to existing pipe shall be swabbed or sprayed with a 1% hypochlorite solution prior to being installed.
B. When existing water mains are opened, either by accident or by design, liberal quantities of hypochlorite in tablet format shall be applied to the trench to minimize potential contamination of the water main.

6.4 REPLACEMENT AND RELOCATION OF WATERLINE

6.4.1 Pipe Jointing

For exterior piping, all joints shall be made in a dry trench and in accordance with the manufacturer's recommendations and the best practices for class of pipe laid. The ends of the pipe shall be wiped clean with a dry cloth before making the joint. Apply pipe lubricant suitable for potable water supply prior to joining the pipe.

6.4.2 Pipe Laying

A. Installation of ductile iron shall be in accordance with the requirements of AWWA C600.
B. Where possible, all pipe shall be laid with a minimum of five feet and a maximum of 7-feet of cover over the top of the pipe.
C. All pipe laid within 3 feet of a culvert or with less than 4 feet 6 inches of cover shall be insulated with 2-inch 40 pound density Styrofoam material. The insulation shall extend the width of the trench, a minimum of 4 feet, above the pipe envelope and on the vertical sides of the trench bottom from the bottom to above the pipe envelope. No pipe shall be laid with less than 4 feet 6 inches of cover without prior approval.
D. The deflection of alignment at a joint shall not exceed the appropriate permissible deflection, as specified in AWWA C600 of latest revision.
E. When mechanical joint, push-on joint, ball and socket, or similar pipe is laid, the bell of the pipe shall be cleaned of excess tar or other obstruction and wiped out before the cleaned and prepared spigot of the next pipe is inserted into it. The gasket, bell, and spigot shall be lubricated with gasket lubricating compound compatible with potable water. The new pipe shall be shoved firmly into place until properly seated and held securely until the joint has been completed. All pipe shall be pushed home by a method that protects the driving end of the pipe. Also, a minimum of two copper or bronze wedges shall be driven between each cast iron and/or ductile joint.
F. No pipe laying will be allowed to begin at any point other than a stub end or other appurtenance without prior approval. Whenever the work is stopped temporarily, or for any reason whatsoever, the end of the pipe shall be carefully protected against dirt, water, or other extraneous material. Bedding shall be as shown on the plans. No pipe shall be covered or trench backfilled until approved.

6.5 GATE VALVES

A. Gate valves are normally installed at street lines of intersecting streets. Upon University review, additional valves may be required to facilitate future main extensions.
B. All valves shall be non-rising stem with an integral thrust collar and shall be OPEN RIGHT - CLOCKWISE with a 2-inch square operating nut. Gate valves shall be mechanical joint (MJ x MJ). The valve shall be rated for 250 psi working pressure.
C. Gate valves shall be in conformance with AWWA 515 and AWWA C550. The valve body and bonnet shall be constructed of high-strength ductile iron encapsulated inside and out with fusion bonded epoxy for corrosion resistance with wall thickness as defined in AWWA C515. Materials shall comply with the Safe

Drinking Water Act and all local, state and federal requirements.

D. Gate valves shall be capable of withstanding, without structural damage, an internal test pressure of twice the rated design working pressure of the valve and full rated internal working pressure when the closure member is cycled from fully opened to fully closed.
E. With the valve fully opened, the unobstructed waterway shall at least equal to the nominal diameter of the valve. The waterway shall be smooth with no depression or cavities in the seat area for foreign matter to lodge and prevent closure or seating.
F. The valve stem and nut shall be to resist corrosion and abuse.
G. The stem shall be sealed by a minimum of two (2) "O" rings. Stem seals above the thrust collar shall be replaceable with the valve fully opened and while subject to full rated working pressure.
H. The wedge shall consist of a ductile iron casting encased in a bonded-in-place nitrile elastomer covering which forms the resilient sealing surfaces.
I. All exterior nuts and bolts shall be 5/8-inch minimum diameter and shall be Type 18-8 stainless steel.
J. Gaskets, "O" rings and other suitable elastomeric seals shall be used on all flanged joints such that the joints are watertight.

6.6 VALVE BOXES

A. Each exterior valve shall be provided with a valve box. Valve boxes shall be cast iron, bitumastic coated, two piece, sliding type with a top flange and a minimum inside shaft diameter of 5 ¼-inches and a cover. They shall be so designed and constructed as to prevent the direct transmission of traffic loads to the pipe or valve.
B. The box shall be adjustable through at least 6-inches vertically without reduction of lap between sections to less than 4 inches. The length shall be as necessary to suit the ground elevation. The valve box shall have a smooth cast seat to accept the valve box cover and insure a non-rocking installation.
C. Covers shall be close fitting and substantially dirt-tight. The cover shall be heavy, non tilting 2-inch drop style, recessed in the box top to prevent plow breakage with pick holes for easy removal. The word "WATER" shall be cast into the cover.
D. The valve box base shall be designed to center the operating nut and provide stability.

6.7 SPECIAL REQUIREMENTS

6.7.1 Removing Asbestos Cement (AC) Pipe

Check and comply with all local jurisdiction requirements. Comply with the requirements of OSHA's Construction Industry Standard for the Occupational Exposure to Asbestos. Provide a hand/face wash station for workers. Employ at least one worker who will act as the "Competent Person" and is capable of identifying existing asbestos hazards, qualified to train other works and has authority to take prompt corrective measures to eliminate hazardous exposure. Hand excavate around pipe where cuts are planned. Workers shall be equipped with protective clothing and equipment consisting at a minimum of Tyvek suits, steel toe boots, hard hats, safety glasses, and rubber or leather gloves. When cutting pipe, provide adequate wetting with potable water to prevent asbestos fibers from becoming air-borne. Remove pipe sections at joint collars, where possible, by cutting them with a wetted saw. Trim cut ends with wheel-type pipe cutter. Remove pipe sections, when possible, in intact condition using lifting straps or other methods that prevent damage to pipe section. Wet, wrap and seal section of pipe removed in a minimum 6-mil poly wrap and securely fasten and tape close pipe ends to prevent AC materials from becoming friable. Wet and containerize waste material as work progresses. Designate an area to containerize waste materials and provide warning signs labeled: DANGER, Contains Asbestos Fibers, Avoid Creating Dust, Cancer and Lung Disease Hazard.

6.7.2 Horizontal and Vertical Separation of Sanitary and Water Mains

Water mains shall be constructed at least 10 feet from any existing or proposed sewer main. The horizontal distance shall be measured from outside of the water pipe to outside of the sewer pipe. Where 10 feet horizontal separation is not attainable, the water main may be constructed closer to the sewer main provided that the water main is in a separate trench or on an undisturbed earth shelf and the invert of the water main is a minimum of 18-inches above the crown of the sewer main. If it is impossible to obtain the horizontal and vertical separation described above, perform one of the following as directed by the ENGINEER:

A. Relocate the water main in a separate trench with the invert of the water main a minimum of 18-inches above the crown of the sewer.
B. Construct both the water main and sewer main (from manhole to manhole) of pipe equivalent to water main standards of construction and pressure test both to 150 psi.

6.7.3 Sewer Mains Crossing Water Mains

Whenever possible, sewers shall cross perpendicular under water mains. Sewers crossing water mains shall be laid to provide a minimum of 18-inches vertical separation from the outside of the water main to the outside of the sewer main. This shall be the case whether the sewer crosses above or below the water main. Construct crossings such that one full length of sewer pipe is centered at the crossing so that the joints of the sewer pipe are equidistant and as far as possible from the water main. When the sewer must be constructed above the water, provide adequate structural support for the sewer to maintain line and grade. If it is impossible to obtain the vertical separation described above, perform one of the following methods as directed:

A. Relocate the water main to provide a vertical separation of 18-inches from the sewer.
B. Encase the sewer main in a watertight carrier pipe which extends 10 feet on both sides of the crossing, measured perpendicular to the water main. The carrier pipe shall be constructed of pipe equivalent to water main standards of construction.
C. Construct the sewer main (from manhole to manhole) of pipe equivalent to water main standards of construction and pressure test at 150 psi.

6.7.4 Separation of Water Line from Cable TV lines, Telephone Lines, and Electrical Cables

For parallel installation water lines shall be laid with at least 10 feet of separation from any cable without exception. All water line crossings of cables shall be at an angle not less than 45 degrees, the cable shall be housed in an iron or steel conduit where possible at least six feet on either side of the water line, and the water line and cable carrying conduit shall be separated by at least 18-inches.

6.7.5 Assembling Mechanical Joints

Surfaces against which the gasket will come in contact shall be thoroughly brushed with a wire brush prior to assembly of the joint. The gasket shall be cleaned. The gasket, bell, and spigot shall be lubricated by using gasket lubricating compound compatible with potable water. The spigot shall be inserted into the bell until it is correctly seated. The gasket shall then be seated evenly in the bell at all points, centering the spigot, and the gland shall be pressed firmly against the gasket. After all bolts have been inserted and the nuts have been made up finger-tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint to the proper tension by means of a torque wrench. Mechanical joints shall be assembled with mechanical joint retainer glands where approved. Restraint gaskets shall be used in conjunction with retainer glands to adequately restrain joints.

Bolts for mechanical joints shall be tightened to the normal range of bolt torque as indicated below. Use torque indicating wrench to tighten bolts.

MECHANICAL –JOINT BOLT TORQUE

Joint Size (in.)	Bolt Size (in.)	Range of Torque (ft-lb)
3	5/8	45-60
4-24	¾	75-90
30-36	1	100-120
42-48	1 ¼	120-150

Mechanical joint bolts shall be re-torqued to the range specified after waiting a period of two hours.

If effective sealing of the joint is not attained at the maximum torque indicated above, the joint shall be disassembled and thoroughly cleaned, then reassembled. Bolts shall not be overstressed to tighten a leaking joint.

6.8 DISINFECTION OF WATER LINES

Water mains will be flushed and disinfected. At completion of water service installation, flush and disinfect in conformance with AWWA C651 of latest revision. Prevent contaminated or highly chlorinated water from entering new or previously disinfected mains.

6.8.1 Flushing Prior to Disinfection

Flush using water from existing main to eliminate air pockets and remove particulates. Flushing velocity shall not be less than 2.5 ft/s. To achieve flushing velocity, provide the following minimum flow in gallons per minute: 4-inch diameter - 100 GPM; 6-inch diameter - 200 GPM; 8-inch diameter - 400 GPM; 12-inch diameter - 900 GPM.

6.8.2 Method

Continuous feed method using calcium hypochlorite as described in the latest revision of AWWA C651 Standard for Disinfecting Water Mains.

6.8.3 Flushing After Disinfection

After the required retention time, flush the heavily chlorinated water from the mains, valves, fittings, hydrants and branch lines until chlorine measurements show that the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the distribution system.

6.9 TESTING OF WATER LINE

A. All inline valves and hydrant branch valves within the test section shall be fully opened before pressure test is conducted.
B. The duration of the hydrostatic test shall be at least two hours. The test pressure shall be 1.5 times the working pressure at the lowest point, but in no case less than 150 psi. The test pressure shall not vary by more than +/-5 psi for the duration of the test.
C. Fill the water main to be tested slowly to completely expel air from the test section. Allow the test section to stabilize at the test pressure before conducting the hydrostatic test.
D. The allowable leakage for ductile iron pipe may be determined by the formula:

$$L = \frac{SD\,p^{1/2}}{133{,}200}$$

Where L is the allowable leakage in gallons per hour, S is the length of pipe in feet, D is the nominal diameter in inches, and P is the average test pressure in psi.

For convenience, the following table may be used to estimate allowable leakage for ductile iron water main installations:

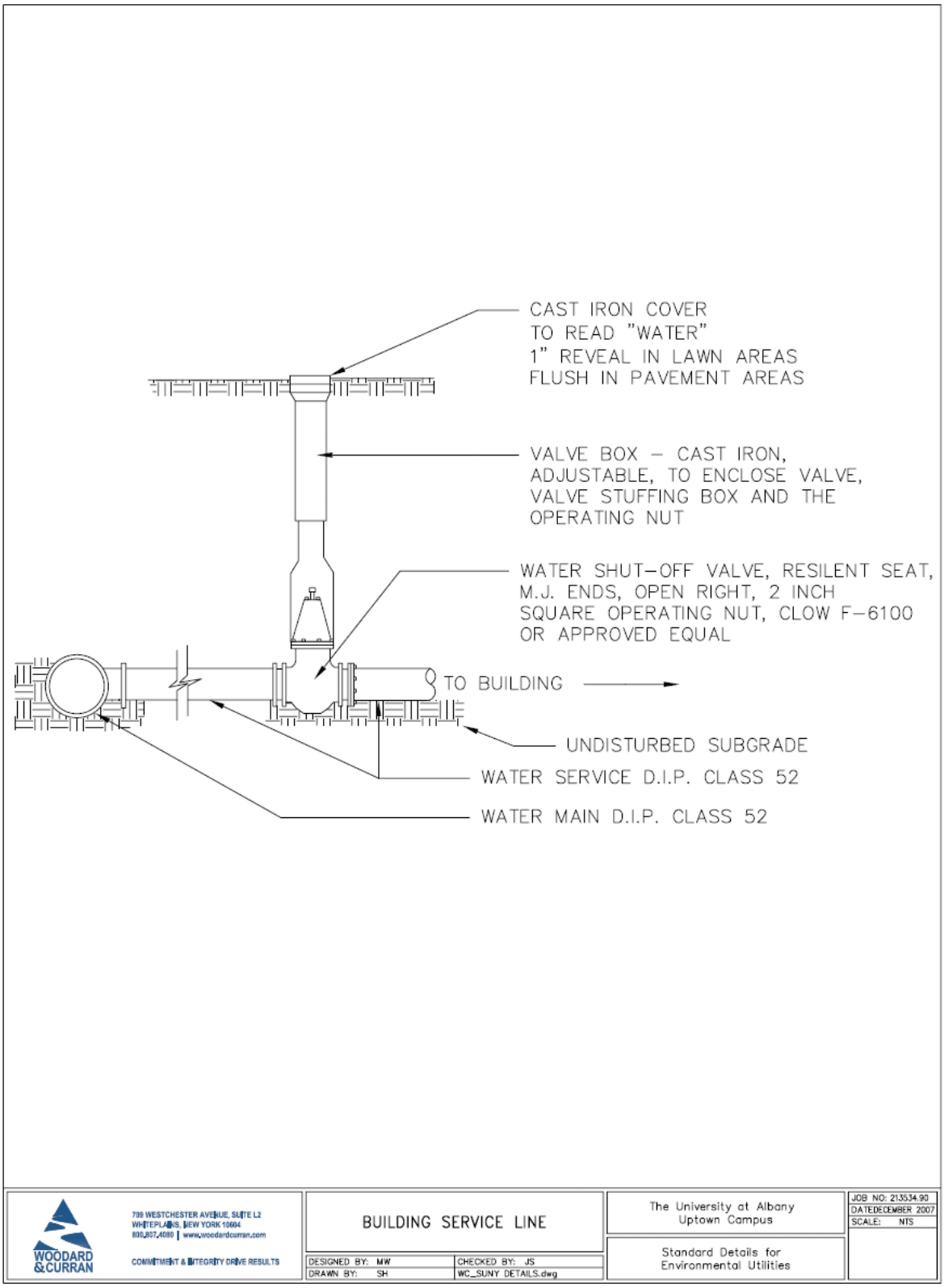
CIPRA RECOMMENDED ALLOWABLE LEAKAGE PER 1000-FT. OF PIPELINE*

(GALLONS PER HOUR)

Avg. Test Pressure	NOMINAL PIPE DIAMETER - INCHES					
PSI	4	6	8	10	12	16
450	0.64	0.95	1.27	1.59	1.91	2.55
400	0.60	0.90	1.20	1.50	1.80	2.40
350	0.56	0.84	1.12	1.40	1.69	2.25
300	0.52	0.78	1.04	1.30	1.56	2.08
275	0.50	0.75	1.00	1.24	1.49	1.99
250	0.47	0.71	0.95	1.19	1.42	1.90
225	0.45	0.68	0.90	1.13	1.35	1.80
200	0.43	0.64	0.85	1.06	1.28	1.70
175	0.40	0.59	0.80	0.99	1.19	1.59
150	0.37	0.55	0.74	0.92	1.10	1.47
125	0.34	0.50	0.67	0.84	1.01	1.34
100	0.30	0.45	0.60	0.75	0.90	1.20

* For mechanical or push-on joint pipe with 18-foot nominal lengths. To obtain the recommended allowable leakage for pipe with 20-foot nominal lengths, multiply the leakage calculated from the above table by 0.9.

If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.


CAST IRON COVER
TO READ "WATER"
1" REVEAL IN LAWN AREAS
FLUSH IN PAVEMENT AREAS
VALVE BOX – CAST IRON,
ADJUSTABLE, TO ENCLOSE VALVE,
VALVE STUFFING BOX AND THE
OPERATING NUT
WATER SHUT–OFF VALVE, RESILENT SEAT,
M.J. ENDS, OPEN RIGHT, 2 INCH
SQUARE OPERATING NUT, CLOW F–6100
OR APPROVED EQUAL
TO BUILDING
UNDISTURBED SUBGRADE
WATER SERVICE D.I.P. CLASS 52
WATER MAIN D.I.P. CLASS 52
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7. HYDRANTS

All products used in the construction that come in contact with drinking water shall meet the National Sanitation Foundation Standard 61 for Drinking Water System Components - Health Effects. The primary focus of the standard is on contaminants or impurities which may be imparted indirectly to drinking water. The products and/or materials covered include, but are not limited to, protective materials (coatings, linings, liners, etc.), joining and sealing materials (solvent cements, welding materials, gaskets, etc.), and mechanical devices used in transmission/distribution systems, (valves, etc.).

7.1 FIRE HYDRANTS

A. Fire hydrants shall have mechanical joint, two 2½-inch NST hose connections and one 4½-inch NST steamer connection with a main valve opening 5¼-inch in diameter. Hydrants shall be 5'-6" bury, 6-inch mechanical joint with a pentagonal operating nut. The nozzle cap shall be provided with non-kink safety chains. The barrel shall be a minimum of 6-inches inside diameter. Friction loss through the hydrant shall not exceed 3.0 psi at 1,000 gpm through the pumper nozzle. Hydrants shall be OPEN RIGHT - CLOCKWISE and the bonnet shall be stamped with an arrow indicating direction of opening.

B. Hydrants shall be painted inside and out with a primer. The section below grade shall be painted with two (2) coats of shop applied black asphaltum paint to resist corrosion. The exterior surface above ground shall be painted with a shop applied primer and high-grade enamel. The hydrants shall receive a minimum of two (2) additional coats of field applied epoxy paint conforming to the color code currently in use by the University.

C. Fire hydrants shall comply with the latest revision of AWWA C502 and with Factory Mutual Research Corporation and Underwriters' Laboratories UL 246 Standards. The rated working pressure shall be a minimum 200 psi with a test pressure of 400 psi. The hydrant shall have an oil reservoir to provide lubrication to all stem threads, bearing surfaces and "O" rings each time the hydrant is operated.

D. The main valve closure on the hydrants shall be compression type, capable of opening against pressure and closing with pressure. The hydrant shall be designed to rotate a full 360º during field installation with a breakable traffic flange.

E. Fire hydrants shall be designed so that removal of seat, drain valve mechanism, internal rod and all working parts can be removed through the top of the hydrant without disturbing the ground line joint or nozzle section. A bronze seat shall be mated into bronze thread.

F. The draining system shall be bronze and activated by the main stem without use of auxiliary rods, toggles or pins and shall fully close within three (3) turns of the operating nut in the opening direction. The drain shut off shall be by direct compression closure. There shall be a minimum of two inside ports and four drain ports to the exterior of the hydrant.

G. The operating nut shall be bronze, designed for slow closing to reduce the possibility of water hammer. Operating nut, main stem, coupling and main valve shall be capable of withstanding 200 ft/lb. of torque in both the opening and closing directions. The internal top housing shall contain triple "O" ring seals.

H. The hydrant rod shall be furnished in two sections of high tensile steel. The upper section shall have a bronze sleeve where it passes through "O" rings. The upper and lower sections shall be joined by a cast iron coupling with stainless steel pins.

I. The nozzle section shall be bronze, designed to permit field replacement without special tools or excavation, locked into the hydrant barrel with locking lugs and sealed by heavy duty "O" ring.

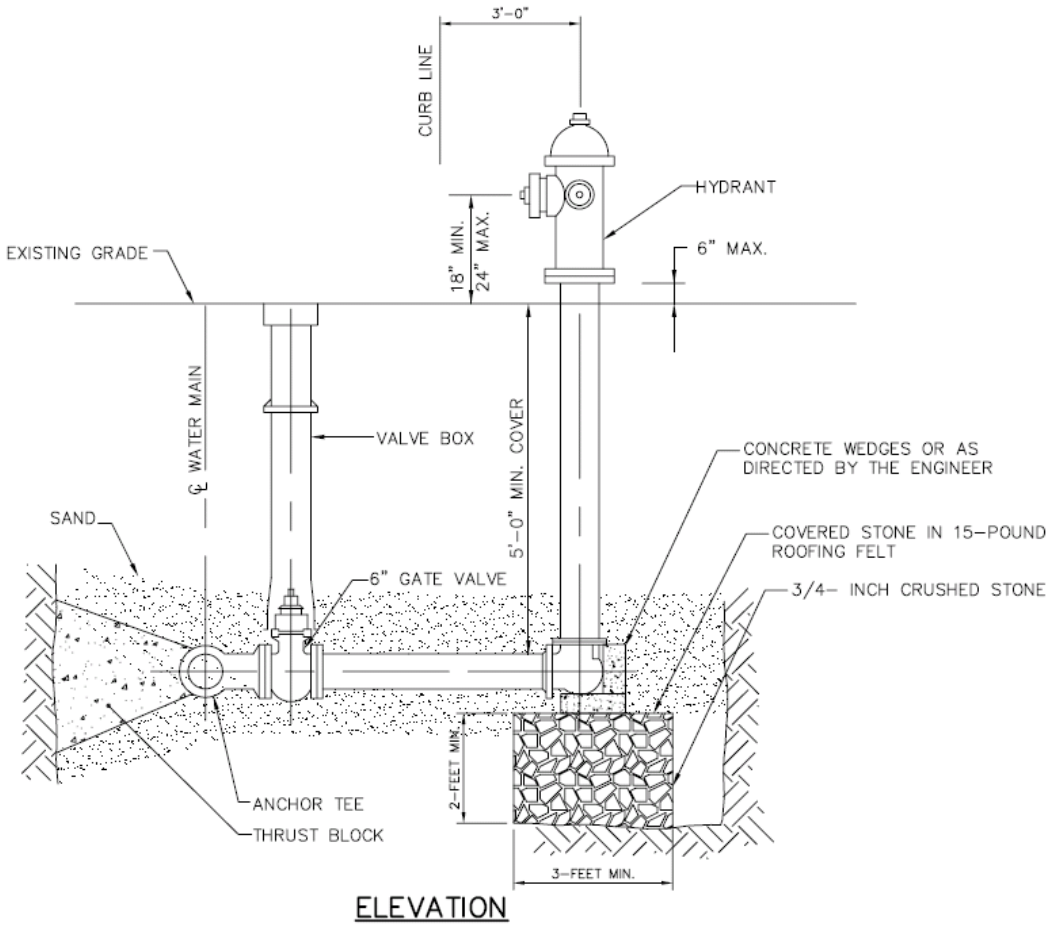
J. Hydrants shall have a 6" pipe with a 6" gate valve controlling each hydrant. Gate valve operation shall be OPEN RIGHT - CLOCKWISE.

7.2 YARD HYDRANTS

Yard hydrants are to have shutoff valves located no more than five feet from the nozzle side of the hydrant.

7.3 FIRE HYDRANT INSTALLATION

A. Hydrants shall be installed in accordance with AWWA C502, the manufacturer's recommendations and as shown on the drawing.
B. Hydrants shall be installed on the side of the street closest to the water main, in the area directly behind the curb or pavement line, normally 2-3 feet from the face of curb to center line of hydrant.
C. Hydrants shall be installed such that the existing grade is flush with the bury line. Install offsets or extensions as needed to assure that the bury line shall meet the existing grade. Mounding of soil to make existing grade flush with the bury line is not acceptable.
D. All hydrant locations shall have anchor tees. Hydrant valves shall be 6-inch OPEN RIGHT - CLOCKWISE. The valve shall be bolted directly to the anchor tees and in true vertical alignment. Valve boxes shall be centered over the operating nut and carefully backfilled such that the valve box remains centered over the operating nut.
E. The hydrant lateral shall be 6-inch cement lined ductile iron pipe. There shall be no joints in the hydrant laterals unless absolutely necessary. The hydrant shall be secured to the valve by means of rods or retaining glands. If joints are required in the hydrant lateral and retaining glands are used, the joint shall be installed with a retaining gasket.
F. The hydrant shall be installed in true vertical alignment and checked with a level in both the vertical and horizontal directions.
G. Each hydrant shall be constructed with a crushed stone sump to the dimensions indicated on the drawing. The sump shall be constructed to one side of the hydrant. The crushed stone shall cover the drain holes. Provide 15# roofing felt over the crushed stone sump to prevent siltation of the sump.
H. Thrust blocks or concrete wedges shall be installed behind the anchor tee and against the undisturbed trench wall.
I. Service connections shall not be made off of the hydrant laterals.
J. Apply two (2) coats of epoxy paint conforming to the color code currently in use by the University.



ELEVATION

NOTES:

- ALL JOINTS FOR HYDRANT INSTALLATION SHALL BE MECHANICALLY RESTRAINED.
- HYDRANT LATERALS SHALL BE CONSTRUCTED FROM ONE CONTINUOUS PIPE LINK WHEN POSSIBLE. JOINT RESTRAINTS ARE REQUIRED WHEN MORE THAN ONE PIPE LINK IS USED.
- CONTRACTOR SHALL CONSTRUCT A HYDRANT DRAINING SUMP TO EITHER SIDE OF THE HYDRANT. THE HYDRANT DRAINING SUMP SHALL BE 3-FEET WIDE BY 2-FEET IN DEPTH. THE SUMP SHALL CONSIST OF 3/4-INCH CRUSHED STONE WITH A 15-POUND ROOFING FELT LAID OVER THE 3/4-INCH CRUSHED STONE.

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8. TAPPING SLEEVE AND VALVE AND WATER SERVICE LINE

All products used in the construction that come in contact with drinking water shall meet the National Sanitation Foundation Standard 61 for Drinking Water System Components - Health Effects. The primary focus of the standard is on contaminants or impurities which may be imparted indirectly to drinking water. The products and/or materials covered include, but are not limited to, protective materials (coatings, linings, liners, etc.), joining and sealing materials (solvent cements, welding materials, gaskets, etc.), and mechanical devices used in transmission/distribution systems, (valves, etc.).

8.1 GATE VALVES

A. All valves shall be non-rising stem with an integral thrust collar and shall be OPEN RIGHT- CLOCKWISE with a 2-inch square operating nut. Gate valves shall be mechanical joint (MJ x MJ). The valve shall be rated for 250 psi working pressure.
B. Gate valves shall be in conformance with AWWA 515 and AWWA C550. The valve body and bonnet shall be constructed of high-strength ductile iron encapsulated inside and out with fusion bonded epoxy for corrosion resistance with wall thickness as defined in AWWA C515. Materials shall comply with the Safe Drinking Water Act and all local, state and federal requirements.
C. Gate valves shall be capable of withstanding, without structural damage, an internal test pressure of twice the rated design working pressure of the valve and full rated internal working pressure when the closure member is cycled from fully opened to fully closed.
D. With the valve fully opened, the unobstructed waterway shall at least equal to the nominal diameter of the valve. The waterway shall be smooth with no depression or cavities in the seat area for foreign matter to lodge and prevent closure or seating.
E. The valve stem and nut shall be to resist corrosion and abuse.
F. The stem shall be sealed by a minimum of two (2) “O” rings. Stem seals above the thrust collar shall be replaceable with the valve fully opened and while subject to full rated working pressure.
G. The wedge shall consist of a ductile iron casting encased in a bonded-in-place nitrile elastomer covering which forms the resilient sealing surfaces.
H. All exterior nuts and bolts shall be 5/8-inch minimum diameter and shall be Type 18-8 stainless steel.
I. Gaskets, “O” rings and other suitable elastomeric seals shall be used on all flanged joints such that the joints are watertight.

8.2 VALVE BOXES

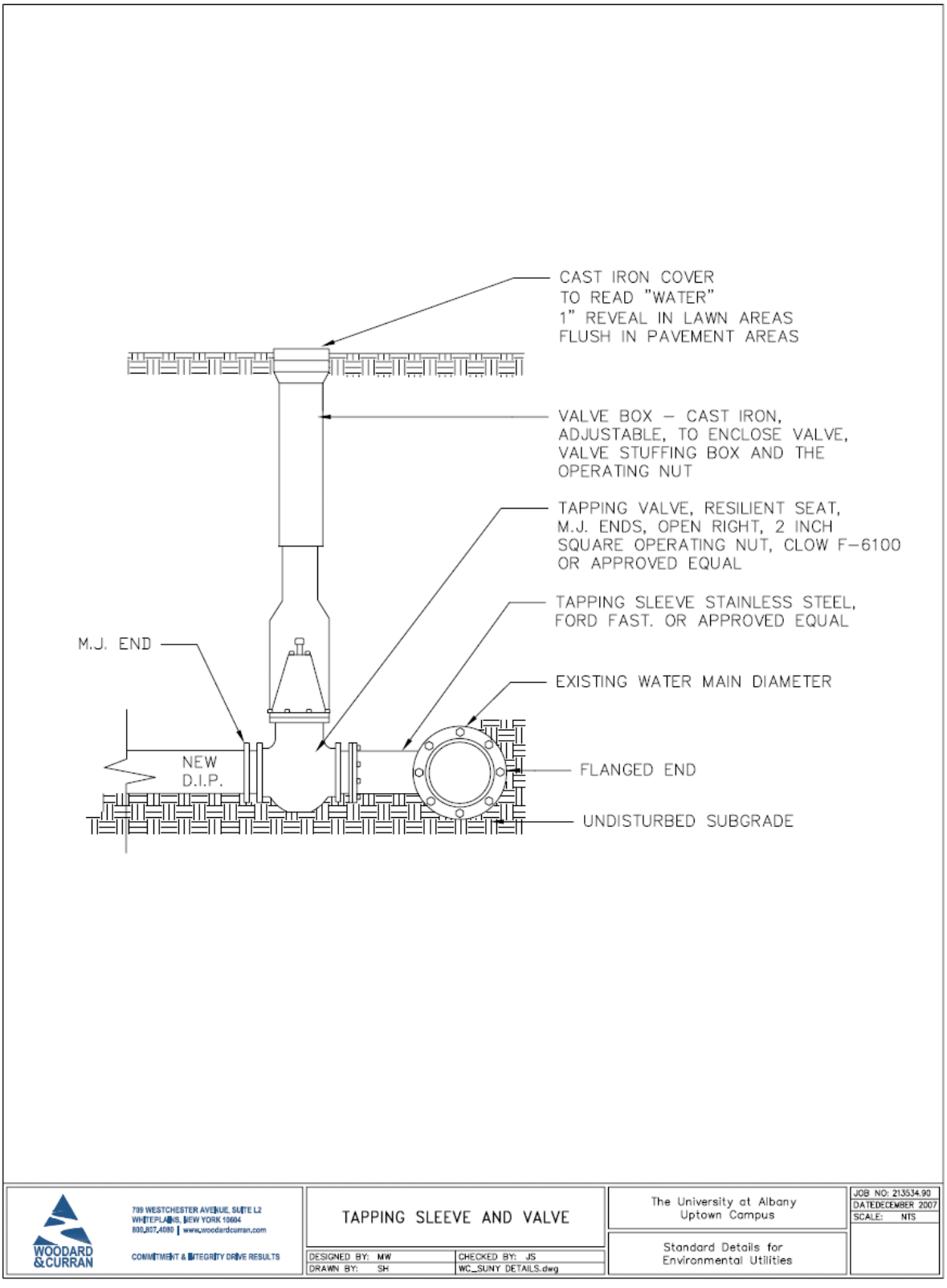
A. Each exterior valve shall be provided with a valve box. Valve boxes shall be cast iron, bitumastic coated, two piece, sliding type with a top flange and a minimum inside shaft diameter of 5 ¼-inches and a cover. They shall be so designed and constructed as to prevent the direct transmission of traffic loads to the pipe or valve.
B. The box shall be adjustable through at least 6-inches vertically without reduction of lap between sections to less than 4 inches. The length shall be as necessary to suit the ground elevation. The valve box shall have a smooth cast seat to accept the valve box cover and insure a non-rocking installation.
C. Covers shall be close fitting and substantially dirt-tight. The cover shall be heavy, non tilting 2-inch drop style, recessed in the box top to prevent plow breakage with pick holes for easy removal. The word “WATER” shall be cast into the cover.
D. The valve box base shall be designed to center the operating nut and provide stability.

8.3 TAPPING SLEEVES AND VALVES

A. Valves with tapping sleeves shall be in conformance with the requirement of AWWA C509 and shall be

resilient seated gate type in conformance with that specified under paragraph 2.01 of this Section. The waterway shall include appropriate clearance for the diameter of the tapping machine cutter recommended by the valve manufacturer.

B. The end flange of the tapping valve that forms a joint with the tapping sleeve shall conform to the dimensions of MSS MP-60. The connecting end of the tapping valve that mates with the tapping sleeve shall be parallel and concentric with the opposite flange and concentric with the waterway to provide proper alignment for the tapping operation. The end flange of the tapping valve that forms a joint with the tapping machine shall conform to the dimension of MSS SP-113.
C. Tapping sleeves shall be ductile iron meeting ASTM A536 Grade 65-14-12, constructed of two sections for easy installation and capable of being assembled around the water main without disruption in service. The sleeve shall be mechanical joint and furnished with complete end joint accessories and split glands necessary for assembling the sleeve to the pipe. No special tools shall be required other than a standard socket wrench. The flange seals shall be of "O" ring type. The sleeve shall be rated for a working pressure of 250 psi
D. Tapping sleeves must be capable of working on Class A, B, C or D pipe diameters without changing either half of the sleeve.



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TAPPING SLEEVE AND VALVE

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9. SMALL DIAMETER WATER SERVICE

All products used in the construction that come in contact with drinking water shall meet the National Sanitation Foundation Standard 61 for Drinking Water System Components - Health Effects. The primary focus of the standard is on contaminants or impurities which may be imparted indirectly to drinking water. The products and/or materials covered include, but are not limited to, protective materials (coatings, linings, liners, etc.), joining and sealing materials (solvent cements, welding materials, gaskets, etc.), and mechanical devices used in transmission/distribution systems, (valves, etc.).

9.1 CORPORATIONS, CURB STOPS, AND COMPRESSION FITTINGS

9.1.1 Corporation Stops

A. Corporation stops shall be designed and manufactured to conform to AWWA Standard C800 of latest revision. Corporation stops shall be individually inspected and tested for leaks by air pressure under water and shall be capable of being installed using standard tapping machines.

B. Corporation stops shall be bronze with lapped ground key, full bore, ball type, with AWWA or iron pipe inlet threads and rated for 300 psi working pressure. The corporation shall be constructed with molded nitrile (Buna-N) seals, sealed in place with adhesive, nitrile (Buna-N) “O” ring with a flange stem design to prevent failure due to blowout.

9.1.2 Curb Stops

Curb stops shall conform to the latest revision of AWWA Standard C800. They shall be draining, one piece of angle design, brass construction in conformance with ASTM B62, with closed bottom body to minimize exposure to moving parts. The curb stops shall contain “O” ring seals fully supported in machined groove to provide positive sealing and shall have a minimum pressure rating of 175 psi. The tee head shall be an integral part of the plug and capable of indicating if the valve is opened or closed. End connection shall include copper flare, compression, pack joint and F.I.P. thread.

9.1.3 Compression Connections

Compression connections shall be pack joint type with Buna-N beveled gasket, watertight, with machine grooved split clamp to draw down securely on the tubing. The tightening screws shall be stainless steel.

9.2 COPPER TUBING

Copper tubing shall be Type K annealed copper tubing meeting the requirement of Federal Specification WW-T 7996, conforming to ASTM specifications B-75, B-88, B-68 as they apply to Type K copper tubing and meeting the requirement of AWWA C800.

9.3 COVERS

Covers shall be close fitting and substantially dirt-tight. The cover shall be heavy, non tilting 2-inch drop style, recessed in the box top to prevent plow breakage with pick holes for easy removal. The word “WATER” shall be cast into the cover.

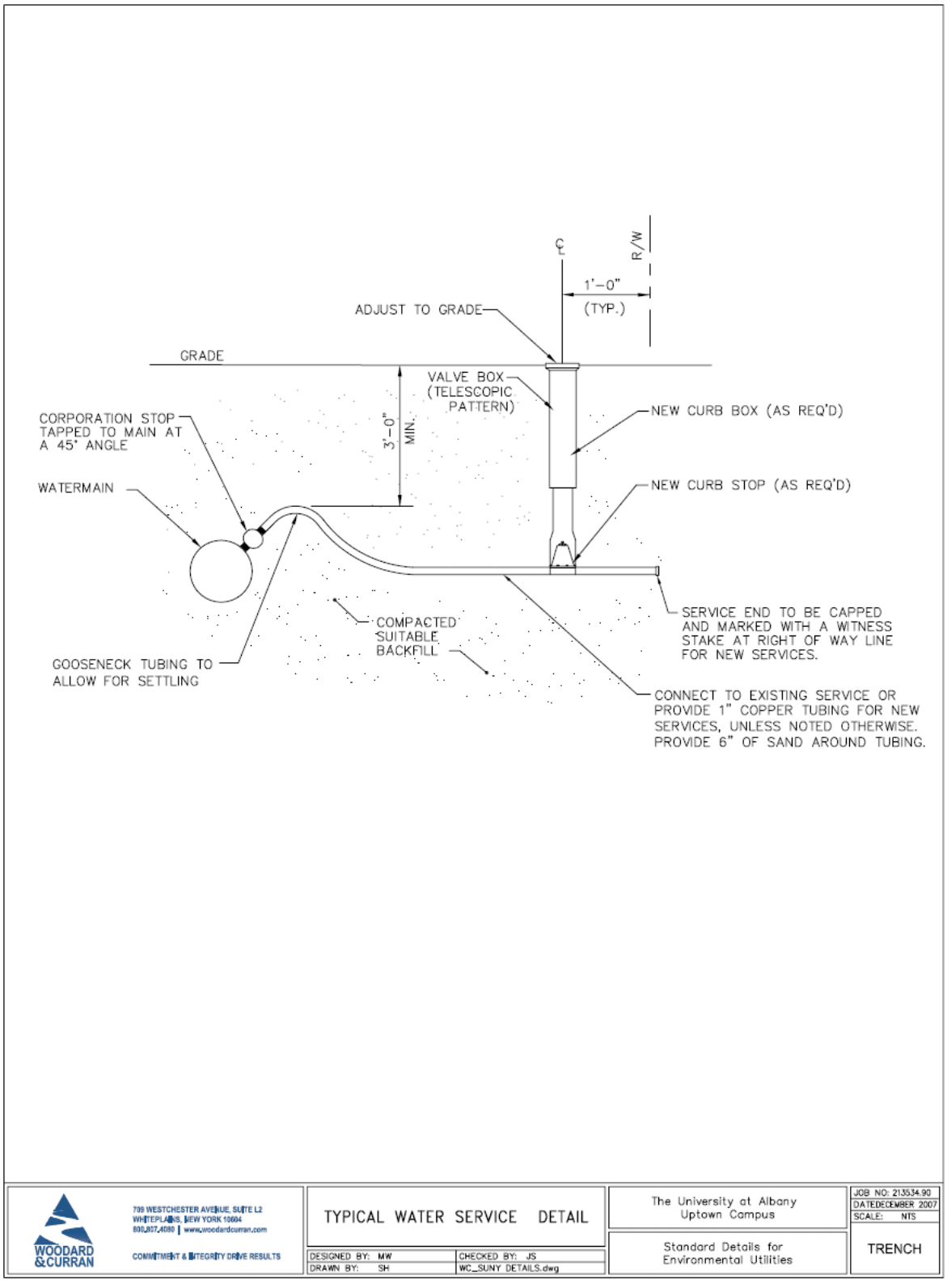
9.4 INSTALLATION

9.4.1 Service Connections

A. Install service connections in accordance with AWWA C800 and manufacturers' specifications.
B. Service connections shall be inspected for leaks under static pressure prior to backfilling. Disinfection of service connections shall be as provided in AWWA C651 of latest revision. If leaks are detected, the defect shall be removed and new material shall be installed from the main to the curb stop.
C. Service connections shall be installed on a 6-inch sand bedding, covered with 12-inches of sand and compacted.

9.4.2 Service Boxes

Service boxes shall be installed to prevent direct transmission of traffic loads to the tubing or curb stop. The service box shall be centered over the tee head of the curb stop and remain plumb during backfilling operations. The box cover shall be installed flush with the existing grade.


℄
R/W
1'-0"
(TYP.)
ADJUST TO GRADE
GRADE
VALVE BOX
(TELESCOPIC
PATTERN)
NEW CURB BOX (AS REQ'D)
CORPORATION STOP
TAPPED TO MAIN AT
A 45° ANGLE
3'-0"
MIN.
WATERMAIN
NEW CURB STOP (AS REQ'D)
SERVICE END TO BE CAPPED
AND MARKED WITH A WITNESS
STAKE AT RIGHT OF WAY LINE
FOR NEW SERVICES.
COMPACTED
SUITABLE
BACKFILL
GOOSENECK TUBING TO
ALLOW FOR SETTLING
CONNECT TO EXISTING SERVICE OR
PROVIDE 1" COPPER TUBING FOR NEW
SERVICES, UNLESS NOTED OTHERWISE.
PROVIDE 6" OF SAND AROUND TUBING.
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JOB NO: 213534.90
DATEDECEMBER 2007
SCALE: NTS
TRENCH

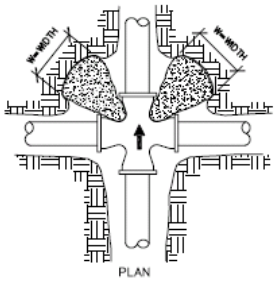
10. THRUST BLOCKS

Thrust blocks shall be installed as shown on the drawing. All concrete shall be 3000 psi and be located at all changes in vertical and horizontal alignment at all bend, tees, end caps, or where directed. The use of stones, rock or other material will not be permitted for use as thrust blocks. Thrust blocks shall not be backfilled until given sufficient time to cure and until approved.

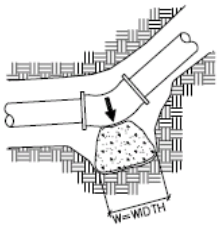
TABLE 1

SAFE BEARING LOADS OF SOILS & MULTIPLICATION FACTORS FOR MODIFICATION OF THRUST BLK. AREAS

SOIL	SAFE BEARING LOAD (LBS./SQ. FT.)	FACTOR
MUCK	0	0
SOFT CLAY	1000	2.00
SAND	2000	1.00
SAND & GRAVEL	3000	0.67
SAND & GRAVEL CEMENTED WITH CLAY	4000	0.50
SHALE	10000	0.20



PLAN
4 WAY INTERSECTION

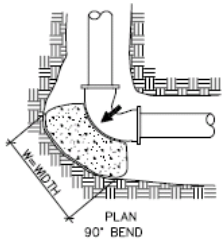


PLAN
BEND

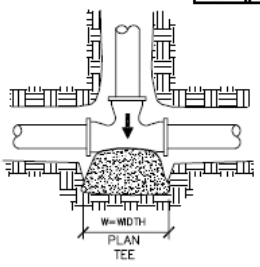
TABLE 2

REQUIRED BEARING AREAS & DIMENSIONS FOR CONCRETE THRUST BLOCKS

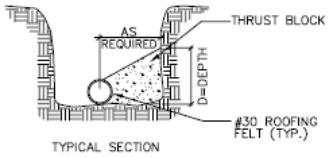
PIPE SIZE INCHES	TEE		90°(1/4) BEND		45°(1/8) BEND		22-1/2°(1/16)BEND		11-1/4°(1/32)BEND	
	AREA Sq.Ft.	Dimensions D x W	AREA Sq.Ft.	Dimensions D x W	AREA Sq.Ft.	Dimensions D x W	AREA Sq.Ft.	Dimensions D x W	AREA Sq.Ft.	Dimensions D x W
2	0.4	0.5 X 1.0	0.5	0.5 X 1.0	0.3	0.5 X 1.0	0.1	0.5 X 1.0	0.1	0.5 X 1.0
3	0.8	1.0 X 1.0	1.1	1.0 X 1.5	0.6	0.5 X 1.5	0.3	0.5 X 1.5	0.2	0.5 X 1.0
4	1.4	1.0 X 1.5	2.0	1.0 X 2.0	1.1	1.0 X 1.5	0.6	0.5 X 1.5	0.3	0.5 X 1.0
6	3.2	1.5 X 2.5	4.5	2.0 X 2.5	2.4	1.5 X 2.0	1.2	1.0 X 1.5	1.1	1.0 X 1.5
8	5.7	2.0 X 3.0	8.0	2.0 X 4.0	4.3	2.0 X 2.5	2.2	1.5 X 1.5	1.1	1.0 X 1.5
10	8.8	2.5 X 3.5	12.5	3.0 X 4.5	6.8	2.0 X 3.5	3.4	1.5 X 2.5	1.7	1.0 X 2.0
12	12.7	3.5 X 3.5	18.0	4.0 X 4.5	9.7	2.5 X 4.0	5.0	2.0 X 2.5	2.5	1.5 X 2.0
14	17.3	3.5 X 5.0	24.5	4.5 X 5.5	13.3	3.5 X 4.0	6.8	2.0 X 3.5	3.4	1.5 X 2.5
16	22.6	4.5 X 5.0	32.0	5.0 X 6.5	17.3	3.5 X4.5	8.8	2.5 X 3.5	4.4	2.0 X 2.5
18	28.6	5.0 X 6.0	40.5	5.5 X 7.0	21.9	4.0 X 5.5	11.2	3.0 X 4.0	5.6	2.0 X 3.0
20	35.3	5.5 X 6.5	50.0	6.5 X 8.0	27.0	4.5 X 6.0	13.8	3.5 X 4.0	6.9	2.0 X 3.5



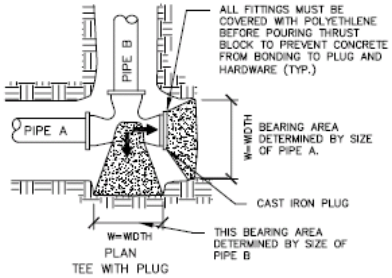
PLAN
90° BEND



PLAN
TEE



TYPICAL SECTION



PLAN
TEE WITH PLUG

NOTES:

1. FOR REQUIRED BEARING AREA AND DIMENSIONS D AND W, SEE TABLE 2. VALUES OF D AND W OTHER THAN THOSE SHOWN IN TABLE 2 MAY BE USED PROVIDED THEY YIELD A BEARING AREA EQUAL TO OR LARGER THAN THAT REQUIRED.
2. CONCRETE NOT TO OVERLAP ANY JOINT.
3. CONCRETE TO BE PLACED SO AS NOT TO INTERFERE WITH REMOVING OR INSTALLING ANY OF THE JOINTING HARDWARE.
4. FOR END PLUGS, CAPS AND TAPPING SLEEVES USE VALUES LISTED FOR TEES.
5. ALL THRUST BLOCKS SHALL BE 3000 PSI POURED CONCRETE.
6. REQUIRED BEARING AREAS ARE DUE TO THRUSTS CAUSED BY 150 P.S.I. WORKING PRESSURE PLUS 50% (75 P.S.I.) SURGE ALLOWANCE RESULTING IN 225 P.S.I. TOTAL INTERNAL PRESSURE, NOMINAL PIPE DIAMETER USED.
7. REQUIRED BEARING AREAS ARE BASED ON ALLOWABLE SOIL BEARING CAPACITY OF 2000 P.S.F. FOR SAND. DUE TO OTHER SOIL CONDITIONS ENCOUNTERED, BEARING AREAS MAY BE MODIFIED BY THE ENGINEER BY MULTIPLYING THE AREA GIVEN IN TABLE 1 FOR THE APPROPRIATE PIPE SIZE AND FITTING BY THE LISTED CORRECTION FACTORS.
8. IN MUCK, PEAT OR RECENTLY PLACED FILL ALL THRUST SHALL BE RESISTED BY PILES OR TIE RODS TO SOLID FOUNDATIONS OR BY REMOVAL OR SUCH UNSTABLE MATERIAL AND REPLACEMENT WITH BALLAST OF SUFFICIENT STABILITY TO RESIST THRUSTS. ALL AS REQUIRED BY THE ENGINEER.

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TYPICAL THRUST BLOCKS

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11. PRECAST CONCRETE MANHOLES AND CATCH BASINS

11.1 MANHOLES

All structures shall be capable of supporting AASHTO H20 loading and conform to the following additional requirements:

1. The wall sections shall be not less than five inches thick.
2. No more than two lift holes may be cast or drilled in any section.
3. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of the riser section.
4. Acceptance of the sections will be on the basis of material tests and inspection of the completed product.
5. Openings for pipe and materials to be embedded in the walls of the structures shall be cast in the structures at the required locations during their manufacture.

11.1.1 Base Sections

Base sections shall be recast monolithic construction with steps. Manhole bases shall be built as shown on the drawing. Invert channels shall be formed smoothly to the greatest possible radius, and changes in grade shall be made smoothly and evenly. The floor at the channel shall match the invert of the largest pipe. Channel and Benchwalls are to be constructed of 3000psi concrete, trowelled smooth. Channel shall be 80% of the internal diameter of the invert pipe.

11.1.2 Barrel Sections

Precast with steps.

11.1.3 Top Sections

Precast eccentric cone with steps. Use flat cover only if otherwise specified.

11.1.4 Pipe to Manhole Connections

A. Pipe diameter 6" or larger: Flexible manhole sleeves meeting ASTM C923. Size to fit diameter and type of pipe without use of gaskets.
B. Pipe diameter less than 6": Thermoplastic pipe sleeve equal to "Link-Seal Century Line" model CS100 by Thunderline Corp. with sleeve seal equal to "Link-Seal" by Thunderline Corporation.
C. Opening in concrete wall shall be cored using high speed diamond drill.
D. All metal fixtures shall be of stainless steel.

11.1.5 Joints Between Precast Sections

Watertight, shiplap-type seal with and all weather performed joint sealant made of butyl rubber material in flexible rope form. It shall meet or exceed all requirements of AASHTO M-198 and ASTM C-990 section 6.2.1, Butyl rubber

sealants. Follow manufacturer's instructions for sealing joints between precast sections with material as specified. Point joints inside and out with butyl caulk.

11.2 DROP MANHOLES

Conform to requirements for manholes. Provide inside drop as detailed in section "Precast Manhole with Inside Drop."

11.3 CATCH BASINS

All precast structures and castings shall be capable of supporting AASHTO H20 loading. Except as modified or supplemented herein, all concrete catch basin units shall meet the requirements of ASTM C478 latest revision.

11.3.1 Materials

A. Catch basins shall be precast structures conforming to ASTM C478.
B. All structures shall be capable of supporting AASHTO H20 loading and conform to the following additional requirements:
    1. The wall sections shall be not less than 5-inches thick.
    2. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of the riser section.
    3. No more than two lift holes may be cast or drilled in any section.
    4. Acceptance of the sections will be on the basis of material tests and inspection of the completed product.
C. Cone sections shall be precast sections of similar manufacture. The height of precast cone sections shall vary to meet construction conditions, but the cone must meet these specifications.
D. Precast Bases and Top Slabs
    1. Precast concrete bases and top slabs shall be of the same construction as the precast riser sections.
    2. Dimensions of the base sections and top slabs shall conform to the drawing.
    3. Precast concrete base and first riser shall be monolithic.

11.3.2 Joints Between Precast Sections

Watertight, shiplap-type seal with and all weather performed joint sealant made of butyl rubber material in flexible rope form. It shall meet or exceed all requirements of AASHTO M-198 and ASTM C-990 section 6.2.1, Butyl rubber sealants. Follow manufacturer's instructions for sealing joints between precast sections with material as specified. Point joints inside and out with butyl caulk.

11.4 FRAMES, GRATES AND COVERS

Frames, grates and covers shall be cast iron, ASTM A48, Class 30.

11.4.1 Manhole Frames and Covers

Labeled with "SEWER" or "DRAIN" in 3" high raised letters on cover and displaying the year of the installation.

A. Set to final grade; 1/2" below pavement grade in paved areas or 24" above grade in cross country areas. Provide adequate temporary covers to prevent accidental entry until final placement of frame and cover is made.
B. Set manhole frames and covers to final grade only after pavement base course has been applied or after final grading of gravel roads.

11.4.2 Catch Basin Frames and Grates

Grates are to allow for safe passage of bicycles. Grates are to be circular for catch basins greater than five (5) feet deep.

11.5 INSTALLATION OF MANHOLES AND OTHER PRECAST STRUCTURES

11.5.1 Placement

Structures shall be built to the lines, grades, dimensions, and designs shown on the Contract Drawings and as directed, with the necessary frames, covers, fittings, cleanouts, and appurtenances, etc., and in accordance with these Specifications.

11.5.2 Dampproofing

The exterior surfaces of all precast manhole bases, walls, and cones shall be given a minimum of two shop coats of bituminous dampproofing using cutback asphalt, AASHTO M81 or M82, Asphalt emulsion AASHTO M140 or approved equal, at 5 gallons per 100 square feet minimum per coat. Touch up in the field prior to backfilling as required.

11.5.3 Material

All material removed from excavation for manholes that remains after the backfilling the finished structure, shall be used wherever possible within the location. If it is not needed or not suitable, it shall be removed and legally disposed of without additional compensation.

11.6 LEAKAGE TESTING

Manholes must be complete for final test acceptance except for shelf and invert brickwork. Plug all pipes and other openings in the structure walls prior to test. Test all precast concrete manholes soon as they are installed to demonstrate that the work conforms to these specifications.

A. After manhole has been constructed, a Manhole Acceptance Test using the vacuum test procedure in ASTM C1244 shall be conducted.
B. If the vacuum drops in excess of the prescribed rate, the leak shall be located, proper repairs made, and the manhole retested.
C. If the unit fails the test after repair, the unit shall be water exfiltration tested.

11.6.1 Exfiltration Test

A. Plug pipes into and out of manhole and secure plugs.

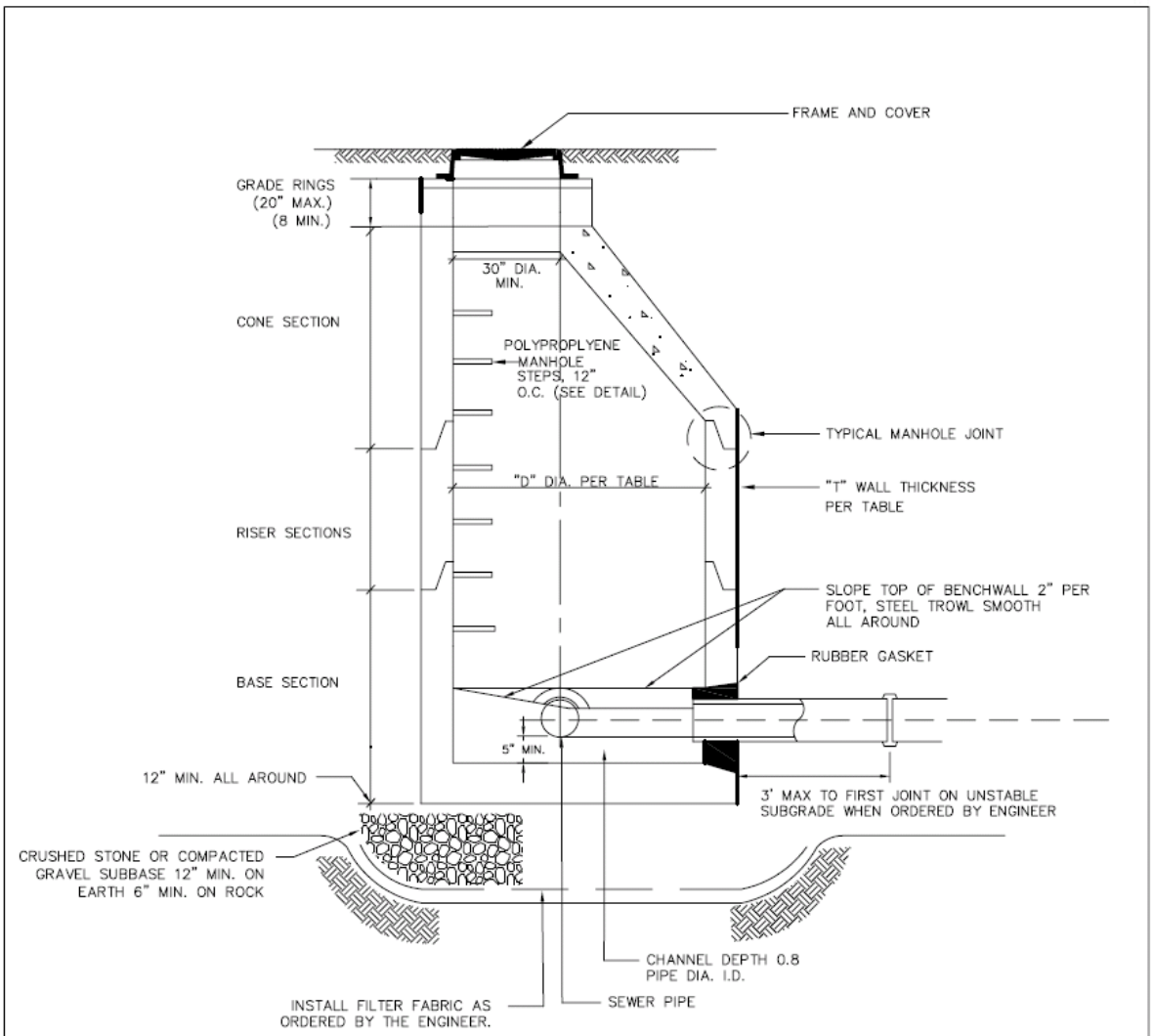
B. Lower groundwater table (GWT) to below manhole. Maintain GWT at this level throughout test. Provide means of determining GWT level at any time throughout test.
C. Fill manhole with water to top of cone.
D. Allow a period of time for absorption.
E. Refill to top of cone.
F. Determine volume of leakage in an 8 hour (min) test period and calculate rate.
G. Acceptable leakage rate: Not more than 1 gallon per vertical foot per 24 hours.
H. An infiltration test may be required if the results of the exfiltration test are not approved.

11.7 REPAIRS

A. Determine causes of all leaks and repair them. Manhole exfiltration rates should not exceed 3 gallons per vertical foot per 24-hours. If exfiltration is less than 3 gallons per vertical foot per 24-hours but more than one gallon per vertical foot per 24-hours, repairs may be made by approved methods as directed to bring the leakage within the allowable rate of one gallon per vertical foot per 24-hours. If repairs fail to reduce the leakage rate to less than one gallon per vertical foot per 24-hours after exfiltration test repairs, manhole shall be rejected.
B. Perform repairs using approved methods and materials. Remove and replace or reconstruct if necessary. Remove and replace defective sections if required.

11.8 CLEANING

Clean and flush all precast structures after work is completed and before final acceptance.



TABLE

OUTLET SEWER PIPE SIZE	"D" DIA. MIN.	"T" WALL THICKNESS MIN.
8" THRU 24"	4'–0"	5"
30"	5'–0"	6"
INSIDE DROP	6'–0"	6"

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PRECAST CONCRETE MANHOLE

DESIGNED BY: MW | CHECKED BY: JS
DRAWN BY: SH | WC_SUNY DETAILS.dwg

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JOB NO: 213534.90
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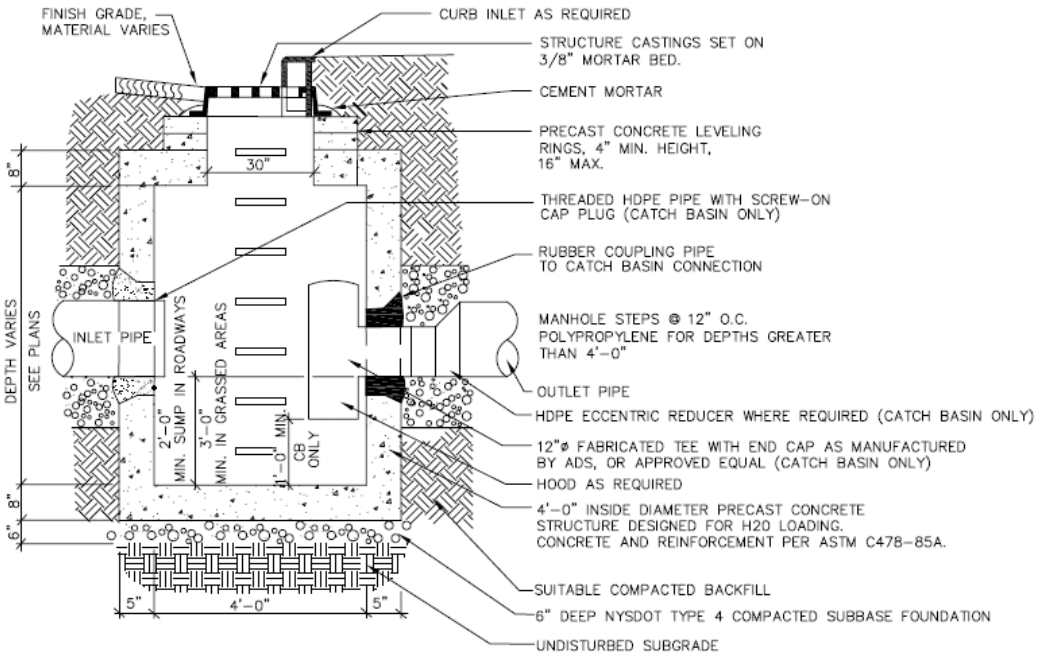
NOTES:

CATCH BASIN AND GRATES
1. GRATE TO BE BICYCLE SAFE TYPE GRATE
2. ROUND GRATES PREFERRED FOR CATCHBASIN AND MANHOLE DEPTHS GREATER THAN 5'–0"

MANHOLE AND FRAME COVER
1. COVER TO READ "STORM" WITH FOUR 3/4" VENT HOLES

PIPES
1. SDR 30/35 FOR PIPES <12",
HDPE BLACK ABS FOR PIPES >12"



NOTE: PROVIDE SAFE OPERATION SHEETING IF NEEDED IN ACCORDANCE WITH NYSDOT SECTION 552

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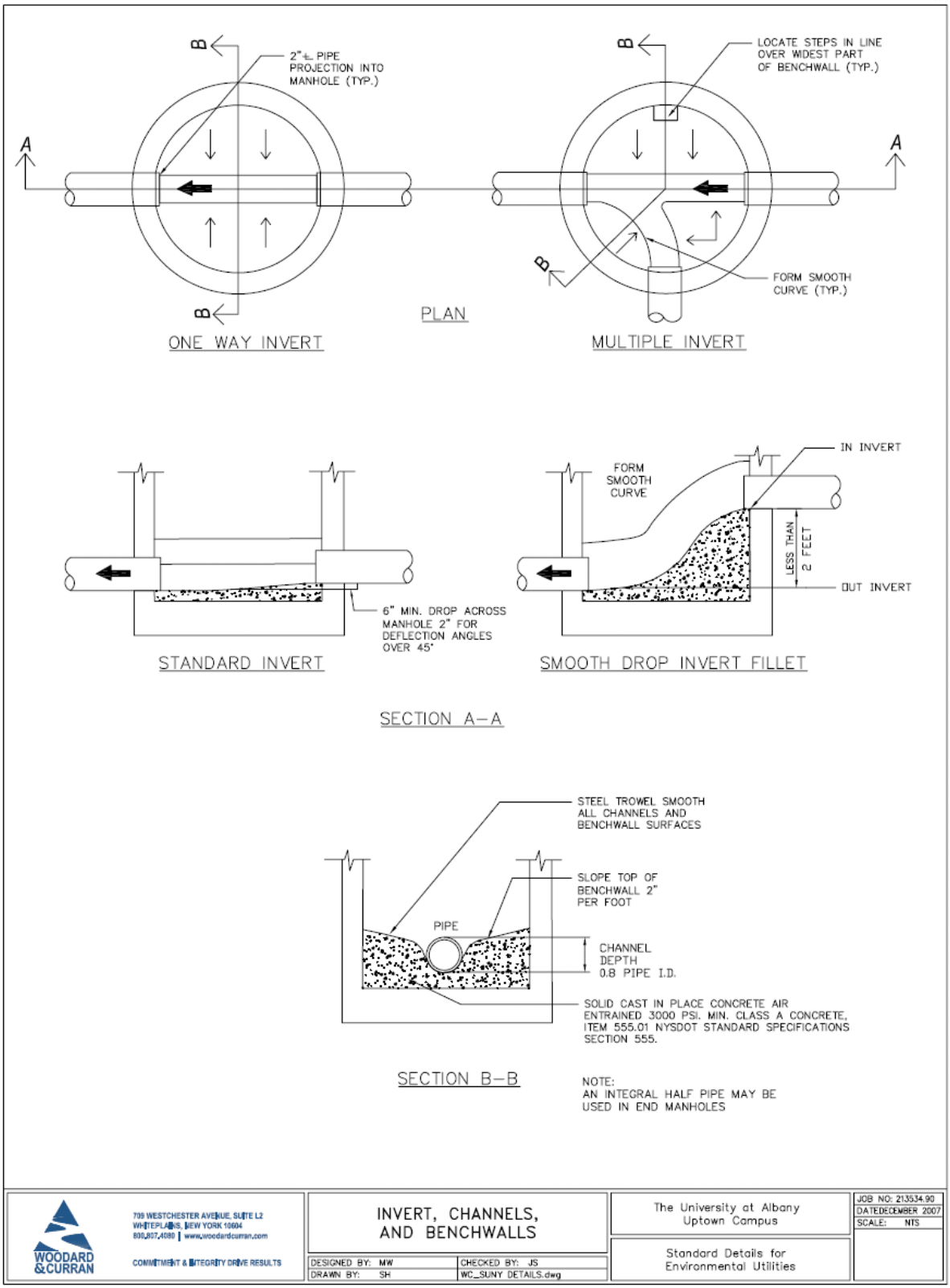
B
2" ℄ PIPE PROJECTION INTO MANHOLE (TYP.)
A
B
ONE WAY INVERT
PLAN
B
LOCATE STEPS IN LINE OVER WIDEST PART OF BENCHWALL (TYP.)
A
B
FORM SMOOTH CURVE (TYP.)
MULTIPLE INVERT
6" MIN. DROP ACROSS MANHOLE 2" FOR DEFLECTION ANGLES OVER 45°
STANDARD INVERT
FORM SMOOTH CURVE
IN INVERT
LESS THAN 2 FEET
OUT INVERT
SMOOTH DROP INVERT FILLET
SECTION A–A
STEEL TROWEL SMOOTH ALL CHANNELS AND BENCHWALL SURFACES
SLOPE TOP OF BENCHWALL 2" PER FOOT
PIPE
CHANNEL DEPTH 0.8 PIPE I.D.
SOLID CAST IN PLACE CONCRETE AIR ENTRAINED 3000 PSI. MIN. CLASS A CONCRETE, ITEM 555.01 NYSDOT STANDARD SPECIFICATIONS SECTION 555.
SECTION B–B
NOTE:
AN INTEGRAL HALF PIPE MAY BE USED IN END MANHOLES
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INVERT, CHANNELS, AND BENCHWALLS
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12. PRECAST MANHOLE WITH INSIDE DROP

12.1 PIPING

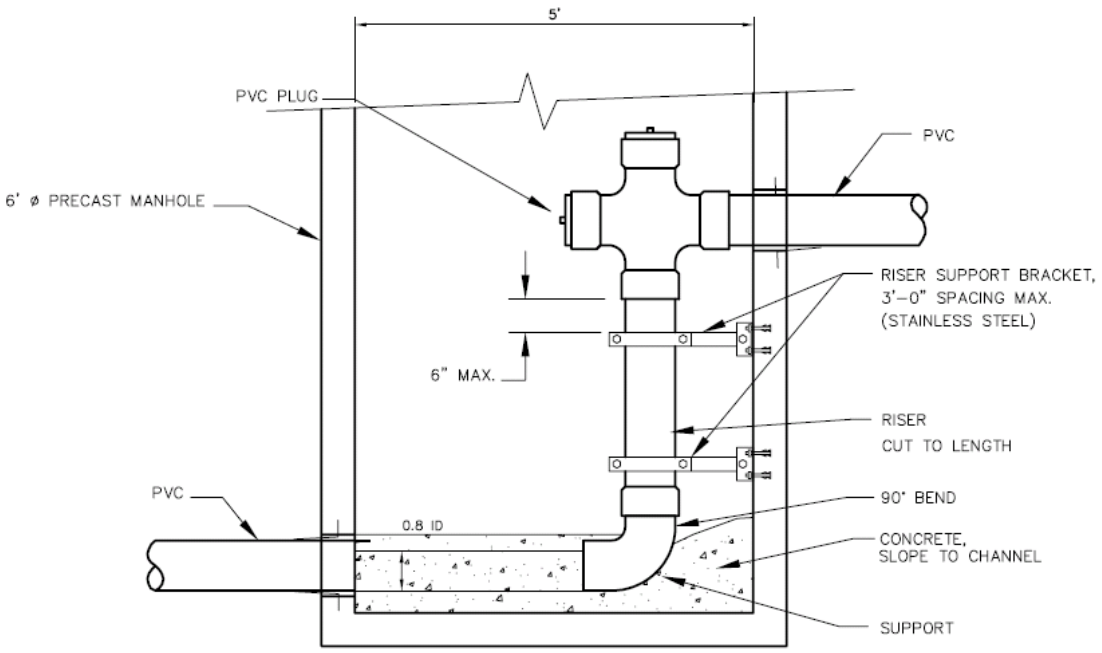
Piping shall be installed in accordance with the manufacturer recommendations and as shown in the drawings. A 4-way connection, or alternative configuration sufficient to clean and service the interior of the drop structure, shall be provided.

12.2 RISER SUPPORT BRACKET

Riser support bracket shall be 10 gauge, type 304, No. 3 finish stainless steel.

12.3 MANHOLE

Manhole structure, benchwall, and channel to conform with design guidelines in sections titled “Precast Manholes and Catchbasins” and “Invert Channel and Benchwalls.” Drop manholes shall be five feet in diameter.



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PRECAST MANHOLE
WITH INSIDE DROP (PVC)

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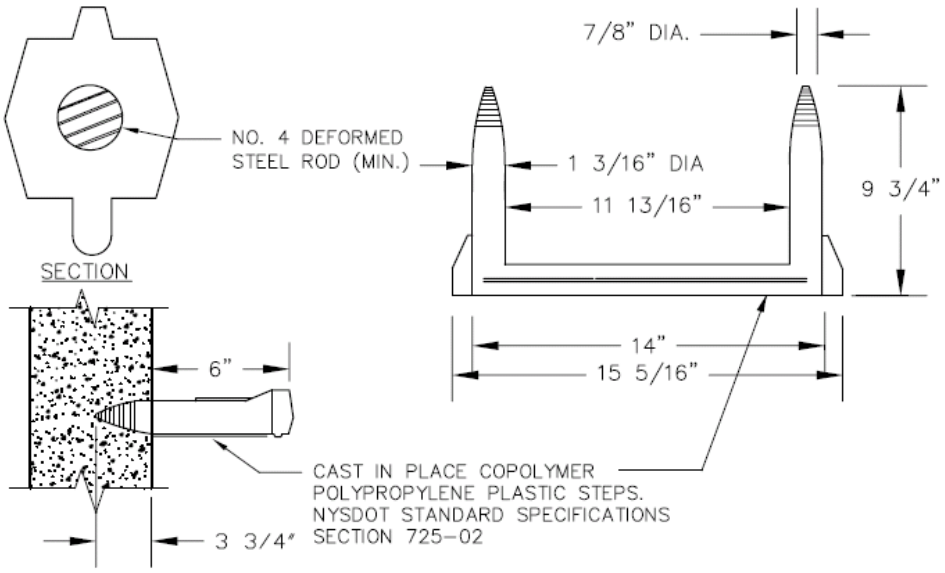
13. MANHOLE STEPS

Manhole sections shall contain manhole steps accurately positioned and imbedded in the concrete. The steps shall be manufactured from deformed ½" steel reinforcement rod complying with ASTM A615 and encased in polypropylene complying with ASTM D4101. Include pattern design to prevent lateral slippage off step. Steps are to be located 12-inches on center with minimum width of 15 5/6-inches and 6-inches from wall for full height of manhole. Replace any steps that are out of plumb and proper horizontal placement.



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14. TRENCHES

14.1 EARTHWORK

Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

14.2 SOIL MATERIALS

14.2.1 Suitable Backfill Materials

Suitable backfill material for outside building and pavement areas below topsoil except in slope areas shall be a well-graded granular material. It shall be free from peat, organic matter and debris, and shall not contain any stones or clay lumps in excess of 6-inches in their greatest dimensions. On-site soils containing higher silt content may be used if approved. Any materials of whatever description which are too uniformly graded or saturated to be readily compactable shall not be utilized for earth borrow.

14.2.2 Unsuitable Materials

Unsuitable materials include materials containing excessive clay, vegetation, organic matter, debris, pavement, stones or boulders over 6-inches in greatest dimension, and frozen material. Unsuitable material shall be material which will not provide a suitable foundation or structural support for the pipe or material unsuitable for use in backfill.

14.2.3 NYSDOT Type 4 Compacted Material

Type 4 compacted material for below building footings and below slab and pavement base courses shall be free from ice and snow, roots, sod, rubbish and other deleterious or organic matter. On-site NYSDOT Type 4 compacted material shall contain no stone greater than two-thirds (2/3) the loose lift thickness and shall be at a suitable moisture content to allow for proper compaction. On-site soils that are too wet for proper compaction will not be suitable for use as NYSDOT Type 4 compacted material. Sandwiching on-site soils with alternating layers of off-site sand-gravel fill may be permitted provided the on-site soil is not excessively wet based upon field observations in an effort to increase the re-use potential of these on-site soils.

14.2.4 ¾-inch Crushed Stone

Durable, clean angular rock fragments obtained by breaking and crushing rock material. Sieve analysis by weight:

Sieve Size	% Passing by Weight
1"	100
3/4"	95-100
1/2"	35- 70
3/8"	0- 25

14.2.5 Excavation for Trenches

A. Excavate to widths shown on the drawing.
B. Produce an evenly graded flat trench bottom at the subgrade elevation required for installation of pipe and bedding material.
C. Load excavated material directly into trucks unless otherwise permitted.
D. Place backfill material directly into trench or excavation. Do not stockpile material to be used as backfill in roadways.

14.3 STABILITY OF EXCAVATIONS

A. Excavations shall be made in such a manner and to such width as required to give suitable room for laying and jointing the piping or for construction of structures; all sheeting, bracing, and supports shall be furnished and placed; all cofferdamming, pumping, and draining shall be done; and the bottoms of the excavations shall be rendered firm and dry and acceptable in all respects. Temporary sheeting, shoring, and bracing shall be provided in all locations where required to protect all excavated areas, as required for safety or compliance with OSHA.
B. When excavating near existing structures, attention is directed to the fact that there are pipes, manholes, drains, and other utilities and structures in certain locations. The drain layer contractor should exercise caution when excavating, because the completeness or accuracy of the given information is not guaranteed.
C. Trenches in pavement shall have the traveled way surface cut in a straight line by a concrete saw or equivalent method to the full depth of pavement.
D. Pipe trenches shall be made as narrow as practicable and shall not be widened by scraping or loosening materials from the sides. Every effort shall be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated.
E. Trenches in streets or highways shall conform to the requirements and specifications of the state, city or town authorities having jurisdiction.
F. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state and federal safety regulations. Specifically, the current OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926 should be followed. These regulations are strictly enforced by OSHA. A "responsible person", as defined in 29 CFR Part 1926, will evaluate the soil exposed in the excavations as part of the safety procedures. If an excavation, including a trench, is extended to a depth of more than twenty feet (20'), a Professional Engineer registered in New York State shall be engaged to design the slopes and/or shoring required for the excavation. The "responsible person" will establish a minimum lateral distance from the crest of the slope for all vehicles and spoil piles and protective measures for exposed slope faces.

14.4 BACKFILL AND FILL

Unless directed, excavations and trenches shall not be backfilled until new utilities have been inspected, and if required, tested satisfactorily. The work shall conform to all requirements of the drawings and specifications prior to being backfilled. Place acceptable soil material in layers to required elevations as shown on the Drawings or as specified. Fill, backfill, and compact in accordance with the requirements of this section to produce minimum subsequent settlement of the material and provide adequate support for the surface treatment or structure to be placed on the material. Place material in approximately horizontal layers beginning at lowest area to be filled. Do not impair drainage. Fill which becomes frozen or saturated in stockpiles shall be replaced with suitable off-site fill.

14.4.1 Ground Surface Preparation

A. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Scarify surfaces so that fill material will bond with existing surface.
B. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

14.4.2 Placement

A. Place backfill and fill materials in layers not more than 6-inches in loose depth for material compacted by heavy compaction equipment or hand-operated tampers. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
B. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying material uniformly around structure to approximately same elevation in each lift.
C. Do not allow heavy machinery within 5 feet of structure during backfilling and compacting.

14.4.3 Backfilling Excavations

A. Backfill excavations as promptly as work permits, but not until completion of the following:
    1. Acceptance of construction below finish grade including, dampproofing, waterproofing, and perimeter insulation.
    2. Inspection and recording locations of underground utilities.
    3. Removal of concrete formwork.
    4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
    5. Removal of trash and debris.
    6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
B. Use care in backfilling to avoid damage or displacement of underground structures and pipe.
C. Backfill under all existing utility pipes crossed by new utility pipes with NYSDOT Type 4 crushed stone. The crushed stone backfill will extend continuously from the bedding of the new pipe to the utility pipe crossed, including a 6-inches thick envelope of crushed stone all around the existing utility pipes.
D. The backfill shall stand at its own angle of repose. No "haunching" or "forming" with common fill will be allowed.

14.4.4 Backfilling Trenches

A. See Trench drawing.
B. Screened gravel bedding shall be placed to the extent and dimensions shown on the drawings so that the pipes and structures have complete and uniform bearing.
C. Screened gravel pipe bedding shall be graded, compacted and shaped so that the full length of pipe barrel has complete and uniform bearing. Bell holes and depressions for joints shall be dug after the gravel bedding has been graded and compacted, and shall be the proper clearance for jointing the pipes.
D. Following inspection and approval of pipe installation, additional approved bedding shall be carefully hand placed and properly compacted. Hand or mechanical tamping on the sides of the pipe is required.

E. Flow barriers (bentonite or concrete) shall be installed in the locations shown on the drawings but not less than every 300 feet along the pipeline or as required. If bentonite is used, it shall be hydrated per the manufacturer's specifications.
F. The balance of backfill in trenches shall be compactable suitable backfill material as approved, not frozen and without stones larger than 6-inches in their greatest dimension. It shall be spread in layers not exceeding 6-inches in loose thickness, and each layer shall be compacted by at least 4 passes of an approved vibratory compactor. For compaction types and standards see section "Compaction." All trench backfilling shall be carefully placed to avoid disturbance of new work and of existing structures. The moisture content of backfill shall be such that proper compaction will be obtained.
G. Except where otherwise indicated, bed pipe in NYSDOT Type 4 crushed stone.

14.5 COMPACTION

14.5.1 Methods

Use methods which produce the required degree of compaction throughout the entire depth of material placed without damage to new or existing facilities. Adjust moisture content of soil as required. Remove and replace material which is too wet to compact to required density. Compact each layer as work progresses.

14.5.2 Degree of Compaction

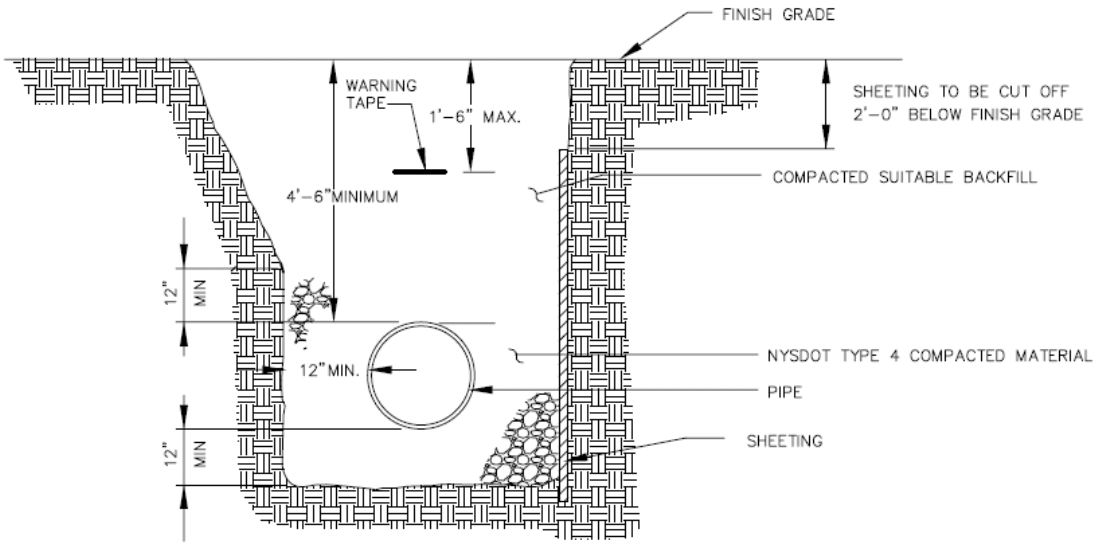
Compact to the following minimum densities:

FILL AND BACKFILL LOCATION	DENSITY
Top 2 feet under pavement	95% of max.
Below top 2 feet under pavement	92% of max.
Trenches through unpaved areas	90% of max.
Embankments	90% of max.
Pipe Bedding	92% of max.
Beside structure foundation walls,	90% of max.

Maximum density: ASTM D1557, modified.

Field density tests: ASTM D1556 (sand cone) or ASTM D2922 (nuclear methods).

Note: Fill that is too wet for proper compaction shall be disced, harrowed, or otherwise dried to proper moisture content for compaction to the required density. Layering on-site soils with alternating lifts of gravel borrow may be attempted to stabilize the on-site soils. No more than one lift of on-site soil and one lift of sand and gravel may be placed unless the combined "sandwich" lifts have been adequately compacted to a firm and stable condition. If the fill material cannot be dried within forty-eight (48) hours of placement, it shall be removed and replaced with drier fill.



NOTES:

1. MAINTAIN UNIFORM TRENCH WIDTH TO 12" OVER PIPE.
2. SDR 30/35 FOR PIPE <12"
   HDPE BLACK ABS FOR PIPES >12"

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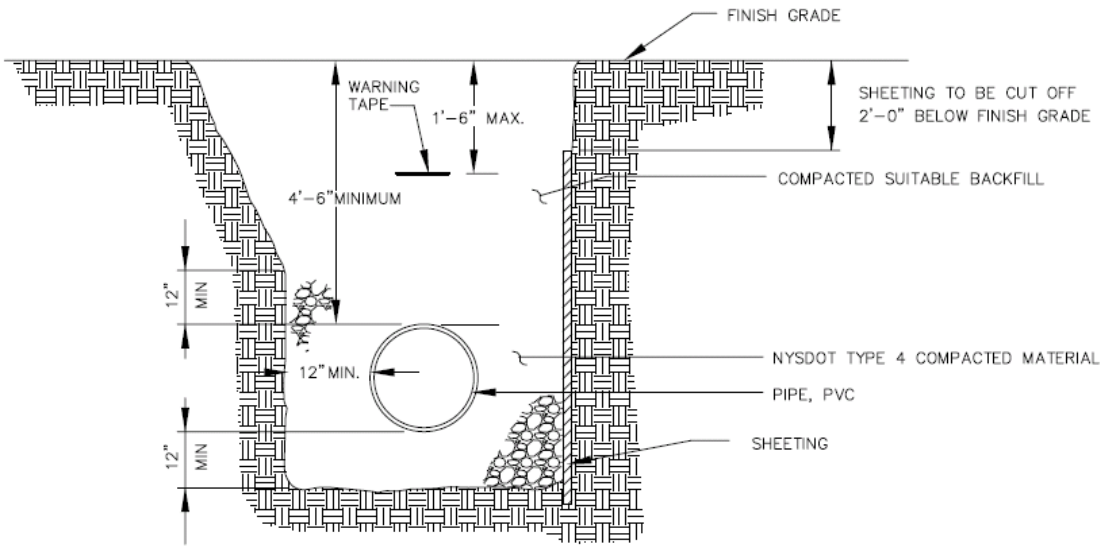

NOTES:

1. MAINTAIN UNIFORM TRENCH WIDTH TO 12" OVER PIPE.

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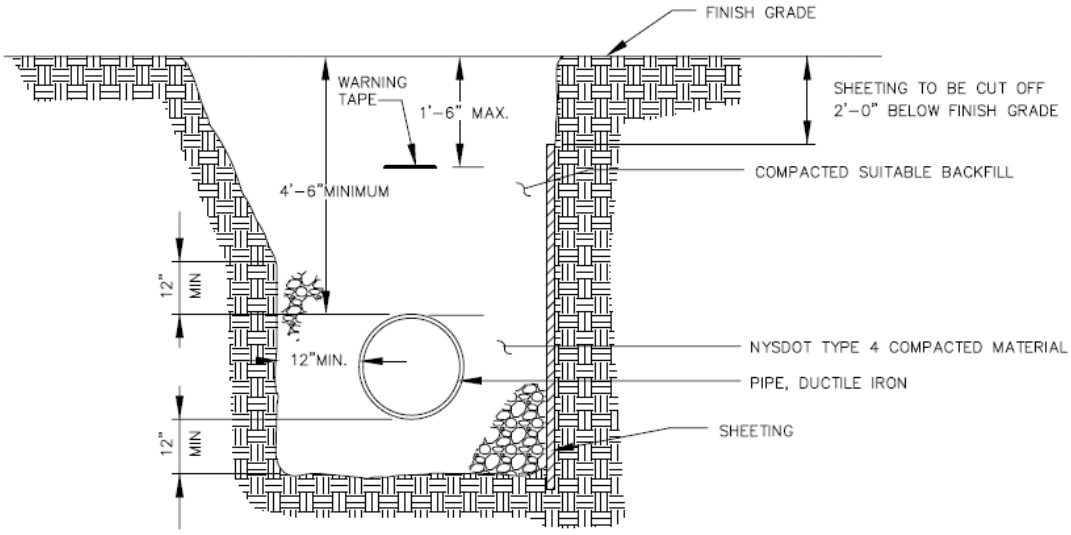

NOTES:

1. MAINTAIN UNIFORM TRENCH WIDTH TO 12" OVER PIPE.

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15. PIPE ABANDONMENT

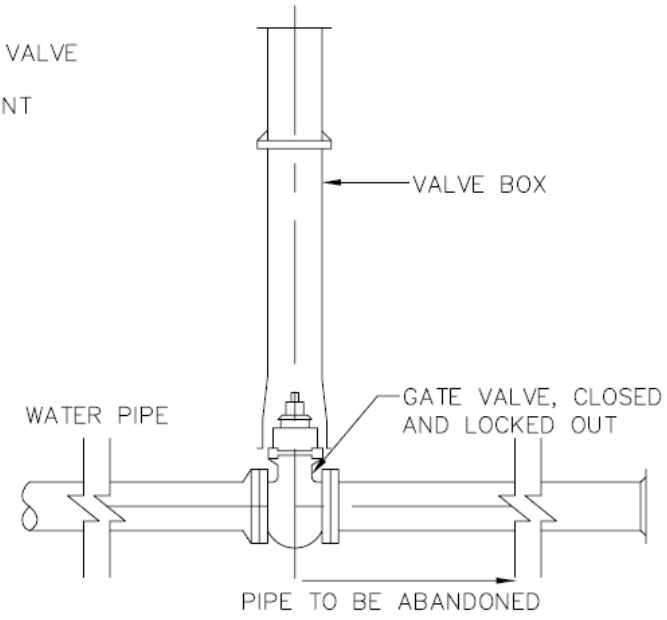
15.1 SANITARY AND STORM SEWER

Close open ends of abandoned underground utilities which are not indicated to be removed. Grout all open ends to prevent infiltration of groundwater or sediment. Closures are to be "locked out" and properly labeled to prevent accidental re-opening of closure.

15.2 WATER

Water utilities are to be abandoned at valve boxes. If a valve box does not exist where the water line is to be abandoned, one should be installed. Grout all open ends to prevent infiltration of groundwater or sediment

NOTE:
DO NOT REMOVE VALVE BOX FOR WATER PIPE ABANDONMENT



FOR WATER PIPE ABANDONMENT DETAIL
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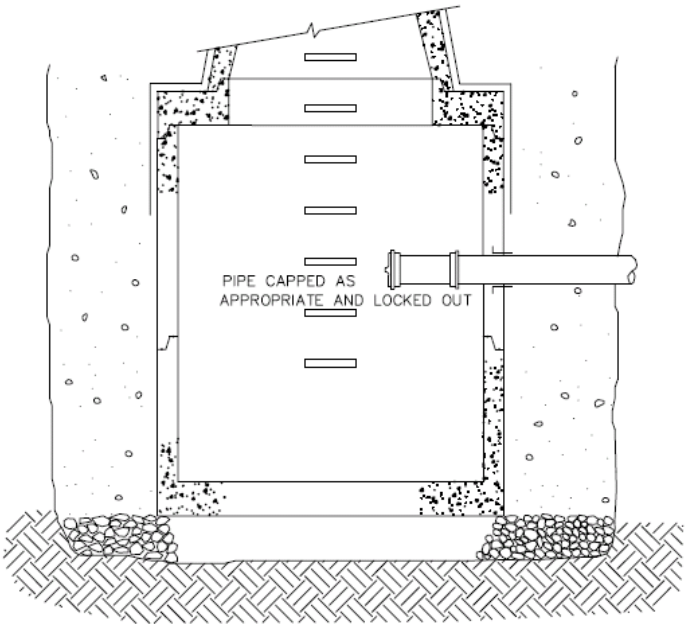

FOR SANITARY AND STORM SEWER
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PIPE ABANDONMENT DETAIL

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16. IRRIGATION

16.1 IRRIGATION PUMP

A. Irrigation pump stations are to be automatic and prefabricated.. Design, fabrication, testing and service shall be the sole responsibility of the pump station manufacturer. The pump station shall provide water to the irrigation system while simultaneously maintaining a constant discharge pressure by using a prefabricated pump station with variable frequency drive (VFD) pumps for pressure regulation under varying flow conditions up to the maximum specified capacity.

1. The prefabricated pump station shall have a minimum capacity and discharge pressure at skid edge as described in the technical specifications. The overall pump length shall extend to within twelve inches of the bottom of the wet well. The main pumps shall operate at no more than 1800 RPM.
2. The station shall be completely wired, piped, hydraulically, electrically, and flow tested to full station capacity at factory prior to shipment to job site. Documentation of dynamic test shall be verified by owner prior to pump station shipment.
3. Construction shall include a fabricated steel plate and skid assembly to support all components during shipping and to serve as the installation mounting base.
4. The discharge manifold from the pump station shall terminate at or near the pump station skid edge and be provided by the pump station manufacturer.

16.1.1 On-Site Pump Station Start Up

A. Technical start up shall be furnished by the pump station manufacturer or a qualified, certified service agency. Location and mounting details shall be furnished by the pump station manufacturer. Electrical connection, by purchaser, shall consist of a single conduit from owners disconnect to the pump station main disconnect. Additional purchaser responsibility shall include confirming correct motor rotation and securing local inspection/approval.

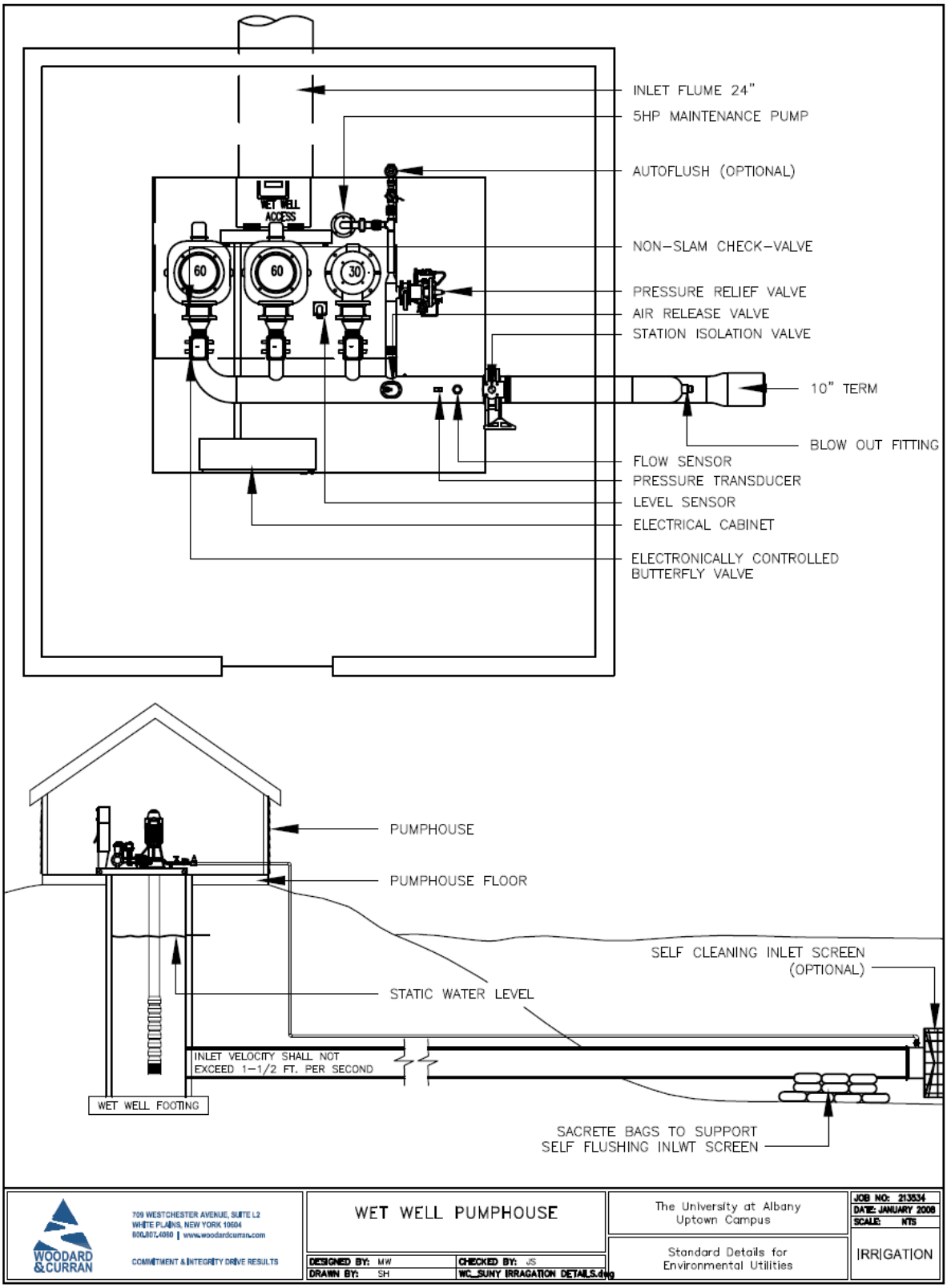
B. Technical start up procedures by the pump station technician shall include the following:

1. Station start up and pressurization.
2. Pressure, flow and programming adjustments.
3. Monitoring of complete irrigation cycle when possible.
4. Customer training and presentation of owners manual.

16.1.2 Irrigation Pump Power Supply

A. Booster pump power supply to be supplied from a dedicated circuit and brought to the booster pump location.

B. All wiring is to be in accordance with all state and local codes.


INLET FLUME 24"
5HP MAINTENANCE PUMP
AUTOFLUSH (OPTIONAL)
WET WELL ACCESS
NON-SLAM CHECK-VALVE
60
60
30
PRESSURE RELIEF VALVE
AIR RELEASE VALVE
STATION ISOLATION VALVE
10" TERM
BLOW OUT FITTING
FLOW SENSOR
PRESSURE TRANSDUCER
LEVEL SENSOR
ELECTRICAL CABINET
ELECTRONICALLY CONTROLLED BUTTERFLY VALVE
PUMPHOUSE
PUMPHOUSE FLOOR
SELF CLEANING INLET SCREEN (OPTIONAL)
STATIC WATER LEVEL
INLET VELOCITY SHALL NOT EXCEED 1-1/2 FT. PER SECOND
WET WELL FOOTING
SACRETE BAGS TO SUPPORT SELF FLUSHING INLWT SCREEN
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WET WELL PUMPHOUSE
DESIGNED BY: MW
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WC_SUNY IRRAGATION DETAILS.dwg
The University at Albany
Uptown Campus
Standard Details for
Environmental Utilities
JOB NO: 213534
DATE: JANUARY 2008
SCALE: NTS
IRRIGATION

16.2 IRRIGATION SPRINKLERS AND SPRAYHEADS

Adjustment of sprinkler equipment is to be done upon completion of the installation, to provide optimum performance and sprinklers that are properly set to grade.

16.2.1 Sprinklers and Sprayheads

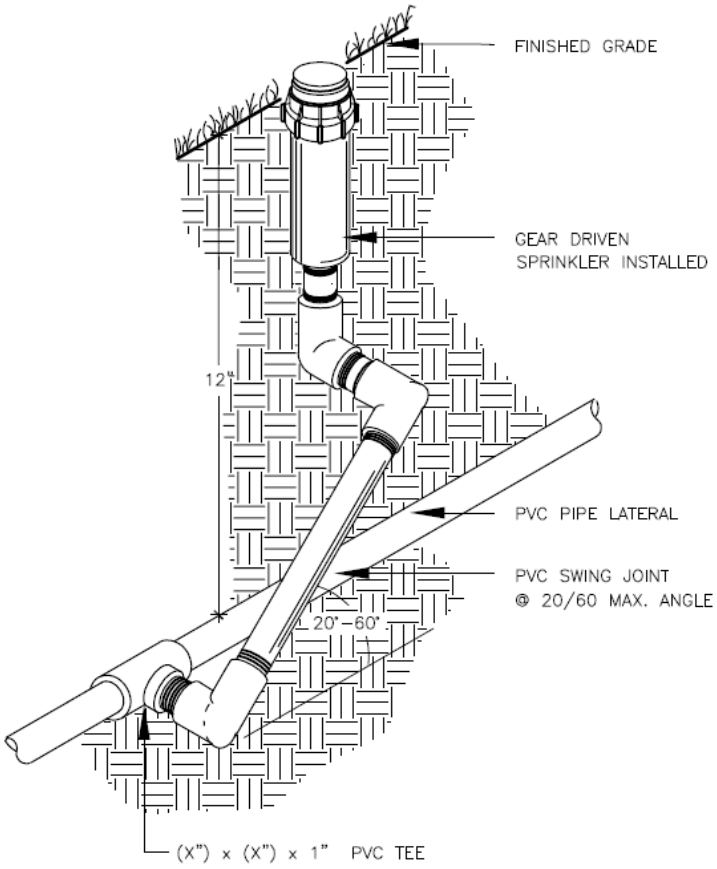
A. Sprinklers to be of the gear driven type with internal check valve, stainless steel riser, adjustable or fitted radius, and rubber cover.
B. Full circle 50'-65' radius sprinklers (true 360 rotation) to be model I-40-36S, as manufactured by Hunter Industries, or approved equal.
C. Part circle 50'-65' radius sprinklers to be model I-40-ADS as manufactured by Hunter Industries, or approved equal.
D. Full circle 40'-50' radius sprinklers (true 360 rotation) to be model I-25-36S, as manufactured by Hunter Industries, or approved equal.
E. Part circle 40'-50" radius sprinklers to be model I-25-ADS as manufactured by Hunter Industries, or approved equal.
F. Full circle 25'-40' radius sprinklers (true 360 rotation) to be model I-20-36S as manufactured by Hunter Industries, or approved equal.
G. Part circle 25'-40' radius sprinklers to be model I-20-ADS as manufactured by Hunter Industries, or approved equal.
H. 6" Pop-Up spray head to be model 1806 PRS-SAM, as manufactured by Rainbird approved equal.
I. 12" Pop-Up spray head to be model 1812 PRS-SAM, as manufactured by Rainbird approved equal.
J. Nozzles (Planter areas) for Pop-Up spray heads to be Series MP1000, MP2000 and MP3000 MP Rotator as manufactured by Hunter Industries or approved equal.
K. Nozzles (Lawn areas) for Pop-Up spray heads to be Matched Precipation Rate (MPR) U-series plastic nozzles.

16.2.2 Sprinkler and Sprayhead Accessories

A. Shrub adapters to be model PA-80 and model PA-8S-PRS (pressure regulating) as manufactured by Rainbird or approved equal.

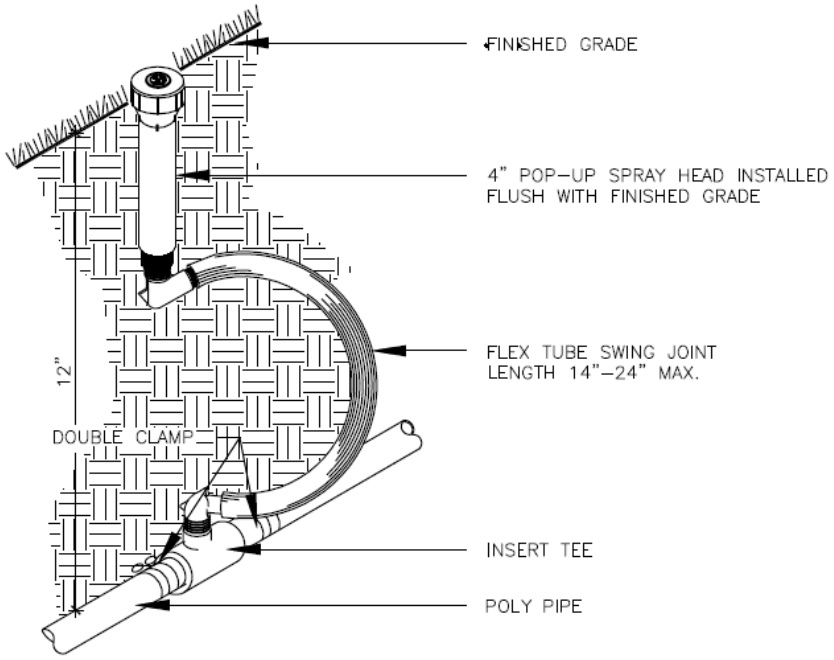
16.2.3 Sprinkler and Sprayhead Installation

A. Flush out lateral piping with full head of water and install sprinklers after hydrostatic test is completed.
B. Sprinklers to be connected to the piping system by installing factory assembled PVC swing joints. Swing joint size to be the same size as that of the IPS inlet of the sprinkler. The long nipple of the swing joint to be set between 20 and 60 degrees from the horizontal.
C. Pop-Up spray heads to be installed with factory assembled flex pipe swing joint.
D. Install sprinklers and spray heads perpendicular and flush with finished grades.
E. Install shrub risers at heights indicated.
F. Locate sprinklers and spray heads a maximum of 3" from curbs, walls, sidewalks etc unless otherwise indicated.



NOTE:
(X") SIZE TO PIPE SIZE

WOODARD & CURRAN 709 WESTCHESTER AVENUE, SUITE L2 WHITE PLAINS, NEW YORK 10604 800.807.4090 | www.woodardcurran.com COMMITMENT & INTEGRITY DRIVE RESULTS	ROTARY SPRINKLER LANDSCAPE AREAS DESIGNED BY: MW CHECKED BY: JS DRAWN BY: SH WC_SUNY IRRAGATION DETAILS.dwg	The University at Albany Uptown Campus Standard Details for Environmental Utilities	JOB NO: 213534 DATE: JANUARY 2008 SCALE: NTS IRRIGATION



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SPRAY HEAD

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DATE: JANUARY 2008
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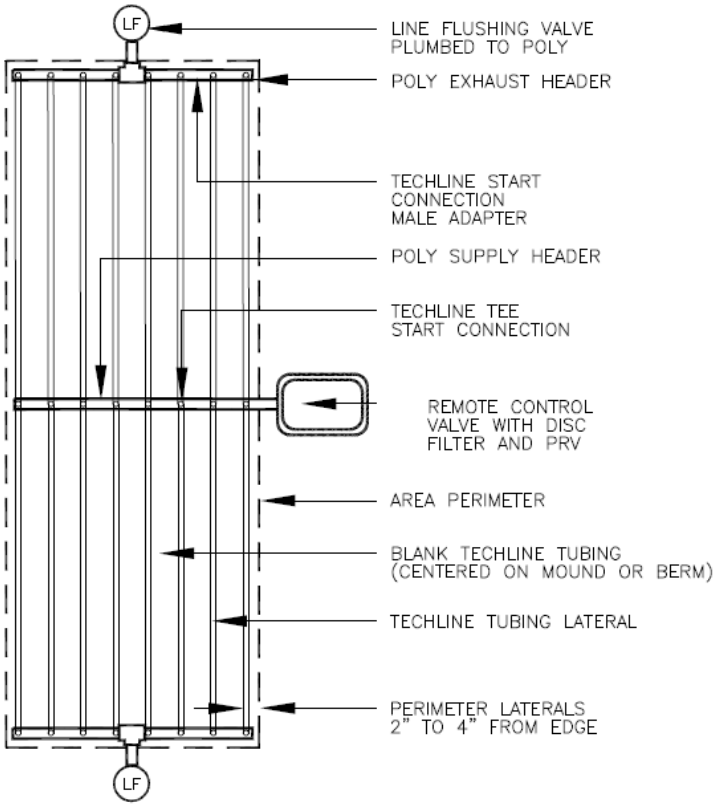
IRRIGATION

16.3 DRIP IRRIGATION

A. Drip Tubing: Flexible low-density linear polyethylene tubing with internal pressure compensating, continuously self cleaning, integral drippers. Drip tubing to be model TLCV-9, TLCV-6, TLCV-4 Techline Tubing, as manufactured by Netafim.
    1. Size: 1/2-inch (17mm) NPS.
B. Pressure Regulators: Plastic housing, 3/4-inch size, with spring-operated piston-type regulator, corrosion-resistant internal parts, and capable of controlling outlet pressure to approximately 20 psig. Pressure regulator to be models PRV075LF20V2K (low flow .25 – 4.4 gpm) and PRV075LF20V2K (high flow 4.5 – 17.6 gpm as manufactured by Netafim or approved equal.
C. Filters: Plastic housing, disc filter with corrosion-resistant internal parts, of size and capacity required for emitters, drip tubes, and devices downstream of unit. Filters to be manual disc filter as manufactured by Netafim.
D. Emitters: Pressure compensating plastic body with single outlet, to deliver the following flow rates at approximately 20 - 60 psig:
    1. Flow: 1/2 gallon per hour.
    2. Flow: 1 gallon per hour.
    3. Flow: 2 gallons per hour.
    4. Tubing: Include 120 inches 1/4-inch (EDTUBE) polyethylene (PE) tubing as manufactured by Netafim.
    5. Outlet Caps: Include plastic bug caps.
E. Emitters to be series Techflow drippers as manufactured by Netafim.
F. Fittings: Insert fittings for use with Techline tubing, as manufactured by Netafim.
G. Line Flushing Valve: Plastic housing with ½" MPT connection. Line flushing valve to be model TL050MFV-1
H. Other Devices: As specified and as indicated.

16.3.1 Drip Irrigation Installation

A. Install polyethylene header and exhaust manifold with saddles and risers prior to installing drip tubing.
B. Begin installation of drip tubing a minimum of 2" from sidewalks, curbs, pavement etc. and 4" away from softscape areas.
C. Install drip tubing in linear runs at specified row spacing and perpendicular to the header and exhaust manifold.
D. Hand trench and install drip tubing 3" below finished grade. Do not lay drip tube on grade and cover with mulch. Install soil staple every 2'-0" on drip tubing..
E. Install flushing valve on exhaust manifold.
F. After installing drip tubing and prior to backfilling take digital photographs of drip layout to submit to the Owner.
G. Flush out drip piping with full head of water prior to operation
H. Install drip ring on all trees and shrubs over 2'0" tall.



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RECTANGULAR DRIP IRRIGATION

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IRRIGATION

16.4 AUTOMATIC CONTROL SYSTEM

Low-voltage controller system, made for control of irrigation system automatic control valves, Controller operates on 120 volts AC building power system, provides 24 volts AC, power to control valves, and includes stations for at least the number of control valves indicated.

A. Exterior Control Enclosures to be weatherproof enclosure with locking cover and 2 matching keys. Enclosure construction to comply with NFPA 70 and NEMA 250. Type 4, and includes provision for grounding-
    1. Material: Enameled-steel, sheet metal.
    2. Material: Stainless-steel, sheet metal.
    3. Material: Molded plastic.
    4. Mounting: Free-standing-type for concrete-pad mounting.
    5. Mounting: Surface-type for wall mounting.
B. Interior Control Enclosures to be drip-proof enclosures with locking cover and 2 matching keys, Enclosure construction complies with NFPA 70 and NEMA 250, Type 12.
    1. Material: Enameled-steel, sheet metal.
    2. Material: Stainless-steel, sheet metal.
    3. Material: Molded plastic.
    4. Mounting: Free-standing-type for concrete-pad mounting.
    5. Mounting: Surface-type for wall mounting.
C. Transformer to be internal-type, and suitable for converting 120 volts AC, building power to 24 volts AC power.
D. Each Controller Station for Automatic Control Valves to be variable from approximately 5 to 60 minutes. Switch for manual or automatic operation of each station to be included.
E. Timing Device to be adjustable, 24-hour, 14-day clock to operate any time of day. Include provision for the following settings:
    1. Setting to skip operation any day in timer period.
    2. Setting for operation every other day.
    3. Settings for operation 2 or more times daily.
    4. Include manual or semi-automatic operation without disturbing preset automatic operation.
    5. Provide NI-CAL battery and trickle charger to automatically power the timing device during power outages.
F. Wiring to be UL 493, solid copper conductor, insulated cable, suitable for direct burial.
    1. Feeder Circuit Cables to be Type UF, NO- 12 AWG minimum, between building and controllers.
    2. Low-Voltage, Branch Circuit Cables to be Type UF, No. 14 AWG minimum, between controllers and automatic control valves. Jacket color is other than feeder-circuit-cable jacket color. Furnish cables with jackets of different colors for multiple cable installation in same trench.
    3. Splicing Materials to be pressure-sensitive thermoplastic tape and other materials required to make specified connections.

16.4.1 Central Control System

A. The computerized central control system shall be capable of controlling a single site with up to 8 locations, upgradable to 16. The control shall include a Rain Bird central controller system. The control equipment shall include a satellite interface (TWI) or decoder interface unit (SDI). The satellite interface (TWI) shall control up to 28 channels per wire group and each wire group shall control up to 672 satellite stations. The satellite interface (TWI) shall be upgradable from 1 wire group to 4 wire groups with the purchase of an "additional wire path" software module. The central control system shall be Rain Bird Site Control.
B. The central control system shall include Hybrid Software Module. The hybrid module shall offer both types of system communication — satellite and decoder— on the same system. The hybrid module shall also allow expansion of the control system with the addition of 1 more TWI or SDI, doubling hardware capabilities. SiteControl Plus allows operating one to four LDI's or, combined with the hybrid module, up to four total decoder and/or satellite interface devices.

16.4.2 TWI Series Two Wire Interface

A. The Two-Wire Interface (TWI) serves as an interface between the Central Controller and ESP-SAT Satellite Controller on the SiteControl System. The interface will communicate to the Central Controller via 2-wire path or MAXILink wireless radiio. Two wire interface to be model TWISAT OR TWISATL as manufactured by Rainbird.

16.4.3 Remote Radio Control System

A. The central control system shall be equipped with the Freedom remote radio control system, model H59503, supply (2) two hand held radio units with key pads. All components to meet all current Rain Bird requirements. Rainbird 5-year global service plan with laptop office computer.

16.4.4 Field Controller

A. The irrigation system controller shall be of a hybrid type that combines electromechanical and microprocessor-based circuitry capable of fully automatic and manual operation. The controller will be housed in a weatherproof, lockable, 16-gauge seamless steel cabinet suitable for wall mounting or free-standing stainless steel pedestal mounting.
B. The controller shall operate on a 117 VAC ± 10% power input and be capable of actuating up to two 24 VAC, 7VA solenoid valves per station plus a master valve or pump start relay. The controller shall be capable of operating four stations plus the master valve simultaneously. Controller output shall be protected against severe electrical surge. The controller shall be model ESP-SAT satellite controller as manufactured by Rainbird

16.4.5 Weather Station

A. The central control system shall include a remote connected weather station. The unit shall be complete with the necessary instruments for recording wind run, wind direction, relative humidity, rainfall, solar radiation, and high and low air temperature. A micrologger shall poll and record the data every 5 seconds on an around-the-clock basis. Short-haul modems shall be used for communication between the computer and the weather station. Two twisted-pair wires (4 wires total) on a dedicated cable shall be furnished for both the connection to the weather station short-haul modem and the connection to the computer short-haul modem. The unit shall be complete with a 120 VAC/16 VDC transformer. A 120 VAC power connection shall be furnished at the transformer. The transformer shall be installed either remotely or in the weather station. The weather station shall be model WS-PRO-SH as manufactured by Rainbird.

16.4.6 Controller System Installation

A. Controller system shall be mounted in accordance with manufacturer's specifications and connected so as to form an operational system.
B. Controller shall be installed on a dedicated circuit utilizing surge protection in accordance with local codes.
C. Install free-standing controllers on concrete pads. Where dimensions are not indicated, furnish bases not less than 36 inches by 24 inches by 4 inches thick, and not less than 6 inches greater in each direction than overall dimensions of controller,
D. Install control wiring in same trench with piping.
E. Computer Control System backup and protection to be model DB42003 receptacle protector with model DB24001 telephone line protector plug in unit. A PW5115-750 with approximately 15 minutes of backup and continuous voltage regulation shall also be installed. All to be as manufactured by D&B Power Associates.
F. Remote Satellites controllers shall have a Model 907T Ac line protector installed. If a signal line is employed a DLPT-10-10 (Toro System) shall be utilized or DLPT-10-25 (Rainbird System) as manufactured.

16.4.7 Electrical Equipment

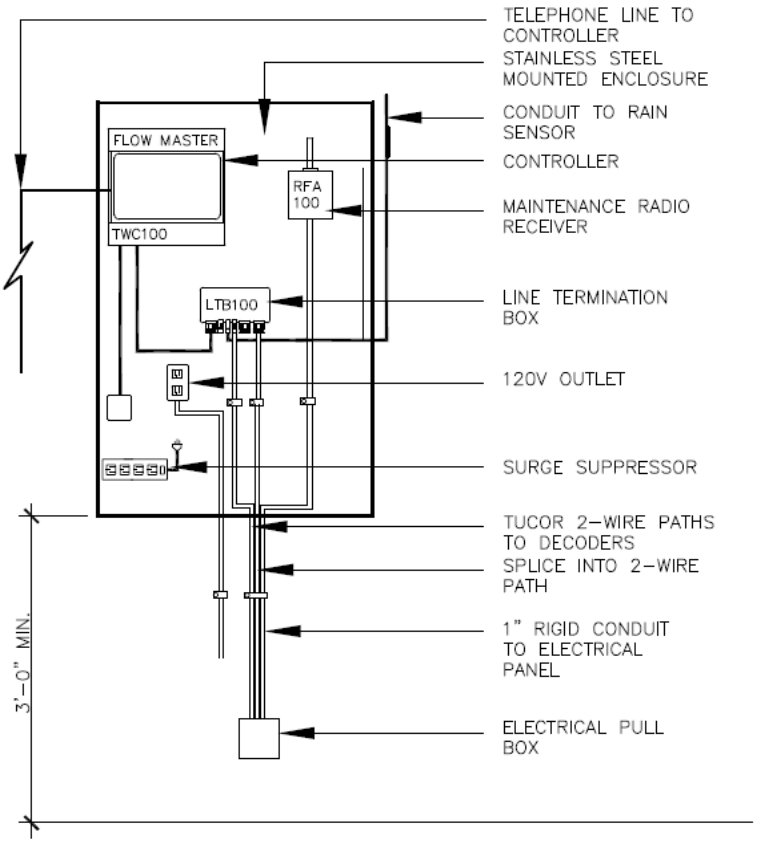
A. Low voltage (24 VAC) wire splice kits shall be 3M DBR, DBY, or approved equal. Listed 600 volt as manufactured by Paige Electric or approved equal.
B. All 120 VAC wire splice kits shall be 3M - DBY(R), 3M- #3570 Scotchlok Sealing pack, 3M 82A Scotchcast kit.
C. Wire connectors shall be 3M - Scotchlok Insulated Connector (Y, R, G, B), or equal - size in accordance to wire AWG used.

16.4.8 Controller Power Supply

A. Power to the controller to be supplied from a dedicated circuit.
B. Electrical power supply wire (120 VAC) from the power source to the controller locations shall be copper conductor, type UF with ground - UL listed. Wire shall be as manufactured by Paige Electric, or approved equal.
C. Valve control wire and common shall be single, solid copper conductor, U.L. listed PE 600 volt direct burial irrigation wire. Control wires shall be #14 AWG and shall be the following colors -
    1. Control - Red
    2. Spare - black w/yellow stripe.

    Common wire color shall be White and shall be #12 AWG. Each controller shall have a separate common. Wire shall be type P7079D as manufactured by Paige Electric, or approved equal.
D. The communication cable between the central computer and the field controllers shall be Rainbird - Type P7072D (AWG #14) or Toro - Type P7162D-A (AWG #16) as manufactured by Paige Electric. The three (3) communication legs shall be the following colors:
    1. Wire path #1 - red
    2. Wire path #2 - blue
    3. Wire path #3 - green
E. The communication cable between the central computer and weather station shall be Belden #9883 or approved equal.
F. Pump station communication wire to be Paige P718318 gauge.
G. Earth grounding wire from controller to the ground rod shall be AWG #6/1 solid bare copper conductor. Ground wire from rod to rod shall be AWG #6/1 solid bare copper conductor.
H. Shielding wire (Bonding Wire) to be AWG #6/1 solid bare copper conductor.

I. Underground warning tape for power and/or communication cable shall be red 3" non-detectable tape imprinted with “CAUTION ELECTRIC LINE BURIED BELOW”.



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WALL MOUNT
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Standard Details for
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DATE: JANUARY 2008
SCALE: NTS

IRRIGATION

16.5 IRRIGATION TWO-WIRE IRRIGATION SYSTEM

16.5.1 Two-Wire Decoder Interface

The Small Decoder Interface Unit (SDI) shall have the capacity to control a maximum of 200 decoder addresses and up to 400 solenoids. The Large Decoder Interface Unit (LDI) shall have the capacity to control a maximum of 500 decoder addresses and up to 1,000 solenoids (specific performance parameters depend on system design). The hybrid module shall offer both types of system communication — satellite and decoder— on the same system. The hybrid module shall also allow expansion of the control system with the addition of 1 more TWI or SDI, doubling hardware capabilities. SiteControl Plus allows operating one to four LDI's or, combined with the hybrid module, up to four total decoder and/or satellite interface devices.

16.5.2 Two-Wire Path

Communication wire to be double jacketed two (2) conductor cable specially designed for use with the Rainbird Two-Wire LDI/SDI Two-Wire Decoder Interface control systems, suitable for direct burial. The conductors to be tin coated, soft drawn, annealed, solid copper conforming to ASTM 33 with 4/64" thick PVC (polyvinyl chloride) insulation, conforming to UL Standard #493 for thermoplastic-insulated style UF (Underground Feeder), rated at 60 degree C.

16.5.3 Line Decoders

The line decoder shall be a fully programmable direct bury decoder that provides an interface between the controller and automatic valve. The output of the decoder shall be 24 VAC. The line decoders shall be model FD-102TURF as manufactured by Rainbird. Install on each automatic valve assembly a line decoder in accordance with manufacturer's specifications. The contractor is to be responsible for accurately recording on the as-built drawings, as each decoder is being installed, the address number of the decoder at that location. It is also necessary that it be indicated which remote controls valves controlled by each specified decoder.

16.5.4 Sensor Decoders

The sensor decoder shall be a fully programmable direct bury decoder that provides a direct interface between the flowmaster controller and field sensor, it maybe programmed to operate with a 4-20 mA, analog or digital input. Sensor decoder shall be model SD210TURF as manufactured by Rainbird, or approved equal.

16.6 IRRIGATION COMMUNICATION CABLE

Communication wire shall be double jacketed two (2) conductor cable specially designed for use with the control systems, suitable for direct burial. The conductors shall be tin coated, soft drawn, annealed, solid copper conforming to ASTM 33 with 4/64" thick PVC (polyvinyl chloride) insulation, conforming to UL Standard #493 for thermoplastic-insulated style UF (Underground Feeder), rated at 60 degree C.

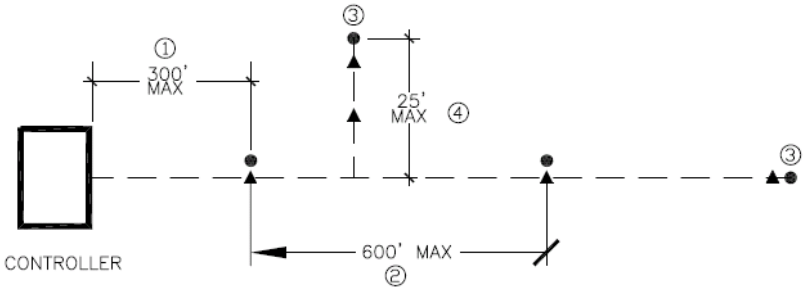
16.6.1 2-Wire Communication Cable Installation and Connections

A. Install a separate 2-wire path for each irrigation zone. Minimum depth of cover: 24"
B. Wire under pavement access to be installed in PVC conduit. Conduit to extend two (2) feet beyond pavement and to be plugged with duct seal or approved equal.
C. Tucor wire to be installed in the same trench as the pipe where ever possible and laid on the right hand side of the pipe. All wire to be installed with at least 1% slack, 36" expansion loop at each 45 degree or 90 degree turn in the trench. Never pull wire with a vibratory plow.

D. Splice all wires by baring a minimum of three-quarters inch of copper conductor, twisting the leads together. Wire nuts are to be used over the connection. Make the splice completely waterproof using connector kits in strict accordance with manufacturer's recommendations. Only one splice to be put in a connector kit. House all power splices not located in boxes at remote control valve or controller sites in a reach well consisting of a Brooks #70 box, or approved equal, and cover and accurately locate same on the "Construction Record Drawing".
E. When wire runs do not follow pipe trenches, lay them in a straight line which will be carefully located on the "Construction Record Drawing". If a change of direction is required on these runs, they are to be made at an angle between two straight runs, and not as a sweeping curve. A splice box (valve box) is to be installed at the angle point with sufficient wire slack to allow wires to be raised at least 24" above grade.
F. Loop wire at automatic valves in control boxes to allow raising the valve bonnet to the surface without disconnecting the wires when repair is required.
G. Connect two wire paths to line termination box.
H. Connect each remote control value to one line decoder and connect to two-wire path.
I. Make all two wire connections to automatic valves completely waterproof using DBM connector kits in strict accordance with the manufacturer's recommendations.
J. The Grounding Network to measure not more than 15 OHMS when measured with a Vibra-Ground, or similar type instrument. It will greatly increase the effectiveness of the surge protection equipment, if the grounding grid network can be 5 OHMS or less. It is extremely important that a good ground be maintained for the surge Arrestors to be effective and periodic testing is recommended, to assure that you do have a good grounding system at all times.
K. Wire is to have a minimum of twenty four inches (24") of cover; where wire passes under pavement, install the wire in two inch (2") I.D. schedule 40 PVC sleeves.

16.7 IRRIGATION SYSTEM SURGE PROTECTION

Field surge protection to be installed at every line termination point. Additional surge protection is needed per 600 feet of wire cable, located at the nearest line decoder. The surge protection ground wires to be connected to a single 8 foot ground rod. If the valve is metallic or the solenoid valve has a metallic center pin, one surge protection ground wire to be connected to this. All surge protection, grounding and installation of equipment, therefore specified, to be installed in strict compliance with the manufacturer's recommendations and in accordance with local, State and Federal codes and requirements.



▲ SURGE PROTECTOR

● DECODER

— — — 2–WIRE PATH

① INSTALL FIRST SP–100 100' MAX FROM CONTROLLER ALONG EACH TWO WIRE PATH

② INSTALL ADDITIONAL SP–100's 600' MAX ALONG TWO WIRE PATH

③ INSTALL A SP–100 AT END OF EACH TWO WIRE RUN

④ IF LATERAL BRANCH IS LESS THAN 25' AN SP–100 IS NOT REQUIRED.

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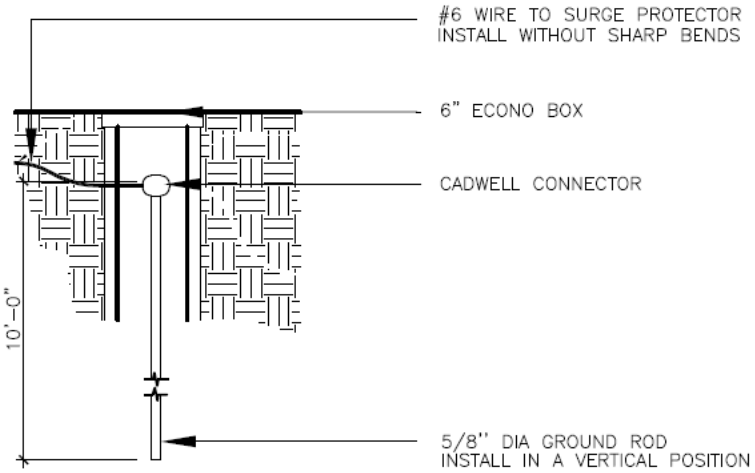
16.8 IRRIGATION EARTH GROUND EQUIPMENT

A. Ground rods to be 5/8" by 8' copper clad steel rods. Ground rod connectors to be of the Caldwell "one shot" fuse type - Model GR1-161G or GT1-161G, as required, or approved equal.
B. Earth grounding wire to the ground rods to be AWG #6/1 solid bare copper conductor. Ground wire from rod to rod to be AWG #6/1 solid bare copper conductor.
C. Ground rod box to be Carson/Brooks 6" econo box, model 708, or approved equal.
D. Earth grounding wire from controller to the ground rod to be AWG #6/1 solid bare copper conductor. Ground wire from rod to rod to be AWG #6/1 solid bare copper conductor.
E. Ground plates to be 4” by 96”.
F. The grounding network at the controller shall measure not more than 15 OHMS when measured with a Vibra-Ground, or similar type instrument. It will greatly increase the effectiveness of the surge protection equipment if the grounding grid network can be 5 OHMS or less. It is extremely important that a good ground be maintained for the surge arrestor to be effective and periodic testing is recommended, to assure that you do have a good grounding system at all times.



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TYPICAL GROUNDING LOCATION

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IRRIGATION

16.9 PIPING

A. Provide pipe continuously and permanently marked with manufacturer's name or trademark, size schedule and type of pipe, working pressure at 73 degrees Fahrenheit and National Sanitation Foundation (NSF) approval.
B. Mainline piping (2 1/2" and larger) to be polyvinyl chloride (PVC) SDR-21-200 psi as per ASTM D-2241 and made from virgin material conforming to ASTM D-1784, Type 1, Grade 1 standards with gasketed joints conforming to ASTM D-3139. All pipe to be new and be continuously and permanently marked with manufacturer's name, materials size and schedule or type. Pipe to be as manufactured by IPEX, Inc., or approved equal.
C. Mainline piping (2" and smaller) shall be PVC SDR-21-200 psi with solvent weld bell end couplings conforming to ASTM-2241. All plastic pipe shall be new and be continuously and permanently marked with manufacturer's name, materials size and schedule or type.
D. Lateral pipe (Athletic Fields) to be polyvinylchloride (PVC) SDR-21-200 psi with solvent weld bell end couplings conforming to ASTM-2241.
E. Lateral pipe (Landscape Areas) to be polyethylene (POLY) PE2306 SIDR-11.5 - 100 psi and conforming to ASTM-2239.
F. High Density Polyethelene pipe shall be SDR-11 psi (Butt Fused) High Density Polyethylene (HDPE) pipe 8600 extruded from Marlex-M-8000. The pipe shall be PE 3408 high density, high molecular weight. The pipe shall be in compliance with ASTM F714 dimension and pressure ratings. Primary properties - Cell classification shall be in accordance with ASTM D 3350-84 and 3345434C
G. PVC sleeves shall be polyvinyl chloride (PVC) Plastic Pipe: ASTM D 1785, PVC 1120, Schedule 40, 160 psig minimum pressure rating for 8-inch and smaller sizes, with plain ends.
H. Polyvinyl Chloride (PVC) Plastic Pipe: ASTM D 1785, PVC 1120, Schedule 80, 250 psig minimum pressure rating for 8-inch and smaller sizes, with plain and threaded ends.
I. Copper tubing shall be Type L, M and K conforming to the requirements of Standard Specification for seamless Copper Water Tube, ASTM Designation B88 or latest revision.
J. Ductile iron pipe to be in accordance with ANSI/AWWA C151/A21.51, 150 psi, Class 52 cement lined; ANSI/AWWA C104/A21.4 with mechanical joints; ANSI/AWWA C111/A21.11, ANSI/AWWA C151/A21.51. Outside coating to be bituminous enamel, minimum thickness 1 mil.

16.9.1 Pipe Installation

A. Install pipe in accordance with ANSI/ASAE Standard #S376.1 and the recommendations of the manufacturer, including leveling of trench bottoms, bedding of pipe in the bottom of the trench and the installation valves of mechanical restraints on pipe joints, fittings and isolation valves.
B. All irrigation piping to be installed below all drainage piping.
C. Allow solvent weld joints to set at least twenty four (24) hours before pressure is applied to the system.
D. Maintain pipe interiors free of dirt and debris. Close open ends of pipe by acceptable methods when pipe installation is not in progress.
E. Install all penetrations by core drilling where required to make plumbing and/or electrical wiring connections. Seal all building wall penetrations with 'Link-Seals' properly sized and watertight.
F. After piping is installed and before sprinklers and spray heads are installed, open control valves and flush out the system with full head of water.
G. Cap all risers and perform system testing upon completion of lateral pipe installation. All pipes are to be tested at one hundred (100) psi for twenty four (24) hours. During this time, a visual inspection will be made. All leaks are to be repaired and the lines retested.

16.9.2 Pipe Fittings

A. Main line fittings and service tees (3" and larger) to be manufactured of ductile iron (DI), Grade 65-45-12 in accordance with ASTM A-536. Fittings to have deep bell push-on joints with gaskets meeting ASTM F-477. Fittings to be HARCO DEEP BELL type, with retainer connecting licks – as required to be manufactured by The Harrington Corp.
B. Main line fittings and service tees (2 1/2" and smaller) to be manufactured of SCH 40 PVC, threaded or socket.
C. Brass fittings to be standard weight with NPT threaded fittings, as manufactured by Lee Brass, or approved equal. Brass nipples to be standard weight with NPT threads.
D. Poly pipe insert fittings to be 125 psi domestic brass NPT fittings conforming to ANSI-B16.15 and Fed. WW-P-460, as manufactured by Lee Brass, or approved equal. Clamps to be stainless steel, worm gear hose clamps with stainless steel screws, series 6800 as manufactured by Ideal or stainless steel "ear" type clamps, series 210 as manufactured by Oetiker.
E. Poly pipe insert fittings to be PVC insert fittings. Clamps to be stainless steel, worm gear hose clamps with stainless steel screws, series 6800 as manufactured by Ideal or stainless steel "ear" type clamps, series 210 as manufactured by Oetiker.
F. Cast iron flange fittings to be Standard Class 125 and made to ANSI B16.1 specifications. Flanges to have dimensions to conform to #WW F-406. Size to correspond to the pipe dimensions used.
G. Weld steel fittings to be of black seamless steel ASTM A234 with beveled edges - 150 psi rated. Size to correspond to the pipe dimension used. Weld flanges to be weld neck or slip-on - 150 psi rated conforming to ASTM A181 Grade 1.
H. Mechanical joint fittings to be used on ductile iron pipe and to be manufactured of ductile iron (ASTM A536) and to be of class 350. Fittings to be of standard dimensions (ANSI A21.53). Size to correspond to the pipe dimension used.
I. Mechanical joint retainer glands to be used with all MJ fittings and to be of ductile iron (60-45-12) with steel bolts (ASTM A307). Size to correspond to the fitting used. Retainer glans for DI pipe to be EBBA series 1200 and EBBA series 5500 for IPS PVC pipe or approved equal.
J. Copper Tube Fittings to be ASME B16.22, wrought copper or cast brass, solder joint, pressure type.
K. Copper Unions to be ASME Bl6.18, cast-copper-alloy body, hexagonal stock, with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded or solder joint, and threaded ends.
    1. Threaded Ends to be threads conforming to ASME B1.20.1.
L. High Density Polyethylene (HDPE) pipe fittings to be SDR-11 160 psi (Butt Fused) High Density Polyethylene (HDPE) pipe 8600 extruded from Marlex M-8000. The fittings to be PE 3408 high density, high molecular weight. The fittings to be in compliance with ASTM F714 dimension and pressure ratings. Primary properties- Cell classification to be in accordance with ASTM D 3350-84 and 345434C. Fittings to be manufactured by ISCO Industries.
M. High Density Polyethelene (HDPE) service saddles to be ductile iron with stainless steel straps. Service saddles to be series 404 as manufactured by JCM Industries Inc.
N. High Density Polyethelene (HDPE) lateral swing joint saddle to be plastic with stainless steel hardware. Saddle to be series SWJSA as manufactured by Lasco.
O. Dielectric Fittings to be assembled or fitted with insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion, These devices are a combination of copper alloy and ferrous metal; threaded- and solder end types matching piping system materials.
    1. Dielectric Flanges to be factory-fabricated, companion-flange assembly for 150 psig (1035 kPa) or 300 psig (2070 kPa) minimum pressure to suit system pressures.

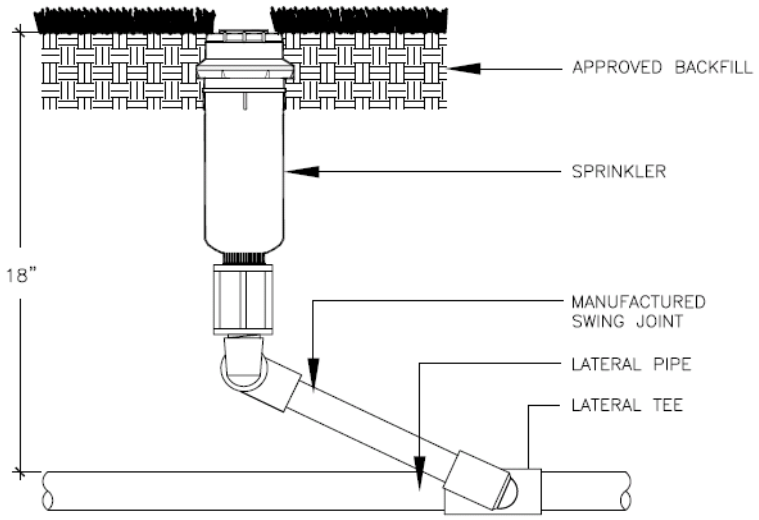
2. Transition Fittings to be manufactured assembly or fitting, with pressure rating at least equal to that of system and with ends compatible to piping where fitting Is to be installed.
3. Dielectric Unions to be factory-fabricated. union assembly, designed for 250 psig (1725 kPa) minimum working pressure at 180 deg F (82 deg C). Include insulating material isolating dissimilar metals and ends with inside threads according to ASME Bl.20.1.

16.9.3 Joining Materials

A. Solvent Cement to be ASTM F 656 primer and ASTM D 2564 solvent cement in color.
B. PVC cement shall be IPS - #721, Wet "R" Dry, Recto-Seal Gold, or approved equal. PVC primer shall be IPS - #P-70 (purple), or approved equal. Cement Schedule 80 nipples with IPS #711 and P-70 Primer (purple) or approved equal. PVC cement shall be of uniform color and consistency and used within its expiration date. Particular attention shall be paid to manufacturer's recommendations for cold weather storage.
C. Solder to be ASTM B 32, Alloys Sn95 and E.
D. Gaskets and fasteners for metal and metal-to-plastic flanged joints to be ASME B16.21, nonmetallic, asbestos-free, flat, 118-inch (3 mm) thickness gaskets and ASME B18.2.1, carbon steel bolts, nuts, and washers.
E. Gaskets for elastic flanged joints to be materials recommended by plastic pipe and fittings manufacturer.
F. Gaskets for elastic flanged joints to be materials recommended by plastic pipe and fittings manufacturer.

16.10 IRRIGATION SWING JOINT ASSEMBLIES

A. Swing joint used for gear driven sprinklers to be PVC factory assembled, 315 psi rated units with 3 elbows and double O-ring seals at threaded connections. Swing joints to be Model #T732-100 (3/4”) as manufactured by Spears Manufacturing, or approved equal.
B. Swing joint used for gear driven sprinklers to be PVC factory assembled, 315 psi rated units with 3 elbows. Model #1-A1-13-12 (1"), #2-A1-17-12 (1 1/4") and #3-A1-21-12 (1 1/2") as manufactured by Dura.
C. Swing joint used for pop-up spray heads to be 6” model SA-6050 and 12” model SA12050 as manufactured by Rainbird or approved equal.
D. Quick-coupling valve swing joints shall be a three (3) elbow 1" brass swing joint. Include Dura quick lock with (2) two 36" epoxy coated rebar.



NOTE:
INSTALL SPRINKLER 1/2" BELOW FIN. GRADE

WOODARD & CURRAN 709 WESTCHESTER AVENUE, SUITE L2 WHITE PLAINS, NEW YORK 10604 800.807.4080 | www.woodardcurran.com COMMITMENT & INTEGRITY DRIVE RESULTS	SWING JOINT ASSEMBLY DESIGNED BY: MW CHECKED BY: JS DRAWN BY: SH WC_SUNY IRRAGATION DETAILS.dwg	The University at Albany Uptown Campus Standard Details for Environmental Utilities	JOB NO: 213534 DATE: JANUARY 2008 SCALE: NTS IRRIGATION

16.11 VALVES

A. Main Line isolation valves (3" and larger) to be resilient wedge type with non rising stem conforming to the requirements of AWWA Spec. C509. They shall be PVC-PVC with "push-on" connections, turn counter-clockwise to open, shall be designed for 200 psi working pressure and have a 2" operating nut. Valves shall be Clow Series 2630 or Nibco, or approved equal.

B. Main line valves (2 ½" and smaller) to be bronze, rising-stem gate valves. MSS SP-80, Type 2, solid wedge; rising, copper-silicon-alloy stem; Class 125, body and screw bonnet of ASTM B 62 cast bronze, with threaded or solder-joint ends- Include polytetrafluoroethylene (PTFE)-impregnated packing, brass packing gland, and malleable-iron handwheel. Valves to be model T-113 as manufactured by NIBCO.

C. Main line gate valves used with High Density Polyethelene pipe to be series 66/00 with HDPE ends as manufactured by AVK.

D. Valves on the pressure side of the automatic valves and lateral line isolation valves to be bronze body ball valves - 150 psi rated and NPT connections. Valves to have stainless steel ball and handle. Valves to be Apollo series #70-100.

E. Quick coupling valves to be one piece bronze bodies, double slot, 1" IPS with lock top; supply four (4) keys. Valves to be Rainbird model #5RC, or approved equal. Coupler to be Rainbird model #55K-1, or approved equal; supply four (4) couplers. Brass hose swivels to be 1" x ¾" Rainbird model # SH-1, or approved equal; supply four (4) swivels.

F. Automatic valves to be plastic globe type, normally closed, electric solenoid-actuated and diaphragm-operated with flow stem. Solenoid to be epoxy impregnated 24 VAC-60 Hz (18 to 30 VAC), 5.8 VA and to be suitable for direct burial. Valves to be capable of manual operation by means of an internal bleed. Valves to be Rainbird PEB series as manufactured by Rainbird. Valves with pressure regulation option to be Rainbird PEB-PRS-B series as manufactured by Rainbird.

    1. Valve identification tags to be standard size, model ID-STD-Y1. The identification tag to be stamped with the following designation A1, A2, A3, A4, etc to match number of valves per controller. The identification tags to be manufactured by T. Christy Enterprises.

G. Master valve to be brass globe type, normally open or normally closed, electric solenoid-actuated and diaphragm-operated with flow stem. Solenoid to be epoxy impregnated 24 VAC-60 Hz (18 to 30 VAC), 5.8 VA and to be suitable for direct burial. Valves to be capable of manual operation by means of an internal bleed. Valve to be 300 series as manufactured by Bermad.

H. Air release valves to be Combination Air Release Valve, having a 1" NPT inlet and a 1" Air & Vacuum outlet with a 3/32" Pressure Air Release orifice, for operating pressures of 0-150 psi. The valve to be Cast Iron Body, Stainless Steel Internals, Stainless Steel Float, and Buna-N seating material. The valve is to exhaust large quantities of air on system start up and allow air to re-enter the pipeline when the line is being emptied or drained. The valve to also vent air that accumulates while the system is under pressure. Valves to be model IC10 as manufactured by Crispin, or approved equal.

I. Quick-coupling valves to be one piece bronze bodies, double slot, 1" IPS. Valves to be:

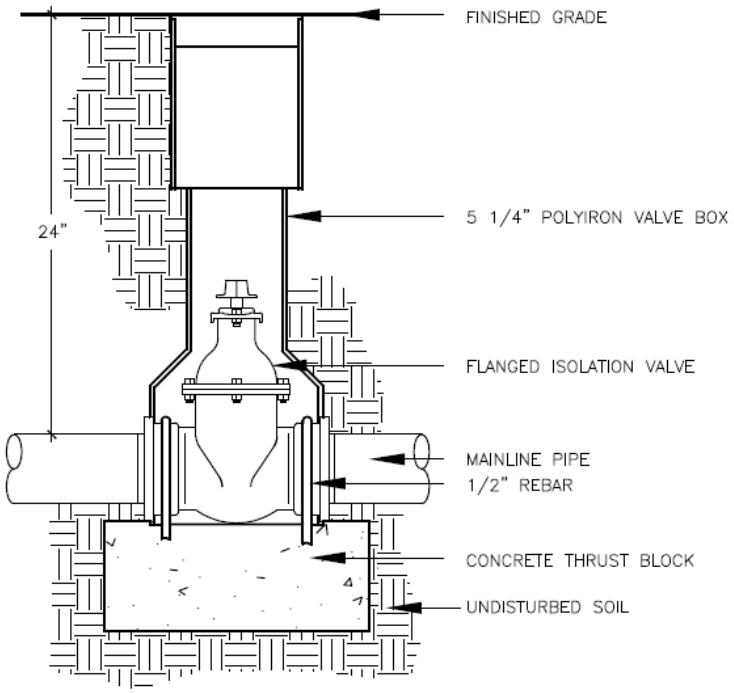
    1. Rainbird Model #5RC
    2. Toro Model #474-00

J. Remote control valves to be plastic globe type, normally CLOSED, electric solenoid-actuated and diaphragm-operated with flow stem. Solenoid to be epoxy impregnated 24 VAC-60 Hz (18 to 30 VAC), 5.8 VA and to be suitable for direct burial. Valves to be capable of manual operation by means of either an internal or external bleed. Valves to be:

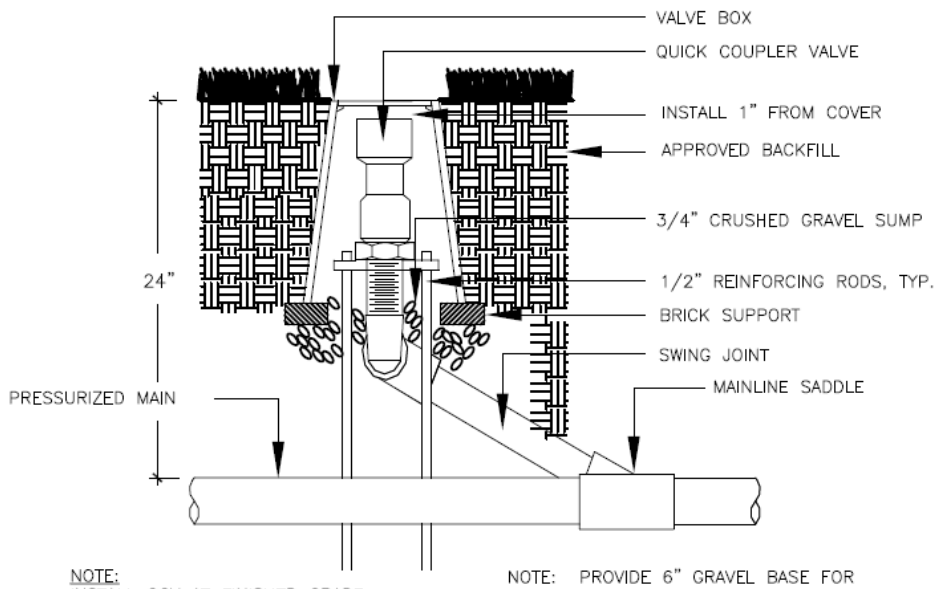
    1. Rainbird Series EFB-CP
    2. Rainbird Series EFB-CP-PRS-B

3. Toro Series 220G
4. Toro Series 220G-27-0X

K. Main line gate valves used with High Density Polyethelene pipe to be series 66/00 with HDPE ends as manufactured by AVK.



WOODARD &CURRAN 709 WESTCHESTER AVENUE, SUITE L2 WHITE PLAINS, NEW YORK 10604 800.807.4000 | www.woodardcurran.com COMMITMENT & INTEGRITY DRIVE RESULTS	TYPICAL MAIN LINE GATE VALVE DESIGNED BY: MW CHECKED BY: JS DRAWN BY: SH WC_SUNY IRRAGATION DETAILS.dwg	The University at Albany Uptown Campus Standard Details for Environmental Utilities	JOB NO: 213534 DATE: JANUARY 2008 SCALE: NTS IRRIGATION



NOTE:
INSTALL QCV AT FINISHED GRADE

NOTE: PROVIDE 6" GRAVEL BASE FOR VALVE BOX AND FILL VALVE BOX WITHIN 1" OF VALVE BOX LID WITH GRAVEL.

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QUICK COUPLING VALVE

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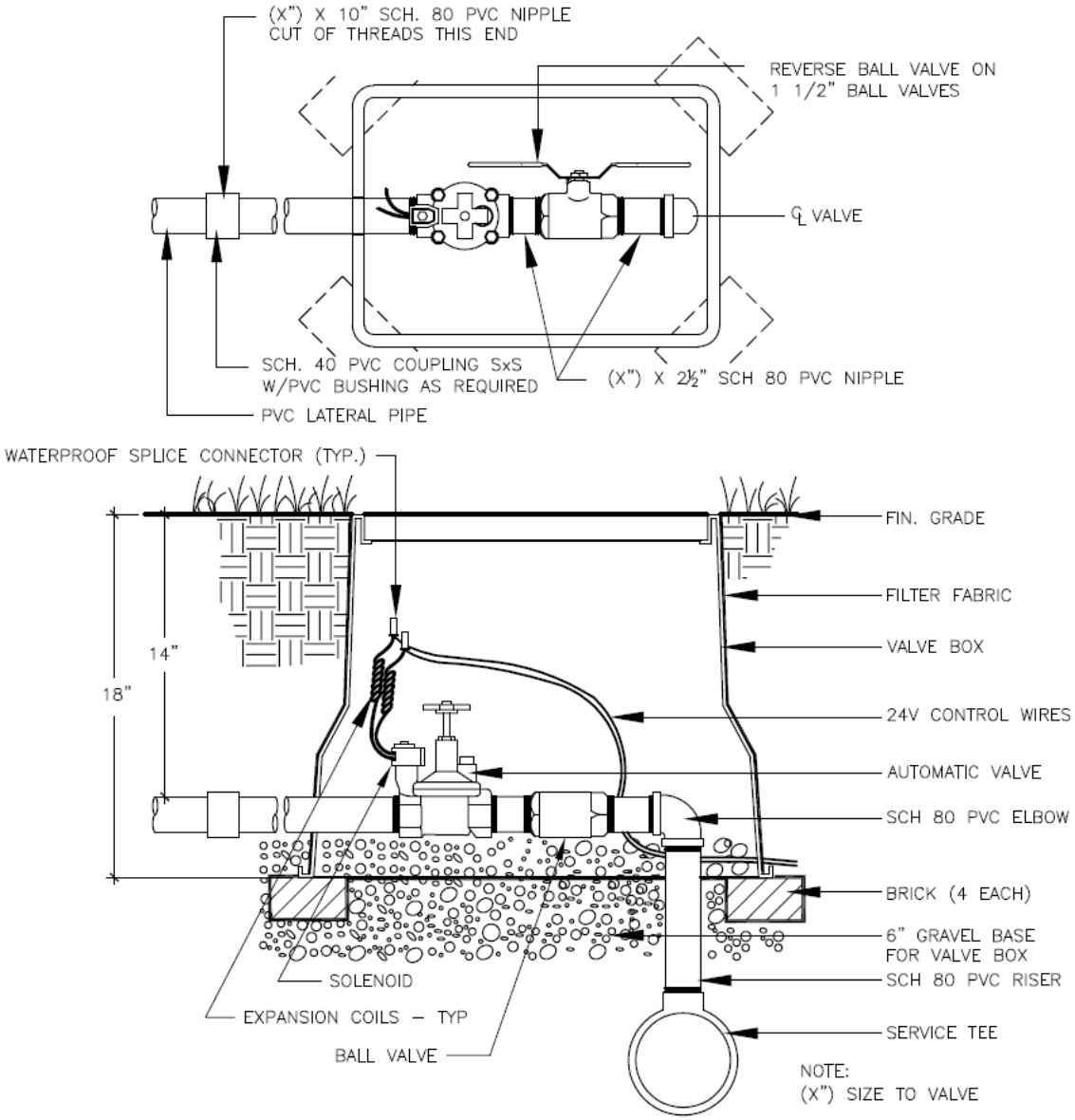
IRRIGATION



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AUTOMATIC VALVE ASSEMBLY
ATHLETIC FIELDS

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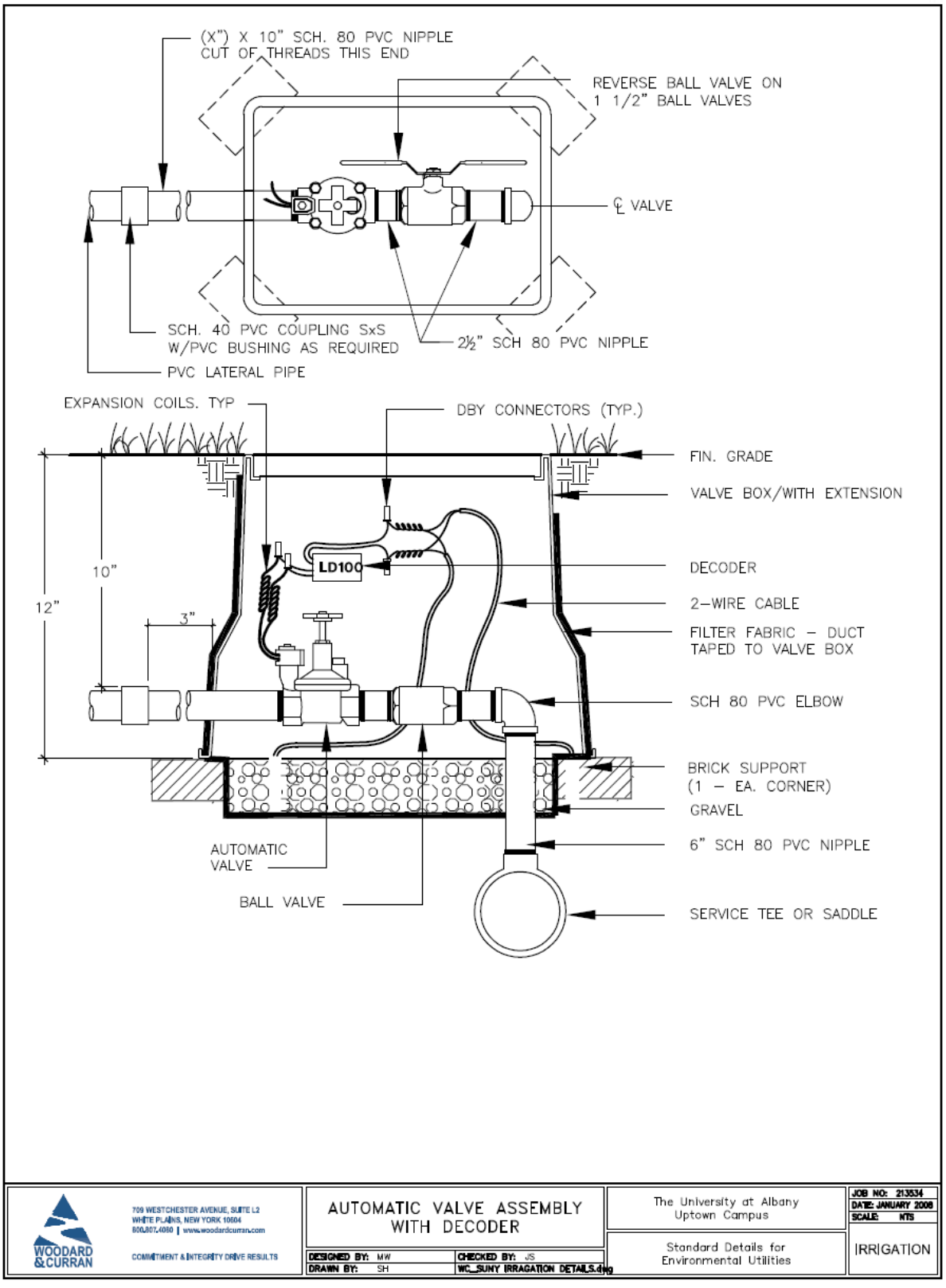
IRRIGATION


(X") X 10" SCH. 80 PVC NIPPLE
CUT OF THREADS THIS END
REVERSE BALL VALVE ON
1 1/2" BALL VALVES
℄ VALVE
SCH. 40 PVC COUPLING SxS
W/PVC BUSHING AS REQUIRED
2½" SCH 80 PVC NIPPLE
PVC LATERAL PIPE
EXPANSION COILS. TYP
DBY CONNECTORS (TYP.)
FIN. GRADE
VALVE BOX/WITH EXTENSION
LD100
DECODER
2-WIRE CABLE
FILTER FABRIC - DUCT
TAPED TO VALVE BOX
SCH 80 PVC ELBOW
BRICK SUPPORT
(1 - EA. CORNER)
GRAVEL
6" SCH 80 PVC NIPPLE
SERVICE TEE OR SADDLE
10"
12"
3"
AUTOMATIC
VALVE
BALL VALVE
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AUTOMATIC VALVE ASSEMBLY
WITH DECODER
DESIGNED BY: MW
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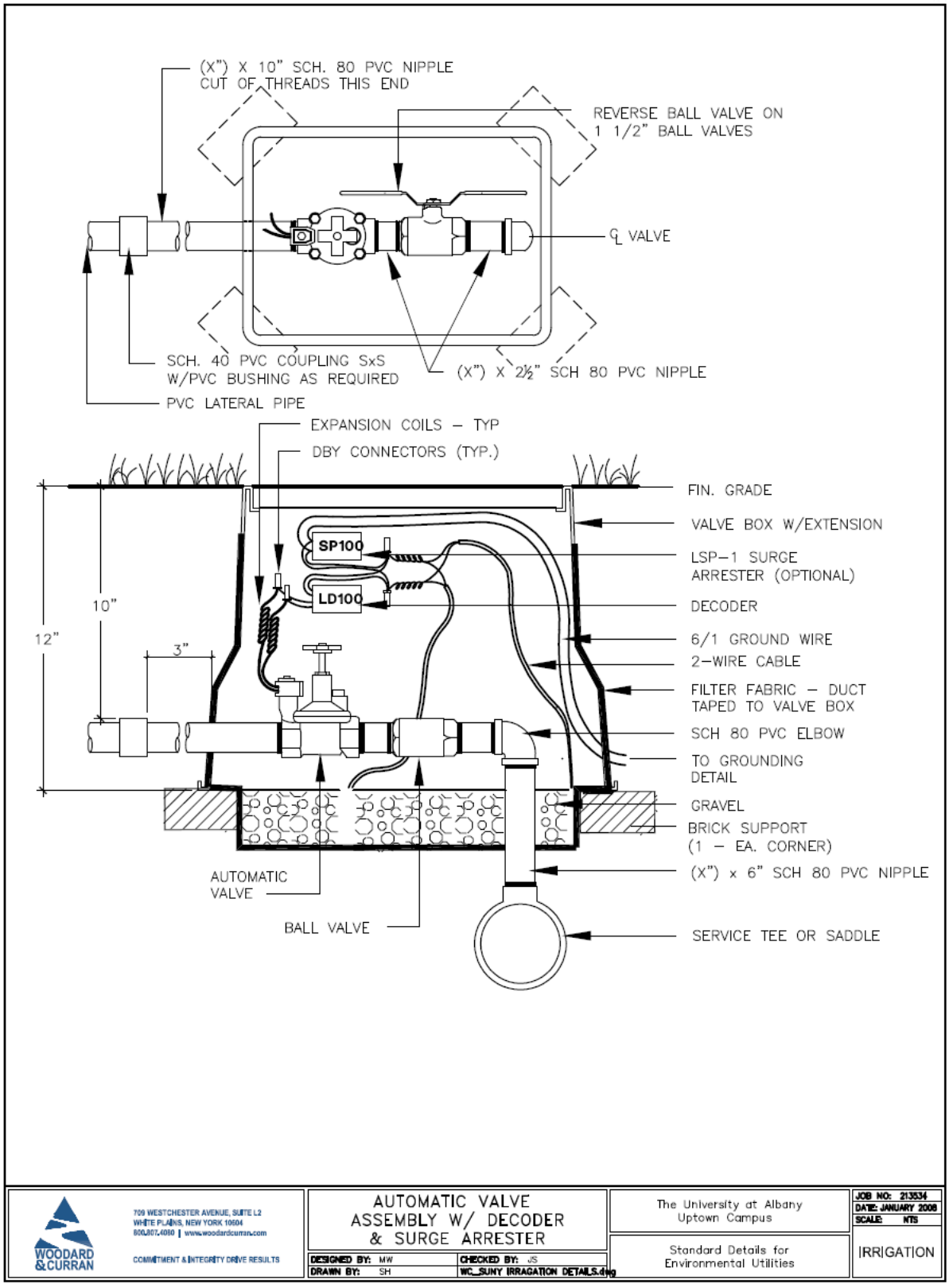
Environmental Utilities
JOB NO: 213534
DATE: JANUARY 2008
SCALE: NTS
IRRIGATION



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AUTOMATIC VALVE ASSEMBLY W/ DECODER & SURGE ARRESTER

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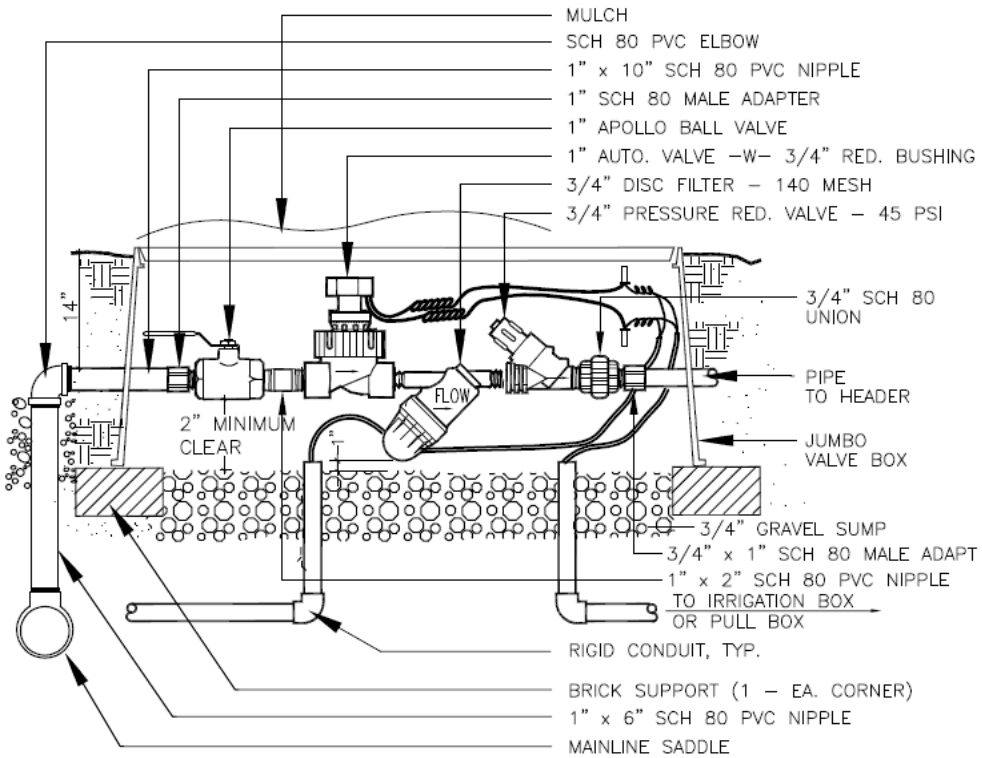

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1" AUTOMATIC VALVE ASSEMBLY FOR DRIP IRRIGATION

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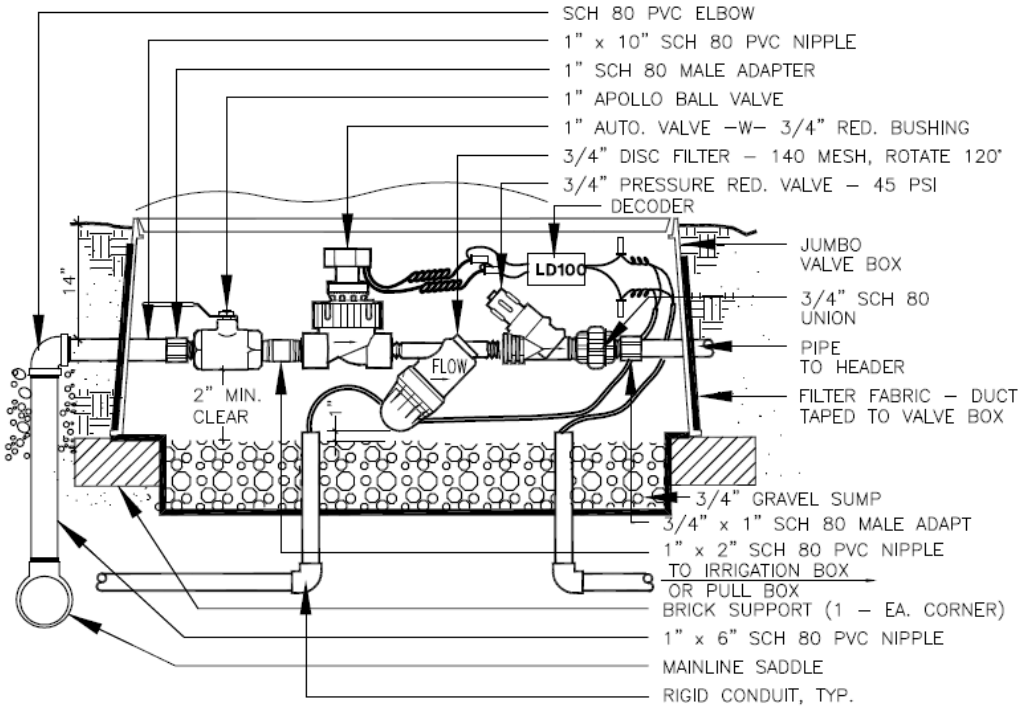
DATE: JANUARY 2008
SCALE: NTS

IRRIGATION



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1" AUTOMATIC VALVE ASSEMBLY WITH DECODER FOR DRIP IRRIGATION

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Standard Details for
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JOB NO: 213534
DATE: JANUARY 2008
SCALE: NTS

IRRIGATION

16.12 VALVE BOXES

A. Valve boxes for main line isolation valves to be (landscaped areas) adjustable telescoping screw type. Box to be 7 ½" x 15 ½" with 15 ½" top section and 15" bottom section or as required for proper depth.
B. Valve boxes for main line isolation valves (Paved Areas), to be 4 ¼" cast iron roadway box Tyler #141-Q.
C. Valve boxes (landscaped areas) used with automatic valve assemblies to be 12" x 17" x 12" deep valve boxes; black in color. Valve boxes to be Carson/Brooks #1419-12" with bolt down T-cover as manufactured by Carson Industries, Inc, or approved equal.
D. Valve boxes (athletic fields) used with automatic valve assemblies to be 12" x 17" x 18" deep valve boxes; black in color. Valve boxes to be Carson/Brooks #1419-18" with bolt down T-cover as manufactured by Carson Industries, Inc, or approved equal.
E. Valve boxes used with drip irrigation valve assemblies to be 16" x 25" x 12" deep valve boxes; black in color. Valve boxes to be Carson/Brooks #1220-12" with bolt down T-cover as manufactured by Carson Industries, Inc, or approved equal.
F. Valve boxes for drip irrigation flush valves and quick coupling valves to be 6" round valve box. Black in color. Valve boxes to be Carson/Brooks #708 with snap down T-cover as manufactured by Carson Industries, Inc, or approved equal.
G. Valve boxes for quick coupling valves to be 10" round. Black in color. Valve boxes to be Carson/Brooks #708 with snap down T-cover as manufactured by Carson Industries, Inc, or approved equal.
H. Valve boxes used with air release assemblies, to be 15" x 21" x 18" deep valve boxes. Black in color. Valve boxes to be Carson/Brooks #708 with snap down T-cover as manufactured by Carson Industries, Inc, or approved equal.
I. Valve box extensions, as required, to be of the same size, color and manufacturer as the box on which it is used.

16.12.1 Valve Assembly/Box Installation

A. Install valve boxes, as detailed, with adequate space for operation, service and removal of the equipment in the box. Install a minimum of six inches (6") of one-half inch (½") sized, crushed stone over the filter fabric placed prior to the installation of the valve box for both drainage and leveling the box flush with finished grade.
B. Where necessary to properly fit the valve assembly pipe, boxes are to be neatly cut so as to provide a firm fit to the pipe. Soil not to enter the valve box through these cut-outs.
C. Mount all boxes plumb and flush to grade. Extensions are to be used, as required for proper installation and setting. Establish the grade of the box with the surrounding grade using a leveling board not less than four feet (4') in length. Install the boxes to the underside of this board.
D. Install all valve boxes in approved locations.
E. Install the automatic valve assemblies as detailed on the drawings using standard Schedule 80 PVC nipples and fittings.
F. Install one (1) valve assembly per valve access box. Obtain acceptance of the height of the valve access boxes.
G. Install the ball valves in "closed" positions. They are not to be opened until the main line piping system has been pressurized and flushing has been completed through the blow-out valve assembly.
H. Assemble brass to brass threaded fitting connections with non-hardening thread sealant using Lasco Blue Pipe Thread Sealant, or Permatex #80045. Assemble threaded PVC to PVC, or brass to PVC, with use of two (2) wraps of Teflon tape.
I. Assemble threaded connections so that sealant or Teflon tape does not enter the pipe or fitting.
J. Do not use automatic valve manual bleeds for continual operation. For extended use without 24 VAC wiring, the manual bleed is to be left in the 'open' position and the flow to the zone controlled (on-off) by the ball

valve.

K. Adjust all automatic valves by means of the flow control stem and verify sprinkler discharge pressure on each lateral zone, with a pilot tube and gauge, to obtain optimum sprinkler performance.

16.13 IRRIGATION BACKFLOW PREVENTERS

ASSE Standard backflow preventers, of size indicated for maximum flow rate and maximum pressure loss indicated. The working pressure is to be 150 psig (1035 kPa) minimum except where otherwise indicated.

A. Backflow preventers (2" and smaller) to be bronze body with threaded ends.
B. Backflow preventers (2 ½" and larger) to be bronze, cast-iron. steel, or stainless-steel body with flanged ends.
    1. Interior protective coating to be AIWA C550, epoxy coating for backflow preventers with cast-iron or steel body.
C. Interior components to be corrosion-resistant materials.
D. Strainer supplied with and compatible for size and capacity with unit, on Inlet, where strainer is indicated.
E. Hose connection vacuum breakers to be ASSE 1011, nickel-plated, with non-removable and manual drain features, and ASME Bi.20.7 garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.
F. Reduced-pressure-principal backflow preventer to be ASSE 1013, with (OS&Y) gate valves on inlet and outlet and strainer on inlet. Include test cocks and pressure differential relief valve with ASME Al 12.1.2 air-gap fitting located between 2 positive-seating check valves for continuous pressure application.
    1. Pressure Loss to be 15 psig (1 03 kPa) maximum, through middle third of flow range.
    2. Gate valves supplied with and compatible for size and testing of unit on inlet and outlet. Valves 2" and smaller may be ball valves It these are unit manufacturers standard valve for this application.
    3. Test Kit to be unit manufacturer supplied, complete calibrated backflow preventer testing equipment kit with carrying case.
G. Double check backflow prevention assemblies to be ASSE 1015, with shutoff valves on inlet and outlet and strainer on inlet. Include test cocks with 2 positive-seating check valves for continuous pressure application.
    1. Pressure loss to be 12 psig (83kPa) maximum, through middle third of flow range.
    2. Gate valves supplied and compatible for size and testing of unit on inlet and outlet. Valves 2" and smaller may be ball valves if these are unit manufacturer's standard valve for this application.
    3. Test Kit to be unit manufacturer supplied, complete calibrated backflow preventer testing equipment kit with carrying case.
H. Antisiphon pressure type vacuum breakers to be ASSE 1020 with valves, spring loaded check valve, and spring loaded floating disc. Include test cocks and atmospheric vent for continuous pressure application.
    1. Pressure loss to be 6 psig (41 kPa) maximum, through middle third of flow range.
    2. Gates valves supplied with and compatible for size and testing of unit on inlet and outlet. Valves 2" and smaller may be ball valves if these are unit manufacturer's standard valve for this application.
    3. Test Kit to be unit manufacturer supplied, complete calibrated backflow preventer testing equipment kit with carrying case.

16.13.1 Backflow Preventer Installation

A. Install backflow presented of type, size, and capacity indicated. Include valves and test cooks. Install according to plumbing code and health department authorities with jurisdiction,
B. Install pressure-type vacuum breakers minimum of 12" above downstream piping system.
C. Do not install bypass around backflow presented.
D. Do not install backflow preventers with drains or vents in pits or areas subjected to flooding.
E. Support backflow preventers, valves, and piping on 3000-psi (20.7MPa) minimum, Portland-cement-mix concrete piers.

16.14 IRRIGATION PRESSURE REGULATORS

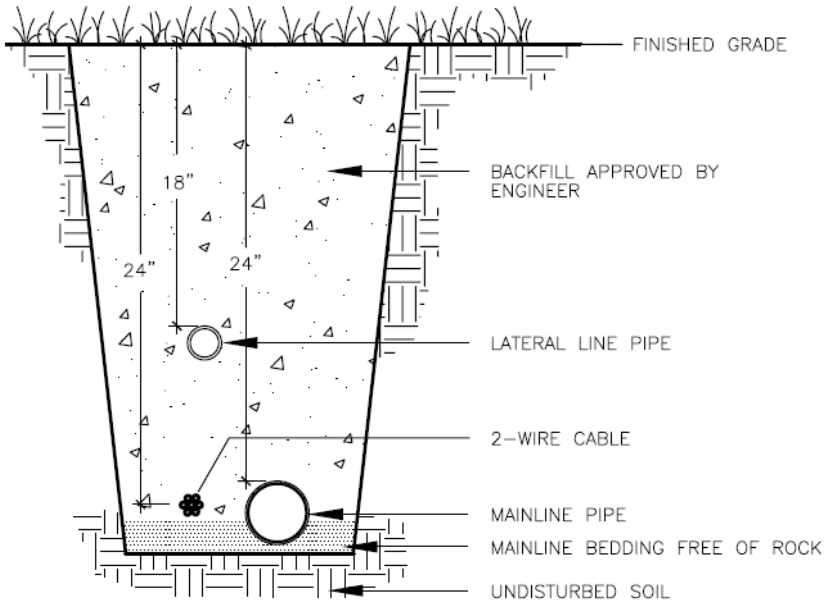
A. ASSE 1003, single-seated, direct-operated-type water pressure regulators, rated for initial working pressure of 150 psig (1035 kPa) minimum, with size, flow rate, and inlet and outlet pressures indicated. Include integral factory-installed or separate field-installed Y-pattern strainer that is compatible with unit for size and capacity.
    1. Pressure regulators (2" and smaller) to be bronze body with threaded ends.
    2. Pressure regulators (2 ½" and larger) to be bronze or cast-iron body with flanged ends.
    3. Interior protective coating to be AIWA 050, epoxy coating. for regulators with a cast-iron body.
    4. Interior components to be corrosion-resistant materials.
B. ASSE 1003, single-seated, direct-operated. integral-bypass-type. water pressure regulators, rated for initial working pressure of 150 psig (1 035 kPa) minimum, with size, flow rate, and inlet and outlet pressures indicated, include integral factory-installed or separate field-installed Y-pattern strainer that is compatible with unit for size and capacity.
    1. Pressure regulators (2" and smaller) to be bronze body with threaded ends.
    2. Pressure regulators (2 ½" and larger) to be bronze or cast-iron body with flanged ends.
        a. Interior protective coating to be AIWA 050, epoxy coating for regulators with a cast-iron body.
    3. Interior components to be corrosion-resistant materials.
C. ASSE 1003, pilot-operated-type,.single- or double-seated, water pressure regulators, rated for initial working pressure of 1 50 psig (I 035 kPa) minimum, with size, flow rate, and inlet and outlet pressures indicated- Include cast-iron body main valve, bronze-body pilot valve, integral factory-installed or separate field-installed Y-pattern strainer that is compatible with unit for size and capacity.
    1. Pressure regulators (2 ½" inches and larger) to be cast iron body with Awwa C550, epoxy coating, and flanged ends.
    2. Interior components to be corrosion-resistant materials.

16.14.1 Pressure Regulator Installation

Install pressure regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet and valved bypass where indicated.

16.15 IRRIGATION EXCAVATION AND BACKFILLING

A. Excavation is to include all materials encountered; maintain open trenches dry at all times.
B. Minimum trench width is to be three inches (3") on each side of the main line pipe and one and one half inches (1½") on each side of lateral pipe to allow for proper compaction of backfill material.
C. Excavate to the depths required to provide a three inch (3") depth of sand bedding material for piping when unsuitable bearing materials are encountered.
D. Minimum depth of cover for piping:
    1. Mainline pipe: twenty four inches (24").
    2. Lateral pipe: eighteen inches (18").
    3. Backfill material to be free from rock, large stones, or other unsuitable substances to prevent damage to pipe during backfilling operations.
E. Backfill trenches to match adjacent grade elevations with approved trench backfill material. Place and compact fill in layers not greater than six inches (6") in depth to ninety-five percent (95%) maximum dry density at optimum moisture content under all paving areas and ninety percent (90%) maximum dry density under lawn and planting areas.
F. Excavate trenches, install piping and backfill during the same working day. Do not leave open trenches or partially filled trenches overnight.
G. Pipe bedding material to be course, mason sand conforming to ASTM C-33.



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TYPICAL TRENCHING DETAIL

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DRAWN BY: SH | WC_SUNY IRRAGATION DETAILS.dwg

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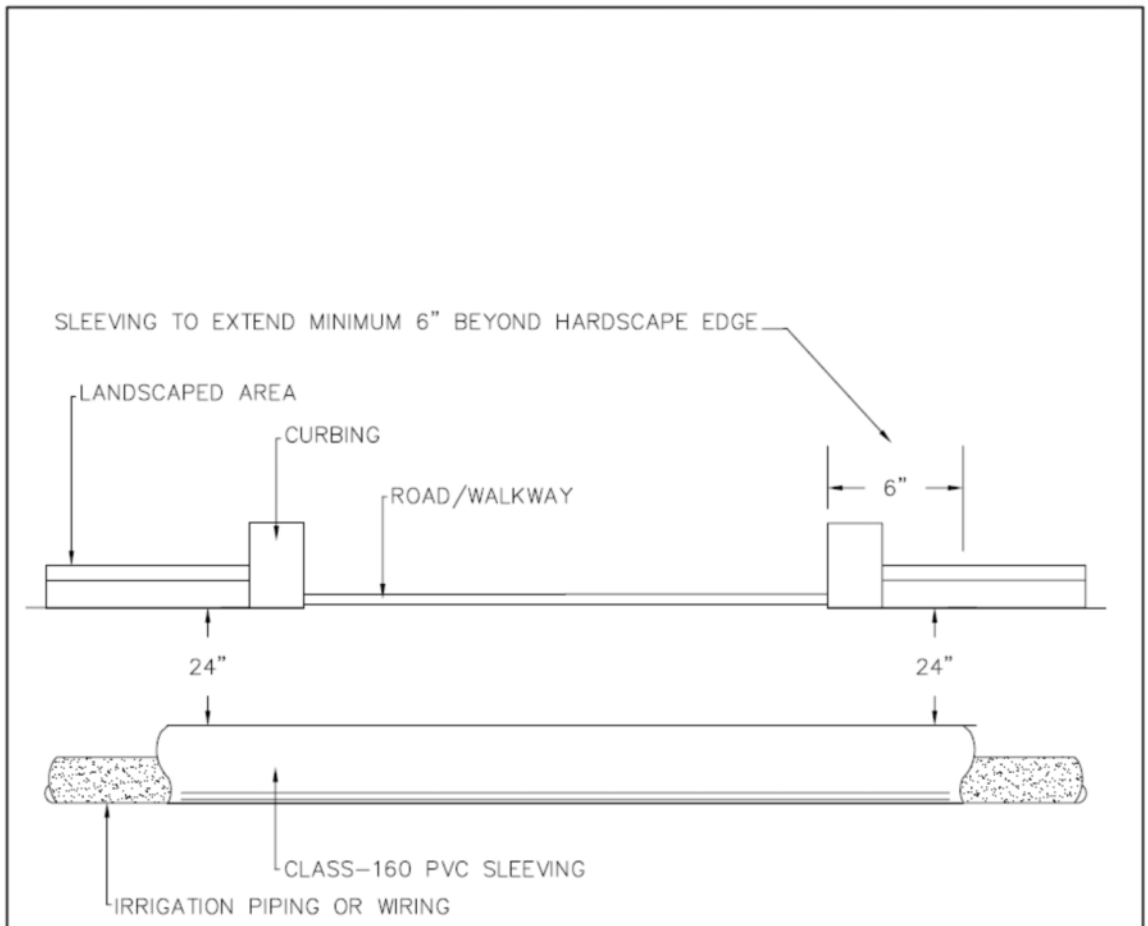
IRRIGATION

16.16 IRRIGATION THRUST BLOCKS

A. Install all gasketed main line piping with cast-in-place concrete thrust blocks in accordance with ANSI/ASAE 376.1 and the pipe manufacturer's recommendations.
B. All thrust blocks must bare against undisturbed soil.
C. Install thrust blocks as not to interfere with any pipe joint or connection.
D. Do not use wood or stone for thrust blocks.
E. For additional information and standard detail drawing, see Section 10.

16.17 IRRIGATION PIPING SLEEVES

A. Backfill and thoroughly compact around all sleeves.
B. Install ends of sleeves twenty four inches (24") beyond the edge of all pavement and curbs.
C. All sleeves to have a minimum cover of twenty four inches (24").
D. Install four inch (4") sleeve for irrigation piping and two inch (2") sleeve for control wiring at all pavement crossings.



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PIPE AND WIRE SLEEVING DETAIL

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