

MASTER SPECIFICATIONS

AMHERST COUNTY SERVICE AUTHORITY

Amherst County, VA

December 2021



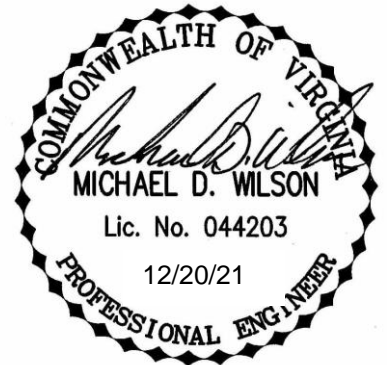
**Service
Authority**
AMHERST COUNTY | VIRGINIA

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Commission No. 20210001

**AMHERST COUNTY SERVICE AUTHORITY
MASTER SPECIFICATIONS**

2021 revisions:

Cover

Updated with Current Director

Basic Design Standards:

Section 2.10.1, Added RPZ information and removed references to BP-1 & BP-2.
Section 3.19, Revisions to entire section.

Technical Specifications:

None

Appendices:

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BASIC DESIGN STANDARDS FOR THE AMHERST COUNTY SERVICE AUTHORITY

SECTION 1

WATER DISTRIBUTION SYSTEM

1.1. MATERIALS

1. The pipe selected shall have been manufactured in conformity with the current available standards issued by the American Water Works Association.
2. In the absence of such standards, pipe meeting applicable commercial standards and acceptable to the Authority may be considered.
3. Packing and joint materials used in the joints of pipe shall meet the standards of the American Water Works Association.
4. Mechanical joints or slip joints with resilient gaskets are required, unless otherwise specified by the Authority.
5. Refer to Technical Specifications, Section 3, Water Main Materials, Paragraph 3.1 for additional information.

1.2. MINIMUM PIPE SIZE

1. The minimum size pipe for water distribution systems shall be eight (8) inches in diameter. Pipe of lesser diameter may be used in the following instances.
 - a. The last 300 LF on a dead end line may be 6" diameter, if located after the last fire hydrant, or 2" diameter SDR 17 PVC in selective locations approved in writing by the Authority, when line static pressures are not in excess of 135 psi and no more than six residential dwellings will be served.
2. The minimum size of pipe where fire protection is to be provided or required shall be eight (8) inches in diameter.
3. The standard grading schedule of the Insurance Services Office and other related organizations shall be followed in other cases, where approved by the Authority.
4. Any departure in sizing shall be justified by hydraulic analysis and future water use and can be considered only in special circumstances.
5. Water mains not sized to carry fire flows shall not be connected to fire hydrants.
6. Refer to Technical Specifications, Section 3, Water Main Materials, Paragraph 3.1 for additional information.

1.3. SYSTEM DESIGN

1. All water systems shall be designed and sized so as to provide fire flow capabilities of no less than 750 gpm at any point, during peak demand conditions, and maintain a minimum of 30 psi at all service connections.
2. All water systems shall provide fire hydrants approximately every 600' and at road intersections. A main line valve shall be placed downstream from each hydrant. Main line valves shall be required on main and branch lines at any intersection. Additional valving may be required by the Authority dependent on site specific circumstances.
3. Where insufficient system pressure and flow exist to provide for a minimum of 750 gpm fire flow under peak demand conditions, no fire hydrants may be installed. All necessary valving must be installed at proper intervals to allow for future hydrant installation by the Authority when suitable hydraulic conditions exist. Funds equal to the current cost of the hydrants plus a nominal labor charge must be paid to the Authority to provide this future installation. A 8' x

- 2" galvanized indicator post, painted red and set with at least a 2' bury must be installed at future fire hydrant locations, for ease of locating.
4. Dead-ends should be minimized by looping of all mains.
 5. The ends of all lines shall terminate at a blow-off assembly. Wherever a right-of-way is provided for future road extensions, or interconnections, a bulkheaded/rodded main line control valve must be provided, along with a temporary blow-off assembly.
 6. Air release valves shall be placed at high places in water mains where no fire hydrant or house service connections are present. A 8' x 2" galvanized indicator post, painted blue and set with at least a 2' bury, is required behind the ditch line for all air release valves.
 7. Blow-off assemblies shall be placed at low places in the water mains where no fire hydrant or house connections are present. A 8' x 2" galvanized indicator post, painted blue and set with at least a 2' bury, is required behind the ditch line for all mid-line blow-off assemblies.

1.4. INSTALLATION OF WATER MAINS

1. The Authority and the Virginia Department of Transportation (VDOT) will be consulted during the design process about the proper location of new water mains. New water mains shall be placed in the road right-of-way, the preferred location is a minimum of three feet (3') behind the ditch line, except in fill slopes, unless otherwise approved by VDOT. If the preferred location cannot be obtained, the water line is to be installed a minimum of five feet (5') from the edge of pavement for Primary Roads and three feet (3') for Secondary Roads. This location enables public utility easements to be preserved for power, telephone, cable TV, and natural gas services, unless the Authority and VDOT outside the right-of-way, but within the inside two feet (2') of the public utility easement, or such other alignment as may be dictated. Wherever water lines leave the road right-of-way and roadside public utility easements, the dedicated water line easements may not be less than 20' wide. All lines 8" and smaller shall have a minimum cover of 36". All 10" – 12" lines shall have a minimum of 48" cover. All 16" lines shall have a minimum of 60" cover. Unless specifically indicated, water lines may not have more than 60" of cover. If a water line is placed in a public utility easement or road right-of-way, the depth of the line shall be such that when an entrance is installed, the final cover over the water line shall not be less than those stated above.
2. Adequate supports shall be provided for all pipes.
3. Pipe line bedding shall be in accordance with details TB-3 and TB-5.
4. Stones and rocks found in the trench shall be removed for a depth of at least six (6) inches below the bottom of the pipe and select fill bedding provided to a depth of twelve (12) inches above the pipe.
5. The specifications for installation shall include:
 - a. Pressure testing on installed pipe;
 - b. Allowable leakage of installed pipe; and
 - c. Reference to applicable American Water Works Association standards or manufacturer's recommended installation procedures.
6. Any plastic or other nonmetallic pressurized conduit installed underground shall have copper wire installed parallel and metallic marking tape as discussed in Section 2 of the Technical Specifications.

1.5. SEPARATION OF WATER MAINS AND SEWERS

1. The following factors shall be considered in providing adequate separation of water mains and sewers:
 - a. Materials and types of joints for water and sewer mains;
 - b. Soil conditions;
 - c. Service branch connections into the water main and sewer mains;
 - d. Compensating variations in the horizontal and vertical separations;

- e. Space for repairs and alterations of water and sewer mains;
- f. Offsetting of pipes around manholes; and
- g. Identification of the physical restraints preventing normal separation.

2. Parallel installation:

- a. Under normal conditions, water mains shall be laid at least 10 feet horizontally from a sewer or sewer manhole. The distance shall be measured edge-to-edge.
- b. Under unusual conditions when local conditions prevent a horizontal separation of 10 feet, the water main may be laid closer to a sewer or sewer manhole provided that:
 - i. The bottom (invert) of the water main shall be at least 18 inches above the top (crown) of the sewer;
 - ii. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved Class 52 ductile iron water pipe, pressure tested in place without leakage prior to backfilling; and
 - iii. Any sewer manholes shall be watertight construction and tested in place.

3. Crossings:

- a. Under normal conditions, water lines crossing sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer whenever possible.
- b. Under unusual conditions when local conditions prevent a vertical separation described in Subsection "a" of this section, the following construction shall be used:
 - i. Sewers passing over or under water mains shall be constructed of the materials described in Subsection "2 b ii" of this section; and
 - ii. Water lines passing under sewers shall, in addition, be protected by providing:
 - 1) A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water line;
 - 2) Adequate structural support for the sewers to prevent excessive deflection of the joints and the settling on and breaking of the waterline; and
 - 3) That the length of the water line be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.
- 4. No water pipes shall pass through or come in contact with any part of a sewer manhole.
- 5. For all new development, a minimum separation of thirty feet (30') shall be maintained between water lines and septic drainfields.

1.6. VALVE, AIR RELIEF, METER AND BLOWOFF CHAMBERS

- 1. Air and sediment accumulations may be removed through a standard fire hydrant, compressed air and pumping may be used for dewatering mains through hydrants.
- 2. Chambers or pits containing valves, blowoffs, meters, or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer, nor shall blowoffs or air relief valves be connected directly to any sewer.
- 3. Such chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water or to absorption pits located above the seasonal groundwater table elevation. Sump pumps may be used where other means are not practicable.

1.7. HYDRANTS

1. Fire hydrant drains shall not be plugged. They shall be drained to dry wells provided exclusively for this purpose.
2. Hydrant drains shall not be connected to sanitary sewers or storm sewers.
3. Fire hydrants shall be connected only to water systems adequately designed for fire flows in addition to domestic flow.

1.8. SURFACE WATER CROSSINGS

Surface water crossings, both over and under water, present special problems and should be discussed with the Authority before final plans are prepared.

1. Above water crossings shall be:
 - a. Adequately supported;
 - b. Protected from freeze damage;
 - c. Accessible for repair or replacement; and
 - d. Above 100-year flood level.
2. Under water crossings shall be:
 - a. The pipe shall be of special construction, having flexible watertight joints.
 - b. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repair; the valves shall be easily accessible and not subject to flooding.
 - c. Permanent taps shall be made for testing and locating leaks.

1.9. WATER SERVICES AND PLUMBING

1. Water services and plumbing shall conform to the Uniform Statewide Building Code.

1.10. DISINFECTION OF WATER MAINS

1. All water mains shall be disinfected prior to being placed in operation and bacteriological test results supplied to the Authority. See Technical Specifications Section 2.

1.11. METERING

1. Each service connection shall be metered, and conform to details M-1 through M-4.

1.12. HYDROSTATIC PRESSURE TESTING OF WATER MAINS

1. All water mains shall be hydrostatically tested prior to being placed in operation and test results supplied to the Authority. See Technical Specifications Section 2.

1.13. BACKFLOW PREVENTION

1. To protect the Amherst County Service Authority's water system, a backflow prevention device must be installed for all service connections.

1.14. CROSS-CONNECTION PREVENTION

1. Preventative measures must be installed to prevent potential contamination of the Amherst County Service Authority's water supply by cross-connections.
2. For structures, all plumbing connections shall comply with the current Building Code.

BASIC DESIGN STANDARDS FOR THE AMHERST COUNTY SERVICE AUTHORITY

SECTION 2

SANITARY SEWER SYSTEM

2.1 TYPE OF SEWERS

1. Sewer systems shall be designed and constructed to achieve total containment. New combined sewers shall not be approved. Interceptor sewers for existing combined sewers shall be designed and constructed to prevent the discharge of inadequately treated wastes. Overflows from intercepting sewers shall not be permitted.

2.2 DESIGN PERIOD

1. In general sewer systems should be designed for the estimated ultimate tributary population with an upper limit consisting of the 50-year population growth projection, except when considering parts of the systems that can be readily increased in capacity. Consideration shall be given to land use plans and to other planning documents and to the maximum anticipated capacity of institutions, industrial parks, apartment developments, etc.

2.3 DESIGN FACTORS

1. In determining the required capacities of sanitary sewers, the following factors shall be considered:
 - a. Maximum hourly sewage flow.
 - b. Additional maximum sewage or wastewater flows from industrial sources
 - c. Ground water infiltration.
 - d. Topography of area.
 - e. Location of sewage treatment works.
 - f. Depth of excavation.
 - g. Pumping requirements.
 - h. Occupancy rates.

2.4 DESIGN BASIS

1. Per Capita Flow: New sewer systems shall be designed on the basis of an average daily per capita flow of sewage of not less than that set forth in the "Design Sewage Flows" table hereinafter. These figures are assumed to include infiltration but do not address inflow from surface water. When deviations from the foregoing per capita rates are proposed, a description from the procedure used to establish design flows shall be included with the submission.
2. Sewer Line Type and Design Capacity:
 - a. "Lateral" means a sewer that has no other common sewers discharging into it.
 - b. "Submain" means a sewer that receives flow from one or more lateral sewers.
 - c. The minimum peak design capacity for lateral and sub-main sewers should be 400 percent of the average design flow. When deviations from the foregoing minimum peak design flow rates are proposed, a description of the procedure used for sewer design shall be included with the submission.
 - d. "Main or trunk" means a sewer that receives sewage flow from one or more submain sewers.

- e. "Interceptor" means a sewer that receives sewage flow from a number of gravity mains, trunk sewers, sewage force mains, etc.
- f. Minimum peak design capacity of main, trunk and interceptor sewers should be 250 percent of the average design flow. When deviations from the foregoing minimum peak flows are proposed, a description of the procedure used to establish design peak flow shall be included with the submission.

2.5. DETAILS OF GRAVITY SEWER LINE DESIGN AND CONSTRUCTION

1. Minimum Size:

- a. Sewer size shall not be less than eight inches in diameter, except for laterals serving six connections or fewer on cul de sacs or as sidewalk collector lines which may be six inches in diameter.
- b. Engineering calculations and justifications indicating that such reduced line size is adequate shall be included with the submission.
- c. 8" sewer shall be on min. slope of 0.40% with a terminal cleanout, detail CO-1 or CO-T.

2. Depth and Slope:

- a. Sewers shall have a minimum of 60" cover. Line depth shall be sufficient that if an entrance is installed, final cover shall not be less than 60".
- b. Sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second based on Manning's formula using a pipe material roughness coefficient ("n") value of 0.014. Use of other "n" values and slopes less than those specified herein shall be justified on the basis of pipe material specifications, research, or field data, presented with the submission for approval. The following are the minimum slopes which should be provided; however, slopes greater than these are desirable:

<u>Sewer Size</u>	<u>Minimum Slope in Feet per 100 Feet</u>
6 inch	0.49
8 inch	0.40
10 inch	0.28
12 inch	0.22
14 inch	0.17
15 inch	0.15
16 inch	0.14
18 inch	0.12
21 inch	0.10
24 inch	0.08
27 inch	0.067
30 inch	0.058
36 inch	0.046

- c. Decreased slopes may be provided where the depth of flow will be three tenths (0.3) of the diameter or greater for design average flow. Whenever such decreased slopes are selected, the design engineer must furnish, with his report, his computations of the depth of flow in such pipes at minimum, average, and peak daily or hourly rates of flow. Otherwise, it must be recognized that decreased slopes may require available resources for additional sewer maintenance. Sewers shall be laid with uniform slope between manholes. Sewers constructed on sixteen (16) percent slope or greater shall be Class 52 ductile iron pipe and anchored securely with concrete anchors, detail CA-4, or equal. Minimum anchorage is as follows:
 - i. Not over 36 feet center-to-center, on grades 16 percent and up to 35 percent.

- ii. Not over 24 feet center-to-center, on grades 35 percent and up to 50 percent.
- iii. Not over 16 feet center-to-center, on grades 50 percent and over.

3. Easement Width/Cover/Alignment:

- a. Sewer line easements shall not be less than 20' wide. All sewer lines must have a minimum of 60" of cover. Line depth shall be such that if an entrance is installed final cover may not be less than stated above.
 - b. Gravity sewers shall be laid with a straight alignment between manholes. Curved force main sewers should be installed only on curved streets, where the curve of the street and curve of the sewer are concentric. The use of curved gravity sewers shall not be considered.
4. Increasing Size: Gravity sewer size shall normally remain constant between manholes. Where a similar sewer joins a larger one, the relative elevations of the inverts of the sewers shall be arranged to maintain approximately the same energy gradient. An approximate method for securing these results, which may be used, is to align the eighty percent (0.8) capacity flow level, or to align the internal pipe crown or top invert, of both sewers, at the same elevation.
5. High Velocity Protection: Where velocities greater than 15 feet per second are expected, special provisions shall be made to protect against internal erosion by high velocity. The pipe shall conform to applicable ASTM, AWWA, ANSI, or other appropriate standards or specifications, which provide protection against internal erosion.
6. Materials: Plastic sewer pipe, meeting the SDR-35 standard, may be used at depths of up to 12 feet, except for under pavement and in stream crossings. Class 52 ductile iron pipe must be used at depths of 12 feet or greater, under pavement, and in stream crossings.

2.6. DETAILS OF GRAVITY SEWER LINE DESIGN AND CONSTRUCTION

- 1. Manhole Location: Manholes shall be installed at the end of each line of ten (10) inch diameter or greater; at all changes in grade, size, or alignment; at all intersections, and at distances not greater than 300 feet. Terminal cleanouts may be acceptable on lines eight (8) inches diameter or less in lieu of manholes, detail CO-1 or CO-T.
- 2. Manhole Data: A table shall be on all development plans which include the following: manhole designation number or letter, station, type (ACSA Standard Detail No.), top elevation, inverts in and out, and piping deflections. Profile sheets shall include: manhole designation number or letter, station, type (ACSA Standard Detail No.), top elevation, and inverts in and out.

2.7. PROTECTION OF WATER SUPPLIES

- 1. Water Supply Interconnections: There shall be no cross connection between a drinking water supply and a sewer, or appurtenance thereto.
- 2. Relation to Waterworks Structures:
 - a. Minimum Separation: No sewer line shall pass within fifty feet of a drinking water supply well, source, or structure unless special construction and pipe materials are used to obtain adequate protection as determined by the Amherst County Service Authority and approved by the Virginia Department of Health. The proposed design shall identify and adequately address the protection of all drinking water supply wells, sources, and structures up to a distance of 100 feet of the sewer line installation.

3. Relation to Water Mains: See Technical Specifications, Page T-1.
4. For all new development, a minimum separation of thirty feet (30') shall be maintained between water lines and septic drainfields.

TECHNICAL SPECIFICATIONS

SECTION 1

GENERAL REQUIREMENTS

1.1. SCOPE OF WORK

1. General: The work to be done hereunder shall include the furnishing of all labor, materials, tools, transportation, supplies, plant, equipment, and appurtenances necessary for the complete and satisfactory construction of water mains, gravity sewer lines, manholes, and force mains as shown on the drawings or in the specifications, as approved by the AMHERST COUNTY SERVICE AUTHORITY (the AUTHORITY), complete and ready for service.

1.2. SEPARATION OF WATER LINES AND SEWERS

1. Parallel Installation: Water lines shall normally be separated from sanitary sewers horizontally by a distance of 10 feet. This distance shall be measured edge to edge. When local conditions prevent a horizontal separation of 10 feet, the bottom of the water line shall be at least eighteen inches above the top of the sewer. Where this vertical separation cannot be obtained, the sanitary sewer shall be constructed of AWWA approved Class 52 ductile iron water pipe, pressure tested in place to 50 psi without leakage prior to backfilling.
2. Crossings: Water lines crossing house, storm, or sanitary sewers shall provide separation of at least 18 inches between the bottom of the water line and the top of the sewer. If this vertical separation is not possible, sanitary sewers shall be constructed and tested per Section 1.2.1.
3. When local conditions require water lines to pass under such sewers, adequate structural support shall be provided for the sewer to prevent excessive deflection. Also, the length of water pipe shall be centered at the point of crossing, and a vertical separation of at least 18 inches shall be provided between the bottom of the sewer and the top of the water line. In this case, sanitary sewers passing over shall be constructed and tested as noted in Section 1.2.1.
4. No water pipe shall pass through or come in contact with any part of a sewer or sewer manhole.

1.3. EXISTING WATER LINES AND APPURTENANCES:

1. No valve, hydrant, or other appurtenance on existing water lines shall be opened or closed for any purpose by the CONTRACTOR. Any opening or closing of valves, hydrants, or other appurtenance shall be by the AUTHORITY or under their direct guidance. The CONTRACTOR shall notify the AMHERST COUNTY SERVICE AUTHORITY at least 48 hours prior to the need to open or close any appurtenance, except in emergencies, at which time the AMHERST COUNTY SERVICE AUTHORITY shall be notified immediately.

1.4. REFERENCES:

1. The work shall comply with most recent standards or tentative standards as published at the date of the contract and as listed in these specifications using the abbreviation shown:

American Society for Testing and Materials ASTM
American Water Works Association AWWA
American Association of State Highways and Transportation Officials..... AASHTO

Virginia Department of Transportation	VDOT
National Sanitation Foundation	NSF
Chain Link Fence Manufacturers Institute	CLFMI
Occupational Safety and Health Administration	OSHA

1.5. WASTE AREAS:

1. Disposal of unsuitable and surplus material will be carried out in accordance with VDOT Road and Bridge Specifications, Section 106.04, except that the CONTRACTOR shall be responsible for obtaining the rights to any waste area for disposal of unsuitable or surplus material either shown or not shown on the plans. All work in disposing of such material shall be considered incidental to the work

1.6. COORDINATION WITH PROPERTY OWNERS:

1. The CONTRACTOR shall notify the owner of property upon which work is to be performed in advance of commencing work thereon. In the event of the necessity of disrupting utility or other services to such property, he shall notify the owner or responsible person in charge of such utility or other services and arrange for the disruption and restoration of such service in a manner which will result in a minimum of inconvenience to parties concerned. The CONTRACTOR shall cooperate fully with the AMHERST COUNTY SERVICE AUTHORITY to effect proper coordination and progress to complete the project on schedule and in proper sequence. Insofar as possible, decisions of all kinds required by the AMHERST COUNTY SERVICE AUTHORITY shall be anticipated by the CONTRACTOR to provide ample time for inspection, investigation, or the preparation of instructions.

1.7. UNDERGROUND UTILITIES:

1. The CONTRACTOR shall contact the appropriate utility companies and have utilities located prior to starting construction (see Appendix B). Locations of existing facilities should be determined by the CONTRACTOR far enough in advance of the construction to provide for modification in design, if required. In Central Virginia underground utilities locating is coordinated through One Number Information Systems, Inc., "Miss Utility", (804) 530-1898.

1.8. CLEARING AND EROSION CONTROL

1. General: The CONTRACTOR shall be responsible for complying with all provisions of the erosion and sediment control plans and notes, including the construction, installation, and maintenance of all mechanical and vegetative erosion and sediment control measures for the duration of the project. If unforeseen erosion and sediment problems arise during the construction, the CONTRACTOR shall implement corrective measures acceptable to the AMHERST COUNTY SERVICE AUTHORITY.
2. Siltation and pollution control requirements shall be in accordance with VDOT Road and Bridge Specifications, Section 107.14(a), (b1), and (b2).
3. Only that portion of the right-of-way or easement actually needed for construction shall be cleared or used by heavy equipment, unless directed by the AMHERST COUNTY SERVICE AUTHORITY. In no case shall clearing or debris from clearing operations be taken past right-of-way or permanent easement lines onto private property. Areas disturbed by construction operations shall be protected from erosion by suitable means outlined in the "Amherst County Erosion Control Ordinance." Equipment and materials shall be stored only in approved areas.

1.9. BLASTING:

1. Blasting shall be done in strict accordance with the most recent edition of the Virginia Statewide Fire Prevention Code (VR 394-01-6). The CONTRACTOR shall adhere to the requirements of Amherst County and shall notify the County prior to any blasting.

1.10. TRENCH PROTECTION:

1. The CONTRACTOR shall furnish and erect such sheathing, bracing, and shoring, and shall furnish necessary signs, barricades, and temporary lighting, as may be pertinent for the protection of this work, employees, the public, and adjacent structures, and to guard against contingencies which might give rise to delays in the work. Sheathing left in place shall be at the CONTRACTOR'S expense. Responsibility for preservation of trench banks and other excavated spaces and the prevention of injury to any persons or property shall rest entirely with the CONTRACTOR. Normally, a maximum of 200 feet of trench will be allowed open at any one time. No trench will remain open overnight unless authorized by the AMHERST COUNTY SERVICE AUTHORITY.

1.11. OSHA REQUIREMENTS:

1. The CONTRACTOR shall be responsible for performing all excavation, pipe installation, and backfilling, in accordance with the 1990 OSHA Excavation Standards 29 CFR Part 1926, Subpart P – Excavations. The CONTRACTOR'S responsibility also extends to providing a "Competent Person", as defined by the OSHA regulation referenced above, on the job site.

1.12. TRAFFIC:

1. All traffic control and directional signs shall be supplied by the CONTRACTOR. See detail drawings for standards of typical traffic control. Placement of excavated material on existing pavement shall be permitted upon approval of a written request to VDOT and provided a stone dust or sand layer is first placed on the pavement. No cleated equipment shall be used on pavements. Road drainage shall not be clogged, and shoulders, ditches, roadside drainage facilities, and pavement affected by the grading operations shall be maintained in a condition satisfactory to VDOT. Traffic shall not be blocked or rerouted without permission of VDOT. Where one way traffic is permitted to be maintained, it shall be flagged 24 hours per day. Traffic shall at all times be properly protected by adequate lights, barricades, and signs, and also flagging personnel when needed.

1.13. INSTALLATION WITHIN VDOT RIGHT-OF-WAY:

1. CONTRACTOR shall install water main within VDOT right-of-way as required by the AMHERST COUNTY SERVICE AUTHORITY and approved by VDOT.

1.14. CLEANUP:

1. Before final acceptance, all borrow pits, waste areas, storage areas, and all grounds occupied by the CONTRACTOR in connection with the work, shall be cleaned of all rubbish, excess materials, and temporary structures, and all parts of the work shall be left in a neat and presentable condition.

1.15. SHOP DRAWINGS:

1. Five copies of shop drawings for materials shall be submitted by the CONTRACTOR to the AMHERST COUNTY SERVICE AUTHORITY for review prior to construction.

1.16. AS-BUILT DRAWINGS:

1. Marked-up as built drawings shall be supplied to the Engineer upon completion of the project. Engineer shall supply three sets of final as-built drawings to AMHERST COUNTY SERVICE AUTHORITY.

1.17. SAFETY:

1. All pertinent safety regulations, including federal and state OSHA standards, shall be followed. In addition, all safety precautions noted on the manufacturer's product data sheets and labels shall be observed for both material and equipment. The CONTRACTOR shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work.

1.18. ACCESS AND MAINTENANCE

1. Unless otherwise approved in writing by AMHERST COUNTY SERVICE AUTHORITY, improvements to existing or new water or sewerage systems that are or will be owned and/or operated by AMHERST COUNTY SERVICE AUTHORITY shall be completed in such a manner as to facilitate post-improvement operation and maintenance by AMHERST COUNTY SERVICE AUTHORITY. Consultants, contractors, developers, and others shall consult and coordinate with AMHERST COUNTY SERVICE AUTHORITY prior to beginning such work to ensure that AMHERST COUNTY SERVICE AUTHORITY requirements are met.

Final grading of trench backfills and other areas to be maintained by AMHERST COUNTY SERVICE AUTHORITY shall be designed and constructed to facilitate future access, mowing, bushhogging, excavation, backfilling, service connections, and other expected maintenance by AMHERST COUNTY SERVICE AUTHORITY. Piping installed within hillsides shall be aligned and installed to minimize surface slopes in any direction to the greatest extent possible. Surface slopes shall not exceed 4 horizontal to 1 vertical (4H:1V). Piping installed in slopes that exceed 4H:1V shall have surface cross-slopes that are benched or terraced within the AMHERST COUNTY SERVICE AUTHORITY utility easement to ensure positive runoff of surface runoff, but not exceed 4H:1V.

Design and construction of roads, access easements, and other installations providing maintenance access to water and sewerage sites and facilities for AMHERST COUNTY SERVICE AUTHORITY shall be coordinated with AMHERST COUNTY SERVICE AUTHORITY to ensure that AMHERST COUNTY SERVICE AUTHORITY requirements are met. Such requirements include, but are not limited to, ease of access, durability, stormwater management, and maintenance of the access.

1.19. ACCESS AND SYSTEM OPERATIONS

1. Unless approved in writing by AMHERST COUNTY SERVICE AUTHORITY, no one other than AMHERST COUNTY SERVICE AUTHORITY operators shall enter or operate water or sewerage sites or equipment. Water and sewerage systems valves, pumps, tanks, plants, manholes, and other equipment shall only be entered or operated by AMHERST COUNTY SERVICE AUTHORITY personnel. Contractors and other unauthorized personnel needing access to or manipulation of water or sewerage systems, sites, or equipment shall contact AMHERST COUNTY SERVICE AUTHORITY a minimum of 24 hours before such access or manipulation is needed, unless otherwise approved in writing by AMHERST COUNTY SERVICE AUTHORITY.

1.20. CONTRACTOR APPROVAL PROCEDURE

1. All projects that will be accepted into the Amherst County Service Authority potable water treatment and distribution and / or wastewater collection and treatment system(s) must be

completed by an experienced utility contractor approved by the Service Authority, as determined by completion and submittal by the contractor, and approval by the Service Authority, of a Contractor Application for Approval (see Appendix G). Developers who wish to directly contract such utility projects must contact the Service Authority Public Utilities Director for a list of currently approved contractors.

TECHNICAL SPECIFICATIONS

SECTION 2

WATER MAIN EXCAVATION, INSTALLATION, AND BACKFILLING

1.1. COVER:

1. All lines 8" and smaller shall have a minimum cover of 36". All 10" – 12" lines shall have a minimum of 48" cover. All 16" lines shall have a minimum of 60" cover. Unless specifically indicated, water lines may not have more than 60" of cover.

1.2 EXCAVATION AND PREPARATION OF TRENCH

1. Width: Width shall be sufficient to allow laying without walking or standing on the pipe and shall not be less than six inches on each side of the pipe's largest diameter. The maximum clear width at the top of the pipe shall not be more than the outside diameter of the pipe plus two feet.
2. Bell holes shall be excavated to accommodate each bell.
3. Rock Excavation: Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least six inches below and on each side of all pipe, valves, and fittings. Before the pipe is laid, the subgrade shall be made by backfilling with approved material and shall be tamped and graded. Commercial stone, if used, shall be VDOT #26 for ductile iron pipe and #10 for PVC pipe.
4. Excavation to Grade: The trench shall be excavated so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground between bell holes. Any part of the bottom of the trench excavated below the specified grade shall be brought back to grade with approved material, thoroughly compacted. The finished subgrade shall be prepared accurately by means of hand tools.
5. Unsuitable Material: Wet or otherwise unsuitable soil at the subgrade shall be removed and replaced with approved sound materials as part of the original contract cost. Excess or unsuitable material shall be legally disposed of by the CONTRACTOR.
6. Topsoil Storage: Topsoil to be used in landscaping shall be stockpiled separately from other backfill material.
7. Trench Protection: The CONTRACTOR shall furnish and erect such sheathing, bracing, and shoring, and shall furnish necessary signs, barricades, and temporary lighting as may be pertinent, for the protection of his work, employees, the public, and adjacent structures. Sheathing left in place shall be at the CONTRACTOR'S expense. Normally a maximum of 200 feet of trench will be allowed open at any one time. No excavation within VDOT right-of-way or elsewhere will be allowed to remain open overnight unless special permission is obtained.
8. Pumping, Bailing, and Ditching: The CONTRACTOR shall remove by appropriate means any water which may accumulate in the trenches or other excavations and shall keep the excavations clear of water while the work is being installed.
9. Road or Driveway Crossings: All VDOT road crossings must be bored unless otherwise shown on the plans. Driveways may be open cut unless otherwise shown on the plans. Paved driveways must be restored in accordance with STANDARD DETAIL NO. TB-5 in

Appendix A. Concrete driveways shall be replaced in accordance with detail TB-6 in Appendix A.

Wherever road pavement is permitted to be cut, not over one-half width shall be disturbed at one time; and on crossings, the first opening shall be completely restored to satisfactory travelable condition before the second half can be opened. Where this is not possible, steel crossing plates must be used to maintain access at all times. Where the pavement is disturbed, or deemed weakened, it, in its entirety, or such portions of it as deemed desirable by VDOT shall be restored or replaced in a manner directed by and to the satisfaction of VDOT.

When pavement must be cut, the cut shall be made in a straight line, parallel to the pipe and six inches wider than the trench, on each side, so that an undisturbed shoulder will be provided under the new work. Sidewalks or curb and gutter disturbed by construction shall be removed and replaced at existing joints. Cutting shall be done neatly so that a uniform, straight joint will result to provide a bond with the original concrete or pavement.

Placement of excavated material on existing pavement shall be avoided if possible. Where allowed by VDOT, material can be placed on paved road surfaces provided a stone dust or sand layer is first placed on the pavement. No cleated equipment shall be used on pavements. Road drainage shall not be clogged, and shoulders, ditches, roadside drainage facilities, and pavement affected by trenching operations shall be maintained in a condition satisfactory to VDOT. Entrances shall be blocked except for short periods as arranged with the property owner, and ingress and egress to adjacent property shall be maintained at all times.

10. Erosion and Siltation Control: Within all easements and right-of-ways, straw barriers, silt fencing, settlement basins, and brush barriers are to be utilized in prevention of erosion and siltation control.

2.3. INSTALLATION OF PIPE, FITTINGS, AND ACCESSORIES

1. Handling: Pipe shall be placed, in the trench in such a manner as to prevent damage to the pipe and protective coatings and linings. Under no circumstances shall pipe be dropped or dumped into the trench.
2. Cleaning: Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. Spigot and bell ends of the pipe and gaskets shall be cleaned and lubricated according to the manufacturer's instructions. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug.
3. Direction of Laying: Pipe shall be laid with bell ends facing in the direction of laying, unless otherwise directed by the AMHERST COUNTY SERVICE AUTHORITY. The laying shall start at the bottom and shall proceed upward with the bell ends of the pipe upgrade where feasible.
4. Roadway Crossings Through Casings: When special conditions require use of casings, spiders shall be bolted to the pipe before it is pushed into the casing, to keep it centered and avoid damage during installation. Care shall be taken to insure that the installed pipeline is well secured to prevent movement, as shown in Standard Detail CS-1.
5. Deflection at Joints: Maximum deflection for joints will be as follows:

Maximum Allowable Deflection in Inches

Pipe Size	Ductile Iron (Mechanical) Lengths				Ductile Iron (Push On) Lengths				PVC SDR 14
	12'	16'	18'	20'	12'	16'	18'	20'	20'
4"	21	28	31	34	12	17	19	21	12
6"	18	24	27	30	12	17	19	21	4
8"	13	18	20	22	12	17	19	21	3
10"	13	18	20	22	12	17	19	21	2.5
12"	13	18	20	22	12	17	19	21	2
16"	9	12	13.5	15	7.5	10	11	12	--

6. Setting of Valves, Hydrants, and Fittings: A valve box shall be provided for every valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or as directed by the AMHERST COUNTY SERVICE AUTHORITY. Valve boxes shall be installed in accordance with Standard Detail VB-1. Hydrants shall be set so that the center of the outlet is 16 to 18 inches above finished grade when connected to the main and shall be tied to the main or anchored to control thrust. At least 0.5 cubic yards of crushed stone or gravel shall be provided under the base to allow drainage from the hydrant drain valve. Hydrants shall not be subject to surface flooding and shall be installed per Standard Detail FH-1. Extra supports are required for fittings, valves, and hydrants when PVC pipe is used. Only valves, valve boxes, and hydrants approved by the AMHERST COUNTY SERVICE AUTHORITY may be used during system construction.

7. Anchorage: Pressure pipe lines shall be protected against joint pulling or thrust damage by suitable anchors, braces, or tie rods installed at direction changes as a result of fittings and all other critical points. Rods and clamps shall be galvanized or otherwise rustproof treated. Reaction backing shall be of the size indicated on the plans and in the Standard Detail Sheets CA-1 and CA-2 and shall bear on solid undisturbed earth. Where Mega Lug, AquaGrip, Lok-Tyton, Super-Lock or a similar joint or mega lug restraining gland is used, bracing and anchorage will not be required. Hydrants shall be anchored according to Standard Details CA-1 and CA-2.

8. Hydrostatic Pressure Testing of Water Mains:
 - a. Testing shall be performed in accordance with this specification and in the presence of the Owner and/or his representative cited in the construction documents. Where this specification cites that work shall be "approved" or "acceptable", it shall be understood that such approval or acceptance shall be by the Owner or his representative.
 - b. All construction, including piping, valves, equipment, thrust restraints, and sufficient backfill to prevent pipe movement, shall be complete, inspected, and approved before testing is performed. Testing shall be performed within 30 days after completion of pipe installation, but at least 7 days after the final concrete thrust anchor has been poured.
 - c. Hydrostatic pressure testing shall be performed against closed fire hydrants, if present; after installation of service taps, if applicable; and with closed air release valves.
 - d. Flushing of water lines shall be performed in such a manner as to prevent erosion control nuisance, interruption of traffic, or damage to downstream properties.
 - e. The section of pipe to be tested shall be isolated from connecting sections in an acceptable manner and slowly filled with potable water. When existing water mains are used as the water source, acceptable backflow prevention measures shall be utilized, which measures shall be removed before testing begins. All air shall be expelled from the pipe before testing is performed. Prevent entrapment of air at high points.
 - f. Test equipment shall be supplied by the constructor, properly calibrated and approved before use, and shall maintain a stable test pressure, ± 5 psi, for the duration of the test. The test pressure shall be 1.5 times the anticipated working pressure of the water main, based on the highest static pressure within the project limits, as determined by the Owner or the Owner's Engineer, but not less than 150 psi, nor higher than 250 psi.

- g. The duration of the test shall be a minimum of two hours. During this time, all pipe, joints, fittings, and equipment shall be observed for apparent leakage.
- h. Leakage shall be defined as observed water loss at any point within the section of pipe being tested, or as the quantity of water that must be supplied to maintain the test pressure, ± 5 psi. Leakage shall not be measured by a drop in pressure over time.
- i. Section Removed.
- j. Allowable leakage using $L = S \cdot D \cdot (P)^{0.5} / 148,000$ where:

L = testing allowance (make up water), gallons per hour

S = Length of pipe tested, feet.

D = Nominal pipe diameter, inches.

P = Hydrostatic test pressure, psi (gauge).

Avg. Test Pressure (psi)	Nominal Pipe Diameter, in.								
	2	4	6	8	10	12	14	16	18
250	0.23	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92
225	0.22	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82
200	0.20	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72
175	0.19	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61
150	0.17	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49

- k. All defective materials and workmanship shall be repaired. In addition, measured leakage that exceeds the limits specified in the tables in Section 2 shall be cause for the constructor to investigate and correct the leaks, in accordance with construction documents.
- l. Upon completion of corrective measures, the pressure test shall be repeated.
- m. This procedure shall be repeated until leakage is within the limits cited above. Acceptance shall be based on allowable leakage.
- n. The cost of all testing and repairs shall be the responsibility of the constructor, as part of the construction project and contract. Additional cost to the Owner for engineering and/or inspection services for re-testing shall be the responsibility of the constructor and shall be deducted from contract proceeds.

9. Disinfecting Water Mains:

- a. Water mains and accessories shall be disinfected in accordance with AWWA C.651. Care shall be taken to minimize entrance of foreign material into pipe, fittings, and valves. Unless the tablet method of disinfection is used, the main shall be flushed prior to disinfection with sufficient flow to produce a velocity of 3.0 fps. Flushing shall take place in areas with adequate drainage. The tablet method of disinfection will be allowed only if the pipes and appurtenances are kept clean and dry during construction. If the Contractor does not take sufficient steps to keep the main clean, the tablet method of disinfection will be disallowed.

Diameter (in.)	GPM @ 2.5 ft/sec
4	98
6	220
8	392
10	612
12	881
16	1567

- b. A chlorine application by an approved method shall be made using water from the existing distribution system or water supply. The initial chlorine concentration in the water to be used shall be a minimum of 50 mg/L free available chlorine. The chlorinated water shall be retained in the main for at least 24 hours, but not more than 72 hours during which time all valves and hydrants in the section treated shall be operated. At the end of this period, the treated water shall contain no less than 25 mg/L free available chlorine throughout, and final flushing shall follow to insure that the chlorine concentration is not higher than that generally prevailing in the system, before being used by any customer. Chlorinated water shall not be discharged to any water course or drainageway until it is diluted or reduced to a level, which will result in no damage to aquatic life. A dechlorination device detail shall be submitted to the AMHERST COUNTY SERVICE AUTHORITY and their Engineer for approval prior to use.
- c. After final flushing and before the water main is placed in service, two consecutive samples shall be collected at 24 hours intervals for each 1,200 feet of line. These samples shall be tested for bacteriologic quality by a laboratory approved by the Virginia Division of Consolidated Laboratories and shall show the absence of coliform organisms in both samples. Samples will be collected by the CONTRACTOR. At its discretion, the AUTHORITY may require that it collect all samples. If the initial disinfection fails to produce satisfactory results, defined as the absence of coliform in both samples, the line shall be flushed and disinfection shall be repeated until satisfactory samples have been obtained. Costs associated with flushing, disinfection and the laboratory testing will be at the CONTRACTOR'S expense.
- d. Method of Application:
 - i. Tablet Method:

The tablet method consists of placing calcium hypochlorite tablets in the water line as it is being installed and filling the line with potable water when installation is completed. Since preliminary flushing is eliminated in this type of chlorine application, it should only be used when scrupulous cleanliness has been exercised.

The following table gives the number of tablets to be used according to the size of the pipe. Tablets shall be placed in each section of pipe and also in hydrants, hydrant branches, and other appurtenances. They shall be attached by a food grade adhesive, such as a 100%-Silicon caulking, except for the tablets placed in hydrants. All the tablets within the main must be placed at the top of the main. Tablets shall be fastened within the spigot end of each pipe joint before it is placed in the trench, their position shall be marked on the section to assure that there will be no rotation. The adhesive is to be placed on the tablet on the broad side next to the surface to which the tablet is attached.

Number of Hypochlorite Tablets of 5-G
Required for Dose of 50 Mg/l *

Diameter of Pipe	No. of Tablets
2	1
4	2
6	2
8	3
10	5
12	6

*Based on 3 3/4 g available chlorine per tablet, and section lengths of 18 feet.

When installation has been completed, the main shall be filled with water at a velocity of less than 1 ft/sec. Care should be taken to eliminate air pockets in the line. The

water shall remain in the pipe for at least 24 hours, 48 hours if the water temperature is less than 45°. Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.

2.4 BACTERIOLOGIC TESTS

1. After final flushing, and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriologic quality and shall show the absence of coliform organisms. At least two samples shall be collected at least 24 hours apart, in every 1,200 lf section of water line, and tested by a Virginia Division of Consolidated Laboratories approved laboratory and results submitted to the Authority and Engineer. The Contractor shall be responsible for collecting all bacteriological samples and having the laboratory tests made to determine the presence of total coliform bacteria. At its discretion, the Authority may require that it collect all samples. All costs associated with bacteriologic testing shall be the responsibility of the contractor.
2. Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulphate. If laboratory results indicate the presence of total coliform bacteria, the samples are unsatisfactory and disinfection shall be repeated until the samples are satisfactory. The tablet method shall not be used in repeated disinfections. Cleaning and disinfection will be the responsibility of the Contractor. Water for these operations will be furnished by the Owner, but the Contractor shall be responsible for loading, hauling and discharging of water.
3. If a corporation stop or other sampling means is not available at the required minimum intervals along the water line, the Contractor shall install a sampling tap consisting of a corporation cock installed in the pipe with a copper goose neck assembly at his own expense.
4. Testing and disinfection of the completed sections shall not relieve the Contractor of his responsibility to repair or replace any cracked or defective pipe. All work necessary to secure a tight line shall be done at the Contractor's expense.

2.5 BACKFILLING

1. Materials: All backfill materials shall be free from mud, refuse, construction debris, organic material, boulders, stones over 1 inch, frozen or otherwise unsuitable material. From one foot above the top of the pipe to the original ground elevation, however, material containing stones up to 6 inches in their greatest dimension may be used, unless otherwise specified. The CONTRACTOR may backfill with the excavated material, provided it meets the conditions as stated above.
2. Initial Backfill: All trenches shall be backfilled by hand with approved material in layers not exceeding 4 inches from the bottom of the trench to the centerline of the pipe. Special care shall be taken to backfill under the pipe and to tamp this material into place to provide a firm bed. Material shall be deposited on both sides of the pipe simultaneously and compacted into place by tamping. From the centerline of the pipe to a depth of one foot above the pipe, the trench shall be backfilled in six-inch layers and thoroughly compacted. Mechanical or pneumatic tampers must be used throughout this operation. Compaction equipment must not come in contact with the pipe.
3. Backfilling to Grade: The remainder of backfilling shall be carried up in increments of no greater than 1 foot, except in road rights-of-way where layers shall be no greater than 6 inches thick. Minimum required density shall be the density of the adjacent undisturbed material except under pavement or in road shoulders where backfill shall be compacted to a minimum of 95% density when tested in accordance with AASHTO Specification T-99 (Standard Proctor). Each layer of earth shall be compacted into place by tamping before the next layer is applied. A hydro-hammer shall not be used. All pipelines shall have a minimum

of 18 inches of cover before any rolling equipment is used. Damage to pipelines or other structures resulting from compaction shall be corrected by the CONTRACTOR without expense to the AMHERST COUNTY SERVICE AUTHORITY.

A copper wire (size #10 or larger) shall be installed parallel to, and at the same depth as, all PVC pipe and looped around all valves. In addition, a blue metallic foil backed plastic marking tape imprinted the words "WATER LINE BELOW" (See Appendix B) shall be installed over all PVC pipe. The marking tape shall be buried 18 inches above the top of the pipe.

4. Backfill Testing: The CONTRACTOR shall demonstrate the adequacy of backfill compaction by performing density testing of the completed trench in backfill areas as designated by the AMHERST COUNTY SERVICE AUTHORITY. Backfill in roadway or parking areas such as VDOT rights-of-way or in areas designated by the AMHERST COUNTY SERVICE AUTHORITY shall be compacted to a minimum of 95% Standard Proctor as measured by AASHTO Specification T-99.

Density testing shall be performed at three depths for each test location: surface, mid-depth, and near maximum trench depth. In grass and lawn areas, the testing shall be performed at two depths for each test location: under the topsoil backfill, and near maximum trench depth. The character of the backfill material will be observed during the excavation for density testing to determine conformance with the specifications. Density testing shall be performed using nuclear field density equipment or conventional weight-volume methods. If the weight-volume method is used, volume shall be determined by using the sand replacement test (ASTM D 1556) or liquid displacement methods (ASTM D 2167). If nuclear methods are used, the trench correction effect shall be accounted for by recalibrating the nuclear gage on its calibration block at the location of each test prior to taking the density measurement. The density of the backfill shall be equal to or greater than the density of the undisturbed material in the immediate area adjacent to area under test. The CONTRACTOR shall furnish all equipment, tool, and labor to conduct the testing. Testing shall be performed by an independent testing laboratory qualified to perform such tests. All testing shall be witnessed by the AMHERST COUNTY SERVICE AUTHORITY. The testing shall be repeated until satisfactory results are obtained. The CONTRACTOR shall be charged for all retests at the normal rates for inspection services.

- a. Normal Testing Frequency: At the option of the AMHERST COUNTY SERVICE AUTHORITY, one test shall be performed within the first 500 feet of pipe installed by each crew. This test will be used as an initial evaluation of the compaction methods being used. Beyond the initial 500 feet, one test shall be performed in each 1,000-foot section of pipe installed. The location of each test within the designated section shall be selected by the AMHERST COUNTY SERVICE AUTHORITY. Testing which indicates that unacceptable material has been incorporated into the backfill, or that insufficient compaction is being obtained shall be followed by expanded testing to determine the limits of the unacceptable backfill. Normal testing shall be performed at the CONTRACTOR'S expense.
- b. Expanded Testing Requirements: If normal testing within the first 500-foot section or any 1,000-foot section indicates unacceptable backfill, the AMHERST COUNTY SERVICE AUTHORITY may require additional testing within the 500-foot of any 1,000-foot section to determine the limits of unacceptable backfill. Additional testing required by the AMHERST COUNTY SERVICE AUTHORITY shall not exceed testing of 4 additional locations within the 500-foot or any 1,000-foot section. Unacceptable backfill within the limits established by the testing shall be removed and replaced by the CONTRACTOR at no additional cost to the AMHERST COUNTY SERVICE AUTHORITY. Expanded testing required shall be performed at the CONTRACTOR'S expense. Additional testing beyond that required may be performed by the CONTRACTOR at his expense to further delineate limits of unacceptable backfill.

- c. Additional Testing: Testing beyond the normal frequency or expanded testing required which is requested by the AMHERST COUNTY SERVICE AUTHORITY shall be at the AMHERST COUNTY SERVICE AUTHORITY expense.
5. Finished Surfaces: Uniformly smooth grading of disturbed areas shall be required after backfill and compaction. Road shoulders shall have a minimum depth of six inches of VDOT #25 or #26 crusher run aggregate, thoroughly compacted to a minimum 95% Standard Proctor density as measured by AASHTO Specification T-99. Ditches and gutters shall be finished to drain readily. In grass or lawn areas, the last four inches of slightly compacted fill will consist of topsoil or an approved soil, which will support a turf growth after fertilizing and seeding. Settlement or other damage that occurs prior to acceptance of this work shall be repaired and grades satisfactorily re-established. The CONTRACTOR will be responsible for and shall repair any settlement in the backfill for a period of one year after completion of the work.
6. Backfill Under Pavement: Backfilling of trenches under pavement or proposed pavement shall be in layers of selected earth not more than 6 inches in thickness, and each layer shall be compacted to a minimum of 95% density as compared to density of the same material when tested in accordance with AASHTO Specification T-99. Compaction shall be by mechanical or pneumatic vibratory tampers or by hand and in accordance with instructions in Section 2.4.2 – 2.4.3 as modified herein. The top course of backfill directly under pavement shall consist of aggregate base material meeting the requirements of VDOT #21 or #21A stone. The depth of this course shall be at least 1 ½ times greater than the existing base course, but in no case shall be less than 6 inches. This material shall be thoroughly and uniformly tamped with pneumatic tampers or other approved methods. Moisture content shall be within 20% of optimum. The CONTRACTOR will be responsible for and shall repair any settlement in the backfill or pavement for a period of one year after completion of the work.
7. Restoration of Pavement, Structures, and Other Property: The CONTRACTOR shall restore all sidewalks, curbing, gutter, shrubbery, fences, poles, culverts, or other property and surface structures remove or disturbed as a part of the work to a condition equal to or better than that before the work began.

Within the public right-of-way, the CONTRACTOR shall give the property owner two weeks written notice to remove shrubbery, trees, or other property, with the exception of fences, which will be affected by the construction. If such property has not been moved after sufficient notification, the CONTRACTOR may remove or take other measures as needed to proceed with the work. Fences shall be removed and replaced by the CONTRACTOR. Property located within easements shall be considered the same as that within the public right-of-way unless shown otherwise on the plans or specific instructions concerning such property are transmitted to the CONTRACTOR in writing. The CONTRACTOR may negotiate with a property owner to restore property to a condition other than that before the work began. Any agreements with property owners should be written and shall be made available to the AMHERST COUNTY SERVICE AUTHORITY upon request.

Pavement shall be repaired with a bituminous concrete, VDOT Type SM-2B or SM-2C at least 1 ½ times the thickness of existing surface material but in no case less than 2 inches. On VDOT roads, after placement of the bituminous concrete patch, a pavement seal shall be applied a minimum of 5 feet on each side of the crossing. In cases of pavement cuts parallel to the road centerline, the entire width of road shall have a pavement seal applied after initial patching. Where required, pavement seal shall be performed in accordance with VDOT Specification 315. The following rates shall be required:

CRS-2	Bituminous Material	0.30 Gal/S.Y.
#78	Cover Stone	25 lbs./S.Y.

2.6. CLEANUP

1. The CONTRACTOR shall at all times keep the job clean to the satisfaction of the AMHERST COUNTY SERVICE AUTHORITY. In all cases, he shall "broom" the surfaces of paved streets immediately following backfilling. All surplus materials shall be removed and disposed of from the site of the work unless directed otherwise by the AMHERST COUNTY SERVICE AUTHORITY. Where material is placed on pavement, a layer of stone dust or sand shall be applied first to facilitate cleanup.

2.7. SERVICE CONNECTIONS

1. All service taps shall be made under pressure with the proper tapping machine for the pipe being tapped. Water main shall be pressure tested and disinfected after tapping for service connections.

2.8. SERVICE METERS

1. The 5/8" and 1-inch service meters shall be installed per Standard Details M-3 and M-4 in Appendix A.

2.9. LARGE SERVICE METER

1. The 2-inch service meters and larger shall be installed per Standard Details M-1 and M-2 in Appendix A.

2.10. IRRIGATION SYSTEM METER/BACKFLOW PREVENTER

1. Irrigation meters and reduced pressure zone (RPZ) backflow preventers shall be installed per Standard Detail BP-3 in Appendix A.

2.11. SEEDING

1. General: The seeding, fertilizing, and mulching of all lawn and grass areas disturbed shall be in accordance with these specifications and Section 604, Seeding, of the current edition of the VDOT Road and Bridge Specifications.
2. Lime: Unless otherwise noted, agricultural ground or pulverized limestone shall be applied at the rate of 2 tons per acre.
3. Fertilizer: Areas to be seeded shall be fertilized with a 5-10-5 fertilizer at the rate of 3,000 pounds per acre. The fertilizer shall be worked into the soil by harrow or rake at least 48 hours prior to seeding.
4. Seed Mixture: All seeds shall comply with applicable State and Federal Seed Laws. Seeds shall conform to Section 257.03 of the VDOT Road and Bridge Specifications and shall be compatible with the surrounding land use. The seed mixture shall be as follows:

Grass Type	A	B	C	D
KY-31 Fescue		83	88	
Red Top	2	2	2	2
KY Blue Grass	60			58
Creeping Red Fescue	38			30
Weeping Lovegrass		5		
Foxtail (of Common) Millet		10		
Abruzzi (or Balbo) Rye			10	10
POUNDS PER ACRE	100	100	100	100

5. Schedule of Application: The noted mixture shall be used according to the following calendar periods:

A – February 1 to May 15
B – May 16 to August 15
C – August 16 to October 15
D – October 16 to January 31
6. Mulch: After adequate rolling to compact the seed area, straw or hay mulch shall be applied at the rate of 2 tons per acre. Three tons per acre shall be applied between October 16 and January 31. Mulch shall be anchored to the seeded surface by spraying with asphalt, disking, netting, or by other methods approved by the AMHERST COUNTY SERVICE AUTHORITY.
7. Existing Lawns/Pasture Land: Where existing lawns or pastureland are disturbed, seeding shall match the original grass. Care shall be taken to avoid over-compaction in these areas.
8. Alternative Methods: Alternative methods incorporating fertilizing, seeding, and mulching in a single operation, such as “hydroseeding,” may be used upon prior approval of the AMHERST COUNTY SERVICE AUTHORITY.

TECHNICAL SPECIFICATIONS

SECTION 3

WATER MAIN MATERIALS

3.1. PIPE

1. **General:** At the CONTRACTOR'S option, water main pipe shall be one of the following materials. Water main pipe installed beneath paved streets shall be ductile iron pipe. Water main pipe installed through casing pipe shall be locked gaskets or restrained joints such as "Mega-Lug", "AquaGrip" or "Lock Tyton".
2. **Ductile Iron Pipe:** **All water main piping greater than 8" diameter shall be ductile iron. All water main construction with working pressures 135 psi or higher, anywhere in the line, at any time of day, shall be ductile iron.** Ductile iron pipe shall be centrifugally cast in accordance with AWWA C151. Unless noted otherwise, pipe sizes 16 inches and smaller shall be Thickness Class 50; greater than 16 inches shall be the minimum thickness class available in that size, unless otherwise required by the Authority. Ductile iron pipe used in areas with working pressures less than 170 psi shall be Thickness Class 50; in areas with working pressures exceeding 170 psi, Thickness Class 52 shall be used. Pipe shall be nominal 18-foot or 20-foot lengths. Joints shall be push-on, complying with AWWA C.111.
3. **PVC Pipe:** PVC (SDR 14) C900 pipe shall be Class 200 polyvinyl chloride plastic furnished in 20-foot nominal lengths. Such pipe shall have a 4 to 1 sustained pressure safety factor at its recommended maximum working pressure. This pipe shall conform to AWWA Specification C900 for PVC pressure pipe. Joints shall be the push-on type, such as "Ring Tite" or equal, with rubber rings conforming to ASTM D3139 and ASTM F477. PVC pipe with 6" and 8" diameters shall conform to the following criteria.
 - a. Where working pressures range from 90 – 135 psi at any time and at any location in the line, Class 200 SDR14 C900 pipe shall be used.
 - b. Class 150 SDR18 PVC C900 pipe may be substituted for Class 200 where static pressures for the entire length of constructed water main will not exceed 90 psi, as demonstrated to the satisfaction of the Authority, and written approval is obtained from the Authority prior to application of this section of the specifications.
 - c. 2" SDR 17 PVC pipe may be used on cul-de-sacs for a maximum of 300 feet, when no more that six units are being served and where line pressures are not in excess of 135 psi. Each instance shall be submitted to and reviewed and approved in writing by AMHERST COUNTY SERVICE AUTHORITY before construction begins.

3.2 JOINT CONSTRUCTION

1. All joint assembly shall be in accordance with the manufacturer's directions. Restrained joints, such as "Mega-Lug", "AquaGrip" or "Lock Tyton" may be used for ductile iron pipe upon approval by the AMHERST COUNTY SERVICE AUTHORITY. Where such joints are used, concrete anchorage shown on the drawings will not be required.

3.3 FITTINGS

1. All fittings for pipe shall be mechanical joint, ductile iron or cast iron, in compliance with AWWA C.110 or C.153. When connecting any PVC pipe to a cast iron bell fitting, the pipe end shall be prepared for installation in accordance with the manufacturer's directions.

3.4 PROTECTIVE COATING

1. Ductile iron pipe and fittings shall be cement lined and sealed in accordance with AWWA C.104. Underground metal pipe, fittings, and accessories, and metal piping in casings shall also have an exterior coat of a bituminous material.

3.5 LUBRICANT

1. Lubricant for joints shall be that supplied by the manufacturer of the pipe being used. If PVC pipe is used, the lubricant for PVC pipe shall be used at joints with valves, fittings, hydrants, or other pipe materials. With PVC pipe, no lubricant harmful to polyvinyl chloride plastic shall be used.

3.6 GATE VALVES

1. Valves shall be either cast iron or ductile iron body, resilient seated with reinforced rubber seat ring or permanently bonded disc, and machined seating surface, brass or bronze non-rising stems, and complying with AWWA C.509. Body shall be self centering or shall have guides for alignment of wedge disc and have internal epoxy coating approved for potable water. Working pressure shall be at least 250 psi and hydrostatically tested to 500 psi for valves 12 inches in diameter and smaller. Valves shall have O-ring seals and open left (counterclockwise) with a 2-inch square wrench nut. Valve ends shall be of mechanical joint type with all bolts, glands, and rubber gaskets furnished in the price of the valve. Valves shall be Mueller A-2360-20, or equal approved by the AMHERST COUNTY SERVICE AUTHORITY, when used in water mains. Valves larger than 12" and valves used in valve vaults shall be Mueller R-2360-20 OS&Y, or equal approved by the AMHERST COUNTY SERVICE AUTHORITY.

3.7 VALVE BOXES

1. Adjustable cast iron valve boxes of suitable diameter, length, and design shall be furnished and installed for all buried valves. Boxes shall be Tyler No. 562-A, or Bingham and Taylor No. 5562-S telescoping valve boxes of suitable length for the pipe bury depth.

3.8 CONCRETE

1. Miscellaneous concrete shall be Type A-3 conforming to VDOT Specifications.

3.9 TIE RODS

1. ¾-inch thread steel rods for hydrant clamping shall be galvanized or otherwise rustproof treated. Compatible washers and nuts shall be similarly rustproof treated. Tie bolts shall be A36 steel.

3.10 STONE

1. Stone for repair of gravel road shoulder shall be VDOT #25 or #26.

3.11 SERVICE CONNECTIONS

1. Service Lines: Service lines shall be as indicated on the drawings and be of the material as specified below:
 - a. Copper: Type "K" seamless, soft copper tubing shall have the ability to be flared and be in conformance with ASTM Specification B-88.
 - b. All service connections shall be made in accordance with the Uniform Statewide Building Code, and details M-1, M-2 and M-3.

2. Corporation Stops: Corporation stops shall be $\frac{3}{4}$ inch unless otherwise indicated. Inlet threads for corporation stops shall conform to AWWA C.800. Outlets shall be flared connections similar to Ford FB600. Tapping saddles are required for all PVC pipe. Pipe dope or any other materials that contain solvents or compounds which may be harmful to PVC pipe shall not be used in conjunction with PVC pipe.
3. Tapping Saddles: Saddles shall be made of a malleable material and have a single broad stainless steel strap secured by four (4) bolts. Rubber gaskets shall be required for all pipe sizes and classes. Lead gaskets will not be allowed. Saddles shall provide full support around the circumference of the pipe. Saddles shall not have lugs that will dig into the pipe when the saddle is tightened. The U-bolt type of strap will not be allowed. Saddles shall be as the Ford FS202 for cast iron diameters, or approved equal.

3.12 STANDARD SERVICE METERS, METER SETTERS, METER BOX, METER BOX COVER

1. Service Meters: Service meters larger than 1 inch shall be determined by the AMHERST COUNTY SERVICE AUTHORITY. Residential meters shall be bronze frost-proof $\frac{5}{8}$ " positive displacement meters unless otherwise shown conforming to AWWA Standard C700. The meter shall have internal strainer and hermetically sealed non-fogging standard registers operated by magnetic drive totaling flow in cubic feet. The main case shall be bronze with a cast iron freeze bottom. Meters shall be Sensus SR units, or other approved by AMHERST COUNTY SERVICE AUTHORITY.
2. Meter Setters: Setters for typical domestic meter settings ($\frac{5}{8}$ ") shall be Ford VBHH71-9 with flare copper inlet and double purpose nut outlet and padlock wings. One (1) inch setters shall be Ford VBHH74-10.
3. Meter Box & Cover: All meter boxes for $\frac{3}{4}$ " and 1" services shall be concrete with cast iron lids and frames conforming to Standard Detail Sheet M-3.

3.13 LARGE SERVICE METERS

1. General: The 2-inch positive displacement water meters shall consist of magnetic drive, hermetically sealed standard registers that records the totaled flow in cubic feet. The meter shall have a maximum working pressure of 150 psi. Two inch meter shall be Invensys SR meters with flanged ends. For multi-family connections, a Invensys compound meter is required. Meters shall be mounted in a Ford VBHH77-12B x 21 $\frac{1}{2}$ custom setter.
2. Meter Vault: Vaults shall conform to detail M-1, M-2, FP-1, FP-2 or FP-3, as determined appropriate by the AMHERST COUNTY SERVICE AUTHORITY.

3.14 AIR RELEASE VALVES

1. Automatic Valves: Air release valves shall automatically function to release to the atmosphere small amounts of entrained air, which may accumulate in the pipeline. Once the accumulated air is exhausted, valves shall seat tightly to prevent water leakage. Air release valves shall be $\frac{3}{4}$ " for pipe sizes 8" and smaller; valves shall be 1" for pipe sizes larger than 8". Such valves shall have a working pressure of not less than 150 psi and shall be the size shown on the plans. Valves shall be installed in a vault according to the Standard Detail AR-1. Air release valves shall be as manufactured by Armstrong, or approved equal.

3.15 CASING PIPE

1. Steel casing pipe shall conform to the Materials Standards of ASTM Designation A-139, Grade B, or approved equal. Only new prime pipe will be permitted. Wall thickness will be as shown on the plans. The pipe shall have an exterior coat of bituminous material.

3.16 HYDRANTS

1. General: Fire hydrants shall be traffic type with safety flange protection conforming to AWWA C.502 and shall have not less than 6-inch diameter barrel, 5 ¼-inch minimum hydrant valve and a measured loss of not more than 2.5 psi through the hydrant at 600 gpm. Hydrants shall have a 6 inch mechanical joint connection to the water main, two 2 ½-inch hose outlets, and one 4 ½-inch pumper outlet and nozzle threading shall be National Standard. Hydrants shall be so designed that if broken off, the hydrant valve will remain closed. Direction of opening shall be left (counterclockwise) with 1 ½-inch pentagon-shaped operating nut. Such hydrants shall have a working pressure of not less than 250 psi. Hydrants shall be Mueller A-423, or approved equal.
2. Line Stubs: All line stubs to fire hydrants shall be Class 52 D.I. pipe from tee to hydrant. Pipe shall be in accordance with Section 3.1.3 of this specification.

- 3.17 BLOWOFFS: Blowoffs shall be field assembled in accordance with Standard Detail BO-1, BO-2, as shown on the plans or shall be provided in the form of a box hydrant.

- 3.18 DETECTOR DOUBLE GATE-DOUBLE CHECK VALVE ASSEMBLY FOR FIRE SERVICE: Detector or fire service valve assemblies shall be designated backflow preventers consisting of a mainline double gate double check valve and a positive displacement bypass meter. The meter shall have magnetic drive, hermetically sealed, standard registers that record flow in units of cubic feet. This valve assembly shall have standard flanges and a working pressure of not less than 175 psi. Bypass metering for the valve shall be right-hand, furnished with piping, check valve, gate valve, and an appropriately sized Invensys SR meter registering in cubic feet. The meter assembly shall be Hersey Model DDC II, or approved equal, of the size specified on the plan. Details FP-1, FP-2 and FP-3.

3.19 BACKFLOW PREVENTION

1. Double Gate, Double Check Valve Assembly: Assembly shall be a designated backflow preventer, double gate-double check valve type, with two spring loaded independently operating check valves mounted in series. Test clocks shall be provided to allow testing of each valve without removal of the assembly from the line. The assembly shall be manufactured of corrosion resistant materials, with bronze and stainless steel working parts. The check valves shall be designed to open under normal flow conditions at a pressure differential not less than 1 psi at each check valve. The check valves will be designed to close when the downstream pressure is greater than the supply pressure. Unless otherwise noted, gate valves will be supplied independently and installed external to the check valve installation as noted on the plans and on Standard Detail BP-1 and BP-2. Units shall be Hersey No. 2, Watts 709, Mueller H-9505, or approved equal.
 - a. Manhole Chamber: Enclosure for double check valve shall be VDOT approved reinforced, precast manhole with flat top and cast iron frame and cover as noted on Standard Detail BP-1 or BP-2. Pipe connections shall be by approved watertight gaskets similar to Interpace or equal. Internal piping shall be ductile iron, Class 52, cement lined with standard 125 pound flanges. Manhole shall be assembled using butyl rubber seals to make joints watertight. Steps shall be provided per VDOT standard with 16 inch spacing maximum. If an underground chamber is used for a double check valve assembly, a floor drain system must drain by gravity.
2. Reduced Pressure Zone (RPZ) Backflow Preventor: The RPZ assembly shall consist of two independent check valves, relief port, test ports, and an in-line strainer. The body shall be bronze and supplied with ball type shut off valves. RPZs shall meet ASSE 1013 and be USC approved. Manufactures include Ames Fire & Waterworks, Febco, Watts, and Zurn.

- a. Enclosure: All RPZ assemblies shall be installed in an approved heated enclosure. The housing shall provide at least 12 inches of clearance to allow for maintenance and testing of the horizontally installed RPZ. Manufacturers include G&C Enclosures and Hot-Box.
- b. Separate Service Connection: All new construction shall have an approved RPZ installed on each service line connection (residential, commercial, fire sprinkler service, irrigation)

3.20 DRAIN LINES

1. Drain lines for meter and check valve shall be 4 inch Schedule 40 PVC with solvent weld joints and fittings and drain to gravity with screened outlets.

3.21 TAPPING SLEEVES

1. Tapping sleeves for connecting to existing water mains shall be full circle stainless sleeves equal to Ford Model FAST.

3.22 BALL VALVES

1. Ball valves for 2" and smaller lines shall be equal to Ford. Unless noted otherwise, valves shall have female iron pipe threads.

TECHNICAL SPECIFICATIONS

SECTION 4

SEWER EXCAVATION, INSTALLATION, AND BACKFILLING

4.1 EXCAVATION AND PREPARATION OF TRENCH

1. General: Only that portion of the right-of-way or easement actually needed for construction shall be cleared unless directed otherwise by the AMHERST COUNTY SERVICE AUTHORITY. In no case shall clearing or debris from clearing operations be taken past right-of-way or permanent easement lines onto private property.
2. Depth: Depth of trenches shall be as shown on plans and cut sheets except that the trench shall be excavated to allow for a depth of $\frac{1}{4}$ of the pipe's outside diameter, or a minimum of 4 inches, of VDOT #10 or #26 aggregate bedding in earth and 6 inches of aggregate bedding when passing through rock.
3. Width: Width shall be sufficient to allow pipe installation without walking or standing on pipe. The trench width at a point 12 inches above the top of the pipe shall not be less than 6 inches nor more than 12 inches on each side of the pipe's largest diameter unless otherwise directed by the AMHERST COUNTY SERVICE AUTHORITY.
4. Unsuitable Material: Wet or otherwise unsuitable soil at the subgrade shall be removed and replaced with approved sound materials as part of the original contract cost. Excess or unsuitable materials shall be disposed of by the CONTRACTOR.
5. Rock Excavation: Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least 6 inches below and on each side of all pipe and manholes. Before the pipe is laid, the subgrade shall be established by backfilling, tamping, and grading with approved material.
6. Topsoil: Topsoil shall be stripped from excavation areas and stockpiled in approved areas until needed for finish backfill and grading.
7. Pumping, Bailing, & Draining: The CONTRACTOR shall remove any water which may accumulate or be found in the trenches or other excavations and shall keep the excavations clear of water while work is being installed.
8. Trench Protection: The CONTRACTOR shall furnish and erect such sheathing, bracing, and shoring, and shall furnish necessary signs, barricades, and temporary lighting as may be pertinent for the protection of his work, employees, the public, and adjacent structures. Sheathing left in place shall be at the CONTRACTOR'S expense. Normally a maximum of 200 feet of trench will be allowed open at any one time. No excavation within VDOT right-of-way or elsewhere will be allowed to remain open overnight unless special permission is obtained.
9. Road or Driveway Crossings: All crossings of VDOT roads shall be made by boring, jacking, or tunneling unless otherwise noted. If the crossing cannot be made by any of the above methods, the permittee must contact the VDOT Amherst Residency for permission to cut the roads. Wherever pavement is permitted to be cut, not over one-half width shall be disturbed at one time; and on crossings, the first opening shall be completely restored to satisfactory travelable condition before the second half can be opened. Where this is not possible, steel crossing plates must be used to maintain access at all times. Where the pavement is disturbed, or deemed weakened, it, in its entirety, or such portions of it as deemed desirable

by VDOT shall be restored or replaced in a manner directed by and to the satisfaction of VDOT.

When pavement must be cut, the cut shall be made in a straight line, parallel to the pipe and 6 inches wider than the trench, on each side, so that an undisturbed shoulder will be provided under the new work. Sidewalks or curb and gutter disturbed by construction shall be removed and replaced at existing joints. Cutting shall be done neatly so that a uniform, straight joint will result to provide a bond with the original concrete or pavement.

Placement of excavated material on existing pavement shall be avoided if possible. Where allowed by VDOT, material can be placed on paved road surfaces provided a stone dust or sand layer is first placed on the pavement. No cleated equipment shall be used on pavements. Road drainage shall not be clogged, and shoulders, ditches, roadside drainage facilities, and pavement affected by trenching operations shall be maintained in a condition satisfactory to VDOT. Entrances shall not be blocked except for short periods as arranged with the property owner, and ingress and egress to adjacent property shall be maintained at all times. Paved or concrete driveways must be restored in accordance with STANDARD DETAIL NO. TB-5 in Appendix A.

10. Erosion and Siltation Control: Within all easements and right-of-ways, straw barriers, silt fencing, settlement basins, and brush barriers are to be utilized in prevention of erosion and siltation control.

4.2 INSTALLATION OF PIPE, FITTINGS, AND MANHOLES

1. Handling: Pipe shall be placed in the trench in such a manner as to prevent damage to pipe and protective coatings and linings. Under no circumstances shall pipe be dropped or dumped into the trench. As the temperature approaches or drops below freezing, extra care shall be used in handling PVC pipe.
2. Cleaning: Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. Spigot and bell ends of pipe and gaskets shall be cleaned and lubricated according to manufacturer's instructions. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug.
3. Direction of Laying: Pipe shall be laid upgrade with bell ends facing in the direction of laying unless otherwise indicated by the AMHERST COUNTY SERVICE AUTHORITY. Each piece of pipe shall be laid true to line and grade. The bottom of the trench shall be smoothly graded and bell holes provided so that the aggregate bedding gives uniform support to the barrel of the pipe when in final position. Adjustments to line or grade shall be made by removing or adding granular material under the barrel. In no case shall wedges or blocks be used under the body of the pipe. The pipe shall be pushed fully "home" by hand, with a bar and block of wood to cushion the bell, or similar methods for large diameter pipe.
4. Bedding: Bedding shall consist of VDOT #10 or #26 crusher run aggregate and shall conform to Standard Detail TB-1. In areas of high water table, #57 stone may be used upon approval of the AMHERST COUNTY SERVICE AUTHORITY.
5. Roadway Crossings through Casings: Care shall be taken to maintain the proposed plan grade. Before pushing the sewer pipe through the casing, spiders shall be bolted to the pipe to keep it centered in the casing and to prevent damage when installation is made. Care shall be taken to insure that the installed pipeline is well secured to prevent movement as detailed in Standard Detail CS-1.
6. Installation of Tees and Laterals: Tees and laterals shall be installed with the same care that mainline sewers are laid. Slopes shall be not less than 1% unless otherwise indicated. Laterals shall be 6-inch or 4-inch pipe of the same material as the main sewer pipe and shall run to property lines unless otherwise indicated on the plans. Connections to existing lateral

pipes shall be made with the use of a watertight pipe coupling. Non-connected laterals shall be properly capped and suitably sealed to prevent filtration of water into the laterals. Caps or plugs shall be braced to prevent blowoff during exfiltration or air testing. Ends of laterals shall be marked by a steel marker driven flush with the ground and in such a manner as to brace the plug on the lateral. Couplings shall be provided as needed for ductile iron pipe connections to plastic tees. All laterals shall be installed in accordance with the Uniform Statewide Building Code. Wherever service laterals cross a road, a cleanout, conforming to detail CO-1 must be placed at the edge of the right-of-way closest to the structure being served.

7. Installation of Service Line Cleanout: Sanitary sewer service line cleanouts shall be installed below grade in a cast iron box, Dewey Brothers MH-VA-16. Cleanouts shall be on private property adjacent to the right-of-way or edge of easement. The cleanout will mark the end of public utility maintenance responsibility.
8. Installation of Manhole Stubouts: Manhole stubouts shall be provided where indicated or directed. Stubout pipe shall be 8 inches in diameter unless otherwise indicated on the drawings and shall be the same pipe material as the sewer pipe. Manhole stubouts shall be sealed, braced, and marked as described in Section 4.2.6.
9. Installation of Manholes: The subgrade and bedding for the monolithic base for the precast manhole shall be prepared similar to that for pipe. The invert channels shall be formed with concrete as shown in the VDOT Road and Bridge Specifications and shall be smooth and semi-circular in shape, conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as size of the manhole will permit. (See Detail MH-4.) The floor of the manhole outside of the channels shall be smooth and shall slope toward the channels not less than 2 inches per foot nor more than 4 inches per foot. Manhole frames shall be set on a double ring of butyl rubber rope caulk to form a watertight seal. When leveling is required manhole frames shall be set level on a full bed of mortar to the proper grade prior to the application of the butyl caulk. Under no circumstances shall manholes be left in an incomplete condition such that surface water could enter into the sewer lines. The base may be constructed separately from the first vertical section of the manhole as detailed in Standard Detail MH-2.
10. Connections to Existing Manholes: Flexible watertight connections shall be used when tying into existing manholes. The exterior portion of the connection shall be compatible with grout. Existing manholes with new connections shall be tested in the same manner as new manholes.
11. Anchorage: Pressure pipelines shall be protected against joint pulling or thrust damage by suitable anchors, braces, or tie rods installed at direction changes affected by fittings and all other critical points. Rods and clamps shall be galvanized or otherwise rustproof treated. Reaction backing shall be of the size indicated on the appropriate Standard Detail CA-1 or CA-2, and shall bear on solid undisturbed or properly compacted earth. In special instances restraining joints may be used, as approved by the AMHERST COUNTY SERVICE AUTHORITY.

4.3 TESTING

1. General: All sewer lines shall be tested by any or all of the following methods for both displacement or structural faults and for water tightness by the CONTRACTOR. The testing methods shall be at the option of the AMHERST COUNTY SERVICE AUTHORITY. The CONTRACTOR shall make all preparations and shall supply the labor for all tests. The CONTRACTOR shall supply specialized equipment, such as T.V. cameras for the conduction of such tests. No charge shall be made for initial witnessing of tests, but witnessing of each succeeding test required on the same section of line caused by failure of the tests shall be charged to the CONTRACTOR.

2. Displacement Testing- Lights: A light will be flashed between manholes by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipeline shows visible leaks, poor alignment, displaced pipe or any other defects, they will be remedied by the CONTRACTOR at his expense.
3. Displacement and Structural Testing- T.V.: A T.V. camera may be used to locate defects in pipeline. These shall then be remedied by the CONTRACTOR at his expense. T.V. inspection will only be required upon failure of the CONTRACTOR to make necessary repairs such that the pipe fails subsequent retests.
4. Deflection Testing: Pipe may be measured for vertical ring deflection after completion of the backfill. Maximum ring deflection of the pipe under load shall be limited to 5% of the vertical internal pipe diameter. Testing shall be accomplished by recording deflectometer or by approved mandrel, sphere, or pin type go/no-go device. Such equipment shall be furnished by the CONTRACTOR.
5. Water Tightness Testing- Infiltration: When, in the opinion of the engineer, the trench or excavation is sufficiently (4 feet above crown) saturated as a result of ground water or rain, tests may be made on the basis of infiltration. The CONTRACTOR shall carefully measure the flow of water at the nearest downgrade manhole. The necessary supply of water, plugs, labor and equipment shall be furnished by the CONTRACTOR at his expense. Three series of measurements shall be made at not less than one-hour intervals, and the results shall be reduced to an average. This average shall then be computed so as to apply for the 24-hour period. All such tests shall be made only under the supervision of the ENGINEER. All defective work shall be immediately repaired and retested until proven to be satisfactory. Infiltration shall not exceed a rate of 100 gallons per inch of pipe diameter per mile per day for any section of the system.
6. Water Tightness Testing- Exfiltration: When conditions are not suitable for making infiltration tests, an exfiltration test may be made. The line to be tested shall be filled so that head of at least 4 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a two-hour test period shall be measured. Leakage measured by this test shall not exceed 100 gallons per inch diameter per mile of pipeline per day. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished.
7. Water Tightness Testing- Air: The following procedure shall be followed for the air test:
 - a. Clean pipe to be tested by propelling snug-fitting inflated rubber ball through the pipe with water if necessary.
 - b. Plug all pipe outlets with suitable test plugs. Brace each plug securely.
 - c. If the pipe to be tested is submerged in ground water, insert a pipe probe by boring or jetting into the backfill material adjacent to the center of the pipe, and determine the pressure in the probe when air passes slowly through it. This is the back pressure due to ground water submergence over the end of the probe. All gauge pressure in the test should be increased by this amount.
 - d. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
 - e. After an internal pressure of 4.0 psig is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
 - f. After stabilizing the internal pressure at 4.0 psig, reduce the internal air pressure to 3.5 psig, and start stopwatch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. Minimum permissible pressure holding times for runs of single pipe diameter and for systems of 4-inch, 6-inch, or 8-inch laterals in combination with trunk lines are indicated in seconds in the table in Appendix C.

Note: The air test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. In as much as a force of 250 lbs. is exerted on an 8-inch plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous. As a safety precaution, pressurizing equipment should include a regulator set at perhaps 10 psi to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

8. Manhole Exfiltration Testing: A separation exfiltration test shall be conducted on each manhole. Inlet and outlet lines shall be suitably plugged before starting the presoak period. After a presoak period of at least four hours, the manhole shall be filled to a depth of one foot below the top of the casting. The amount of water required to maintain this level during a two-hour test period shall be measured. A detectable leakage shall be cause for rejection and the leakage shall be corrected and retesting accomplished at the expense of the CONTRACTOR.
9. Manhole Vacuum Testing: When requested by CONTRACTOR and approved by the AMHERST COUNTY SERVICE AUTHORITY, manholes may be tested by the vacuum method. Manholes shall be tested after assembly and prior to backfilling. Stubouts, manhole boots, and pipe plugs shall be secured to prevent movement while the vacuum is drawn. Installation and operation of vacuum equipment and indicating devices shall be in accordance with equipment specification for which performance information has been provided by the manufacturer and approved by the Health Department. A measured vacuum of 10 inches of mercury shall be established in the manhole. The time for the vacuum to drop to nine inches of mercury shall be recorded.

Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from 10 inches to 9 inches of mercury. The maximum allowable leakage rate for a four-foot diameter manhole shall be in accordance with the following:

<u>Manhole Depth</u>	<u>Minimum Elapsed Time for a Pressure Change of 1 Inch HG</u>
10 ft. or less	60 seconds
>10 ft. but <15 ft.	75 seconds
>15 ft. but <25 ft.	90 seconds

For manholes five feet in diameter, add an additional 15 seconds, and for manholes six feet in diameter, add an additional 30 seconds, to the above time requirements.

If the manhole fails the test, necessary repairs shall be made and the vacuum test and repairs shall be repeated until the manhole passes the test or the manhole shall be tested in accordance with the standard exfiltration test and rated accordingly.

If a manhole joint sealer is completely pulled out during the vacuum test, the manhole shall be disassembled and the sealer replaced.

10. Water Tightness Testing- Force Mains: The CONTRACTOR shall make all preparation, furnish all preparation, furnish all equipment, and shall supply the labor for all tests. Pressure and leakage tests shall be in accordance with the AWWA C.600, Section 4. The test pressure shall be 1 ½ times the working pressure at the lowest point in the test section. The pressure and leakage tests shall be conducted concurrently for duration of two hours.

The section of pipe under consideration shall be slowly filled with water and brought to the specified pressure by means of a pump. Before supplying the specified test pressure, all air shall be expelled from the pipe. Testing shall not begin until at least seven (7) days after the

last concrete anchor has been poured on the section of line being tested (if high early strength concrete is used- two days).

Leakage shall be defined as the quantity of water that must be supplied into the pipe section to maintain pressure within 5 psi of the specified test pressure.

The AMHERST COUNTY SERVICE AUTHORITY shall observe all leakage tests. If the pipe fails to meet test requirements, all leaks shall be repaired and defective pipe repaired or replaced at the CONTRACTOR'S expense. The test shall be repeated until satisfactory results are obtained. The CONTRACTOR shall be charged for all retests at the normal rates for inspection services.

**Maximum Allowable Leakage Per 1,000 Feet (305 meters) of Pipeline
(Gallons per Hour)**

Avg. Test Pressure (psi)	Pipe Diameter (inches)											
	2	3	4	6	8	10	12	14	16	18	20	24
300	0.26	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12
275	0.25	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99
250	0.24	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85
225	0.23	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70
200	0.21	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55
175	0.20	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38
150	0.18	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21
125	0.17	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01
100	0.15	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80

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

4.4 BACKFILLING

1. Materials: All backfill materials shall be free from mud, refuse, construction debris, organic material, boulders, stones over 1 inch, and frozen or otherwise unsuitable material. From one foot above top of pipe to original ground elevation, however, material containing stones up to 6 inches in their greatest dimension may be used, unless otherwise specified. CONTRACTOR may backfill with excavated material, provided it meets conditions stated above.
2. Initial Backfill: All trenches shall be backfilled with VDOT #10 or #26 crusher run aggregate in layers not exceeding 4 inches from bottom of trench to the centerline of the pipe. Special care shall be taken to backfill under the pipe and to tamp this material into place to provide a firm bed. Material shall be deposited on both sides of the pipe simultaneously and compacted into place by tamping to a minimum 95% standard Proctor density as measured by AASHTO Specification T-99. From the centerline of the pipe to a depth of 1 foot above the pipe, the trench shall be backfilled with approved material in 6-inch layers and thoroughly compacted. Mechanical or pneumatic tampers must be used throughout this operation. Special care shall be taken to prevent damage to the pipe by backfilling and compaction equipment.
3. Backfilling to Grade: The remainder of backfilling shall be carried up in increments of 1 foot, except in road rights-of-way where layers shall be no greater than 6 inches thick. Minimum required density shall be the density of the adjacent undisturbed material except under pavement or in road shoulders where backfill shall be compacted to a minimum of 95%

density when tested in accordance with AASHTO Specification T-99 (standard Proctor). Each layer of

earth shall be compacted into place by mechanical vibratory tamping before the next layer is applied. A hydro-hammer shall not be used. All pipelines have a minimum of 18 inches to cover before any rolling equipment is used. Damage to pipelines or other structures resulting from compaction shall be corrected by the CONTRACTOR without expense to the AMHERST COUNTY SERVICE AUTHORITY.

A copper wire (size #10 or larger) shall be installed parallel to and at the same depth with all PVC force main pipe and looped around all valves. In addition, a green or safety orange plastic marking tape imprinted with the words "CAUTION: SEWER LINE BELOW" (See Appendix B) shall be installed over all PVC force main pipe. The marking tape shall be buried 18 inches above the top of the pipe.

4. Backfill Testing: The CONTRACTOR shall demonstrate the adequacy of backfill compaction by performing density testing of the completed trench in non-controlled backfill areas as designated by the AMHERST COUNTY SERVICE AUTHORITY. Density testing shall be performed at three depths for each test location: surface, mid-depth, and near maximum trench depth. In grass and lawn areas, the testing shall be performed at three depths for each test location: under the topsoil backfill, mid-depth, and near maximum trench depth. The character of the backfill material will be observed during the excavation for density testing to determine conformance with the specifications. Density testing shall be performed using nuclear field density equipment or conventional weight-volume methods. If the weight-volume method is used, volume shall be determined by using the sand replacement test (ASTM D 1556) or liquid displacement methods (ASTM D 2167). If nuclear methods are used, the trench correction effect shall be accounted for by recalibrating the nuclear gage on its calibration block at the location of each test prior to taking the density measurement. The density of the backfill shall be equal to or greater than the density of the undisturbed material in the immediate area adjacent to area under test. The CONTRACTOR shall furnish all equipment, tools, and labor to conduct the testing. Testing shall be performed by an independent testing laboratory qualified to perform such tests. All testing shall be witnessed by the AMHERST COUNTY SERVICE AUTHORITY. The test shall be repeated until satisfactory results are obtained. The CONTRACTOR shall be charged for all retests at the normal rates for inspection services.
 - a. Normal Testing Frequency: At the option of the AMHERST COUNTY SERVICE AUTHORITY, one test shall be performed with the first 500 feet of pipe installed by each crew. This test will be used as an initial evaluation of the compaction methods being used. Beyond the initial 500 feet, one test shall be performed in each 1,000-foot section of pipe installed. The location of the test within each 1,000-foot section shall be selected by the AMHERST COUNTY SERVICE AUTHORITY. Testing which indicated that unacceptable material has been incorporated into the backfill, or that insufficient compaction is being obtained shall be followed by expanded testing to determine the limits of the unacceptable backfill. Normal testing shall be performed at the contractor's expense.
 - b. Expanded Testing Requirements: If normal testing within any section indicated unacceptable backfill, the AMHERST COUNTY SERVICE AUTHORITY may require additional testing within the same 1,000-foot section to determine the limits of unacceptable backfill. Additional testing required by the AMHERST COUNTY SERVICE AUTHORITY shall not exceed testing of 4 additional locations within the 1,000-foot section. Unacceptable backfill with the limits established by the testing shall be removed and replaced by the CONTRACTOR at no additional cost to the AMHERST COUNTY SERVICE AUTHORITY. Expanded testing required shall be performed at the contractor's expense. Additional testing beyond that required may be performed by the CONTRACTOR at his expense to further delineate limits of unacceptable backfill.

- c. Additional Testing: Testing beyond the normal frequency or expanded testing required which is requested by the AMHERST COUNTY SERVICE AUTHORITY shall be at the AMHERST COUNTY SERVICE AUTHORITY'S expense.
5. Fill: Materials for fill areas shown on the plans shall be secured from excavation after rejection of any unsuitable materials. Rock or rocky material may be incorporated into fills if size and shape permit, if placed in lower portion of fills where the stability will not be affected, and if placed in such a manner that the perviousness will not be increased. Material shall be spread in layers with moisture controlled and then compacted to a minimum density of 95% in accordance with AASHTO T-99 (standard proctor).
6. Finished Surfaces: Uniformly smooth grading of disturbed areas shall be required after backfill and compaction. Road shoulders shall have a minimum depth of 6 inches of VDOT #25 or #26 crusher run aggregate, thoroughly compacted to a minimum 95% standard Proctor density as measured by AASHTO Specification T-99. Ditches and gutters shall be finished to drain readily. In grass or lawn areas, the last 4 inches of slightly compacted fill will consist of topsoil or an approved soil, which will support a turf growth after fertilizing and seeding. Settlement or other damage that occurs prior to acceptance of this work shall be repaired and grades satisfactorily re-established. The CONTRACTOR will be responsible for and shall repair any settlement in the backfill for a period of one year after completion of the work.
7. Backfill Under Pavement: Backfilling of trenches under pavement shall be in layers of selected earth not more than 6 inches in thickness, and each layer shall be compacted to a minimum of 95% density as compared to density of the same material when tested in accordance with AASHTO Specification T-99. Compaction shall be in accordance with instructions in Section 4.4.2- 4.4.3 as modified herein. The top course of backfill directly under pavement shall consist of aggregate base material meeting the requirements of VDOT #21 or #21A stone. The depth of this course shall be at least 1 ½ times greater than the existing base course, but in no case shall be less than 6 inches. This material shall be thoroughly and uniformly tamped with pneumatic tampers or other approved methods. Moisture content shall be within 20% of optimum. The CONTRACTOR will be responsible for and shall repair any settlement in the backfill or pavement for a period of one year after completion of the work.
8. Restoration of Pavement, Structures, and Other Property: The CONTRACTOR shall restore all sidewalks, curbing, gutter, shrubbery, fences, poles, culverts, or other property and surface structures removed or disturbed as a part of the work to a condition equal to or better than that before the work began.

Within the public right-of-way, the CONTRACTOR shall give the property owner two weeks written notice to remove shrubbery, trees or other property, with the exception of fences, which will be affected by the construction. If such property has not been moved after sufficient notification, the CONTRACTOR may remove or take other measures as needed to proceed with the work. Fences shall be removed and replaced by the CONTRACTOR. Property located within easements shall be considered the same as that within the public right-of-way unless shown otherwise on the plans or specific instructions concerning such property are transmitted to the CONTRACTOR in writing. The CONTRACTOR may negotiate with a property owner to restore property to a condition other than that before the work began. Any agreements with property owners should be written and shall be made available to the AMHERST COUNTY SERVICE AUTHORITY or ENGINEER upon request.

Pavement shall be repaired with bituminous concrete, VDOT Type SM-2B or SM-2C at least 1 ½ times the thickness of existing surface material but in no case less than 2 inches. On VDOT roads, after placement of the bituminous concrete patch, a pavement seal shall be applied a minimum of 5 feet on each side of the crossing. In cases of pavement cuts parallel to the road centerline, the entire width of road shall have a pavement seal applied after initial

patching. Where required, pavement seal shall be performed in accordance with VDOT specification 315. The following rates shall be required:

CRS-2	Bituminous Material.	0.30 Gal/S.Y.
#78	Cover Stone	25 lbs./S.Y.

9. Cleanup: The CONTRACTOR shall at all times keep the job cleaned to the satisfaction of the AMHERST COUNTY SERVICE AUTHORITY. In all cases, he shall "broom" the surfaces of paved streets immediately following backfilling. All surplus materials shall be removed and disposed of from the site of the work unless directed otherwise by the AMHERST COUNTY SERVICE AUTHORITY. Where material is placed on pavement, a layer of stone dust or sand shall be applied first to facilitate cleanup.

4.5 SEEDING

1. General: The seeding, fertilizing, and mulching of all lawn and grass areas disturbed shall be in accordance with these specifications and Section 604, Seeding, of the current edition of the VDOT Road and Bridge Specifications.
2. Lime: Unless otherwise noted, agricultural ground or pulverized limestone shall be applied at the rate of 2 tons per acre.
3. Fertilizer: Areas to be seeded shall be fertilized with a 5-10-5 fertilizer at the rate of 3,000 pounds per acre. The fertilizer shall be worked into the soil by harrow or rake at least 48 hours prior to seeding.
4. Seed Mixture: All seeds shall comply with applicable State and Federal Seed Laws. Seeds shall conform to Section 257.03 of the VDOT Road and Bridge Specifications and shall be compatible with the surrounding land use. The seed mixture shall be as follows:

Grass Type	A	B	C	D
KY-31 Fescue		83	88	
Red Top	2	2	2	2
KY Blue Grass	60			58
Creeping Red Fescue	38			30
Weeping Lovegrass		5		
Foxtail (of Common) Millet		10		
Abruzzi (or Balbo) Rye			10	10
POUNDS PER ACRE	100	100	100	100

5. Schedule of Application: The noted mixture shall be used according to the following calendar periods:

 A – February 1 to May 15
 B – May 16 to August 15
 C – August 16 to October 15
 D – October 16 to January 31
6. Mulch: After adequate rolling to compact the seed area, straw or hay mulch shall be applied at the rate of 2 tons per acre. Three tons per acre shall be applied between October 16 and January 31. Mulch shall be anchored to the seeded surface by spraying with asphalt, disking, netting, or by other methods approved by the AMHERST COUNTY SERVICE AUTHORITY.
7. Existing Lawns/Pasture Land: Where existing lawns or pastureland are disturbed, seeding shall match the original grass. Care shall be taken to avoid over-compaction in these areas.

8. Alternative Methods: Alternative methods incorporating fertilizing, seeding, and mulching in a single operation, such as “hydroseeding,” may be used upon prior approval of the AMHERST COUNTY SERVICE AUTHORITY.

TECHNICAL SPECIFICATIONS

SECTION 5

SEWER MATERIALS

5.1 GRAVITY SEWER PIPE

1. General: Sanitary sewer and lateral pipe shall be one of the following materials, at the CONTRACTOR'S option, except where otherwise indicated on the plans. Ductile Iron Pipe or Polyvinyl Chloride (PVC) Pipe.
2. Ductile Iron Pipe: Ductile iron pipe shall be centrifugally cast in accordance with AWWA C.151. Pipe. Unless noted otherwise, pipe sizes 12 inches and smaller shall be Thickness Class 50, pipe sizes greater than 12 inches shall be Pressure Class 350. Pipe shall be in nominal 18-foot or 20-foot lengths and joints shall be push-on in compliance with AWWA C.111 and be cement lined in accordance with AWWA C.104.
3. Polyvinyl Chloride (PVC) Pipe: PVC pipe shall be SDR 35 furnished in 20-foot nominal lengths, conforming to ASTM Specification D.3034.

5.2 JOINTS

1. Ductile Iron Joints: Jointing material for mechanical or slip-on joints in ductile iron pipe shall conform to the requirements of AWWA C.111. Where sewer pipe is installed in casing, locked gaskets or restrained joints such as "Mega-Lug" , "AquaGrip" or "Lock Tyton" shall be used.
2. Polyvinyl Chloride Pipe Joints: PVC piping joints shall be the gasket, push-on type, such as "Ring-Tite" or equal unless otherwise indicated. Joint assembly shall be made according to the manufacturer's directions and shall comply with the guidelines for installation of PVC pipe as developed by the Uni-Bell Plastic Pipe Association. PVC pipe joints with cast iron fittings shall be installed in accordance with manufacturer's directions in compliance with these specifications. Integral bells shall be required. Where sewer pipe is installed in casing, locked gaskets or restrained joints such as "Mega-Lug" , "AquaGrip" or "Lock Tyton" shall be used. Alternately, Yellowmine with restrained joints may be used at road crossings in steel casing.
3. Pipe Couplings: Watertight, semi-flexible couplings for connection different types of sewer pipe, or plain ends, shall be FERNCO Series 1000 with #305 stainless steel clamps or approved equal.

5.3 FITTINGS

1. General: Tees or wyes installed shall be the same type as the main gravity sewer pipe. Plugs or caps used shall be those manufactured specifically for the type of pipe used. They shall be secured such that they will be watertight and will withstand the internal pressure applied by air or exfiltration testing. Pressure pipe fittings shall be cast or ductile iron in compliance with AWWA C.110 or C.153 and AWWA C.104. The proper adapter and/or transition gasket shall be supplied with PVC pressure pipe. Pipe ends shall be prepared for installation in accordance with the manufacturer's directions.

5.4 FORCE MAIN

1. General: Pressure pipe for force main installation shall be one of the following materials, at the CONTRACTOR'S option, except where otherwise indicated on the plans.

2. Ductile Iron Pipe: As specified in Section 5.1.2.
3. Polyvinyl Chloride (PVC) Pipe: PVC pipe (SDR 14) shall be Class 200, conforming to AWWA Standard C.900.

5.5 JOINTS

1. Ductile Iron Joints: Jointing material for mechanical or slip-on joints in ductile iron pipe shall conform to the requirements of AWWA C.111. Where sewer pipe is installed in casing, locked gaskets or restrained joints such as "Mega-Lug" , "AquaGrip" or "Lock Tyton" shall be used.
2. Polyvinyl Chloride Pipe Joints: PVC piping joints shall be the gasket, push-on type, such as "Ring-Tite" or equal unless otherwise indicated. Joint assembly shall be made according to the manufacturer's directions and shall comply with the guidelines for installation of PVC pipe as developed by the Uni-Bell Plastic Pipe Association. PVC pipe joints with cast iron fittings shall be installed in accordance with manufacturer's directions in compliance with these specifications. Integral bells shall be required. Where sewer pipe is installed in casing, locked gaskets or restrained joints such as "Mega-Lug" , "AquaGrip" or "Lock Tyton" shall be used. Alternately, Yellowmine with restrained joints may be used at road crossings in steel casing.

5.6 MANHOLES

1. Precast manholes shall conform to ASTM C.478. Minimum inside diameter shall be 48 inches with minimum of 5-inch thick walls. Joints shall be the O-ring joint or tongue and groove using butyl rubber conforming to ASTM C.443. Manholes steps, according to Standard Detail MS-1, shall be provided in all manholes and shall be 16-inch center maximum. All manholes shall have monolithic bases except when a new manhole is built on an existing line. The eccentric design manhole shall be used. Provision for indicated pipe connections shall be made by means of an approved flexible, watertight gasket. Existing lines shall be grouted into place.

5.7 FRAMES AND COVERS

1. Frames and covers shall be of cast iron conforming to ASTM A.48 for Class 30 Gray Iron, as shown on the Standard Detail Sheet FC-2. Solid covers are required where plans indicate that all covers shall be buried. Watertight frame and cover shall be as shown on detail FC-2.

5.8 CONCRETE

1. Concrete used for shaping of manhole channels, sidewalk, and miscellaneous work shall meet requirements of VDOT Type A3 or C1.

5.9 MARKING TAPE

1. Marking tape shall be required on all pipelines except sanitary sewer mains where manholes will be exposed at both ends of the pipe segment. Detectable mylar marking tape shall be similar to Lineguard, Inc. utility marking tape, Type II or equal. The tape shall bear the printed identification "CAUTION: SEWER LINE BELOW". The printing shall be under mylar (reverse printed) so as to be readable through the clear mylar. Surface painting on the tape is not acceptable. The tape shall be "Safety Orange" in color and shall be 2 inches in width. Marking tape colored green to comply with the color coding of the Underground Utilities Damage Prevention Act (See Appendix B) shall also be permitted.

5.10 SELECT BACKFILL MATERIAL

1. Select backfill material, if needed, shall conform to the Sewer Excavation, Installation, and Backfill Section of the specifications and, if not available on site, shall be obtained from other sources.

5.11 VALVES & BOXES

1. Gate Valves: Valves shall be either cast iron or ductile iron body, resilient seated with reinforced rubber seat ring or permanently bonded disc, and machined seating surface, brass or bronze non-rising stems, and complying with AWWA C.509. Body shall be self-centering or shall have guides for alignment of wedge disc and have internal epoxy coating approved for potable water. Working pressure shall be at least 250 psi and hydrostatically tested to 500 psi for valves 12 inches in diameter and smaller. Valves shall have cast iron valve boxes and operate with a two-inch square wrench nut. Exposed valves shall be operated with a handwheel. Valve ends shall be mechanical joint or flanged as indicated on the drawings. Valves shall be Mueller A-2360-20, or equal as approved by the AMHERST COUNTY SERVICE AUTHORITY.
2. Air Release Valves: Air release valves shall be a short bodied valve intended for sewage service with ½-inch orifice, vacuum check valve, 2-inch screened inlet and with backflushing attachment. Valves shall be equal to Crispin Model 320 ASB. See Standard Detail AR-3.
3. Valve Boxes: Gate valves shall be accessible through valve boxes of suitable diameter, length and design. Boxes shall be Tyler No. 562-A or Bingham and Taylor No. 5562-S telescoping valve boxes of suitable length for the pipe bury depth.

5.12 SURFACE STONE

1. General: All trench work in road shoulders shall be topped of with six inches of surface stone. Surface stone shall consist of VDOT #25 or #26 crusher run aggregate and shall conform to the specifications in VDOT Road and Bridge Specifications Section 206.

TECHNICAL SPECIFICATIONS

SECTION 6

SEWER LIFT STATION

6.1. SEWER LIFT STATION

1. General: The CONTRACTOR shall furnish and install one factory-built, automatic pumping station, as designed by Hurt & Proffitt, Inc. and manufactured by Gorman-Rupp Pump Company, Mansfield, Ohio. The station shall be complete, with all needed equipment, factory-installed on a welded steel base with fiberglass cover, and meet all specifications developed by Hurt & Proffitt, Inc. for that unique pump station installation. The pumping station must meet all state, federal, and local regulations.
 - a. The principal items of equipment shall include, but not be limited to, horizontal, self-priming centrifugal pumps; V-belt drives; valves; internal and external piping; central control panel with circuit breakers; motor starters and automatic pumping level controls; heater; ventilating blower; priming pumps and appurtenances; all internal and external wiring; and all appurtenant features required to provide a fully functional pumping station meeting the intent of this specification and the Drawings.
 - b. Construction of the facility shall be in accordance with the contract documents, drawings, specifications, and equipment manufacturer's recommendations.
 - i. Positive stormwater drainage away from the pump station and to adequate drainage facilities shall be provided by CONTRACTOR.
 - ii. Construction of facilities near or within the limits of a 100 year floodplain shall include elevation of the pump station platform and the access to the platform at least five feet (5') above the 100 year flood elevation.
 - c. CONTRACTOR shall be responsible for furnishing all equipment, materials, and labor for the proper installation, testing, and operation of the pump station, including all electrical equipment necessary to ensure proper operation of the pump station, compliance with all pertinent codes and regulations, and compatibility of all pump station equipment.
 - i. General: In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.
 - ii. Included in the installation shall be all required equipment, installation, and testing to provide for lightning/surge protection of the facility electrical system and equipment. This is in addition to the surge protection specified in Sections 6.1.6.4.4 and 6.1.8.4.6 for the SCADA system.
 - iii. Specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for service anticipated. CONTRACTOR shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.
 - d. Performance Requirements: Each pump shall be capable of delivering rate of wastewater (in gpm) against total dynamic head (in feet), at the minimum acceptable efficiency, all as specified in contract documents. Maximum allowable speed, rated horsepower for each motor, and impeller diameter shall be as specified. All openings

and passages shall be large enough to permit passage of a sphere 3" in diameter. Pump motors shall not be overloaded beyond nameplate rating at design conditions or at any head in respective range.

- i. Pressure Rating of Sewage Pumps and Discharge Piping Components: At least equal to sewage pump discharge pressure, but not less than 125 psig.
 - ii. Site power furnished to pump station shall be three phase, 230 volts, maintained within industry standards. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.
- e. Submittals: Submittals shall include shop drawings, electrical ladder logic drawings, and support data as follows: catalog cut sheets showing characteristics for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), hydraulic brake horsepower (BHP), and efficiency (EFF). Electrical components used in the motor branch and liquid level control shall be fully described. Submittals shall be in accordance with the contract documents. Specific products, equipment, and components to be used in the work shall be identified.
- i. Product Data: Include rated capacities; shipping, installed and operating weights; furnished specialties and accessories:
 - 1. Pumps.
 - 2. Motors.
 - 3. Controls and panels.
 - 4. Valves and accessories.
 - 5. Piping.
 - 6. Pump station base and housing.
 - 7. Appurtenances.
 - ii. Shop Drawings: Provide layout of mechanical equipment and anchor bolt locations. Pipe penetrations and station access clearances shall be dimensioned relative to station centerline. Electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits sufficiently to validate function and integration of circuits to form a complete working system. Show fabrication and installation details for each packaged pumping station. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of all field connections.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
 - iii. Product Certificates: For sewage pumps, signed by product manufacturer.
 - iv. Inspection Certification: For sewage pump stations, completed by product manufacturer after inspection of completed installation, to certify that all adjustments have been made, and that the completed installation meets all requirements stipulated in this specification.
 - v. Design Confirmation: Prior to ordering equipment, CONTRACTOR shall have manufacturer confirm that equipment will meet performance parameters.
 - vi. Operation and Maintenance Manual: For packaged pumping stations and all appurtenant equipment.
 - 1. Operation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with

pumps, motors, piping and valves, but lack experience on exact equipment supplied.

2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:
 - a. Functional description of each component complete with operating instructions.
 - b. Instructions for operating pumps and pump controls in all modes of operation.
 - c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
 - d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
 - e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA 79. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.
 - f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.
3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual are not acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with the specifications.
4. Five copies of the operation and maintenance instructions shall be submitted, bound in an 8 1/2" x 11" hardback, three ring binder.
- vii. Warranties: Special warranties specified in this Section.
- viii. As-built Drawings: Marked-up as built drawings shall be supplied to the Engineer upon completion of the project

f. Quality Assurance:

- i. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of piping and specialties, and size, profiles, and dimensional requirements of packaged pumping stations, and are based on the specific system indicated.
- ii. Regulatory Requirements:
 1. Comply with requirements of AMHERST COUNTY SERVICE AUTHORITY for sewage collection and delivery and pump station installation and operation.
 2. Comply with standards of authorities having jurisdiction for sanitary sewage collection and delivery piping, including materials, installation, and testing.

- iii. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- iv. Comply with appended standard details of AMHERST COUNTY SERVICE AUTHORITY.
- v. Installer Qualifications: An authorized representative of packaged pumping station manufacturer for installation and maintenance of units required for this Project.
- vi. The pumps and pump station manufacturer must be certified to ISO 9001 by an accredited certification agency.
- vii. Upon request from the ENGINEER, pump station manufacturer shall prove financial stability and ability to produce station within specified delivery schedules. Evidence of facilities, equipment, and expertise shall demonstrate manufacturer's commitment to long term customer service and product support.
- viii. Pump Performance Certifications:
 - 1. All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the ENGINEER, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.
 - 2. Reprime Performance:
 - a. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.
 - b. The pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rate speed in a completely open system. Neither suction check valve nor external priming device shall be required.
 - c. Pump must be capable of repriming in the specific application at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test:
 - 1) A check valve shall be installed downstream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.
 - 2) A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to atmosphere at all times, duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.
 - 3) The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90° elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.
 - 4) Impeller clearances shall be set as recommended in the pump service manual.
 - 5) Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
 - 6) Liquid to be used for reprime test shall be water.

3. Upon request from the ENGINEER, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.
- ix. **Factory System Test**
1. All internal components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational test shall simulate actual performance anticipated for the complete station.
 2. Upon request from the ENGINEER, the operational test may be witnessed by the ENGINEER, and/or representatives of his choice, at the manufacturer's facility.
 3. The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment.
- x. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- xi. **HI Compliance:** Comply with HI 1.1-1.5 for sewage pumps.
- xii. **NEMA Compliance:** Comply with NEMA MG 1 for electric motors.
- xiii. **UL Comply with NEMA MG 1 for electric motors.**
- g. **Existing Utilities:** Do not interrupt utilities serving facilities occupied by AMHERST COUNTY SERVICE AUTHORITY or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.
- i. Notify ENGINEER not less than two days in advance of proposed utility interruptions.
 - ii. Do not proceed with utility interruptions without ENGINEER's written permission.
 - iii. CONTRACTOR shall contact appropriate utility companies to locate utilities prior to starting construction. Locations of existing facilities should be determined by CONTRACTOR far enough in advance of construction to provide for modification in design, if required. CONTRACTOR shall call "Miss Utility", 800-552-7001.
- h. **Blasting:** Blasting shall be done in strict accordance with Virginia Statewide Fire Prevention Code (VR 394-01-6), latest edition. CONTRACTOR shall adhere to requirements of Amherst County and shall notify the AMHERST COUNTY SERVICE AUTHORITY prior to any blasting.
- i. **Clearing and Erosion Control:**
- i. CONTRACTOR shall be responsible for complying with all provisions of erosion and sediment control plans and notes, including construction, installation, and maintenance of all mechanical and vegetative erosion and sediment control measures for the duration of project. If unforeseen erosion and sediment problems arise during construction, CONTRACTOR shall implement corrective measures acceptable to ENGINEER.
 - ii. Siltation and pollution control requirements for installation, operation, maintenance, and removal shall be in accordance with Virginia Erosion and Sediment Control Manual, latest edition, Virginia Department of Transportation Road and Bridge Specifications, latest edition, and Amherst County Erosion Control Ordinance, latest edition.
 - iii. Only that portion of right-of-way or easement actually needed for construction shall be cleared or used by heavy equipment, unless directed by ENGINEER. In no case shall clearing or debris from clearing operations be taken past right-of-way or

permanent easement lines onto private property. Areas disturbed by construction operations shall be protected from erosion by suitable means outlined in the Amherst County Erosion Control Ordinance. Equipment and materials shall be stored only in approved areas.

- j. Safety: All pertinent safety regulations, including federal and state OSHA standards, shall be followed. In addition, all safety precautions noted on manufacturer's product data sheets and labels shall be observed for both material and equipment. CONTRACTOR shall be responsible for initiating, maintaining, and supervising all safety precautions and programs required in connection with the work.
- k. Waste Areas: Disposal of unsuitable and surplus material will be carried out in accordance with Virginia Department of Transportation Road and Bridge Specifications, except that the CONTRACTOR shall be responsible for obtaining rights to any waste area for disposal of unsuitable or surplus material either shown or not shown on plans. All work in disposing of such material shall be considered incidental to work.
- l. Cleanup: Before final acceptance, all borrow pits, waste areas, storage areas, and all grounds occupied by CONTRACTOR in connection with the work, shall be cleaned of all rubbish, excess materials, and temporary structures, and all parts of work shall be left in a neat and presentable condition.
- m. Coordination:
 - i. Coordinate connection to sanitary sewer main with Authority.
 - ii. CONTRACTOR shall notify owner of property upon which work is to be performed in advance of commencing. In event of necessity of disrupting utility or other services to such property, CONTRACTOR shall notify owner of such utility or other services and arrange for disruption and restoration of such service in a manner which will result in a minimum of inconvenience to parties concerned. CONTRACTOR shall cooperate fully with the AMHERST COUNTY SERVICE AUTHORITY to effect proper coordination and progress to complete Project on schedule and in proper sequence. Insofar as possible, decisions of all kinds required by the AMHERST COUNTY SERVICE AUTHORITY shall be anticipated by CONTRACTOR to provide ample time for inspection, investigation, or preparation of instructions.
- n. Warranty:
 - i. Special Warranty: Manufacturer's standard form, in which manufacturer agrees to repair or replace components of packaged pumping stations that fail in materials or workmanship within specified warranty period.
 - ii. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
 - 1. Fiberglass components of the station enclosure shall be warranted for twenty (20) years to resist UV damage, corrosion from moisture or corrosive soils, or physical failures occurring in normal service, without the need for special protective coatings, when installed according to the manufacturer's recommendations.
 - 2. All other equipment, apparatus, and parts furnished shall be warranted for five (5) years, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, belts, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.
 - iii. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product

or part which fails to properly operate, however caused. Consequential damages resulting from defects in design or delays in delivery are also beyond the manufacturer's scope of liability.

- iv. The warranty shall become effective upon acceptance by the AMHERST COUNTY SERVICE AUTHORITY.

2. Pumps:

- a. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed in this specification.

- b. Materials and Construction Features:

- i. Pump casing: Casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:

- 1. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
 - 2. Fill port coverplate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.
 - 3. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.
 - 4. Liquid volume and recirculation port design shall be consistent with performance criteria listed in this specification.

- ii. Coverplate: Coverplate shall be cast iron Class 30. Design must incorporate following maintenance features.

- 1. Retained by hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wearplate or check valve without removing suction or discharge piping.
 - 2. A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS.
 - 3. In consideration for safety, a pressure relief valve shall be supplied in the cover plate. Relief valve shall open at 75-200 PSI.
 - 4. Two O-rings of Buna-N material shall seal coverplate to pump casing.
 - 5. Pusher bolt capability to assist in removal of coverplate plate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.
 - 6. Easy-grip handle shall be mounted to face of coverplate.

- iii. Rotating Assembly: A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate the following features:

- 1. Sealplate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

- a. The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil

- level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.
- b. The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.
 - c. Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.
2. Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.
 3. Shaft shall be AISI 4140 alloy steel, unless otherwise specified by the ENGINEER, in which case AISI 17-4 pH stainless steel shall be supplied.
 4. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.
 5. Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the sealplate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be Viton. Cage and spring to be AISI 316 stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed in this specification.
 6. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.
- iv. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.
 1. Clearances shall be maintained by external shimless coverplate adjustment, utilizing collar and adjusting screw design for incremental adjustment of clearances by hand. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings.
 2. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above.
 3. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.
 - v. Suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the coverplate opening, without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

- vi. Spool flanges shall be one-piece cast iron, Class 30, fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.
- vii. Pumps to be supplied with a drain kit for ease of maintenance. Kit to contain 10' length of reinforced plastic hose with a female quick connect fitting at one end, and factory installed drain fittings in each pump. Fittings include a stainless steel pipe nipple, stainless steel bushing, stainless steel ball valve and aluminum male quick connect fitting.
- viii. The following minimum spare parts shall be furnished with pump station:
 - 1. One spare pump mechanical seal (complete with sleeve).
 - 2. One cover plate O-Ring.
 - 3. One rotating assembly O-Ring.
 - 4. One set of impeller clearance adjustment shims.

c. Serviceability:

- i. The pump manufacturer shall demonstrate to the ENGINEER's satisfaction that consideration has been given to reducing maintenance costs.
- ii. No special tools shall be required for replacement of any components within the pump.

3. Liquid Level Controls:

- a. Control Sequence of Operation: Cycle each pump on and off automatically to maintain wet-well sewage level. Automatic control operates both pumps in parallel if wet-well level rises above point indicated, until shutoff level is reached. Automatic alternator, with manual disconnect switch, changes sequence of lead-lag pumps at completion of each pumping cycle.
- b. The manufacturer of the liquid level control system must be certified to ISO 9001 by an accredited certification agency.
- c. The level control system shall be capable of operating as either an air bubbler type level control system or a float-type system.
- d. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second pump when the liquid reaches the "lag pump start level" so that both pumps are operating. These levels shall be adjustable as described below.
 - i. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.
 - ii. The electronic pressure switch shall be capable of operating on a supply voltage of 12VDC in an ambient temperature range of -10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Control range shall be 0 to 12.0 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be retained using a non-volatile lithium battery back-up.

- iii. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators and output relays.
 - 1. The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-15 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 0.25% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.
 - 2. The electronic pressure switch shall incorporate a digital back lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet well, and the preset start and stop level for both lead and lag pump. The display shall include twenty (20), 0.19" high alpha-numeric characters calibrated to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.
 - 3. Level adjustments shall be electronic comparator set-points to control the levels at which the lead and lag pumps start and stop. Each of the level settings shall be easily adjustable with the use of membrane type switches and accessible to the operator without opening any cover panel on the electronic pressure switch. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation, or introduction of pressure to the electronic pressure switch.
 - 4. Each output relay in the electronic pressure switch shall be solid state. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. The "ON" state of each relay shall be indicated by illumination of a light emitting diode. Output of each relay shall be individually fused providing overload and short circuit protection. Each output relay shall have an inductive load rating equivalent to one NEMA size 4 contactor. Pilot relay shall be incorporated for loads greater than size 4 contactor.
- iv. The electronic pressure switch shall be equipped with an output board which shall include LED status indicators and a connector with cable for connection to the main unit.
- v. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.
- vi. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.
- vii. The electronic pressure switch shall be capable of controlling liquid levels in either a pump up or pump down application.
- viii. The electronic pressure switch shall be equipped with one (1) 0-33 ft. W.C. input, one (1) scalable analog input of either 0-5VDC, 0-10VDC, or 4-20mA, and one (1) 4-20mA scalable output. Output is powered by 10VDC supply. Load resistance for 4-20mA output shall be 100-400 ohms.
- ix. The electronic pressure switch shall include a DC power supply to convert 120VAC control power to 12VDC EPS power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.
- x. The electronic pressure switch shall be equipped with an electronic comparator and solid state output relay to alert maintenance personnel to a high liquid level in the wet well. An indicator, visible on the front of the control panel, shall indicate that a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.

- e. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be oil tight design with contacts rated NEMA A300 minimum.
- f. Select one or both of first two paragraphs below.
 - i. Primary Liquid Level Control (Self-Purging Air-Bubbler System): Senses variations of sewage level in wet well. Include duplex-arrangement oilless air compressors to furnish bubbler air; filters; air-storage reservoir; piping; airflow meter with needle valve adjustment for airflow regulation; sewage depth gage; air-bubbler piping to wet well; and pressure-sensing, dustproof mercury switches.
 - ii. The primary level control system shall be the air bubbler type, containing air bubbler piping which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.
 - 1. Two vibrating reed, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors delivering greater quantities of air at higher pressures, requiring pressure reducing valves, air storage reservoirs, and other maintenance nuisance items, are not acceptable. A selector switch shall be furnished to provide manual alternation of the air pumps. The switch shall be connected in such a way that either pump may be selected to operate continuously. The switch shall be oil-tight design with contacts rated NEMA A300 minimum.
 - 2. An air bell constructed of PVC 3 inches in diameter shall be provided for installation at the outlet of the air bubbler line in the wet well. The air bell shall have a 3/8" NPT tapped fitting for connection to the bubbler line.
 - 3. An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.
- g. Secondary Liquid Level Control (Intrinsically Safe Mercury Float Switch Type):
 - i. Level control system shall start and stop pump motors in response to changes in wet well level. It shall be mercury float switch type, incorporating intrinsically safe relays. Floats to be secured to vertical pipe in wet well. Rising and falling liquid level in wet well causes switches within floats to open and close, sending start and stop signals to level control system.
 - ii. The level control system shall start and stop the pumps in accordance to the wet well level. Upon operator selection of automatic operation, a float switch shall start one pump motor when water rises to the "lead pump start level". When the water is lowered to the "lead pump stop level", the system shall stop this pump. These actions shall constitute one pumping cycle. Should the water level continue to rise, an additional float switch will start the second pump after reaching the "lag pump start level" so that both pumps operate together. Both pumps shall stop at the same "all pumps off level". Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.
 - iii. Level control system shall work in conjunction with an alternator relay to select first one pump, then the second pump, to run as "Lead" pump. Alternation will occur at end of each pump cycle.
 - iv. Float switches shall be supplied for installation by contractor. Each float shall contain a mercury switch sealed in a polypropylene housing, with 30 feet of power cord, and polypropylene mounting hardware. The float switches shall be secured to a weighted PVC chain.

- v. A junction box shall be supplied for installation in the wet well by the contractor. Junction box shall be NEMA 4X, non-corrosive type incorporating terminal blocks match-marked to terminals in the control panel.
- vi. Intrinsically safe relays shall be supplied in a separate level control enclosure. Relays must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Station manufacturer shall make all connections from relays to feeder lines and motor controls. Installing contractor shall make connections from relays to float switch junction box.
- vii. Separate float switch and intrinsically safe relay shall be used to alert maintenance personnel to high water level in the wet well (low water float switch is optional). Should the wet well level rise to the "high water alarm" level, the float switch assembly and intrinsically safe relay shall energize alarm signal. Alarm signal shall complete a 115-volt AC circuit for external alarm device. An indicator, visible from front of control panel, shall indicate high level condition exists. Alarm signal shall be maintained until wet well level is lowered and alarm circuit manually reset.
- viii. An alarm silence switch and relay shall provide maintenance personnel a means to de-energize the external alarm device while corrective actions are under way. After silencing the alarm, manual reset of the alarm signal shall provide automatic reset of the alarm silence relay.

4. Valves and Piping:

- a. Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O-ring, and shall be replaceable. The valve body shall be cast iron, incorporating a clean-out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings. Shaft nut shall have double O-rings which shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid are not acceptable.
- b. Plug valves shall be of the non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connection drilled to ANSI 125 lb. standard. Valves shall have ports designed to pass spherical solids equal to the pumps capability. Valves shall be furnished with a drip-tight shutoff plug mounted in stainless steel or Teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface.
- c. Automatic air release valves:
 - i. An automatic air release valve shall be furnished for each pump designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.
 - ii. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric-reinforced neoprene or similar inert material.
 - iii. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.
 - iv. Valves shall be field adjustable for varying discharge heads.
 - v. Connection of the air release valves to the station piping shall include stainless steel fittings.

vi. Gauge Kit:

1. A gauge kit shall be supplied for each pump. Suction pressure must be monitored by a glycerin-filled compound gauge, and discharge pressure by a glycerin filled pressure gauge. Gauges to be at least 4 inches in diameter, graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauge shall be graduated -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum.
2. Gauges to be factory mounted on a resilient panel with frame assembly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings, including a shutoff valve for each gauge line at the point of connection to suction and discharge pipes.

d. Piping

- i. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and Class 53 thickness.
- ii. Flanges shall be cast iron Class 125 and comply with ANSI B16.1.
- iii. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.
- iv. Bolt holes shall be in angular alignment within 1/2 between flanges. Flanges shall be faced with a gasket finish.
- v. CONTRACTOR shall insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

5. Drive Unit:

a. Motors (Note; Maximum motor frame size is 326T open drip-proof).

- i. Pump motors shall be of horsepower and RPM specified by ENGINEER, 3 phase, 230 VAC, horizontal ODP, NEMA design B with cast iron frame with copper windings, induction type, with Class F insulation and 1.15 service factor for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.
- ii. Motors shall be tested in accordance with provisions of ANSI/IEEE Std 112.

6. Drive Transmission:

- a. Power to pumps transmitted by or via V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions.
- b. Each drive assembly shall utilize at least two V-belts providing minimum a combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5 are not acceptable. Computation of safety factors shall be based on performance data published by the drive manufacturer.
- c. The pump manufacturer shall submit power transmission calculations which document the following:
 - i. Ratio of pump/motor speed.
 - ii. Pitch diameter of driver and driven sheaves.
 - iii. Number of belts required per drive.
 - iv. Theoretical horsepower transmitted per belt, based on vendor's data.
 - v. Center distance between pump and motor shafts.
 - vi. Arc-length correction factor applied to theoretical horsepower transmitted.
 - vii. Service factor applied to established design horsepower.
 - viii. Safety factor ratio of power transmitted/brake horsepower required.

- ix. Pump drives to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed 1/2 inch.
 - 1. Guards shall be completely removable without interference from any unit component, and shall be securely fastened and braced to the unit base.
 - 2. Metal to be free from burrs and sharp edges. Structural joints shall be continuously welded. Rivet spacing on panels shall not exceed five inches. Tack welds shall not exceed four inch spacing.
 - 3. The guard shall be finished in accordance with Section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.
- 7. Painting: Pumps, piping, and exposed steel framework shall be cleaned prior to painting. Exposed surfaces to be coated with one coat gray W.R. non-lift primer and one coat white acrylic alkyd W.R. enamel. Paint shall be low VOC, alkyd based, high solids, semi-gloss white enamel for optimum illumination enhancement, incorporating rust inhibitive additives. The finish coat shall be 1.0 to 1.2 MIL dry film thickness (minimum), resistant to oil mist exposure, solvent contact, and salt spray. The factory finish shall allow for over-coating and touch up after final installation.
- 8. Electrical Control Components:
 - a. The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.
 - b. Panel Enclosure:
 - i. Electrical control equipment shall be mounted within a common NEMA 1 stainless steel, dead front type control enclosures. Doors shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on removable steel back panel secured to enclosure with collar studs.
 - ii. All control devices and instruments shall be mounted using threaded fasteners and clearly labeled to indicate function.
 - c. Branch Components:
 - i. Motor branch components to be of highest industrial quality, secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; self-tapping screws shall not be used to mount any component.
 - ii. Circuit Breakers and Operating Mechanisms:
 - 1. A properly sized heavy duty circuit breaker shall be furnished for each pump motor. Circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.
 - 2. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position.
 - d. Motor Starters:
 - i. Open frame, across-the-line, NEMA rated magnetic starter with under-voltage release and overload protection on all phases to be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least 2 auxiliary contacts. Starters rated "O", "OO", or fractional size are not acceptable. Power

contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils shall be easily replaceable without removing starter from its mounted position. Each starter shall have a metal mounting plate for durability.

- ii. Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, re-establishing control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection.
- iii. A reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the door.
- iv. Transient Voltage Surge Suppressor: A transient voltage surge suppressor shall be furnished to minimize damage to pump motors and control as result of transient voltage surges. The suppressor shall utilize metal-oxide varistors encapsulated in a non-conductive housing. The arrester shall be rated 480 volts RMS nominal with a discharge capability of 2000 amps.

e. Control Circuit

- i. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
- ii. Pump mode selector switches shall permit manual start or stop of each pump individually or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be oil-tight design with contacts rated NEMA A300 minimum.
- iii. Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.
- iv. Six digit elapsed time meter (non-reset type) shall be connected to each motor starter to indicate total running time of each pump in "hours" and "tenths of hours". Separate pilot lights shall be provided to indicate which motor is energized and should be running.
- v. A high pump temperature protection circuit shall override the level control and shut down the pump motors when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing. If casing temperature rises to a level sufficient to cause pump damage, the high pump temperature protection circuit shall interrupt power to the pump motor. A visible indicator, mounted through control panel door shall indicate motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.
- vi. A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.
- vii. Wiring:
 - 1. The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the main entrance terminal blocks and final connections to remote alarm devices.
 - 2. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).
 - 3. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:
 - a. Black: Line and Load Circuits, AC or DC power
 - b. Red: AC Control Circuit Less Than Line Voltage
 - c. Blue: DC Control Circuit

- d. Yellow: Interlock Control Circuit, from External Source
- e. Green: Equipment Grounding Conductor
- f. White: Current Carrying Ground
- g. Orange: Hot With Circuit Breaker Open

4. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.
5. Motor branch and other power conductors shall not be loaded above 60°C temperature rating, on circuits of 100 amperes or less, nor above 75°C on circuits over 100 amperes. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.
6. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.

viii. Factory installed conduit shall conform to following requirements:

1. All conduit and fittings to be UL listed.
2. Liquid tight flexible metal conduit to be constructed of smooth, flexible, galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
3. Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
4. Conduit shall be sized to meet National Electric Code.

ix. Grounding:

1. Station manufacturer shall ground all electrical equipment inside pump station to control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.
2. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

x. Equipment Marking:

1. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
 - a. Equipment serial number.
 - b. Supply voltage, phase and frequency.
 - c. Current rating of the minimum main conductor.
 - d. Electrical wiring diagram number.
 - e. Motor horsepower and full load current.
 - f. Motor overload heater element.
 - g. Motor circuit breaker trip current rating.
 - h. Name and location of equipment manufacturer.

2. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.
 3. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above, the device.
9. Alarm Light (External): Station manufacturer will supply one 115 VAC alarm light fixture with vapor-tight red globe, guard, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the contractor.

10. Alarm Monitoring System:

- a. Equipment: CONTRACTOR shall furnish and install an automatic alarm system equivalent to Verbatim Series VSS system with SCADA system manufactured by RACO Manufacturing and Engineering Co. (see Appendix E). The unit shall be mounted in a watertight enclosure NEMA Type 3R as specified in detail drawings with the bottom of the enclosure 42" from ground level and mounted on a 36" by 36" concrete pad directly adjacent to the steel electrical circuit panel control panel box, approximately 6' from the fiberglass pump station hood.
- b. Types of Alarms: The automatic alarm system shall be equipped and programmed to begin its dial-out sequence for the following conditions:
 - i. High water level in the wet well
 - ii. Failure of either pump to come on
 - iii. Power failure at the pump station
- c. Programmed Telephone Numbers: The following telephone numbers shall be programmed into the alarm system. The alarm system will dial these numbers (in order) until the alarm is acknowledged. Acknowledgement of an alarm is to be accomplished by pressing the number "9" on a touch tone telephone.

Amherst County Service Authority Filter Plant SCADA modem.....384-2109

Amherst County Service Authority Filter Plant voice.....384-1979

Note: Do not under any circumstances program any more phone numbers into the unit, like Home Phone numbers, Cell Phone numbers, Sheriff's Department, pagers, etc.

- d. Miscellaneous Programming and Other Options Required: The following items shall be programmed into the unit at start-up via the stored program in the computer at the filter plant by Computer & Terminal Services, Inc., or included with the unit.
 - i. A phone line that is terminated at the TELCO Customer Interface Device within 2 feet of the weathertight enclosure for the Verbatim unit by the phone company, and is then to be connected to the jack installed inside the weathertight enclosure.
 - ii. A 180 second delay before an alarm response is activated.
 - iii. Run time meters for both pumps in each pump station shall be connected and set to "0".
 - iv. Alarm reset time shall be set at 30 minutes.
 - v. 24 hour battery backup life.
 - vi. An American Power Conversion (APC) PRO3T surge protector is to be installed with the power cord and the telephone line from Verbatim unit connected through the (APC) PRO3T.
 - vii. NEMA 3R Enclosure.
 - viii. A thermostatically controlled heater shall be installed within the weathertight enclosure.

- ix. The unit shall include all necessary components for connection to the Service AMHERST COUNTY SERVICE AUTHORITY's SCADA System, and shall be connected to that SCADA system and shall provide both voice and digital alarms.
- e. Warranty: The automatic alarm system shall be covered by a two (2) year warranty covering parts and labor performed at the Factory. This does not alleviate the CONTRATOR of his 12 month warranty of the project.
- f. The enclosure must be: Hoffman A-24R248HCLO - 24" by 24" Hinged cover type 3R medium enclosure, Hoffman A-24R24 – Panel, Hoffman A-PMK3RLO14 Panel mounting kit.
- g. A Hoffman D-AH2001A heater shall be installed inside the weathertight enclosure as shown on detail drawings.
- h. The phone cable will be run from the TELCO Customer interface to inside of the weathertight enclosure to an RJ11 jack mounted to the back panel. A phone cable RJ11 to RJ11 will be installed from the phone jack inside the weathertight enclosure to the American Power Conversion PRO7T surge protector in the jack labeled "IN". A 3' phone cable will be attached inside of the Raco/Verbatim control box with a RJ11 plug on the other end of the cable to attach to the APC PRO7T surge protector in the jack labeled "OUT".
- i. The Raco/Verbatim control unit will have a 16 gauge SJT cord hard wired inside the Raco/Verbatim unit with a 3 prong plug on the other end to plug into one of the APC PRO7T outlets. The APC PRO7T will plug into the receptacle mounted inside the weathertight enclosure.

APPENDIX A



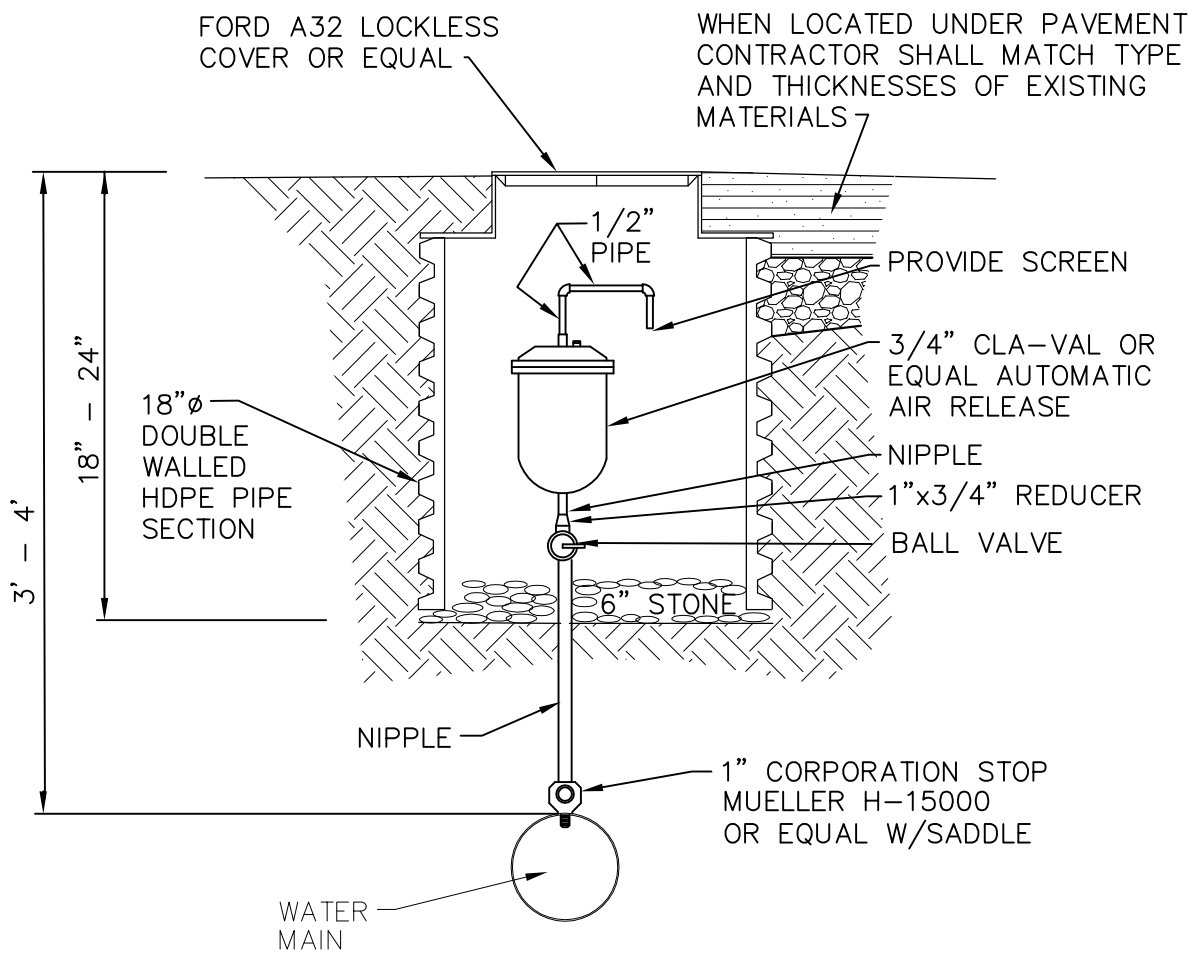
STANDARD DETAILS

STANDARD DETAILS INDEX

<u>DETAIL</u>	<u>REV. DATE</u>
AR-1 Automatic Air Release Valve Assembly - Water, Type I	5/13/03
AR-2 Offset Automatic Air Release Valve Assembly - Water, Type II	5/13/03
AR-3 Automatic Air Release Valve Assembly-Sewer	4/3/09
BO-1 BlowOff Assembly, Type I	1/07
BO-2 Mid-Line BlowOff Assembly, Type II	12/06
BP-3 Backflow Preventer Reduced Pressure Zone - Commercial Irrigation	7/13/07
CA-1 Concrete Anchor – For Horizontal and Sag Anchors	11/08
CA-2 Concrete Anchor – For Crest Anchors	4/15/03
CA-3 Concrete Anchor – For Water and Force Mains	9/30/99
CA-4 Concrete Anchor – Gravity Sanitary Sewer Anchor, Grades Over 16%	9/30/99
CA-5 Water Line Bulkhead Permanent End-of-Line BlowOff Anchor Detail	1/07
CA-6 Water Line Bulkhead Anchor With Temporary BlowOff Detail	10/08
CA-7 Water Line Bulkhead Anchor For 2" Water Service Extension Detail	10/08
CA-B Values of B (in feet) For Vertical Pipe Anchors	9/30/99
CE-1 Concrete Encasement – For Underground Piping	1/07
CE-2 Crossing Encasement – Storm Sewer Crossing Sanitary Sewer	4/15/03
CO-1 Sanitary Cleanout Type 1 – Terminal Line Cleanout	3/10
CO-2 Sanitary Cleanout Type 2	9/10
CO-T Cleanout Cover – Traffic Bearing	9/30/99
CS-1 Sealed Casing Installation Spider	9/30/99
CS-2 Typical Water or Sewer Main Location within VDOT Right-of-Way	2/16
FC-1 Standard Manhole Frame & Cover – Sewer Project	4/15/03
FC-2 Watertight Manhole Frame & Cover – Sewer Project	4/15/03
FC-3 Inflow Prevention Insert for Standard Manhole Frame & Cover (FC-1)	2/08

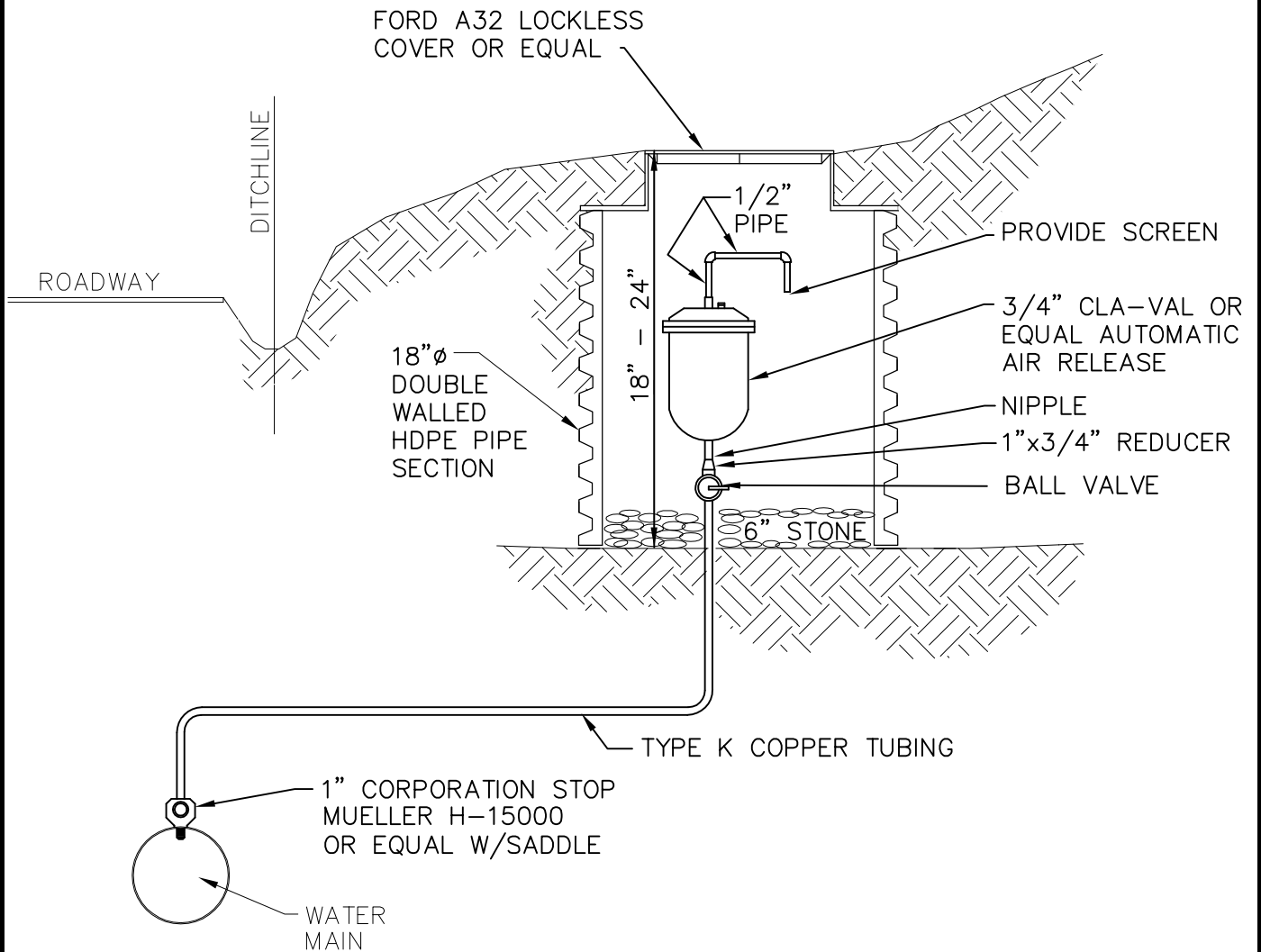
FH-1 Fire Hydrant Setting	5/10
FP-1 Fire Protection Vault – Private Sprinklers / F.H., 2” – 10”	12/12
GT-1 1,000 Gal Non-Traffic Rated Grease Interceptor	6/13
GT-2 1,000 Gal Traffic Rated Grease Interceptor	6/13
GT-3 1,500 Gal Non-Traffic Rated Grease Interceptor	6/13
GT-4 1,500 Gal Traffic Rated Grease Interceptor	6/13
HC-1 House Connection – Sanitary Sewer Crossing Water Line	1/07
HC-2 House Connection – Sanitary Sewer Crossing Storm Sewer	12/06
HC-3 House Connection – Sanitary Sewer	12/06
HC-4 Sanitary Sewer Roof Drain Disconnection	4/15/03
LD-1 Line Purge Diffuser/Dechlorinator	9/30/99
M-1 Meter Installation, 3” And Above	10/08
M-2 Meter Installation, 1.5” & 2”	1/12
M-3 Meter Installation, 5/8” & 1”	1/12
M-4 Double Residential Water Meter Installation	1/12
M-5 Triple Residential Water Meter Installation	1/12
MH-1 Precast 4’ Manhole	3/10
MH-2 Precast Concrete Manhole – For Use on Existing Lines	3/10
MH-3 Sanitary Sewer Precast Drop Manhole – Eccentric with monolithic base	3/10
MH-4 Inlet Shaping	4/3/09
MS-1 Standard Manhole Step	4/15/03
PS-1 Sanitary Sewer Pump Station	11/18/03
PS-2 Private Sewage Pump Station Connection	6/09
PS-3 Private Sewage Pump Station Component Location Plan View	12/13
PS-4 Private Sewage Pump Station Overflow Storage Installation	12/13
PS-5 Sewage Force Main Terminal Flushing Cleanout End of Line	1/12

PS-6	Low Pressure Sewage Force Main Residential Connection	2/16
PS-7	Sewage Pump Station Slab Mounting Detail	2/16
PS-8	Residential E-One Model 2010-74 Sewage Pump Station Installation	2/16
PS-9	Grinder Sewage Pump Station	2/16
PSEBV-1	Sanitary Sewer Pump Station Emergency Bypass Vault	11/23/04
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RV-2	Pressure Reducing Valve – Individual Service	5/13/03
TB-1	Trench Bed – Sanitary Sewer	1/07
TB-2	Trench Bed – Storm Sewer	5/13/03
TB-3	Trench Bed – Water Main	8/07
TB-4	Trench Bed – Force Main / Sanitary Sewer Parallel Installation	1/07
TB-5	Open Cut Trench/Road Repair - Water & Sewer	2/16
TB-6	Open Cut Concrete Drive Repair - Water & Sewer	2/16
VB-1	Valve Box Installation	3/10
VB-2	Valve Box Pre-Cast Slab Shoulder Installation	5/10
WE- 1	Weathertight Enclosure For Pump Station Alarm Monitor	4/22/02

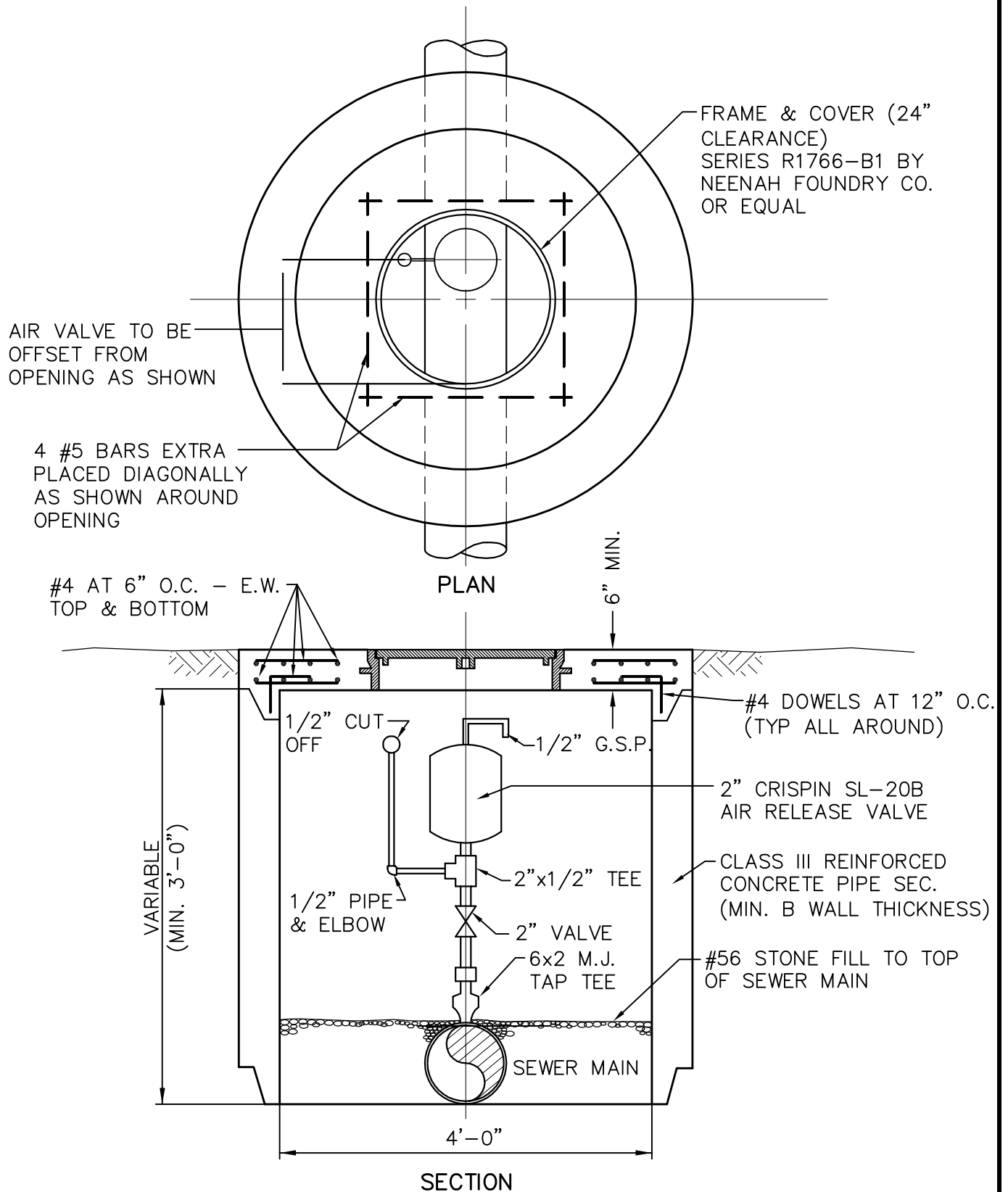


AUTOMATIC AIR RELEASE VALVE ASSEMBLY, TYPE I

N.T.S.



OFFSET AUTOMATIC AIR RELEASE VALVE
ASSEMBLY-WATER, TYPE II
 N.T.S.



AUTOMATIC AIR RELEASE VALVE ASSEMBLY-SEWER

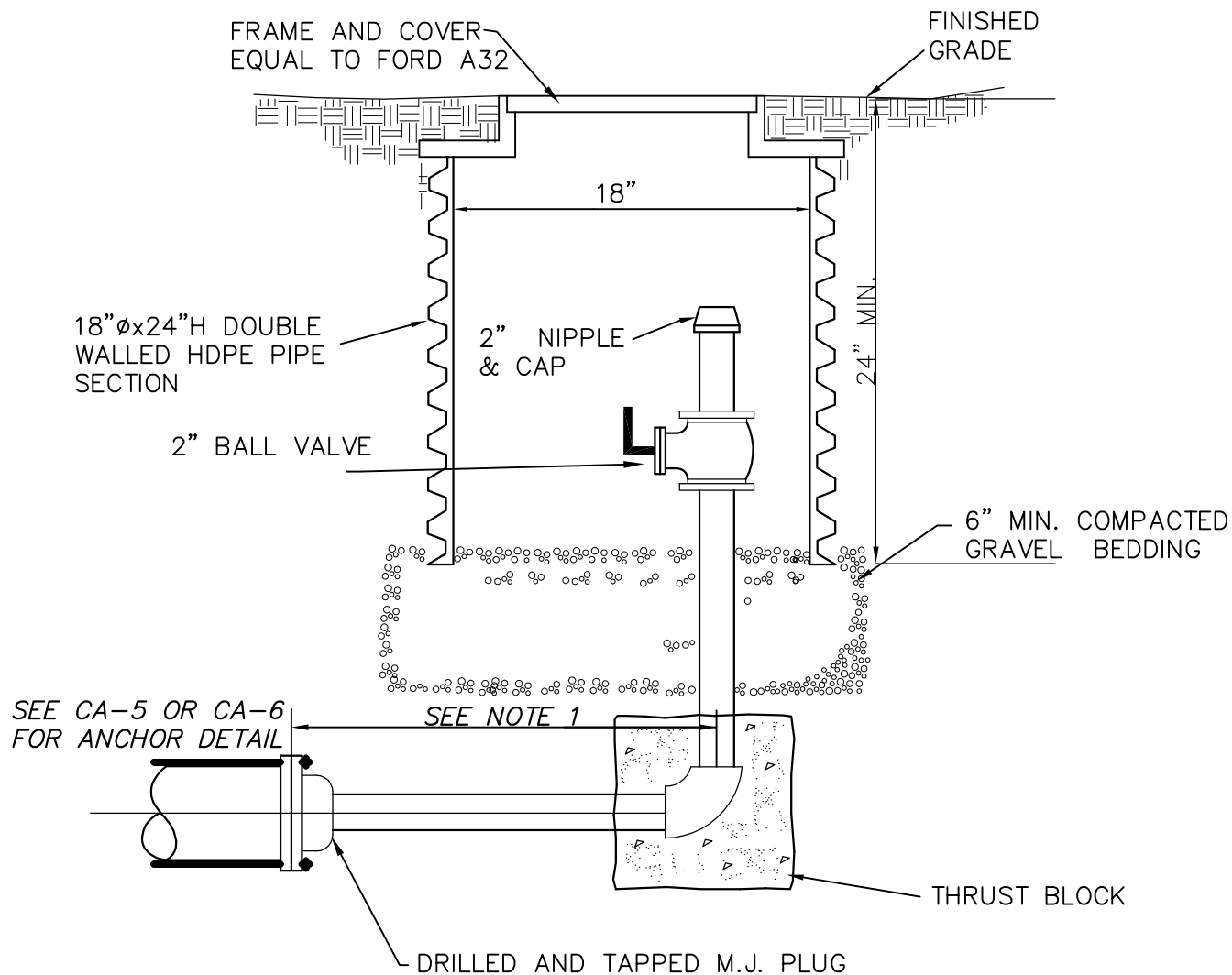
N.T.S.

04/03/09



AMHERST COUNTY
SERVICE AUTHORITY

AR-3



NOTE:
FOR USE AT TERMINAL END OF MAIN

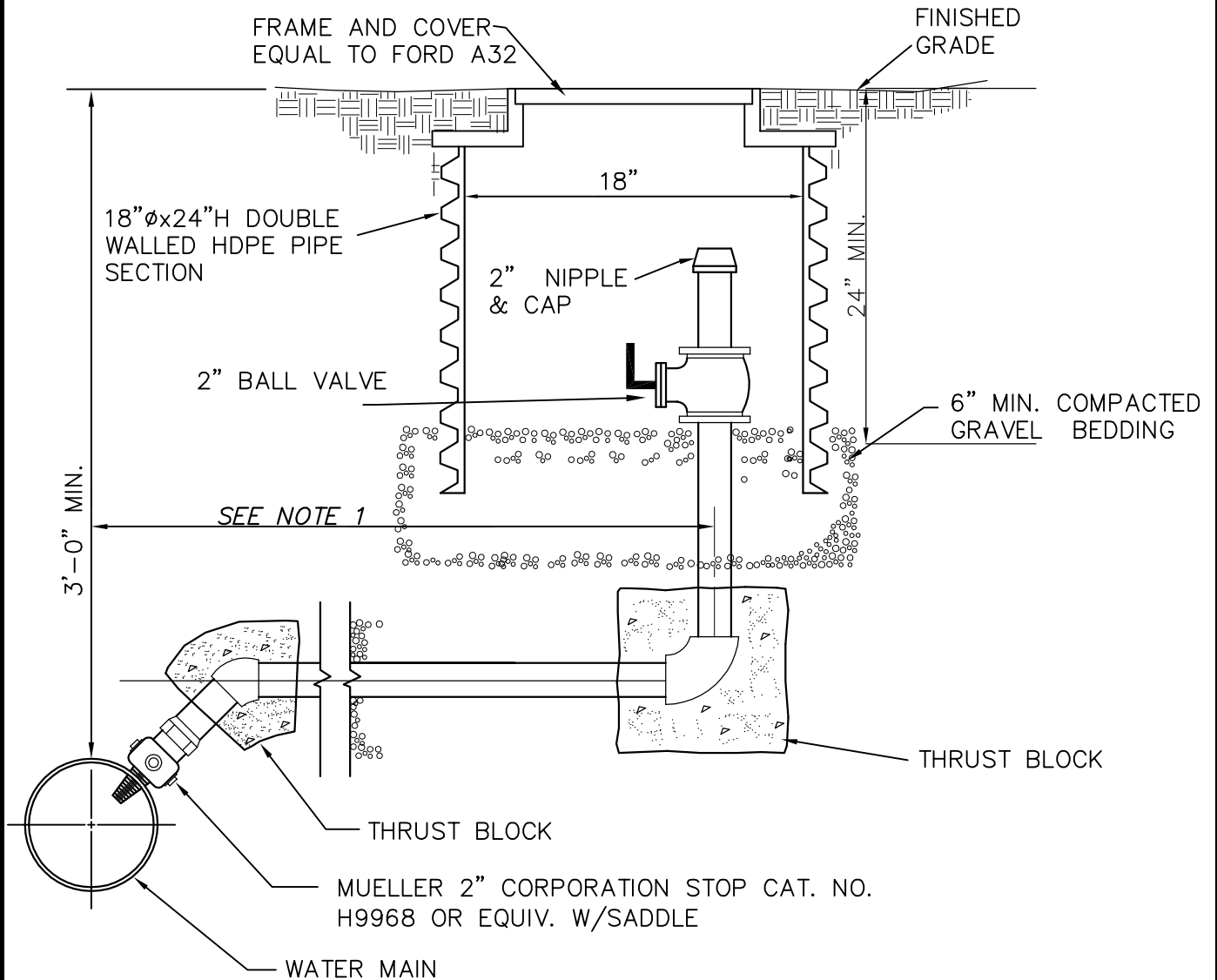
BLOWOFF ASSEMBLY, TYPE I

N.T.S.

NOTES:

1. IF DISTANCE FROM 2" TAP AT END OF MAIN TO BLOWOFF EXCEEDS 12", 2" NIPPLE MUST BE BRASS.
2. IF WATER MAIN IS 2" IN ACCORDANCE WITH DETAIL CA-7, ALL BLOWOFF PIPING MUST BE 1" COPPER TUBING WITH 1" BALL VALVE.





NOTE:
6" & LARGER WATER MAIN = 2" BLOWOFF

MID-LINE BLOWOFF ASSEMBLY

TYPE II
N.T.S.

NOTE: 1. 2" WATER LINE FROM MAIN TO THRUST BLOCK BELOW BLOWOFF ASSEMBLY WILL BE BRASS OR COPPER.

REV. 12/06



AMHERST COUNTY
SERVICE AUTHORITY

B0-2

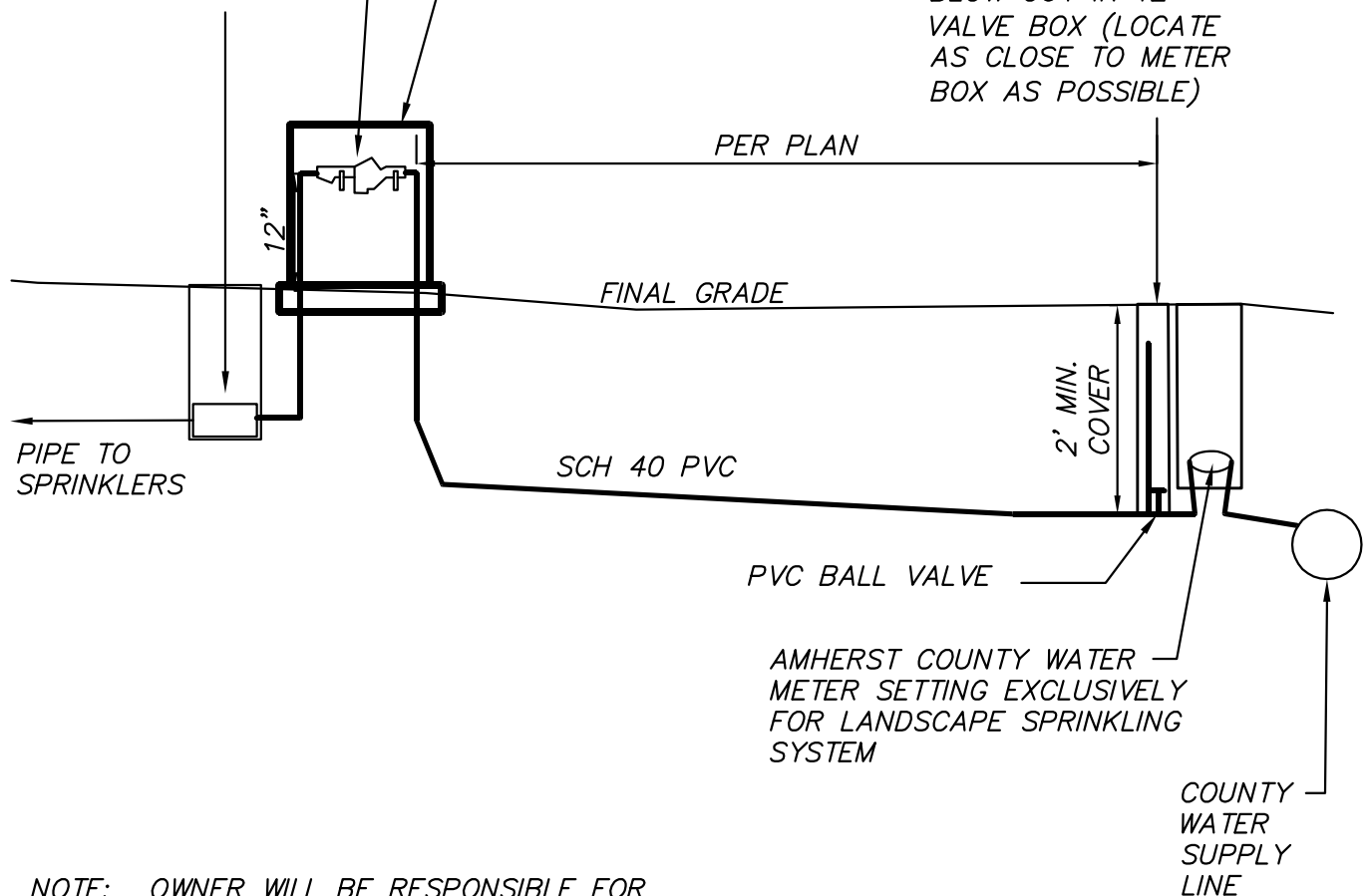
WATTS SERIES 909
REDUCED PRESSURE ZONE (RPZ)
BACKFLOW PREVENTER OR
APPROVED EQUAL (SIZED FOR
SPECIFIC APPLICATION)

HEATED ENCLOSURE ON CONCRETE SLAB,
SIZED TO FIT RPZ. (EQUAL TO WATTSBOX®
OR HOT BOX®)

**THIS ENCLOSURE MAY NOT BE ELIMINATED
UNLESS THE OWNER ESTABLISHES AN ANNUAL
WINTERIZATION CONTRACT TO PROTECT THE
RPZ AND SPRINKLER SYSTEM**

ELECTRONIC
SPRINKLER VALVE
CONTROLS
INSTALLED PER
MANUFACTURER

CAPPED PVC
EXTENSION FOR
ANNUAL COMPRESSED
AIR WINTERIZATION
BLOW OUT IN 12"
VALVE BOX (LOCATE
AS CLOSE TO METER
BOX AS POSSIBLE)



NOTE: OWNER WILL BE RESPONSIBLE FOR
MAINTENANCE AND OPERATIONS OF SPRINKLER
SYSTEM AND ALL EQUIPMENT ON OWNER SIDE OF
METER SETTING; **INCLUDING ANNUAL TESTING OF
RPZ AND PROTECTION OF RPZ FROM FREEZING.**

BACK FLOW PREVENTER REDUCED PRESSURE ZONE FOR LANDSCAPE IRRIGATION

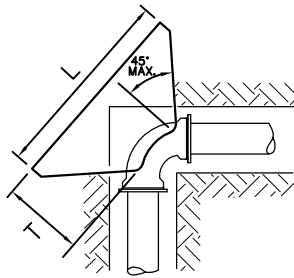
N.T.S.

REV - 07/13/07

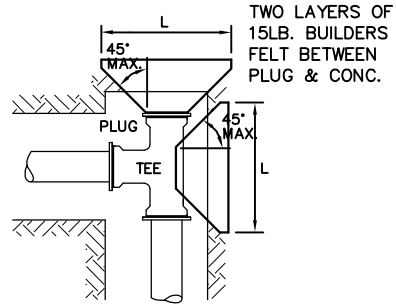


AMHERST COUNTY
SERVICE AUTHORITY

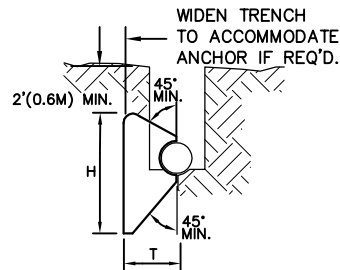
BP-3



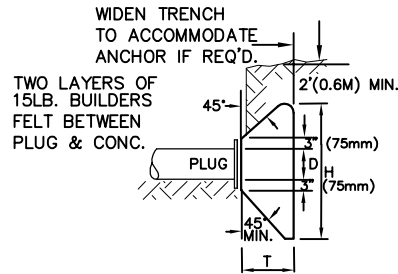
FOR ALL BENDS



FOR TEE AND PLUG FITTINGS



SECTION FOR BEND
AND TEE ANCHORS



SECTION FOR
PLUG ANCHORS

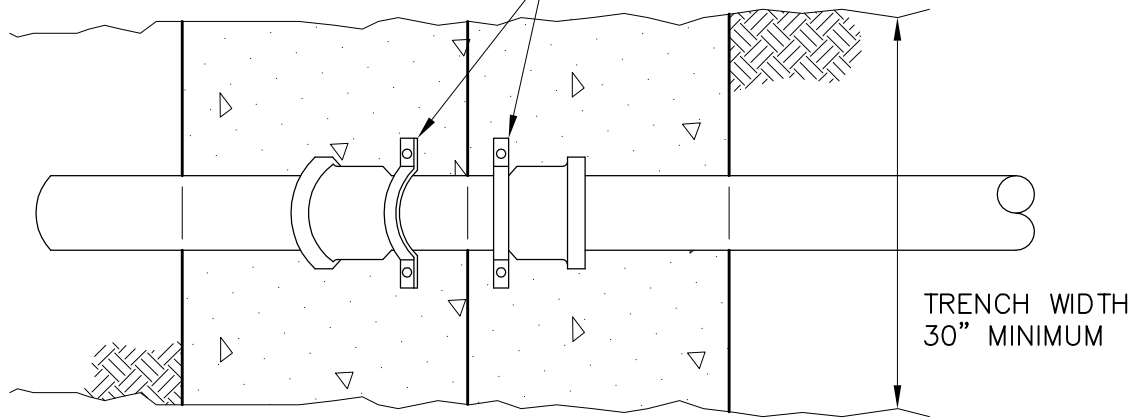
TYPE "F" ANCHOR BLOCK FOR 250 PSI WORKING PRESSURE										
TYPE FITTING	PIPE SIZE, INCH	DIMENSIONS (FT)			VOL. CONC. CU. YARDS	PIPE SIZE, mm	DIMENSIONS (M)			VOL. CONC. CU. METERS
		L	H	T			L	H	T	
90°	4	2.50	2.50	3.00	0.23	100	0.75	0.75	0.90	0.17
45°	4	1.50	2.00	2.50	0.09	100	0.45	0.60	0.75	0.07
22.5°	4	1.50	2.00	2.50	0.09	100	0.45	0.60	0.70	0.06
11.25°	4	1.50	2.00	2.50	0.09	100	0.45	0.60	0.70	0.06
TEE	4	2.00	2.00	2.50	0.12	100	0.60	0.65	0.70	0.09
PLUG	4	2.00	2.00	2.33	0.11	100	0.60	0.65	0.70	0.09
90°	6	3.50	3.00	3.00	0.45	150	1.10	0.90	0.90	0.30
45°	6	2.50	2.50	2.50	0.19	150	0.75	0.75	0.80	0.15
22.5°	6	1.50	2.00	2.50	0.09	150	0.45	0.60	0.75	0.07
11.25°	6	1.50	2.00	2.50	0.09	150	0.45	0.60	0.75	0.07
TEE	6	3.00	2.75	2.50	0.26	150	0.90	0.85	0.75	0.19
PLUG	6	3.00	2.75	2.50	0.26	150	0.90	0.85	0.75	0.19
90°	8	4.75	3.75	3.25	0.72	200	1.45	1.15	1.00	0.56
45°	8	3.75	3.25	2.75	0.42	200	1.10	1.00	0.85	0.31
22.5°	8	2.50	2.50	2.75	0.21	200	0.75	0.75	0.80	0.15
11.25°	8	2.00	2.25	2.75	0.15	200	0.55	0.65	0.80	0.10
TEE	8	4.25	3.50	2.75	0.50	200	1.25	1.05	0.80	0.35
PLUG	8	4.25	3.50	2.75	0.50	200	1.25	1.05	0.80	0.35
90°	10	4.75	3.74	3.21	0.71	250	4.75	3.74	3.21	0.71
45°	10	3.66	3.16	2.77	0.42	250	3.66	3.16	2.77	0.42
22.5°	10	2.40	2.41	2.69	0.19	250	2.40	2.41	2.69	0.19
11.25°	10	1.80	2.16	2.67	0.13	250	1.80	2.16	2.67	0.13
TEE	10	4.16	3.41	2.66	0.49	250	4.16	3.41	2.66	0.49
PLUG	10	4.16	3.41	2.66	0.49	250	4.16	3.41	2.66	0.49
90°	12	4.75	3.74	3.21	0.71	300	4.75	3.74	3.21	0.71
45°	12	3.66	3.16	2.77	0.42	300	3.66	3.16	2.77	0.42
22.5°	12	2.40	2.41	2.69	0.19	300	2.40	2.41	2.69	0.19
11.25°	12	1.80	2.16	2.67	0.13	300	1.80	2.16	2.67	0.13
TEE	12	4.16	3.41	2.66	0.49	300	4.16	3.41	2.66	0.49
PLUG	12	4.16	3.41	2.66	0.49	300	4.16	3.41	2.66	0.49

CONCRETE ANCHORS

N.T.S.



1/2" X 2 1/2" STAINLESS STEEL STRAP



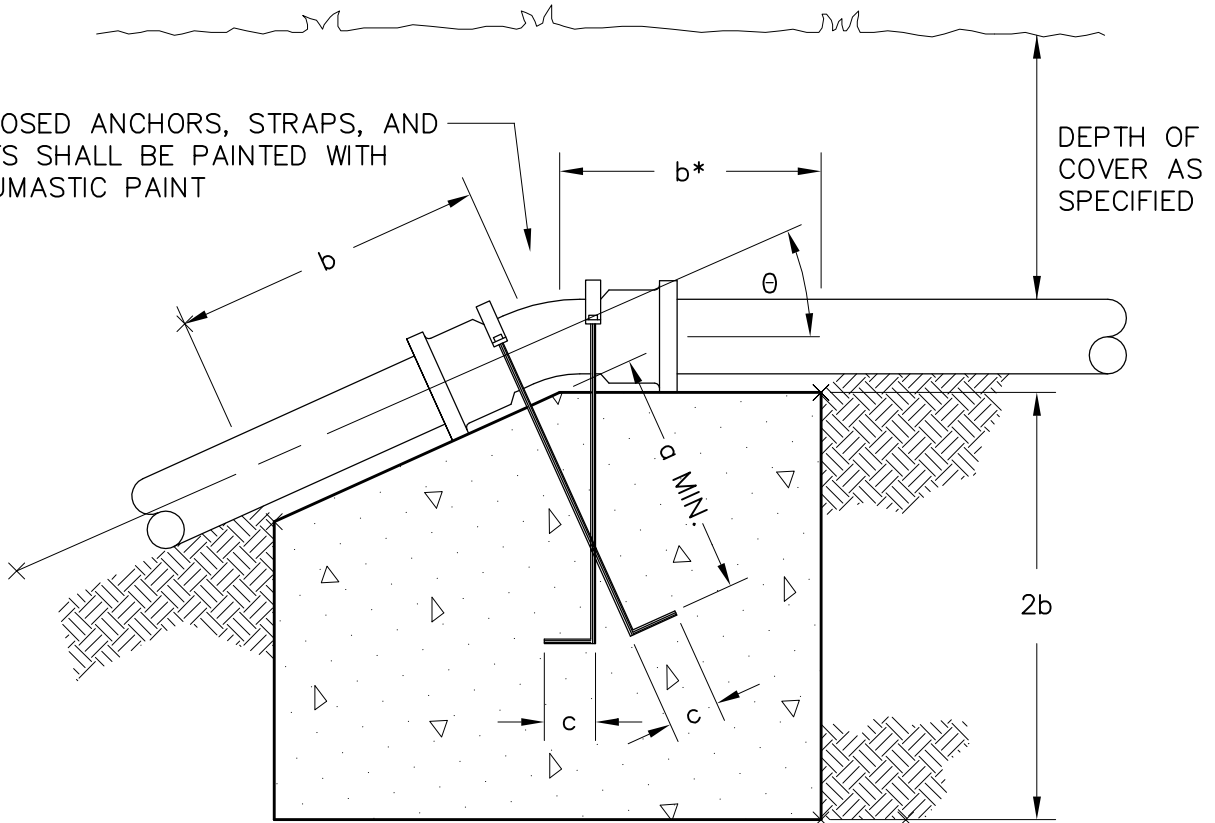
NOTES:

1. FITTING FLANGE BOLTS SHALL REMAIN FREE OF CONCRETE
2. DO NOT BACKFILL UNTIL CONCRETE HAS SET FOR A MINIMUM OF 4 HOURS

PLAN

REDUCE "b" DIMENSION IN SOLID ROCK AS APPROVED BY ENGINEER.

EXPOSED ANCHORS, STRAPS, AND NUTS SHALL BE PAINTED WITH BITUMASTIC PAINT



ANCHOR BOLT SIZE			
b	dia.	a	c
0 to 1'-0"	5/8"	8"	3 3/4"
1'-1" to 2'-6"	5/8"	12"	3 3/4"
2'-7" to 3'-0"	3/4"	12"	4 1/2"
3'-1" to 3'-5"	7/8"	12"	5 1/4"

PROFILE

* USE "b" VALUES AS SHOWN ON PLAN

CONCRETE ANCHOR-CREST ANCHORS

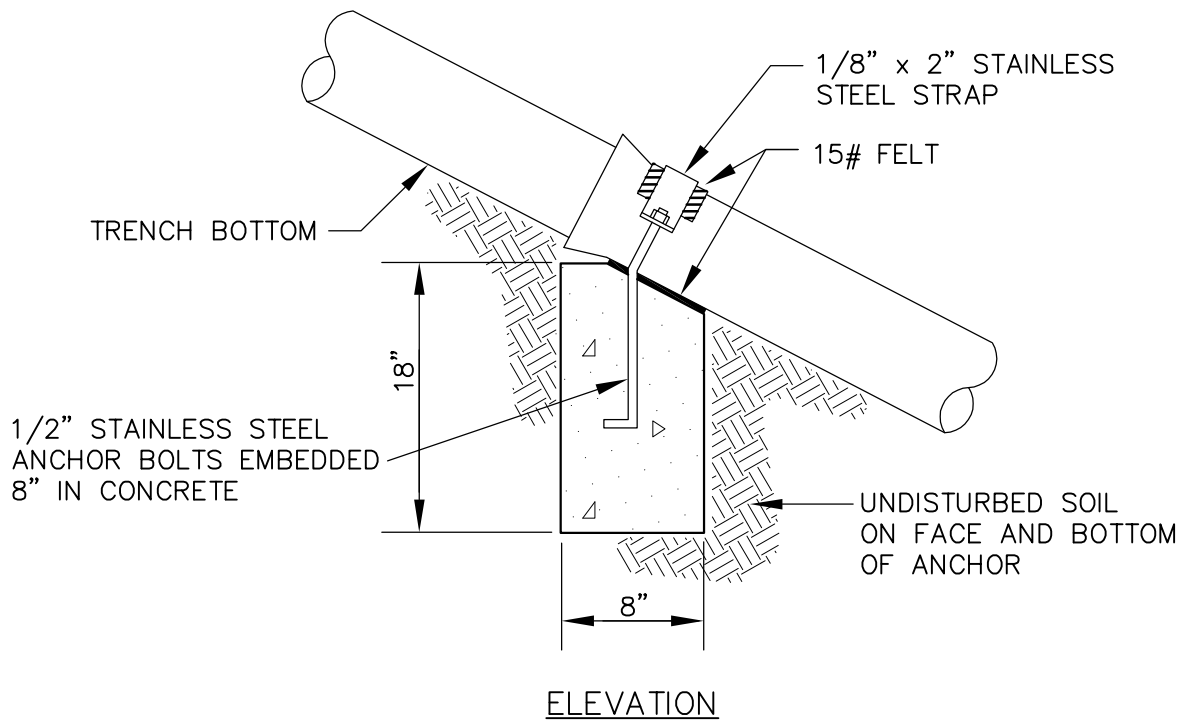
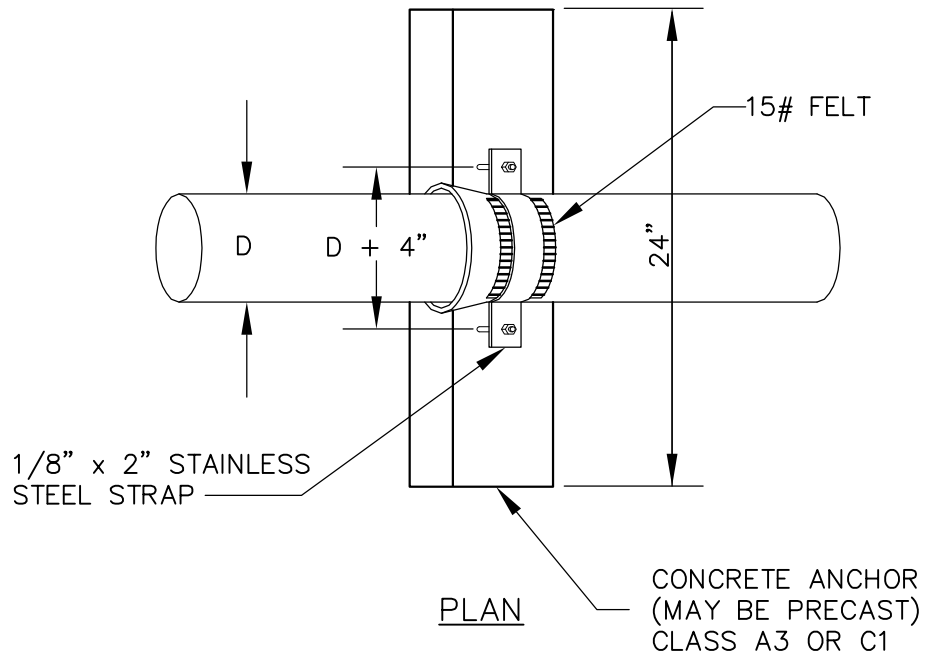
N.T.S.

04/15/03



AMHERST COUNTY
SERVICE AUTHORITY

ANCHORS SHALL BE SPACED
AS SHOWN ON PLAN



CONCRETE ANCHOR FOR WATER & FORCE MAINS

N.T.S.

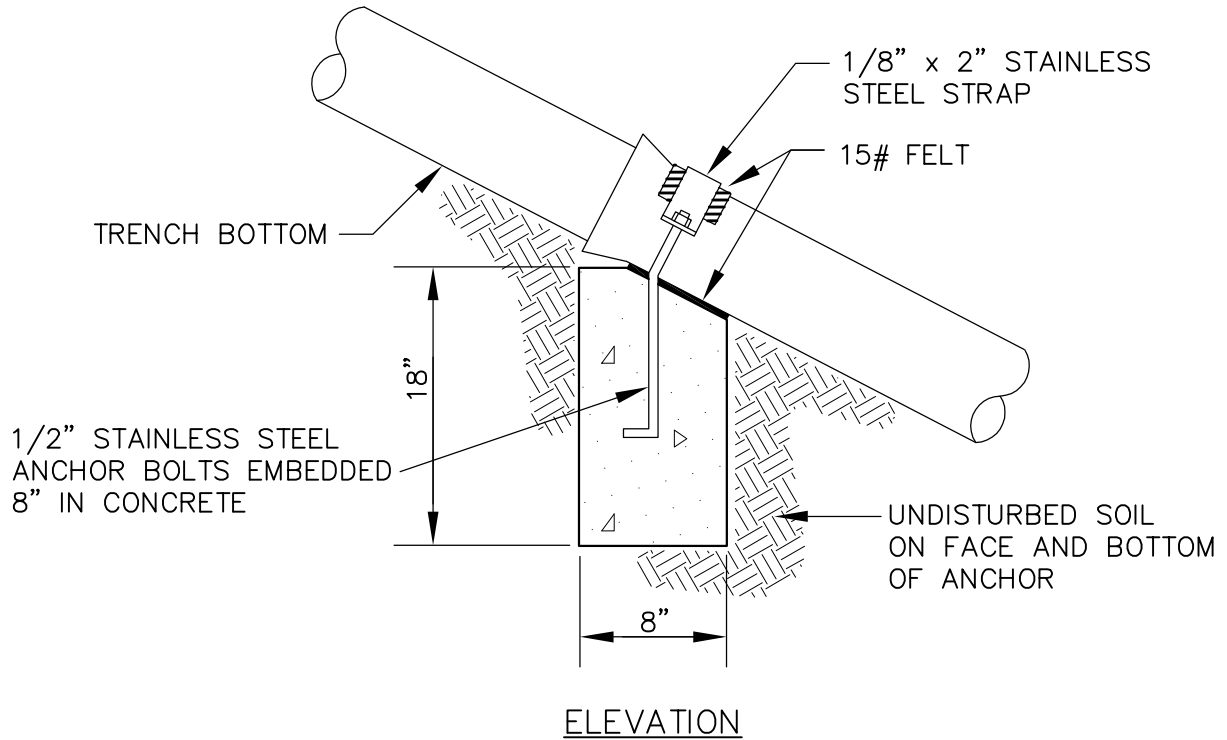
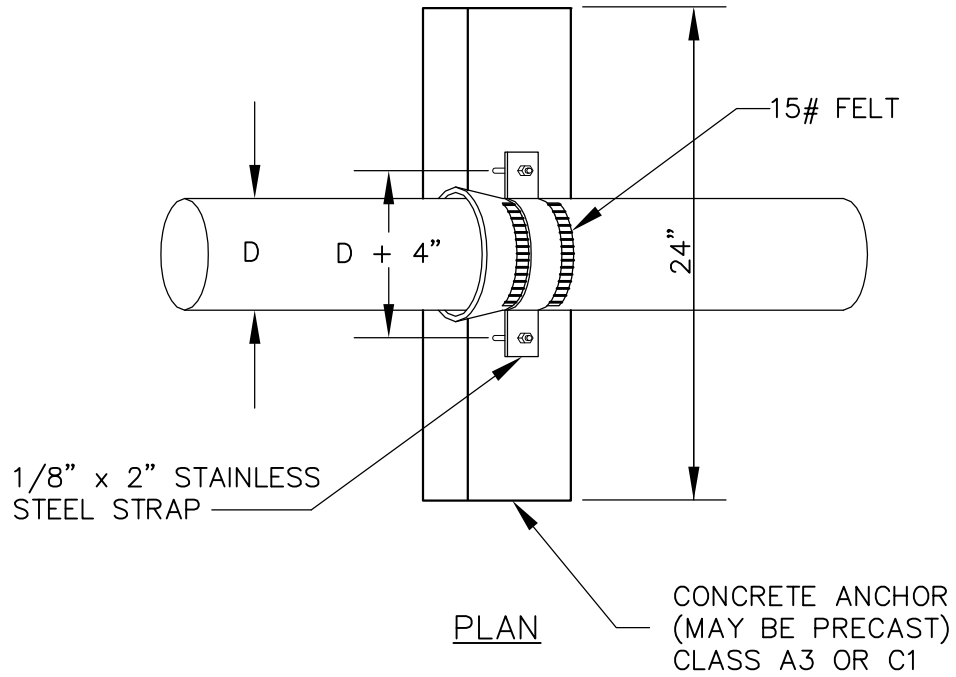
09/30/99



AMHERST COUNTY
SERVICE AUTHORITY

CA-3

ANCHORS SHALL BE SPACED
AS SHOWN ON PLAN



CONCRETE ANCHOR—GRAVITY SANITARY SEWER ANCHOR

WHERE GRADES EXCEED 16%

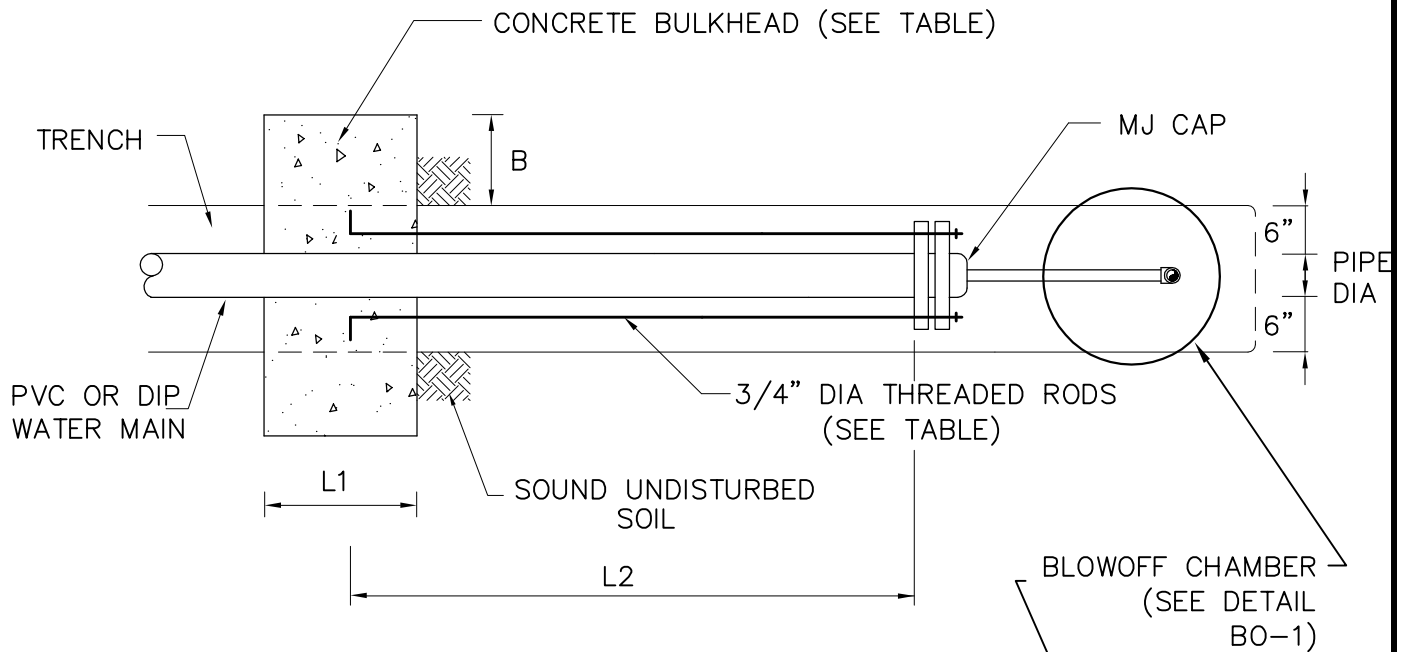
N.T.S.

09/30/99

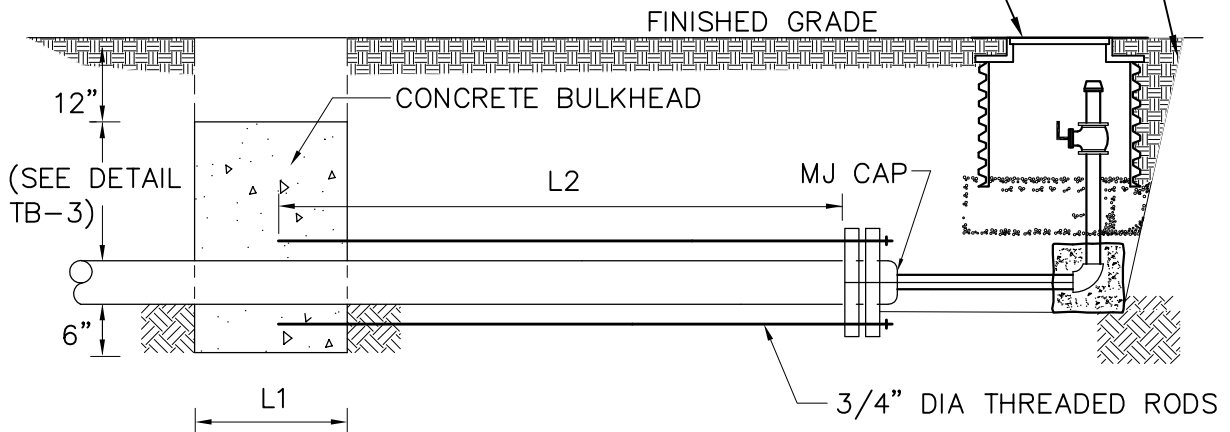


AMHERST COUNTY
SERVICE AUTHORITY

CA-4



PLAN VIEW



SECTION VIEW

RETAINER GLAND FOR PVC PIPE SHALL BE SERIES 2000 PV, AND FOR DIP SERIES 1100, BY EBAA IRON SALES, INC. "MEGA-LUG" OR APPROVED EQUAL

PIPE DIAMETER (in)	B min (in)	L1 min (in)	NUMBER OF RODS PER RETAINER	L2 min (in)
4-8	12	18	2	27
10-12	27	33	2	50
14-16	44	50	4	75

NOTE: FOR USE WITH TEST OR WORKING PRESSURES 200 PSI OR LESS.

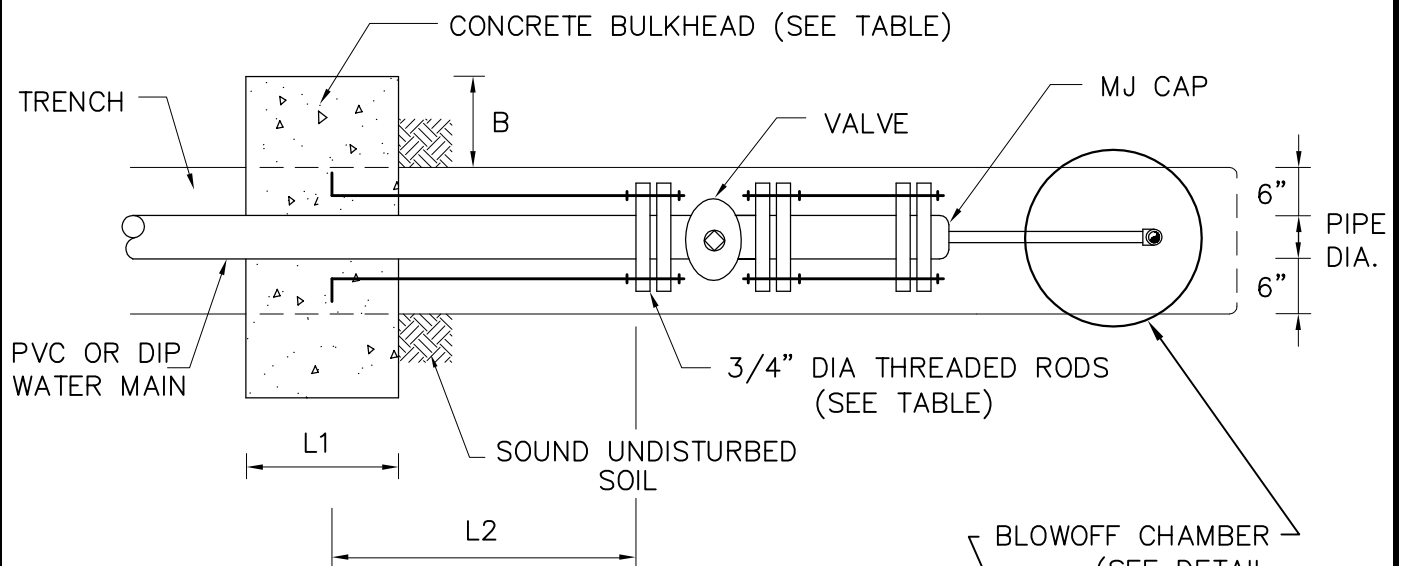
**WATERLINE BULKHEAD PERMANENT
END-OF-LINE BLOWOFF ANCHOR DETAIL**

N.T.S.

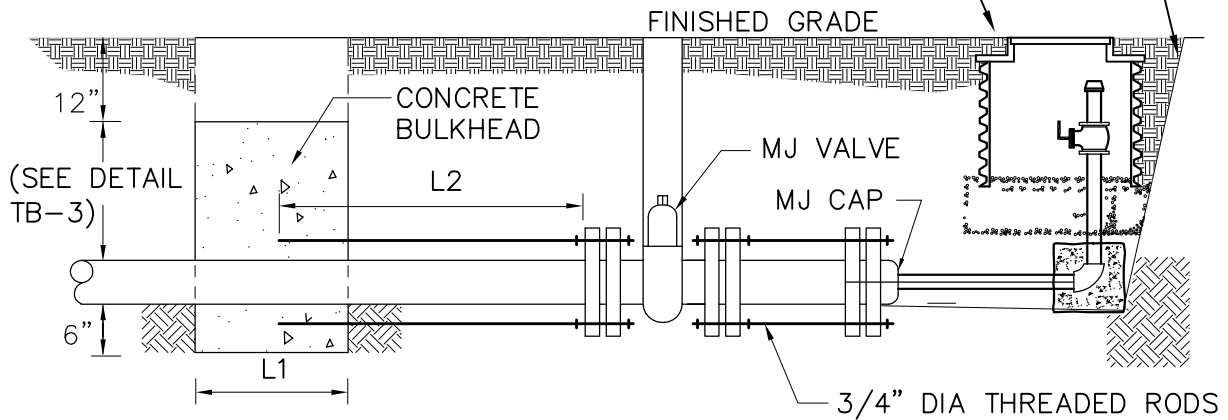
REV. 1/07



AMHERST COUNTY
SERVICE AUTHORITY



PLAN VIEW



SECTION VIEW

NOTES:

1. RETAINER GLAND FOR PVC PIPE SHALL BE SERIES 2000 PV, AND FOR DIP SERIES 1100, BY EBAA IRON SALES, INC. "MEGA-LUG" OR APPROVED EQUAL.
2. GATE VALVES, 2" THRU 12" - MUELLER A-2360 RESILIENT WEDGE GATE VALVES.
3. GATE VALVES, 14" AND LARGER - MUELLER A-2361 RESILIENT WEDGE GATE VALVES.

PIPE DIAMETER (in)	B min (in)	L1 min (in)	NUMBER OF RODS PER RETAINER	L2 min (in)
4-8	12	18	2	27
10-12	27	33	2	50
14-16	44	50	4	75

NOTE: FOR USE WITH TEST OR WORKING PRESSURES 200 PSI OR LESS.

REV. 10/08

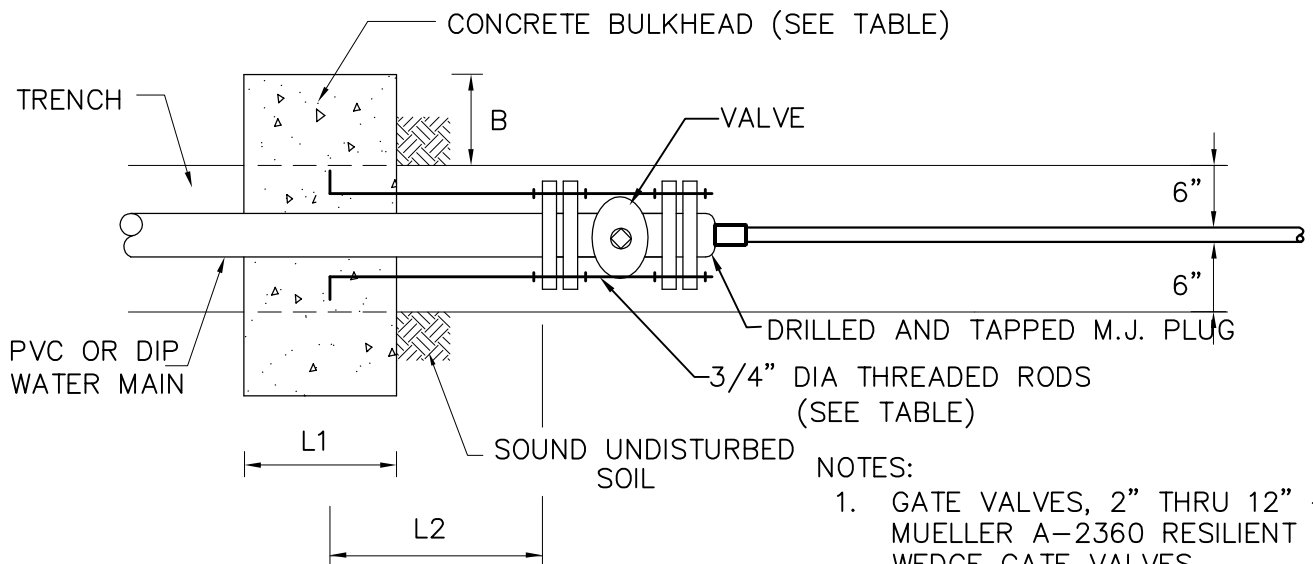


AMHERST COUNTY
SERVICE AUTHORITY

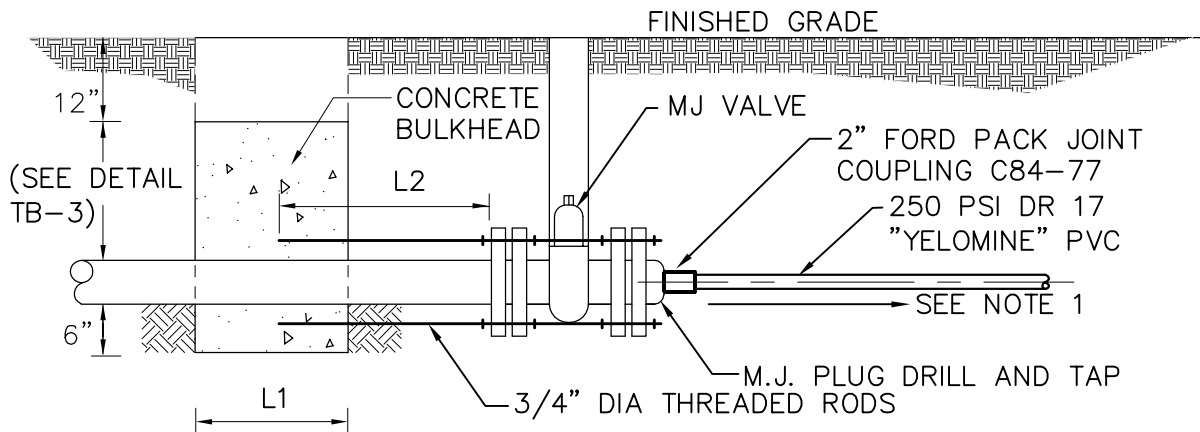
**WATERLINE BULKHEAD ANCHOR WITH
TEMPORARY BLOWOFF DETAIL**

N.T.S.

CA-6



PLAN VIEW



SECTION VIEW

RETAINER GLAND FOR PVC PIPE SHALL BE SERIES 2000 PV, AND FOR DIP SERIES 1100, BY EBAA IRON SALES, INC. "MEGA-LUG" OR APPROVED EQUAL

PIPE DIAMETER (in)	B min (in)	L1 min (in)	NUMBER OF RODS PER RETAINER	L2 min (in)
4-8	12	18	2	27
10-12	27	33	2	50
14-16	44	50	4	75

NOTE:

1. 2" WATER MAINS ARE ONLY ALLOWED IN SELECTIVE LOCATIONS APPROVED BY ACSA. NO MORE THAN 300 LF OF 2" WATER LINE MAY BE ALLOWED NEAR A CUL-DE-SAC, SERVING A MAXIMUM OF 6 DWELLINGS.

NOTE: FOR USE WITH TEST OR WORKING PRESSURES 200 PSI OR LESS.

REV. 10/08



AMHERST COUNTY
SERVICE AUTHORITY

WATER LINE BULKHEAD ANCHOR FOR 2" WATER MAIN EXTENSION DETAIL

N.T.S.

CA-7

TRENCH WIDTH = 2.0' DEPTH OF COVER = 30"

SIZE		PRESSURE					
$\theta=45^\circ$		50	100	150	200	250	300
<u>6" AS SHOWN</u>	4"	0.56	0.86	1.09	1.27	1.43	1.58
	6"	0.91	1.34	1.67	1.94	2.17	2.38
	8"	1.24	1.81	2.24	2.59	2.91	3.19
	10"	1.57	2.27	2.81	3.25	3.64	4.00
	12"	1.90	2.74	3.37	3.91	4.38	4.80
<u>$\theta=22.5^\circ$</u>	4"	0.30	0.54	0.70	0.83	0.94	1.04
	6"	0.56	0.88	1.10	1.29	1.45	1.60
	8"	0.80	1.20	1.49	1.74	1.96	2.15
	10"	1.02	1.51	1.88	2.19	2.46	2.69
	12"	1.24	1.83	2.27	2.63	2.96	3.25
<u>$\theta=11.25^\circ$</u>	4"	—	0.30	0.43	0.54	0.61	0.69
	6"	0.30	0.56	0.72	0.86	0.98	1.08
	8"	0.48	0.79	1.00	1.18	1.33	1.47
	10"	0.64	1.01	1.27	1.49	1.68	1.85
	12"	0.79	1.22	1.54	1.80	2.03	2.23

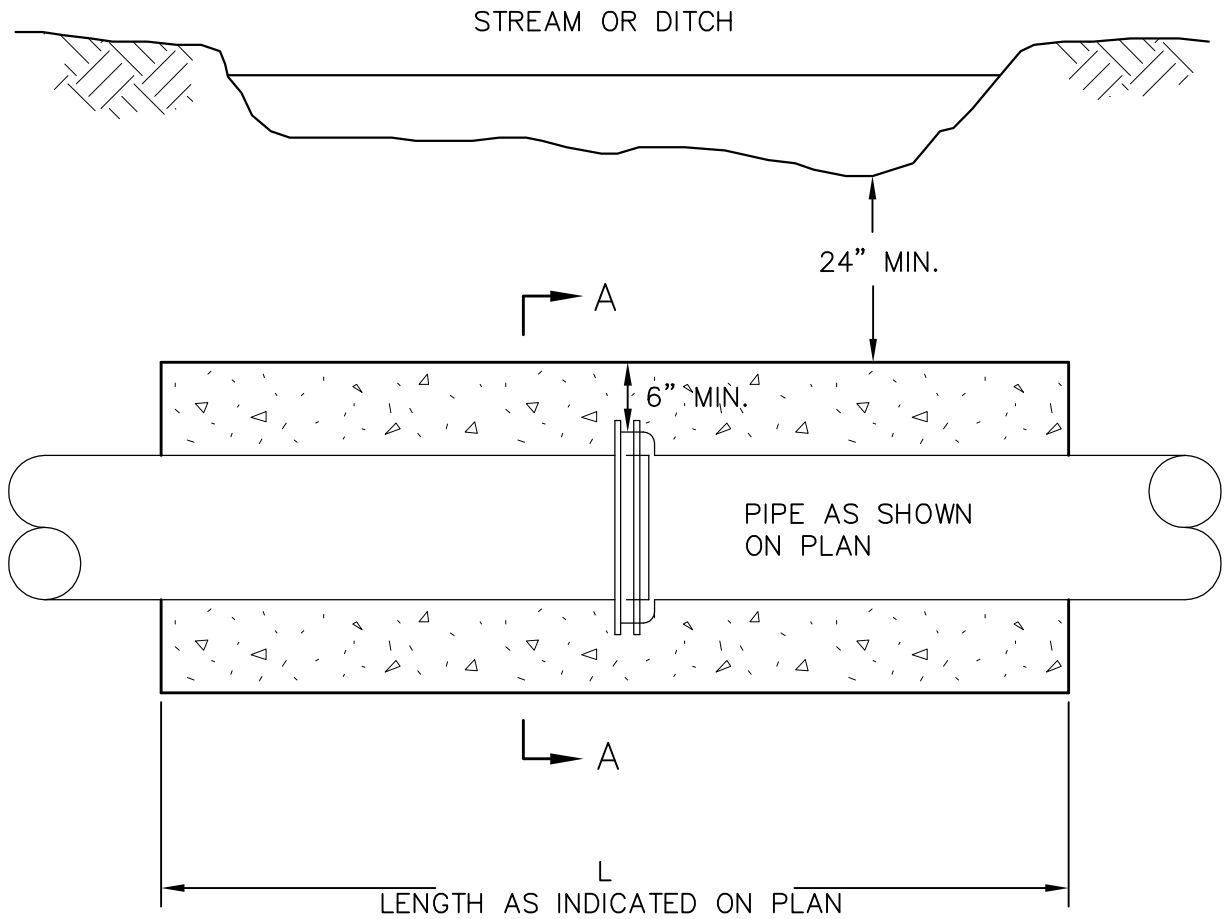
TRENCH WIDTH = 3.0' DEPTH OF COVER = 42"

SIZE		PRESSURE					
$\theta=45^\circ$		50	100	150	200	250	300
<u>6" AS SHOWN</u>	4"	0.36	0.65	0.85	1.01	1.15	1.27
	6"	0.70	1.07	1.35	1.58	1.78	1.95
	8"	0.99	1.47	1.83	2.13	2.39	2.63
	10"	1.27	1.86	2.31	2.68	3.01	3.30
	12"	1.55	2.25	2.78	3.23	3.62	3.97
<u>$\theta=22.5^\circ$</u>	4"	0.02	0.37	0.52	0.64	0.74	0.82
	6"	0.39	0.68	0.88	1.04	1.18	1.30
	8"	0.61	0.96	1.21	1.42	1.60	1.76
	10"	0.81	1.23	1.54	1.80	2.02	2.22
	12"	1.00	1.49	1.86	2.17	2.44	2.68
<u>$\theta=11.25^\circ$</u>	4"	—	0.05	0.26	0.36	0.44	0.51
	6"	0.07	0.39	0.55	0.67	0.77	0.86
	8"	0.32	0.60	0.79	0.94	1.08	1.19
	10"	0.47	0.81	1.02	1.21	1.37	1.51
	12"	0.61	0.98	1.25	1.47	1.66	1.83

VALUES OF B (IN FEET) FOR VERTICAL PIPE ANCHORS

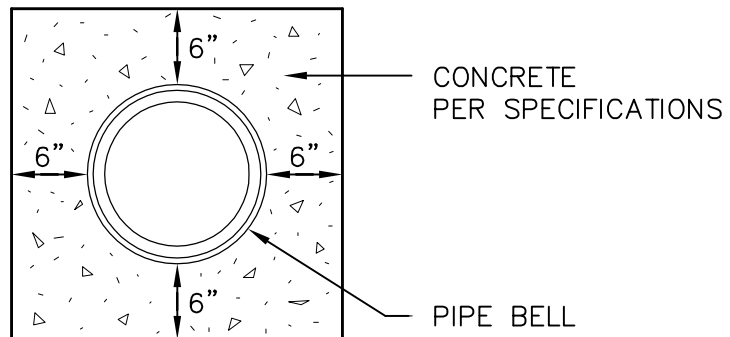
N.T.S.





PROFILE

FOR CONCRETE ARCH
WHERE CALLED FOR ON
PLANS, ELIMINATE
CONCRETE BELOW PIPE,
EXTEND TO TRENCH
WALL AND SET L=18".



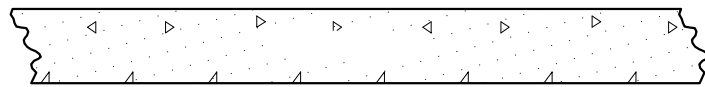
SECTION A-A

CONCRETE ENCASEMENT
N.T.S.

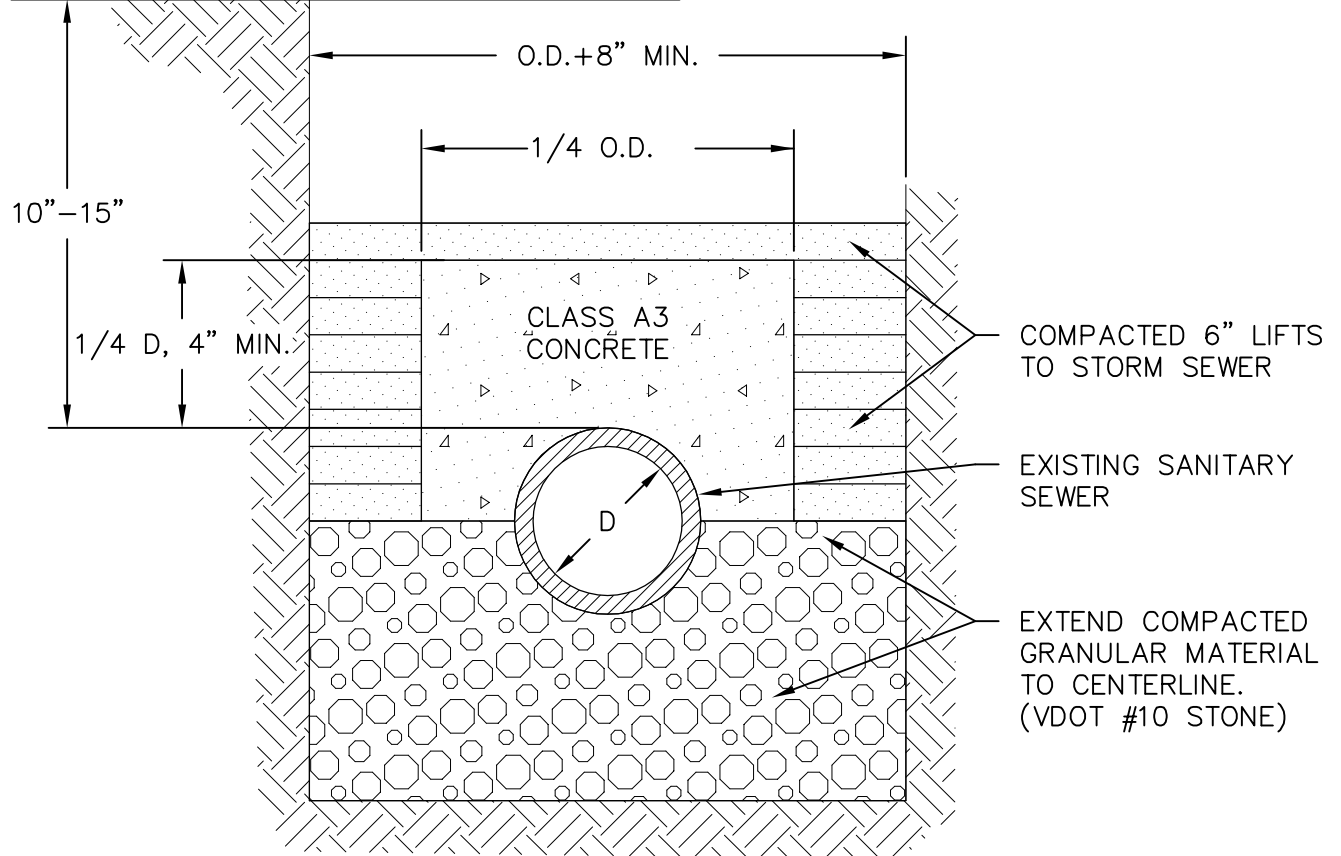
REV. 1/07



AMHERST COUNTY
SERVICE AUTHORITY



STORM SEWER
CROSSING OVER
SANITARY



O.D.=OUTSIDE DIAMETER
OF EXISTING PIPE

CONCRETE ENCASEMENT— STORM SEWER CROSSING SANITARY SEWER N.T.S.

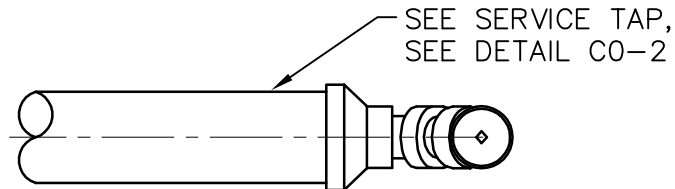
04/15/03



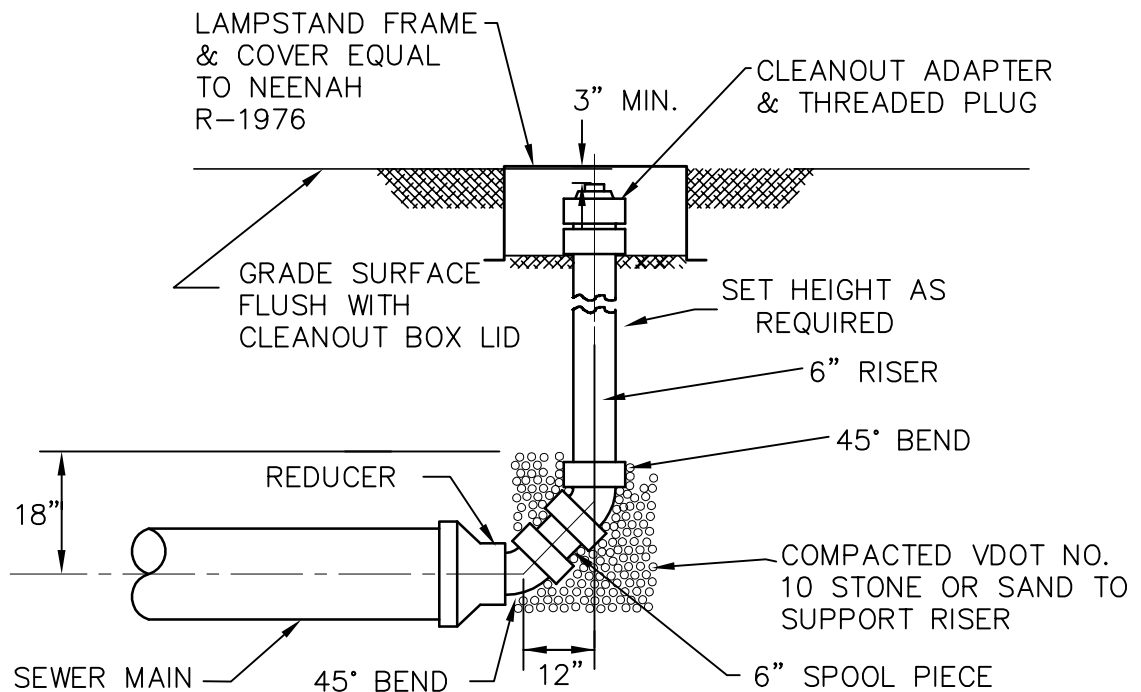
AMHERST COUNTY
SERVICE AUTHORITY

NOTE:

ANY CLEANOUT NOT IN A PUBLIC ROAD RIGHT OF WAY WILL HAVE PLACED IN ITS IMMEDIATE VICINITY A METAL FENCE POST TO FACILITATE LOCATION. FENCE POST SHALL BE 8' LONG, WITH TOP 2' PAINTED FLOURESCENT ORANGE, AND AT LEAST 18" IN GROUND.



PLAN



ELEVATION

TERMINAL LAMPSTAND
SANITARY CLEANOUT TYPE I
TERMINAL LINE CLEANOUT

N.T.S.

REV. 03/10

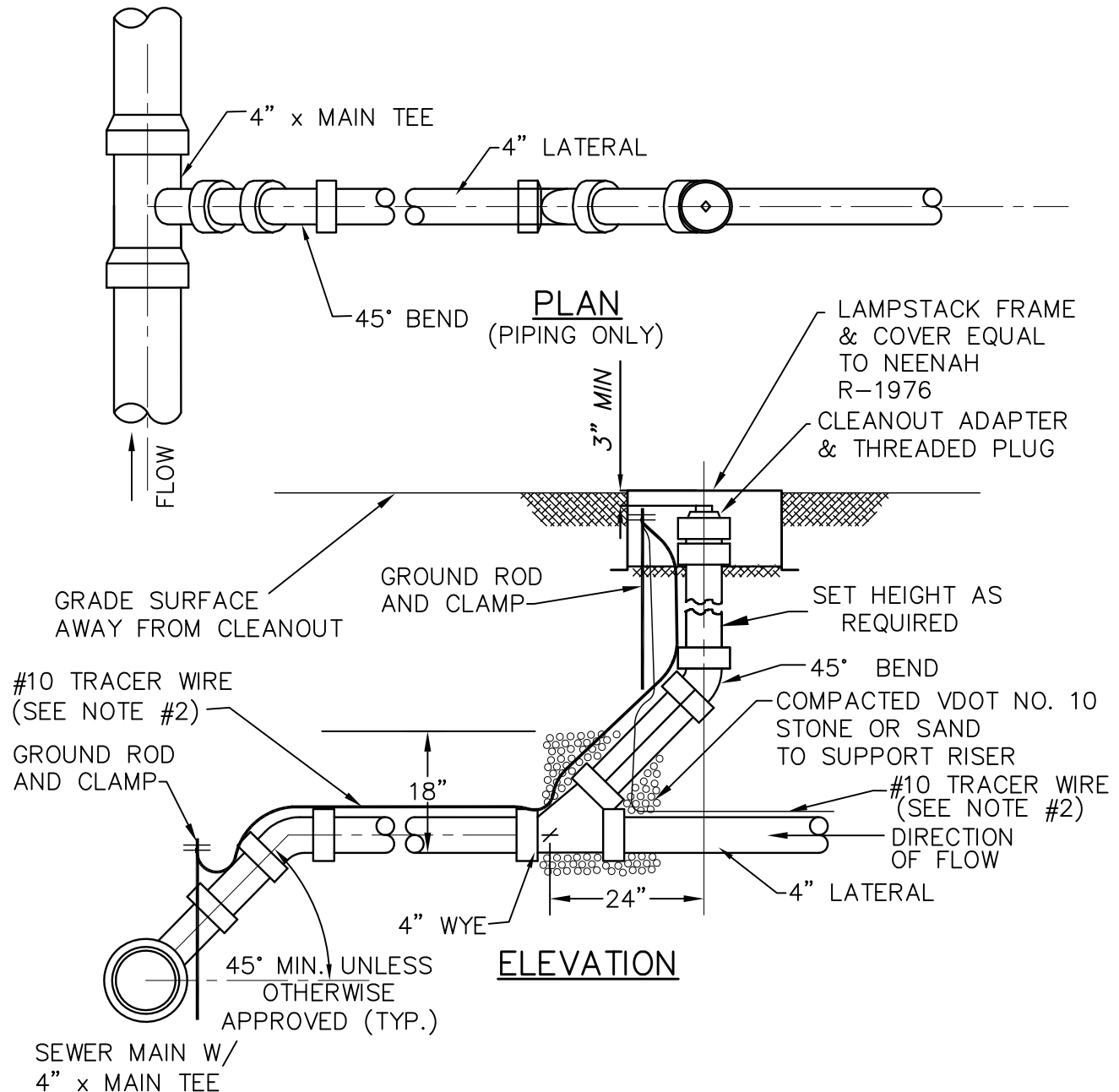


AMHERST COUNTY
SERVICE AUTHORITY

C0-1

NOTE:

1. ANY CLEANOUT NOT IN A PUBLIC ROAD RIGHT OF WAY WILL HAVE PLACED IN ITS IMMEDIATE VICINITY A METAL FENCE POST TO FACILITATE LOCATION. FENCE POST SHALL BE 8' LONG, WITH TOP 2' PAINTED FLUORESCENT ORANGE, AND AT LEAST 18" IN GROUND.
2. #10 (AWG) TRACER WIRE SHALL BE ADJACENT TO THE LATERAL PIPE, WITH A 24" LONG, 5/8" GALVANIZED GROUND ROD, WITH BRASS GROUND CLAMP, 6" FROM THE SEWER MAIN AND ALSO IN THE CLEANOUT BOX. TRACER WIRE MUST BE PLACED ALONG THE FULL SEWER LATERAL LENGTH. IF LATERAL IS NOT INSTALLED AT TIME OF SERVICE TAP AND CLEANOUT PLACEMENT, TRACER WIRE IS TO BE EXTENDED 12" BEYOND TEMPORARY CAP ON LATERAL. SUBSEQUENT LATERAL EXTENSION MUST INCLUDE ADJACENT EXTENSION OF TRACER WIRE TO STRUCTURE.



REV. 09/10



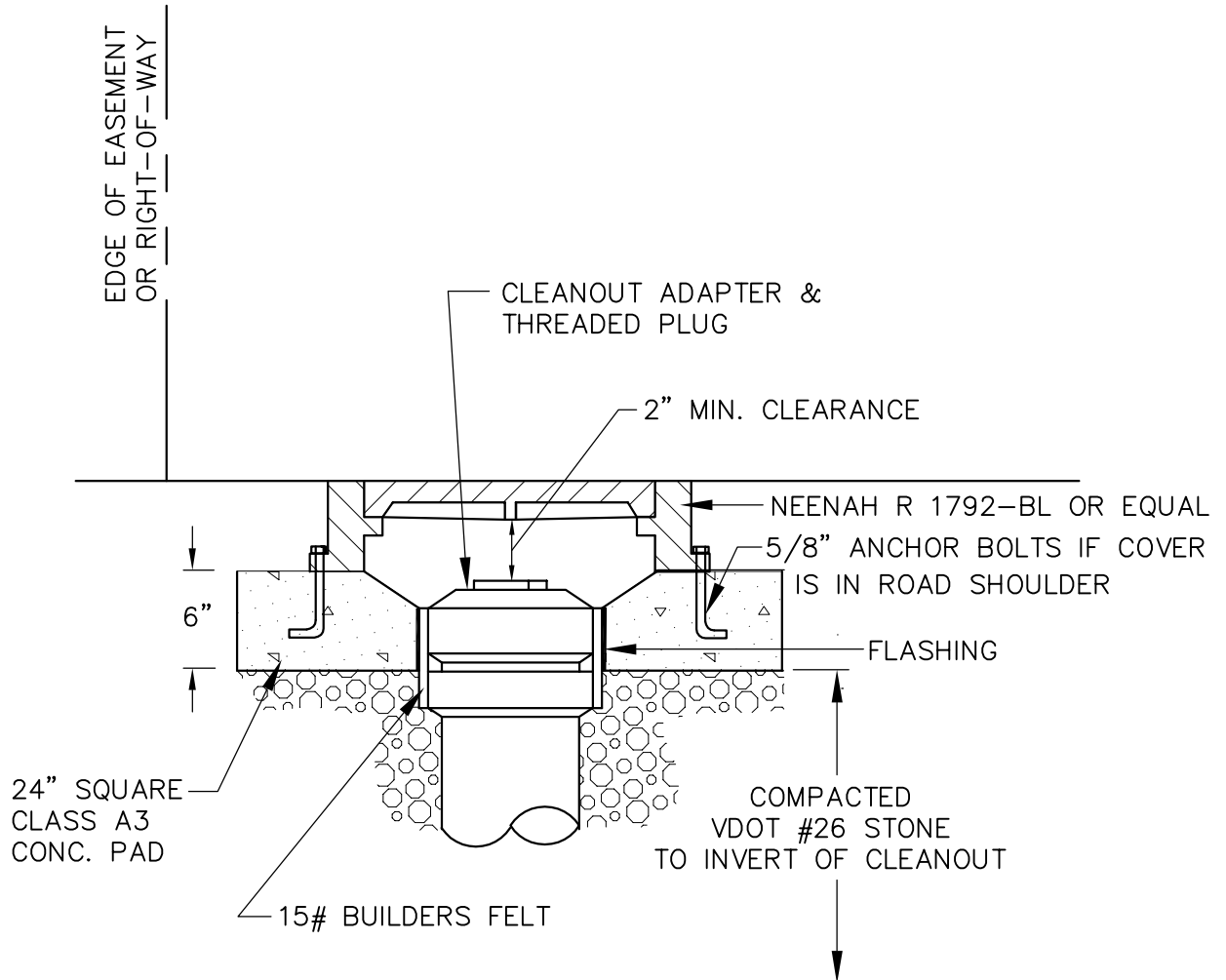
AMHERST COUNTY
SERVICE AUTHORITY

SANITARY CLEANOUT TYPE 2

(WITH PRIVATE SEWER LATERAL TRACER WIRE)

N.T.S.

CO-2



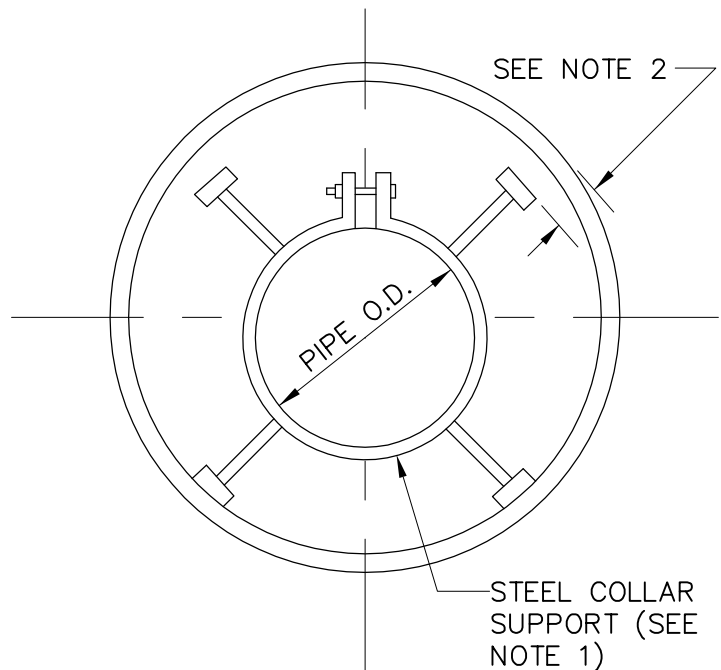
CLEANOUT COVER — TRAFFIC BEARING

N.T.S.

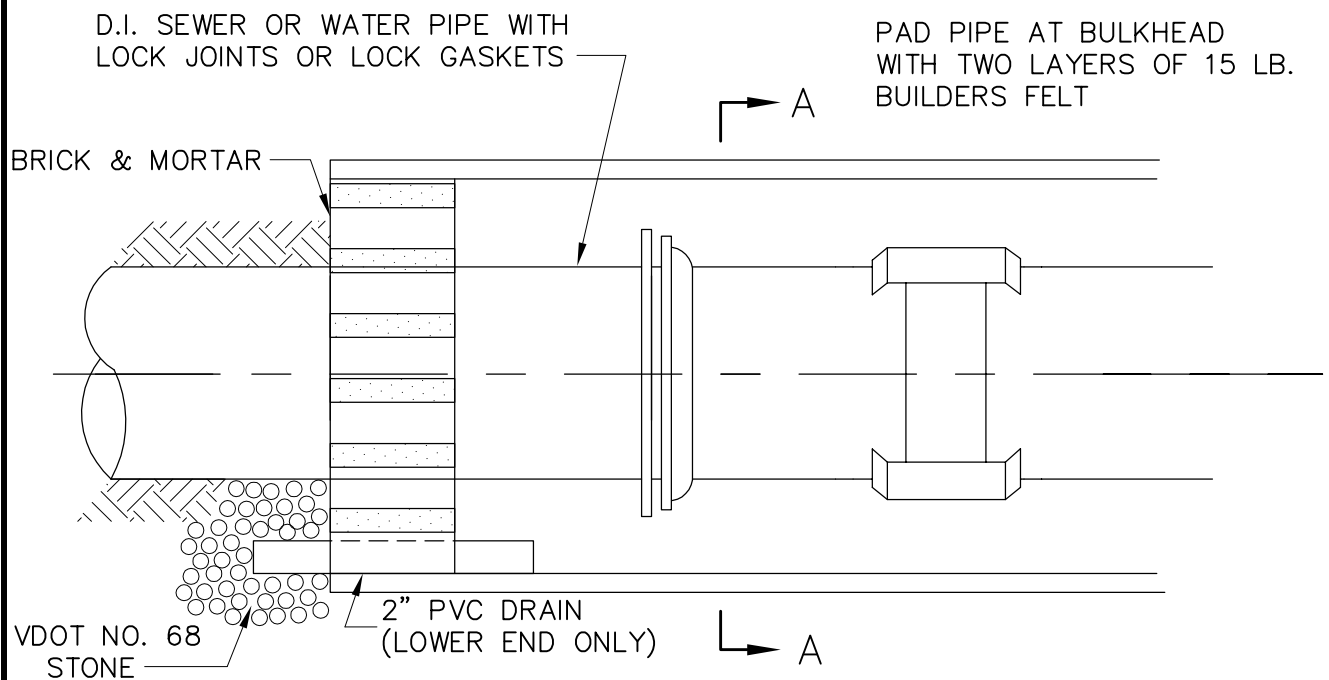
FOR USE WITH ALL CLEANOUTS IN PAVEMENT,
ROAD SHOULDERS, OR TRAFFIC AREAS

NOTES

1. SINGLE-PIECE COLLAR SHOWN;
2-PIECE COLLAR USED FOR CARRIER
PIPES 18" OR LARGER.
2. DIMENSION AS NECESSARY TO PROVIDE
MINIMUM CLEARANCE NEEDED TO SLIDE
PIPE THROUGH CASING.
3. THIS STANDARD APPLICABLE FOR 4"
DIA. AND LARGER PIPE INSTALLED
UNDER PRIMARY AND SECONDARY
HIGHWAYS. FOR LINES SMALLER THAN
4", USE DUCTILE IRON PIPE FOR
CASING AND MODIFY INSTALLATION
ACCORDINGLY.
4. CORRUGATED METAL PIPE SHALL NOT
BE USED AS CASING.



SECTION A-A



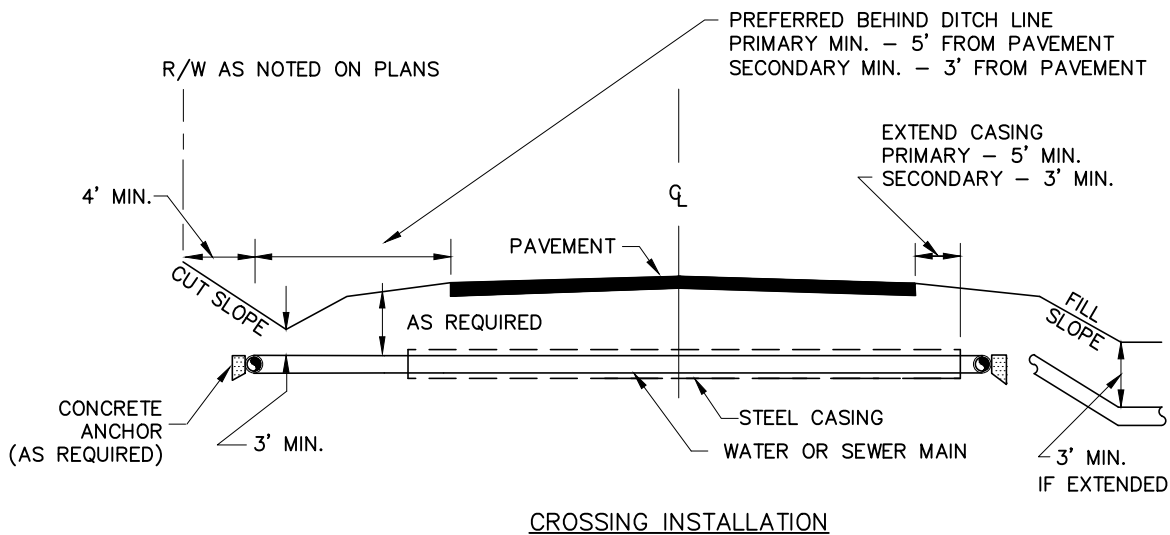
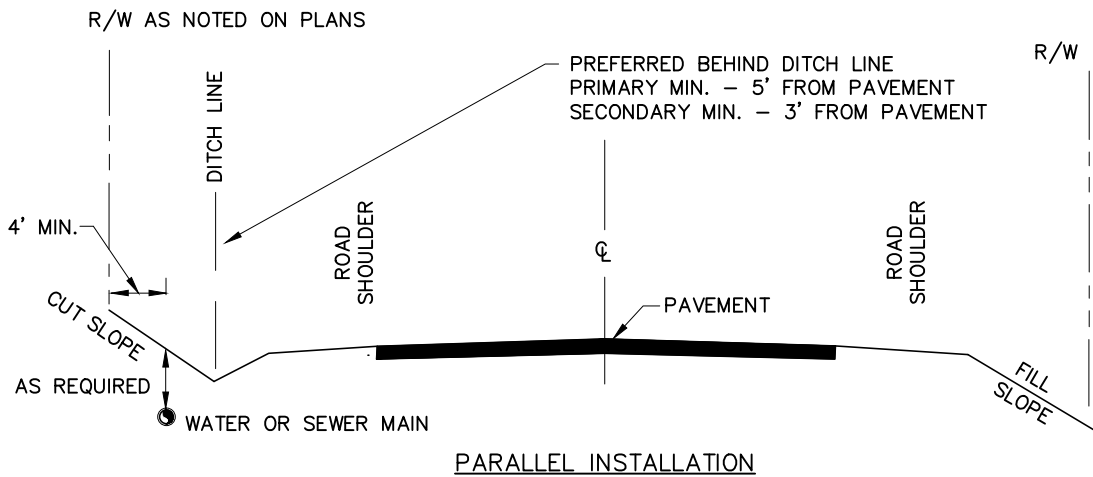
SEALED CASING INSTALLATION SPIDER

N.T.S.

09/30/99



AMHERST COUNTY
SERVICE AUTHORITY



NOTES

1. PLACE VALVES AS NOTED ON PLAN.
2. VERIFY LOCAL REQUIREMENTS WITH VDOT RESIDENCY.
3. NOT TO SCALE.

TYPICAL WATER OR SEWER MAIN LOCATION WITHIN V.D.O.T. RIGHT-OF-WAY

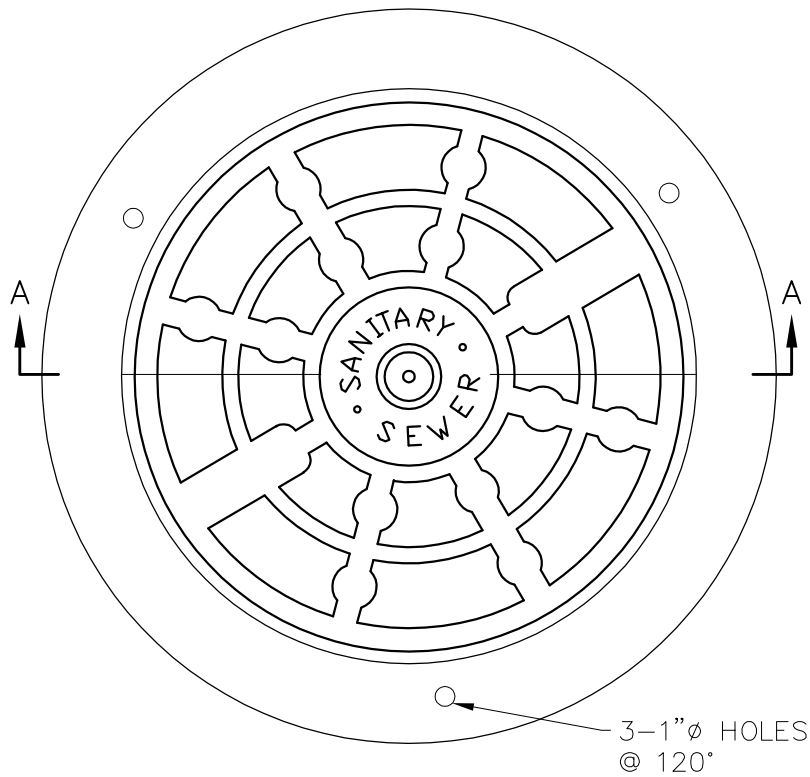
N.T.S.

REV: 02/16

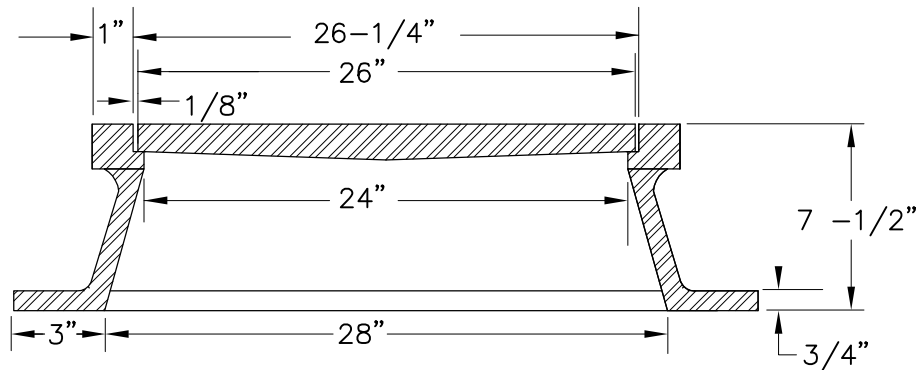


AMHERST COUNTY
SERVICE AUTHORITY

CS-2



PLAN



SECTION A-A

MANHOLE FRAME AND COVER SHALL CAST IRON
EQUAL TO CAPITOL FOUNDRY ITEM: MH-3000

APPROXIMATE WEIGHT
CAST IRON FRAME: 190±LBS
COVER: 145±LBS

04/15/03

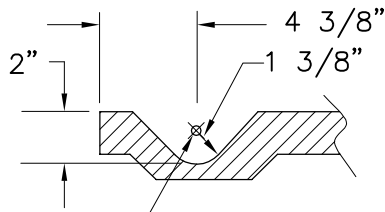


AMHERST COUNTY
SERVICE AUTHORITY

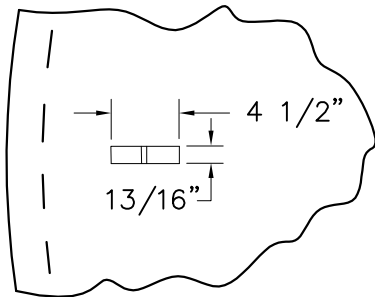
SEWER PROJECT STANDARD
MANHOLE FRAME & COVER
N.T.S.

FC-1

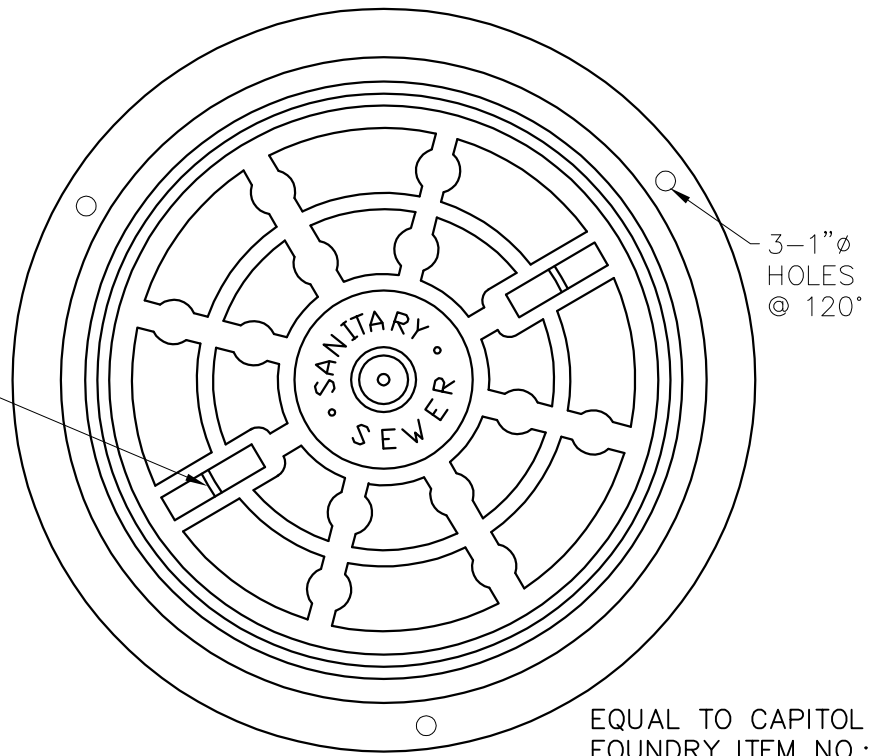
LIFTING DEVICE



SECTION



PLAN



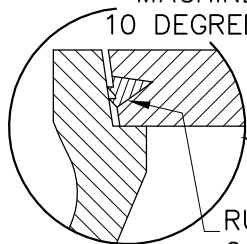
EQUAL TO CAPITOL
FOUNDRY ITEM NO.:
MH-3000-WT/C

TYP. AVERAGE WEIGHT

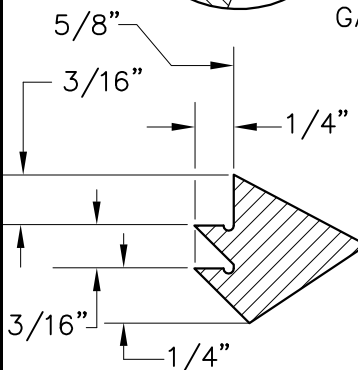
FRAME	190±LBS
COVER	160±LBS

WATERTIGHT DETAIL

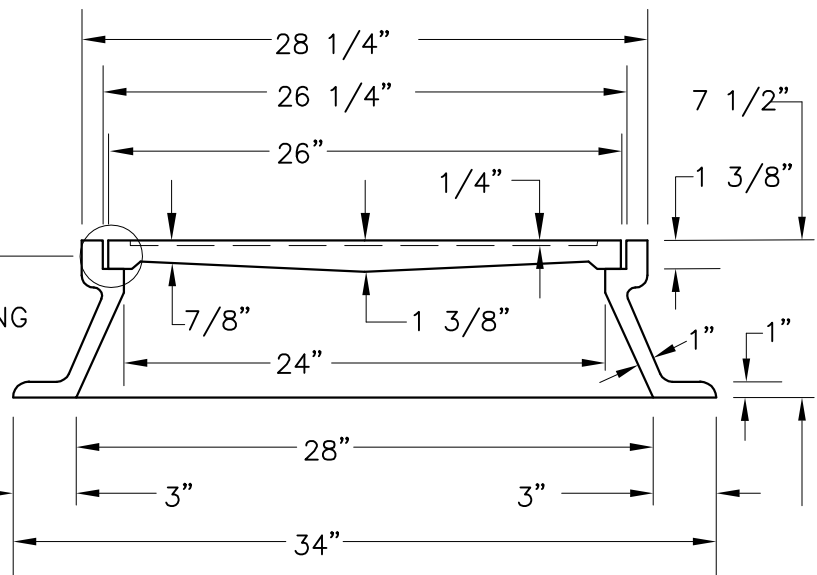
FRAME & COVER
MACHINED AT
10 DEGREE BEVEL



RUBBER RING
GASKET



GASKET
DETAIL



WATERTIGHT MANHOLE FRAME & COVER SEWER PROJECT

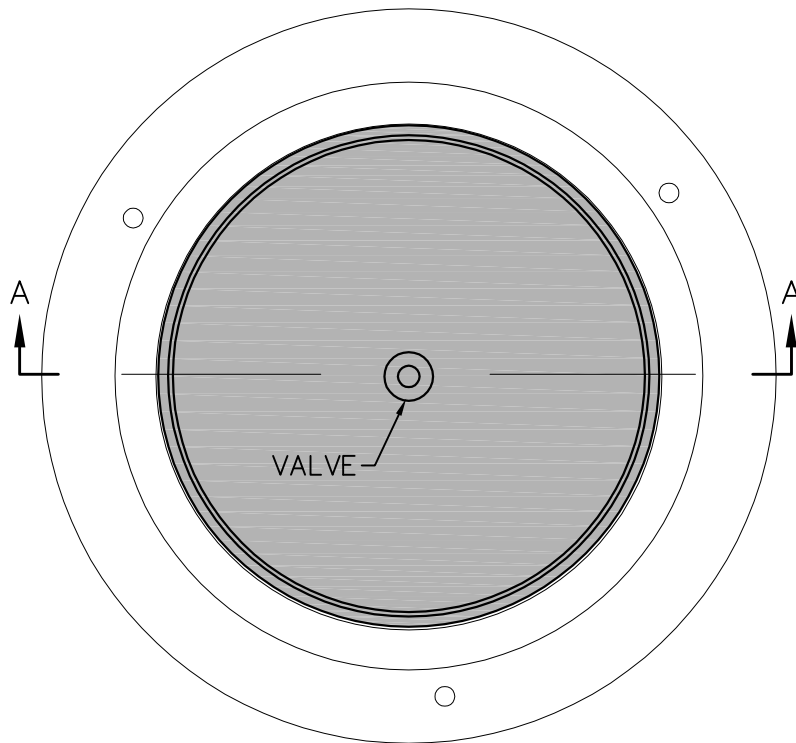
N.T.S.

FC-2

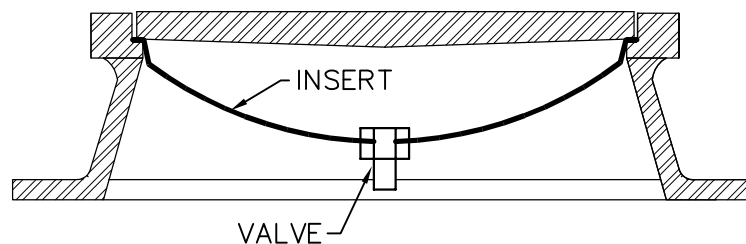
04/15/03



AMHERST COUNTY
SERVICE AUTHORITY



PLAN W/COVER REMOVED



SECTION A-A

HDPE MANHOLE INFLOW RESTRICTION INSERT W/VALVE
 EQUAL TO THAT MANUFACTURED BY PARSON
 ENVIRONMENTAL PRODUCTS, INC. (800-356-9023) OR
 NO FLOW IN FLOW CO. (800-950-8268)
INSTALL PER MANUFACTURERS INSTRUCTIONS
APPLICABLE FOR STREAM SIDE OR WETLAND
APPLICATIONS ONLY.

INFLOW PREVENTION INSERT FOR STANDARD MANHOLE FRAME & COVER (FC-1)

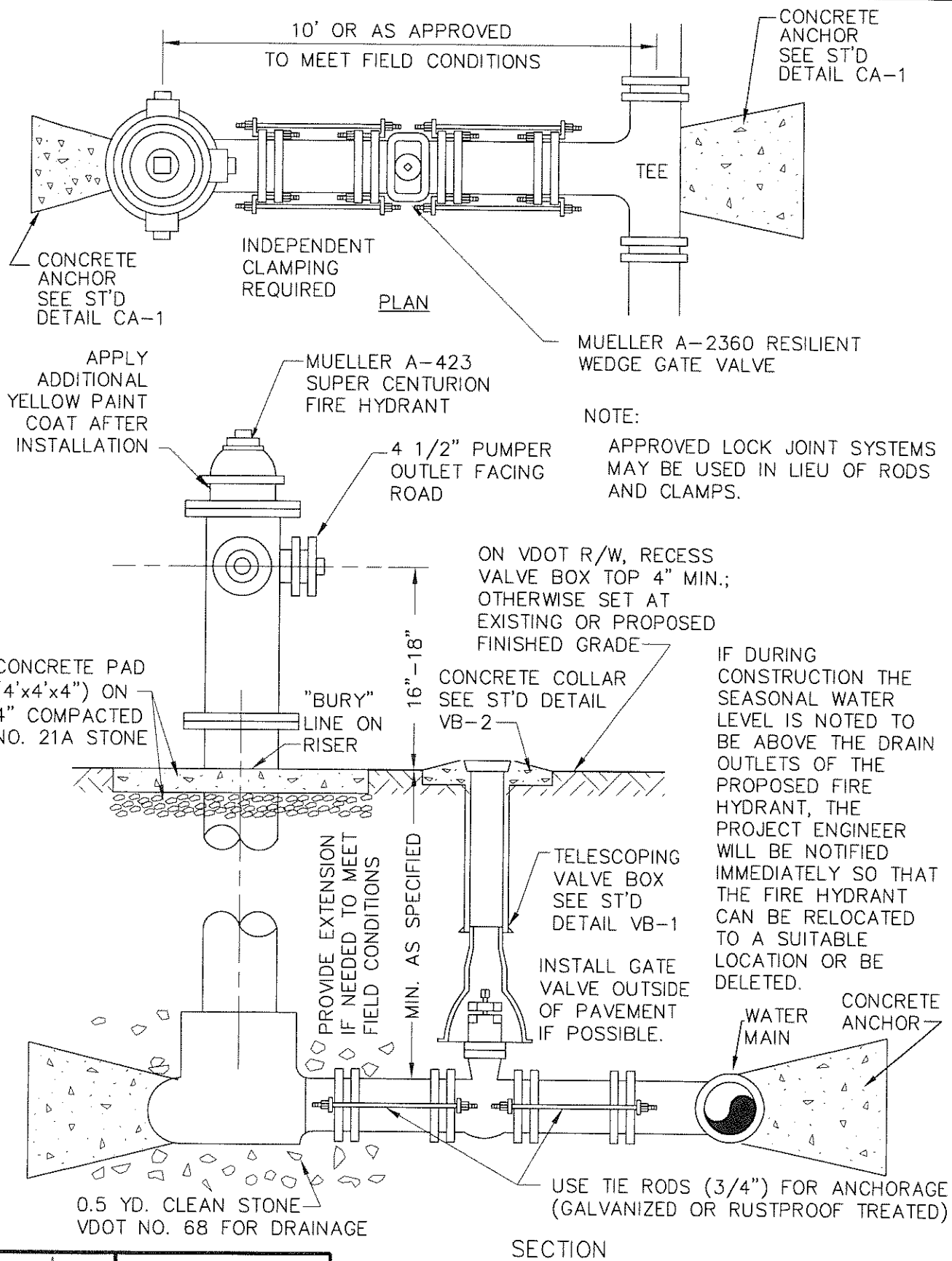
REV. 02/08



AMHERST COUNTY
 SERVICE AUTHORITY

N.T.S.

FC-3



REV. 05/10



AMHERST COUNTY
SERVICE AUTHORITY

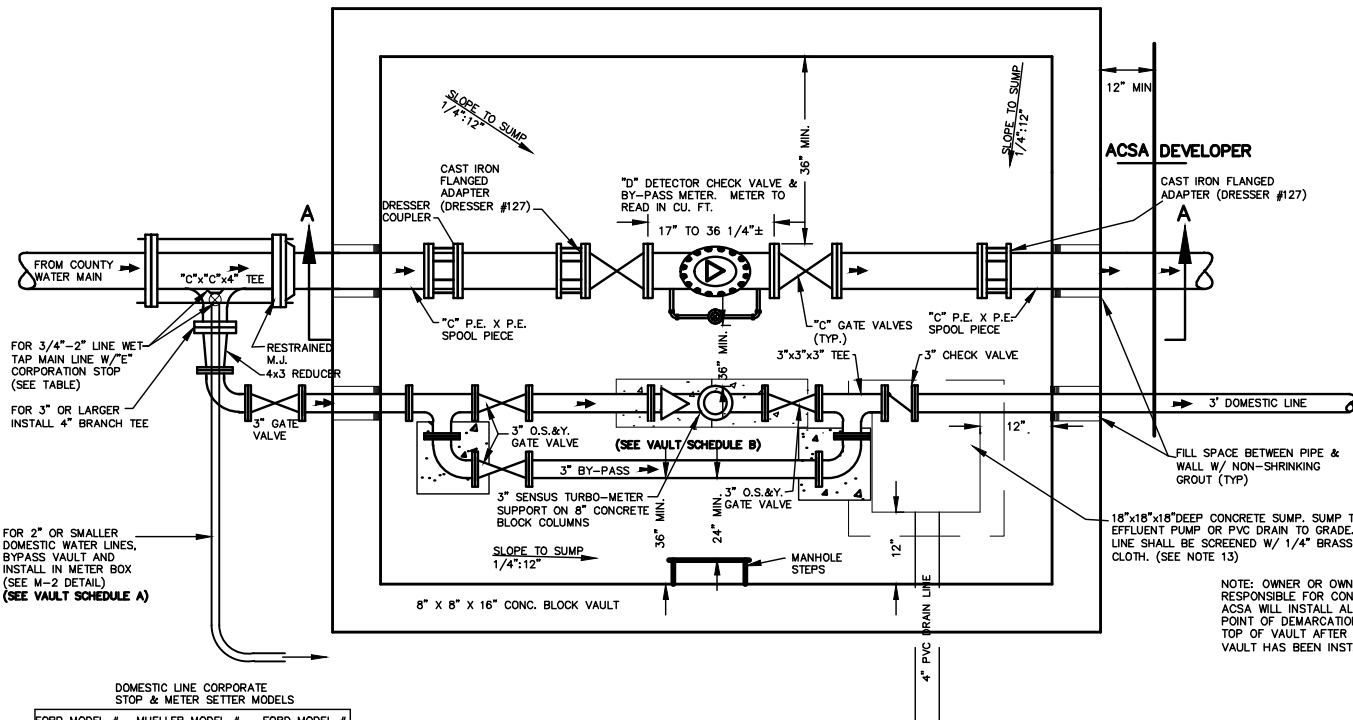
FIRE HYDRANT SETTING

N.T.S.

FH-1

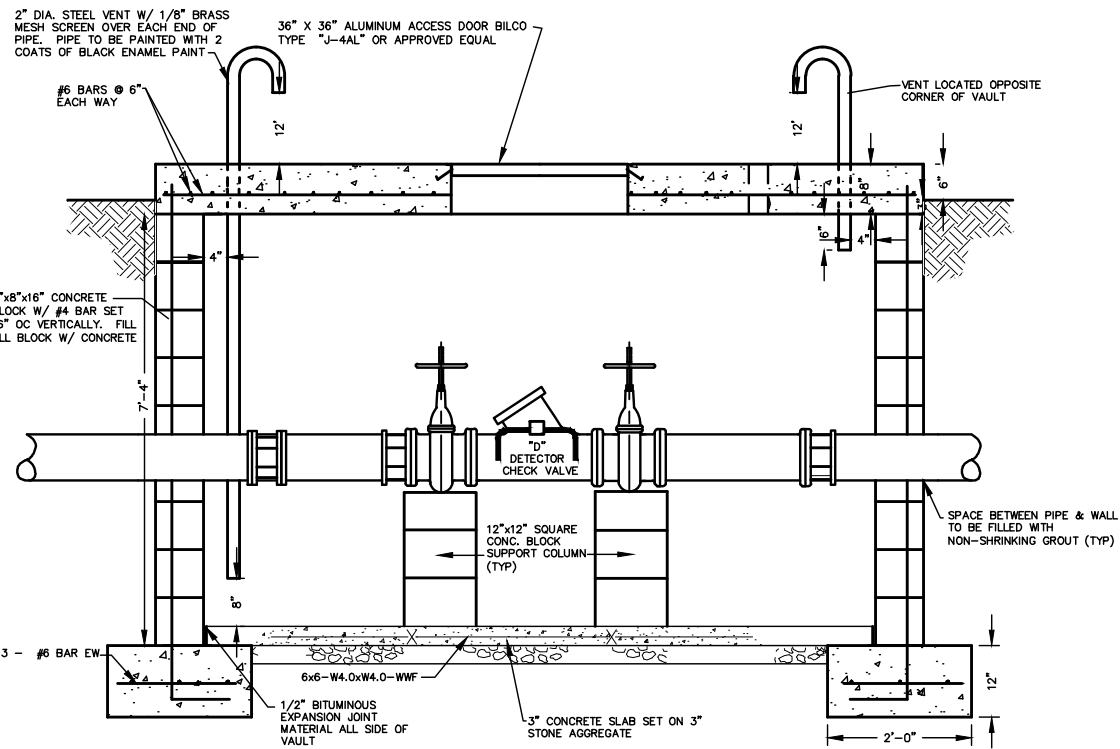


AMHERST COUNTY
SERVICE AUTHORITY



FORD MODEL #	MUELLER MODEL #	FORD MODEL #
F-800-3/4"	H-15000-3/4"	VHH71-9
F-800-1"	H-15000-1"	VHH74-10
FB-400-2"	H-9968-2"	VFH77-12BX21 1/2

INTERIOR PLAN VIEW



SECTION A-A

NOTES:

1. FIRE LINE MUST BE PROTECTED BY A REDUCED PRESSURE BACKFLOW PREVENTER (RPZ) LOCATED IN AN EXTERIOR HEATED ENCLOSURE ("HOT BOX") OR WITHIN THE BUILDING SERVED.
2. RPZ MUST BE TESTED ANNUALLY BY AN INDIVIDUAL CERTIFIED BY STATE TO PERFORM THIS WORK. COPIES OF TEST RESULTS MUST BE PROVIDED TO ACSA ANNUALLY.
3. RPZ MUST BE SHOWN ON SITE PLANS SUBMITTED FOR ACSA REVIEW.
4. CONTRACTOR TO COORDINATE INSTALLATION WITH BUILDING INSPECTOR.

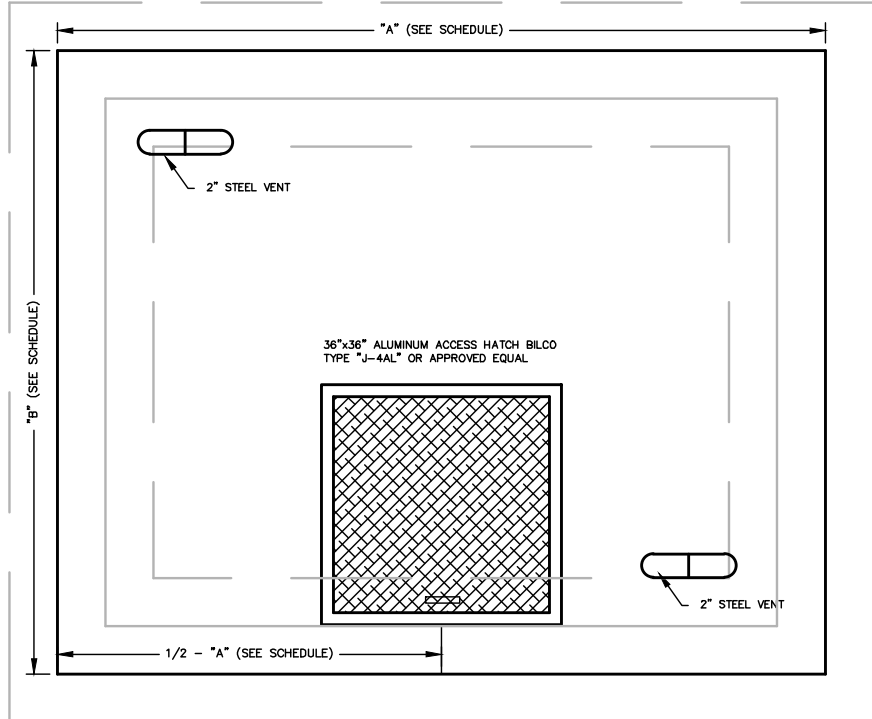
NOTE: OWNER OR OWNERS' REPRESENTATIVE IS RESPONSIBLE FOR CONSTRUCTION OF VAULT. ACSA WILL INSTALL ALL PIPING UP TO THE POINT OF DEMARCATION. OWNER WILL INSTALL TOP OF VAULT AFTER ALL PIPING INSIDE THE VAULT HAS BEEN INSTALLED. (SEE NOTE 14)

VAULT SCHEDULE A - W/DOMESTIC SERVICE (2" & SMALLER) OUTSIDE OF VAULT					LEAK DETECTION BYPASS METER SIZE
DETECTOR CHECK VALVE SIZE	VAULT DIMENSIONS (Inside) A	PIPE SIZE B	PIPE SIZE C	DETECTOR CHECK MODEL # D	
2"	6'-0"	6'-8"	2"	HERSEY DC*	5/8"
3"	6'-0"	7'-4"	3"	HERSEY EDC IV**	5/8"
4"	6'-0"	8'-0"	4"	HERSEY EDC IV** FEBCO SERIES 800***	5/8"
6"	7'-0"	8'-0"	6"	HERSEY EDC IV** FEBCO SERIES 800***	1"
8"	7'-8"	8'-0"	8"	HERSEY EDC IV** FEBCO SERIES 800***	1"
10"	8'-8"	8'-8"	10"	HERSEY EDC IV** FEBCO SERIES 800***	1"

- *UNIT TO BE FLANGE TO FLANGE TYPE AND TO COME WITH OPTIONAL TRIM KIT AND RIGHT SIDE MOUNTED POSITIVE DISPLACEMENT LEAK DETECTION BYPASS METER, EQUAL TO HERSEY MODEL 400 IIS OR SENSUS MODEL SR - READING IN CUBIC FEET.
- **UNIT TO BE FLANGE TO FLANGE TYPE AND VALVE BODY TO HAVE OPTIONAL FUSION BONDED EPOXY COATING. UNIT TO COME WITH OPTIONAL TRIM KIT AND RIGHT SIDE MOUNTED POSITIVE DISPLACEMENT LEAK DETECTION BYPASS METER, EQUAL TO HERSEY MODEL 400 IIS OR SENSUS MODEL SR - READING IN CUBIC FEET.
- ***UNIT TO BE FLANGE TO FLANGE TYPE AND LEAK DETECTION BYPASS METER TO READ IN CUBIC FEET.

VAULT SCHEDULE B - W/DOMESTIC SERVICE THROUGH VAULT					LEAK DETECTION BYPASS METER SIZE
DETECTOR CHECK VALVE SIZE	VAULT DIMENSIONS (Inside) A	PIPE SIZE B	PIPE SIZE C	DETECTOR CHECK MODEL # D	
2"	8'-0"	9'-8"	2"	HERSEY DC*	5/8"
3"	8'-0"	10'-4"	3"	HERSEY EDC IV**	5/8"
4"	8'-0"	11'-0"	4"	HERSEY EDC IV** FEBCO SERIES 800***	5/8"
6"	8'-0"	11'-0"	6"	HERSEY EDC IV** FEBCO SERIES 800***	1"
8"	8'-0"	11'-0"	8"	HERSEY EDC IV** FEBCO SERIES 800***	1"
10"	8'-8"	11'-8"	10"	HERSEY EDC IV** FEBCO SERIES 800***	1"

- *UNIT TO BE FLANGE TO FLANGE TYPE AND TO COME WITH OPTIONAL TRIM KIT AND RIGHT SIDE MOUNTED POSITIVE DISPLACEMENT LEAK DETECTION BYPASS METER, EQUAL TO HERSEY MODEL 400 IIS OR SENSUS MODEL SR - READING IN CUBIC FEET.
- **UNIT TO BE FLANGE TO FLANGE TYPE AND VALVE BODY TO HAVE OPTIONAL FUSION BONDED EPOXY COATING. UNIT TO COME WITH OPTIONAL TRIM KIT AND RIGHT SIDE MOUNTED POSITIVE DISPLACEMENT LEAK DETECTION BYPASS METER, EQUAL TO HERSEY MODEL 400 IIS OR SENSUS MODEL SR - READING IN CUBIC FEET.
- ***UNIT TO BE FLANGE TO FLANGE TYPE AND LEAK DETECTION BYPASS METER TO READ IN CUBIC FEET.

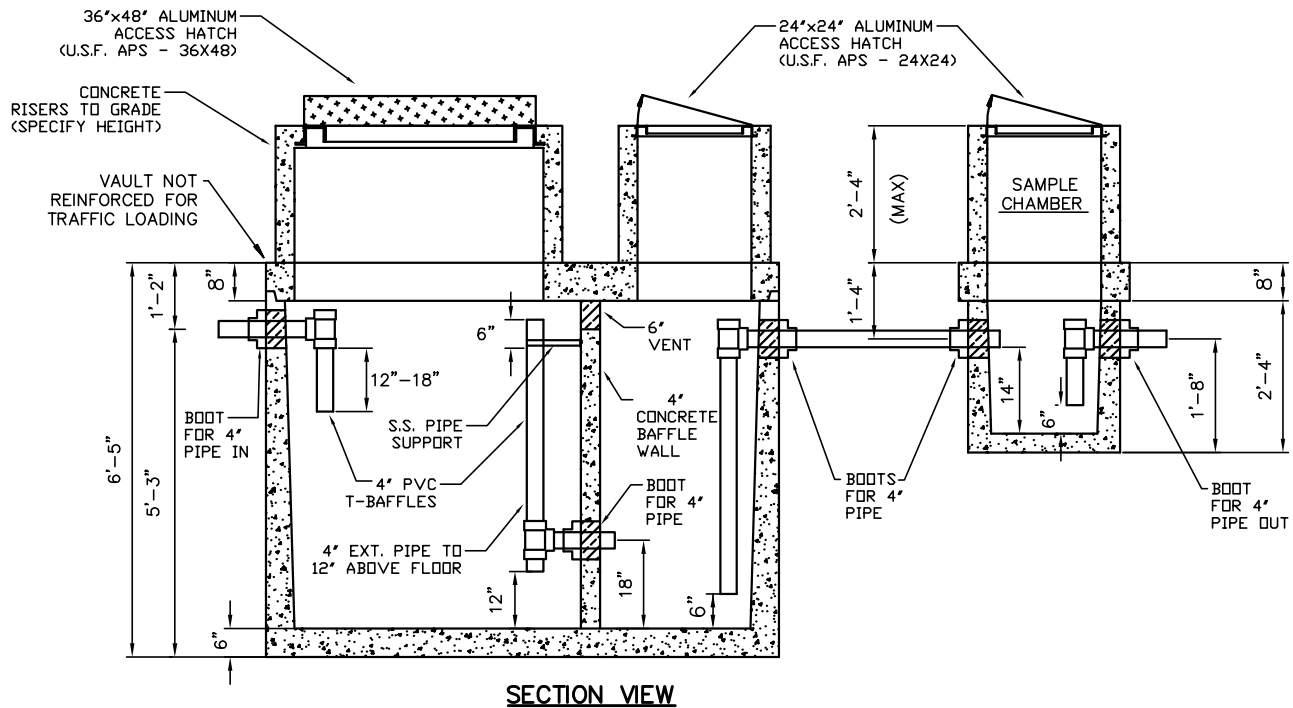
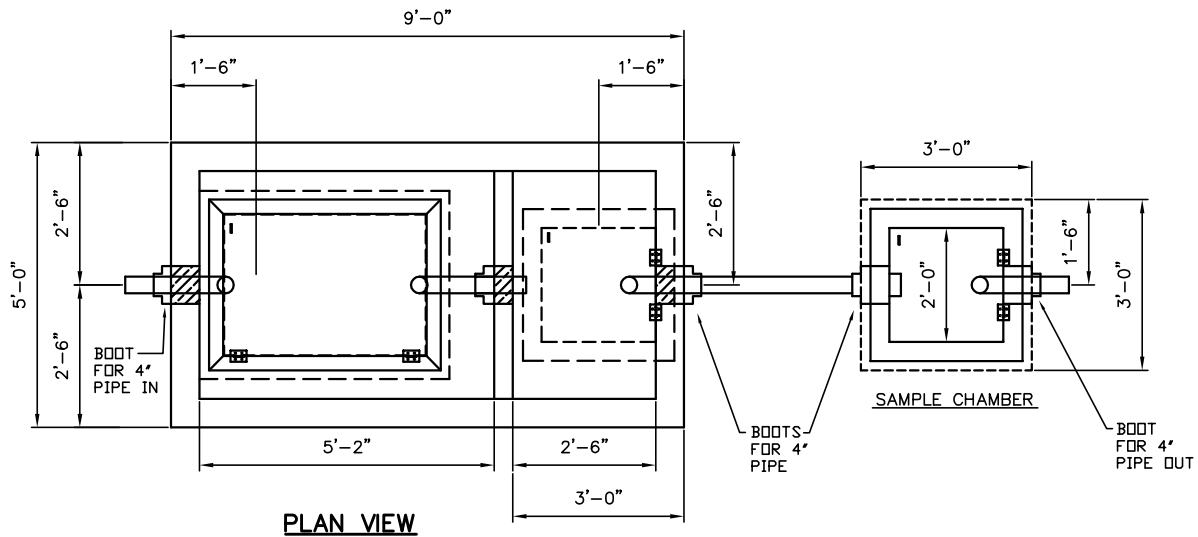


EXTERIOR PLAN VIEW

GENERAL NOTES

1. THIS VAULT DESIGN DOES NOT ALLOW FOR VEHICULAR TRAFFIC. IF VEHICULAR TRAFFIC MUST PASS OVER VAULT, THE ENGINEER SHOULD BE CONSULTED FOR POSSIBLE CHANGES IN DESIGN.
2. VAULT IS TO BE CONSTRUCTED SO THAT FOUNDATION LIES ON THE OWNER'S PROPERTY JUST BEHIND THE RIGHT-OF-WAY LINE.
3. THE EXACT DIMENSION OF VAULT ARE REFLECTED IN THE TABLE BELOW. SIZES OF ALL PIPE, FITTINGS AND METER WILL BE DETERMINED BY THE UTILITIES ADMINISTRATOR OR HIS REPRESENTATIVE.
4. WALLS OF VAULT TO BE CONSTRUCTED OF 8"x8"x16" (NOMINAL DIMENSIONS) CONCRETE BLOCK MEETING REQUIREMENTS OF ASTM C-139. MORTAR JOINTS SHALL BE FINISHED FLUSH ON INTERIOR SURFACES AND MAY BE LEFT EXTRUDED ON THE EXTERIOR FACES. VAULT MAY BE A PRECAST UNIT PROVIDED INTERIOR DIMENSIONS AND STRENGTH OF MATERIALS EQUAL OR EXCEED THOSE OF THE DESIGN SHOWN HERE. PRECAST UNIT MUST BE APPROVED BY ENGINEER PRIOR TO ORDERING.
5. ALL CONCRETE SHALL MEET VDOT CLASS A-3 STANDARDS.
6. DEFORMED REINFORCING BARS SHALL CONFORM TO ASTM A-615, GRADE 60.
7. ALL PIPE USED IN METER INSTALLATIONS SHALL BE FLANGED, CLASS 50, DUCTILE IRON PIPE (3" OR LARGER).
8. ALL METERS SHALL REGISTER IN CUBIC FEET.
9. VAULT FOOTINGS SHALL BE PLACED ON UNDISTURBED SOIL.
10. THE VAULT TOP SHALL BE SET IN PLACE AFTER THE VAULT PIPING HAS BEEN SET & COMPLETELY TESTED FOR ITS WATERTIGHTNESS. THE VAULT TOP MAY BE EITHER CAST-IN-PLACE OR PRECAST. VAULT & LID SHALL BE CONSTRUCTED BY THE CONTRACTOR. AFTER VAULT PLACEMENT, THE CONTRACTOR SHALL SCHEDULE ACSA INSTALLATION OF VAULT CONTENTS IN ACCORDANCE WITH ABOVE DRAWING. FOLLOWING CONTENTS INSTALLATION, CONTRACTOR MAY PLACE VAULT LID.
11. NO FILL SHALL BE PLACED ON VAULT UNLESS APPROVED BY ENGINEER AND AFTER APPROPRIATE MODIFICATIONS ARE MADE.
12. THE VAULT MUST BE KEPT FREE FROM FLOODING AT ALL TIMES. THE SUMP PIT MUST EITHER DRAIN TO GRADE OR HAVE AN ELECTRIC SUMP PUMP TO DEWATER THE SUMP WELL. THE WATER CUSTOMER WILL BE RESPONSIBLE FOR THE OPERATION OF THE SUMP PUMP. THE SUMP PUMP OPERATION SHALL BE AUTOMATIC AND 115 VOLT SIZED FOR TOTAL DYNAMIC HEAD OF 18' MAX.
13. THE VAULT SHALL BE LOCATED SUCH THAT NO SURFACE WATER WILL DRAIN ONTO THE TOP OF THE VAULT.
14. THE OWNER OR DEVELOPER WILL BE RESPONSIBLE FOR 100% OF THE COST OF THE VAULT & ITS INTERIOR PIPING.
15. ACCESS HATCH SHALL BE EQUAL TO TYPE J HATCH COVER BY THE BILCO COMPANY, P.O. BOX 1203, NEW HAVEN, CT 06505. DOOR SHALL BE 1/4" ALUMINUM DIAMOND PATTERN PLATE, MODEL J-4AL, SHALL BE REINFORCED TO WITHSTAND LIVE LOAD OF 300 LBS PER SQ. FT. DOOR SHALL HAVE HEAVY DUTY STAINLESS STEEL PINS, FORGED BRASS HINGES, COMPRESSION SPRING & AUTO. HOLD-OPEN ARM. A 1-1/2" DRAIN COUPLING SHALL BE LOCATED SUCH TO DRAIN INTO THE SUMP PIT IN THE VAULT.
16. GATE VALVES - 2" THRU 12" ARE TO BE MUELLER A-2360 O.S.&Y. RESILIENT WEDGE GATE VALVES.

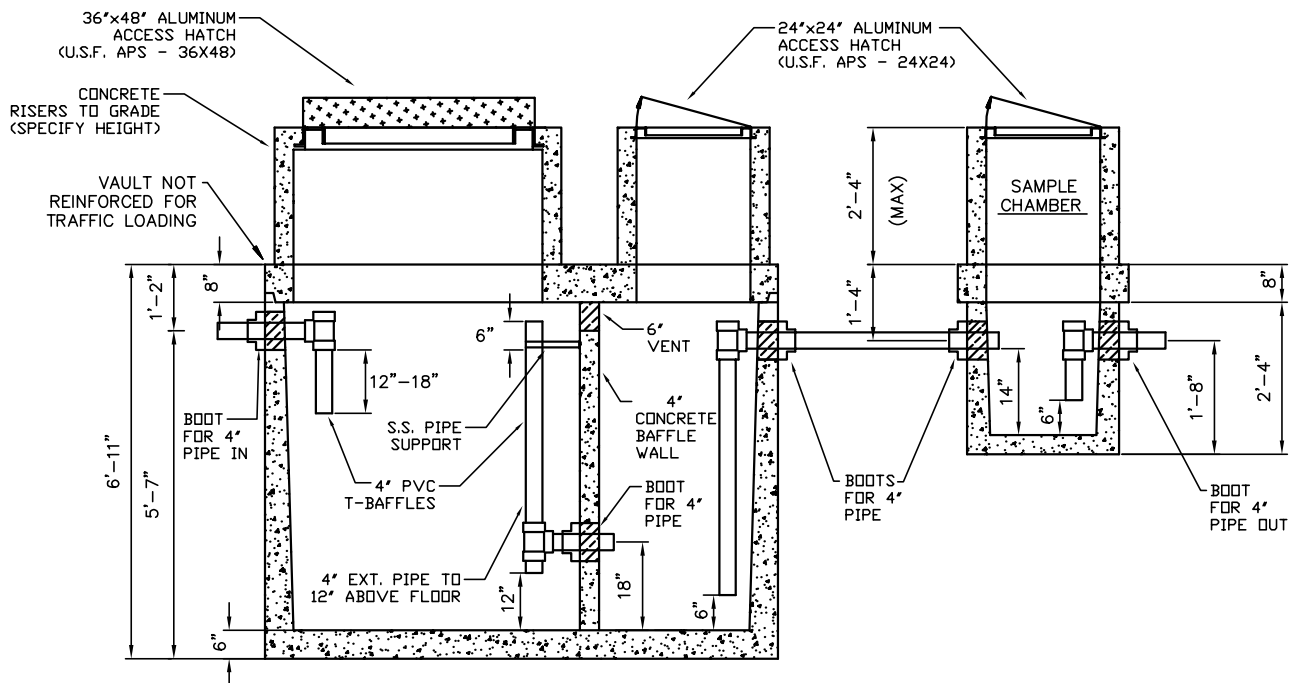
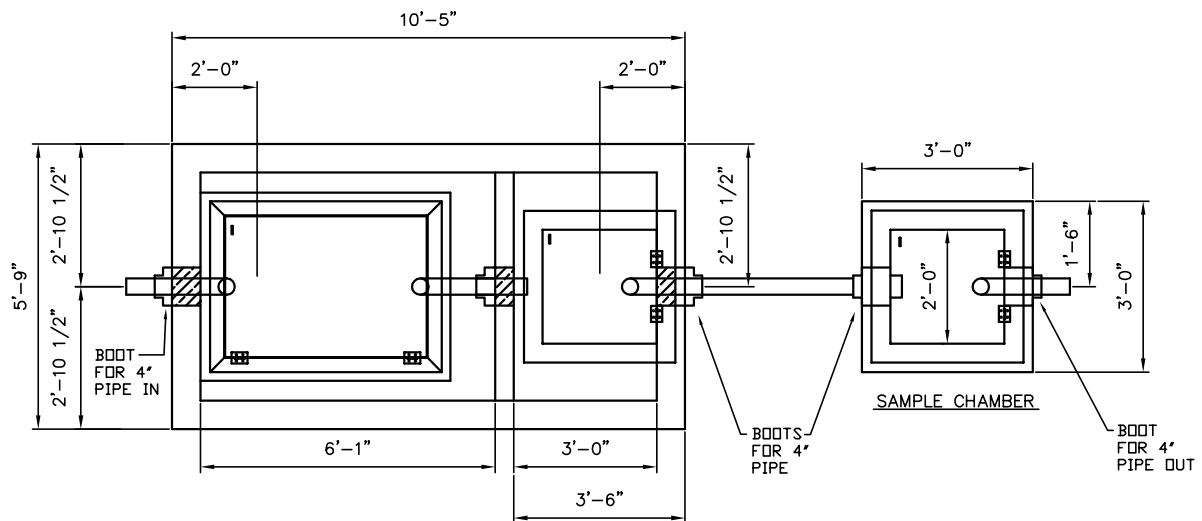
FIRE PROTECTION VAULT -
PRIVATE SPRINKLER / F.H. 2"-10"
N.T.S.



- NOTES:
1. DIMENSIONS SHOWN ARE FOR REFERENCE AND MAY VARY WITH MANUFACTURER.
 2. ALUMINUM ACCESS HATCHES TO BE CAST INTO RISERS TO GRADE. CONTRACTOR TO SPECIFY RISER HEIGHT PRIOR TO CASTING.
 3. THIS VAULT IS NOT DESIGNED FOR TRAFFIC LOADING.

1,000 GAL. NON-TRAFFIC
RATED OFFSET BAFFLE
GREASE INTERCEPTOR
N.T.S.





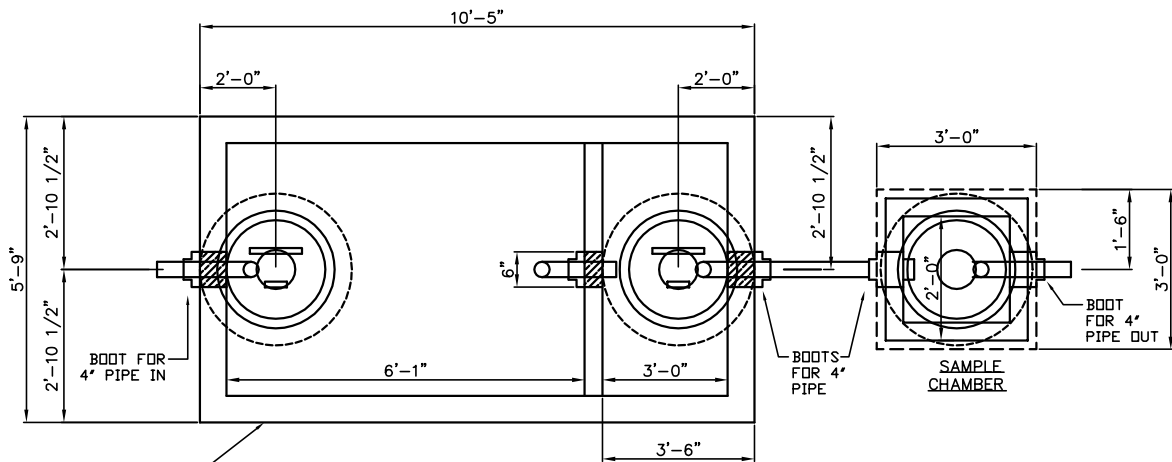
SECTION VIEW

NOTES:

1. DIMENSIONS SHOWN ARE FOR REFERENCE AND MAY VARY WITH MANUFACTURER.
2. ALUMINUM ACCESS HATCHES TO BE CAST INTO RISERS TO GRADE. CONTRACTOR TO SPECIFY RISER HEIGHT PRIOR TO CASTING.
3. THIS VAULT IS NOT DESIGNED FOR TRAFFIC LOADING.

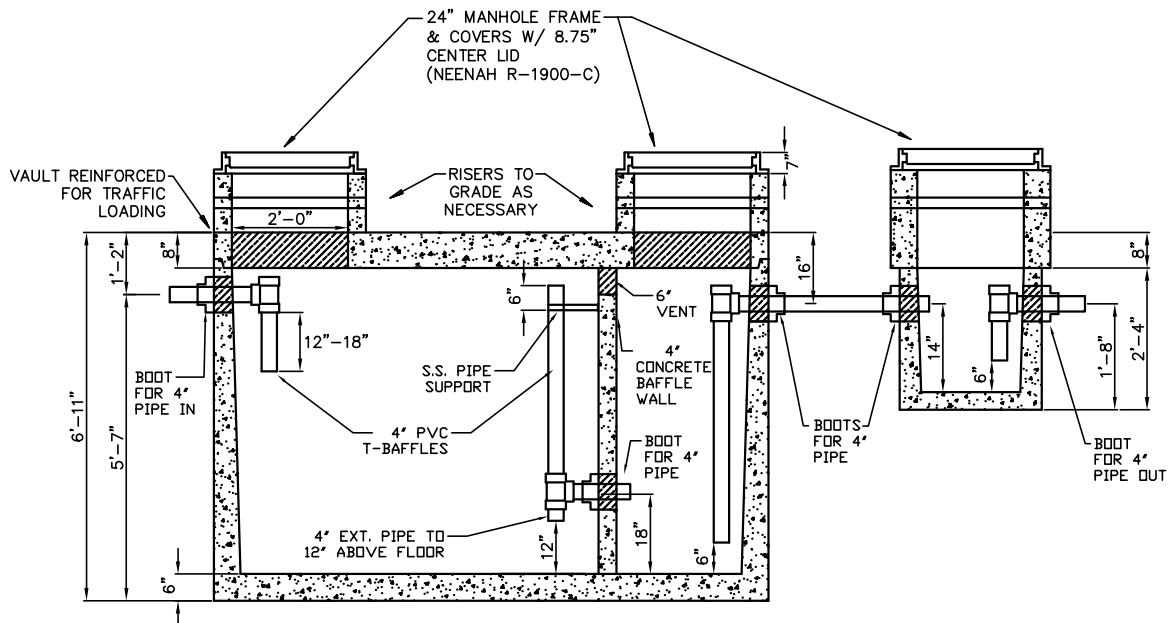
**1,500 GAL. NON-TRAFFIC
RATED OFFSET BAFFLE
GREASE INTERCEPTOR
N.T.S.**





PLAN VIEW

5,000 PSI
REINFORCED
CONCRETE

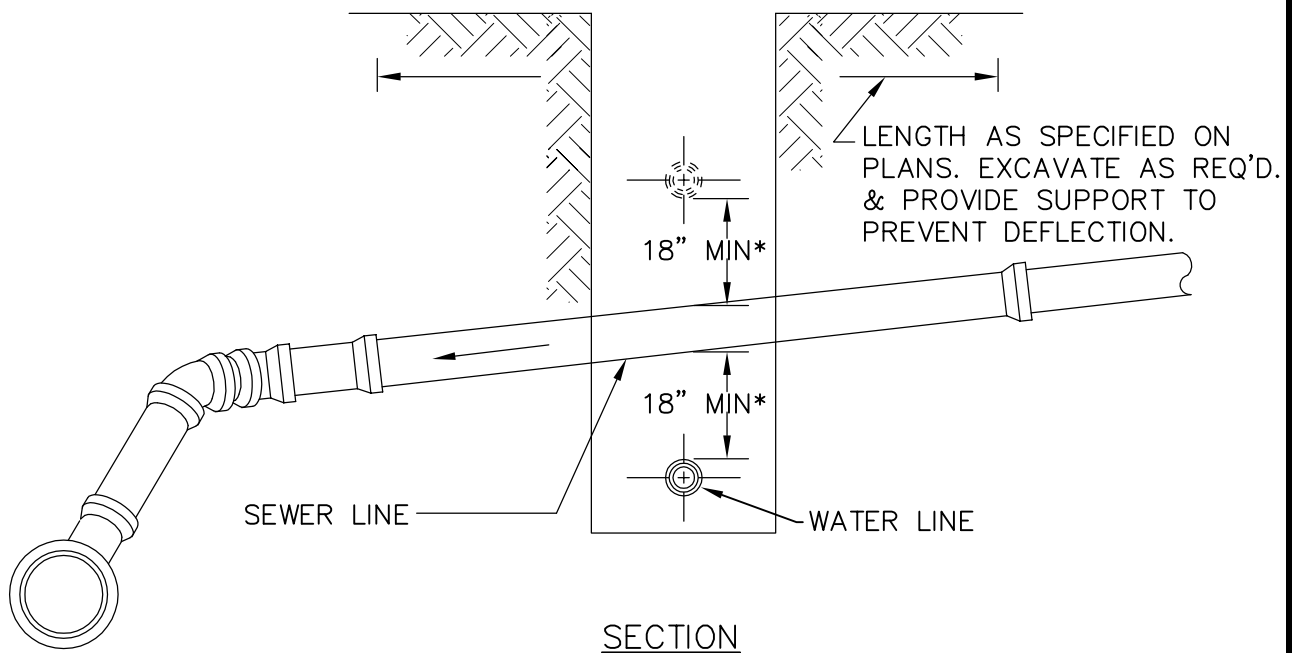
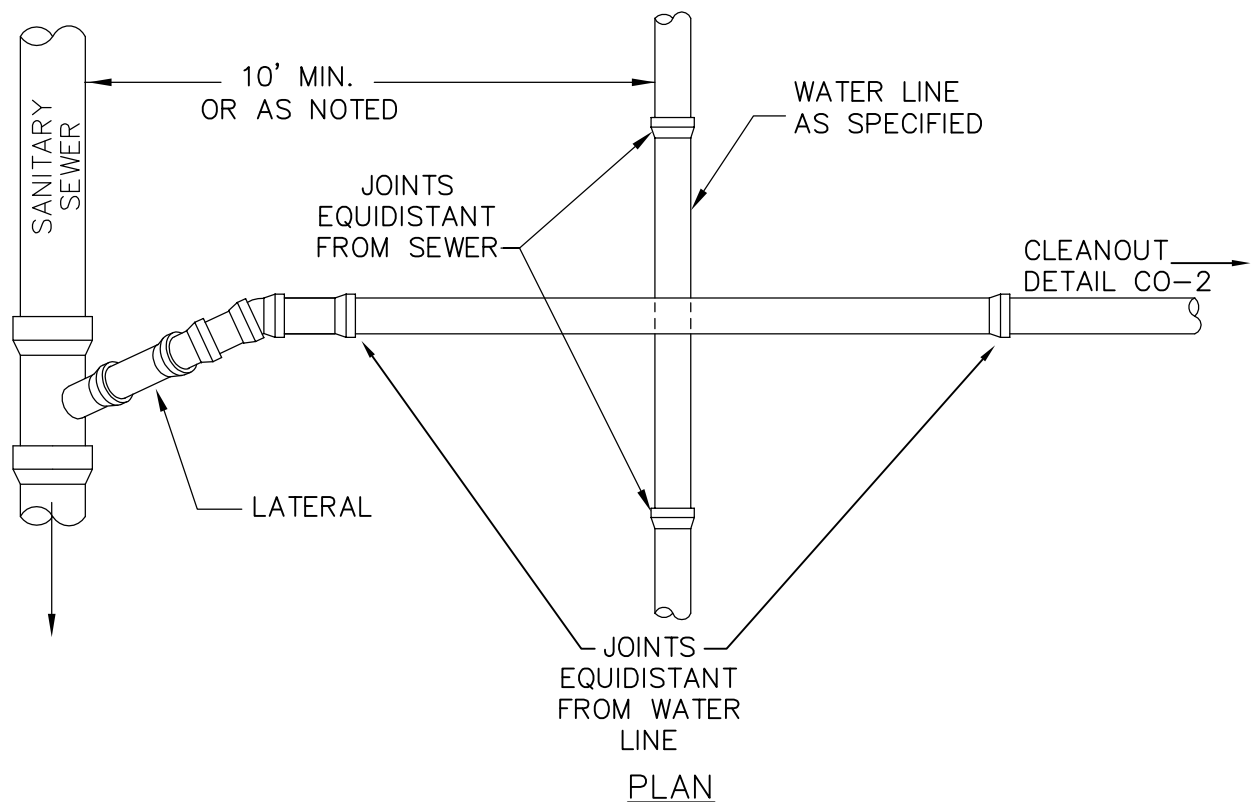


SECTION VIEW

NOTES: 1. DIMENSIONS SHOWN ARE FOR REFERENCE AND MAY VARY WITH MANUFACTURER.

1,500 GALLON TRAFFIC
RATED OFFSET BAFFLE
GREASE INTERCEPTOR
N.T.S.





HOUSE CONNECTION—SANITARY SEWER CROSSING WATER LINE

N.T.S.

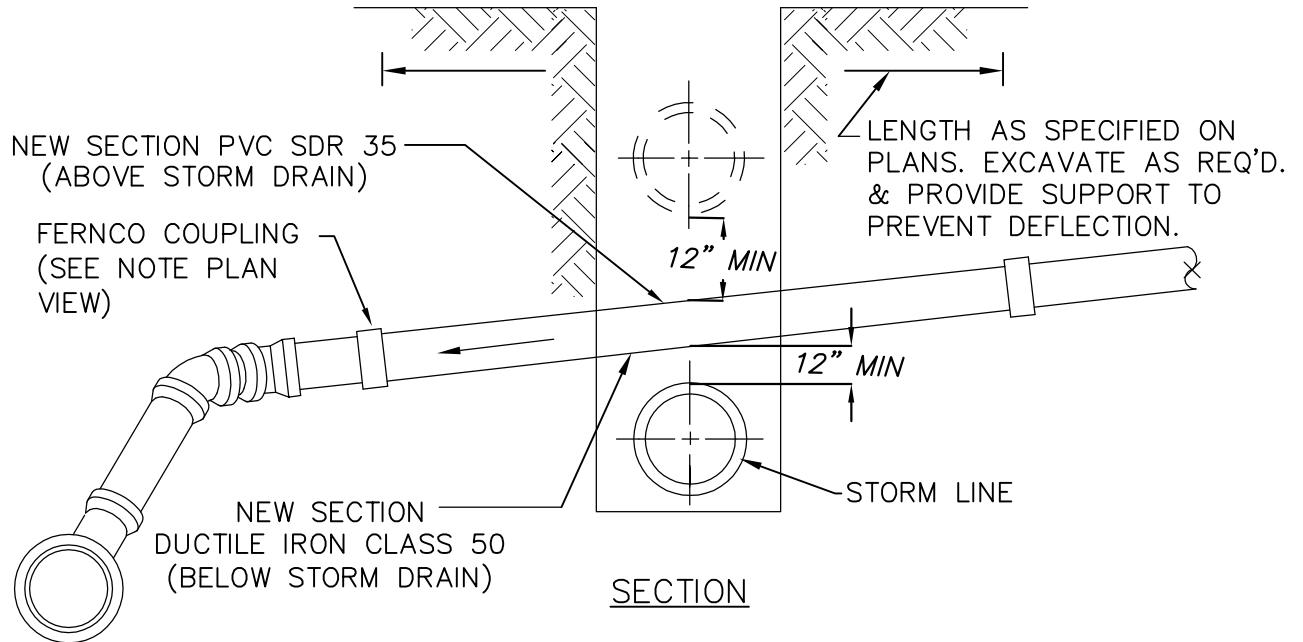
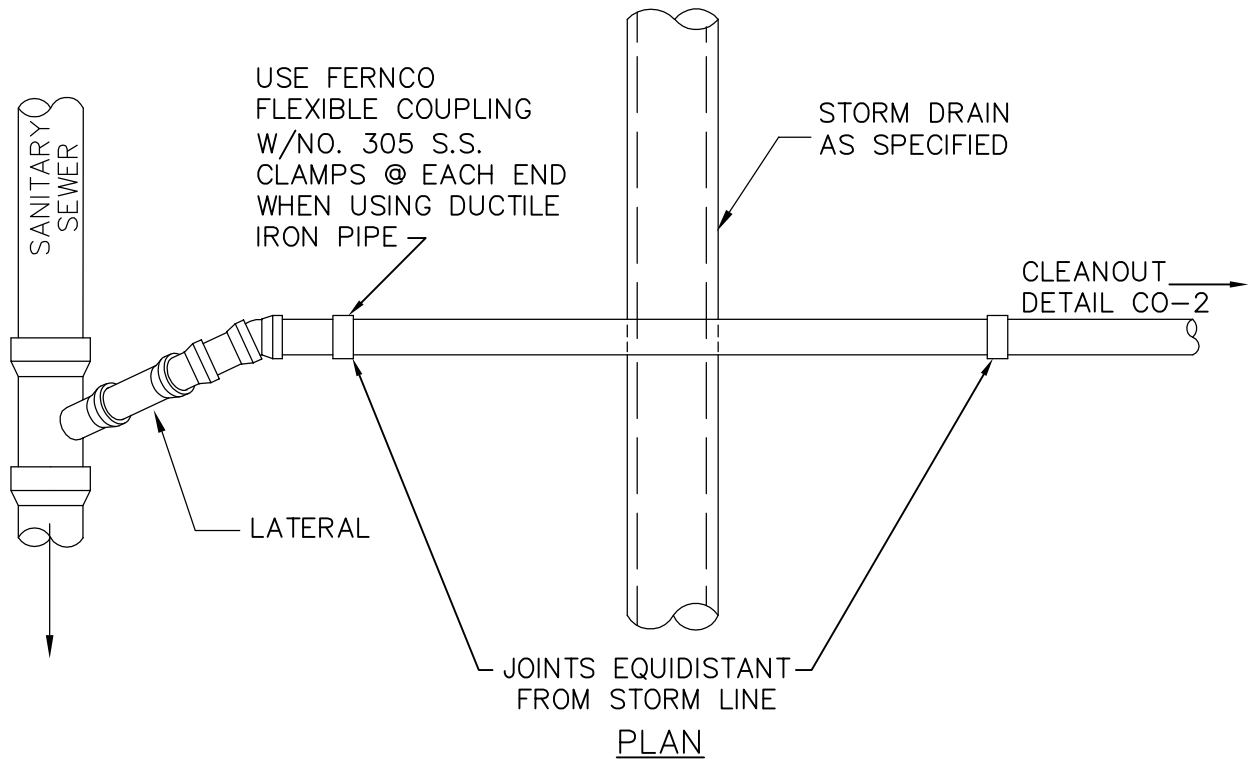
*IF SEPARATION IS LESS THAN 18", THE
SEWER LINE IS TO BE AWWA PRESSURE
RATED PIPE

REV. 1/07



AMHERST COUNTY
SERVICE AUTHORITY

HC-1



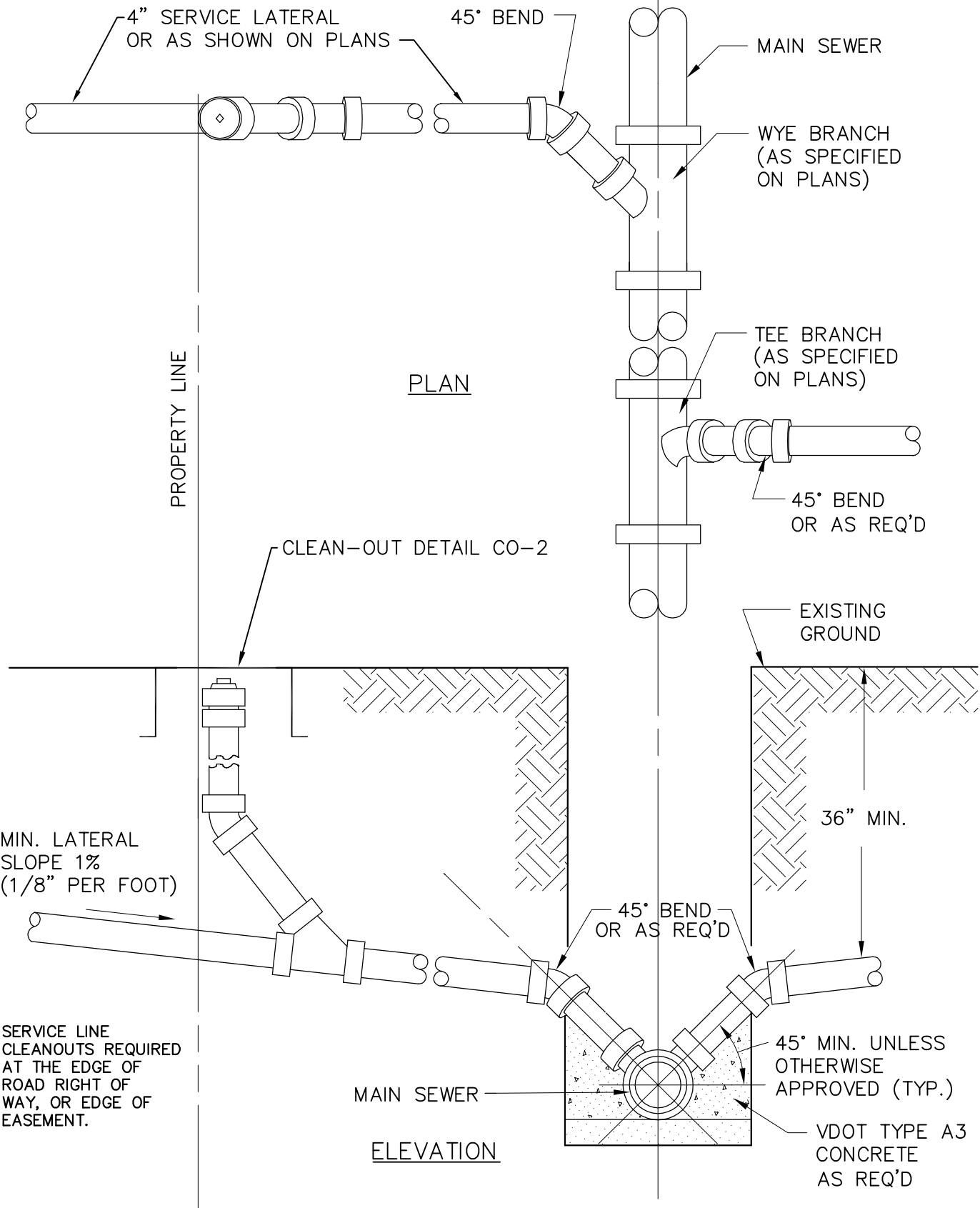
HOUSE CONNECTION-SANITARY SEWER CROSSING STORM SEWER N.T.S.

REV. 12/06



AMHERST COUNTY
SERVICE AUTHORITY

HC-2



HOUSE CONNECTION SANITARY SEWER

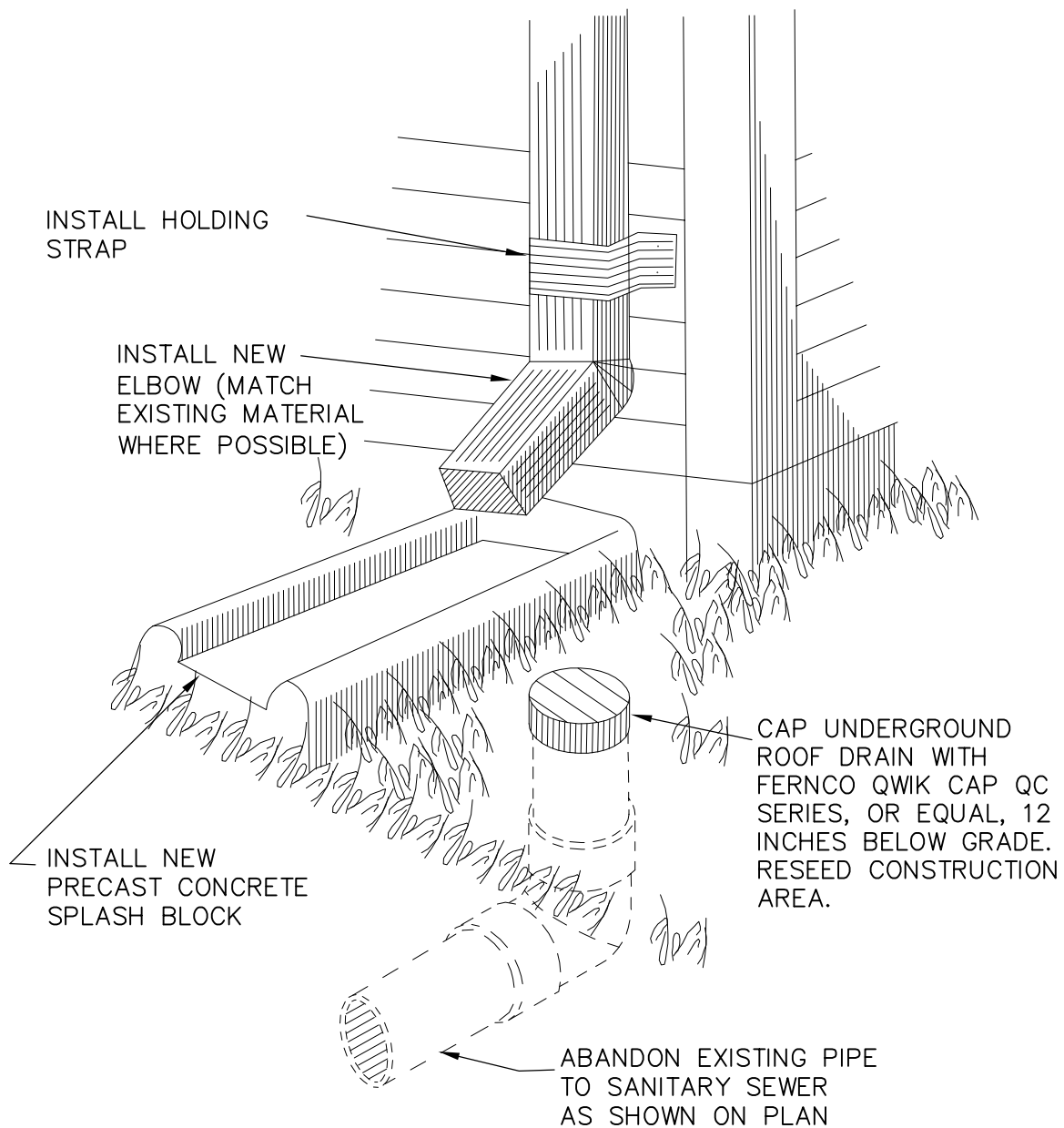
N.T.S.

REV. 12/06



AMHERST COUNTY
SERVICE AUTHORITY

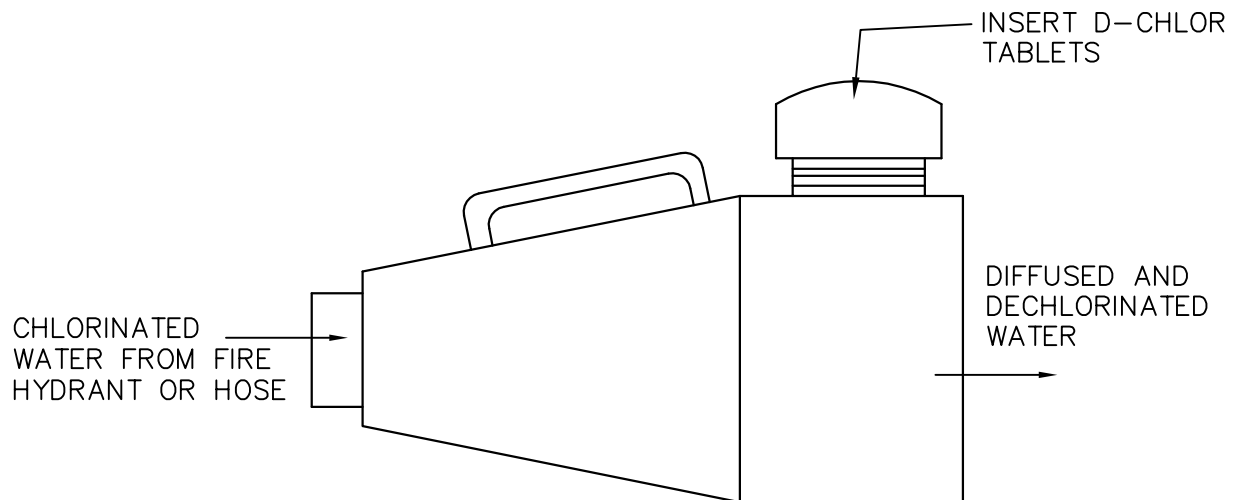
HC-3



MINIMUM GAUGES AND SIZES FOR GUTTER					
GIRTH (INCHES)	GALVANIZED STEEL (GAUGE)	COPPER (OZ.)	ALUMINUM (INCHES)	STAINLESS STEEL (GAUGE)	PVC (SCH.)
UP TO 15	26	16	0.025	26	40
16 TO 20	24	16	0.032	26	40
21 TO 25	22	20	0.051	24	40

SANITARY SEWER ROOF DRAIN DISCONNECTION

N.T.S.



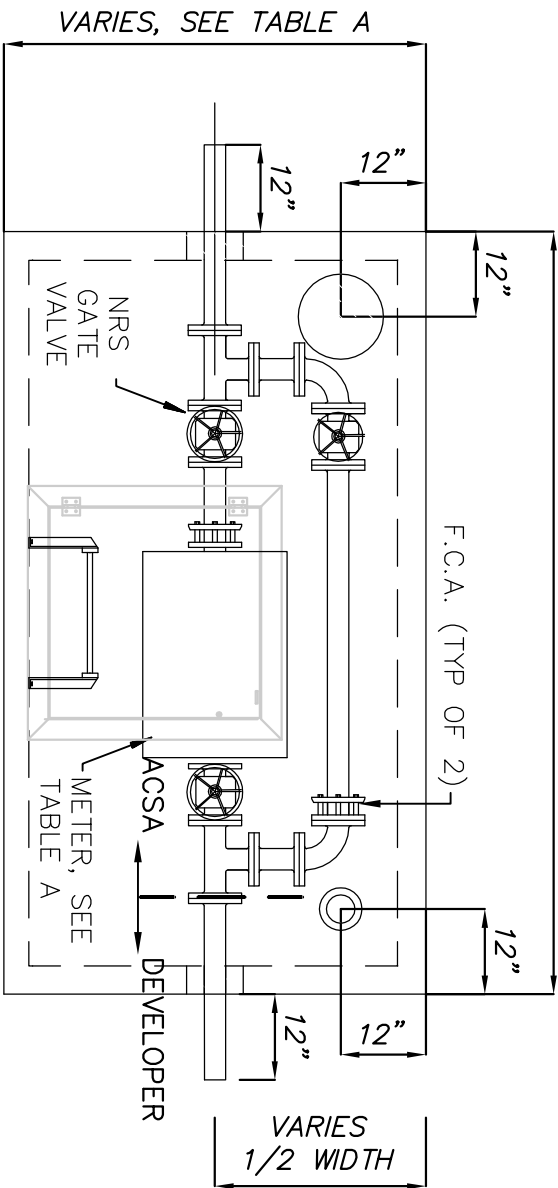
MODEL LPD-250 (OR EQUIVALENT) DIFFUSER FOR USE WITH CHEMICALLY TREATED (CHLORINE/CHLORAMINE) POTABLE WATER. THIS DIFFUSER USES D-CHLOR TABLETS AND DISSOLVES THEM INTO THE DISCHARGE STREAM AT A CONCENTRATION OF ABOUT 16 PPM. IT CAN HANDLE ABOUT 10,000 GALLONS BETWEEN TABLET RECHARGE. RATED FOR HYDRANT STATIC PRESSURE TO 200 PSI WITH FLOW RATES UP TO 1,600 GPM.

MANUFACTURER: POLLARD WATER (800) 437-1146
(WWW.POLLARDWATER.COM) OR EQUAL.

LINE PURGE DIFFUSER/DECHLORINATOR

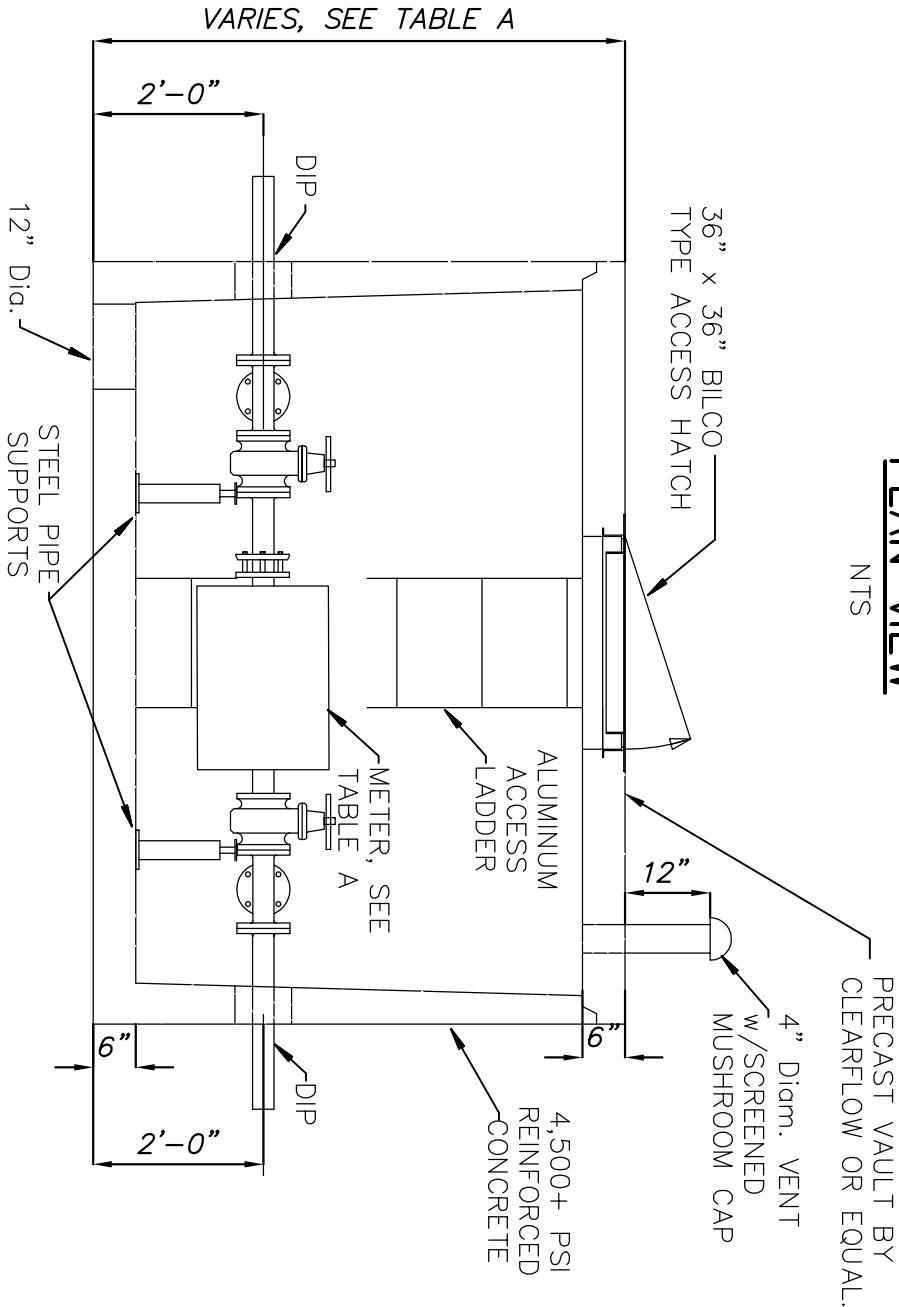
N.T.S.

VARIES, SEE TABLE A



PLAN VIEW

NTS



SECTION VIEW

NTS

PIPE TO GRAVITY DRAIN
WITH SCREENED OUTLET
OR PROVIDE SUMP PUMP



AMHERST COUNTY
SERVICE AUTHORITY

GENERAL NOTES:

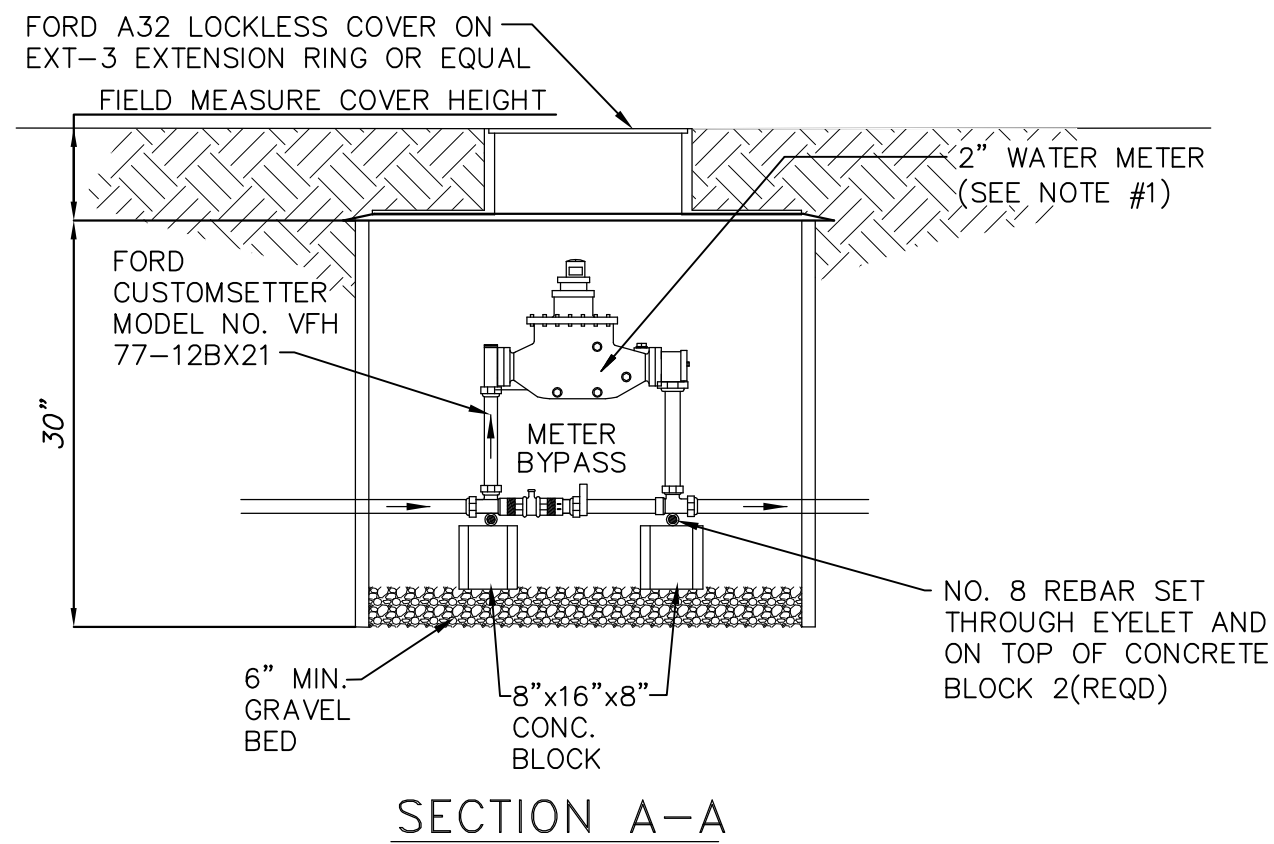
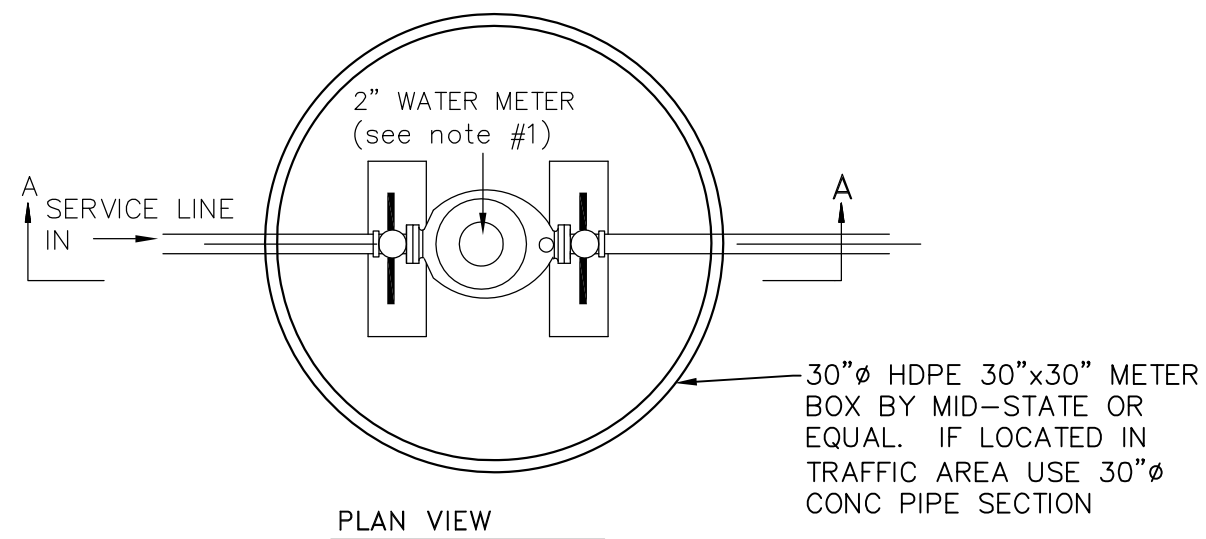
- 1.) METERS SHALL BE SENSUS COMPOUND METERS OR AS APPROVED BY THE AMHERST COUNTY SERVICE AUTHORITY.
- 2.) THIS VAULT DESIGN DOES NOT ALLOW FOR VEHICULAR TRAFFIC. IF VEHICULAR TRAFFIC MUST PASS OVER VAULT, THE ENGINEER SHOULD BE CONSULTED FOR CHANGES IN DESIGN.
- 3.) VAULT TO BE INSTALLED SO THAT FOUNDATION LIES ON THE OWNER'S PROPERTY JUST BEHIND THE V.D.O.T. RIGHT-OF-WAY LINE.
- 4.) NO FILL SHALL BE PLACED ON VAULT UNLESS APPROVED BY ENGINEER AND APPROPRIATE MODIFICATION MADE.
- 5.) THE VAULT TOP SHALL BE SET IN PLACE AFTER THE VAULT PIPING HAS BEEN SET & COMPLETELY TESTED FOR ITS WATERTIGHTNESS.
- 6.) THE OWNER OR DEVELOPER WILL BE RESPONSIBLE FOR 100% OF THE COST OF THE VAULT & ITS INTERIOR PIPING.
- 7.) THE VAULT MUST BE KEPT FREE FROM FLOODING AT ALL TIMES.
- 8.) THE VAULT SHALL BE LOCATED SUCH THAT NO SURFACE WATER WILL DRAIN ONTO THE TOP OF THE VAULT.
- 9.) GATE VALVES, 2" THRU 12" – MUELLER A-2360 RESILIENT WEDGE GATE VALVES.
- 10.) GATE VALVES, 14" OR LARGER – MUELLER A-2361 RESILIENT WEDGE GATE VALVES.

TABLE A

METER SIZE	VAULT LENGTH (MIN.)	VAULT WIDTH (MIN.)	VAULT HEIGHT (MIN.)
3" OR 4"	8'-11 1/2"	4'-11 1/2"	6'-3"
6" – 10"	11'-7"	6'-1"	7'-6"

METER INSTALLATION, 3" AND ABOVE

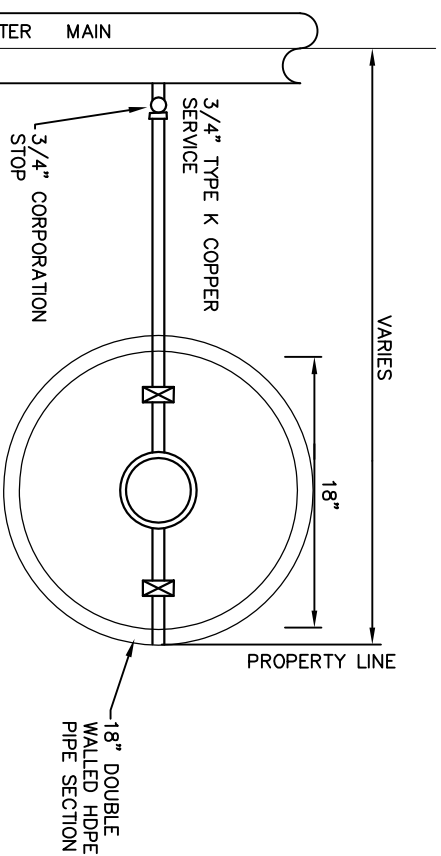
N.T.S.



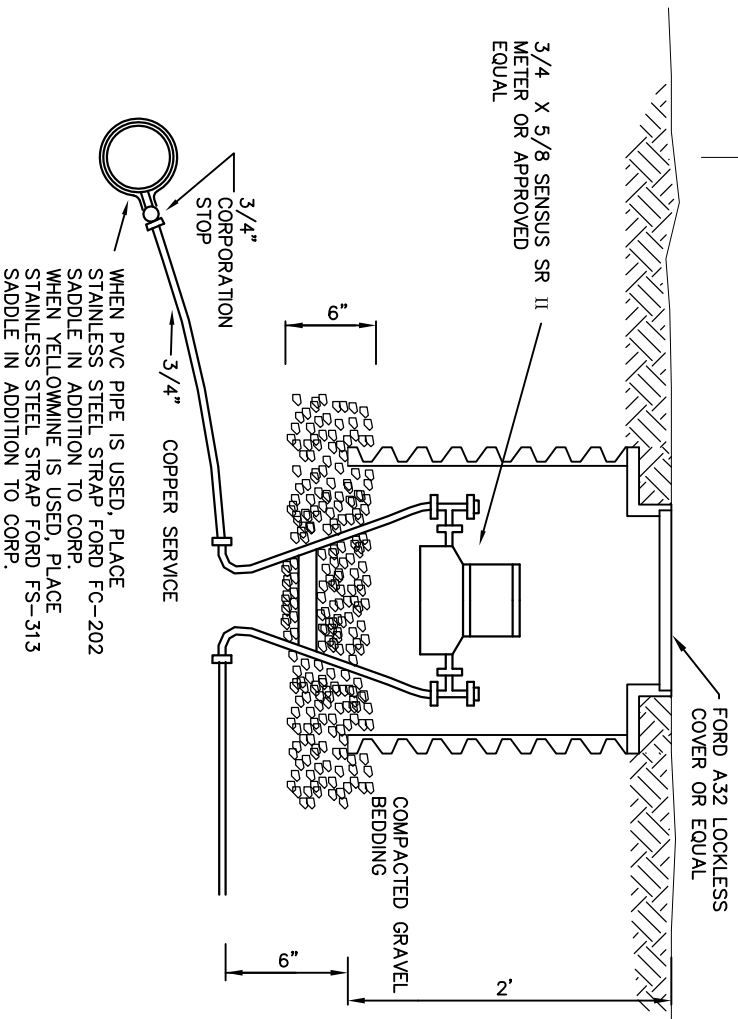
GENERAL NOTES:

- 1.) SENSUS C² OMNI METER IN SIZE SPECIFIED BY ACSA.
- 2.) EITHER METER IS TO BE MOUNTED IN A FORD VFH-77-12BX21 CUSTOM SETTER.
- 3.) METER BOX TO BE INSTALLED SO THAT IT LIES ON THE OWNER'S PROPERTY JUST BEHIND THE V.D.O.T., RIGHT-OF-WAY LINE.
- 4.) THE OWNER OR DEVELOPER WILL BE RESPONSIBLE FOR 100% OF THE COST OF THE METER BOX & ITS INTERIOR PIPING.
- 5.) THE METER BOX MUST BE KEPT FREE FROM FLOODING AT ALL TIMES. BOX SHALL BE LOCATED SUCH THAT NO SURFACE WATER WILL DRAIN ONTO THE TOP OF THE COVER.

METER INSTALLATION, 1½" & 2"
N.T.S.



SINGLE WATER METER BOX



METER MATERIALS LIST

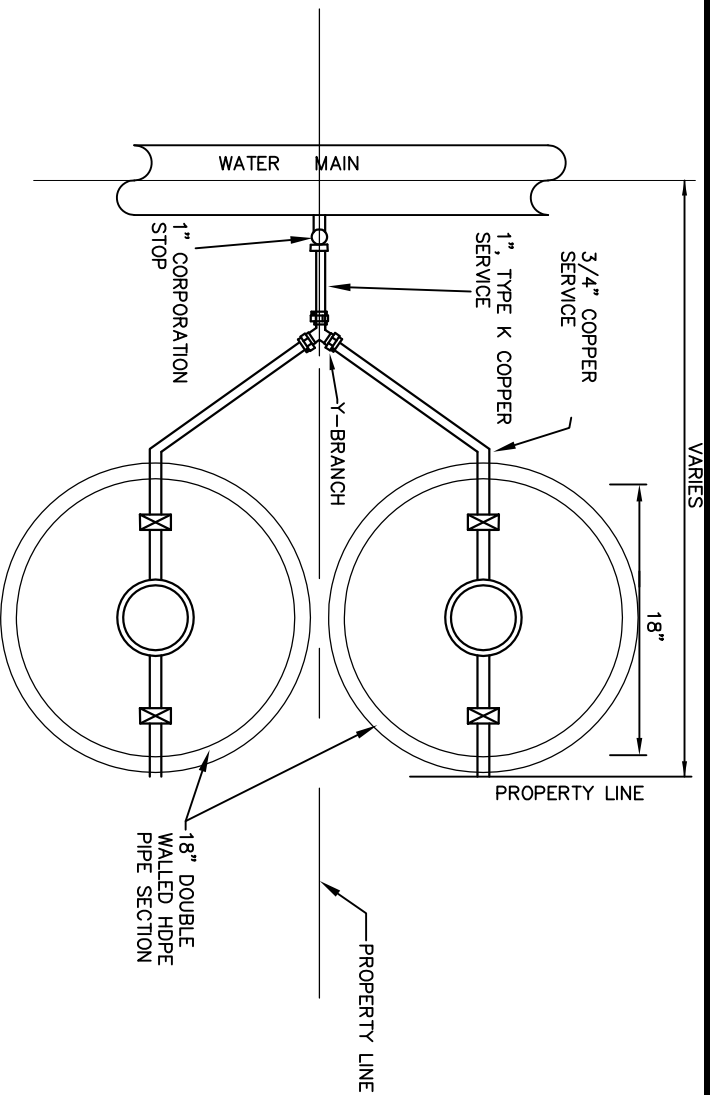
1. METER BOX EQUAL TO 18" DOUBLE WALLED HDPE PIPE SECTION W/ FORD A32 LOCKLESS LID
2. METER SETTER MUST BE FORD VBHH 71-81 OR APPROVED EQUAL
3. METER MUST BE SENSUS SR II POSITIVE DISPLACEMENT METER OR APPROVED EQUAL
4. CORPORATION STOP MUST BE MUELLER H15000, FORD F-600 OR APPROVED EQUAL
5. SERVICE LINE MUST BE TYPE K COPPER
6. FOR 1" METERS ALL FITTINGS & COMPONENTS MUST BE UPSIZED TO 1"



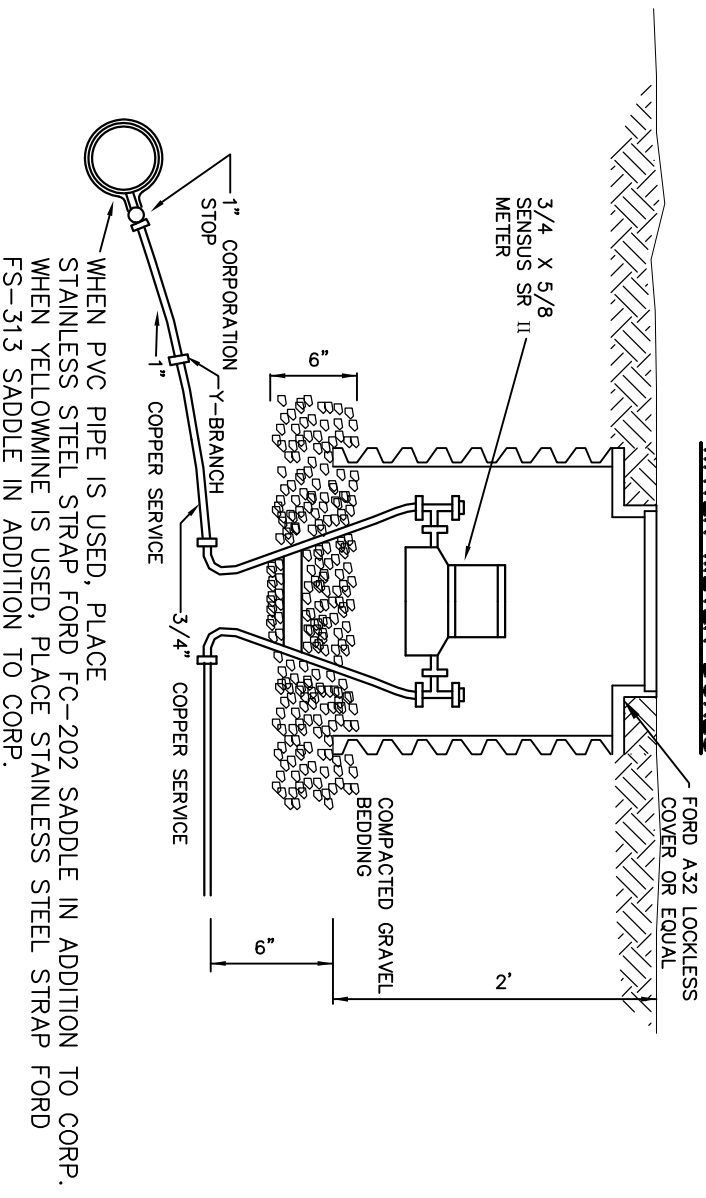
AMHERST COUNTY
SERVICE AUTHORITY

METER INSTALLATION, 5/8" & 1"

N.T.S.



WATER METER BOXES



METER MATERIALS LIST

1. METER BOX EQUAL TO 18" DOUBLE WALLED HDPE PIPE SECTION W/ FORD A32 LOCKLESS LID
2. METER SETTER MUST BE FORD VBHH 71-81 OR APPROVED EQUAL
3. METER MUST BE SENSUS SR II POSITIVE DISPLACEMENT METER OR APPROVED EQUAL
4. CORPORATION STOP MUST BE MUELLER H15000, FORD F-600 OR APPROVED EQUAL
5. SERVICE LINE MUST BE TYPE K COPPER
6. FOR 1" METERS ALL FITTINGS & COMPONENTS MUST BE UPSIZED TO 1"
7. Y-BRANCH MUST BE FORD Y22-243 OR APPROVE EQUAL

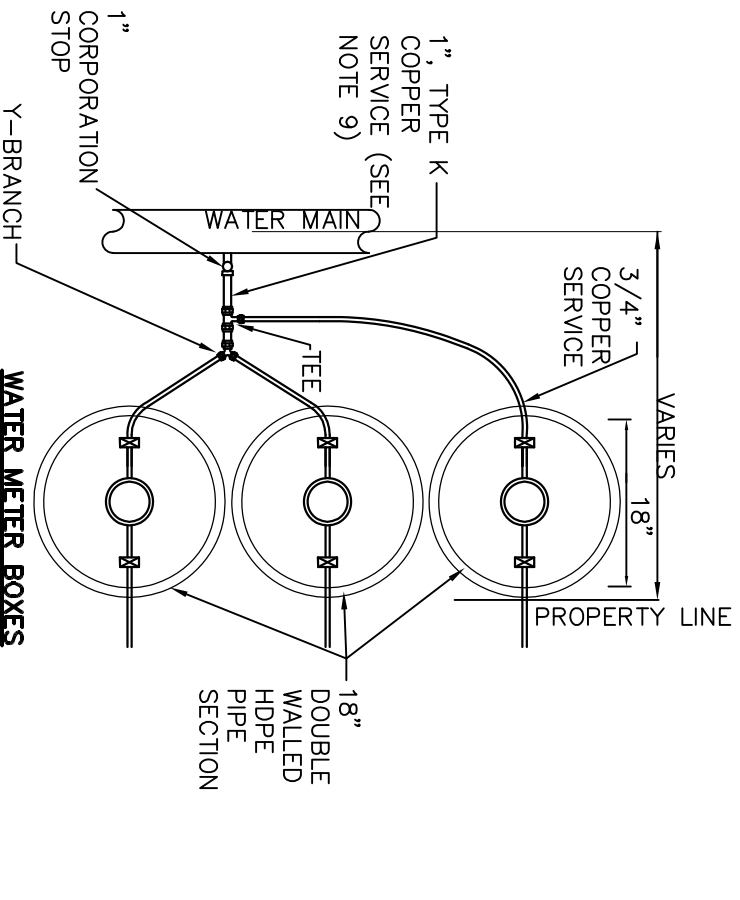
DOUBLE RESIDENTIAL

WATER METER INSTALLATION

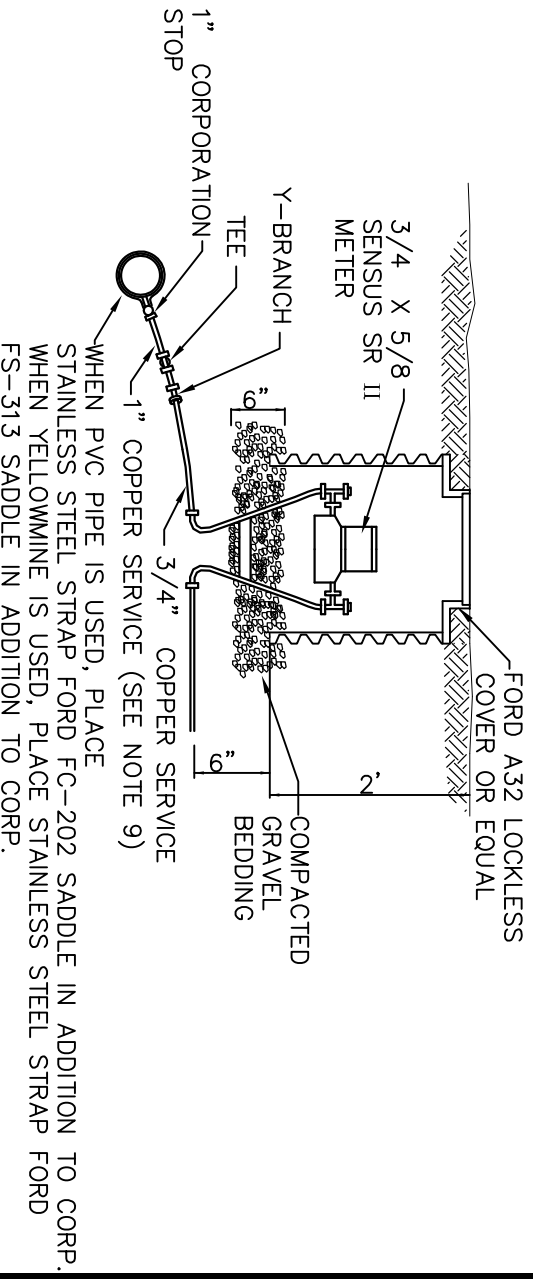
N.T.S.



AMHERST COUNTY
SERVICE AUTHORITY



WATER METER BOXES



METER MATERIALS LIST

1. METER BOX EQUAL TO 18" DOUBLE WALLED HDPE PIPE SECTION W/ FORD A32 LOCKLESS LID
2. METER SETTER MUST BE FORD VBHH 71-81 OR APPROVED EQUAL
3. METER MUST BE SENSUS SR II POSITIVE DISPLACEMENT METER OR APPROVED EQUAL
4. CORPORATION STOP MUST BE MUELLER H15000, FORD F-600 OR APPROVED EQUAL
5. SERVICE LINE MUST BE TYPE K COPPER
6. FOR 1" METERS ALL FITTINGS & COMPONENTS MUST BE UPSIZED TO 1"
7. Y-BRANCH MUST BE FORD Y22-243 OR APPROVE EQUAL
8. TEE MUST BE FORD T222-443 OR APPROVED EQUAL
9. TRIPLE METER SETTING FED BY A 1" SERVICE LINE IS ACCEPTABLE TO ACSA WHERE WATER MAIN PRESSURES EXCEED 60 PSI. WHERE LINE PRESSURES ARE LESS THAN 60 PSI, A 1 1/2" SERVICE LINE IS REQUIRED WITH FORD Y-BRANCH (Y22-346) AND (3) FORD 1"x3/4" REDUCERS (C22-34) AND NO TEE.

REV. 1/12



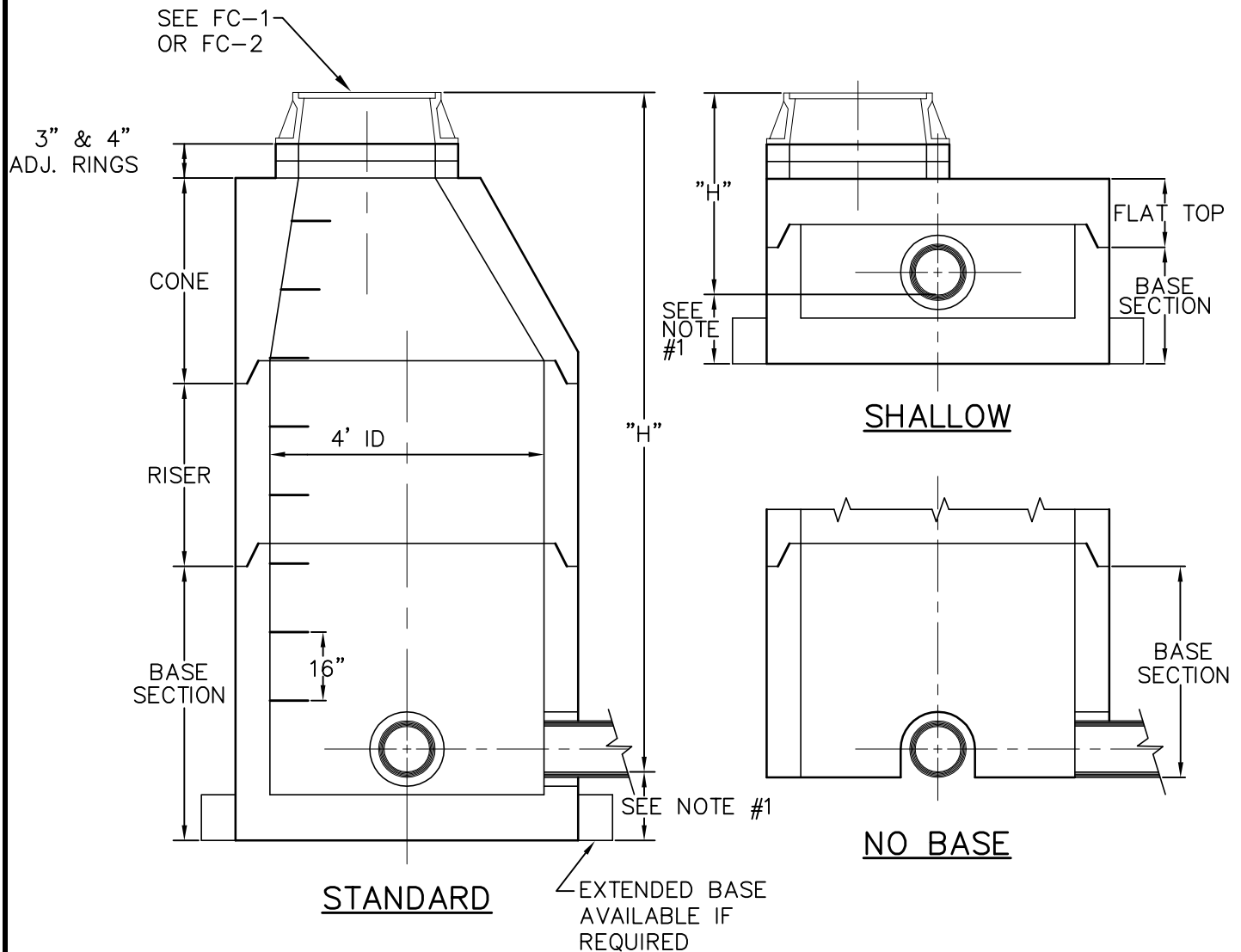
AMHERST COUNTY
SERVICE AUTHORITY

TRIPLE RESIDENTIAL **WATER METER INSTALLATION**

N.T.S.

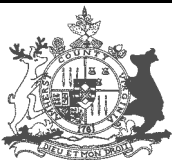
NOTE:

ANY MANHOLE NOT IN A PUBLIC ROAD RIGHT OF WAY WILL HAVE PLACED IN ITS IMMEDIATE VICINITY A METAL FENCE POST TO FACILITATE LOCATION. FENCE POST SHALL BE 8' LONG, WITH TOP 2' PAINTED FLOURESCENT ORANGE, AND AT LEAST 18" IN GROUND.



NOTES:

1. INVERT TO BOTTOM OF BASE = 1' (NORMALLY), GREATER FOR LARGE PIPE OR STEEP SLOPES.
2. BASE SECTION HEIGHTS - MULTIPLES OF 6"
3. RISER HEIGHTS - MULTIPLES OF 16"
4. STEPS - MA INDUSTRIES PS-1-PF COPOLYMER, OR EQUAL POLYPROPYLENE ENCAPSULATED STEEL.
5. MANHOLE SECTIONS - ASTM C478-02 W/O-RING GASKET JOINTS - ASTM C443.



3" MIN.
12" MAX.
3" OR 4" PRE-
CAST OR BRICK
ADJUSTING RINGS

SEE FC-1 OR FC-2

NOTE:

ANY MANHOLE NOT IN A PUBLIC ROAD RIGHT OF WAY WILL HAVE PLACED IN ITS IMMEDIATE VICINITY A METAL FENCE POST TO FACILITATE LOCATION. FENCE POST SHALL BE 8' LONG, WITH TOP 2' PAINTED FLOURESCENT ORANGE, AND AT LEAST 18" IN GROUND.

24" I.D.

ON WATERTIGHT COVER, USE SPECIFIED JOINT SEALER BETWEEN EACH RING.

SEAL UNDER CASTING AND ALL JOINTS WITH BUTYL RUBBER ROPE SEALER, AASHTO M-198

STEP
CAST IN
PLACE
(TYP.)

STEPS SHALL HAVE CONTINUOUS ALIGNMENT BETWEEN SECTIONS

SLEEVE OR GASKET

BENCH FROM SPRING LINE OF PIPE TO WALL @ 2"-4"/FT. SLOPE

2500# CONCRETE

SUPPORT PIPE TO UNDISTURBED EARTH WITH CONCRETE (MIN. LENGTH 36" OR TO JOINT)

8" MIN.
THICK BED OF
CRUSHED STONE
VDOT #25 OR #26

SECTION

NOTE: MATERIALS AND FABRICATION IN ACCORDANCE WITH ASTM C478-02, CONE WILL BE OF THE ECCENTRIC TYPE. GROUT PIPE INTO MANHOLE WALL.

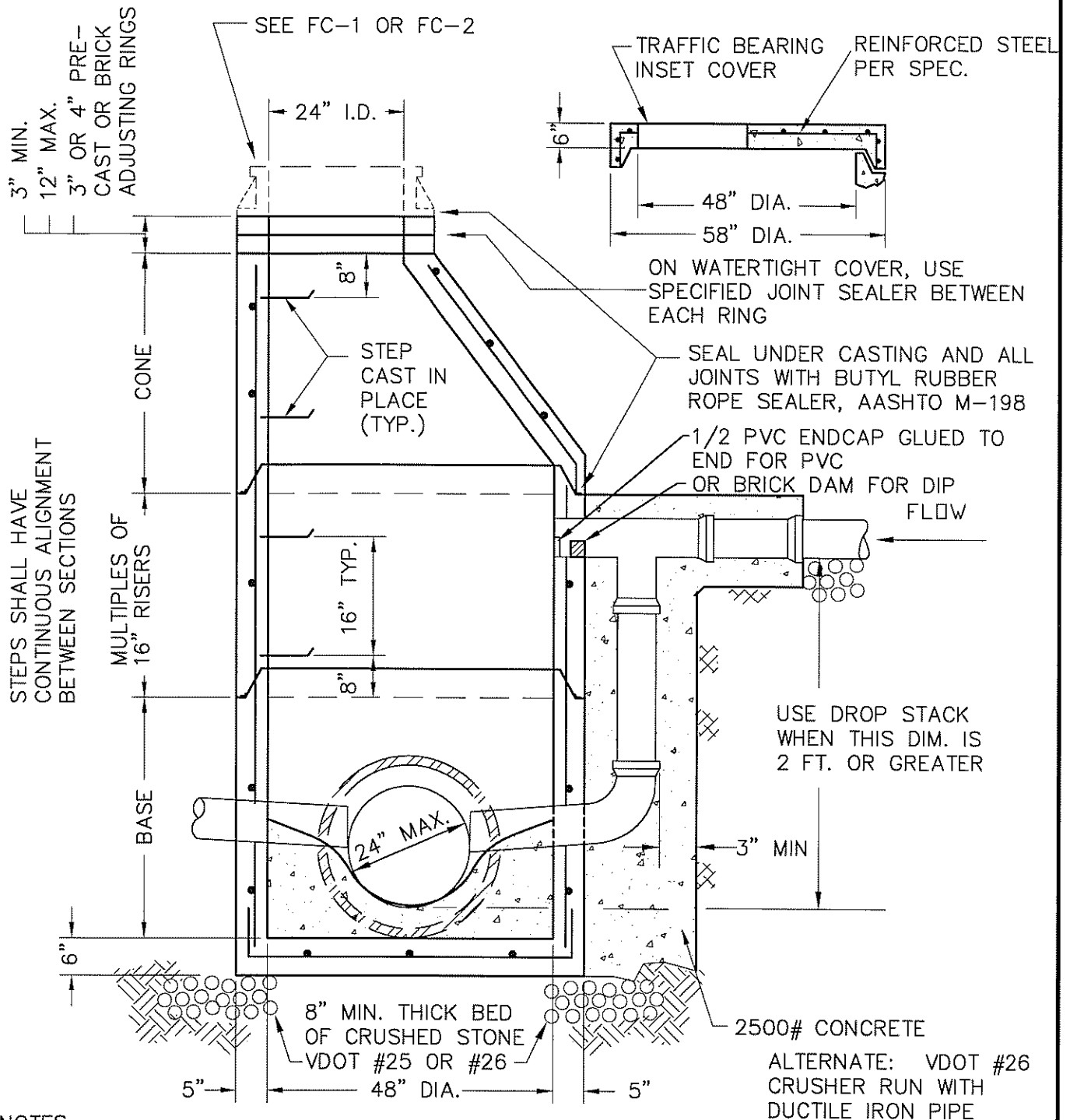
REV: 03/10



AMHERST COUNTY
SERVICE AUTHORITY

PRECAST CONCRETE MANHOLE
(FOR USE ON EXISTING LINES)
N.T.S.

MH-2



NOTES:

ANY MANHOLE NOT IN A PUBLIC ROAD RIGHT OF WAY WILL HAVE PLACED IN ITS IMMEDIATE VICINITY A METAL FENCE POST TO FACILITATE LOCATION. FENCE POST SHALL BE 8' LONG, WITH TOP 2' PAINTED FLOURESCENT ORANGE, AND AT LEAST 18" IN GROUND.

MATERIALS AND FABRICATION SHALL BE IN ACCORDANCE WITH ASTM C478-02. CONE SHALL BE OF THE ECCENTRIC TYPE. FOR NEW LINES, CONNECT PIPE TO SECTION WITH APPROVED FLEXIBLE WATER-TIGHT SLEEVE OR GASKET (INTERPACE OR EQUAL). THE FLEXIBLE WATER-TIGHT SLEEVE OR GASKET SHALL BE INSTALLED PER THE MANUFACTURER'S RECOMMENDATIONS.

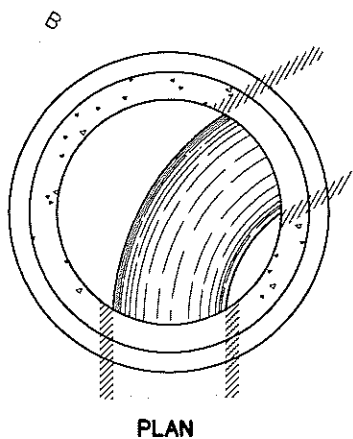
REV: 03/10



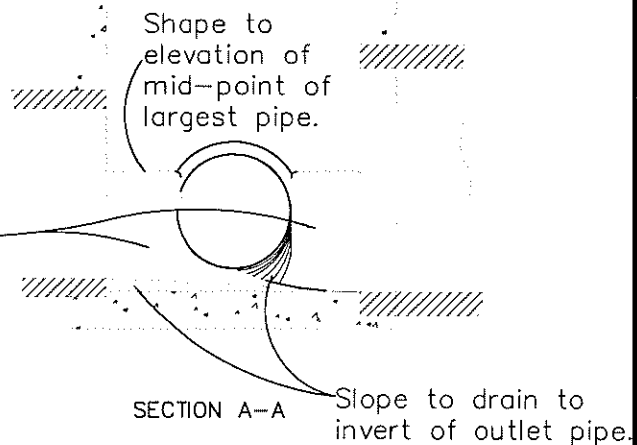
AMHERST COUNTY
SERVICE AUTHORITY

**PRECAST SANITARY SEWER
DROP MANHOLE**
ECCENTRIC WITH MONOLITHIC BASE
N.T.S.

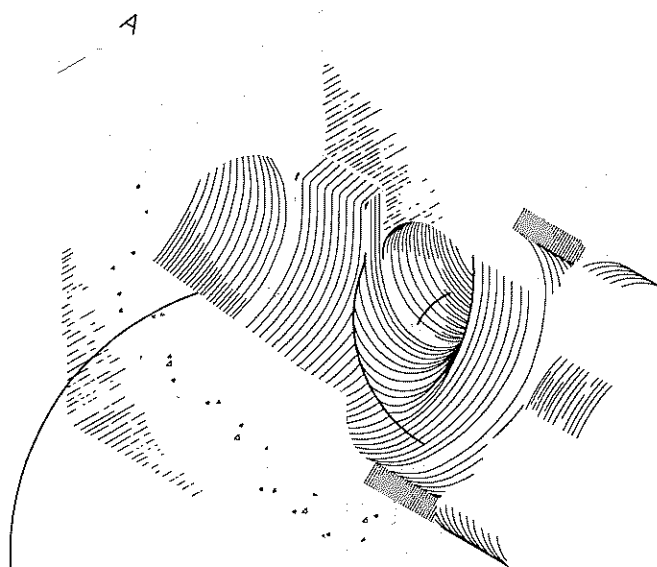
MH-3



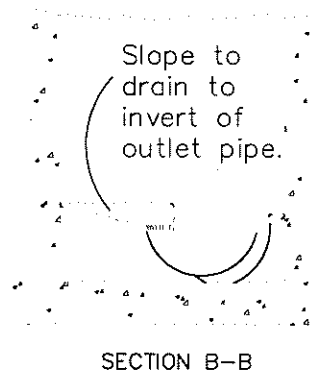
Shape to contour of pipe.



METHOD OF TREATMENT IN DROP INLETS



Transition between pipe diameters when different sizes of pipe are encountered.



METHOD OF TREATMENT IN MANHOLES

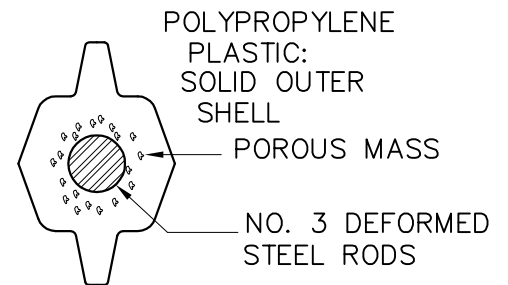
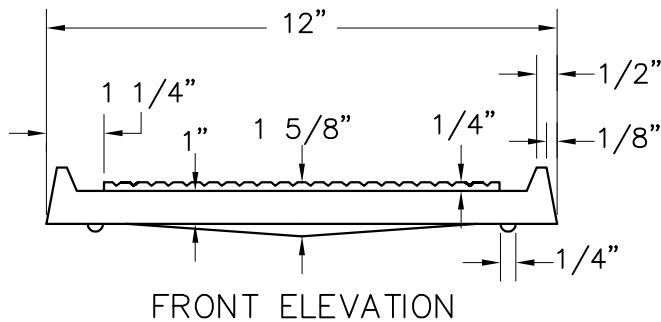
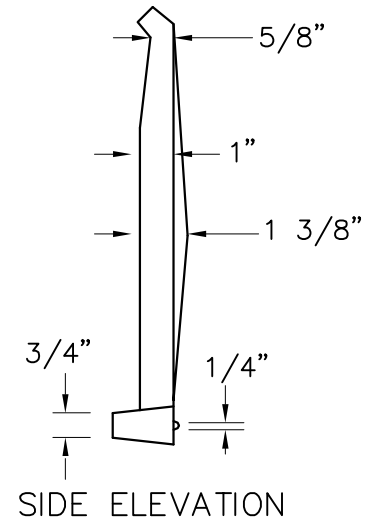
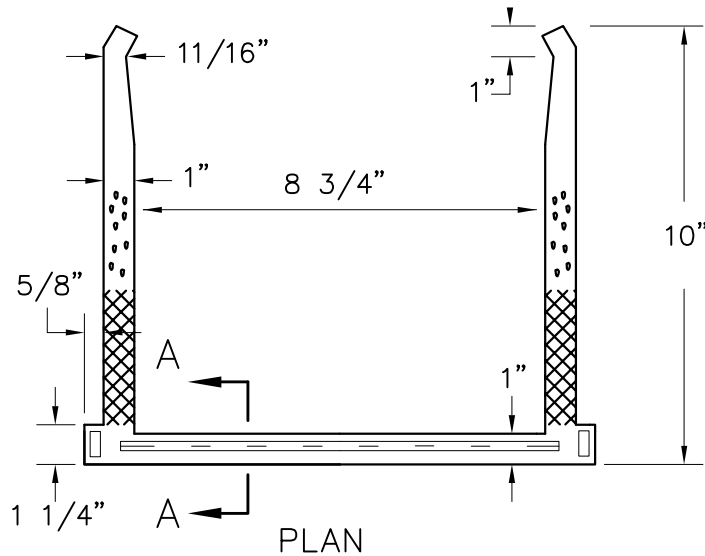
Notes:

Shaping of manhole and inlet inverts in accordance with this drawing is to apply to those structures specified on plans or where invert of pipe is above invert of structure. Manhole or drop inlet is to be formed and constructed in accordance with applicable standard or special drawing.

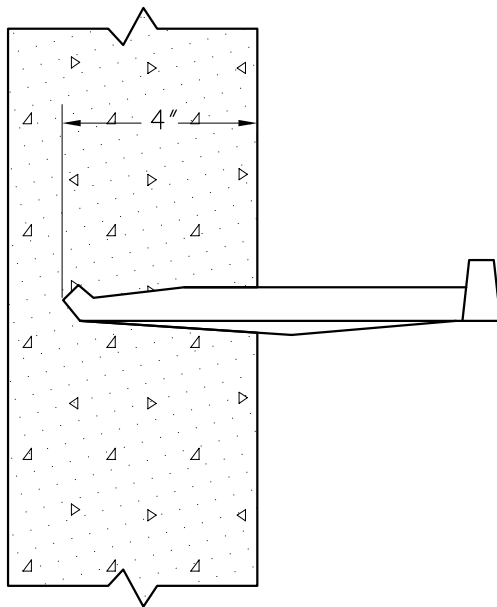
The invert shaping as detailed hereon is to consist of a Portland Cement Concrete mix conforming to Class 20 or Class 10, except that 25% of coarse aggregate may be up to 100 mm in diameter and consist of stone, broken brick, broken concrete or broken concrete block. The surface shall be left smooth by means of hand toweling. None of the coarse aggregate shall remain exposed.

Details of invert shaping as shown hereon are for example purposes only. Each manhole or drop inlet is to be shaped individually to best fit the particular inlet and outlet configuration and flow lines.





SECTION A-A



MATERIALS:

POLYPROPYLENE PLASTIC
ASTM D-4101-95b.

STEEL REINFORCING BAR — CONFORMS
TO A.S.T.M. STD A-615

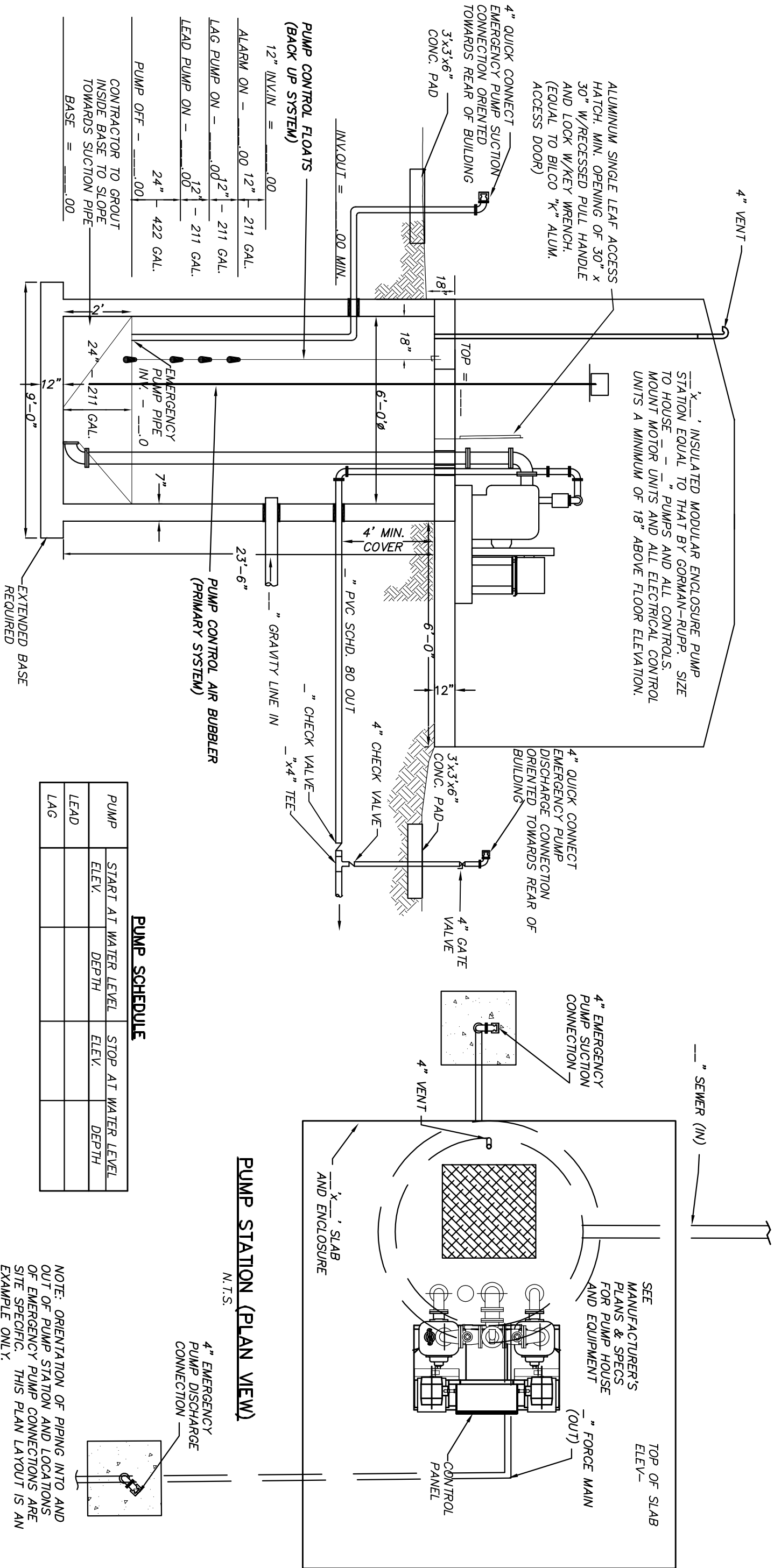
STANDARD MANHOLE STEP N.T.S.

04/15/03



AMHERST COUNTY
SERVICE AUTHORITY

MS-1



- NOTES:
1. PRE-CAST WET WELL EQUAL TO CLEARFLOW 6' DIAMETER UNIT (5,000 PSI REINFORCED)
 2. ALL PIPE PENETRATIONS ARE TO BE SEALED W/ "LINKSEAL" OR EQUAL WATERTIGHT SEALS (ADJUSTED FROM INSIDE VAULT)
 3. PUMP SHALL ALTERNATE AS LEAD AND LAG PUMP AFTER EACH OPERATION OF EACH PUMP.
 4. CONTRACTOR SHALL PROVIDE SUFFICIENT LENGTH OF 4" PRESSURE HOSE TO BE CONNECTED BETWEEN COUNTY EMERGENCY PUMP AND EMERGENCY PUMP CONNECTION RISERS.

PUMP STATION

N.T.S.

PUMP SPECIFICATIONS

CAPACITY = ____ GPM	IMPELLER = ____"
T.D.H. = ____	R.P.M. = ____
H.P. = ____	

PUMP SCHEDULE

PUMP	START AT WATER LEVEL ELEV.	STOP AT WATER LEVEL DEPTH	DEPTH
LEAD			
LAG			

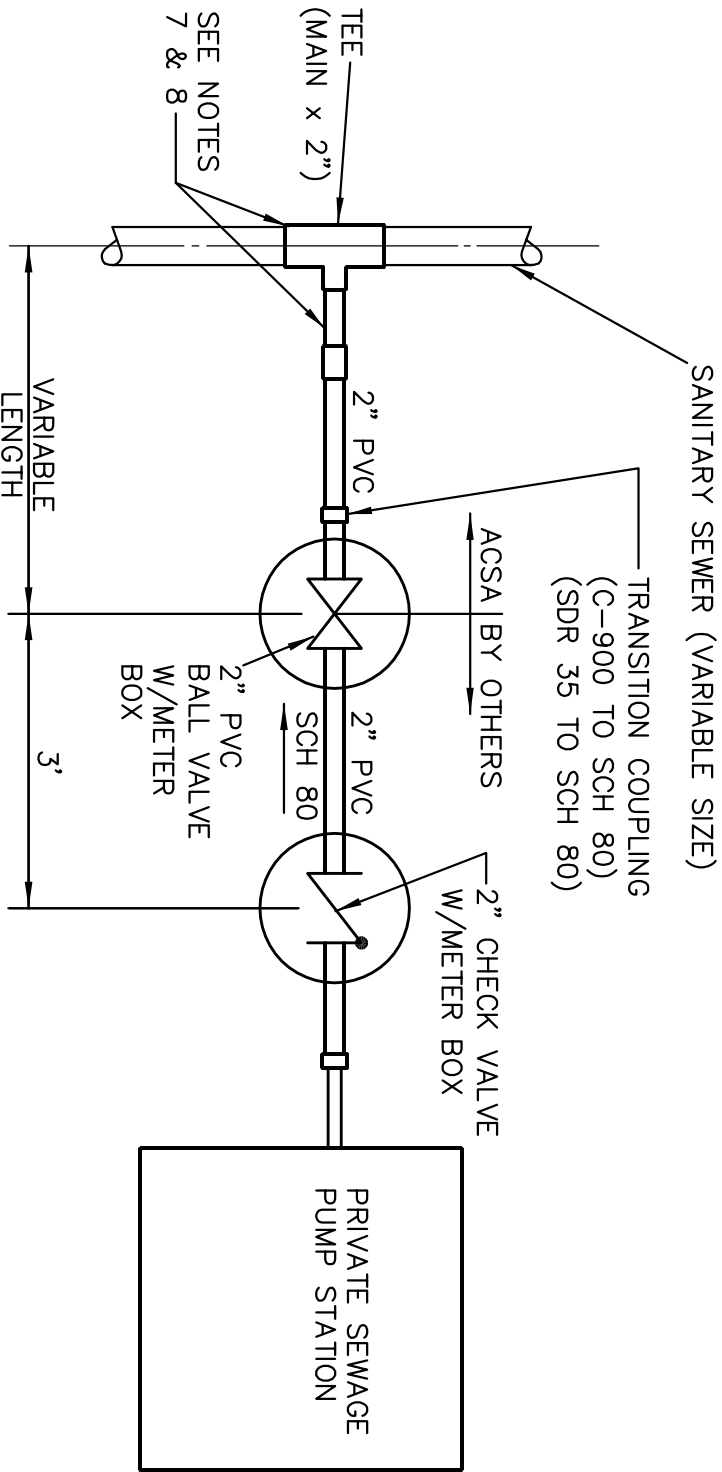
PUMP STATION (PLAN VIEW)

N.T.S.

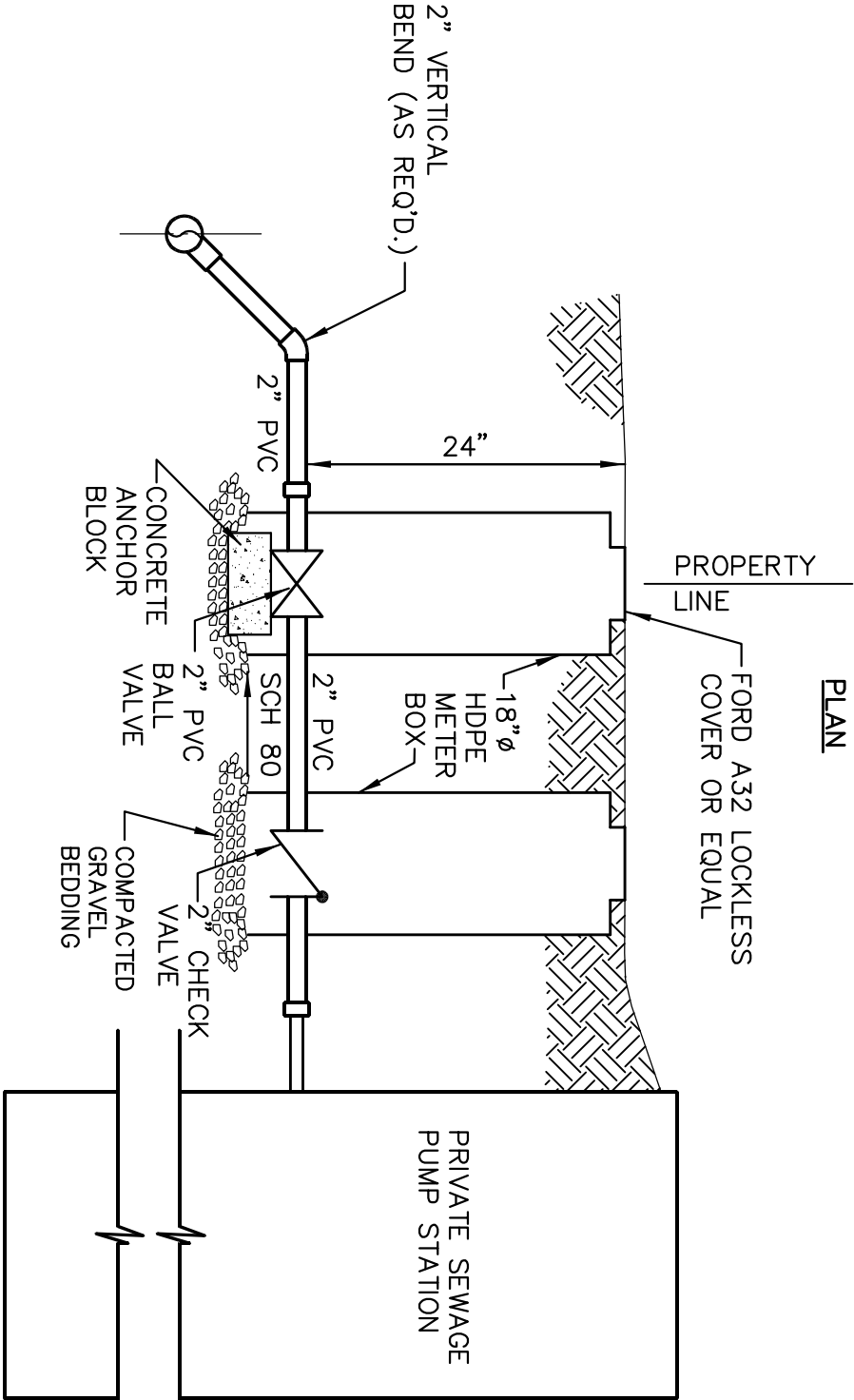
NOTE: ORIENTATION OF PIPING INTO AND OUT OF PUMP STATION AND LOCATIONS OF EMERGENCY PUMP CONNECTIONS ARE SITE SPECIFIC. THIS PLAN LAYOUT IS AN EXAMPLE ONLY.

SANITARY SEWER PUMP STATION

N.T.S.



PLAN

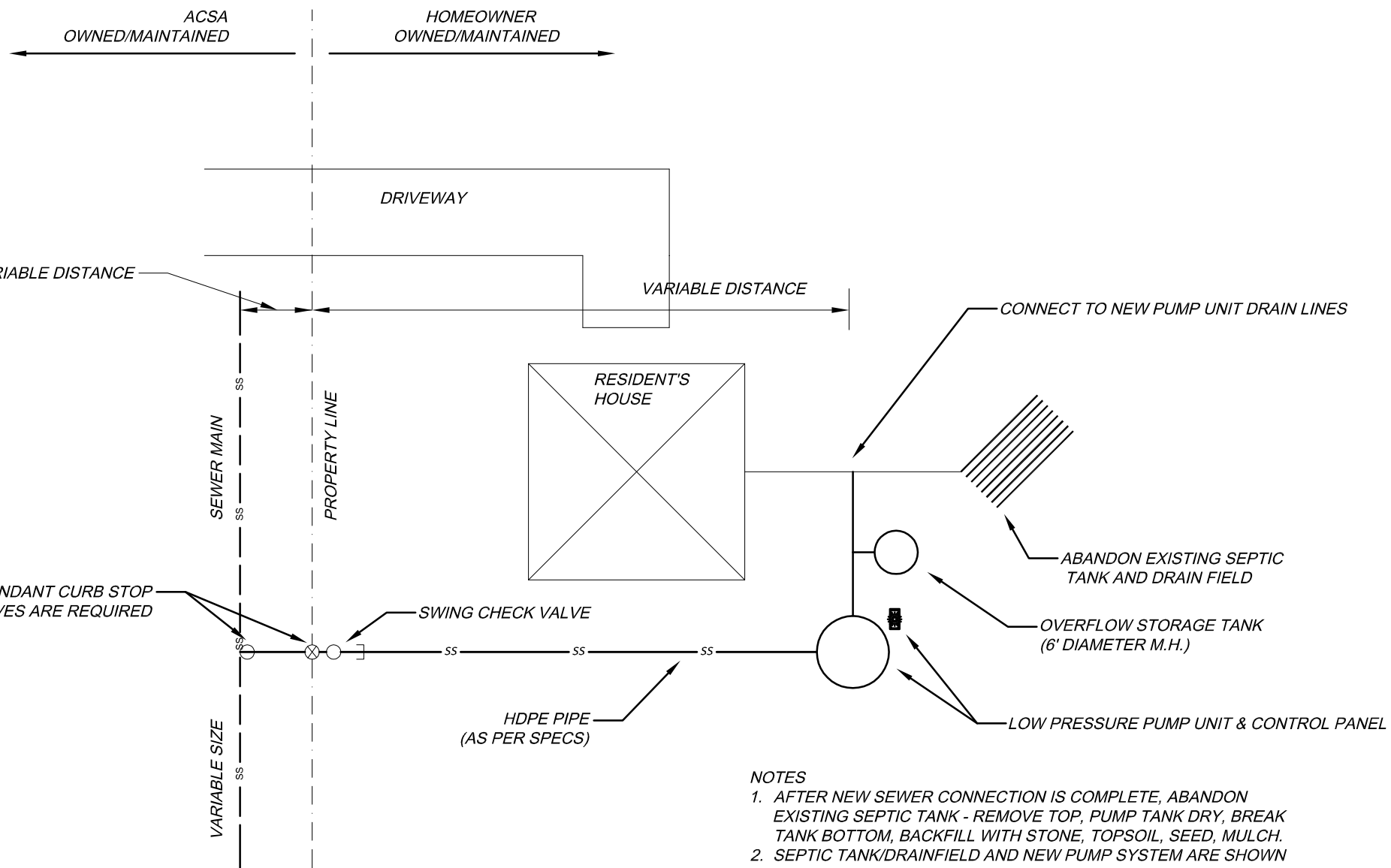


ELEVATION

NOTES:

1. MINIMUM SIZE OF FORCE MAIN FROM CHECK VALVE TO SANITARY SEWER SHALL BE 2".
2. THE BALL VALVE SHALL BE LOCATED BEHIND THE DITCH LINE.
3. ALL PIPING BETWEEN THE CHECK VALVE AND SANITARY SEWER SHALL BE SCH 80 PVC.
4. TRACER WIRE IS REQUIRED TO BE INSTALLED WITH THE PVC PIPE FROM THE PRIVATE PUMP STATION TO THE SANITARY SEWER CONNECTION.
5. CONNECTION TO SANITARY SEWER, PIPING TO BALL VALVE, BALL VALVE AND METER BOX BY ACSA.
6. 2" PVC BETWEEN BALL VALVE AND CHECK VALVE, 2" CHECK VALVE AND METER BOX BY OTHERS.
7. IF PUMP STATION DISCHARGE IS TO ACSA GRAVITY SANITARY SEWER, USE PVC SDR 35 PIPE FROM EXISTING SEWER TO TRANSITION COUPLING.
8. IF PUMP STATION DISCHARGE IS TO ACSA FORCE MAIN SEWER, USE PVC C900 PIPE FROM EXISTING FORCE MAIN TO TRANSITION COUPLING.
9. ACSA WILL CONSIDER HDPE PIPE AND CEPEX VALVES AT CONTRACTOR'S REQUEST.

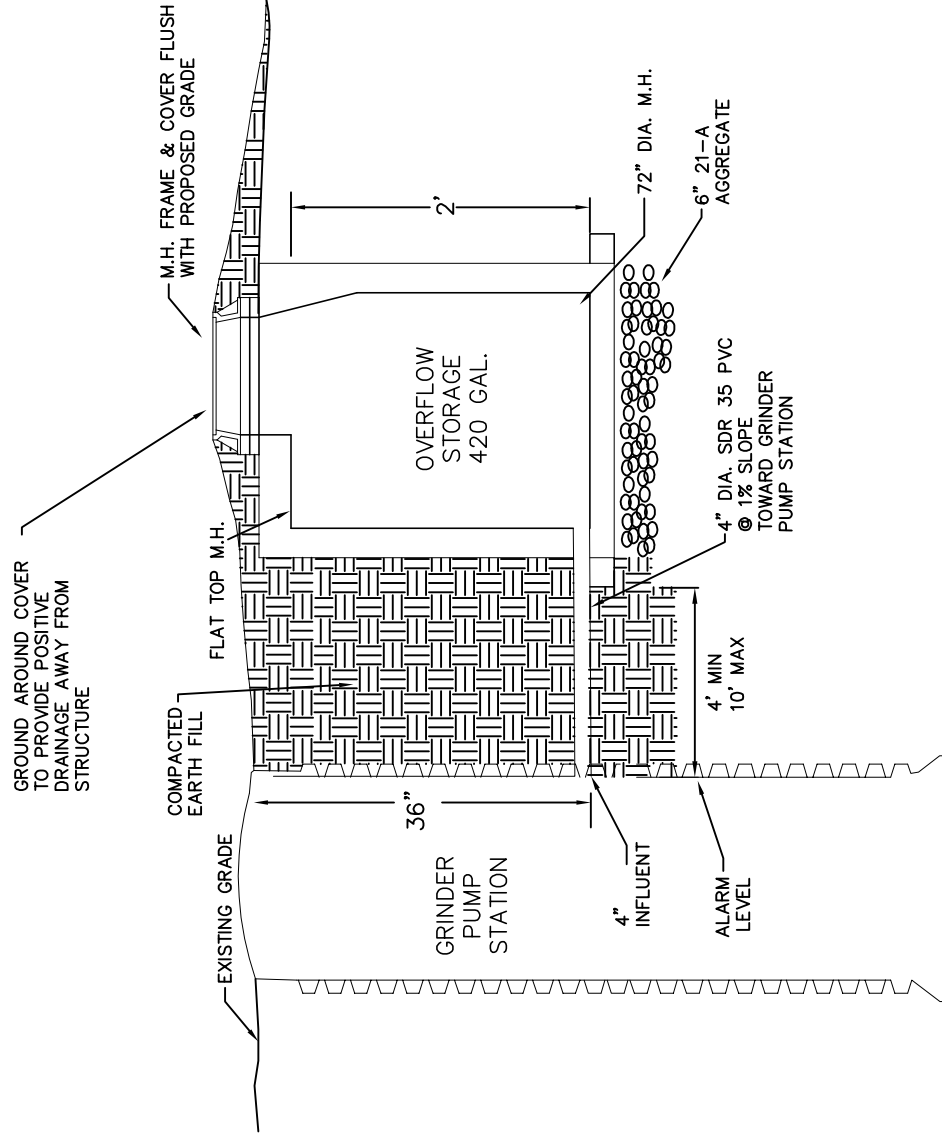




- NOTES
1. AFTER NEW SEWER CONNECTION IS COMPLETE, ABANDON EXISTING SEPTIC TANK - REMOVE TOP, PUMP TANK DRY, BREAK TANK BOTTOM, BACKFILL WITH STONE, TOPSOIL, SEED, MULCH.
 2. SEPTIC TANK/DRAINFIELD AND NEW PUMP SYSTEM ARE SHOWN FOR REFERENCE. CONTRACTOR TO COORDINATE INSTALLATION/LOCATION WITH HOME OWNER. FIELD SKETCH OF FINAL INSTALLATION TO BE PART OF AS-BUILT SUBMITTAL.
 3. SEE PS-4 FOR DISTANCE OF LOW PRESSURE SEWER UNIT TO HOME.

PRIVATE SEWAGE PUMP STATION
COMPONENT LOCATION PLAN VIEW
 (N.T.S.)





LOW PRESSURE FORCE MAIN NOTES:

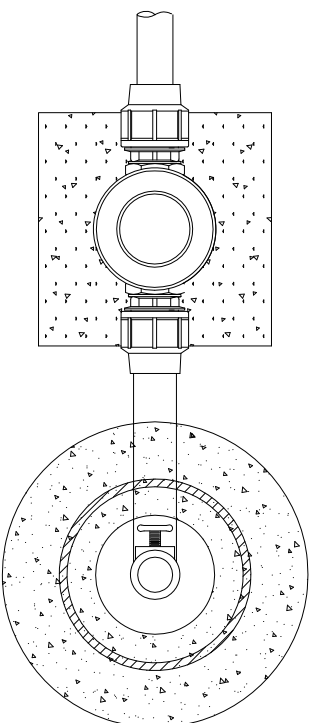
1. CONCRETE BASE SLAB IS NOT REQUIRED IF SELECT COMPACTED BACKFILL AND QUICKRETE IS USED FOR GRINDER PUMP BASE.
2. MINIMUM DISTANCE OF PUMP STATION FROM DWELLING SHALL BE 10 FT., UNLESS RESIDENCE HAS A BASEMENT. 20 FT. MIN. FROM BASEMENTS.
3. INSTALL PUMP STATION SO THAT GRADE SLOPES AWAY FROM UNIT IN ALL DIRECTIONS.
4. ALL E-ONE CONTROL PANELS ARE TO HAVE EMERGENCY GENERATOR HOOK UP OPTION INSTALLED FROM FACTORY.

**PRIVATE SEWAGE PUMP STATION
OVERFLOW STORAGE INSTALLATION**

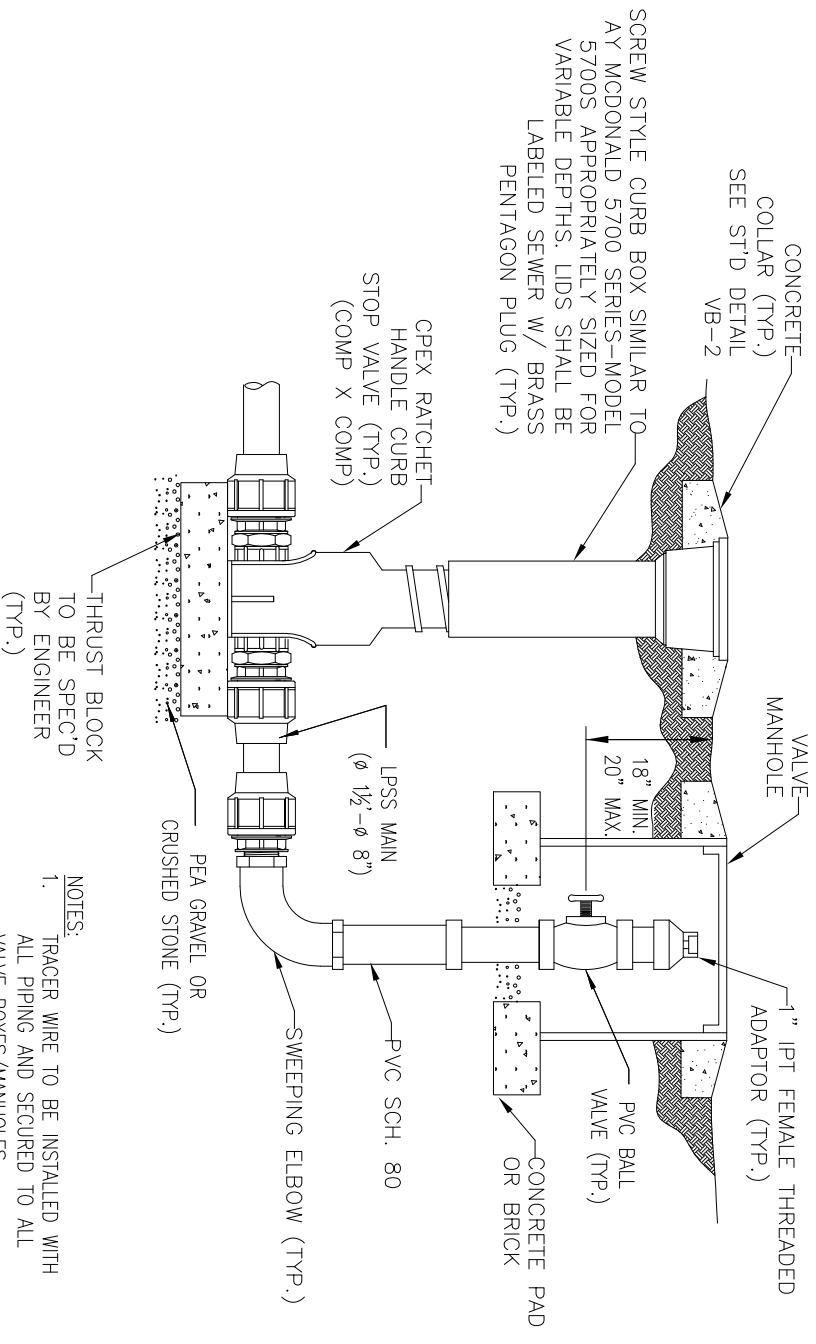
N.T.S.



AMHERST COUNTY
SERVICE AUTHORITY



PLAN VIEW



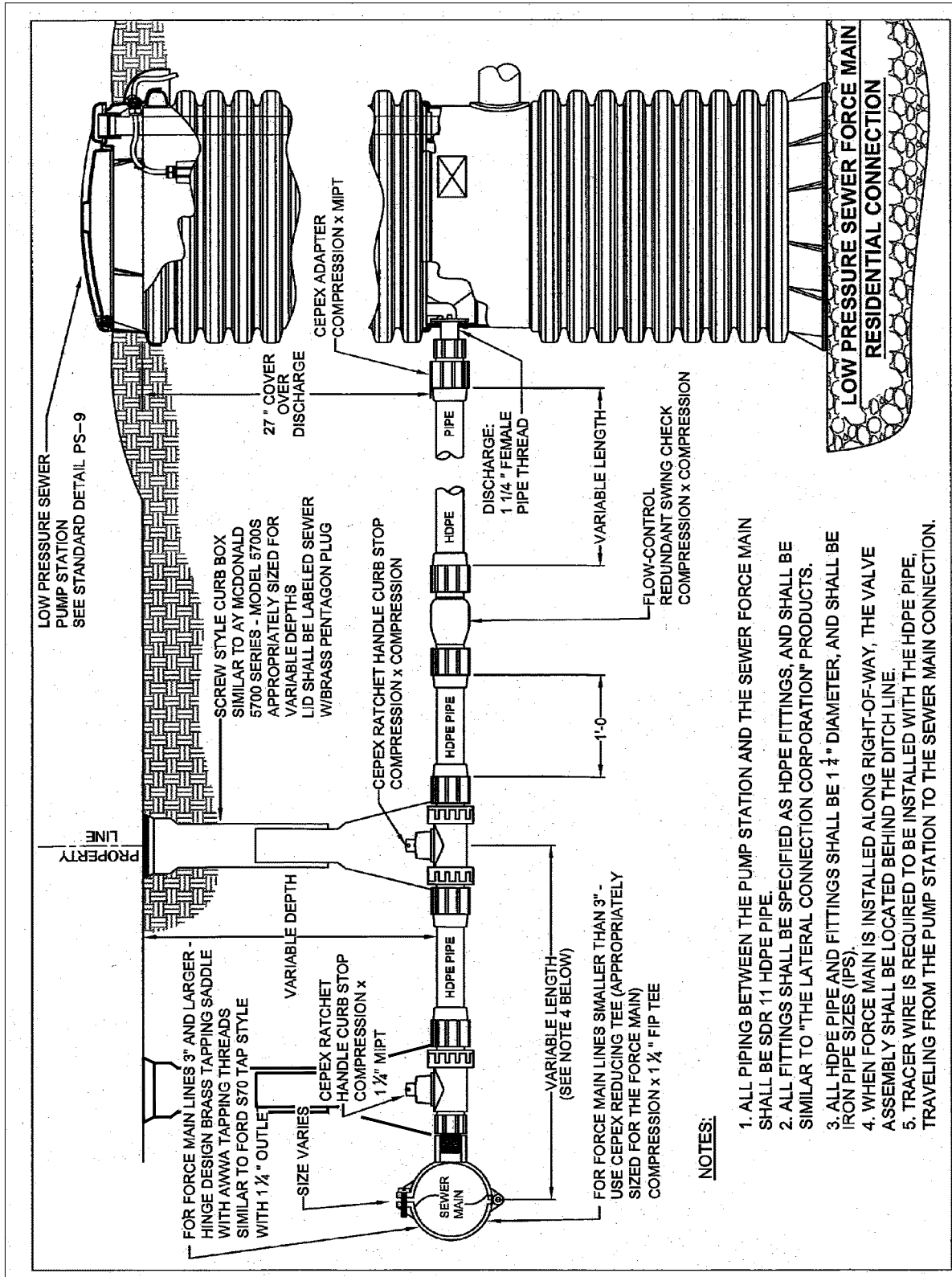
- NOTES:
1. TRACER WIRE TO BE INSTALLED WITH ALL PIPING AND SECURED TO ALL VALVE BOXES/MANHOLES
 2. CONTRACTOR TO SUPPLY 2 WRENCHES FOR VALVE OPERATION.

SEWER FORCEMAIN TERMINAL FLUSHING CLEANOUT END OF LINE

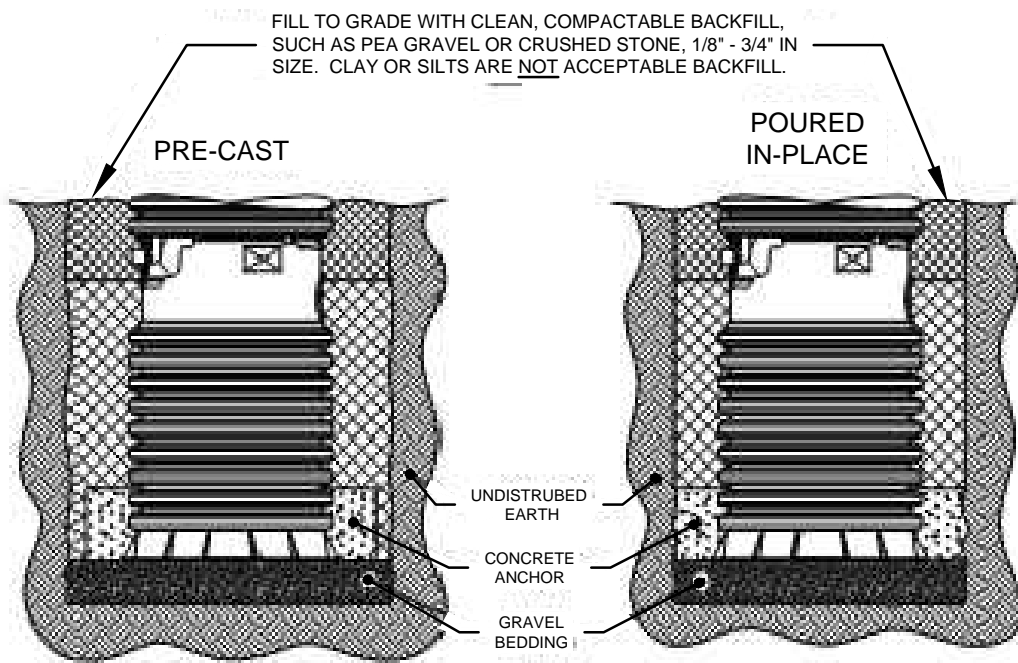
N.T.S.



AMHERST COUNTY
SERVICE AUTHORITY

**NOTES:**

1. ALL PIPING BETWEEN THE PUMP STATION AND THE SEWER FORCE MAIN SHALL BE SDR 11 HDPE PIPE.
2. ALL FITTINGS SHALL BE SPECIFIED AS HDPE FITTINGS, AND SHALL BE SIMILAR TO "THE LATERAL CONNECTION CORPORATION" PRODUCTS.
3. ALL HDPE PIPE AND FITTINGS SHALL BE 1 1/2" DIAMETER, AND SHALL BE IRON PIPE SIZES (IPS).
4. WHEN FORCE MAIN IS INSTALLED ALONG RIGHT-OF-WAY, THE VALVE ASSEMBLY SHALL BE LOCATED BEHIND THE DITCH LINE.
5. TRACER WIRE IS REQUIRED TO BE INSTALLED WITH THE HDPE PIPE, TRAVELING FROM THE PUMP STATION TO THE SEWER MAIN CONNECTION.

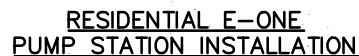


TYPICAL IN-GROUND
SECTION VIEW



1. GRINDER PUMPS SHALL BE LOCATED ON EACH LOT/PARCEL AS SHOWN ON THE APPROVED DEVELOPMENT PLANS.
2. GRINDER PUMP ASSEMBLIES SHALL BE ENVIRONMENT-1 (240 VOLT) AS MANUFACTURED BY E-ONE CORPORATION
3. ASSEMBLY TO BE LOCATED AT A MINIMUM 10' DISTANCE FROM HOME OR PERMANENT STRUCTURE

1" SCH. 80 ELECTRICAL CONDUIT (TYP.)
 **SEAL CONDUIT PER
 NEC SECTION 300.5 & 300.7



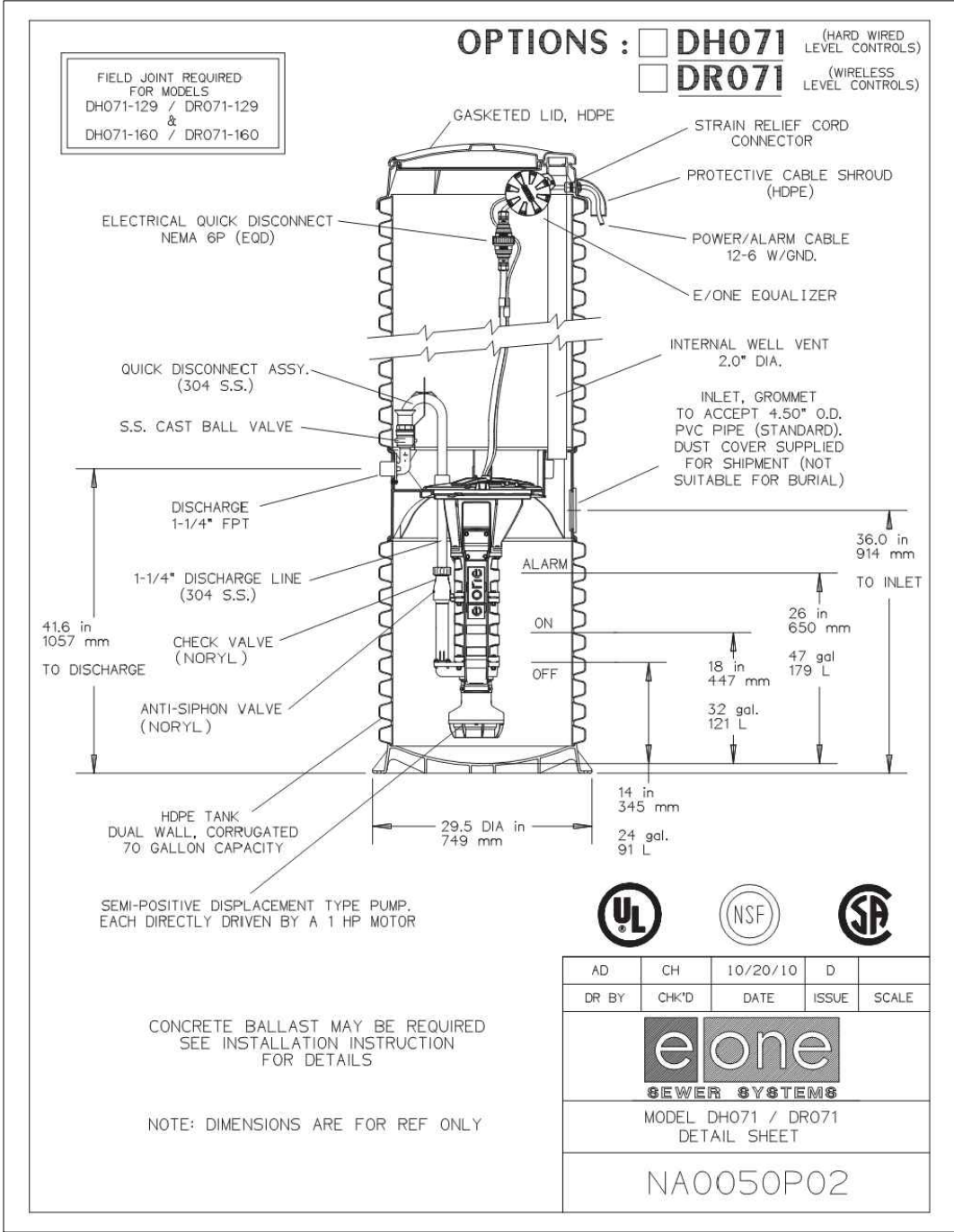
**240 V POWER SUPPLY FROM CUSTOMER'S
ELECTRIC PANEL/BREAKER BOX
**TO BE INSTALLED/CONNECTED BY THE
CUSTOMER'S ELECTRICIAN**

240 V POWER SUPPLY FROM CUSTOMER'S
ELECTRIC PANEL/BREAKER BOX
**TO BE INSTALLED/CONNECTED BY
UTILITY CONTRACTOR

REV: 02/16

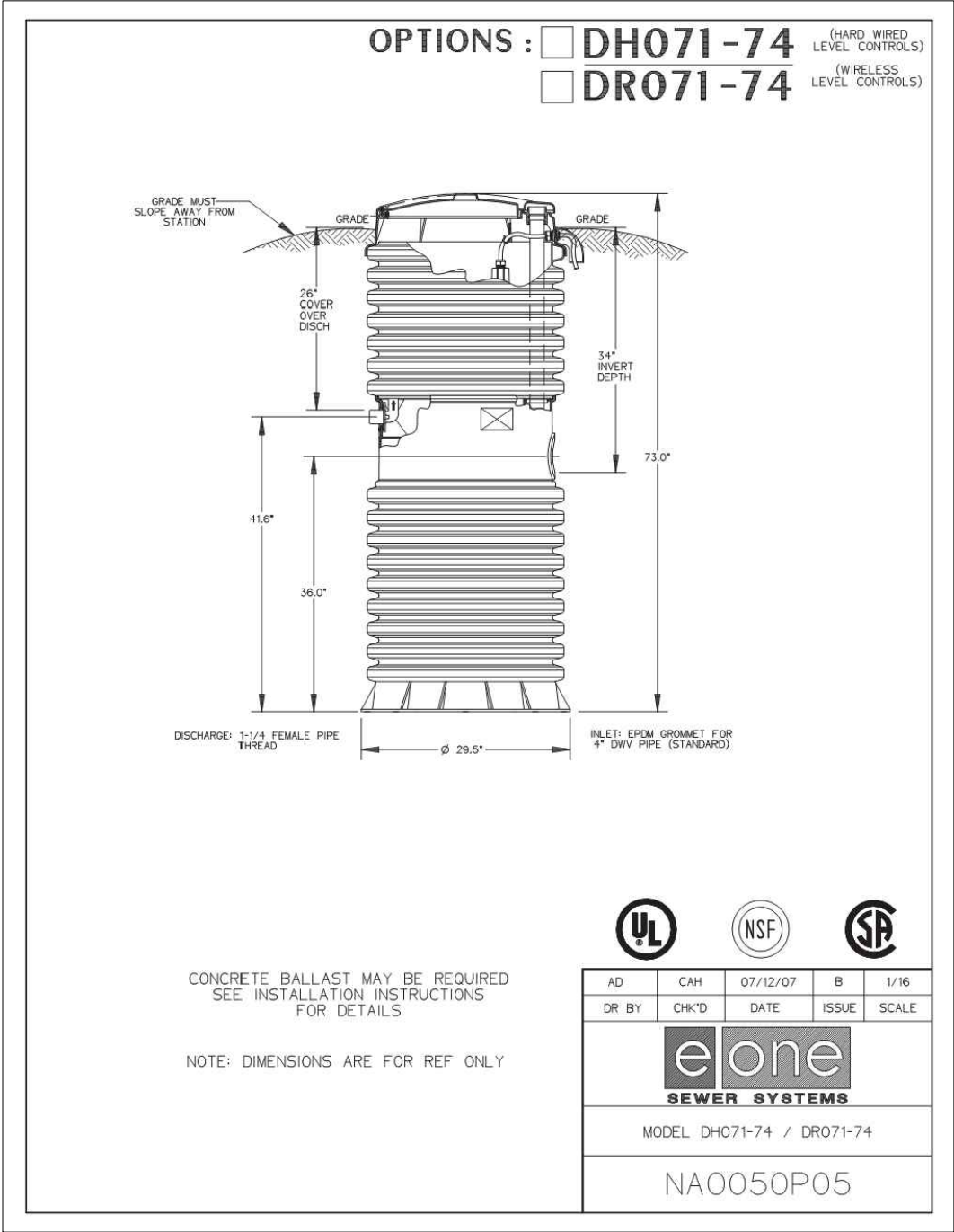


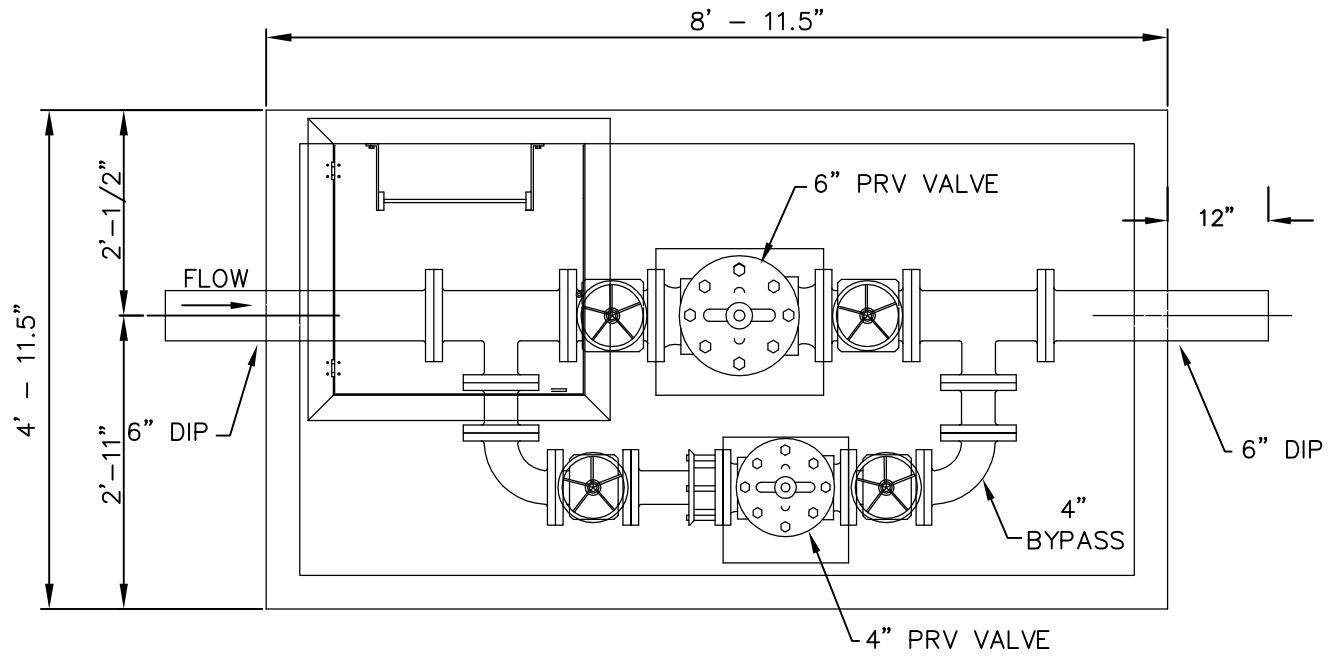
AMHERST COUNTY
SERVICE AUTHORITY



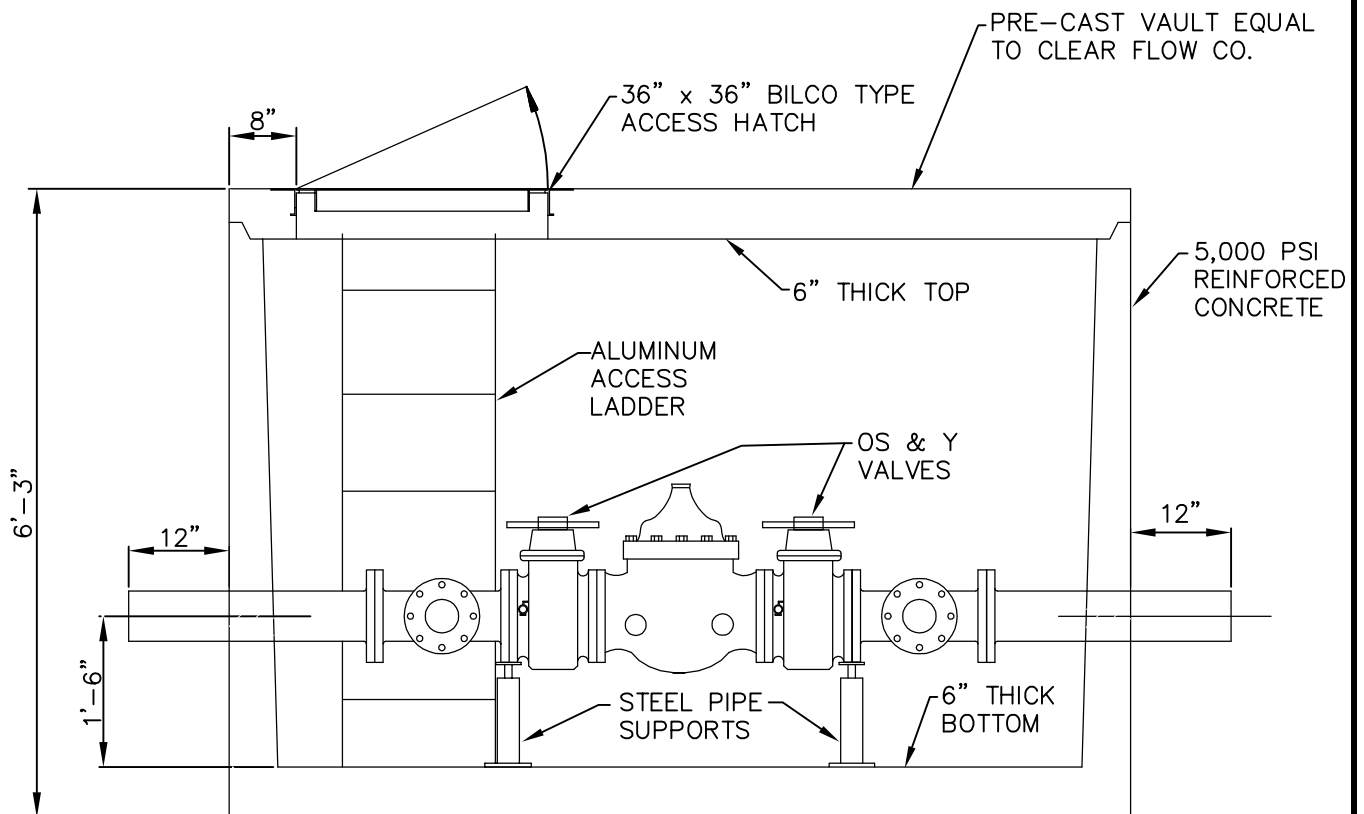
GRINDER PUMP STATION

N.T.S.





PLAN VIEW



SECTION VIEW

NOT FOR TRAFFIC LOADED CONDITIONS

PRESSURE REDUCING VALVE VAULT

PRV TO 6"

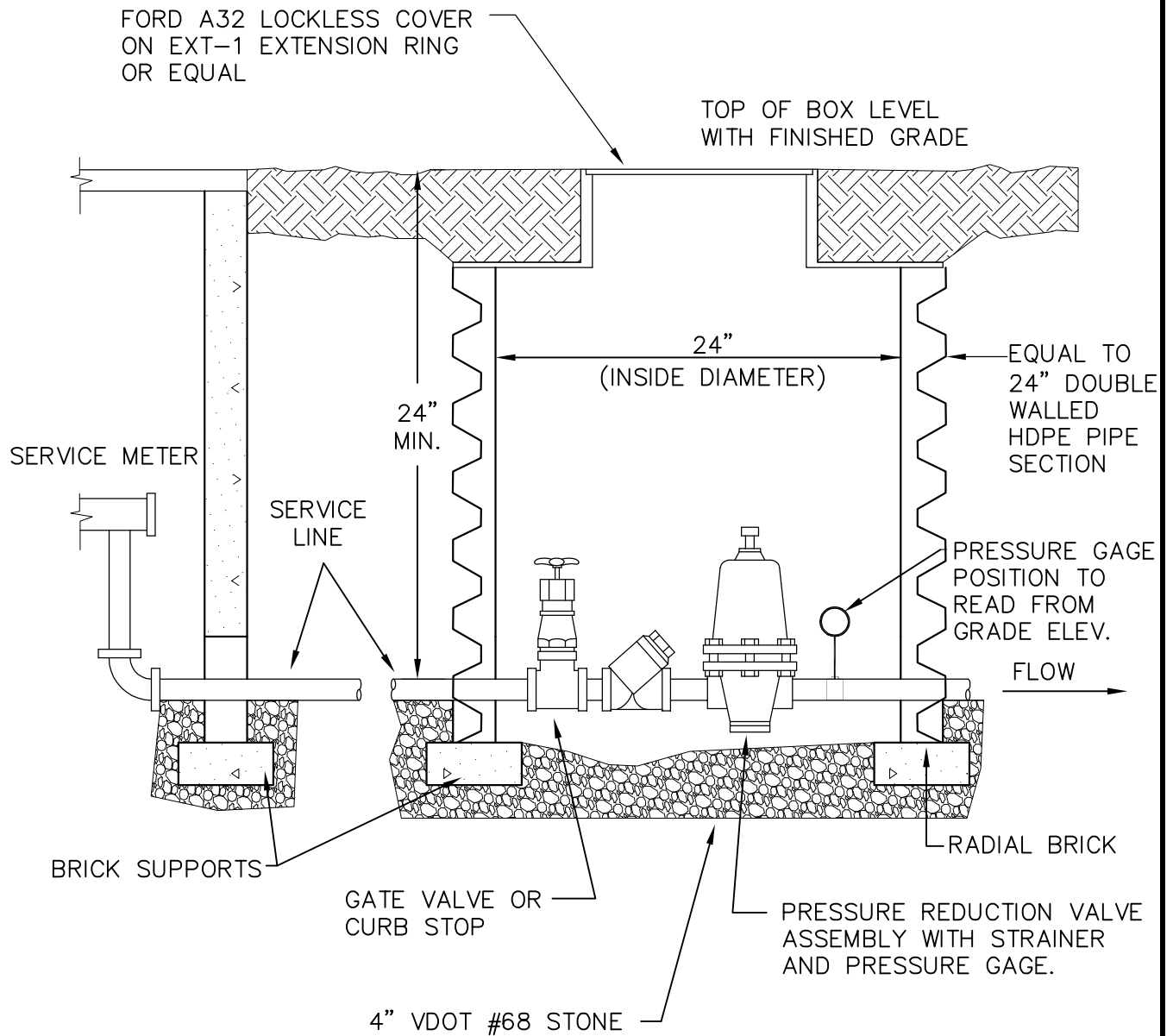
N.T.S.

04/15/03



AMHERST COUNTY
SERVICE AUTHORITY

RV-1



PRESSURE REDUCING VALVE INDIVIDUAL SERVICE

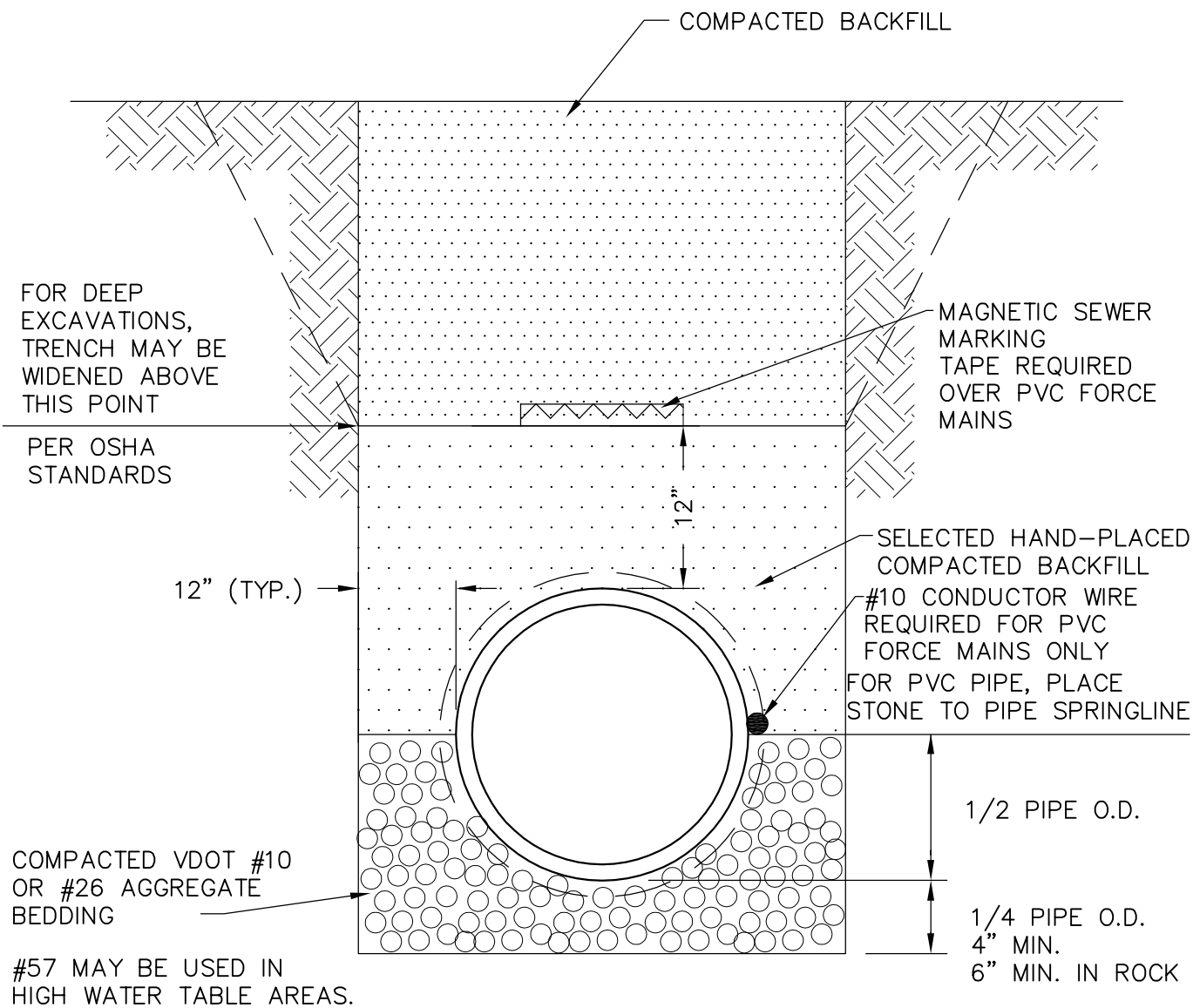
N.T.S.

05/13/03



AMHERST COUNTY
SERVICE AUTHORITY

RV-2



TRENCH BED—SANITARY SEWER

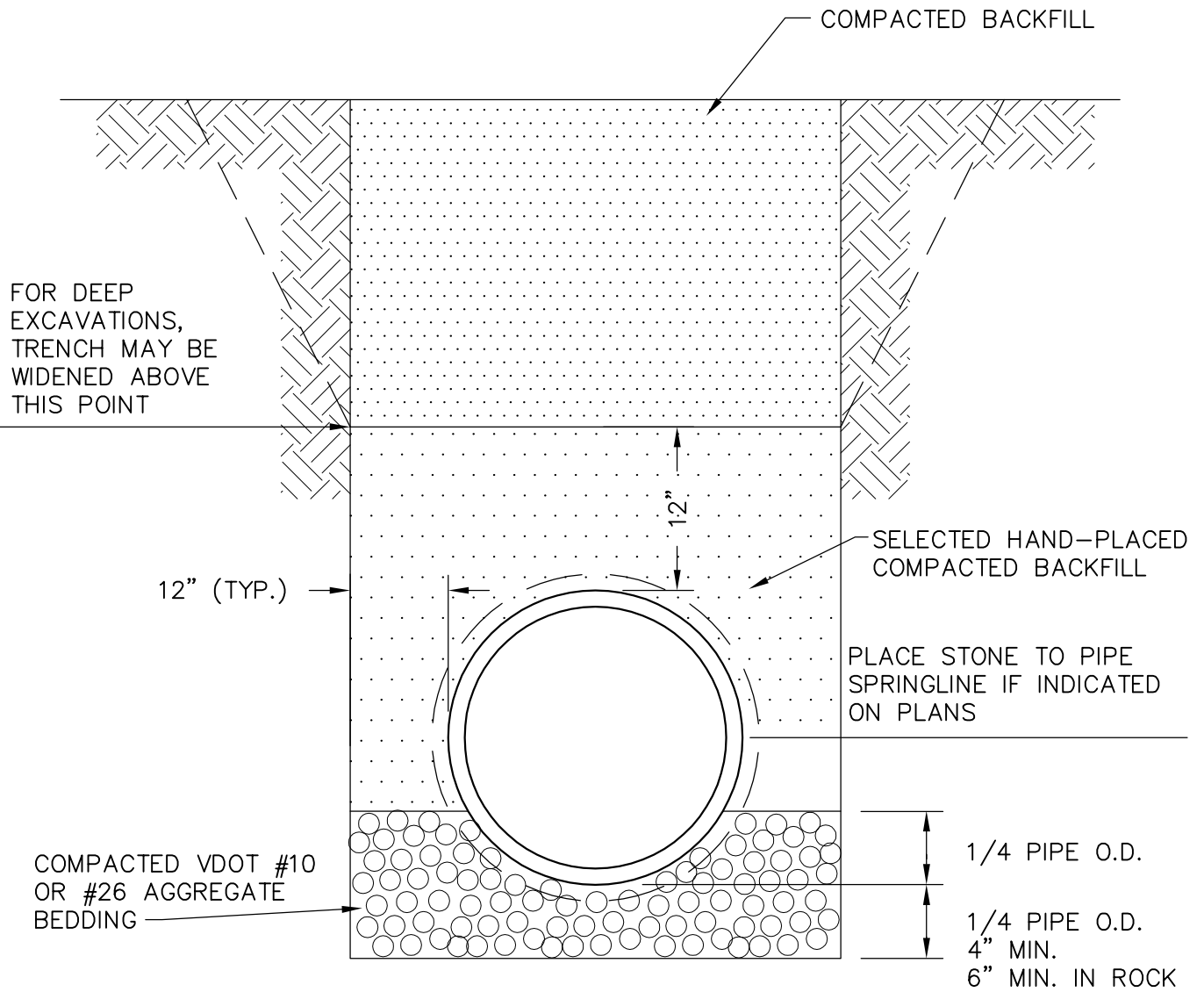
N.T.S.

REV. 1/07



AMHERST COUNTY
SERVICE AUTHORITY

TB-1



THIS DETAIL APPLICABLE
FOR DEPTHS LESS THAN 14 FEET.
SEE PLANS FOR MODIFICATIONS
IN DEEPER TRENCHES.

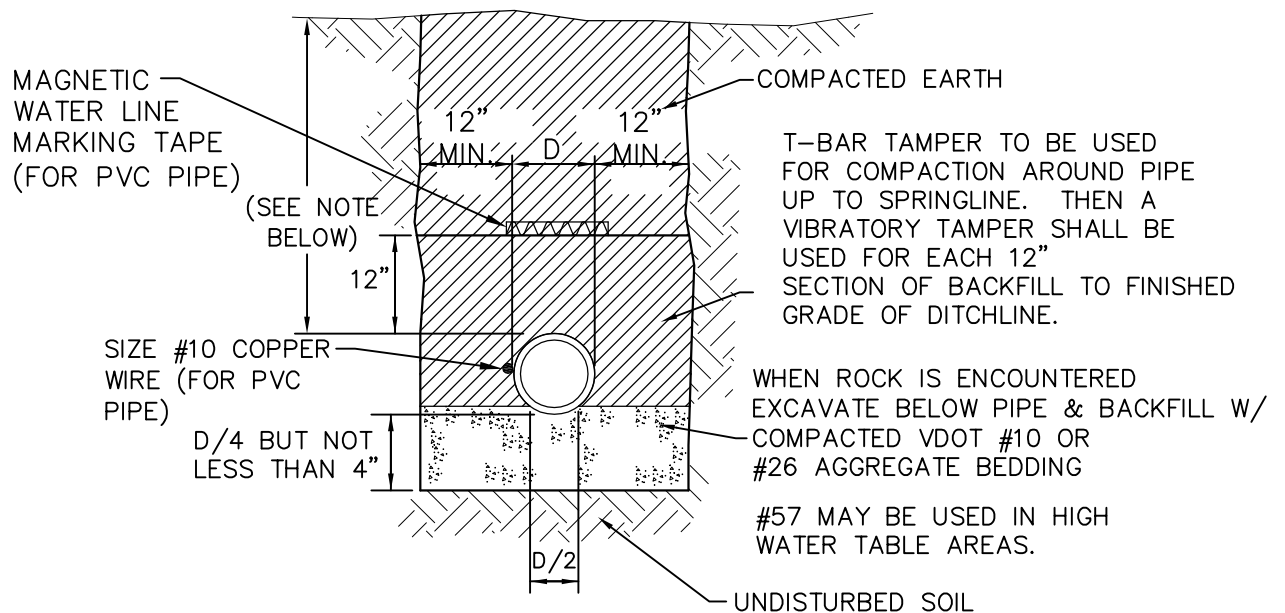
TRENCH BED—STORM SEWER

N.T.S.

05/13/03



AMHERST COUNTY
SERVICE AUTHORITY

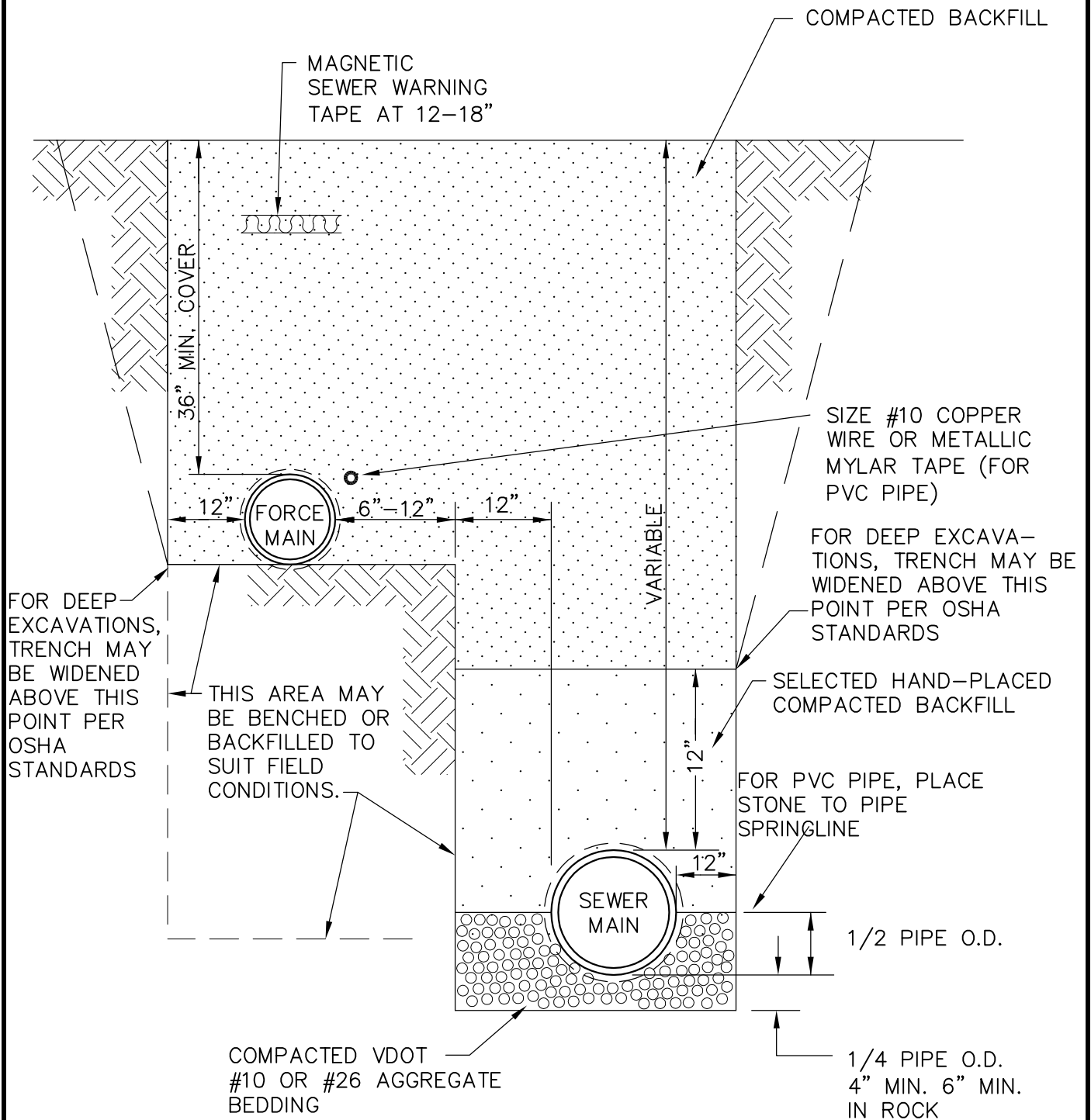


NOTE: 3' COVER REQUIRED FOR 8" AND SMALLER PIPE.
 4' COVER REQUIRED FOR 10" AND LARGER PIPE.
 MAX. COVER 4' UNLESS AUTHORIZED IN WRITING BY ACSA

TRENCH BED – WATER MAIN

N.T.S.





TRENCH BED-FORCE MAIN/SANITARY SEWER PARALLEL INSTALLATION

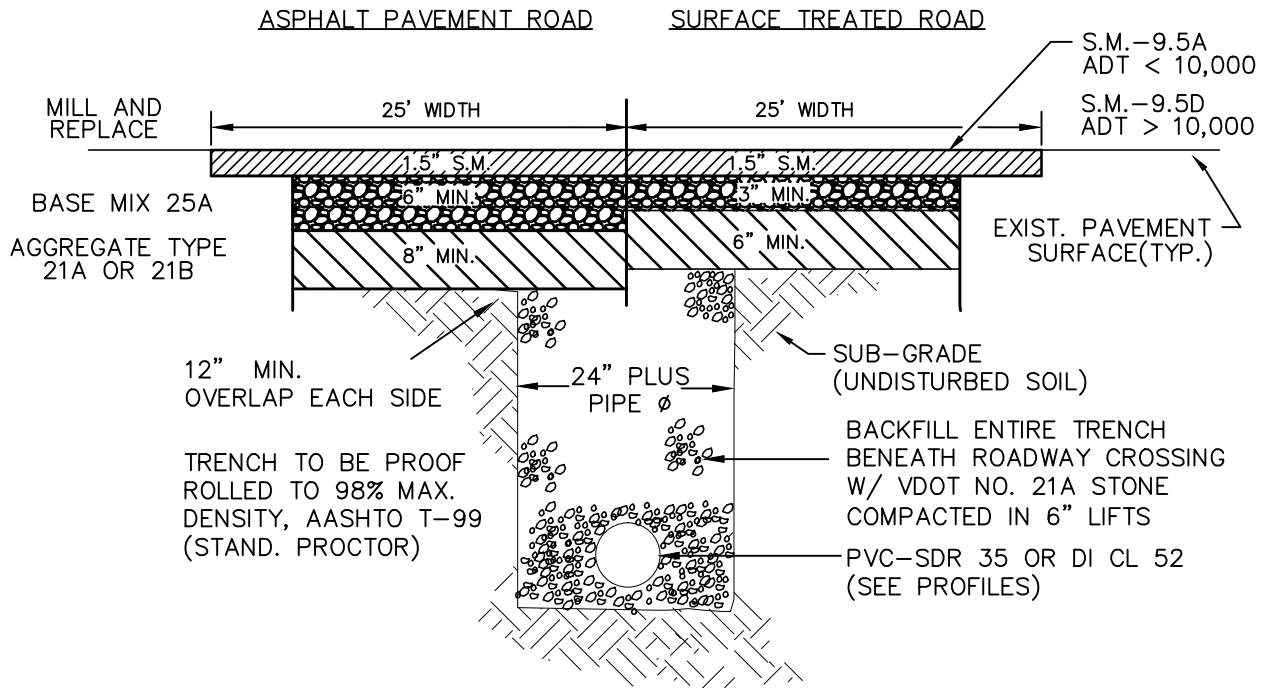
N.T.S.

REV. 1/07



AMHERST COUNTY
SERVICE AUTHORITY

TB-4



NOTES:

- 1.) A TRENCH BOX SHOULD BE USED IN ROAD AREAS WHERE THE DEPTH IS GREATER THAN 5'.
- 2.) FOR LONGITUDINAL CUTS, MILL / REPLACEMENT SHALL EXTEND 12 INCHES BEYOND BASE MIX.

OPEN CUT TRENCH/ROAD REPAIR
WATER & SEWER
 N.T.S.

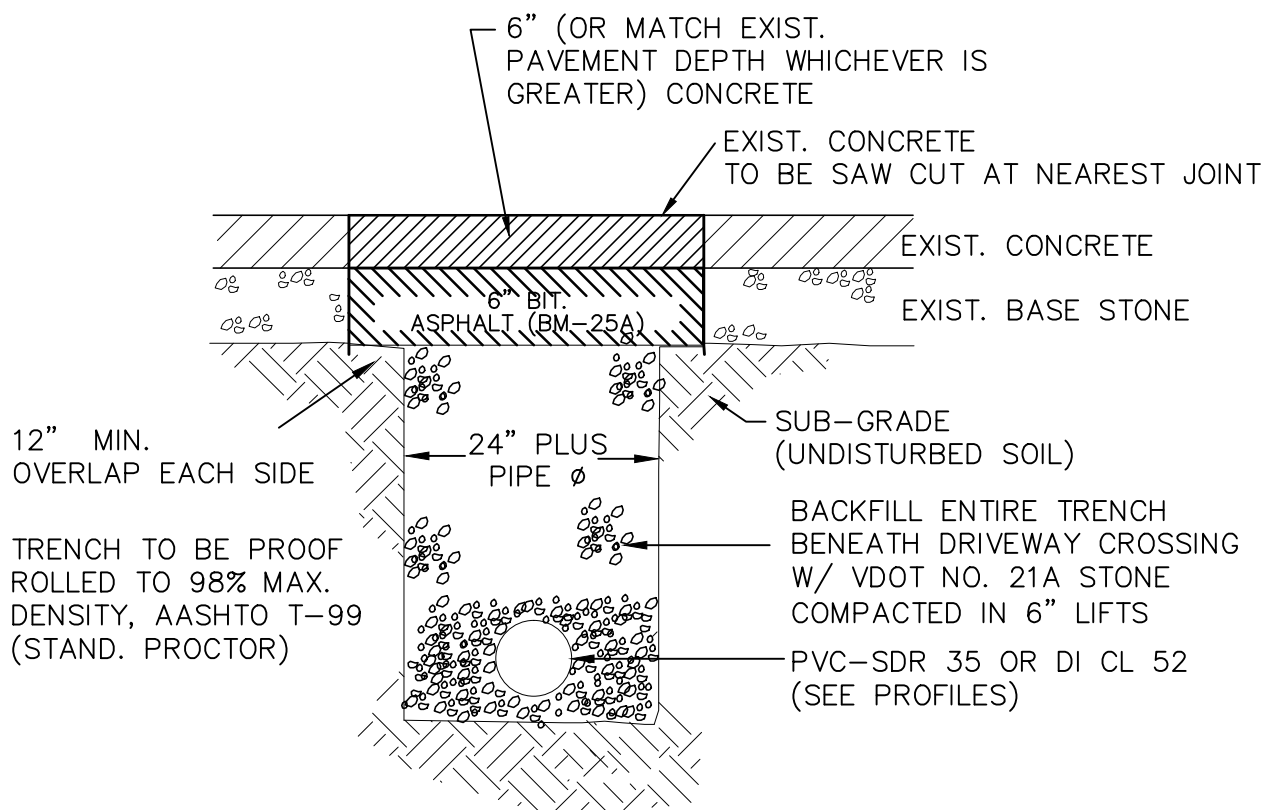
REV: 02/16



AMHERST COUNTY
SERVICE AUTHORITY

TB-5

REV: 02/16



NOTE: A TRENCH BOX SHOULD BE USED IN ROAD AREAS WHERE THE DEPTH IS GREATER THAN 5'

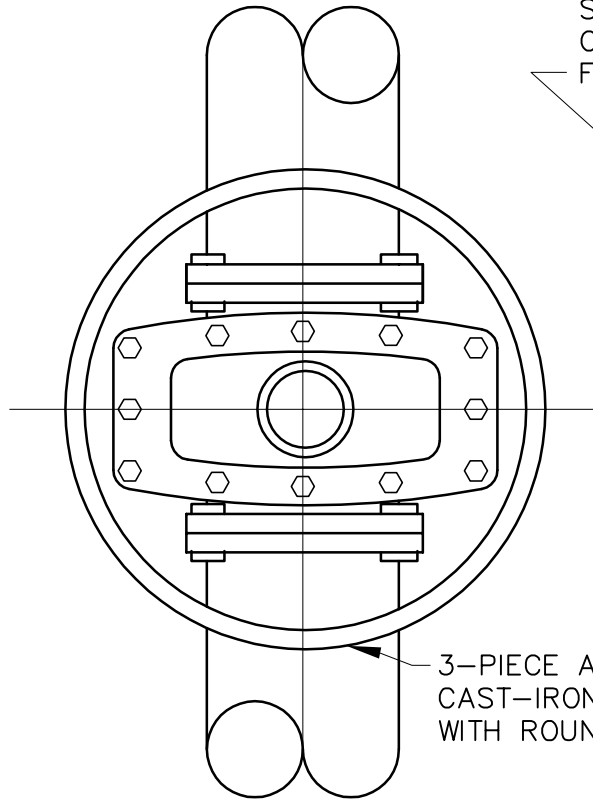
OPEN CUT CONCRETE DRIVE REPAIR— WATER & SEWER

N.T.S.



AMHERST COUNTY
SERVICE AUTHORITY

TB-6



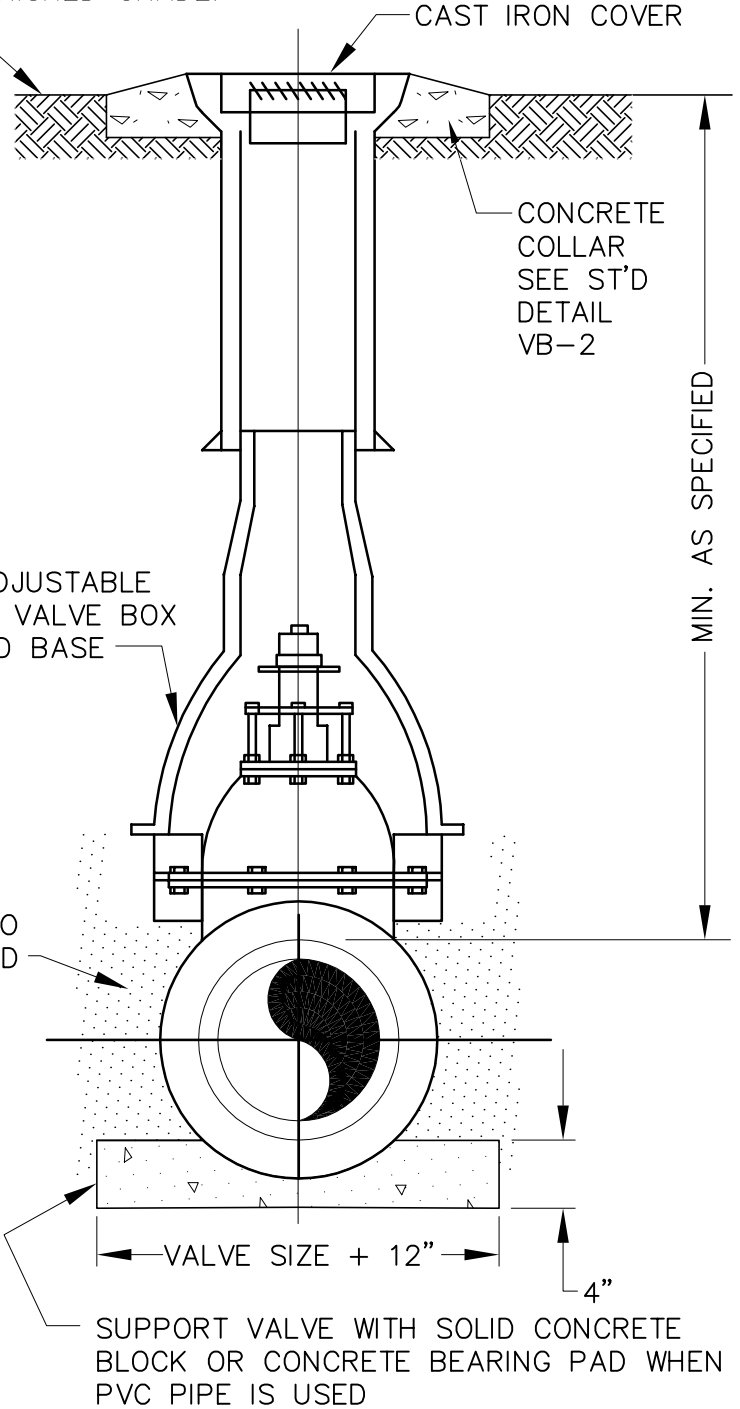
PLAN

COMPACTED BACKFILL TO
NATURAL GROUND

NOTE:

1. VALVES NOT PERMITTED
IN DITCH LINE.

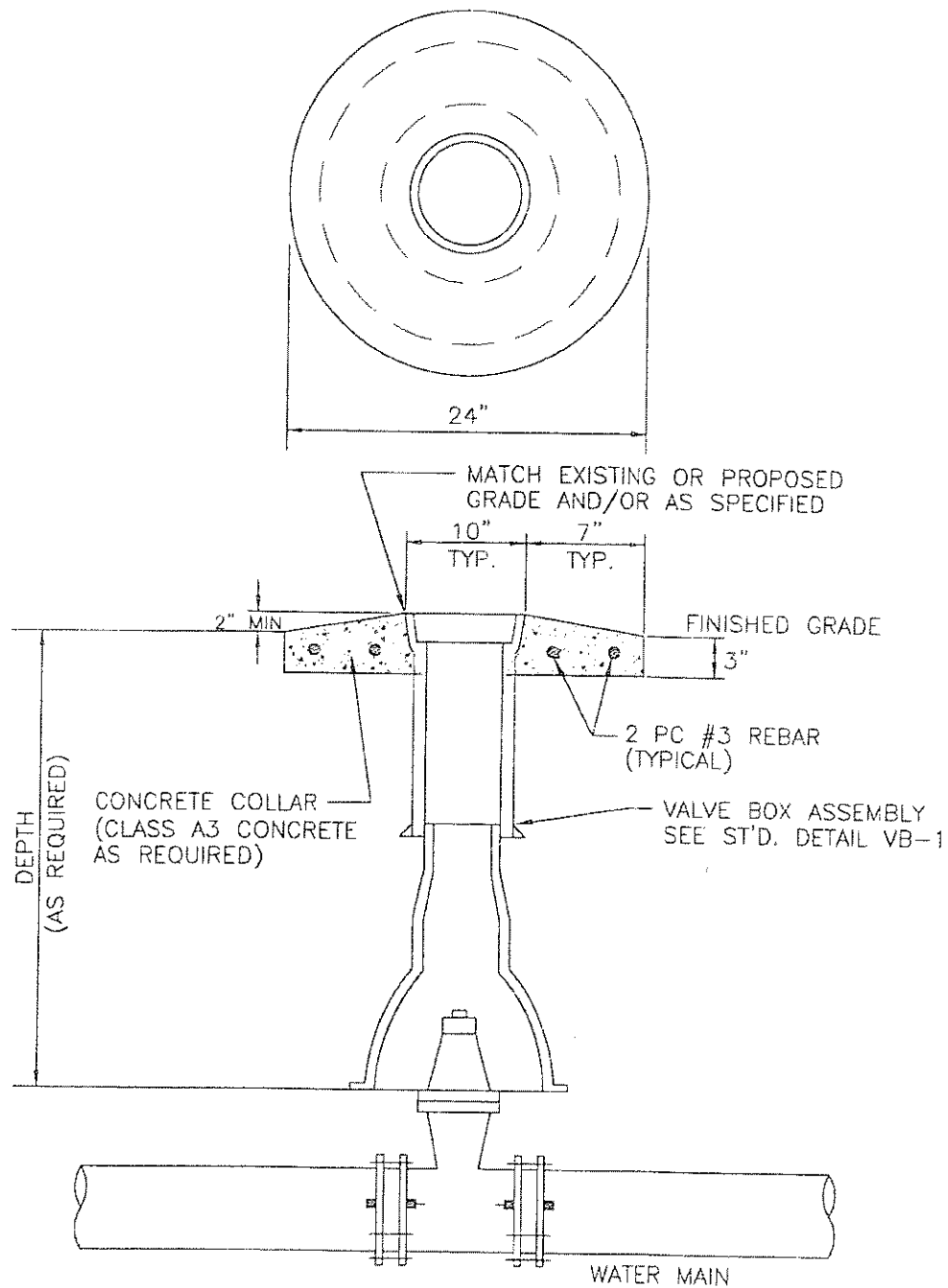
ON VDOT R/W, RECESS TOP 2" MINIMUM IN
SHOULDER TO PREVENT MOTORGRADER DAMAGE.
OTHERWISE, MATCH EXISTING OR PROPOSED
FINISHED GRADE.



SECTION

NOTES:

1. VALVE BOX PAD IS TO BE MADE OF CLASS A-3 CONCRETE (3000 PSI @ 28 DAYS)
2. TO BE USED IN UNPAVED AREAS NOT IN GRAVEL ROAD SHOULDERS OR PAVED AREAS.
3. VALVES NOT PERMITTED IN DITCH LINE.



05/10

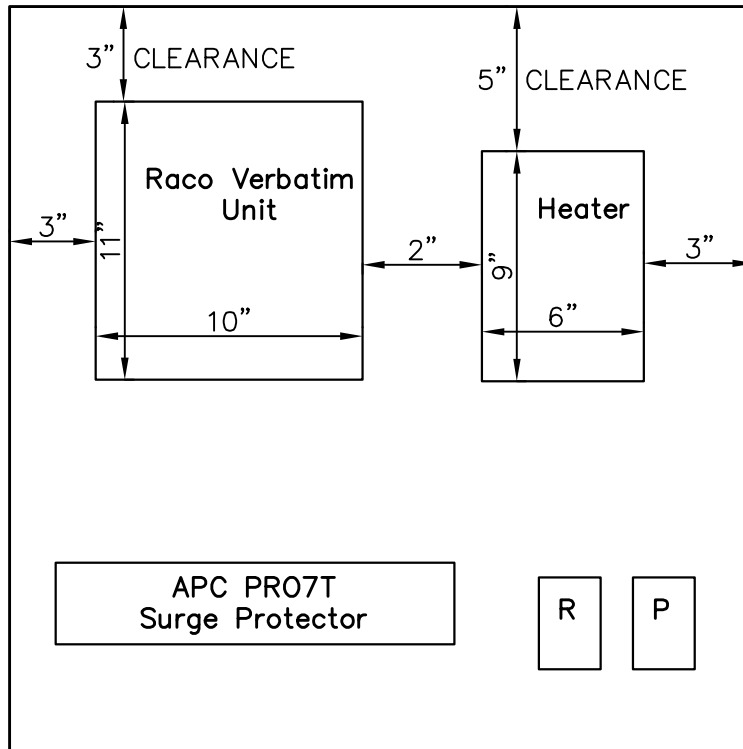


AMHERST COUNTY
SERVICE AUTHORITY

VALVE BOX PRECAST
SLAB INSTALLATION

N.T.S.

VB-2



WEATHERTIGHT ENCLOSURE FOR PUMP STATION ALARM MONITOR

N.T.S.

NOTES:

1. R is a NEMA type 520, 120 volt 20 amp receptacle.
2. P is a single RJ11 phone jack.
3. Enclosure is to be NEMA type 3R.



APPENDIX B



HIGHLIGHTS OF UNDERGROUND UTILITIES DAMAGE PREVENTION ACT

HIGHLIGHTS OF UNDERGROUND UTILITIES DAMAGE PREVENTION ACT

1. Each utility is required to file with the Clerk of the Circuit Court, the name, address, and telephone number of the person to be contacted locally.
2. No excavation is to begin without 48-hour notice (excluding Saturdays, Sundays, holidays). Notice is to be given to every local utility. Within 48 hours of notification, each utility is to mark on the ground (by stake or paint) the horizontal location of existing facilities within five feet of the proposed excavation. The utilities are also to contact the contractor doing the proposed work (or make at least two attempts to contact him) if the utility cannot mark existing facilities within 48 hours. Notification of inability to mark location shall be within 24 hours. However, deferral to mark for extraordinary circumstances will not exceed 96 hours.
3. Notification Requirements:
 - A. Name of Contractor.
 - B. Location of proposed work.
 - C. Office and field telephone numbers of excavator, demolisher to whomever notification can be given.
 - D. Nature of proposed work.
 - E. Name of person for whom work is being performed.
 - F. Approximate dates and time work is to begin.
4. The utilities are to participate in a preconstruction meeting held by the state, county or municipality.
5. If the utility has not marked existing facilities within the time limit, the contractor may begin excavation three hours after an additional notice to the utility.
6. Color coding of the utilities are below:

<i>Electric</i>	<i>Red</i>	<i>Cable TV</i>	<i>Orange</i>
<i>Gas</i>	<i>Yellow</i>	<i>Water</i>	<i>Blue</i>
<i>Steam</i>	<i>Yellow</i>	<i>Sewer</i>	<i>Green</i>
<i>Telephone</i>	<i>Orange</i>		
7. Re-excavation (for maintenance, for example) within the limits of the original excavation does not require notification.
8. For excavation within two feet of a marked utility location, the contractor shall take precautions to not damage the existing facilities; he shall properly protect the existing utility while backfilling. The utility is to be notified immediately of any damage or disturbance of existing facilities. The contractor shall not backfill until the existing utilities have been repaired.
9. The contractor is liable for damage to any properly marked utility if he has not adequately protected the utility.

APPENDIX C



AIR TEST TABLES AND DATA SHEET

AIR TEST TABLE

Based on Formulas from ASTM C 828

SPECIFICATION TIME (min: sec) REQUIRED FOR PRESSURE DROP FROM 3 1/2 TO 2 1/2 PSIG
WHEN TESTING ONE PIPE DIAMETER ONLY

PIPE DIAMETER, INCHES

	4	6	8	10	12	15	18	21	24	27	30	33	36	39	42
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38	3:20	4:08	4:59	5:56	6:58	8:00
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17	6:41	8:15	9:59	11:53	13:37	16:01
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55	10:01	12:23	14:58	17:00	18:25	19:05
100	0:18	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34	12:45	14:10	15:35	—	—	—
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20	—	—	—	—	—	—
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30	—	—	—	—	—	—	19:58	23:00
175	0:31	1:09	2:03	3:13	4:37	7:05	—	—	—	13:24	16:32	20:01	23:49	27:57	32:2
200	0:35	1:19	2:21	3:40	5:17	—	—	—	12:06	15:19	18:54	22:52	27:13	31:56	36:5
225	0:40	1:29	2:38	4:08	5:40	—	—	10:25	13:36	17:13	21:16	25:44	30:37	35:56	41:3
250	0:44	1:39	2:56	4:35	—	—	8:31	11:35	15:07	19:08	23:38	28:35	34:01	39:56	46:3
275	0:48	1:49	3:14	4:43	—	—	9:21	12:44	16:38	21:03	25:59	31:27	37:25	43:55	50:4
300	0:53	1:59	3:31	—	—	—	10:12	13:53	18:09	22:58	28:21	34:18	40:49	47:55	55:2
350	1:02	2:19	3:47	—	—	8:16	11:54	16:12	21:10	26:47	33:05	40:01	47:38	55:54	64:4
400	1:10	2:38	—	—	6:03	9:27	13:36	18:31	24:12	30:37	37:48	45:44	54:26	63:53	73:5
450	1:19	2:50	—	—	6:48	10:38	15:19	20:50	27:13	34:27	42:32	51:27	61:14	71:52	83:1
500	1:28	—	—	5:14	7:34	11:49	17:01	23:09	30:14	38:16	47:15	57:10	68:02	79:51	92:2
550	1:37	—	—	5:45	8:19	13:00	18:43	25:28	33:16	42:06	51:59	62:53	74:51	87:50	110:5
600	1:46	—	4:02	6:17	9:04	14:11	20:25	27:47	36:17	45:56	56:42	68:36	81:39	95:49	110:5
650	1:54	2:50	4:22	6:48	9:50	15:21	22:07	30:06	39:19	49:45	61:26	74:19	88:27	103:48	120:0

Note: If the section of line to be tested includes more than one pipe size, calculate the test time for each size and add the test times to arrive at the total test time for the section.

AIR TEST DATA SHEET

Owner (Name of city, district, etc.) _____ Test No. _____

Field Test Data: (To be filled in by the inspector)

Date: _____ Specified Maximum Pressure Drop: _____ psig

Identification of Pipe Material Installed _____

[illegible]

Inspector's Name and Title: _____
Signature of Inspector: _____

If a section fails, the following items should be completed:

Identify section(s) that failed _____

Leak (was) (was not) located. Method used: _____

Description of leakage found: _____

Description of corrective action taken: _____

For test/results after repair refer to Test No. _____ Inspector _____

Watermain Pressure Test Record

Project:
Contractor:
Plans:

Inspector:
Date:
Design Engineer:

[illegible]

Leakage calculation refer to table in PSA specifications

Signature of Inspector: _____

If test fails, complete:

Identify sections(s) that failed

Describe problem / corrective action taken / Date corrected

Manhole Vacuum Test Record

Inspector:

Date:

Design Engineer:

Signature of Inspector: _____
If test fails, complete: Identify sections(s) that failed
Describe problem / corrective action taken / Date corrected

APPENDIX D

VDOT TRAFFIC CONTROL

Note: The following traffic control details are for general purposes only. Contractor is responsible for contacting VDOT and providing adequate traffic control for all affected areas for the duration of construction activities. ACSA accepts no responsibility for contractor negligence in traffic control matters.

TYPICAL TRAFFIC CONTROL
 SHORT-DURATION OPERATION ON MULTI-LANE ROADWAY
 (FIGURE TTC-11.0)

NOTES

Standard:

1. This typical traffic control layout shall not be used for Limited Access Highway or Two-lane roadways.
2. Each vehicle involved in the short duration operation shall be equipped with at least one rotating amber light or high intensity amber strobe light. Although vehicle hazard warning signals can be used to supplement the rotating lights or strobe lights, they shall not be used instead of rotating lights or strobe lights.
3. Vehicle-mounted signs shall be mounted with the bottom of the sign at a minimum height of 48 inch above the pavement.

Guidance:

4. *The minimum distance between the sign/shadow vehicle and the truck mounted attenuator (TMA) vehicle should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Option:

5. The first advance warning shadow vehicle on the shoulder side where the operation is occurring may be replaced with a "ROAD WORK AHEAD" sign on low speed (less than 45 mph), low volume (less than 500 vehicles per day) roadways.
6. The static warning sign and arrow panel may be replaced with a vehicle mounted CMS with a minimum of 10" height characters.

Standard:

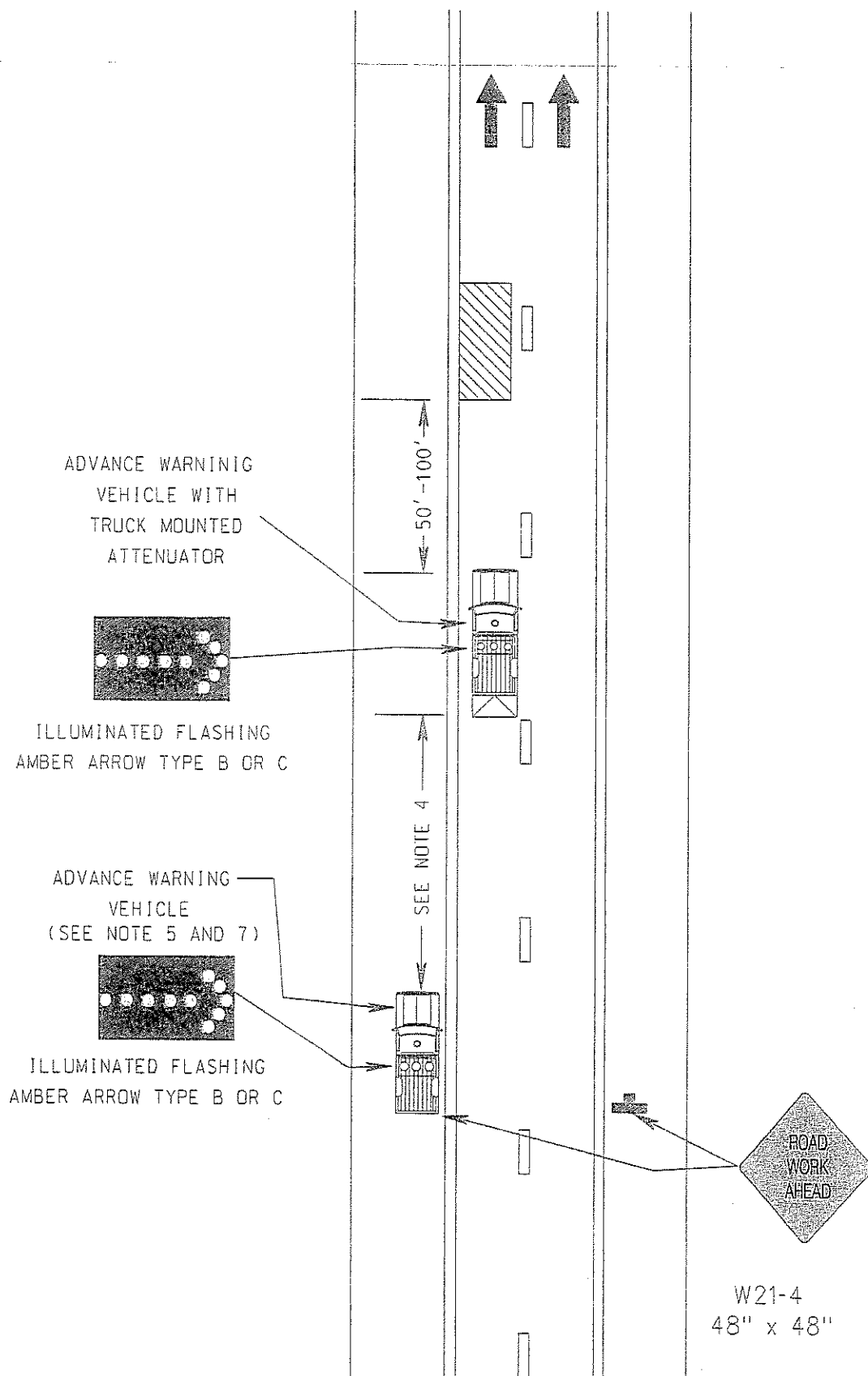
7. A truck mounted attenuator (TMA) shall be used on the second shadow vehicle in the travelway regardless of the posted speed limit. If the first shadow vehicle occupies any part of the travel lane, it shall be equipped with a TMA, or replaced with the "ROAD WORK AHEAD" sign.

Guidance:

8. *When using a CMS to replace the static sign and arrow panel, each word message phase should be followed by the type B arrow display.*

Support:

9. A short duration operation is defined as an operation that requires 16 minutes to 60 minutes to perform in the immediate area. (The immediate area is defined as a 1000' \pm linear distance.)



SHORT DURATION OPERATION ON MULTI-LANE ROADWAY
FIGURE TTC-11.0

**TYPICAL TRAFFIC CONTROL
OUTSIDE LANE CLOSURE OPERATION ON FOUR-LANE ROADWAY
(FIGURE TTC-12.0)**

NOTES

Standard:

1. On roadways having a median wider than 8', left and right sign assemblies shall be required.

Guidance:

2. Sign spacing distance should be 1000'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
3. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.
4. All vehicles, equipment, workers and their activities should be restricted to one side of the pavement.

Standard:

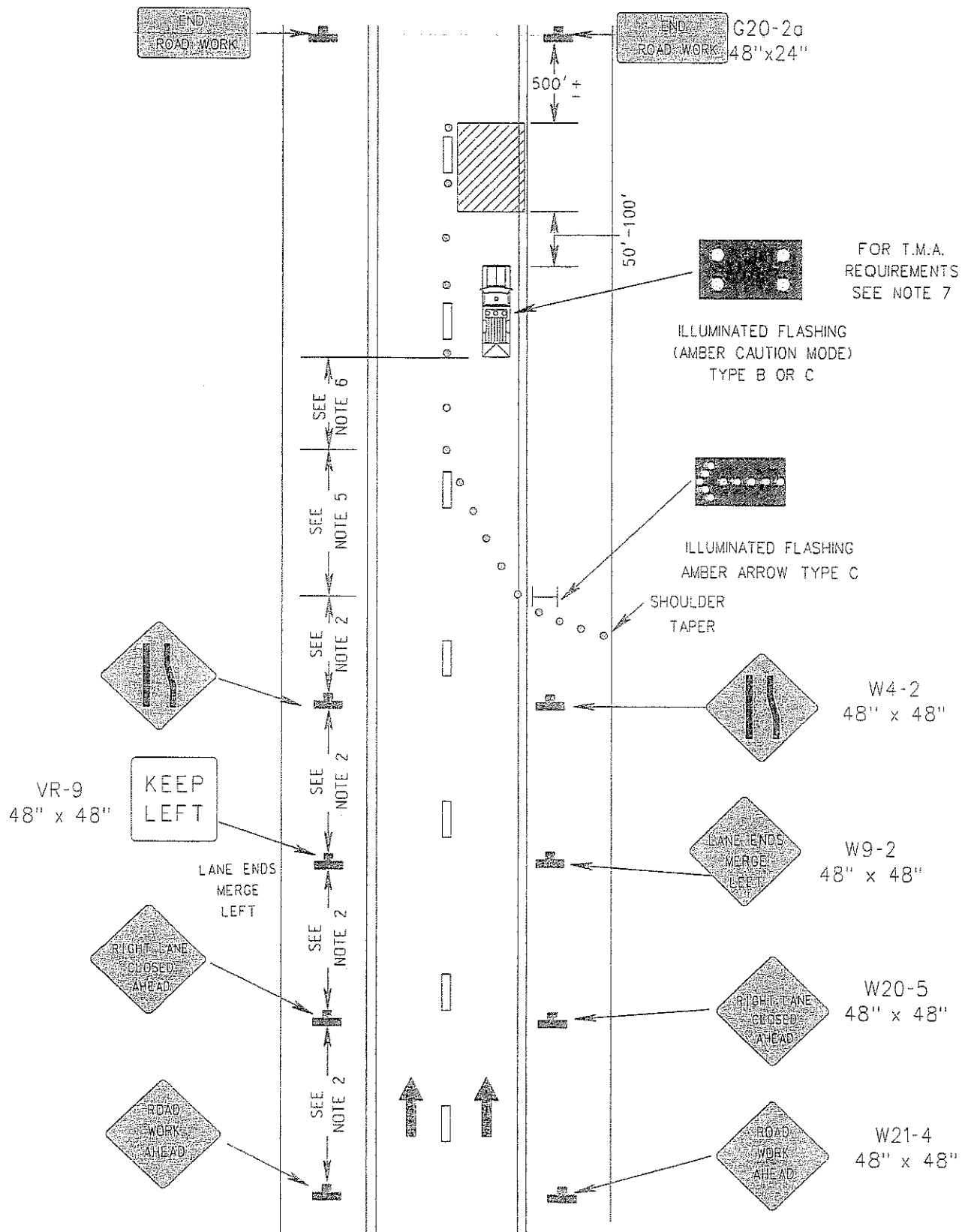
5. Taper Length and Channelizing Device Spacing shall be:

Taper Length				Channelizing Device Spacing		
Speed Limit M.P.H	Taper Length Lane Width In Feet			Location	Speed (mph)	
	10	11	12		0-35	36+
25	105	115	125	Transition Spacing	20'	40'
30	150	165	180	Travelway Spacing	40'	80'
35	205	225	245			
40	270	295	320			
45	450	495	540			
50	500	550	600			
55	550	605	660			
60	600	660	770			
65	650	715	780			

(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

6. The buffer space length shall be as shown in Table 6H-3.0 on page 6H-5 for the posted speed limit.
7. A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.
8. When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.



OUTSIDE LANE CLOSURE OPERATION ON FOUR-LANE ROADWAY
FIGURE TTC-12.0

TYPICAL TRAFFIC CONTROL
INSIDE LANE CLOSURE OPERATION ON FOUR-LANE ROADWAY
 (FIGURE TTC-13.0)

NOTES

Standard:

1. On roadways having a median wider than 8', left and right sign assemblies shall be required.

Guidance:

2. Sign spacing distance should be 1000'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
3. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.
4. All vehicles, equipment, workers and their activities should be restricted to one side of the pavement.

Standard:

5. Taper Length and Channelizing Device Spacing shall be:

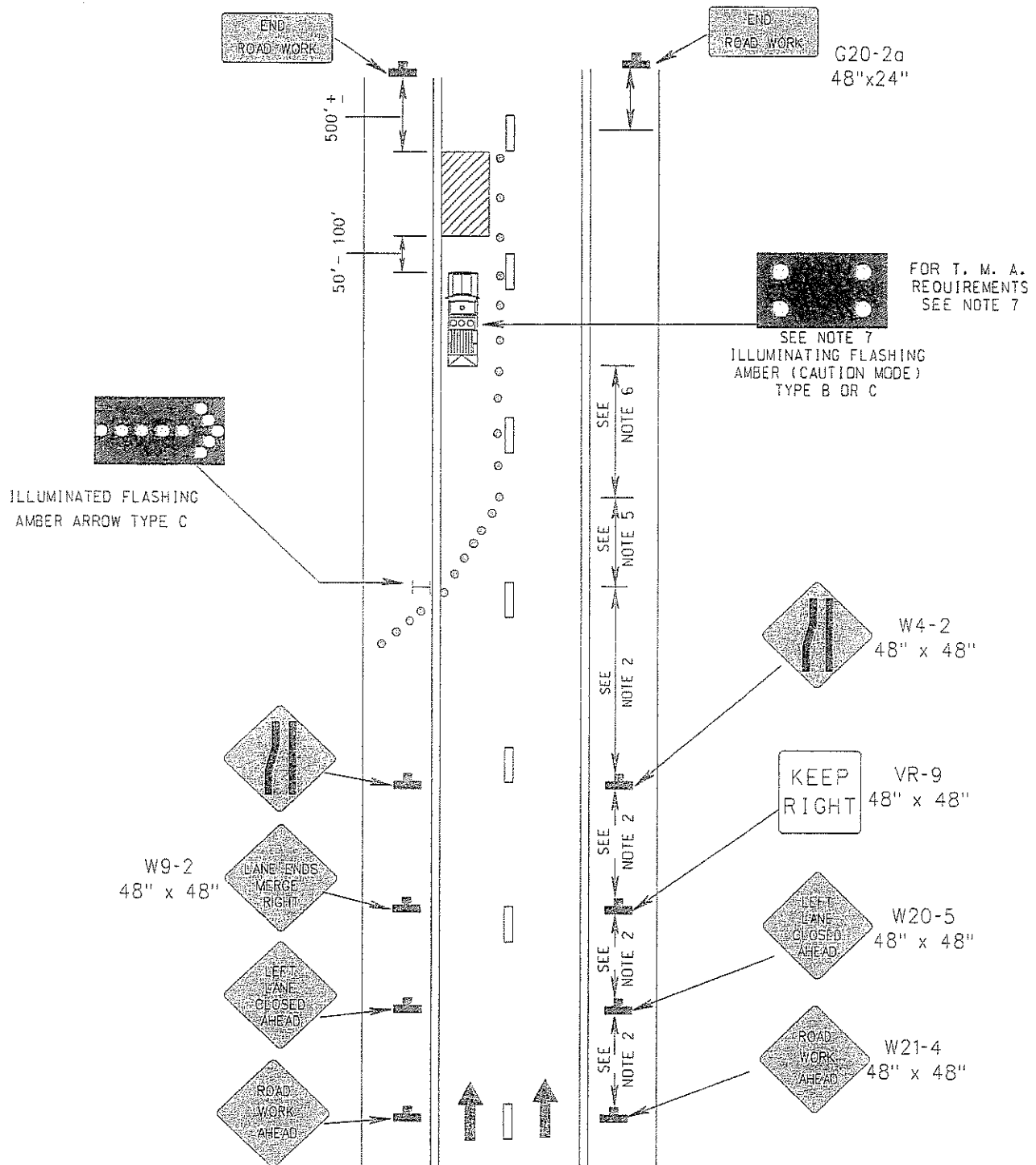
Taper Length			
Speed Limit M.P.H	Taper Length		
	Lane Width In Feet		
	10	11	12
25	105	115	125
30	150	165	180
35	205	225	245
40	270	295	320
45	450	495	540
50	500	550	600
55	550	605	660
60	600	660	770
65	650	715	780

Channelizing Device Spacing		
	Speed (mph)	
Location	0-35	36+
Transition Spacing	20'	40'
Travelway Spacing	40'	80'
(Shoulder Taper = 1/3 L Minimum)		

(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

6. The buffer space length shall be as shown in Table 6H-3.0 on page 6H-5 for the posted speed limit.
7. A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be marked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.
8. When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.



INSIDE LANE CLOSURE OPERATION ON FOUR-LANE ROADWAY
FIGURE TTC-13.0

**TYPICAL TRAFFIC CONTROL
MULTI-LANE CLOSURE OPERATION
(FIGURE TTC-14.0)**

NOTES

Standard:

1. On roadways having a median wider than 8', left and right sign assemblies shall be required.

Guidance:

2. Sign spacing distance should be 1000'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
3. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.
4. All vehicles, equipment, workers and their activities should be restricted to one side of the pavement.

Standard:

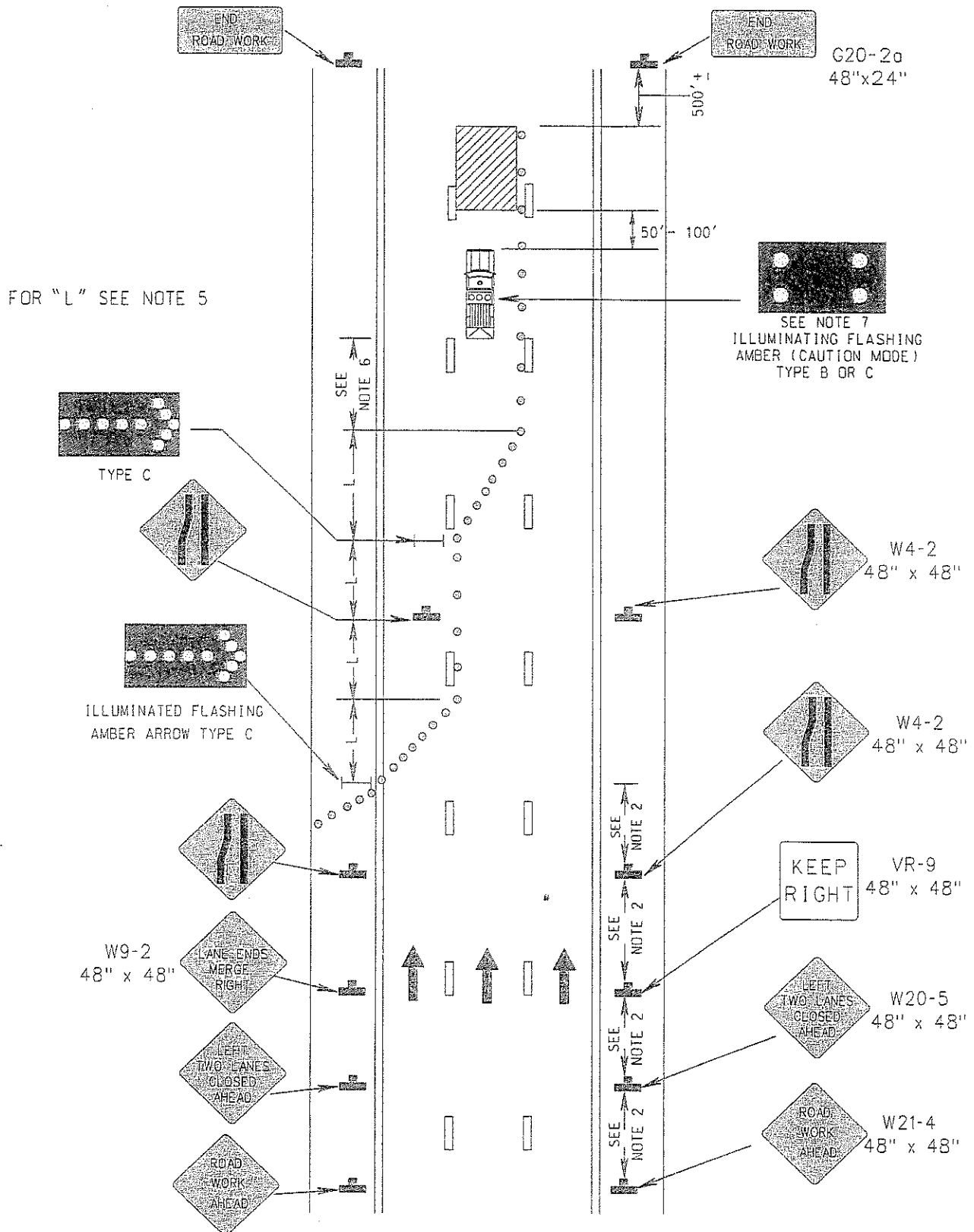
5. Taper Length and Channelizing Device Spacing shall be:

Speed Limit M.P.H	Taper Length			Channelizing Device Spacing		
	Lane Width In Feet			Location	Speed (mph)	
	10	11	12		0-35	36+
25	105	115	125	Transition Spacing	20'	40'
30	150	165	180	Travelway Spacing	40'	80'
35	205	225	245			
40	270	295	320			
45	450	495	540			
50	500	550	600			
55	550	605	660			
60	600	660	770			
65	650	715	780			

(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

6. The buffer space length shall be as shown in Table 6H-3.0 on page 6H-5.0 for the posted speed limit.
7. A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.
8. When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.



MULTI-LANE CLOSURE OPERATION
FIGURE TTC-14.0

**TYPICAL TRAFFIC CONTROL
LANE CLOSURE OPERATION WITH LANE WEAVE
(FIGURE TTC-15.0)**

NOTES

Standard:

1. On roadways having a median wider than 8', left and right sign assemblies shall be required.

Guidance:

2. Sign spacing distance should be 1000'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
3. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.

Standard:

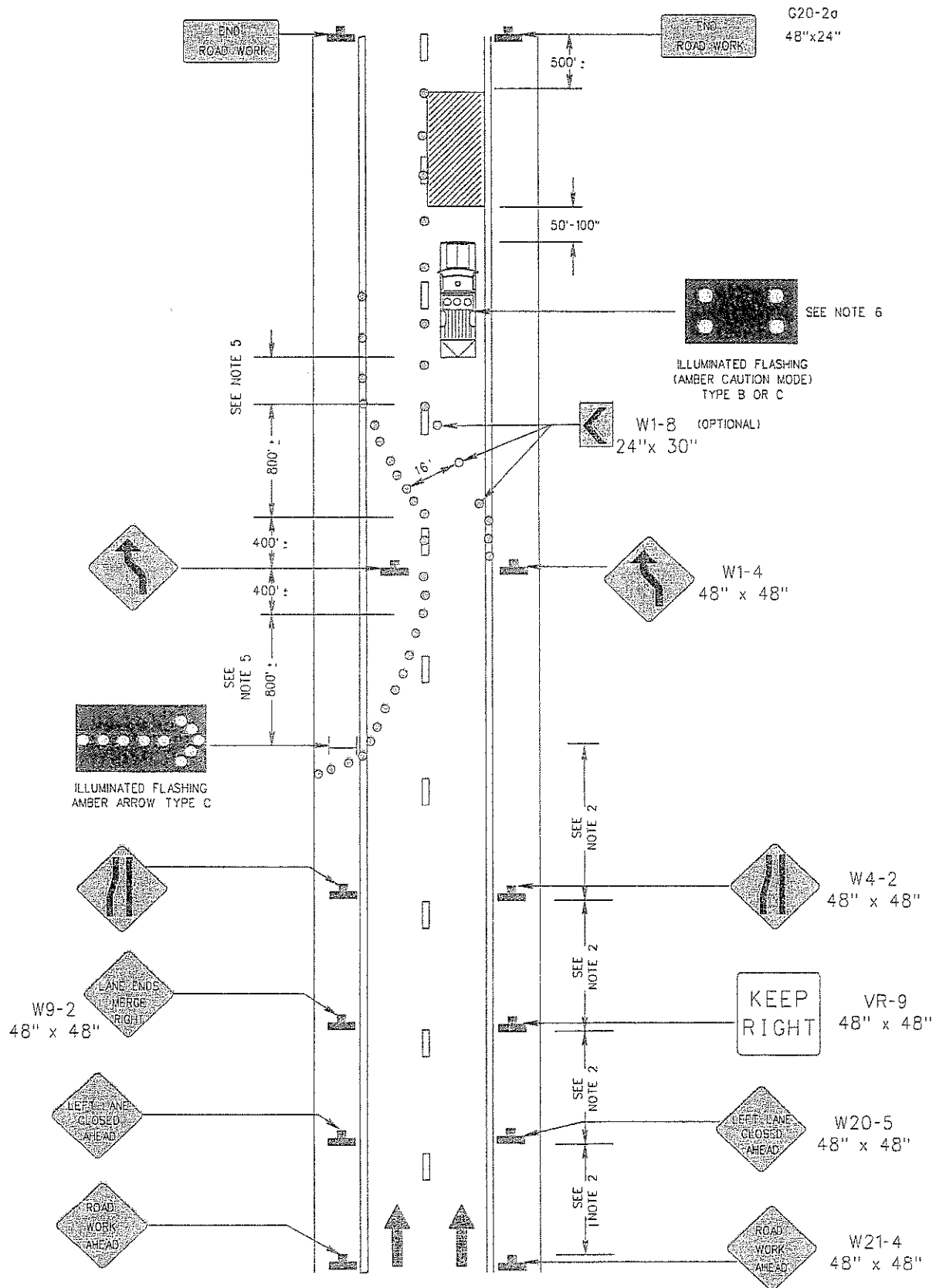
4. Taper Length and Channelizing Device Spacing shall be:

Speed Limit M.P.H	Taper Length			Channelizing Device Spacing		
	Lane Width In Feet			Location	Speed (mph)	
	10	11	12		0-35	36+
25	105	115	125	Transition Spacing	20'	40'
30	150	165	180	Travelway Spacing	40'	80'
35	205	225	245			
40	270	295	320			
45	450	495	540			
50	500	550	600			
55	550	605	660			
60	600	660	770			
65	650	715	780			

(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

5. The buffer space length shall be as shown in Table 6H-3.0 on page 6H-5.0 for the posted speed limit.
6. A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.
7. When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.



LANE CLOSURE WITH LANE WEAVE
FIGURE TTC-15.0

**TYPICAL TRAFFIC CONTROL
LANE CLOSURE OPERATION WITH CONCRETE TRAFFIC BARRIER
(FIGURE TTC-16.0)**

NOTES

Standard:

1. On roadways having a median wider than 8', left and right sign assemblies shall be required.

Guidance:

2. Sign spacing distance should be 1000'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
3. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.

Standard:

4. Group 2 Channelizing device spacing shall be at the following:

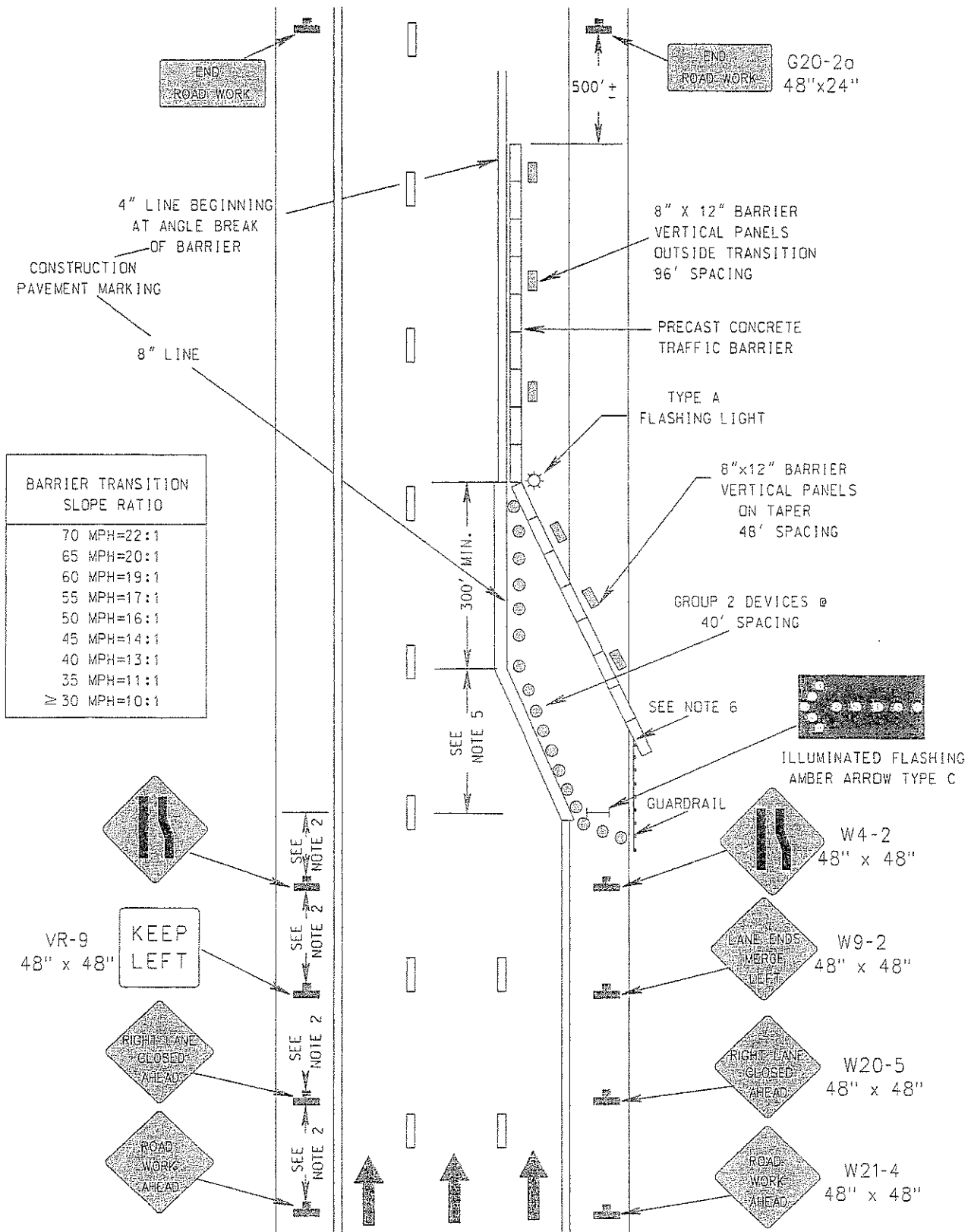
Location	Speed (mph)	
	0-35	36+
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

5. Length of pavement marking transition (L) = Posted Speed (S) x Width of Transition (W). (Example: 55 x 12' = 660')
6. End treatment of barrier in order of preference shall be:
 - a. Where guardrail exists, attach to barrier with appropriate fixed object attachment.
 - b. Where cut slope exists, bury barrier into cut slope and provide for drainage as needed.
 - c. Extend end of barrier until it is beyond the established clear zone (see Appendix A, page 4 for clear zone values).
 - d. When barrier end is inside the established clear zone, attenuator service Type I or Type II shall be used. Refer to L&D special design drawings.
7. Barrier transition slope ratio shall be as follows:

70 mph=20:1	60 mph=17:1	50 mph=14:1	40 mph=11:1	30 > mph=8:1
65 mph=19:1	55 mph=16:1	45 mph=13:1	35 mph=10:1	

When the barrier transition slope is on a horizontal alignment, the total offset shall be prorated around the curve in lieu of a straight-line slope.

8. Barrier vertical panels 8 inches in width and 12 inches in height shall be placed on top of the concrete barrier and spaced 96' on centers along the parallel or tangent sections and 48' on centers along the transition or taper sections. Reflectorized surface shall be fluorescent orange prismatic lens sheeting. The light at the breakpoint where the taper ends and the barrier becomes parallel to the roadway shall be a Type A flashing light.



LANE CLOSURE OPERATION WITH CONCRETE TRAFFIC BARRIER
FIGURE TTC-16.0

TYPICAL TRAFFIC CONTROL
CENTER TURN LANE CLOSURE OPERATION
(FIGURE TTC-17.0)

NOTES

Guidance:

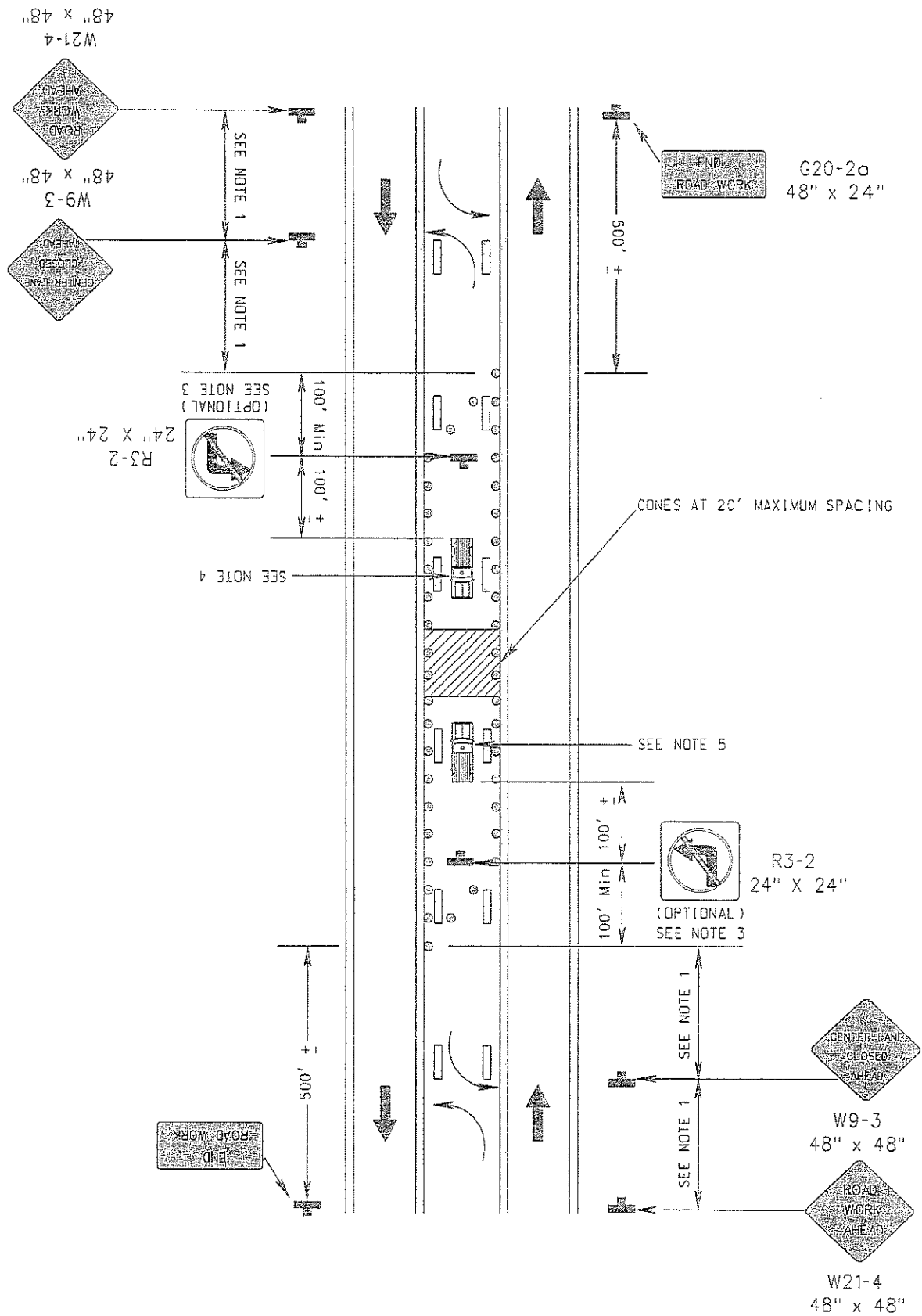
1. *The distance between signs and beginning of cone transition should be a minimum of 500' and a maximum of 800'.*

Option:

2. Where Right-of-Way or geometric conditions prevent use of 48" x 48" signs, 36" x 36" signs may be used.
3. For locations with a high volume of left turning movements, R3-2 graphic "NO LEFT TURN" signs may be used within the closed lane.

Standard:

4. To prevent vehicles from entering into the work zone, channelizing device spacing shall be a maximum of 20' on centers.
5. A shadow vehicle shall be parked 50'-100' in advance of the work crew. If multiple lanes are present (four or more lanes, excluding the center turn lane) and the posted speed limit is 45 mph or greater, the vehicle(s) shall be equipped with a truck mounted attenuator (TMA).



CENTER TURN LANE CLOSURE OPERATION
FIGURE TTC-17.0

**TYPICAL TRAFFIC CONTROL
FLAGGING OPERATION ON TWO-LANE ROAD
(FIGURE TTC-18.0)**

NOTES

Guidance:

1. Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
2. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8.

Option:

3. Where Right-of-Way or geometric conditions prevent the use of 48" x 48" signs, 36" x 36" signs may be used.

Standard:

4. Flagging stations shall be located far enough in advance of the work zone to permit approaching traffic to reduce speed and/or stop before passing the work zone and allow sufficient distance for departing traffic in the left lane to return to the right lane before reaching opposing traffic (see Table 6H-4, on page 6H-5).
5. All flaggers shall be state certified and have their certification card in their possession when performing flagging duties. (See Section 6E.01, Qualifications for Flaggers)
6. Cone spacing shall be at the following:

<u>Location</u>	<u>Speed (mph)</u>	
	<u>0-35</u>	<u>36+</u>
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

7. A shadow vehicle with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew.

Option:

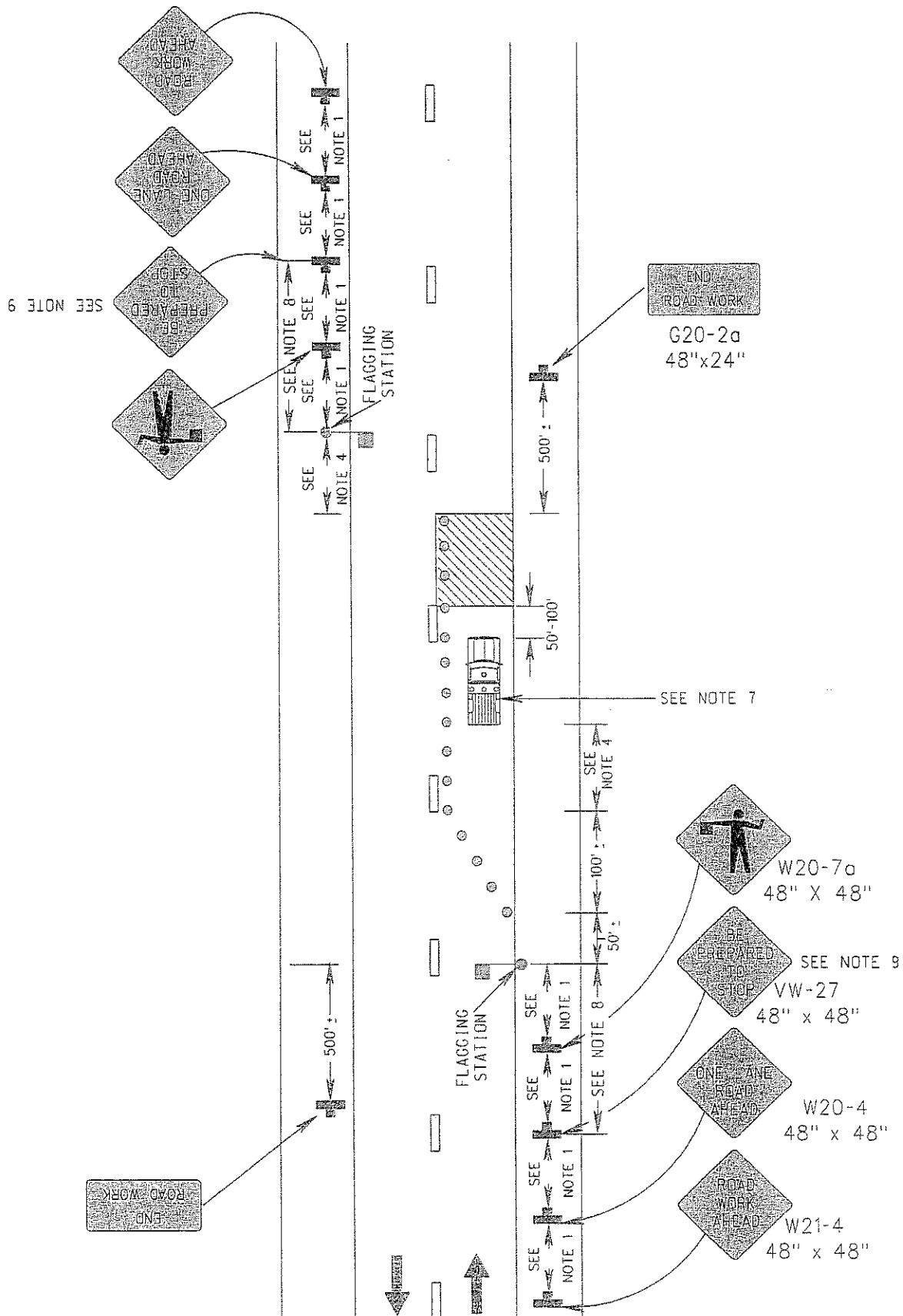
8. A supplemental flagger may be required in this area to give advance warning of the operation ahead by slowing approaching traffic prior to reaching the flagger station or queued traffic.

Guidance:

9. If the queue of traffic reaches the "BE PREPARED TO STOP" sign, then the signs should be readjusted at greater distances.

Option:

10. Cones may be eliminated when using a pilot vehicle operation.



FLAGGING OPERATION ON TWO-LANE ROAD
FIGURE TTC-18.0

TYPICAL TRAFFIC CONTROL
NON-STATIONARY FLAGGING OPERATION ON TWO-LANE ROAD
(FIGURE TTC-19.0)

NOTES

Guidance:

1. Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.
2. Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8.

Option:

3. Where Right-of-Way or geometric conditions prevent the use of 48" x 48" signs, 36" x 36" signs may be used.

Standard:

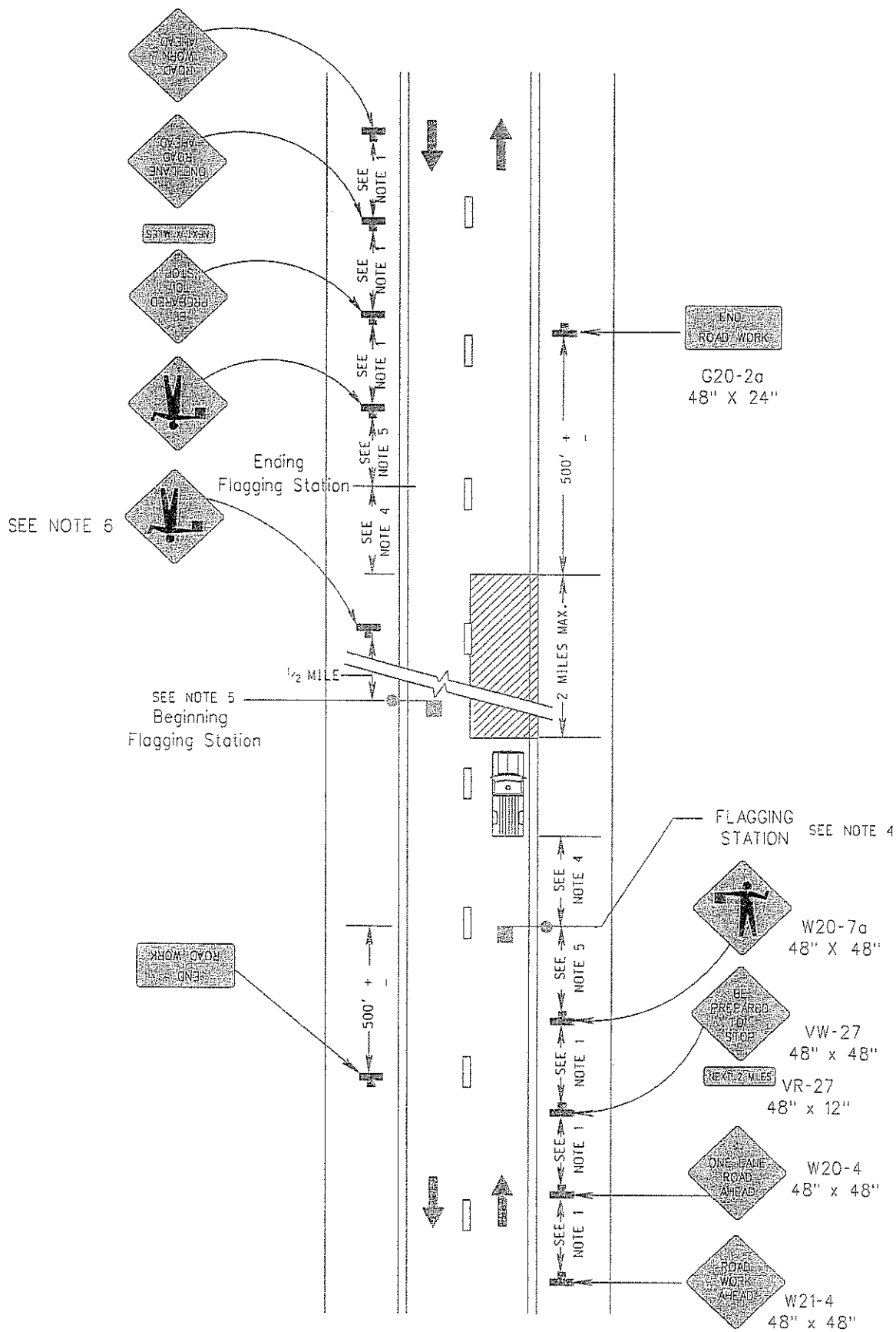
4. Flagging stations shall be located far enough in advance of the work zone to permit approaching traffic to reduce speed and/or stop before passing the work zone and allow sufficient distance for departing traffic in the left lane to return to the right lane before reaching opposing traffic (see Table 6H-4. on page 6H-5).
5. The GRAPHIC FLAGGER AHEAD sign (W20-7A) shall stay within ½ mile of each flagger.

Guidance:

6. Additional GRAPHIC FLAGGER AHEAD signs should be placed at ½ mile intervals and either erected by the approaching flagger, or taken down as the operation proceeds past this point.

Standard:

7. All flaggers shall be state certified and have their certification card in their possession when performing flagging duties. (See section 6E.01 Qualifications for Flaggers)
8. A shadow vehicle with at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the first work crew.
9. The maximum length of the work area shall be two miles.



NON-STATIONARY FLAGGING OPERATION
FIGURE TTC-19.0

APPENDIX E



VERBATIM VOICE RECORDING AUTODIALER SPECIFICATION MANUAL

*Verbatim*TM

SPECIFICATION MANUAL

RACO[®]

REMOTE ALARMS AND CONTROLS

RACO MANUFACTURING & ENGINEERING, CO.

1400 62nd Street, Emeryville, CA 94608 (415) 658-6713

1-800-722-6999 FAX # 1-415-658-3153

VERBATIM MODEL VSS-4C

SPECIFICATION MANUAL

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LIMITED WARRANTY

Raco Manufacturing and Engineering Co Inc., Emeryville, California warrants this product to be in good working order for a period of one year from date of purchase as a new product. In the event of failure of any part(s), due to defect in material or workmanship occurring in that one year period, Raco will, at its option, repair or replace the product at no charge for parts or labor. Any alteration of the product without instruction from Raco's Engineering Department will automatically void this warranty. If alterations of the unit are authorized by Raco, please complete the authorization form in the Owners Manual and return the form to Raco to ensure the warranty. Under no circumstances will Raco be responsible for consequential or secondary damages.

The defective product should be returned, insured and freight prepaid, securely packaged to the address listed below. Please include a copy of your sales receipt, the dialers serial number, and a detailed description of the problem you are experiencing.

Raco Manufacturing and Engineering Co Inc.
Service Department
1400 62nd Street
Emeryville, California 94608

WARRANTY CERTIFICATE

Model _____
Serial Number _____
Date of purchase _____
Owner's name _____
Address _____
Dealer's name _____
Address _____

Detach here before mailing

WARRANTY REGISTRATION

IMPORTANT: Please complete this Warranty Registration and mail to Raco Manufacturing and Engineering Co Inc., Service Department, 1400 62nd Street, Emeryville, California 94608, within 14 days of purchase.

Model _____
Serial number _____
Date of purchase _____
Name _____
 /position _____
Company/Organization _____
Division/Department _____
Address _____

Telephone _____
Dealer's Name _____
Address _____

The following additional information will assist us in our continuing efforts to provide you with products that meet your specific requirements.

• This autodialer is used in: _____ wastewater, _____ gas pipeline, _____ remote equipment, _____ cold storage, _____ chemical manufacture, _____ energy generation, _____ agriculture, _____ other.

• It uses the following types of transducers: _____ pressure, _____ temperature, _____ flow, _____ electrical detection, _____ gas (all types), _____ intrusion, _____ float level, _____ other.

 first became aware of this autodialer from: _____ dealer showroom, _____ colleague, _____ trade show, _____ professional association, _____ magazine inquiry, _____ other.

4. I read the following publication(s) regularly: _____

Please send me more information on the following quality products from RACO Manufacturing.

_____ Chatterbox CB-4
_____ Chatterbox CB-8
_____ Chatterbox CB-16
_____ Analog inputs
_____ Non-Volatile memory
_____ NEMA 4X enclosures
_____ Custom Vocabulary
_____ 24 hr power supply
_____ Asynchronous
_____ communications
_____ Extended Warranty

SECTION 1. PRODUCT DESCRIPTION

The VERBATIM® Voice Recording Autodialer functions as a remote alarm monitor, typically monitoring critical facilities which are not staffed 24 hours a day.

The VERBATIM® autodialer monitors 4 inputs (8, 16, 24 or 32 input options are available) from user-supplied external sensors, such as float switches, limit switches, etc. These sensors are usually dry, isolated contacts which close or open to indicate the sensed condition.

When any of the external sensors indicate an alarm condition, or when AC power fails, the VERBATIM® autodialer accesses the standard phone line to which it is connected, dialing the appropriate phone numbers and delivering the user's own pre-recorded voice message corresponding to those particular alarm conditions that are currently active. Dialing continues repeatedly through the entire list of up to 16 programmed phone numbers, until the alarm is acknowledged by touch tone command or by calling the VERBATIM® autodialer back.

The user may also call the VERBATIM autodialer at any time from any telephone, to hear a complete voice report of current conditions.

The VERBATIM autodialer incorporates many flexible, voice-supported programming and message recording options, to meet a wide range of user requirements. Yet, in most cases the user may rely on pre-existing default programmed parameters, greatly simplifying programming. Even default voice alarm messages are provided.

ALL USER PROGRAMMING AND VOICE MESSAGE RECORDING MAY BE ENTERED, REVIEWED OR CHANGED EITHER FROM THE FRONT PANEL OR FROM A REMOTE TELEPHONE AT ANY TIME. THUS, INSTALLATION AND PROGRAMMING MAY EASILY BE DONE BY SEPARATE PERSONNEL AT SEPARATE TIMES. Most programming is entered in the form of 3-digit codes as described herein. All user programming, including recorded messages, is maintained in permanent non-volatile memory.

Individual standard contact inputs may be optionally programmed to report status only or to accumulate run times, or even to totalize pulses from flowmeters, etc.. In most cases, the outputs of logic controllers may be connected directly to standard contact inputs without need for interfacing relays.

The VERBATIM autodialer incorporates extremely thorough and effective electrical surge protection and overall rugged construction, to deliver reliable operation under real-world conditions.

SECTION 2. INSTALLATION

STEP 1: LOCATION AND MOUNTING

Choose a mounting location which is not exposed to condensing humidity or temperatures beyond the limits of 20°-130°F. This location should ideally be within 5 feet of a standard RJ-11 phone jack and a GROUNDED 120 VAC power outlet.

Mount the dialer on centers of 6" x 11 3/8" using the external mounting ears on the enclosure. #10 or 3/16" bolt sizes are best.

An optional NEMA 4X weatherproof outer enclosure is available. This allows the dialer to be mounted outdoors as long as temperature limits are not violated. It is best to provide at least an overhead shelter to minimize direct precipitation and solar heating effects.

An optional heater/thermostat is also available for cold or humid environments. The 120 vac heater dissipates 75 watts, providing a temperature rise of approximately 30 degrees, or 60 degrees when enclosed in the optional NEMA 4X enclosure.

STEP 2: INSTALLATION

Inspect and remove any foreign materials which might create short circuits.

Connect the red (positive) battery lead to the positive terminal on the gel-cell battery.

Connect dry (unpowered) contacts to the terminal strip connection points. The contact input wires should ideally be light (18 to 24 gauge) signal wire rather than heavy power wire. This reduces problems of bulk and stiffness.

Plug the power cord into a GROUNDED 120 VAC OUTLET. Or, remove the power cord from the dialer and install well-grounded 120 VAC power to terminal strip TS3, located on the lower right of the main circuit board. If the dialer turns on when power is applied; turn it off with the red ON/OFF key.

Plug the unit into the phone jack and press the POWER ON/OFF button.

SECTION 3. INITIAL BASIC PROGRAMMING AND TESTING

3.1 PHONE NUMBER PROGRAMMING

Program your desired phone numbers, from 1 to 16. Each number may be up to 24 digits in length. Be sure to include any necessary area codes or "1" prefixes.

3.2 STEP 3: PROGRAMMING INPUT CHANNELS

The VERBATIM autodialer needs to know whether its input channels are to be NORMALLY CLOSED (alarm on Open Circuit), NORMALLY OPEN (alarm on closed circuit), set for NO ALARM, or set for special functions, such as totalizing.

All contact inputs are initially set NORMALLY CLOSED (i.e. they will alarm on Open Circuit). This is the default setting and, therefore, any Open Circuits, including any inputs left unconnected during installation, will appear as alarms until the inputs are programmed.

Input channels may be programmed individually. However, a convenient "auto-set" feature may be used to accept all present inputs as "NORMAL."

SECTION 4. RECORDING MESSAGES IN YOUR OWN VOICE

Recording messages is an optional step. The VERBATIM autodialer comes with built-in default normal and alarm messages for all channels, so recording messages in your own voice can be postponed if you so desire, until you have become more familiar with the unit. You may even choose to record or re-record your own messages from a remote telephone at any time.

Ordinary contact input channel default messages are "Channel N Normal" and "Channel N Alarm" (where N is the channel number).

For "Status Only" and Run Time Meter programmed channels (never causing an alarm), the default messages are "Channel N is ON" when the input circuit is closed, and "Channel N is OFF" when the input circuit is open.

The default Station ID message is "ID Number One." The ID message is included in every phone call to identify the calling unit.

In addition to the overall Station ID message, two different messages are used for each contact input channel: one message for the NORMAL CONDITION and another for the ALARM (fault) CONDITION. Many users can leave the existing default "Channel N is Normal" message in place rather than devoting recording time to the Normal

Condition message for each channel. This leaves more recording time available for recording ALARM (fault) CONDITION messages for each channel.

Unless you have installed extra speech memory, the available recording time is:

<u>"Initial" total recording time (at Rate 1):</u>		<u>Extendable to:</u>
		<u>(Rate 2, 3 or 4)</u>
4 channel unit	14 sec	21, 28 or 40 sec
8 channel unit	28 sec	42, 56 or 80 sec
16 or more	56 sec	84, 112 or 160 sec

Initially, the unit is set for the fastest memory use rate ("Rate 1"), giving the highest fidelity sound recording.

If you need more time, or if you are not certain, the VERBATIM autodialer's exclusive Autoextend™ feature will automatically extend the available recording time, selecting the optimum recording rate (speech memory rate) to give you the highest possible recording sound quality for your length of recording.

SECTION 5. USING THE PROGRAMMED VERBATIM AUTODIALER

5.1 PLACING INQUIRY CALLS TO THE VERBATIM AUTODIALER

You may call the VERBATIM autodialer any time from any phone. After the programmed number of rings (default 1 ring), the VERBATIM autodialer will answer, first giving its Station ID Message, then any special warning messages (such as not having any phone numbers programmed, unit is in the disarmed state, etc.), and then the status of each channel input. If there are no unacknowledged or acknowledged alarm conditions on any channel, then just before the status report the VERBATIM autodialer will say "All channels normal". If this call is acknowledging an unacknowledged alarm, the VERBATIM autodialer will say "Alarm is acknowledged".

The channel status report will be recited 3 times. Between each recital the VERBATIM autodialer will issue a prompting beep and then wait a few seconds for you to optionally enter a special Command Tone. If you have not chosen to enter a tone, the unit will say "Goodbye" and terminate the call.

5.2 "CHECK STATUS" INQUIRY AT PANEL

When the NORM LED is lit, you may hear a report of current conditions by pressing the NORM/CHECK STATUS key. You may cut this report short by again pressing the NORM/CHECK STATUS key.

5.3 RECEIVING ALARM CALLS FROM THE VERBATIM AUTODIALER

When any input condition violates the alarm condition programming, and if that violation persists for the duration of the Alarm Trip Delay for that input, the unit goes into an Unacknowledged Alarm state and begins dialing the first of up to 16 programmed phone numbers. (You may optionally program for Alarm Call Grouping if you want the numbers dialed to depend on which channel is in alarm.) The corresponding channel alarm LED begins flashing to indicate an unacknowledged alarm.

After dialing the first number, the VERBATIM autodialer waits a few seconds and then begins speaking its messages. The messages follow the same format as for an inquiry call, including the prompting beep, except that channels that have no alarm activity are not included in the alarm report. If there is no acknowledgement, the VERBATIM autodialer will repeat the message for the programmed number of repeats (default 3 repeats), then will say "Goodbye" and terminate the call.

If the alarm violation is corrected after the unit has gone into an Unacknowledged Alarm state, calling will not cease. However, the phrase "now normal" will be added at the end of each recital of the Alarm Condition message. Exception: For power failure alarms, when power is restored the message is "Power is on."

If the alarm has been acknowledged, the word "acknowledged" will be added.

These alarm messages will then continue to be included in any status reports until the Alarm Reset time expires.

If a channel is in violation but its Alarm Trip Delay has not timed out, the channel's alarm message will be recited, with the word "alert" added.

5.4 CONTINUED DIALING IN THE ABSENCE OF ACKNOWLEDGEMENT

The VERBATIM autodialer will then wait for the programmed Time Between Alarm Calls (default 2 minutes), during which you may call the VERBATIM autodialer back to acknowledge the alarm. If no acknowledgement is received at the end of this period, the next phone number will be dialed. The process will be repeated indefinitely, repeatedly going through all the designated phone numbers, until acknowledgement is received.

5.5 ACKNOWLEDGING THE ALARM CALL

To acknowledge the alarm during the alarm call, enter a touch tone "9" at the sound of the prompting beep. The VERBATIM autodialer will say "Alarm is acknowledged, Goodbye" and terminate the call.

See SECTION 5.7 for additional ways of acknowledging an alarm without ending the call.

An alternate way to acknowledge the alarm is to wait for the alarm call to end, then call the VERBATIM autodialer back. At the front panel, pressing NORMAL, PROGRAM, DISARM, or DIALOUT will also acknowledge the alarm. Upon acknowledgement, the channel LED changes from flashing to steady illumination.

5.6 ALARM RESET TIMEOUT AFTER ACKNOWLEDGEMENT

Upon receiving an acknowledgement, the VERBATIM autodialer begins timing out the Alarm Reset Time, (default 1 hour). Further calling on behalf of that channel is suspended, regardless of further activity at that particular input during this period. If new alarms occur on other channels during this period, the unit will go back into the Unacknowledged Alarm state and dial the first appropriate phone number, with dialing continuing until a new acknowledgement is received.

At the end of the Alarm Reset period the channel alarm LED turns off, the Acknowledged Alarm status is cleared for that particular channel input, and it is again ready to go into Unacknowledged Alarm whenever a violation occurs at that input. In particular, this means that if the violation had not been removed prior to the timeout, dialing will begin again immediately upon timeout of that Alarm Reset period.

5.7 REMOTE OVER-THE-PHONE PROGRAMMING

During any phone call (inquiry call or alarm call), at the end of each round of messages, the prompting beep is issued. If you press a Command Tone "1" at the sound of the beep, the VERBATIM autodialer will prompt you to enter a program code. (Or, if you have established a Security Access Code, you will first be prompted for this code). You may enter codes for most of the programming operations described in this manual except reading or changing the optional security access code.

5.8 USING THE VERBATIM AUTODIALER TO DIAL OUT AND CONVERSE (SPEAKERPHONE)

At the panel, you may press the DIALOUT/PRESS TO TALK key and press the digits of the phone number you want to dial. Each digit you press will be dialed as you press it. You will then hear the sound of the ringing. When you hear the phone answered, press and hold the same DIALOUT/PRESS TO TALK key as you speak to the person on the line, and release the key to listen. You can continue the conversation in this manner. To end the call press NORMAL. If the DIALOUT/PRESS TO TALK key remains unpressed for more than 2 minutes, the VERBATIM autodialer will automatically end the call.

To automatically re-dial a number that was previously manually entered by this method, press DIALOUT/ PRESS TO TALK as before, then press ENTER rather than entering digits manually.

If you are at the panel when a phone call is in progress, you may suspend the message report and converse with the person on the other end by pressing the DIALOUT/PRESS TO TALK key as described above. There will be no additional dialing, since connection has already been established. To end the call, press NORMAL.

SECTION 6. VERBATIM® SERIES VSS SPECIFICATIONS

Description & Phone Number Dialing:

1. The dialer shall be a solid state component capable of dialing up to 16 phone numbers, each up to 24 digits in length. Phone numbers and Standard pulse dialing or Touch Tone DTMF dialing are user programmable via the system's keyboard or Touch Tone phone.

Solid State Voice Message Recording and Playback:

2. The unit shall have two different categories of speech message capability, all implemented with permanent non-volatile solid state circuitry with no mechanical tape mechanisms:
 - ** User Field Recorded Messages: The user may record and re-record his own voice messages, for each input channel and for the Station ID. The time for each message shall be adjustable, and recordings may be made at the front panel or from any remote Touch Tone telephone. Provision shall be included for status only (non-alarmable) messages.
 - ** Permanent Resident Non-Recorded Messages: Permanent built-in voice messages shall be included to support user programming operations, to provide supplemental warning messages such as advising that the alarms have been disabled, and to allow the unit to be fully functional even when the user or installer has not recorded any messages of his own.

Local & Remote Programming Capabilities:

3. The user may optionally elect to alter the following parameters from their standard normal default values via keyboard entry or remotely from any Touch Tone phone.
 - ** Alarm Call Grouping: On alarm, system shall selectively call the correct phone numbers according to the current alarm(s).
 - ** Alarm response delay: .1 to 999.9 seconds.
 - ** Delay between alarm call outs: .1 to 99.9 minutes.
 - ** Alarm reset time: 0.1 to 99 hours or "NO RESET".
 - ** Incoming ring response (answer) delay: 1 to 20 rings.
 - ** Number of message repetitions: 1 to 20 repetitions.
 - ** Input alarm criteria: Each channel shall be independently configured for "Alarm On Open Circuit", "Alarm On Closed Circuit", "No Alarm".
 - ** Autocall Test: When enabled, the unit shall place a single

round of test calls, both at the time this function is enabled and also at regular subsequent intervals until this function is disabled at the keyboard.

- ** Run Time Meter: Selected inputs shall accumulate and report the number of hours that its input contacts have been closed.
- ** Remote system microphone activation.
- ** Remote and local arming and disarming of system.
- ** Pulse Totalizer Function.

Nonvolatile Program Memory Retention:

4. User-entered programming and voice messages shall be kept intact even when all power is removed for up to ten years.

Acknowledgement:

5. Acknowledgement of an alarm phone call is to be accomplished by pressing a Touch Tone® "9" as the alarm call is being received, and/or by returning a phone call to the unit after having received an alarm call.

Input Monitoring Function:

6. The unit shall continuously monitor the presence of AC power and the status of four contact closure inputs. AC power failure, or violation of the alarm criteria at any input, shall cause the unit to go into alarm status and begin dial-outs.

Alarm Message:

7. Upon initiating an alarm phone call, the system is to "speak" only those channels that are currently in "alarm status".

Speakerphone:

8. The unit shall be capable of dialing any phone number on command and function as a speakerphone.

Inquiry Message and Function:

9. Inquiry phone calls can be made directly to the unit at any time from any telephone, locally or long distance, for a complete status report of all variables being monitored, including power status.

Power Battery Backup:

10. Normal power shall be 105-135 VAC, 15 watts nominal. The product is to contain its own gel cell rechargeable battery which is automatically kept charged when AC power is present. The system shall operate on battery power for a minimum of six continuous hours in the event of AC power failure. A shorter backup time shall not be acceptable. The built-in charger shall be precision voltage controlled, not a "trickle charger," in order to minimize recharge time and maximize battery life available.

Phone Line:

11. The dialer is to use a standard rotary pulse or Touch Tone "dial-up" phone line (direct leased line not to be required)

and is to be F.C.C. approved. Connection to the telephone is through a 4-pin modular jack (RJ-11).

Integral Surge Protection:

12. Gas tube and solid state surge protection is to be provided on all inputs, including power, phone and signal lines. These protectors are to be integrally incorporated into the main circuit board for maximum protection. Protectors mounted external to the main circuit board shall not be an acceptable substitute. The installer shall provide a good electrical ground connection point near the unit to maximize the effectiveness of the surge protection.

Warranty:

13. The dialer shall be covered by a two (2) year warranty covering parts and labor performed at the Factory.

Modular Upgrades:

14. The system shall include expansion connectors to accommodate field upgrades for additional dry contact inputs, remote supervisory control outputs, analog inputs and communication with remote printers and computers.

Additional Features: Sealed Switches, LED Indicators, Alarm Disable Warning, TalkThrough:

15. All keyboard and front panel switches shall be sealed to prevent contamination. Front panel LED's shall indicate: Normal Operation, Program Mode, Phone Call in Progress, Status for each channel, AC Power Present, AC Power Failure, and Low, Discharging or Recharging Battery. On any Inquiry telephone call or On Site status check, the voice shall provide specific warning if no dialout phone numbers are entered, or if the unit is in the "alarm disable" mode, or if AC power is off or has been off since last reset. A built-in microphone shall allow anyone at a remote phone to listen to local sounds and have a two-way conversation with personnel at the dialer.

Special Order Items:

16. The following options shall be available on specific order:

- a) NEMA 4X (totally sealed) enclosure.
- b) 4, 12, 20, or 28 extra contact channels (8, 16, 24, or 32 respectively, total).
- c) 1, 4, 8, or 16 analog channels.
- d) 24 hour battery backup life (6 hours standard).
- e) Thermostatically controlled heater.
- f) Computer communications interface.
- g) Radio communications interface.
- h) Remote supervisory control (4 or 8 outputs).

(Specifications subject to change without notice.)

6.1.0 FACTORY OPTIONS

6.1.1 24 HOUR BATTERY BACKUP

Achieved by installing low power IC chips, thereby extending battery discharge time to 24 hours before operation is affected.

6.1.2 NEMA 4-X WATERPROOF ENCLOSURE

The VERBATIM in its basic enclosure mounts inside this enclosure. Sturdy fiberglass construction for outdoor applications. Enclosure is corrosion proof and sealed against 12 feet of water, yet opens conveniently for access. Enclosure size 13 1/2" H X 11 1/2" W X 5 5/8" D, Mounting centers 12 3/4" X 8".

6.1.3 HEATER/THERMOSTAT

Recommended for environments below 20 degrees F or where any condensation is anticipated. Heater/Thermostat requires drilling 6 mounting holes in Verbatim® enclosure.

6.2.0 MODULAR OPTIONS

6.2.1 8, 16 OR 24 ADDITIONAL DRY CONTACT INPUTS

Provides additional contact inputs by means of a plug-in modular expansion board inside the VERBATIM enclosure, to provide a total of 8, 16, 24 or 32 contacts total.

6.2.1 COMPUTER COMMUNICATIONS INTERFACE

Allows the unit to communicate over standard phone lines to a central printer/modem, computer, etc. in standard ASCII format at either 300 or 1200 baud. Standard voice communication capability is retained, along with the special alarm voice calls to personnel in the event of an ASCII communication failure. Note that for proper operation the Speaker/Mike switch must normally be left in the Speaker position. On special order at extra cost, a local RS-232 serial port can be provided to allow on-site communication between the VERBATIM and a local terminal or computer or printer, etc.

6.2.2 REMOTE SUPERVISORY CONTROL

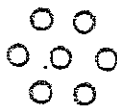
Allows user to add 4 or 8 control outputs which can control pumps, valves, etc. Operations is by DTMF Touch Tone with voice guiding the user and providing confirmation of operations. With the optional COMPUTER COMMUNICATIONS INTERFACE, operation can also be done from a remote computer terminal. In either case, a security code may optionally be programmed at the VERBATIM keyboard. Control operation may also be performed at the keyboard. Operation may be either momentary or maintained.

The plug-in output modules are housed in a separate NEMA 4X enclosure, and require 120 vac power. The output modules may be any combination of the following standard OPTO 22 Modules:

- OAC5 12-120 volt AC, 20 ma - 2 amps.
- OAC5A 24-240 volt AC, 20 ma - 2 amps.
- OAC5A5 120/240 volt AC, Normally Closed.
- ODC5 5-60 volt DC, 5 ma - 2 amps.
- ODC5A 5-200 volt DC, 5 ma - 2 amps.
- ORR5 Dry Reed output, 10 va, 100 vdc, 0.5 amp.

Note that for proper operation, the Speaker/Mike switch on the front panel must normally be left in the Speaker position so that microphone sound pickup does not interfere with remote control tone commands.

MICROPHONE



VerbatimTM

NORMAL MODE; NO
UNACKNOWLEDGED ALARMS.

CHECK STATUS MODE
(LOCAL INQUIRY).

BATTERY CHARGING
OR DISCHARGING.*

AC POWER FAILURE;
RUNNING ON BATTERY.**

PROGRAM MODE; READY
FOR PROGRAM CODES.

MESSAGE IS NOW
BEING RECORDED.

NORM	PROGRAM	01	05	09	13	17	21	25	29
CHECK	RECORDING	02	06	10	14	18	22	26	30
LOBAT	DISARMED	03	07	11	15	19	23	27	31
PFAIL	PHONING	04	08	12	16	20	24	28	32

FLASHES WHEN UNIT
IS DISARMED.

PHONE CALL IN PROGRESS;
ALSO FLASHES BETWEEN CALLOUTS.

PUTS UNIT IN PROGRAM MODE.

EXECUTES PROGRAM
CODE ENTRY.

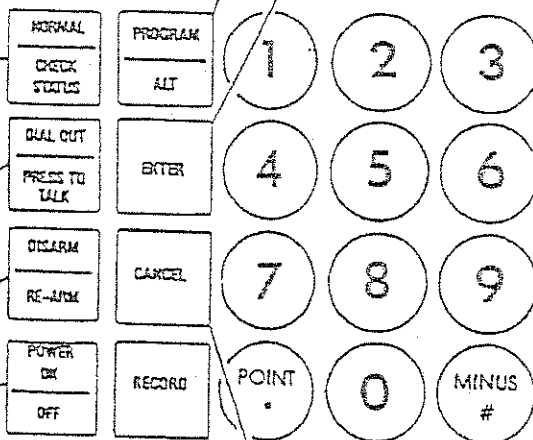
SPEAKER

RETURNS TO NORMAL MODE.
IF ALREADY NORMAL, GIVES
CHECK STATUS REPORT. ALSO
TERMINATES CALLS AND REPORTS.

ACCESS PHONE LINE; PREPARES TO
DIAL DIGITS AS THEY ARE PRESSED.
PRESS TO TALK, RELEASE TO LISTEN.

DISARMS UNIT (PREVENTS ALARM
CALLS). IF ALREADY DISARMED,
RE-ARMS AND CLEARS OLD ALARMS.

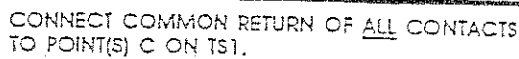
TURNS UNIT OFF. IF ALREADY
OFF, TURNS UNIT ON.



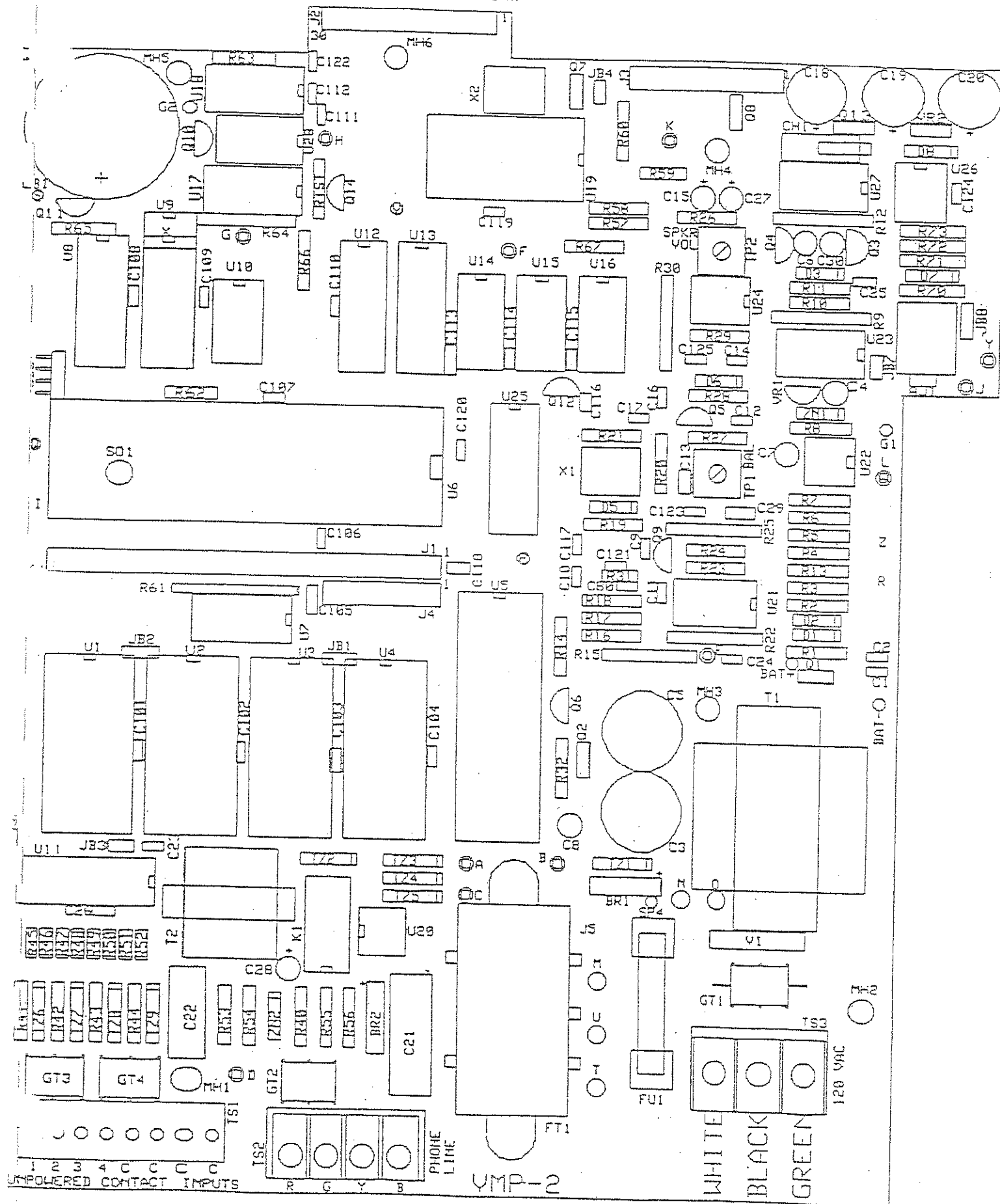
RECORDS SELECTED MESSAGE
UNTIL RELEASED.

* With a fully charged battery, light should go out within a few minutes of turning on. A discharged battery may take up to a day to fully recharge.

** During AC power failure, all illuminated LEDs will flash to conserve battery power.



COMPONENT LAYOUT DIAGRAM





REMOTE ALARMS AND CONTROLS

RACO Manufacturing and Engineering Co., 1400 62nd Street, Emeryville, California 94608 (415) 658-6713

RACO DATA ACQUISITION SYSTEM SPECIFICATIONS

January 29, 1990

Overall System Equipment and Operating Description:

The overall system shall consist of one or more Verbatim voice/data RTU's (see separate RTU specifications), and a Central Station Computer with Raco system software, modem and printer. The RTU's shall communicate with the Central Station Computer, and in voice mode with personnel, using ordinary dial-up telephone lines. Systems requiring leased dedicated or specially conditioned phone lines shall not be accepted. The RTU shall be capable of functioning as an alarm system independent of the operation of the Central Station Computer.

In operation, the Central Station Computer shall call each RTU at programmable polling intervals to get periodic status reports of all functions being monitored. Additionally, if an alarm condition should occur at any RTU, that RTU shall place an alarm call to the Central Station and send an alarm status report. If the Central Station is manned when an alarm call is received the operator may elect to acknowledge the alarm. The Central Station shall also be programmable to automatically acknowledge the alarm. If the alarm is not acknowledged, the RTU shall go on to place alarm calls to a series of programmed phone numbers, giving the alarm report by digitized voice to personnel. Acknowledgement of the alarm report from the additional phone numbers shall be possible by Touch Tone command or by calling the RTU back.

Personnel may also call the dialer at any time from any phone to get a voice digitized report, or from the computer to get a screen and printed report. All remote dialer keyboard programming may be reviewed and changed from the computer, or from any phone using DTMF Touch Tone commands, except that any desired security access code must be initially established at the dialer keyboard only.

A. Central Station Equipment Specification

General Attributes of Central Station Software Program:

1. The Central Station software program shall provide color graphic screens and pulldown menus. Where practical, the program shall allow operator choices to be achieved by toggling among available choices rather than requiring keyboard typing of choices. Where the user enters values, the screen shall provide popup warnings if the entry does not fall within "legal" parameters.

Central Station Alarm Acknowledgement Settings:

2. The program shall allow convenient toggling between three acknowledgement modes: Central Station automatically acknowledges incoming alarms from RTU's; Central Station provides no acknowledgement; and Central Station allows the operator to directly acknowledge alarms when he is present and chooses to do so.

Naming Central Station, RTUs And Their Individual Input Channels:

3. The program shall provide convenient means for entering appropriate identifying names for the Central Station, for each RTU, and for each individual input channel for each RTU. Once entered, these identifying names shall appear in all screen and printed reports in lieu of generic default notations such as "channel 1".

Polling Operation:

4. The program shall allow entry of the phone numbers for the Central Station to use in calling the various RTU's in the system, and for setting the polling interval. In operation, the time and date and all status information from each polling call shall be automatically printed as well as archived to the computer's fixed disk for later retrieval. Convenient provision shall also be made for special polling calls on operator demand, to either a single specified RTU or to the entire system of RTU's, at the operator's choice.

Communications Format:

2. Communications shall be in the standard Bell 212A format (1200 baud) with automatic fallback to Bel 103 format (300 baud). The RTUs shall be capable of both asynchronous data and synthesized voice communications.

Communication between the Verbatim RTU and the Central Station utilizes a RACO proprietary block mode transmission method with Cyclic Redundancy Checking (CRC-16) and Automatic Repeat Request protocol for error-free transmission.

Special Backup Communications Failure Alarm Function:

3. When the unit calls the Central Station Computer, if it should fail to establish proper connection, it shall terminate the call and make another attempt to reach the same number. If, after a programmed number of attempts no computer connection has been established, the unit shall go on to call personnel with a special Communication Failure Alarm message.

Phone Number Dialing:

4. The unit shall be capable of dialing up to 16 phone numbers, each up to 24 digits in length. Dialing shall be programmable as Rotary Pulse, Touch Tone, or High Speed Tone Dialing. Phone numbers and pauses in the dialing string shall be user programmable via the system's keyboard or Touch Tone phone, or the Central Station Computer. To accommodate PBX's, cellular phones and pager systems, the length of each pause shall also be programmable.

Solid State Voice Message Recording and Playback:

5. The unit shall have two different categories of speech message capability, both implemented with permanent non-volatile solid state circuitry with no mechanical tape mechanisms. The unit shall allow for message recording from a remote telephone as well as from the front panel, and shall at a minimum incorporate the following seven speech message attributes:

- A. User Field Recorded Messages: The user may record and re-record his own voice messages, for each input channel and for the Station ID.
- B. User recorded messages shall be retained intact in permanent, 10-year non-volatile memory in the event of AC or system battery failure or disconnection.
- C. There shall be no limit on the length of any particular message, within the overall available message recording time, which shall be 40 seconds for 4 channel units; 80 seconds for 8 channel units, and 160 seconds for 16 or more channels.
- D. The unit shall allow selective recording of both Normal and Alarm advisory messages for each input channel.
- E. The unit shall provide for automatic setting of the optimum speech memory usage rate for the total set of messages recorded, in order to achieve optimum recording sound quality.
- F. Circuit board switches or jumper straps shall not be acceptable means of manipulating message length or recording rates.
- G. Permanent Resident Non-Recorded Messages: Permanent built-in messages shall be included to support user programming operations, to provide supplemental warning messages such as advising that the alarms have been disabled, and to allow the unit to be fully functional even when the installer has not recorded any messages of his own.

Input Monitoring Functions:

6. The unit shall continuously monitor the presence of AC power and the status of four contact closure inputs. Unit shall optionally be field upgradable to incorporate a total of 8, 16, 24, or 32 dry contact inputs. AC power failure, or violation of the alarm criteria at any input, shall cause the unit to go into alarm status and begin dial-outs.

The unit shall, upon a single program entry, automatically accept all the existing input states as the normal non-alarm state, eliminating possible confusion about Normally Open versus Normally Closed inputs. Further, as a diagnostic aid, unit shall have the capability of directly announcing the state of any given input as currently "Open Circuit" or "Closed Circuit", without disturbing any message programming. Each input channel shall also be independently programmable, without need to manipulate circuit board switches or jumpers, as Normally Open or Normally Closed, or for No Alarm (Status Only), or for Pulse Totalizing, or for Run Time Metering, or completely disabled (omitted from all reports).

Run Time Meter Function:

7. Dry contact inputs (up to a total of 8 of the inputs) shall be programmable to accumulate and report the number of hours their respective input circuits have been closed. Any such inputs shall never cause an alarm, but on inquiry shall recite the channel's message according to the status of the input and then report the accumulated closed circuit time to the tenth of an hour. The input shall report up to a total accumulated running time of 99,999.9 hours before rolling over to zero. The initial value of the Run Time Meter shall be programmable to match existing instrumentation. Message recording shall allow customized voice messages of the general form "The lag pump is on. Run time is XXXXX.X hours".

Pulse Totalizer Function:

8. Dry contact inputs (up to a total of 8 of the inputs) shall be programmable to accumulate the number of pulses (momentary contact closures) occurring at the input. An alarm setpoint shall be programmable to create an alarm call upon reaching a particular total value. The input shall accept a pulse rate of up to 100 pulses per second. If the pulse rate exceeds 50 pulses per second, the pulses must have a 50% duty cycle. The Totalizer shall accumulate no less than 4,000,000,000 pulses before rolling over to zero. The initial value of the Pulse Totalizer count shall be programmable to match existing instrumentation. A programmable scale translation factor and voice message recording shall allow completely tailored voice reports in translated spoken units, of the general form "the total main valve water flow is XXXXX.X million gallons".

Voice Reports During Inquiry Calls:

9. When personnel call the unit for voice reports, the station ID message plus the messages indicating the status of all input channels shall be spoken by the unit. The word "alert" shall be appended to the message for any channel detecting a violation which has not yet satisfied the Alarm Trip Delay for that channel. If no channels have any alarm status, the preamble "All channels normal" shall be spoken, to avoid the necessity of listening to all the channel reports. The unit shall also on command give a report of only those channels with some alarm status.

Voice Reports During Alarm Calls:

10. When the unit calls personnel with voice reports, it shall provide the Station ID message plus, the system will report all four classes of active alarm inputs.
- A. Unacknowledged Alarm; Input Signal In Alarm Condition - All inputs that have had their alarm criteria met and are actively in alarm status and have not been acknowledged.
 - B. Unacknowledged Alarm; Input Signal In Normal Condition - All inputs who have had their alarm criteria met and have not been acknowledged, but their input signal has returned to normal prior to acknowledgement.
 - C. Inputs in Alert; Input Signal In Alarm Condition - All inputs that currently have their alarm criteria violated but not long enough to have met the criteria established and have caused an alarm call.
 - D. Acknowledged Alarms Inputs; Input Signal Ignored - All inputs that have been in alarm, have been acknowledged, and have not been automatically or manually reset since acknowledgement.

Regular Interval Autocall Function:

11. Unit shall allow user to optionally program the unit to place regular interval status calls to the Central Station Computer. The interval shall be programmable from 0.1 to 99.9 hours.

Acknowledgement and Alarm Reset Timers:

12. Alarm calls placed by the unit shall be automatically acknowledged by the Central Station Computer if it has been programmed to do so, or upon the keystroke command of personnel at the Computer. Otherwise, the unit shall go on to place voice calls to personnel, who may then acknowledge the alarm by entering a Touch Tone "9", or by calling the unit back. Dialing shall rotate indefinitely through the programmed phone number list until acknowledgement, even if the alarm condition has returned to normal. Once acknowledged, dialing shall be suspended for that particular input channel for the duration of the programmed Alarm Reset Time. At the end of the Alarm Reset Time, the Acknowledged Alarm status for that channel shall be cleared, making that channel again ready for new alarms. Meanwhile, emerging alarm conditions on other channels shall cause dialing to resume immediately, with Alarm Reset Timers maintained independently for each input.

Security Access Code:

13. Unit shall allow a security access code up to 8 digits long to be optionally entered at the front panel keyboard only. If such an access code has been programmed, then the unit shall solicit and require the user to enter that code in order for any programming operations to be performed.

Overall Local & Remote Programming Capabilities:

14. All system functions shall be programmable without need to manipulate circuit board switches or jumpers to alter system functions or programming. All programming shall be accomplished via the front panel keyboard or (except for the Security Access Code) remotely from any Touch Tone phone or from the Central Station Computer.

Unit shall at a minimum allow programming of the following items. However, default values shall be provided so that most of these items do not actually require user programming:

Phone numbers, dialing delays and pulse/tone dialing mode	Alarm reset time
Special number callback/call forward	Ring answer delay
Station ID message	Number of repeats of voice alarm message
Input channel Alarm messages	Autocall on/off and interval
Input channel Normal messages	Security access code
Message recording rate	Arm/disarm alarms
Alarm Criteria for all channels, together or independently	Exit delay before alarms are armed
Channel Run Time Meter, Pulse Totalizer, and disable	Local listening microphone on/off
Alarm trip delays, all channels together or independently	Speaker on/off
Time between alarm calls	Time and Date

Nonvolatile Program Memory Retention:

15. User-entered programming and voice messages shall be kept intact even during power failures or when all power is removed for up to ten years.

Diagnostics:

16. The unit shall provide a complete voice report of all programmable functions and their programmed values on command from any remote Touch Tone phone. A concise summary report listing only the user-entered, non-default programming shall also be available. The accumulated number of inquiry calls, alarm calls, acknowledged alarms and power failure alarms shall also be available from the unit. Complete programming information shall also be available from the Central Station Computer.

Local Microphone, Speakerphone, Dialout on Command:

17. The unit shall allow a remote caller to activate a built-in microphone in order to hear local sounds. At the front panel, a built-in speaker shall operate with the microphone to achieve speakerphone operation, with synthesized voice and data transmissions suspended. Unit shall also allow the user to dial any arbitrary phone number as commanded, digit by digit, and establish speakerphone connection, without need to reprogram any regular dialout phone numbers. A redial function shall be included. The built-in speaker shall be programmable to be off for all reports except for front panel programming operations.

Call Forward/Call Back Function:

18. To allow callback testing or call forwarding, a special phone number shall be programmable. Upon command the unit shall dial this number and provide a regular voice status report.

Public Address Broadcast:

19. The standard dialer shall provide a mini phone jack for optional connection to a local public address system. If connected to the PA system the dialer shall broadcast all alarm messages over the PA system and the telephone simultaneously.

Battery Backup During AC Power Failures:

20. The unit shall provide at least 16 hours of continuous operation from its automatically recharged gel-cell battery, in the event of AC power failure. The charger shall be a precision controlled-voltage type for maximum battery life and efficiency.

Optional DC Power:

21. The user shall be able to optionally configure the dialer for DC power operation. The standard dialer shall provide a mini phone jack for optional connection to a DC power source.

Phone Line:

22. The dialer is to use a standard pulse or Touch Tone "dial-up" phone line and is to be F.C.C. Part 68 approved for such connection. Units requiring direct leased lines shall not be accepted.

Integral Surge Protection:

23. All power, phone line, dry contact, and analog signal inputs shall be protected at the circuit board to IEEE Standard 587, category B (6,000 volts open circuit / 3,000 amps closed circuit). Gas tubes followed by solid state protectors shall be integral to the circuit board for each such line. Protectors mounted external to the main circuit board shall not be an acceptable substitute. The installer shall provide a good electrical ground connection point near the unit to maximize the effectiveness of the surge protection.

Additional Features: Sealed switches, LED Indicators, Alarm Disable Warning, Talk Through:

24. All keyboard and front panel switches shall be sealed to prevent contamination. Front panel LED's shall indicate: Normal Operation, Program Mode, Phone Call in Progress, Status for each channel, AC Power Present, AC Power Failure, and Low, Discharging or Recharging Battery. On any Inquiry telephone call or On Site status check, the voice shall provide specific warning if no dialout phone numbers are entered, or if the unit is in the "alarm disable" mode, or if AC power is off or has been off since last reset. A built-in microphone shall allow anyone at a remote phone to listen to local sounds and have a two-way conversation with personnel at the dialer.

Ambient Temperature and Humidity:

25. Unit shall operate over the ambient temperature range of 32 to 110 degrees F, and 0 to 95% relative humidity (non-condensing).

Warranty:

26. The manufacturer shall repair any defective units returned to the factory at no charge for parts and labor, for a period of two years from the date of shipment, provided that the unit has not been subjected to abuse.

Modular Upgrades:

27. The following options may be ordered with the unit, and may also be modularly added in the field:
- Additional contact input channels, up to 32 total
 - Analog Signal Input Option (1, 4, 8, or 16 inputs)
 - Remote Supervisory Control, 4 or 8 outputs
 - Additional speech recording memory

Special order Items:

28. The following optional items shall be available on units from the factory:
- NEMA 4X Fiberglass Enclosure
 - Internal Heater/thermostat (for ambient temperatures below 32 degrees F or for condensation control)
 - Local Alarm Relay output (activates during unacknowledged alarms).

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DATE: March 6, 1992

TO: Emory L. Wilson & Associates

ATTN: Mike Russo

FROM: Inacom Computer Center, Inc.
Database Computer Systems, Inc.
Keith S. Gullitti

RE: Computer equipment
County of Amherst

Item #	Description
CMPQ-151483	COMPAQ DESKPRO 386/25M MODEL 60 *60 MB hard drive *25 MHz 386 processor w/ 4 MB RAM *3.5" 1.44 MB floppy drive *7 slots - 4 - 8/16/32 bit EISA slots, 1 - EISA slot with Quickblank video feature, 1 - 32-bit processor slot, and 1 - 32 bit memory slot *2 serial, 1 parallel, and 1 mouse port *Enhanced keyboard *Advanced VGA board (640x480)
CMPQ-151166	COMPAQ VGA COLOR MONITOR
CMPQ-151465	COMPAQ DOS V 5.0 3.5"
OKI-599039	OKIDATA 321 PARALLEL PRINTER *9-pin wide carriage
MIS-CABLE-PAR	10' PARALLEL CABLE
INTL-390072	INTEL 2400 BAUD INTERNAL MODEM W/MNP-5
INTL-390018	INTEL 387DX MATH CO-PROCESSOR
ICC-INSTALL	CONFIGURE SYSTEM

TOTAL

**Warranty is one year parts and labor on a depot basis. For on-site coverage during the first year (warranty period), a maintenance contract would cost \$ 236.00.

Installation

I. Central Station Hardware

The RACO Data Acquisition System needs the following Central Station Hardware:

- 1) RACO Data Acquisition System Software
- 2) DOS 3.0 or higher
- 3) Surge protector power strip
- 4) Telephone line - Data Grade Recommended
- 5) 120 vac power
- 6) Uninterruptable power supply strongly recommended

For systems with up to 15 RTUs

- 1 - IBM PS/2 Model 55SX
16 MHz 80386SX CPU
31 MB Hard Drive
1.44 MB 3 1/2" Floppy
VGA display port, IBM dual
Async Adapter/A
1 - NEC Multisync 2A VGA Monitor
1 - Hayes 1200 Smartmodem
1 - Panasonic KX-P1180 Printer
1 - Cable for printer
1 - Cable for modem

For systems with 17 or more RTUs

- 1 - IBM PS/2 Model 70-061
20 MHz 80386 CPU
60 MB Hard Drive
1.44 MB 3 1/2" Floppy
VGA display port, IBM dual
Async Adapter/A
1 - NEC Multisync 2A VGA Monitor
2 - Hayes 1200 Smartmodem
1 - Panasonic KX-P1180 Printer
1 - Cable for printer
2 - Cable for modem

II. RTU Hardware

Any model Verbatim may be used as an RTU but it must have the RACO Asynchronous Communications Option installed before it can be accessed by the Central Station.

III. Central Station Hardware Installation

A. Computer startup

Refer to your computer's DOS manual for configuration and startup of your computer.

B. Printer startup

Refer to your printer manual for correct configuration and startup of your printer. Make sure your printer is connected to LPT #1.

C. Modem startup

Refer to your modem manual for the correct connections of the serial cable and power transformer.

If you are using a Hayes 1200 Baud external modem you will need to set the dip switches inside the modem to the following settings:

Switch 1	UP	Switch 6	UP
Switch 2	UP	Switch 7	UP
Switch 3	DOWN	Switch 8	DOWN
Switch 4	UP	Switch 9	UP
Switch 5	DOWN	Switch 10	UP

After setting the dip switches attach the serial cable to the modem. Now attach the modem to the serial port. Make sure your modem is connected to serial port #1.

Insert telephone cord provided with modem into the port on the back of the modem labeled "To Line". Attach telephone line cord from modem to the telco connector.

IV. RTU Installation

Refer to your Verbatim Owners Manual for Installation and Startup of your Verbatim RTU.

V. Central Station Software Installation

The RACO Data Acquisition Software is already installed on the hard disk of your computer if you bought your computer from RACO. In the unlikely event you should need to reinstall it, first go to the root directory of your hard disk. Next change to drive A by typing:

>A:

Now insert the RACO DAS Disk into your floppy drive A and type:

>INSTALL

VI. Central Station Startup

Once you have successfully completed installation your RACO Data Acquisition Software will automatically load whenever you turn on or re-boot your computer. To start the program without re-booting, go to the root directory of your hard disk and type:

```
>CD\RACO
```

To start the program type:

```
>RACO
```

The program should now be started. If it fails to start, first go back and make sure you have correctly completed all previous instructions, and then try again.

VII. Central Station Operation

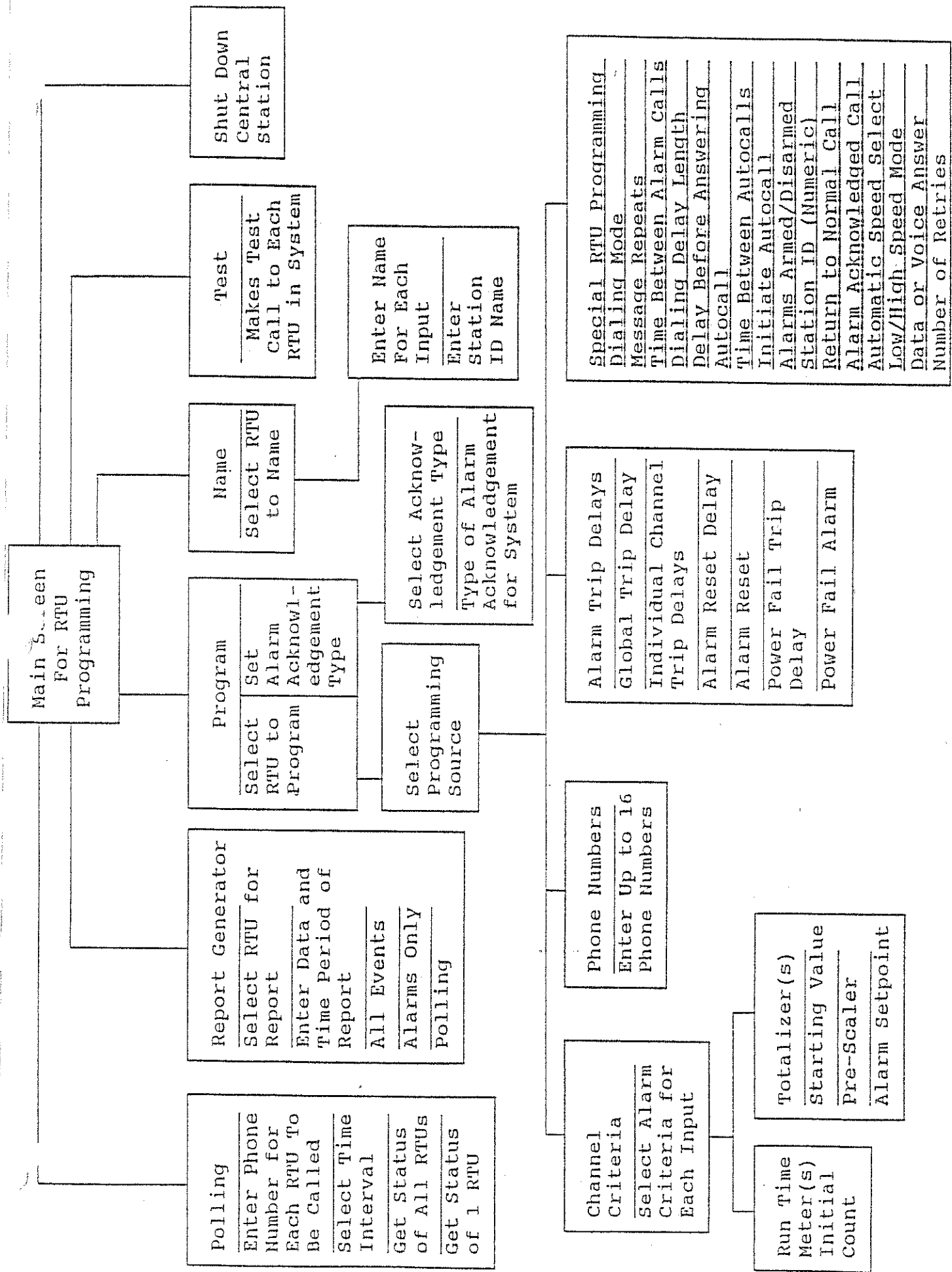
With your RACO Data Acquisition Software running you may access all of its programming menus. A flow chart of the systems programming is illustrated in Figure 1.

To access the desired menu, use the arrow keys to move the cursor, highlight the desired function and press Enter. A menu screen will then appear to allow you further Central Station options or programming of your RTUs.

Once you have selected a menu to work with, you will use your cursor move keys ↑ and ↓ to move a bounce bar to highlight the item you want to select. Once you have highlighted a selection press your Enter key to accept the choice.

You may view menus without making any programming changes. To exit from any menu without making any changes, simply press the ESC key.

Each poll or alarm between the Central Station and an RTU is saved to your hard disk in a file. Using the report generator, you may at a later date generate a report providing you with the details of each communication session with your systems RTUs.



POLLING	REPORTS	PROGRAM	NAME	TEST	QUIT
---------	---------	---------	------	------	------

Current Time: 14:25:02

Next Polling Call (24 hour format): hour: 23 minute: 0

RACO DATA ACQUISITION SYSTEM

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Screen 1

POLLING

In order to call the RTU's in your system, you must first enter the phone numbers for each RTU. During polling operations the RTUs are called in sequence starting with Station 1. The user should determine in advance of polling what sequence to poll each RTU. If you omit a phone number for an RTU it will not be polled.

To call up the Polling Menu from the main menu move the cursor keys to highlight POLLING, then press Enter.

Enter RTU Phone Numbers and Polling Interval
Get Current Status of All RTUs
Get Current Status of One RTU

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Screen 2

To make a choice from this menu use your cursor keys ↑ or ↓ until you have highlighted your selection. To accept your selection press the Enter key.

Press ESC to exit from this menu without doing anything.

List of RTU Telephone Numbers

Remote Terminal Unit 1 6586713
Remote Terminal Unit 2
Remote Terminal Unit 3
Remote Terminal Unit 4
Remote Terminal Unit 5
Remote Terminal Unit 6
Remote Terminal Unit 7
Remote Terminal Unit 8
Remote Terminal Unit 9
Remote Terminal Unit 10
Remote Terminal Unit 11
Remote Terminal Unit 12
Remote Terminal Unit 13
Remote Terminal Unit 14
Remote Terminal Unit 15
Remote Terminal Unit 16
Central Station Phone Number
Current Time: 14:26:21
Time Between Polling Calls: 13 hours 0 minutes
Next Polling Call (24 hour format): hour: 23 minute: 0

Screen 3

Program Phone Numbers For Each RTU

In order to call an RTU you must enter a phone number for the computer to call. During polling operations the RTUs are called in sequence starting with Station 1. The user should determine in advance of programming what sequence to poll each RTU. If you omit a phone number for an RTU it will not be polled.

Next enter the phone number the Central Station computer is connected to. During the test calls placed during the station startup, that number will be entered into the programming of each RTU so that the RTUs will call the Central Station if an alarm condition occurs.

To make a choice from this menu use your cursor keys ↑ or ↓ until you have highlighted your selection. To accept your selection press the Enter key.

Press the ESC key to exit this screen without making any changes. If you exit with the ESC key, any changes you have typed in since you entered this screen will be discarded.

Initially each RTU has a default name, such as "Remote Terminal Unit 1." To replace the default names with your desired station names for each RTU and the Central Station, refer to the section on NAMES.

Select Polling Frequency

For unattended polling of all of your system's RTUs, you may select an automatic polling frequency. A Status Report will be requested from each RTU in the system at the interval you have selected. To make a choice from this portion of the menu use your cursor keys ↑ or ↓ until the cursor is at the desired place on the screen.

Select Time Between Polling Calls to set the polling interval. Enter the time interval in hours and minutes. The Central Station will poll all RTUs in the system at this frequency. The minimum time between Polling Calls is 5 minutes.

Select Next Polling Call (24 hour format) to set the time of the next polling sequence.

As an example, if you wish to poll all RTUs once each day at 11:00 pm, set Time Between Polling Calls to 24 hours 0 minutes, and set Next Polling Call to hour: 23 minute: 0.

If you have connected a printer, it will print the status of each RTU at the time of the polling call. A record will also be saved to your hard drive for later printing using the report function.

Enter RTU Phone Numbers and Polling Interval
Get Current Status of All RTUs
Get Current Status of One RTU

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Screen 4

Get Status of All RTUs

If you selected "Get Current Status of all RTUs" the computer will immediately poll each RTU for which you have entered a phone number. A Status Report from each RTU will be printed on the printer and stored in a file on your hard disk for future use.

Note that for systems with many RTUs the polling sequence will take several minutes, as it takes approximately 30 to 60 seconds to poll each RTU.

Enter RTU Phone Numbers and Polling Interval
Get Current Status of All RTUs
Get Current Status of One RTU

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Screen 5

Get Status of One RTU

If you selected "Get Current Status of One RTU" you will be shown a list of RTUs to choose from.

To make a choice from this menu use your cursor keys ↑ or ↓ until you have highlighted your selection. To accept your selection press the Enter key.

Press ESC to exit from this menu without doing anything.

The RTU you have selected will be polled. A Status Report from this RTU will be printed on the printer and stored in a file on your hard disk for future use.

POLLING	REPORTS	PROGRAM	NAME	TEST	QUIT
Current Time: 14:30:34					
Next Polling Call (24 hour format):					
			hour: 23	minute: 0	

RACO DATA ACQUISITION SYSTEM

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Screen 6

REPORTS

All of the RTU communications are kept in files stored on your hard disk. The RACO Data Acquisition software provides for three types of preformatted reports for which the user can select the time intervals.

To call up the Report Generator menu, from the main menu select REPORTS and press Enter.

Remote Terminal Unit 1
Remote Terminal Unit 2
Remote Terminal Unit 3
Remote Terminal Unit 4
Remote Terminal Unit 5
Remote Terminal Unit 6
Remote Terminal Unit 7
Remote Terminal Unit 8
Remote Terminal Unit 9
Remote Terminal Unit 10
Remote Terminal Unit 11
Remote Terminal Unit 12
Remote Terminal Unit 13
Remote Terminal Unit 14
Remote Terminal Unit 15
Remote Terminal Unit 16

Screen 7

You must first select which RTU you would like to generate a report for.

Use your cursor keys ↑ or ↓ until you have highlighted your selection. To accept your selection press the Enter key.

Press ESC to exit from this menu without doing anything.

Enter times in 24-hour format (hh:mm), dates as mm/dd/yy.

Starting Date:

Ending Date:

Starting Time:

Ending Time:

Operator Name:

Report Type: All Events

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Screen 8

In order to generate a report you must first enter the start date for the report in the format of mm/dd/yy and start time in 24 hour format HH:MM. Next enter an ending date and ending time. A field of entry is provided for the operator to enter their name. Next select the report type by placing the cursor on Report type and pressing the Space Bar until the desired Report type is displayed. The available Report types are:

Alarm Reports - All alarms recorded by the computer.

Polling Reports - All data collected by polling the RTUs in the system.

All Events - All events recorded by the computer; includes all polling calls to the RTU and all alarm and self-poll calls from the RTU.

Before you accept your entry make sure your printer is on and loaded with paper. To accept your selection press the Enter key.

Press ESC to exit from this menu without doing anything.

The printed reports consist of a header block featuring the report mode, start date/time, end date, time, date/time at which report was prepared, name of the person requesting the report, and the name of the RTU. Each call report lists the date/time of call, type of call, general RTU status, and a listing of the status of all channels in the RTU.

The general RTU status may consist of messages such as "RTU has no phone numbers," "Alarms are disarmed," and power failure status.

Channel status for each channel may be any of the following:

- ON
- OFF
- NORMAL
- ALERT
- ALARM
- ALARM, Acknowledged
- ALARM, Now Normal
- ALARM, Now Normal, Acknowledged

Furthermore, any channel set for run-time accumulation or for totalizer will display the current total after that channel's status.

POLLING

REPORTS

PROGRAM

NAME

TEST

QUIT

Current Time: 14:30:34

Next Polling Call (24 hour format): hour: 23 minute: 0

RACO DATA ACQUISITION SYSTEM

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Screen 9

RTU PROGRAMMING OPTIONS

All aspects of RTU programming are covered under PROGRAM. Programming options include the following:

RTU ALARM CRITERIA

Used by the RTU to determine how to respond to changes on channel inputs.

RTU TELEPHONE NUMBER LIST

Numbers which the RTU calls for self-polls (autocalls) and alarms.

RTU ALARM DELAYS

Used by the RTU to determine how long an input must persist in violation state to become an alarm.

SPECIAL RTU PROGRAMMING

Includes dialing mode, number of message repeats, time between alarm calls, dialing delay length, and the number of rings before answering. Also included are, Autocall ON/OFF, time between alarm calls, alarm armed/disarmed status, and Station ID.

Also included under the PROGRAM menu is the selection of the type of acknowledgement desired for incoming alarm calls.

To call up the RTU Programming Options menu select PROGRAM and press Enter.

Set Alarm Acknowledgement Type

Remote Terminal Unit 1
Remote Terminal Unit 2
Remote Terminal Unit 3
Remote Terminal Unit 4
Remote Terminal Unit 5
Remote Terminal Unit 6
Remote Terminal Unit 7
Remote Terminal Unit 8
Remote Terminal Unit 9
Remote Terminal Unit 10
Remote Terminal Unit 11
Remote Terminal Unit 12
Remote Terminal Unit 13
Remote Terminal Unit 14
Remote Terminal Unit 15
Remote Terminal Unit 16

Screen 10

To choose the RTU to program from this menu use your cursor keys ↑ or ↓ until you have highlighted your selection. To accept your selection press the Enter key.

To set the type of Central Station acknowledgement desired, select Set Alarm Acknowledgement Type and press Enter.

Operator Acknowledgement

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You are presented with a single line menu for selection of incoming alarm acknowledgement type. Use the space bar to change to a new acknowledgement type.

If you select Operator Acknowledgement, when an alarm call is received from an RTU, an audible alarm will sound and the operator will be prompted to choose whether to acknowledge the alarm. If the operator chooses to acknowledge the alarm, an acknowledgement call will be placed to the RTU causing the alarm.

If you select Automatic Acknowledgement, all alarm calls will be logged and acknowledged at the time of their receipt.

Selection of No Acknowledgement will cause incoming alarm calls to only be logged to the log files. Acknowledgement must be done when the RTU calls personnel with a voice message or by personnel calling the alarming RTU to receive a voice report.

If you select one of the RTUs to program, you will be presented a menu giving you three possible sources of programming information:

Call for current programming
Use programming from last session
Use default programming

Screen 11

The safest option in a system that is up and running is to Call for current programming. Selecting this option will cause the Central Station to call the RTU and get its current programming. In this way you can ensure that any changes made at the RTU or over voice telephone lines will not be lost.

If you are certain that no changes have been made since the last time you programmed the RTU from the Central Station, you can select the second option, to Use programming from your last session. This option is slightly faster, since you do not have to wait for the Central Station to call the RTU and transfer data.

If you are setting up a new installation, the third option will provide you with the same Use default programming that the RTU is shipped with.

If you select one of the RTUs to program, you will be presented a menu giving you three possible sources of programming information:

Call for current programming
Use programming from last session
Use default programming

Screen 11

The safest option in a system that is up and running is to Call for current programming. Selecting this option will cause the Central Station to call the RTU and get its current programming. In this way you can ensure that any changes made at the RTU or over voice telephone lines will not be lost.

If you are certain that no changes have been made since the last time you programmed the RTU from the Central Station, you can select the second option, to Use programming from your last session. This option is slightly faster, since you do not have to wait for the Central Station to call the RTU and transfer data.

If you are setting up a new installation, the third option will provide you with the same Use default programming that the RTU is shipped with.

RTU Alarm Criteria
RTU Telephone List
RTU Alarm Delays
Special RTU Programming
Send Completed Programming to RTU
Exit, discarding programming

Screen 12

After the call to the RTU has been completed, you will be presented with the RTU Programming Options Menu. You may now select from one of the available options presented.

After you review or change any programming, you may choose to either Send Completed Programming to RTU or Exit, discarding programming. If you choose to send the programming to the RTU, a call will immediately be made to change the programming in the selected RTU.

Press ESC to exit from this menu without doing anything.

In this first example we will select RTU Alarm Criteria programming first and RTU Telephone List second.

To select RTU Alarm Criteria use your cursor keys ↑ or ↓ until you have highlighted RTU Alarm Criteria. To accept your selection press the Enter key.

Set Alarm Criteria for Remote Terminal Unit 1

Channel 1	Pulse Totalizer	Channel 17	Normally Open
Channel 2	Normally Open	Channel 18	Normally Open
Channel 3	Pulse Totalizer	Channel 19	Normally Open
Channel 4	Normally Open	Channel 20	Normally Open
Channel 5	Runtime Mode 1	Channel 21	Normally Open
Channel 6	Normally Open	Channel 22	Normally Open
Channel 7	Runtime Mode 1	Channel 23	Normally Open
Channel 8	Normally Open	Channel 24	Normally Open
Channel 9	Normally Open	Channel 25	Normally Open
Channel 10	Normally Open	Channel 26	Normally Open
Channel 11	Normally Open	Channel 27	Normally Open
Channel 12	Normally Open	Channel 28	Normally Open
Channel 13	Normally Open	Channel 29	Normally Open
Channel 14	Normally Open	Channel 30	Normally Open
Channel 15	Normally Open	Channel 31	Normally Open
Channel 16	Normally Open	Channel 32	Normally Open

Screen 13

The RTU Alarm Criteria screen will appear on your monitor. The Station ID, and all channel alarm criteria will be displayed. Use your cursor keys ↑ or ↓ until you have highlighted the Channel Number you want to program. To change the channel alarm criteria press the Space Bar. Each press of the Space Bar will change the alarm criteria. The available channel alarm criteria settings are:

- Normally Open
- Normally Closed
- Status Report Only
- Runtime Mode 1
- Runtime Mode 2
- Pulse Totalizer 1
- Pulse Totalizer 2

If you select Runtime Mode 1 or Runtime Mode 2, you will be asked if you want to set an initial value for the runtime meter. Press "y" if you want to set a new value, any other key if you do not want to set a new value.

If you have called the RTU for the latest programming information and wish to see, but not alter, the current value, press "y" and the value will be displayed. When you are finished, press ESC to exit leaving the value unchanged. If you press ENTER, the displayed value will be sent back to the RTU when you are finished, setting the programming at the Central Station. If the runtime value has changed between the time you got the programming from the RTU and the time you send it back, the change will be lost.

If you wish to set an initial runtime value, press "Y" and enter the desired value. Press ENTER when you are finished or ESC if you wish to exit the operation without changing the value.

If you select Pulse Totalizer 1 or Pulse Totalizer 2, you will be asked to enter the totalizer starting value, the pre-scaling factor to be applied to pulses, and the alarm setpoint. Please check your Verbatim manual if you have questions about the values to be entered.

As with runtime meters, if you have called the RTU for current programming information and wish to see, but not change the current pulse count, you must press ESC to exit the display of current values. If you press ENTER and pulses have occurred at the RTU, they will be lost when you send the programming back to the RTU.

When you have completed your programming of RTU Alarm Criteria, simultaneously press your Control and Enter keys.

After you have set your alarm criteria, the next step is to set the phone numbers your RTU will call during an alarm. Once again, you are presented with the RTU Programming Options Menu (see Screen 11). This time use your cursor keys to select RTU Telephone List.

RTU Telephone List

Central Station Number: 6586713

Phone Number 2.
Phone Number 3.
Phone Number 4.
Phone Number 5.
Phone Number 6.
Phone Number 7.
Phone Number 8.
Phone Number 9.
Phone Number 10.
Phone Number 11.
Phone Number 12.
Phone Number 13.
Phone Number 14.
Phone Number 15.
Phone Number 16.

Screen 14

After you have selected Telephone List from the menu you will see Screen 13. You may enter up to 16 phone numbers in this screen.

When you have completed your entries in the Telephone List screen, simultaneously press your Control and Enter keys to accept your changes. When you have completed the programming of your RTUs return to the Programming Options screen.

Press the ESC key to exit this screen without making any changes. If you exit with the ESC key, any changes you have typed in since you entered this screen will be discarded.

GLOBAL TRIP DELAY 15.0 seconds

INDIVIDUAL CHANNEL ALARM TRIP DELAYS

Channel 1	10.0 seconds	Channel 17	15.0 seconds
Channel 2	10.0 seconds	Channel 18	15.0 seconds
Channel 3	10.0 seconds	Channel 19	15.0 seconds
Channel 4	10.0 seconds	Channel 20	15.0 seconds
Channel 5	10.0 seconds	Channel 21	15.0 seconds
Channel 6	10.0 seconds	Channel 22	15.0 seconds
Channel 7	10.0 seconds	Channel 23	15.0 seconds
Channel 8	10.0 seconds	Channel 24	15.0 seconds
Channel 8	10.0 seconds	Channel 25	15.0 seconds
Channel 10	10.0 seconds	Channel 26	15.0 seconds
Channel 11	10.0 seconds	Channel 27	15.0 seconds
Channel 12	10.0 seconds	Channel 28	15.0 seconds
Channel 13	10.0 seconds	Channel 29	15.0 seconds
Channel 14	10.0 seconds	Channel 30	15.0 seconds
Channel 15	10.0 seconds	Channel 31	15.0 seconds
Channel 16	10.0 seconds	Channel 32	15.0 seconds

ALARM RESET DELAY	.1	hours	ALARM RESET	ON
POWER FAIL TRIP DELAY	23	minutes	POWER FAIL ALARM	ON

Screen 15

From this menu you may make changes to Individual Channel Alarm Trip Delays, Global Trip Delay, Alarm Reset Delay, Power Fail Trip Delay, Alarm Reset ON/OFF, and Power Fail Alarm ON/OFF.

ALARM TRIP DELAY - The Alarm Trip Delay is the length of time after a violation occurs before the unit goes into Unacknowledged Alarm and begins dialing. The default value is 2 seconds for all inputs and 0.1 minute for power failure.

There are two ways to change this Alarm Trip Delay: global (common for all channels except power failure) programming, and individual programming for each channel and power failure.

To program a new global Alarm Trip Delay, enter a value consisting of 1 to 4 digits, between .1 and 999.9 seconds. For example, possible entries include .1, 5, 5.1, and 600.1 (seconds).

If you wish to program a new individual Alarm Trip Delay for an individual channel, or set a different Power Failure Trip Delay, follow the same procedures described above.

Note that setting trip delay the global overrides any previously set individual channel Alarm Trip Delays. Therefore, if you wish to establish a different Global Alarm Delay and also program selected inputs for still different individual trip delays, perform the global programming first, and then any individual trip delay programming.

To turn the power failure alarm on or off press the space bar until the correct setting is indicated.

ALARM RESET TIME - This is the length of time after acknowledgement before a given channel (or Power Failure) is automatically reset to a clear condition, ready to act on a new alarm condition. Default value is 1 hour; range is 0.1 to 99.9 hours.

CAUTION: YOU SHOULD NOT TURN THE ALARM RESET TIMER FUNCTION OFF under normal circumstances, because once a given channel's alarm has been acknowledged, it would never again cause an alarm callout.

Press the ESC key to exit this screen without making any changes.

SPECIAL PROGRAMMING OPTIONS FOR REMOTE TERMINAL UNIT 1

Dialing Mode	High Speed Dialing
Message Repeats	0 repeats
Time Between Alarm Calls	0.0 minutes
Dialing Delay Length	0 seconds
#Rings Before RTU Answers	0 rings

Autocall	OFF
Time Between Auto Calls	24.0 hours
Initiate Autocall Now?	No

Alarms armed/disarmed	Armed
Station ID:	1

Automatic Speed Select	ON	Low/High Speed Mode	1200
Data or Voice Answer	Data/Voice	Number of Retries	3

Screen 16

Once you have completed the telephone number list you may optionally need to set the Dialing Mode the RTU will use. The Dialing Mode choices are:

- Rotary Pulse
- Touch Tone
- Hi-Speed Tone

MESSAGE REPEATS - This is the total number of times each message or set of messages is spoken during each alarm callout. Normally a value of 3 repeats (strictly speaking, the alarm message plus 2 additional repeats) should be programmed, because some messages would not take long to speak and you need to allow adequate message recital time so that the person called will have adequate time to answer the phone call and hear at least one complete set of messages. Default value is 3 repeats; range is 1 to 20 repeats.

TIME BETWEEN ALARM CALLS - This is the length of time after ending one alarm callout and before beginning the next callout. Default value is 2 minutes; range is 0.1 to 99.9 minutes.

DIALING DELAY LENGTH - In some applications, an extra waiting time is needed between dialed digits. For example, in some PBX systems, a 9 must be dialed, followed by a waiting time of several seconds before the main number may be dialed. The default delay is 1 second; range 1 - 10 seconds.

OF RINGS BEFORE RTU ANSWERS - This is the number of rings required when calling the unit, before the unit will answer. Default value is 1 ring; range is 1 to 20 rings. For use in the Data Acquisition System this must be set to 1 ring.

AUTOCALL - The Autocall function causes the unit to place test calls at regular intervals for the purpose of ongoing verification of dialer and phone line functioning as well as sending routine status reports to the computer. Calls are placed only once for each interval to the Central Station. However, after 5 consecutive failed attempts to successfully communicate with the Central Station, the dialer will go on to the other phone numbers on it's list and report a communications failure alarm.

TIME BETWEEN AUTOCALLS - The first call is made when the Autocall function is turned on. Therefore, if you want the unit to call at 5 PM each day, you will need to turn this function on at that time. The default interval is 24 hours; range is 0.1 to 99.9 hours.

INITIATE AUTOCALL NOW - Allows the user to initiate an immediate autocall from the RTU by selecting Yes and turning Autocall ON. Succeeding calls from the RTU will occur at the interval you have selected.

ALARMS ARMED/DISARMED - If the Alarms armed/disarmed is set for armed the unit will place autocalls and alarm calls. If it is set to disarmed the dialer will not call regardless of the status of the inputs or the autocall function.

STATION ID - This Station ID is numeric only, up to 16 digits can be entered for the ID. The numbers are spoken by the dialer in voice mode operation if there are no voice messages recorded for Station ID.

When the Automatic Speed Select option is turned on the RTU will always try to connect at high speed (1200 baud). If high speed does not work reliably, then the RTU will call at low speed (300 baud). If this option is turned off, the RTU will always call at the speed indicated by Low/High Speed Mode.

If Automatic Speed Select is turned off, the Low/High Speed Mode will determine the data communications speed between the RTU and the Central Station. Note that if Automatic Speed Select is turned on, this setting has no effect.

If the Data or Voice/Answer is set to Data/Voice, the RTU can be called either by the Central Station (DATA calls) or by personnel (VOICE calls). If it is set to Voice Only, only personnel can call the RTU.

NOTE: IF THIS OPTION IS SET TO VOICE ONLY THE CENTRAL STATION WILL NOT BE ABLE TO CONTACT THE RTU.

The Number of Retries option sets the number of times the RTU will call the Central Station before tripping a communications alarm. If Automatic Speed Select is on the RTU may attempt the programmed number of tries at high speed and then make the same number of retries at low speed before tripping an alarm. The default number of retries is 2; range is 1-10.

POLLING

REPORTS

PROGRAM

NAME

TEST

QUIT

Current Time: 14:40:34

Next Polling Call (24 hour format): hour: 23 minute: 0

RACO DATA ACQUISITION SYSTEM

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Screen 17

NAME

To replace the default names of the RTUs, channel inputs within the RTUs, and the Central Station, move the cursor to NAME and press Enter.

Name Central Station
Remote Terminal Unit 1
Remote Terminal Unit 2
Remote Terminal Unit 3
Remote Terminal Unit 4
Remote Terminal Unit 5
Remote Terminal Unit 6
Remote Terminal Unit 7
Remote Terminal Unit 8
Remote Terminal Unit 9
Remote Terminal Unit 10
Remote Terminal Unit 11
Remote Terminal Unit 12
Remote Terminal Unit 13
Remote Terminal Unit 14
Remote Terminal Unit 15
Remote Terminal Unit 16

Screen 18

You will be presented with a menu of RTUs and the Central Station. Select the desired RTU or Central Station. If you select Name Central Station you will be presented with Screen 18.

Press ESC to exit from this menu without doing anything.

RACO DATA ACQUISTION SYSTEM

Screen 19

Enter the name of your Central Station, such as "City Sanitation District." You may enter up to 37 characters for the Station ID name.

Press the ESC key to escape this screen without making any changes. If you exit with the ESC key, any changes you have typed in since you entered this screen will be discarded.

Station ID Name: Remote Terminal Unit 1

1: Channel 1	17: Channel 17
2: Channel 2	18: Channel 18
3: Channel 3	19: Channel 19
4: Channel 4	20: Channel 20
5: Channel 5	21: Channel 21
6: Channel 6	22: Channel 22
7: Channel 7	23: Channel 23
8: Channel 8	24: Channel 24
9: Channel 9	25: Channel 25
10: Channel 10	26: Channel 26
11: Channel 11	27: Channel 27
12: Channel 12	28: Channel 28
13: Channel 13	29: Channel 29
14: Channel 14	30: Channel 30
15: Channel 15	31: Channel 31
16: Channel 16	32: Channel 32

Screen 20

If you select one of the RTUs to name, you will be presented with a screen similar to Screen 19.

You may enter up to 15 characters per name for each channel in the RTU. Thereafter, these names will be shown on all poll and alarm messages on the screen as well as all printed reports, etc.

Press the ESC key to escape this screen without making any changes. If you exit with the ESC key, any changes you have typed in since you entered this screen will be discarded.

POLLING

REPORTS

PROGRAM

NAME

TEST

QUIT

Current Time: 14:50:34

Next Polling Call (24 hour format): hour: 23 minute: 0

RACO DATA ACQUISITION SYSTEM

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Screen 21

TEST

The TEST function is normally only used at the first Central Station start-up. Selecting TEST will cause a test call and callback sequence to be done for each RTU in the system.

Make sure that you have entered a phone number for each RTU, and for the Central Station before you begin the TEST operation.

You may select TEST by moving the cursor to TEST and pressing Enter.

At the next screen you may select either Test All RTUs, or you may select RTUs to test individually.

Setting up modem to call Remote Terminal Unit 1 at 6586713
Calling 6586713
Contact established with Remote Terminal Unit 1
Waiting for test call-back from Remote Terminal Unit 1
Waiting for status information on incoming call
Incoming call type 26 from station 1

Initial communications test call from Remote Terminal Unit 1

Report Received At Fri Jul 21 11:56:47 1989

Channel 1	ALARM, Acknowledged
Channel 2	ALARM, Acknowledged
Channel 3	is OFF Pulse count is 0
Channel 4	is ON Runtime is 100006.1

Test call-back received from Remote Terminal Unit 1

Screen 22

If you selected Test All RTUs, each RTU in the system will be called once. When the call is made the RTU will be commanded to immediately call back the Central Station. This sequence tests the ability of the Central Station to reach all active RTUs and the ability of each RTU to call the Central Station on an alarm or for a self-poll.

The program will return to the main menu when the TEST sequence is finished.

QUIT

If you need to exit the RACO Data Acquisition system you can do so by highlighting QUIT and pressing Enter. Once you have done this the system will proceed to shut itself off in an orderly manner. CAUTION - ANY ALARMS, AUTOCALLS, OR PROGRAM CHANGES WILL NOT BE RECORDED AGAIN UNTIL YOU RESTART THE SYSTEM.

APPENDIX F



MISCELLANEOUS INFORMATION AND CORRESPONDENCE

Sample:
11/10/75

Amherst County Service Authority Water Line Easement Agreement
Virginia Dept. of Health Approval Letter for ACSA Master Specifications

12/12/03

10:21

AMHERST CO SERVICE AUTH -> 434 8470047

NO. 995

002

COMMONWEALTH OF VIRGINIA



MACX I. SHANNHOLTZ, M. D.
COMMISSIONER

DEPARTMENT OF HEALTH
RICHMOND, VA. 23210

SUBJECT: AMHERST COUNTY
Water - Madison Heights Sanitary District

10 November 1975

Mr. Henry L. Lanum, Jr., Superintendent
Madison Heights Sanitary District
P. O. Box 100
Madison Heights, Virginia 24572

Dear Mr. Lanum:

The general specifications for the Sanitary District's water lines, as designed by Hurt and Proffitt, have been reviewed by this office.

Enclosed is one set of stamped approved specifications. Please note the exception of the Virginia Waterworks Regulations as found in Section 3.13.01, page 17. Items pertaining to the BOCA Code are a matter for the local building inspector.

If we may be of additional assistance, please do not hesitate to contact this office at 804-786-6277.

Sincerely,

M. J. Haley, P.E., Regional Director
Bureau of Sanitary Engineering

Enclosure - 1 Set of Stamped Plans

cc: Mr. G. W. Peaks, Hurt & Proffitt

AMHERST COUNTY SERVICE AUTHORITY

WATER LINE EASEMENT AGREEMENT

This DEED OF EASEMENT made and entered into this _____ day of _____ 20____, by and between _____,

parties of the first part, and AMHERST COUNTY SERVICE AUTHORITY, party of the

second part:

W I T N E S S E T H

That for/in consideration of the benefits to accrue unto the parties of the first part by reason of the hereinafter mentioned pipe line, the parties of the first part hereby GRANT AND CONVEY unto the party of the second part a perpetual easement, of variable width, with rights of ingress and egress to and from said property for the purpose of construction, laying, establishing, operating, inspecting, repairing, replacing and perpetually maintaining a trunk water main, and fire hydrants and appurtenances through and under the property of parties of the first part situated in, the _____ Magisterial District, and located _____

The party of the second part, its servants and agents shall have the further rights of ingress and egress to and from said property with the right to inspect or renew said water mains or parts thereof, to tap said water main to provide services for others, and to do all the other acts and things necessary for the purposes of conducting a public water supply system.

The parties of the second part shall leave the property of the parties of the first part in as good condition as reasonably possible after such installations, repairs, replacements, inspection, or tapping on. The parties of the second part shall have the right to use machinery or other power tools to carry out the purposes of this project and operate the same over the lands of the parties of the first part.

The parties of the first part covenant that they have the right to convey this easement; that the party of the second part shall have acquired a peaceably enjoyment and they will execute such other and further assurance of the same as may be requisite.

Witness the following signatures:

STATE OF VIRGINIA

COUNTY OF _____ TO WIT:

I, _____, a NOTARY PUBLIC in and for the

County and State aforesaid, do hereby certify that _____

whose names are signed to the foregoing DEED OF EASEMENT, bearing date of

_____ day of _____ 20____, have each personally appeared

before me and acknowledged the same in my county and state aforesaid.

Given under my hand this _____ day of _____ 20____.

My commission expires the _____ day of _____ 20____.

Notary Public

APPENDIX G



CONTRACTOR'S APPLICATION FOR APPROVAL

CONTRACTOR'S APPLICATION FOR APPROVAL

All questions must be answered in full. Failure to answer in full, or falsification of any statement, may result in immediate denial or revocation of approval. Additional sheet(s) for clarification of answers or additional information may be attached. This Application must be notarized (see Page ??).

If the firm already has a Contractor's Application for Approval on file with the Service Authority, a second Application does not need to be filed. The Contractor must check with the Service Authority to see if there is an Application on file; if so, completion of Item #18 and completion of the authorization and notarization on Page ?? are all that are required.

To be approved as an acceptable Contractor for any specific project, the Contractor must provide a list of at least five (5) significant publicly-owned potable water and / or sewer projects (\$300,000 or more project cost) completed during the last three (3) years, where the firm was working as the bonded contractor (preferably working directly for the utility), and provide satisfactory answers to the questions in this application. Details of the projects must be provided, including the name of the utility, contact name and phone number, detailed description of the scope of work, contract cost, and project year and duration. A list of bonding references, their phone numbers, and the highest bond coverage they provide must be cited. The percentages of any and all work subcontracted to other firms on projects on the list must be stipulated (subcontractors may not have been used for more than twenty percent [20%] of any individual project). No debarments, defaults, or serious litigations may have occurred within the last ten (10) years. Approval to construct specific potable water and / or sewer projects for acceptance into public ownership by Amherst County Service Authority shall be based on this and other information provided in this application and the resulting reference investigation.

1. Name, address, and phone and fax numbers of company.
2. Owner, principal officer, and date and place of organization.
3. General character of work performed by the company in the last ten (10) years.
4. Is the company involved in current litigation for non-completion or contracts that were defaulted on? If so, where and why?

5. List the five most important, publicly-owned, **[TYPE OF PROJECT]** projects of similar character, and with contract prices exceeding \$300,000, within the last three years, where the firm was the bonded contractor. If more than five have been performed within that period, additional pages may be submitted. Include the information requested below:

A. Project: _____

Owner: _____

Contact name and phone no.: _____

Size(s) and type(s) of tank(s): _____

Percentage of work subcontracted to other firms: _____

\$ _____ From _____ To _____

B. Project: _____

Owner: _____

Contact name and phone no.: _____

Size(s) and type(s) of tank(s): _____

Percentage of work subcontracted to other firms: _____

\$ _____ From _____ To _____

C. Project: _____

Owner: _____

Contact name and phone no.: _____

Size(s) and type(s) of tank(s): _____

Percentage of work subcontracted to other firms: _____

\$ _____ From _____ To _____

D. Project: _____

Owner: _____

Contact name and phone no.: _____

Size(s) and type(s) of tank(s): _____

Percentage of work subcontracted to other firms: _____

\$ _____ From _____ To _____

E. Project: _____

Owner: _____

Contact name and phone no.: _____

Size(s) and type(s) of tank(s): _____

Percentage of work subcontracted to other firms: _____

\$ _____ From _____ To _____

6. Has the company or any of its officers taken bankruptcy in the United States Bankruptcy Court within the prior ten (10) years?

7. List the public utility contracts upon which you are currently working. Include the owner, location, approximate cost, and estimated date of completion. (No more than five required).

8. List the major equipment available to the firm for use on this project.

9. List three material suppliers with whom you have an ongoing business relationship.

(1) _____

(2) _____

(3) _____

10. Bank references.

(1) _____

(2) _____

(3) _____

11. Insurance coverage and amount.

Liability - Property _____

Liability - Personal Injury _____

Vehicle and Equipment _____

Other - Identify _____

12. Bonding references - List the surety and highest coverage.

13. Subcontractors you plan to utilize on this project. List the name(s), address(s), specialty(s), and years of experience.

(1) _____

(2) _____

(3) _____

14. Provide a general description of the experience of the company and its key personnel.

15. Number of full time employees: _____

Number of employees at highest level in past twelve months _____

16. Are you on any list of debarred contractors maintained by the U.S. Department of Labor, the U.S. Department of Housing and Urban Development, or the Virginia Department of Highways?

Yes

No

17. List all contracts which have resulted in arbitration, litigation, or legal settlement of claims within the past ten years.

18. I have contacted Amherst County Service Authority and there is a Contractor's Application for Approval on file for this company.

Yes

No

The undersigned hereby authorizes and requests any person, firm or corporation to furnish any information requested by Amherst County Service Authority or its representative(s).

Contractor: _____

By: _____

Title: _____

Date: _____

State of: _____

County of: _____

Statement must be notarized.

_____,

being duly sworn, deposes that he/she is of _____

and that the answers to the foregoing questions and all statements therein contained are true and correct.

Subscribed and sworn before me this _____ day of _____, 20____.

Notary Public: _____

My Commission Expires: _____

APPENDIX H



SEWAGE PUMP STATION INFORMATION