# PROJECT MANUAL

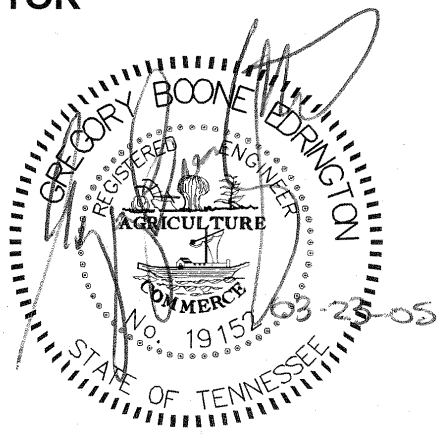
## Technical Specifications

## TOWN OF ASHLAND CITY
## CHEATHAM COUNTY, TENNESSEE

## DEPARTMENT OF PUBLIC WORKS

## STANDARD SPECIFICATIONS AND INSTALLATION GUIDELINES FOR CONSTRUCTION OF INFRASTRUCTURE

**HONORABLE GARY NORWOOD, MAYOR**
**CHRIS CHERRY, PUBLIC WORKS DIRECTOR**




03-23-05

TOWN OF ASHLAND CITY

APPROVED BY:_____

TITLE:_____ DATE:_____

File No.: 0417-12
Dated: January, 2005

## INDEX TO PROJECT MANUAL



These specifications give the minimum requirements for installation of water and sewer additions, paving, storm sewer, and curb and gutter in the Town of Ashland City, Tennessee. Any special construction problems or conditions not covered under these specifications shall be submitted in writing to the Town of Ashland City for approval.

The Standard Drawings are part of these specifications and all construction shall conform to the details shown on these drawings.

## DIVISION: SEWER



## DIVISION : ROADWAYS

## STANDARD DRAWINGS

## I. GENERAL GUIDELINES FOR WATER LINES

a. The purpose of these specifications is to provide a guide to the Developers and their Contractors in order to achieve an acceptable installation for furnishing of water to subdivisions or other areas in the Town. Summarized below are the requirements and conditions that apply to the granting of water service by the Town.

b. No valve or cutoff shall be operated except by a Town Representative.

c. No utility plans will be reviewed until the development plans have received preliminary approval by the planning commission having jurisdiction.

d. Sizes and locations of mains, valves, fittings, plugs, hydrants, and blow-offs shall be in accordance with the plans approved by the Town.

e. Detailed plans and specifications shall be submitted by the Engineer employed by the Developer for any special condition or structures such as pump stations, creek crossings, etc., and shall be approved by the Town before beginning any construction.

f. "Cut-ins" or taps to live mains shall be made only in the presence of a Town Representative, Taps 2" and above shall be made by developer, under 2" shall be made by The Town of Ashland City.

g. Meters (5/8" x 3/4") shall be provided by the Town to the Developers for each lot after builder pays connection fee. The meter box will be installed by the Contractor. After installation, the water meter assembly shall be identified by four (4) foot long wooden stakes a minimum of two (2) feet around the meter box with orange ribbon wrapped around the stakes.

h. Permits for pavement cuts or crossing of public roads, including any special backfill and pavement repair as required by the agency having jurisdiction, are the responsibility of the Developer. A bond shall be provided to the Town by the Developer to cover all costs of repair and maintenance for a period of one (1) year from the date of acceptance of the project for all work performed in existing rights-of-way of all roads in CHEATHAM County and all State highways. The amount of this bond shall be determined by the Town after it receives all requirements for repairs from the appropriate County Highway Department or the Tennessee Department of Transportation.

i. Water mains are not generally permitted in easements, however, when special conditions require them, easements; must be provided with a minimum width of twenty (20) feet.

j. Centerlines of roads shall be staked before beginning construction. The road section and water line relation to the centerline of the road shall be shown on the plans. Front-lot corners shall be marked before services are installed in order for services to be properly located.

k. Hydraulic calculations and data should be submitted for the proposed system.

l. Where the static water pressure exceeds 80 psi, the developer shall provide a water reducing valve on the service line. This pressure reducing valve shall be installed in accordance with the detail in the Standard Drawings section of this document.

## II. Minimum Distribution Pipe Size

(a) The minimum size pipe shall be eight (8) inch diameter except six (6) inch pipe will be permitted when looped in a grid and no leg of such grid exceeds 800 feet in length or as directed by the Town or the Town's Engineer.

(b) The size of pipe shall be justified by hydraulic analysis performed

by an engineer who holds a valid license to practice in the State of Tennessee. Distribution pipes should be capable of providing a minimum flow of 750 gallons per minute.

(c) All assumptions and any flow data used by the design engineer must be clearly documented and submitted with the hydraulic calculations. If actual flow data are not available, theoretical calculations shall be based on all storage facilities being half-full and the appropriate Hazen and Williams friction factor shall be applied for the type pipe being used, but in no case shall such friction factor be greater than 130.

(d) Distribution pipes should be sized for an instantaneous peak demand of 750 gallons per minute.

## III. Fire Protection

(a) Fire hydrants should not be connected to distribution pipes which are not capable of providing a flow of 750 gallons per minute at a residual pressure of 30 psi.

(b) When fire protection is being provided, fire hydrants shall be located at points as required by subregs.

(c) The minimum pipe size to which a fire hydrant may be connected is six (6) inches.

(d) The minimum standards for privately-owned sprinkler service lines shall be the following:

i. Constructed of Class 50 ductile iron pipe.

ii. Backflow prevention device shall be installed.

## IV. Dead Ends

(a) Dead ends shall be minimized in water line extensions.

(b) Where dead end distribution pipes occur, they should be provided with a fire hydrant when fire protection is being provided, or an approved blow-off assembly for flushing purposes.

(c) Dead end water lines shall extend to the property line.

## V. Gate Valves

(a) Unless otherwise specified by the Superintendent of Water and Sewer Systems, gate valves shall be placed at all intersections of distribution pipes. Three (3) valves shall be placed at each tee; one (1) installed in the run and the other two (2) installed in the branch. Four (4) valves shall be placed at each cross. Valves should be positioned in the pipe line approximately three (3) feet distance from the tee or cross.

(b) Valves shall be placed on lead-outs approximately three (3) feet from fire hydrants except those having lead-outs to be connected to fire hydrant type tees, in which case, the valves may be connected to such fire hydrant tee.

## VI. Means of Detecting PVC pipe

When PVC pipe is installed a minimum size 14 gauge copper wire shall be installed along the pipe. The ends of the wire shall terminate in a valve box or other acceptable location whereby detection equipment may be attached. Also, metallic tape marked "water" shall be provided 12" above the water line.

## VII. Separation of Water Mains and Sewers

(a) General:

The following factors should be considered in providing adequate separation:

1. Materials and type of joints for water and sewer pipes.
2. Soil conditions.
3. Service and branch connections into the water main and sewer line.
4. Compensating variations in the horizontal and vertical separations.
5. Space for repair and alterations of water and sewer pipes.
6. Off-setting of pipes around manholes.
7. Water mains and sanitary or storm sewers shall not be laid in the same trench.

(b) Parallel Installation:

1. Normal conditions-Water mains shall be laid at least ten (10) feet horizontally from any sanitary sewer, storm sewer or sewer manhole. Whenever possible; the distance shall be measured edge-to-edge.
2. Unusual conditions-When local conditions prevent a horizontal separation of ten (10) feet, a water main may be laid closer to a storm or sanitary sewer provided that:

   i. The bottom of the water main is at least 18 inches above the top of the sewer.

   ii. Where this vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction and shall be pressure tested to assure watertightness prior to backfilling.

(c) Crossing:

1. Normal conditions-Water mains crossing house sewers, storm sewers, or sanitary sewers will be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer, whenever possible.

2. Unusual conditions-When local conditions prevent a vertical separation as described hereinbefore, the following shall be used:

i. Sewers passing over or under water mains should be constructed of ductile iron.

ii. Water mains passing under sewers shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main; adequate structural support for the sewers to prevent excessive deflection of joints and settling on the breaking the water mains; that the length of water pipe be centered at the point of crossing so that the joints will be equidistant as far as possible from the sewer. Both the sewer and the water main shall be constructed of water pipe and tested in accordance with these Standards.

## VIII. Water Services and Plumbing

(a) Water services and plumbing shall conform to the Standard Plumbing Code as may be revised and adopted from time to time by the Town of Ashland City.

(b) All water services under roadways shall be encased in a two (2) inch schedule 40 casing pipe.

END OF SECTION

## A. GENERAL GUIDELINES

The purpose of these guidelines is to provide a guide to the Developers and their engineers and contractors in order to achieve an acceptable installation for furnishing of utility service to subdivisions and other developments. The words "A/E," "Owner," "TOWN OF ASHLAND CITY," and "Superintendent of Water and Sewer Systems" are to be used interchangeably. Summarized below are requirements and conditions that apply to the granting of utility service by the TOWN OF ASHLAND CITY.

1.1 Prior to the design of any utility line extension or expansion, the design engineer should first confer with the TOWN OF ASHLAND CITY Planning Commission in regard to growth potential and density that may be expected in the general area of the extension being planned. A conference with the Superintendent of Water and Sewer Systems should follow to discuss system standards and requirements, as well as any problems related to the mains being extended.

1.1.1. Construction of utility lines, including individual service connections, may not begin prior to approval by the TOWN OF ASHLAND CITY.

1.2 No connection to an existing utility shall be made until all lines have been completely tested and the tie-in is approved by the Project Inspector and until all tap fees are paid.

1.3 The TOWN OF ASHLAND CITY will not accept utility lines that were not approved by TDEC and in accordance with the Town Code and constructed in accordance with these specifications.

1.4 The TOWN OF ASHLAND CITY requires the following bonds (or certified cashier's check):

1.4.1 Performance Bond - Contractor/Developer will be required to provide a Maintenance Bond for one (1) year after inspection and acceptance by the TOWN OF ASHLAND CITY the improvements in the amount of 25% of construction cost. Contractors or Developers shall contact the Public Works Director of The Town Of Ashland City to obtain information regarding the Performance Bond.

1.4.2 Road Repair Bond - 100% of estimated roadway (public) repair cost, amount to be set by street department, to be returned to Contractor/Developer upon acceptance of the repaired/replaced roadway by the Street Department. Permit shall be obtained from the Town of Ashland City prior to proceeding with any road cuts.

1.4.3 Warranty Bond - The Warranty Bond shall be 25% of the Performance Bond; to be returned to Contractor/Developer at end of warranty period. The typical warranty period is for one year from the date of substantial completion.

1.5 Service connection and service line construction to property line or right-of-way (only) is covered herein. Service line constructed from property line or right-of-way to structure is covered in the latest edition of the Standard Plumbing Code.

1.6 Under the terms of the ASHLAND CITY Municipal Code, water service may be denied to structures connected to a sewer line or service not accepted by the Town.

1.7 All utility lines and services (to property line or right-of-way only) constructed utilizing these specifications become the property of the TOWN OF ASHLAND CITY upon acceptance by the . Utility lines and services (to property line or right-of-way only) will not be accepted by the Town unless and until they are in strict conformance with these specifications.

1.8 Three (3) sets of plans and specifications, including a vicinity map, shall be submitted for the initial review. If the plans are in order, with no major changes, the Developer or his Engineer will submit the number of additional sets of plans needed for the project for approval.

1.9 Five (5) sets of drawings including vicinity map shall be submitted for approval. Submittals shall be at least fourteen (14) days prior to a scheduled meeting in order to be considered at that meeting. Contractor's developers, and others are asked to submit drawings as far in advance as possible in order to conserve time at planning and commission meetings. After approval, four (4) sets of drawings shall be submitted to the Tennessee Department of Environment and Conservation for their approval. Approval of the plans and specifications by the Tennessee Department of Environment and

Conservation, Tennessee Department of Transportation, railroads, Corps of Engineers, Tennessee Valley Authority, and any other agency having jurisdiction is required before beginning construction. One (1) state approved set of drawings and one (1) copy of the State approval letter shall be provided to the Superintendent of Water and Sewer Systems prior to beginning construction. Prior to acceptance of lines by the Town, two sets of reproducible "Record Drawings", one set of digital format (DWG) in Autocad 2000 showing all work, changes, service locations, and other data not shown on the original set shall be given to the Superintendent of Water and Sewer Systems after each project or phase of a project is completed.

1.10 Detail drawings and specifications shall be submitted by the A/E employed by the Developer for any special condition or structures such as pump stations, creek crossings, etc., and approved by the Town before beginning any construction.

1.11 Easements required across private property or in roads are to be acquired by the Developer in the name of the Town. Easements shall have a minimum width of 20 feet. Wider easements may be required for sewer lines over 12 feet deep or deeper.

1.12 All applicable Federal and State laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the construction throughout.

1.13 Sizes and locations of all water and sewer lines and appurtenances, and all construction shall be in accordance with the plans approved by the Town.

1.14 Permits for pavement cuts or crossing of public roads, including any special backfill and pavement repair as required by the agency having jurisdiction, are the responsibility of the Developer. A bond may be required from the Developer to cover all costs of repair and maintenance for a period of one (1) year from the date of acceptance of the project for all work performed in existing rights-of-way of all roads,

1.15 If construction has not started within one (1) year from the date of approval, utility plans shall be resubmitted to renew approval. Renewal is not guaranteed.

1.16 The Contractor's name, project cost, and estimated working time for each project shall be submitted to the Town. The Town will be reimbursed for each day that an inspector is required on the job site until completion of the project.

1.17 Laboratory test reports shall be provided on all pipe to assure that it meets the requirements of the Town's specifications.

1.18 Shop drawings for utility materials shall be submitted to the TOWN OF ASHLAND CITY for review after being thoroughly checked by the Contractor and stamped with his approval.

1.19 The Town reserves the right to relocate water and sewer lines on the construction plans to facilitate maintenance.

1.20 All utility construction shall be in accordance with specifications of the TOWN OF ASHLAND CITY.

1.21 All grading work shall be completed and all roads constructed to subgrade and lot corners are to be marked prior to the installation of utility lines.

1.22 The contractor shall be responsible for locating and verifying the elevations of existing utilities prior to construction.

1.23 The Developer's Engineer shall provide a complete set of Record Drawings on moist erasable Cronaflex mylar reproductions in reverse, or the original drawings on K & E Plat 1 Herculene drafting film or equal, upon completion of construction and they shall include actual field angles between lines, all actual service lines and tee locations, the distance of the end of service lines to property corners and lines, the depth to top of the end of the service line, and shall reflect all alignment and grade changes. This item must be completed and submitted prior to acceptance of the sewers or water mains into the public system and any connections being made thereto.

1.24 The Contractor shall provide a set of construction cut sheets prior to the preconstruction meeting and the cut sheets shall include the stations of all proposed service connections.

1.25 A one (1) year warranty period will begin upon the date of acceptance of the project by the Town.

1.26 Any special requirements shall be transmitted as a part of the approval.

1.27 All plans shall be stamped by a Tennessee Licensed Professional Engineer.

2. Initial Plan Submittals: The plans must be submitted at least twenty-one (21) days prior to the date on which action is desired. The initial submittal should include, but not be limited to the following:

2.1 Three (3) copies of the plan.

2.2 Specifications.

2.3 Engineering reports including design criteria used in sizing mains, and/or pumping stations.

2.4 Drainage calculations for pre- and post-development of the site. Drainage calculations shall be prepared in accordance with the Town's Subdivision Regulations.

3. Easements

3.1 When utility lines are constructed outside a public right-of-way, easements must be a minimum of 20 feet in width.

3.2 Easements for utility line extensions may be provided in either of two (2) ways.

3.2.1 Easement Document on form, approved by the Town, which must include legal description of the easement(s), legal owner's name and Book and Page where deed is recorded, and must be signed by the Owner, and then notarized.

3.2.2 Record with Subdivision Plat - If this method of recording easements is chosen, a preliminary plat of the subdivision must be provided at the time of plans submittal, which clearly defines the easements to be recorded, along with a letter of

intent from the Licensed Engineer or Licensed Surveyor who will stamp the final subdivision plat, assuring that easements will be recorded as shown on the preliminary plat.

3.3 All easements must be obtained and recorded in developed areas before construction can begin. In new subdivisions the letter of intent and preliminary plat showing the easements will be sufficient to start construction. However, the Final Plat must be recorded prior to final acceptance of the new facilities.

3.4 Special easements such as Railroad Crossings, T.V.A. crossings and State Highway crossings must be prepared by the Developer's Engineer.

4. Pre-Construction Meeting

4.1 Before beginning any construction, the Developer shall contact the Town and execute a contract with them paying all tapping privilege fees as required. After this contract is executed and before beginning any construction, the Developer or his Engineer shall schedule a pre-construction conference to be held between the Contractor, Developer, Developer's Engineer, and the Director and their Engineer. At this meeting, the Contractor will be informed of the Town's policies and any special requirements. Listed below is a CHECKLIST of items relating to the project:

4.2 BEFORE Pre-Construction Conference:

4.2.1 Developer is to coordinate conference.

4.2.2 Developer, or his Engineer, is to have project plans approved by all agencies.

4.2.3 Developer is to have a contract with the utility contractor, in order to determine the administration engineering and inspection fees.

4.2.4 Contractor is to have shop drawings approved by the Town.

4.2.5 When submitting plans and shop drawings to the Town's Engineers, they will retain one (1) copy and the Town will retain two (2) copies. Shop drawings will not be reviewed unless they have been checked by the Contractor and stamped by him to indicate that they meet the specifications.

4.2.6 Developer is to have at conference:

4.2.7 Approved plans.

4.2.8 Copy of Contractor's contract (both off-site and on-site).

4.2.9 Signed contract with the Town and produce a check to the Town for tap fees and inspection fees. All fees are subject to final approval by the TOWN OF ASHLAND CITY Board of Alderman.

4.3 To Attend Conference:

4.3.1 Developer.

4.3.2 Developer's Engineer.

4.3.3 Developer's Contractor.

4.3.4 Representative from the Town's Engineer.

4.3.5 Representative of the TOWN OF ASHLAND CITY, Director of Public Works and the Project Inspector.

## B. SANITARY SEWER GENERAL SPECIFICATIONS

1. Sewer Extension and/or Service Connection: The following are guidelines for the preparation of sanitary sewer plans and should not be construed as being the total requirements. The Town may at its option require additions to be made in the plans where circumstances warrant.

2. Plans shall be drawn on a standard 24" x 36" sheet.

3. A cover sheet shall be made a part of all plans, and shall incorporate a location map on an approximate scale not less than 1" = 1,000', the name of the project and, the names, addresses and telephone numbers of the Developer and the Engineer.

4. Include a key map indicating sheet numbers for each sewer line.

5. Sewer plans must be on plan and profile sheets, with contour lines shown in the plan portion and the lowest elevation of the sewer line beginning on the left side of the sheet in the profile.

6. All plans must show the locations of the existing and proposed utilities including, but not limited to, gas lines, underground telephone conduits, power and telephone poles, water mains, sanitary sewer lines, storm sewers, etc.

7. The scale of the plan/profile sheet will be: Plan 1" = 50' horizontal, Profile 1" = 5' or 1" = 10' vertical.

8. All sewer plans shall include at least one (1) bench mark based on U.S.G.S. Datum. Additional bench marks shall be shown at approximately 1,500 feet intervals. The use of a manhole invert elevation or an assumed elevation will not be approved.

9. Show all topographic features, such as driveways, pavement, rights-of-way, property lines, storm drainage structures, etc.

10. The direction of North should be clearly shown on all plans.

11. All property lines should be shown on the plans and each parcel should show the map and parcel number, lot number and/or house number.

12. A connection must be provided for each parcel or proposed lot. The connection will be shown as a tee (machine made only) and a six (6) inch service line extension therefrom where applicable. Hand made tees and "Y" connections are not acceptable. When sewers are constructed by private Developers to serve proposed developments and are to be construed as public mains within the public right-of-way, the Developer will provide a 6" tee to serve all parcels of property which lie along said main extension (which can be provided gravity service by said main). When laying the mains in private property a tee and ten (10) feet of service line shall be provided for each existing parcel.

13. A maximum of only two (2) six (6) inch service lines will be allowed into permanent end manholes, and a minimum 45 degree alignment differential must be maintained between them. At no time will an angle less than 90 degrees be permitted between them and the out or downstream sewer main. The service lines must enter the manhole within 1.9 feet of the base of the manhole and the invert must be properly shaped for them.

14. Special pipe considerations are as follows:

14.1 In areas which have been filled and the proposed pipe will be within the fill, Class 250, ductile iron must be specified.

14.2 If ductile iron pipe is specified for any part of a sewer, then it must be specified from manhole to manhole; jointing of two different type pipes between manholes will not be permitted.

14.3 Due to maintenance considerations, it will be Town's policy to require that all lateral sewers proposed at depths greater than 14 feet be constructed of ductile iron pipe and any service line risers from this depth also be ductile iron pipe. This condition should be avoided whenever possible and first consideration given to other routes.

14.4 All sanitary sewers shall have a minimum of 30 inches cover in private property and 48 inches in paved areas subject to vehicular traffic. Across drains and areas where cover is less than 30 inches, ductile iron pipe or concrete encasement will be required.

15. Manholes shall be installed at the upper end of each line, at all changes in grades, size or alignment, at all intersections, and at distances not greater than 350 feet for sewer 15 inches in diameter or less, 400 feet for sewers 18 inches to 21 inches in diameter, and 500 feet for sewers over 24 inches in diameter.

16. When sewers are proposed along drains and lie within a potential flood plain or lie adjacent to a drainage ditch or drainage structure in which there is a potential problem of storm water entering the sanitary sewer, the Town will require approved watertight frames and covers be installed on the manholes.

17. A vent stack assembly will be required on water tight manholes at 1,000 feet intervals.

18. When sewers are proposed to serve new subdivisions, contour elevations must be shown on the sewer plans. At least one (1) copy of the subdivision grading and drainage plan and a copy of the road plans must be submitted with the sewer plan for review, and must contain a typical section of the proposed roadway. A statement should be incorporated into the letter for transmittal for plans designating which roads are to be public and which are to be private, as well as designating which sewer lines are to be public.

19. Smaller lines shall not be connected to larger lines by utilizing a concrete collar. Only an approved compression or rubber O-ring style coupling will be acceptable. The practice of "hammer tapping" a sewer line is not in conformance with the Standard Plumbing Code and is not an acceptable method of connecting a service line to a new or existing sewer line. In all cases, a tee, wye, or tapping saddle shall be used. Contractors and/or plumbers caught or suspected of utilizing either illegal practice hereinbefore discussed will be asked to provide a guarantee bond as specified in 1.4.3 hereinbefore prior to being allowed to complete improvements to the ASHLAND CITY Sewer System.

20. Any time sewer lines are proposed to serve property where the "serviceability" of a lot or residence is questionable, the lot or residence must be identified with the following note: The service tee is to be placed at the lowest possible elevation on the main line and the service line is to be laid on a minimum slope. The home builder is responsible for locating the elevation of the end of the service line and setting building finished floor elevations such that gravity service is available. This note is also to be put on the recorded plat identifying critical lots.

21. The profiles of all drains adjacent to and crossing proposed sewers must be shown on the sewer plan profile. Concrete protection must be provided on sanitary sewers across drains where there will be less than 2.5 feet of cover.

22. Whenever wastewater lift stations are proposed, the following information must be submitted.

22.1 Complete design criteria for the proposed pumping station including, but not limited to, the following:

22.1.1 Topographic map with the drainage area clearly defined and the acreage shown.

22.1.2 Complete information concerning the proposed area of service, including the number and type of proposed units.

22.1.3 Complete anticipated flow data based on Tennessee Department of Environment and Conservation design criteria and utilizing a peak factor 2.5.

22.1.4 Complete details of possible alternate gravity sewers to serve the same area, including cost estimates of both type systems.

23. In general, wastewater collection extensions shall be designed for the estimated ultimate tributary population.

## C. WATER LINE GENERAL SPECIFICATIONS

1. The purpose of these specifications is to provide a guide to the Developers and their Contractors in order to achieve an acceptable installation for furnishing of water to subdivisions or other areas in the Town. Summarized below are the requirements and conditions that apply to the granting of water service by the Town.

2. No valve or cutoff shall be operated except by a Town Representative.

3. No utility plans will be reviewed until the development plans have received preliminary approval by the planning commission having jurisdiction.

4. Sizes and locations of mains, valves, fittings, plugs, hydrants, and blowoffs shall be in accordance with the plans approved by the Town.

5. Detailed plans and specifications shall be submitted by the Engineer employed by the Developer for any special condition or structures such as pump stations, creek crossings, etc., and shall be approved by the Town before beginning any construction.

6. "Cut-ins" or taps to live mains shall be made only in the presence of a Town Representative.

7. Meters (5/8" x 3/4") shall be provided by the Town to the Developers for each lot. The meter box will be installed by the Contractor. After installation, the water meter assembly shall be identified by four (4) foot long wooden stakes a minimum of two (2) feet around the meter box with orange ribbon wrapped around the stakes.

8. Permits for pavement cuts or crossing of public roads, including any special backfill and pavement repair as required by the agency having jurisdiction, are the responsibility of the Developer. A bond shall be provided to the Town by the Developer to cover all costs of repair and maintenance for a period of one (1) year from the date of acceptance of the project for all work performed in existing rights-of-way of all roads in CHEATHAM County and all State highways. The amount of this bond shall be determined by the Town after it receives all requirements for repairs from the appropriate County Highway Department or the Tennessee Department of Transportation.

9. Water mains are not generally permitted in easements, however, when special conditions require them, easements; must be provided with a minimum width of ten (10) feet.

10. Centerlines of roads shall be staked before beginning construction. The road section and water line relation to the centerline of the road shall be shown on the plans. Front-lot corners shall be marked before services are installed in order for services to be properly located.
11. Hydraulic calculations and data should be submitted for the proposed system.

12. Where the static water pressure exceeds 80 psi, the developer shall provide a water reducing valve on the service line. This pressure reducing valve shall be installed in accordance with the detail in the Standard Drawings section of this document.

## D. DESIGN CRITERIA

1. Design Factors

In determining the required capacities of sanitary sewers, the following factors must be considered:

1. Maximum hourly quantity of wastewater.
2. Additional maximum wastewater from industrial plants.
3. Ground water infiltration.

2. Design Basis

Per capita flow: Sewer systems serving residential development should be designed on the basis of an average daily per capita flow of wastewater of not less than 100 gallons per day when no water use information is available. This amount of flow is assumed to cover nominal infiltration, but an additional allowance should be made where conditions are unfavorable.

Generally, the sewers should be designed to carry, when running full, not less than the following daily per capita contributions of wastewater, exclusive of wastewater from industrial plants:

1. Laterals and sub-main sewers; 400% of average design flow.

2. Main, trunk & outfall sewers: 250% of average design flow.

3. Minimum Size

No sewer collection line shall be less than eight (8) inches in diameter.

4. Depth

In general, sewers should be deep enough to drain basements and to prevent freezing. Where practical, a minimum depth of five (5) feet should be maintained.

5. Slope

All sewers shall be so designed and constructed to give mean velocities, when flowing half full, of not less than 2.0 feet per second. The minimum required slopes for 8 inch through 12 inch sewer mains are shown below. However, these slopes should be used only when required. All sewers shall be laid with uniform slope between manholes.

| SEWER SIZE (inches) | RECOMMENDED MINIMUM SLOPES (feet/100 feet) |
|---|---|
| 8 | 0.40 |
| 10 | 0.30 |
| 12 | 0.20 |

6. Alignment

Sewers shall be designed with straight alignment between manholes.

7. Increased Size

When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An acceptable approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.

8. High Velocity Protection Ductile iron pipe shall be used when slopes are greater than:

| SEWER SIZE INCHES | SLOPE (FT/100 FT) |
|---|---|
| 8 | 18 |
| 10 | 13 |
| 12 | 9 |

9. Pipe Bedding

All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer shall be made because of the width and depth of trench. Backfill material from one (1) foot above the pipe should not exceed six (6) inches in diameter at its greatest dimension. As a general rule, in roadways where cover is less than four (4) feet, or in open areas where cover is less than 2 1/2 feet, ductile iron pipe or concrete encasement shall be used. Ductile iron pipe shall be required when sewer installation occurs in areas of non-virgin soil (i.e. areas of "fill"). Piers shall be provided for when necessary for support. An impermeable barrier of compacted clay or concrete encasement shall be used at the transition from fill to virgin soil to prevent piping of water through the crushed stone bedding.

For structural reasons, ductile iron pipe, concrete encasement, or relocation shall be required when culverts or other conduits are laid such that the top of the sewer is less than 18 inches below the bottom of the culvert or conduit. Special care shall be used in placing bedding in the haunching region.

1. Ductile Iron Pipe: Each sewer pipe section shall be laid on six (6) inch bed of size no. 7 or size no. 67 crushed stone and shall be backfilled to the spring line of the pipe using size no. 7 or size no. 67 compacted crushed stone.

2. PVC Pipe: Each sewer pipe section shall be completely encapsulated with six (6) inches of bedding material on the top, both sides, and the bottom of the pipe. Bedding materials shall be size no. 7 or size no. 67 crushed stone.

10. Joints and Infiltration

Sewer joints should be designed to minimize infiltration and to prevent the entrance of roots. Standard laying lengths for PVC pipe shall not exceed 13.5 feet.

11. Air Pressure Testing

Low pressure air exfiltration testing of all pipes shall be as specified in ASTM C828-80. The pressure drop shall be calculated as the number of seconds for the air pressure to drop from a stabilized pressure of 3 1/2 psig to 2 1/2 psig.

MINIMUM TEST TIME FOR VARIOUS PIPE SIZES
(Based upon ASTM C828-80)

| Nominal Pipe Size (Inches) | Time (Min./100 feet) |
|---|---|
| 6 | 0.7 |
| 8 | 1.2 |
| 10 | 1.5 |
| 12 | 1.8 |

12. Manholes

(a) Location: Manholes shall be installed at the upper end of each collection sewer line, at all changes in grade, at points of changes in size, and at all pipe intersections.

(b) Drop Manholes: A drop pipe shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert should be u-shaped to prevent deposition of solids.

(c) Diameter: The minimum diameter of manholes shall be 48 inches. The entrance tube shall be at least 24 inches in diameter.

13. Protection of Water Supplies

(a) Water Supply Interconnections: There shall be no physicalconnection between a potable water supply line and a sewer or appurtenance thereto which would permit the passage of wastewater or polluted water into the potable supply.

(b) Relation to Water Mains:

1. Horizontal Separation: Whenever possible, sewers should be laid at least ten (10) feet horizontally from any existing or proposed water pipe. Should local conditions prevent a lateral separation of ten (10) feet to the water main if it is laid in a separate trench and if the elevation of the top of the sewer pipe is at least 18 inches below the bottom of the water pipe.

2. Vertical Separation: Whenever a sewer must cross under a water main, the sewer shall be laid at such elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be varied to meet the above requirement, the water main shall be relocated to provide the separation or reconstructed with ductile iron pipe for a minimum distance of ten (10) feet on each side of the sewer. At least one (1) full length of water main should be centered over the sewer so that both joints shall be as far from the sewer as possible.

3. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both the water main and the sewer shall be constructed of ductile iron pipe and shall be pressure-tested to assure watertightness.

14. Force Mains

(a) Velocity: At design flow, velocity in excess of two (2) feet per second shall be maintained.

(b) Air Release Valve: An automatic air release valve shall be placed at high points in the force main to prevent air-locking.

(c) Termination: Force mains shall terminate in the invert of a manhole.

(d) Pipe Diameter: Force mains are to be a minimum of four (4) inches in diameter.

(e) A maximum Hazen and Williams "C" factor used should not be greater than 130 regardless of that actually determined for the pipe.

(f) Force mains using minimum four (4) inch ductile iron, cement-mortar lined, Class 50, slip-on type joint meeting the latest requirements of AWWA Standard C151 with a minimum of three (3) feet of cover will be acceptable to the TOWN OF ASHLAND CITY.

15. Wastewater Lift Stations

Wastewater lift station design criteria is not provided under these Standards. However, lift stations shall be of the wet well/dry sump configuration. Construction of the lift station shall include a paved (asphalt or concrete) driveway, minimum eight (8) feet high chain-link fence enclosing the site, minimum 12 feet wide gate for access, and a permanent potable water supply. The Town will evaluate separately the materials and criteria proposed for use in the design of wastewater lift stations. Plans and specifications must be submitted to the Town for approval. Once approval has been given by the Town, plans and specifications must be submitted to the Tennessee Department of Environment and Conservation, Division of Water Pollution Control, for approval.

16. Minimum Distribution Pipe Size

(a) The minimum size pipe shall be eight (8) inch diameter except six (6) inch pipe will be permitted when looped in a grid and no leg of such grid exceeds 800 feet in length. Two (2) inch pipe will be permitted for serving cul-de-sacs having lengths of 300 feet or less, provided it has been determined by the Town that there will never be a future need for its extension.

(b) The size of pipe shall be justified by hydraulic analysis performed by an engineer who holds a valid license to practice in the State of Tennessee. Distribution pipes should be capable of providing a minimum flow of 750 gallons per minute except in cases of extending two (2) inch pipes as provided under Section 2.0.4 (a) of these Standards. The distribution pipe including any two (2) inch pipes, shall be designed to maintain a minimum pressure of 30 psi at ground level at all points in the system under all conditions of flow.

(c) All assumptions and any flow data used by the design engineer must be clearly documented and submitted with the hydraulic calculations. If actual flow data are not available, theoretical calculations shall be based on all storage facilities being half-full and the appropriate Hazen and Williams friction factor shall be applied for the type pipe being used, but in no case shall such friction factor be greater than 130.

(d) Distribution pipes should be sized for an instantaneous peak demand of 750 gallons per minute except in cases where two (2) inch pipe is used as provided for under Section 2.0.4 (a) of these Standards. When using two (2) inch pipe, an instantaneous peak demand of five

17. Fire Protection

(a) Fire hydrants should not be connected to distribution pipes which are not capable of providing a flow of 750 gallons per minute at a residual pressure of 30 psi.

(b) When fire protection is being provided, fire hydrants shall be located at points designated by the Fire Chief and the Superintendent of Water and Sewer Systems of the TOWN OF ASHLAND CITY.

(c) The minimum pipe size to which a fire hydrant may be connected is six (6) inches.

(d) The minimum standards for privately-owned sprinkler service lines shall be the following:

i. Constructed of Class 50 ductile iron pipe.

ii. A check valve or backflow prevention device shall be installed.

18. Dead Ends

(a) Dead ends shall be minimized in water line extensions.

(b) Where dead end distribution pipes occur, they should be provided with a fire hydrant when fire protection is being provided, or an approved blow-off assembly for flushing purposes.

19. Gate Valves

(a) Unless otherwise specified by the Superintendent of Water and Sewer Systems, gate valves shall be placed at all intersections of distribution pipes. Two (2) valves shall be placed at each tee; one (1) installed in the run and the other installed in the branch. Three (3) valves shall be placed at each cross. Valves should be positioned in the pipe line approximately three (3) feet distance from the tee or cross. (5) gallons per minute per connection shall be assumed.

(b) Valves shall be placed on lead-outs approximately three (3) feet from fire hydrants except those having lead-outs to be connected to fire hydrant type tees, in which case, the valves may be connected to such fire hydrant tee.

20. Means of Detecting PVC pipe

When PVC pipe is installed a minimum size 14 gauge copper wire shall be installed along the pipe. The ends of the wire shall terminate in a valve box or other acceptable location whereby detection equipment may be attached.

21. Separation of Water Mains and Sewers

(a) General:

The following factors should be considered in providing adequate separation:

1. Materials and type of joints for water and sewer pipes.
2. Soil conditions.
3. Service and branch connections into the water main and sewer line.
4. Compensating variations in the horizontal and vertical separations.
5. Space for repair and alterations of water and sewer pipes.
6. Off-setting of pipes around manholes.
7. Water mains and sanitary or storm sewers shall not be laid in the same trench.

(b) Parallel Installation:

1. Normal conditions-Water mains shall be laid at least ten (10) feet horizontally from any sanitary sewer, storm sewer or sewer manhole. Whenever possible; the distance shall be measured edge-to-edge.
2. Unusual conditions-When local conditions prevent a horizontal separation of ten (10) feet, a water main may be laid closer to a storm or sanitary sewer provided that:

i. The bottom of the water main is at least 18 inches above the top of the sewer.

ii. Where this vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction and shall be pressure tested to assure watertightness prior to backfilling.

(c) Crossing:

1. Normal conditions-Water mains crossing house sewers, storm sewers, or sanitary sewers will be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer, whenever possible.

2. Unusual conditions-When local conditions prevent a vertical separation as described hereinbefore, the following shall be used:

i. Sewers passing over or under water mains should be constructed of ductile iron.

ii. Water mains passing under sewers shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main; adequate structural support for the sewers to prevent excessive deflection of joints and settling on the breaking the water mains; that the length of water pipe be centered at the point of crossing so that the joints will be equidistant as far as possible from the sewer. Both the sewer and the water main shall be constructed of water pipe and tested in accordance with these Standards.

(d) Sewer Manholes:

No water pipe shall pass through or come into contact with any part of sewer line or sewer manhole.

22. Surface Water Crossings

Surface water crossings, both under and over water, present special problems which should be discussed with the TOWN OF ASHLAND CITY; the Tennessee Department of Environment and Conservation, Division of Water Supply and Division of Water Pollution Control; and the U.S. Army Corps of Engineers before plans are prepared.

All surface water crossings shall be in accordance with the requirements of the General Permit for an Aquatic Resource Alteration

(a) Above Water Crossings-The pipe shall be:

1. Adequately supported.

2. Protected from damage and freezing.

3. Accessible for repairs and replacement.

(b) When Crossing Water Courses Which are Greater than 15 Feet in Width:

1. The pipe shall be of special construction, having flexible, watertight joints;

2. Valves shall be provided at both ends of the water crossing so that the section can be isolated for test or repair, the valves shall be easily accessible and not subject to flooding;

3. Sampling taps should be available at each end of the crossing;

4. Permanent taps should be made for testing and locating leaks.

23. Cross Connections

(a) There shall be no physical connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or

other contaminating materials may be discharged or drawn into the system.

(b) The approval of the Tennessee Department of Environment and Conservation, Division of Water Supply, shall be obtained for interconnections between potable water supplies.

(c) Neither steam condensate nor cooling water from engine jackets or other heat exchange devices shall be returned to the potable water supply.

24. Water Services and Plumbing

(a) Water services and plumbing shall conform to the Standard Plumbing Code as may be revised and adopted from time to time by the TOWN OF ASHLAND CITY.

END OF SECTION

## PART 1. GENERAL

1.1 REQUIREMENTS INCLUDED

A. Applicability of Reference Standards.

B. Provision of Reference Standards at site.

C. Acronyms used in Contract Documents for Reference Standards. Source of Reference Standards.

1.2 QUALITY ASSURANCE

A. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. The date of the standard is that in effect as of the Bid date, or date of Owner-Contractor Agreement when there are bids, except when a specific date is specified.

C. When required by individual Specifications section, obtain copy of standard. Maintain copy at jobsite during submittals, planning, and progress of the specific work, until Substantial Completion.

1.3 SCHEDULE OF REFERENCES

| | |
|---|---|
| AASHTO | American Association of State Highway and Transportation Officials<br>444 North Capitol Street, N.W.<br>Washington, DC 20001 |
| ACI | American Concrete Institute<br>P.O. Box 19150<br>Reford Station<br>Detroit, MI 48219 |

| | |
|---|---|
| AGC | Associated General Contractors of America<br>1957 E. Street, N.W.<br>Washington, DC 20006 |
| AI | Asphalt Institute<br>Asphalt Institute Building<br>College Park, MD 20740 |
| AISC | American Institute of Steel Construction<br>400 North Michigan Avenue<br>Eighth Floor<br>Chicago, IL 60611 |
| AISI | American Iron and Steel Institute<br>1000 16th Street, N.W.<br>Washington, DC 20036 |
| ANSI | American National Standards Institute<br>1430 Broadway<br>New York, NY 10018 |
| ASHRAE | American Society of Heating, Refrigerating and Air Conditioning Engineers<br>1791 Tullie Circle, N.E.<br>Atlanta, GA 30329 |
| ASME | American Society of Mechanical Engineers<br>345 East 47th Street<br>New York, NY 10017 |
| ASTM | American Society for Testing and Materials<br>1916 Race Street<br>Philadelphia, PA 19103 |
| AWWA | American Water Works Association<br>6666 West Quincy Avenue<br>Denver, CO 80235 |

| | |
|---|---|
| AWPA | American Wood-Preservers Association<br>7735 Old Georgetown Road<br>Bethesda, MD 20014 |
| AWS | American Welding Society<br>550 LeJeune Road<br>Miami, FL 33135 |
| CLFMI | Chain Link Fence Manufacturers Institute<br>1101 Connecticut Avenue, N.W.<br>Washington, DC 20036 |
| CRSI | Concrete Reinforcing Steel Institute<br>933 Plum Grove Road<br>Schaumburg, IL 60195 |
| EJCDC | Engineers Joint Contract Documents Committee<br>American Consulting Engineers Council<br>1050 15th Street, N.W.<br>Washington, DC 20005 |
| EJMA | Expansion Joint Manufacturers Association<br>707 Westchester Avenue<br>White Plains, NY 10604 |
| FM | Factory Mutual System<br>1151 Boston-Providence Turnpike<br>Norwood, MA 02062 |
| FS | Federal Specification<br>General Services Administration<br>Specifications & Consumer Information Distribution Section (WFSIS)<br>Washington Navy Yard, Bldg. 197<br>Washington, DC 20407 |
| GA | Gypsum Association<br>1603 Orrington Avenue<br>Evanston, IL 60201 |

| | |
|---|---|
| IEEE | Institute of Electrical and Electronics Engineers<br>345 East 47th Street<br>New York, NY 10017 |
| IMI | International Masonry Institute<br>815 15th Street, N.W.<br>Washington, DC 20005 |
| MIL | Military Specification<br>Naval Publications and Forms Center<br>5801 Tabor Avenue<br>Philadelphia, PA 19120 |
| ML/SFA | Metal Lath/Steel Framing Association<br>221 North LaSalle Street<br>Chicago, IL 60601 |
| NAAMM | National Association of Architectural Metal Manufacturers<br>221 North LaSalle Street<br>Chicago, IL 60601 |
| NEBB | National Environmental Balancing Bureau<br>8224 Old Courthouse Road<br>Vienna, VA 22180 |
| NEMA | National Electrical Manufacturers Association<br>2101 L Street, N.W.<br>Washington, DC 20037 |
| NFPA | National Forest Products Association<br>1619 Massachusetts Avenue, N.W.<br>Washington, DC 20036 |
| NSWMA | National Solid Waste Management Association<br>1120 Connecticut Avenue, N.W.<br>Washington, DC 20036 |

| | |
|---|---|
| NTMA | National Terrazzo and Mosiac Association<br>3166 Des Plaines Avenue<br>Des Plaines, IL 60018 |
| PCA | Portland Cement Association<br>5420 Old Orchard Road<br>Skokie, IL 60077 |
| PCI | Prestressed Concrete Institute<br>201 North Wacker Drive<br>Chicago, IL 60606 |
| PS | Product Standard<br>U. S. Department of Commerce<br>Washington, DC 20203 |
| SDI | Steel Deck Institute<br>P.O. Box 3812<br>St. Louis, MO 63122 |
| SIGMA | Sealed Insulating Glass Manufacturers Association<br>111 East Wacker Drive<br>Chicago, IL 60601 |
| SJI | Steel Joist Institute<br>1703 Parham Road<br>Suite 204<br>Richmond, VA 23229 |
| SMACNA | Sheet Metal and Air Conditioning Contractors<br>National Association<br>8224 Old Court House Road<br>Vienna, VA 22180 |
| SSPC | Steel Structures Painting Council<br>4400 Fifth Avenue<br>Pittsburgh, PA 15213 |

| | |
|---|---|
| TAS | Technical Aid Series<br>Construction Specifications Institute<br>601 North Madison Street<br>Alexandria, VA 22314 |
| TCA | Tile Council of America, Inc.<br>P.O. Box 326<br>Princeton, NJ 08540 |
| UL | Underwriters Laboratories, Inc.<br>333 Pfingston Road<br>Northbrook, IL 60062 |

PART 2. PRODUCTS

2.1 Not Used.

PART 3. EXECUTION

3.1 Not Used.

END OF SECTION

## PART 1. GENERAL

1.1 REQUIREMENTS INCLUDED

A. General Quality Control.

B. Workmanship.

C. Manufacturers' Instructions.

D. Manufacturers' Certificates.

E. Mockups.

F. Manufacturers' Field Services.

G. Testing Laboratory Services.

1.2 RELATED REQUIREMENTS

A. General Conditions: Inspection and testing required by governing authorities.

B. Section 01090 - Reference Standards: Applicability of specified reference standards.

C. Section 01300 - Submittals: Submittal of Manufacturers' Instructions.

D. Section 03301 - Concrete Work: Tests required for concrete.

1.3 QUALITY CONTROL, GENERAL

A. Maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

1.4 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

B. Perform work by utilizing only persons qualified to produce workmanship of specified quality.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.5 MANUFACTURERS' INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence. Should instructions conflict with Contract Documents, request clarification from A/E before proceeding.

1.6 MANUFACTURERS' CERTIFICATES

A. When required by individual Specification Sections, submit manufacturers' certificate, in duplicate, that products meet or exceed specified requirements.

1.7 MOCKUPS

A. When required by individual Specifications Section, erect complete, full-scale mockup of assembly at Project site. Tests will be performed in accordance with Section 01400, if applicable. Remove mockup at completion when approved by A/E.

1.8 MANUFACTURER'S FIELD SERVICES

A. When specified in respective Specification Sections, require supplier or manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship; start-up of equipment; test, adjust, and balance of equipment, as applicable; and, to make appropriate recommendations.

B. Representative shall submit written report to A/E listing observations and recommendations.

1.9 TESTING LABORATORY SERVICES

A. Contractor shall employ and pay for services of an Independent Testing Laboratory to perform inspections, tests, and other services required by individual Specification Sections.

B. Services will be performed in accordance with requirements of governing authorities or agencies and with specified standards.

C. Reports will be submitted to A/E in duplicate giving observations and results of tests, indicating compliance or non-compliance with specified standards and with Contract Documents.

D. Contractor shall cooperate with Testing Laboratory personnel; furnish tools, samples of materials, design mix, equipment, storage and assistance as requested.

1. Notify A/E and Testing Laboratory at least 48 hours prior to expected time for operations requiring testing services.
2. Make arrangements with Testing Laboratory and pay for additional samples and tests for Contractors' convenience.

PART 2. PRODUCTS

NOT USED

PART 3. EXECUTION

NOT USED

END OF SECTION

## PART 1. GENERAL

This work shall consist of erosion control on all cut and fill operations, excavation, backfill, or other construction activities within the limits of the construction site, within any temporary or permanent easements, and within any borrow site used during the period of construction. The protection of these sites shall continue throughout the construction period. During flood seasons, protect the sites by sandbagging, the pumping of water, and any other means appropriate to restrain flooding of plant and equipment. During dry weather, sprinkle the sites with water or use other means as necessary to provide dust control. In case of abnormally cold weather, any construction such as excavation work may be delayed until warmer weather or covered to prevent freezing.

## PART 2. PRODUCTS

Temporarily stabilize areas from which topsoil has been removed and topsoil stockpiles by seeding fast growing annuals such as rye and annual ryegrass, that provide quick protection. These annual grasses are to be seed certified by the State Department of Agriculture and can be worked into the soil when the site is prepared for final seeding of more permanent species. Use commercial lime and fertilizer on exposed areas, subject to severe erosion.

## PART 3. EXECUTION

3.1 Conduct construction so as to provide the site with maximum protection from erosion at all times.

3.2 Conduct excavation activities to provide erosion and sediment control as follows:

3.2.1 Do not start clearing and excavation until a firm construction schedule is submitted to and approved by the A/E. Continuously coordinate the schedule with the clearing and excavation activity.

3.2.2 In streets and other paved areas, remove excavated material from the site as construction progresses to prevent any erosion of this material.

3.2.3 In other areas, place the excavated material so as not to block any drainage area. Replace this excavated material in the trench immediately after repairs have been completed and are approved by the Owner.

3.2.4 Retain natural vegetation whenever feasible.

3.2.5 Restore and cover exposed areas subject to erosion as quickly as possible by means of seeding and mulching. Use diversion ditches or other methods as appropriate to prevent storm water from running over the exposed area until seeding is established as specified.

3.2.6 Take particular care along streams and drainage ditches so that fallen trees, debris, and excavated material will not adversely affect the streamflow. Exercise care to minimize the destruction of streambanks. Wherever the streambanks are affected by construction, reduce the slope of the streambanks to provide a suitable condition for vegetation protection. Minimize land exposure in terms of area and time.

3.2.7 Cover exposed excavated areas with mulch or vegetation.

3.2.8 Mechanically retard the rate of runoff water.

3.2.9 Trap the sediment contained in the runoff water.

3.2.10 Divert water from erosive areas.

3.2.11 Take care during the pouring of concrete, hauling of materials, etc., to keep vehicles from creating a severe erosion problem. Proper scheduling of operations and prompt repair of ruts created during this operation is necessary from this source.

3.2.12 Control dust by sprinkling or other means as necessary to keep it to a minimum.

3.2.13 Pave or otherwise stabilize roadways and driveways as soon as feasible.

3.2.14 Regrade and reseed surfaces eroded or otherwise damaged during any and all construction operations as necessary.

END OF SECTION

## PART 1. GENERAL

Not Used

## PART 2. PRODUCTS

2.1 Not Used.

## PART 3. EXECUTION

3.1 STORAGE, GENERAL

A. Store products, immediately on delivery, in accordance with manufacturer's instructions, with seals and labels intact. Protect until installed.

B. Arrange storage in a manner to provide access for maintenance of stored items and for inspection.

3.2 EXTERIOR STORAGE

A. Provide substantial platforms, blocking, or skids, to support fabricated products above ground; slope to provide drainage. Protect products from soiling and staining.

B. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.

C. Provide surface drainage to prevent erosion and ponding of water.

3.3 MAINTENANCE OF STORAGE

A. Verify that surfaces of products exposed to the elements are not adversely affected; that any weathering of finishes is acceptable under requirements of Contract Documents.

END OF SECTION

# WATER

## PART 1. GENERAL

1.1 The work called for by this section shall consist of clearing and grubbing, loosening, loading, removing, and disposing of, in the specified manner, all wet and dry materials (including rock) encountered that must be removed for construction purposes; furnishing, placing, and maintaining all sheeting, shoring, bracing, and timbering necessary for the proper protection and safety of the work; the workmen, the public, and adjacent property and improvements; the dewatering of trenches and other excavations; the preparation of satisfactory pipe beds; the backfilling and tamping of trenches, foundations, and other structures; the preparation of fills and embankments; the removal of unsuitable material from outside the normal limits of excavation and, where ordered by the A/E, their replacement with suitable materials; and all other grading or excavation work incidental to or necessary for the work. This work shall be performed as specified below.

## PART 2. PRODUCTS

Not Used.

## PART 3. EXECUTIONS

3.1 PREPARATION OF THE SITE

A. Before starting construction, remove from the work site all vegetable growth (except as hereinafter excluded), debris, and/or other objectionable matter as well as any buildings and/or other structures that the drawings and/or the A/E specifically indicate are to be removed. Dispose of this refuse material in a manner acceptable to the A/E.

B. In certain areas it may be desirable for existing trees, shrubs, or other vegetation on the site to be preserved for the permanent landscape. Such vegetation may be shown on the drawings, specifically listed in the specifications, marked on the site, or identified by the A/E. In no case damage or remove such growth without written permission from the Owner.

C. If the area to be excavated is occupied by trees, brush, or other vegetable growth, clear such growth, grub the excavated area, and remove all large roots to a depth of not less than 2 feet below the bottom of the proposed construction. Dispose of the growth removed in a manner satisfactory to the A/E. Fill all holes or cavities created during this work that extend below the subgrade elevation with suitable material, and compact to the same density as the surrounding material.

D. Trees, cultivated shrubs, etc., that are situated within public rights-of-way and/or construction easements through private property but not directly within the excavation area shall remain undisturbed unless it is necessary to remove them so that the work can be performed safely and unless their removal is specifically ordered by the A/E. Take special precautions to protect and preserve such growth throughout all stages of the construction.

E. Preparation of the site shall be considered an integral part of the excavation and one for which no separate payment shall be allowed.

3.2 UNSUITABLE MATERIALS

A. Wherever muck, quicksand, soft clay, swampy ground, or other material unsuitable for foundations, subgrade, or backfilling is encountered, remove it and continue excavation until suitable material is encountered. The material removed shall be disposed of in the manner described below. Then refill the areas excavated for this reason with 1 inch to 2 inch lifts of crushed stone up to the level of the lines, grades, and/or cross sections shown on the drawings. The top 6 inches of this refill shall be No. 67 (TDOT) crushed stone for bedding.

3.3 ROCKS AND BOULDERS

A. Any material that is encountered within the limits of the required excavation that cannot be removed except by drilling and/or blasting, including rock, boulders, masonry, hard pan, chert, shale, street and sidewalk pavements, and/or similar materials, shall be considered as unclassified excavation, and no separate payment will be made therefore.

B. Should rock be encountered in the excavation, remove it by blasting or otherwise. Where blasts are made, cover the excavation with enough excavation material and/or timber or steel matting to prevent danger to life and property. The Contractor shall secure, at his own expense, all permits required by law for blasting operations and the additional hazard insurance required. Observe all applicable laws and ordinances pertaining to blasting operations.

C. Excavate rock over the horizontal limits of excavation and to a depth of not less than 6 inches below the bottom of pipe up to 30 inches in diameter and not less than 12 inches below the bottom of larger pipes if rock extends to such depth. Then backfill the space below grade with No. 67 (TDOT) crushed stone or other approved material, tamp to the proper grade, and make ready for construction. For brick or monolithic concrete sewers and for structures, excavate rock to the outside bottom of the structure or sewer.

3.4 DISPOSAL OF MATERIALS

A. Whenever practicable, all materials removed by excavation that are suitable for backfilling pipe trenches or for other purposes shown on the drawings or directed by the A/E shall be used for these purposes. Any materials not so used shall be considered waste materials and disposed of by the Contractor as specified below.

B. Waste materials may be deposited in spoil areas at locations approved by the A/E. Do not leave in unsightly piles but instead spread in uniform layers, neatly level, and shape to drain. Seed as specified in Section 02485, Seeding.

C. Once any part of the work is completed, properly dispose of all surplus or unused materials (including waste materials) left within the construction limits of that work. Leave the surface of the work in a neat and workman like condition, as described below.

D. The disposal of waste materials shall be considered an integral part of the excavation work and one for which no separate payment shall be allowed.

## 3.5 EXCAVATION FOR TRENCHES AND STRUCTURES

A. Unclassified excavation for pipelines shall consist of the excavation necessary for the construction of water, sewer, and other pipes and their appurtenances (including manholes, inlets, outlets, headwalls, collars, concrete saddles, and pipe protection) that are called for by the drawings. It shall include clearing and grubbing where necessary, backfilling and tamping pipe trenches and around structures, and disposing of waste materials, all of which shall conform to the applicable provisions set forth elsewhere in these specifications.

B. The Contractor may, if he chooses, use a motor powered trenching machine. If he does, however, he shall be fully responsible for the preservation or repair of existing utility service connections.

C. Unless the construction of lines by tunneling, jacking, or boring is called for by the drawings or specifically authorized by the A/E, make excavation for pipelines in open cut and true to the lines and grades shown on the drawings or established by the A/E on the ground. Cut the banks of trenches between vertical parallel planes equidistant from the pipe centerline. The horizontal distance between the vertical planes (or, if sheeting is used, between the inside faces of that sheeting) shall vary with the size of the pipe to be installed, but shall not be more than the distance determined by the following formula: 4/3d + 15 inches, where "d" represents the internal diameter of the pipe in inches. When approved in writing by the A/E, the banks of trenches from the ground surface down to a depth not closer than 1 foot above the top of the pipe may be excavated to non-vertical and nonparallel planes, provided the excavation below that depth is made with vertical and parallel sides equidistant from the pipe centerline in accordance with the formula given above. Any cut made in excess of the formula 4/3d + 15 inches shall be at the expense of the Contractor and may be cause for the A/E to require that stronger pipe and/or a higher class of bedding be used at no cost to the Owner.

D. For rigid pipe, shape the bottom of all trenches to provide uniform bearing for the bottom of the pipe barrel. For plastic sewer lines, provide a minimum of 6 inches of No. 67 (TDOT) crushed stone for bedding.

E. Excavate bell holes for bell and spigot pipe at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper jointing of the pipe. Do not excavate bell holes more than 2 joints ahead of pipe laying.

F. Excavation for manholes, inlets, and other incidental structures shall not be greater in horizontal area than that required to allow a 2 foot clearance between the outer surface of the structure and the walls of the adjacent excavation or of the sheeting used to protect it. The bottom of the excavation shall be true to the required shape and elevation shown on the drawings. No earth backfilling will be permitted under manholes, inlets, headwalls, or similar structures. Should the Contractor excavate below the elevations shown or specified, he shall, at his own expense, fill the void with either concrete or granular material approved by the A/E.

G. Do not excavate pipe trenches more than 200 feet ahead of the pipe laying, and perform all work so as to cause the least possible inconvenience to the public. Construct temporary bridges or crossings when and where the A/E deems necessary to maintain vehicular or pedestrian traffic.

H. In all cases where materials are deposited along open trenches, place them so that in the event of rain no damage will result to the work and/or to adjacent property.

I. Excavation for other structures may be performed with non-vertical banks except beneath pavements or adjoining existing improvements. Do not permit the horizontal area of the excavation to exceed that required to allow a 2 foot clearance between the outer surface of the structure and the banks of the excavation or the sheeting used to protect the embankments. The bottom of the excavation shall be true to the required shape and elevation shown on the drawings.

3.6 SHEETING, SHORING, AND BRACING

A. Take special care to avoid damage wherever excavation is being done. Sufficiently sheet, shore, and brace the sides of all excavations to prevent slides, cave-ins, settlement, or movement of the banks and to maintain the specified trench widths. Use solid sheets in wet, saturated, or flowing ground. All sheeting, shoring, and bracing shall have enough strength and rigidity to withstand the pressures exerted, to keep the walls of the excavation properly in place, and to protect all persons and property from injury or damage.

Separate payment will not be made for sheeting, shoring, and bracing, which are considered an incidental part of the excavation work.

B. Wherever employees may be exposed to moving ground or cave-ins, shore and lay back exposed earth excavation surfaces more than 5 feet high to a stable slope, or else provide some equivalent means of protection. Effectively protect trenches less than 5 feet deep when examination of the ground indicates hazardous ground movement may be expected. Guard the walls and faces of all excavations in which employees are exposed to danger from moving ground by a shoring system, sloping of the ground, or some equivalent protection.

C. Comply with all OSHA standards in determining where and in what manner sheeting, shoring, and bracing are to be done. The sheeting, shoring, and bracing system shall be designed by a professional engineer licensed in the State of Tennessee and shall be subject to approval by the A/E. However, such approval does not relieve the Contractor of the sole responsibility for the safety of all employees, the effectiveness of the system, and any damages or injuries resulting from the lack or inadequacy of sheeting, shoring, and bracing.

D. Where excavations are made adjacent to existing buildings or structures or in paved streets or alleys, take particular care to sheet, shore, and brace the sides of the excavation so as to prevent any undermining of or settlement beneath such structures or pavement. Underpin adjacent structures wherever necessary, with the approval of the A/E.

E. Do not leave sheeting, shoring, or bracing materials in place unless this is called for by the drawings, ordered by the A/E, or deemed necessary or advisable for the safety or protection of the new or existing work or features. Remove these materials in such a manner that the new structure or any existing structures or property, whether public or private, will not be endangered or damaged and that cave-ins and slides are avoided.

F. Fill and compact all holes and voids left in the work by the removal of sheeting, shoring, or bracing as specified herein.

G. The Contractor may use a trench box, which is a pre-fabricated movable trench shield composed of steel plates welded to a heavy steel frame. The trench box shall be designed to provide protection equal to or greater than that of an appropriate shoring system.

## 3.7 THE DEWATERING OF EXCAVATION

A. Provide and keep in operation enough suitable pumping equipment whenever necessary or whenever directed to do so by the A/E. Give special attention to excavations for those structures that, prior to proper backfilling, are subject to flotation from hydrostatic uplift.

## 3.8 BORROW EXCAVATION

A. Whenever the backfill of excavated areas or the placement of embankments requires more material than is available from authorized excavations, or whenever the backfill material from such excavations is unsuitable, then obtain additional material from other sources. This may require the opening of borrow pits at points accessible to the work. In such cases, make suitable arrangements with the property owner and pay all incidental costs, including any royalties, for the use of the borrowed material. Before a borrow pit is opened, the quality and suitability of its material shall be approved by the A/E. All state and local regulations concerning borrow pits, drainage and erosion control shall be strictly followed.

B. Excavate borrow pits in such a way that the remaining surfaces and slopes are reasonably smooth and that adequate drainage is provided over the entire area. Construct drainage ditches wherever necessary to provide outlets for water to the nearest natural channel, thus preventing the formation of pools in the pit area. Leave the sides of borrow pit cuts at a maximum slope of 2:1 unless otherwise directed by the A/E.

C. Properly clear and grub borrow pits, and remove all objectionable matter from the borrow pit material before placing it in the backfill.

D. The taking of materials from borrow pits for use in the construction of backfill, fills, or embankments shall be considered an incidental part of the work; no separate payment shall be made for this.

## 3.9 BACKFILLING

A. Begin backfilling after the line construction is completed and then inspected and approved by the A/E. On each side of the line, from the bottom of barrel to 1 foot above the top of the pipe, the backfill material shall consist of **#67 CRUSHED STONE ONLY**. Place this backfill simultaneously on either side of

the pipe in even layers that before compaction are no more than 6 inches deep. Thoroughly and completely tamp each layer into place before placing additional layers. When shown on the drawings, this backfill shall, at locations beneath or closely adjacent to pavement, consist of No. 67 (TDOT) crushed stone.

B. From 1 foot above the pipe upward, the backfill material may contain broken stones that make up approximately 3/4 of the backfill's total volume. However, if this type of backfill is used, there must be enough spalls and earth materials to fill all voids completely. The maximum dimension of individual stones in such backfill shall not exceed 6 inches, and the backfill material shall be placed and spread in even layers not more than 12 inches deep. At locations beneath or closely adjacent to pavement or at locations of improvements subject to damage by dis-placement, tamp and thoroughly compact the backfill in layers that, before compaction, are 6 inches deep. In other areas, the backfill for the upper portion of the trenches may be placed without tamping but shall be compacted to a density equivalent to that of adjacent earth material as determined by laboratory tests. Use special care to prevent the operation of backfilling equipment from causing any damage to the pipe.

C. If earth material for backfill is, in the opinion of the A/E, too dry to allow thorough compaction, then add enough water so that the backfill can be properly compacted. Do not place earth material that the A/E considers too wet or otherwise unsuitable.

D. Wherever excavation has been made within easements across private property, the top 1 foot of backfill material shall consist of fine loose earth free from large clods, vegetable matter, debris, stone, and/or other objectionable materials.

E. Wherever trenches have been cut across or along existing pavement, temporarily pave the backfill of such trenches by placing Class A, Grade D base, crushed stone as the top 12 inches of the backfill. Maintain this temporary pavement either until the permanent pavement is restored or until the project is accepted by the Owner. On heavily traveled roadways, cold mix or leveling course binder 2 inches thick shall be installed and maintained until permanent pavement is installed.

F. Conduct backfilling around manholes, inlets, outfalls, and/or structures in the same manner as specified above for pipelines except that even greater care is necessary to prevent damage to the utility structure.

G. Wherever pipes have diameters of 15 inches or less, do not use power operated tampers to tamp that portion of the backfill around the pipe within 1 foot above the pipe.

H. Perform backfilling so as not to disturb or injure any pipe and/or structure against which the backfill is being placed. If any pipe or structure is damaged and/or displaced during backfilling, open up the backfill and make whatever repairs are necessary, whenever directed to do so by the A/E.

I. Backfilling and clean-up operations shall closely follow pipe laying; failure to comply with this provision will result in the A/E's requiring that the Contractor's other activities be suspended until backfilling and clean-up operations catch up with pipe laying.

J. Compaction Requirements: Unless specified otherwise elsewhere, under buildings and 2 times the depth of pipe beyond, and under roads and 2 times the depth beyond the shoulder, compact to 95% maximum density in accordance with ASTM D698. In all other locations, compact to 90% maximum density.

3.10 MAINTENANCE

A. Seed and maintain in good condition all excavated areas, trenches, fills, embankments, and channels until final acceptance by the Owner.

B. Maintain trench backfill at the approximate level of the original ground surface by periodically adding backfill material wherever necessary and whenever directed to do so by the A/E. Continue such maintenance until final acceptance of the project, or until the A/E issues a written release.

3.11 SLOPES

A. Neatly trim all open cut slopes, and finish to conform either with the slope lines shown on the drawings or the directions of the A/E. Leave the finished surfaces of bottom and sides in reasonably smooth and uniform planes like those normally obtainable with hand tools, though the Contractor will not be required to use hand methods if he is able to obtain the required degree of evenness with mechanical equipment. Conduct grading operations so that material is not removed or loosened beyond the required slope.

END OF SECTION

## PART 1. GENERAL

1.1 The work called for by this section shall include, but not necessarily be limited to, finish grading and the spreading any shaping of topsoil to the finished contour elevations indicated by the drawings.

1.2 Refer to other sections for work related to that specified under this heading. Coordinate this work with that specified by other sections for timely execution.

## PART 2. PRODUCTS

2.1 Topsoil: Use stripped topsoil that has been stockpiled as specified elsewhere. If the quantity of topsoil on the job is inadequate, furnish enough additional topsoil. Topsoil furnished shall be natural, fertile, friable soil possessing characteristics of representative productive soils in the vicinity. It shall be obtained from naturally well drained areas. It shall not be excessively acid or alkaline nor contain toxic substances that may be harmful to plant growth. Topsoil shall be without admixture of subsoil and shall be cleaned and reasonably free from clay lumps, stones, stumps, roots, or similar substances two (2) inches or more in diameter, debris, or other objects that are a hindrance to planting operations. Such material shall be subject to testing.

## PART 3. EXECUTION

3.1 Do not begin work until the earth is dry enough to be tillable.

3.2 Inspect subgrades to see that they generally conform to the standards called for elsewhere in these specifications, particularly with regard to the approximate depths required for the work. After work is completed, inspect it to ensure that all finish grading complies with design requirements.

3.3 Place finished grade stakes wherever necessary to bring the work accurately to the elevations required by the drawings.

3.4 Finish grade all areas outside the building line to the depths required for the work as follows:

A. Grade uniformly with rounded surfaces at the tops and bottom of abrupt changes of planes.

B. Hand grade steep slopes and areas that are inaccessible for machine work.

C. Protect graded areas from undue erosion, and repair and regrade areas where erosion does occur.

D. Refill areas where noticeable settlement has occurred.

E. Finish grade areas that are to receive topsoil up to four (4) inches below the finished contour elevations called for by the drawings or, over rock, to 12 inches below these elevations.

3.5 Place topsoil uniformly over disturbed areas that do not receive other work as follows:

A. Obtain approval of the finish grading from the A/E before starting to place topsoil.

B. Scarify subgrade to a depth of three (3) inches.

C. Place the topsoil to a depth of four (4) inches when lightly rolled or, on rock, to a depth of 12 inches.

D. Level the topsoil so that it slopes uniformly and has no water pockets.

E. Carefully rake the topsoil by hand to remove all clods, roots, sticks, stones over one (1) inch in diameter, and other foreign materials from the surface.

3.6 Dispose of excess excavated materials and debris away from the site.

END OF SECTION

## PART 1. GENERAL

1.1 This item consists of furnishing and placing riprap slope protection, subgrage stabilization and roadway fill with 6" surge stone or shotrock in accordance with the drawings and specifications.

## PART 2. PRODUCTS

2.1 The riprap material shall be durable and of hard natural stone or broken concrete. It shall be sound and dense, free from cracks, seams, or other defects that would tend to cause increased deterioration because of freezing and thawing or other natural causes. Riprap material shall be reasonably well graded from the minimum size stone and shall be Class "B" riprap consisting of clean machined stone ranging in size from 3"-27" and an installation layer thickness of 2.5' and containing no more than 20% by weight stone in size less than 6". Class "A-1" riprap consisting of clean machined stone ranging in size from 2"-15" and an installation of 1.5' and containing no more than 20% by weight stone in size less than 4". Fragments or spalls shall be used to fill the voids between the larger rocks. The inclusion of appreciable quantities of dirt, sand, clay, or rock fines will not be accepted. All materials considered for use as riprap shall be approved by the A/E.

## PART 3. EXECUTION

3.1 Earth surface on which riprap is to be placed shall be trimmed and graded so as to provide for the thickness of riprap shown on the drawings. Surfaces that are below grade shall be brought to grade by filling with well-compacted materials similar to the adjacent materials. Prior to placement of riprap, the prepared earth foundation will be inspected and no materials shall be placed thereon until approved by the A/E.

3.2 Place riprap to the full course thickness at one operation and in such a manner as to avoid serious displacement of the underlying materials. Deliver and spread the material so that the mass of pieces in place shall be reasonably well graded, with the larger pieces uniformly distributed and the smaller pieces and spalls filling the voids between the larger pieces. The finished riprap shall be free from objectionable concentrations of large or small pieces.

END OF SECTION

## PART 1. GENERAL

1.1 This work shall be performed in all disturbed areas not receiving such site improvements as buildings, roads, walks, sod, planting, etc., and shall include, but not necessarily be limited to, all seed bed preparation; the supplying and placing of soil additives, seed, and mulch wherever required by the drawings or directed by the A/E; and maintenance.

1.2 Unless otherwise approved in writing by the A/E, seeding operations shall be limited to the following planting periods:

A. Spring - March 1 through May 30
B. Fall - August 15 through October 31

1.3 Refer to other sections for items affecting seeding. Coordi-nate this work with that specified by other sections for timely execution.

## PART 2. PRODUCTS

2.1 GRASS SEED: Kentucky 31 Fescue (Festuca elatior) and/or annual rye meeting the requirements of the State Department of Agriculture and furnished in new bags or bags that are sound and not mended; no "below standard" seed will be accepted.

2.2 FERTILIZER: commercially manufactured; Grade 10-10-10; furnished in standard containers that are clearly marked with the name, weight, and guaranteed analysis of the contents and that ensure proper protection in transportation and handling; and in compliance with all local, state, and federal fertilizer laws.

2.3 AGRICULTURAL LIMESTONE: containing a minimum of 85% calcium carbonate and magnesium carbonate combined, 85% of which passes a No. 10 mesh sieve.

2.4 MULCH: stalks of rye, oats, wheat, or other approved grain crops properly cured prior to bailing, air dried, and reasonably free of noxious weeds and weed seeds or other material detrimental to plant growth.

## PART 3. EXECUTION

3.1 Perform all seeding and related work as a continuous operation. Sow seed as soon as the seed bed has been prepared, and perform subsequent work in a continuous manner.

3.2 Before beginning seeding operations in any area, complete the placing of topsoil and final grading, and have the work approved by the A/E.

3.3 Scarify, disk, harrow, rake, or otherwise work each area to be seeded until the soil has been loosened and pulverized to a depth of not less than 2 inches. Perform this work only when the soil is in a tillable and workable condition.

3.4 Apply fertilizer and agricultural limestone uniformly over the seed bed, and lightly harrow, rake, or otherwise incorporate them into the soil for a depth of approximately 1 inch at the following rates:

Fertilizer: 15 pounds per 1,000 square feet
Agricultural Limestone: 40 pounds per 1,000 square feet

3.5 Sow seed uniformly with a rotary seeder, wheelbarrow seeder, hydraulic equipment or by other satisfactory means.

3.6 The seeding rate shall be 5 pounds per 1,000 square feet for Kentucky 31 Fescue (Festuca elatior).

3.7 When seeding during March 1 through April 1 and October 1 through November 20, add an additional 3 pounds per 1,000 square feet of annual rye grass.

3.8 Perform no seeding during windy weather or when the ground surface is frozen, wet, or otherwise untillable.

3.9 Spread mulch material evenly over the seeded areas immediately following the seeding operation. Mulch Rate: 2 bales (100 pound minimum) per 1,000 square feet.

3.10 The mulch rate may be varied by the A/E, depending on the texture and condition of the mulch material and the characteristics of the area seeded. Cover all portions of the seeded areas with a uniform layer of mulch so that approximately 25% of the ground is visible.

3.11 No equipment, material storage, construction traffic, etc., will be permitted on newly seeded ground.

3.12 Dispose of all surplus materials as directed by the Owner.

## PART 4. INSPECTIONS

The A/E shall inspect the seeding within 60 days after planting and determine if it is acceptable.

PART 5. GUARANTEE

5.1 Secure an acceptable growth of grass in all areas designated for seeding.

5.2 An area is considered acceptable if it is represented by a minimum of 100 seedlings per square foot of the permanent species of grass representative of the seed mixture. If an acceptable growth is not obtained on the first planting, reseeding and remulching will be required.

5.3 If the planting is less than 50% successful, rework the ground, refertilize, reseed, and remulch.

END OF SECTION

## PART 1. GENERAL

1.1 The work specified by this section shall consist of repairing or replacing all damaged pavement, whether public or private. Dirt shoulders, roads, streets, drives, and walks are to be restored to their original condition as an incidental part of the installation of utilities. Repair damaged base on either side of a trench wherever necessary. Trim the oxidation surface to neat lines outside of the trench wall, and repave the entire area as specified below and as shown on the drawings or on the standard drawings.

1.2 Both these specifications and the drawings make reference to the current edition of the standard specifications of the Tennessee Department of Transportation (TDOT). Even though the weather limitations, construction methods, and materials specifications contained in the TDOT specifications may not be explicitly repeated in these specifications, they shall, wherever applicable to the work called for by this section, be considered as implied and therefore adhered to. However, the various subsections "Basis for Payment" contained in the TDOT specifications shall not be considered applicable.

A. Refer to other sections for work related to that covered by this section.

## PART 2. PRODUCTS

2.1 MINERAL AGGREGATE BASE: Class A, Grading D crushed stone (TDOT specifications, Section 303, subsection 903.05)

2.2 BITUMINOUS PRIME COATS: cutback asphalt, Grade RC-250, or emulsified asphalt, Grade AE-P (Section 402, Subsections 904.02 and 904.03)

2.3 CRUSHED STONE CHIPS: Size 6 or Size 7 (Subsection 903.14)

2.4 DOUBLE BITUMINOUS SURFACE: for both courses, either cutback asphalt, Grade RC-800 or RC-3000, or emulsified asphalt, Grade RS-2 (Subsections 904.02 and 904.03)

2.5 ASPHALTIC CONCRETE BINDER: Grading B or C, as directed by the A/E (Section 307)

2.6 BITUMINOUS TACK COAT: Grade AE-3 (Section 403, Subsection 904.03)

2.7 ASPHALTIC CONCRETE SURFACE: Grading E (Section 411)

2.8 QUICK DRY TRAFFIC MARKING PAINT (WHITE AND YELLOW): Subsection 910.05.

PART 3. EXECUTION

3.1 SUBGRADE

A. Before any base material is installed, compact the subgrade of the area to be paved to 95% of optimum density as determined by ASTM D698 (Standard Proctor).

B. The backfill material shall contain no topsoil or organic matter. For all areas where subgrade has been prepared, test for uniformity of support by driving a loaded dump truck at a speed of 2 to 3 mph over the entire surface. Make further improvements on all areas that show a deflection of 1 inch or more. When completed, the finished subgrade shall be hard, smooth, stable, and constructed in reasonably close conformance with the lines and grades that existed prior to beginning construction.

C. When a base course is compacted, cut back the surface course of the existing pavement a minimum of 1 foot beyond the limit of the joint between the old and new base course or as shown on the standard drawings. Take special care to ensure good compaction of the new base course at the joint. Apply and compact the surface to conform to the existing pavement so that it will have no surface irregularity.

3.2 BASE

A. Install a mineral aggregate base of the type specified above in accordance with Section 303 of the TDOT specifications. The maximum compacted thickness of any one layer shall be 6 inches and the total thickness of the base shall be that indicated by the standard drawings or as shown on the plans.

3.3 SEAL COAT SURFACE

A. Uniformly apply a bituminous prime coat of either emulsified asphalt, Grade AE-P, or cutback asphalt, Grade RC-250, over the entire width of the area to be surfaced at a rate of 0.3 gallon per square yard. Immediately after

application, uniformly cover the entire area with Size 7 crushed stone chips at a rate of 12 pounds per square yard.

## 3.4 DOUBLE BITUMINOUS SURFACE

A. Apply the first course at a rate of 0.38 to 0.42 gallon per square yard with either emulsified asphalt, Grade RS-2, or cutback asphalt, Grade RC-800 or RC-3000, and then immediately cover with Size 6 crushed stone chips at a rate of 33 to 37 pounds per square yard. After this is rolled, apply the second course at a rate of 0.30 to 0.35 gallon per square yard, and at once uniformly cover with Size 7 chips at a rate of 20 to 25 pounds per square yard. Then roll the entire area.

B. After the application of the cove aggregate, lightly broom or otherwise maintain the surface for a period of 4 days, or as directed by the A/E. Maintenance of the surface shall include the distribution of cover aggregate over the surface to absorb any free bitumen and cover any areas deficient in aggregate. Sweep excess material from the entire surface with rotary brooms. Sweep the surface at the time determined by the A/E.

## 3.5 ASPHALTIC CONCRETE BINDER

A. Apply a bituminous prime coat of emulsified asphalt, Grade AE-P, or cutback asphalt, Grade RC-250, at a rate of 0.38 to 0.42 gallon per square yard. Take care to prevent the bituminous material's splashing on exposed faces of curbs and gutters, walls, walks, trees, etc; if such splashing does occur, remove it immediately. After the prime coat has been properly cured, apply an asphaltic concrete binder to the thickness shown on the standard drawings or the plans.

B. Carefully place the material to avoid segregation of the mix. Broadcasting of the material will not be permitted. Remove any lumps that do not readily break down.

## 3.6 ASPHALTIC CONCRETE SURFACE

A. If the asphaltic concrete surface course is to be placed directly on the mineral aggregate base, place a bituminous prime coat as described above. If, however, the surface course is to be placed on a binder course, then apply a bituminous tack coat of the sort specified above under PRODUCTS at a rate

of 0.05 to 0.10 gallon per square yard. Take care to prevent the bituminous material's splashing on exposed faces of curbs, gutters, walls, walks, trees, etc.; if such splashing does occur, remove it immediately. After the prime or tack coat has been properly cured, apply the asphaltic concrete to the thickness shown of the drawings or standard drawings.

Apply the surface course as described above for the binder course.

## 3.7 SMOOTHNESS

A. The finished surfaces shall conform to the lines and grades that existed prior to construction. No deviations, variations, or irregularities exceeding 1/4 inch in any direction when tested with a 12 foot straightedge will be permitted in the finished work, nor will any depressions that will not drain. Correct all such defects.

## 3.8 SAMPLING AND TESTING

A. Submit to the A/E test reports made by an independent testing laboratory on the crushed stone aggregate, bituminous materials, and asphaltic concrete design mixes, and obtain his approval of these reports before starting paving operations.

B. Tests shall be made of the completed elements of the pavement to ascertain the compacted thickness of the base and surface courses. If sections with deficient thicknesses are found, the full section for a reasonable distance on each side of the deficiency shall be refused. Remove and reinstall all such sections. Patch all test holes in connection with thickness tests.

C. When making surface tests, furnish one man to mark all surface defects for corrections.

END OF SECTION

## PART 1. GENERAL

1.1 Refer to other sections for work related to that specified under this heading.

## PART 2. PRODUCTS

2.1 VALVES

A. Valves on water lines ten inches and smaller shall be of double disc, parallel seat, iron body bronze mounted type or resilient wedge, iron body, iron gate with bond-in-place Nitrile elastomer designed to work equally well with pressure on either side of the gate. All gate valves shall be in accordance with or exceed AWWA C500. Working pressure shall be 200 psi. Valves installed 5' or deeper shall have operating extension placed on valve.

B. Valves shall be supplied with O-ring seal stuffing boxes and shall open to the left. Valves ten inches and smaller shall be Mueller A2380-20, American Darling No. 55, Clow F-5065, or American Flow Control Series 2500, or equal, with mechanical joints.

C. Valves on water lines up to 12 inches shall be Mueller Gate Valves valves on lines 12" and larger shall be butterfly valves, be designed for direct burial service, and meet or exceed performance requirements for water application of applicable standards such as AWWA C504. Valves shall be fitted with operators designed to accept standard valve boxes and shall open to the left.

D. Bodies shall be constructed of cast iron (ASTM A126, Class B) and shall have integrally cast mechanical joint ends in accordance with AWWA C111. Accessories (bolts, glands, and gaskets) shall be supplied by the valve manufacturer. Valves shall be steel body of molded-in vulcanized Buna-N bonded to the valve body.

E. Vane for the valve employing stainless steel body seat shall be of cast iron ASTM A48, Class 40, and have the rubber seat mechanically secured with an integral 18-8 stainless steel clamp ring and 18-8 stainless steel nylon locked seat not penetrated by the valve shaft. Vane for valves employing molded-in vulcanized, bonded Buna-N body seat shall be constructed of ASTM A436 Ni-Resist, Type I.

F. Valve shaft shall be of one piece extending full size through the valve disc. Stub shafts will not be acceptable for valve sizes 12" and smaller.

G. Valve operators shall be of the traveling nut type designed to withstand a minimum input torque at fully open or fully closed position of 300 foot-pounds without damage to the valve or operator. It shall be designed to resist submergence in water to a head pressure of 25 feet.

H. Valves shall be M&H Valve Company, Henry Pratt Company, American Darling, or equal.

I. All valve box castings shall be made accurately to the required dimensions, and shall be sound, smooth, clean and free from blisters and other defects. Defective casting which have been plugged or otherwise treated to remedy defects shall be rejected. Contact surfaces of frames and covers shall be machined so that the covers rest securely in the frames with no rocking and with the cover in contact with the frames for the entire perimeter of the contact surface. All castings shall be thoroughly cleaned subsequent to machining and before rusting begins, painted with a bituminous coating so as to present a smooth finish, tough and tenacious when cold, but not tacky with no tendency to scale. Install valve boxes on each proposed valve in accordance with the details shown on the standard drawings.

## 2.2 BLOWOFF HYDRANTS

A. Blowoff hydrants shall be post type standard fire hydrants, Mueller A-24058, or equal, with 2-1/8 inch valve opening and one 2-1/2 inch hose nozzle, appropriate bury depth, and a with 3 inch mechanical joint shoe. Hose nozzle threads, operating nut, and cap shall conform to local government standards. Install a gate valve of the size indicated on the plans ahead of each blowoff hydrant.

## 2.3 FIRE HYDRANTS

A. Fire hydrants shall comply in all respects with AWWA C502 and shall be of the compression type, with the main valve opening against the pressure and closing with the pressure. The main valve opening shall be not less than 42 inches in diameter in residential areas and 53 inches in diameter in commercial and industrial areas. The main valve facing of the hydrant shall

be made of balata or similar material especially suited and proven for the service intended. The bottom stem threads of the main valve rod shall be fitted with an acorn nut or suitable means for sealing the threads away from the water. Hydrants shall be connected to the main by a six (6) inch mechanical joint shoe, unless otherwise shown on the drawings, and fitted with strapping lugs. A quantity of two (2) 2-1/2 inch hoses and one (1) 4-1/2 inch steamer nipple shall be threaded and screwed into the nozzle section and then pinned to prevent turning.

B. Operating nut shall be provided with convenient means to afford lubrication to ensure ease of operation and the prevention of wear and corrosion.

C. Hydrant shall be the dry barrel type, and hydrant shoe shall have two positive acting noncorrodible drain valves that drain the hydrant completely by opening as soon as the main valve is closed and by closing tightly when the main valve is open. Drain valves operated by springs or gravity will not be acceptable.

D. The packing gland located in the bonnet shall be solid bronze, and gland bolts shall be steel with bronze nuts. A double O-ring seal may be used in lieu of conventional stuffing box.

E. The hydrant shall open by being turned to the left and be so marked on the bonnet in cast letters with an arrow.

F. Threads on hose and steamer nipples, operating nut, and cap nuts shall conform to local Water Department standards.

G. Bury shall be as required for the installation, with the depth being measured from grade line to bottom of trench or connecting pipe.

H. Hydrants shall be Mueller "Centurion," American Darling Mark 73, or equal.

## PART 3. EXECUTION

### 3.1 SETTING VALVES AND FITTINGS

A. General

1. Set valves, fittings, plugs, and caps and joint to pipe in the manner heretofore specified for cleaning, laying, and jointing pipe. Valve boxes shall have 12" x 12" concrete pad poured to support valve and box.

B. Location of Valves

1. Valves in water mains shall, where possible, be located on the street property lines extended unless otherwise shown on the drawings.

C. Valve Boxes and Valve Pits

1. Provide a valve box for every valve.

2. 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 such other level as may be directed by the A/E.

### 3.2 SETTING HYDRANTS

A. Location and in a manner that will provide complete accessibility and also minimize the possibility of damage from vehicles or injury to pedestrians.

B. Position

1. All hydrants shall stand plumb. Set hydrants to the established grade, with nozzles at least 15 inches above the ground, as shown on the drawings or as directed by the A/E.

C. Connection to Main

1. Connect each hydrant to the main with a 6 inch ductile cast iron branch, as applicable, and a gate valve of the size indicated on the plans. The cost of the ductile cast iron branch shall be included in the unit price for the hydrant, where applicable.

D. Hydrant Drainage

1. Provide drainage at the base of the hydrant by placing coarse gravel No. 57 or crushed stone from the bottom of the trench to at least 6 inches above the waste opening in the hydrant to a distance of 1 foot around the elbow. Connect no drainage system to a sewer.

E. Anchorage for Hydrants

1. Rod the gate valve ahead of each hydrant to the anchor tee, and rod the hydrant from the gate valve. Brace the bowl of each hydrant well against unexcavated earth at the end of the trench with stone slabs or concrete blocking. Where rods cannot be used, metal harness may be used. Metal harness, steel rods, or clamps shall be galvanized or otherwise rustproof treated as approved by the A/E.

END OF SECTION

## PART 1. GENERAL

1.1 Contractor shall be responsible for safely storing materials needed for the work that have been accepted by him until they have been incorporated into the completed project. Keep the interiors of all pipes, fittings, and other accessories free from dirt and foreign matter at all times.

1.2 Wherever reaction blocking is necessary, it shall be considered an integral part of the water line work, and no separate payment shall be made for it.

## PART 2. PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. Ductile cast iron pipe shall be made of good quality ductile iron that meets the requirements for nodular iron castings of ASTM E8. It shall be plain end ductile iron pipe with push-on, single gasket joints. The design thickness shall be that specified by ANSI A21.50/AWWA C150 except that all pipe with a diameter of 12 inches or less shall have a wall thickness of 0.25 inches and all pipe with a diameter of 14 inches or more shall have a thickness of 0.28 inches or greater.

B. Ductile iron pipe shall be centrifugally cast in metal or sand-lined molds and shall conform to the specifications of ANSI A21.51/AWWA C151. It shall be made and tested in accordance with ASTM A339 and shall be subjected to and able to withstand a hydrostatic pressure of 500 psi. The maximum depth of pits shall be half that allowed in the AWWA specifications.

C. The length of each individual piece of ductile iron pipe shipped must be plainly marked on that piece of pipe.

D. The push-on, single gasket joints shall be either Fastite (manufactured by American Cast Iron Pipe Company), Tyton (U. S. Pipe and Foundry Company), Super Bell-Tite (Clow Corporation), or other joints of similar type and equal quality. They shall be UL approved and able to withstand 200 psi of operating pressure.

E. The bell of each pipe shall have a tapered annular opening and a cast or machined retaining groove for the gasket. The gasket groove shall have a flared design so that maximum deflection will be provided. The plain spigot end of the pipe shall be beveled in order to simplify its entry into and centering within the bell and the compression of the gasket.

F. The gasket shall be of high quality vulcanized rubber made in the form of a solid ring to exact dimensions. The design of the gasket groove in the bell of the pipe and the design, hardness, and other properties of the gasket itself shall be such that the joint is liquidtight for all pressures from a vacuum to a maximum rating of 350 psi of internal liquid pressure.

G. Enough lubricant shall be furnished with each order to provide a thin coat on the spigot end of each pipe. This lubricant shall be approved for being in contact with potable water and shall be nontoxic, impart no taste of smell to the water, and have no harmful effect on the rubber gasket. It shall have a consistency that will allow it to be easily applied to the pipe in either hot or cold weather and that will enable it to adhere to either wet or dry pipe. In no case shall lubricant other than that supplied by the pipe manufacturer be used.

H. Standard and special fittings shall be ductile iron. Use standard mechanical joint fittings. All fittings shall conform to the specifications of ANSI A21.10/AWWA C110.

I. Pipe and fittings shall be lined with enameline or a thin cement lining as specified in ANSI A21.4/AWWA C104. In addition, a bituminous seal coat or asphalt emulsion spray coat approximately 1 mil thick shall be applied to the cement lining in accordance with the pipe manufacturer's standard practices.

J. Fitting laying lengths shall conform to ANSI A21.10/AWWA C110, short body.

K. Fittings shall be in accordance with the standard mechanical joint fittings manufactured by the U.S. Pipe and Foundry Company, American Cast Iron Pipe Company, Clow Corporation, or equal.

L. The pipe manufacturer is to furnish the A/E a certificate of inspection, sworn to by the factory inspector in the presence of a notary public, stating that the pieces of pipe in the shipment were made and tested in accordance with ANSI

A21.51 and that they were subjected to and with-stood a hydrostatic pressure of 500 psi. Each statement is to give the number of pieces of pipe in the shipment, the length of each piece of pipe, and the serial number of each piece of pipe making up the shipment. In addition, the weight of each individual piece of pipe making up the shipment is to be listed opposite the serial number of each pipe length and attached to the certificate of inspection.

2.2 PVC PIPE

A. All plastic pipe shall be made from Class 12454-B polyvinyl chloride plastic (PVC 1120) as defined by ASTM D1784.

B. All Class 200, 250, or 315 pipe shall have NSF approval and be manufactured in accordance with ASTM D2241. The following tests shall be run for each machine on each size and type of pipe being produced, as specified below:

1. Flattening Test: once per shift in accordance with ASTM D2412. Upon completion of the test, the specimen shall not be split, cracked, or broken.

2. Acetone Test (Extrusion Quality Test): once per shift in accordance with ASTM D2152. There shall be no flaking, peeling, cracking, or visible deterioration on the inside or outside surface after completion of the test.

3. Quick Burst Test: once per 24 hours in accordance with ASTM D1599.

| SDR | Pressure Rating | Minimum Bursting Pressure, psi |
|---|---|---|
| 13.5 | 315 | 1,200 |
| 17 | 250 | 1,000 |
| 21 | 200 | 800 |

4. Impact Tests: for 6 inches and larger, once per shift in accordance with ASTM D2444; for 4 inches and smaller, once each two hours in accordance with ASTM D2444.

5. Wall Thickness and Outside Dimensions Tests: once per hour in accordance with ASTM D2122.

6. Bell Dimension Test: once per hour in accordance with ASTM D3139.

C. If any specimen fails to meet any of the above mentioned tests, all pipe of that size and type manufactured between the test periods must be scrapped and a full set of tests rerun.

D. Furnish a certificate from the pipe manufacturer stating that he is fully competent to manufacture PVC pipe of uniform texture and strength and in full compliance with these specifications and further stating that he has manufactured such pipe and done so in sufficient quantities to be certain that it will meet all normal field conditions. In addition, the manufacturer's equipment and quality control facilities must be adequate to ensure that each extrusion of pipe is uniform in texture, dimensions, and strength. Also furnish a certificate from the manufacturer certifying that the pipe furnished for this project meets the requirements of these specifications.

E. All pipe shall be manufactured in the United States of America. All pipe for any one project shall be made by the same manufacturer.

F. All 4 inches and 6 inches pipe may be furnished in the manufacturer's standard laying lengths of 20 feet, 38 feet, or 40 feet. Pipe 8 inches and larger shall be furnished in 20 feet lengths. The Contractor's methods of storing and handling the pipe shall be approved by the A/E. All pipe shall be supported within 5 feet of each end; in between the end supports, there shall be additional supports at least every 15 feet. The pipe shall be stored away from heat or direct sunlight. The practice of stringing pipes out along the proposed water line routes will not be allowed.

G. Certain information shall be applied to each piece of pipe. At the least, this shall consist of:
1. Nominal size
2. Type of material
3. SDR or class
4. Manufacturer
5. NSF Seal of Approval

H. Pipe that fails to comply with the requirements set forth in these specifications shall be rejected.

I. The pipe shall have push-on joints designed with grooves in which continuous molded rubber ring gaskets can be placed. Gaskets shall be made of vulcanized natural or synthetic rubber; no reclaimed rubber will be allowed. Gasket materials shall meet the requirements of ASTM F477. The gaskets shall be of the manufacturer's standard design dimensions and of such size and shape as to provide a positive seal under all combinations of joint and gasket tolerance. The gasket and annular groove shall be designed and shaped so that when the joint is assembled, the gasket will be radially compressed to the pipe and locked in place against displacement, thus forming a positive seal.

J. The spigot end of each pipe shall be beveled so that it can be easily inserted into the gasket joint, which in turn shall be designed so that the spigot end may move in the socket as the pipe expands or contracts. The spigot end shall be striped to indicate the distance into which it is to be inserted into the socket. Each joint shall be able to accommodate the thermal expansions and contractions experienced with a temperature shift of at least 75 degrees F.

K. Enough lubricant shall be furnished with each order to provide a coat on the spigot end of each pipe. This lubricant shall be approved for being in contact with potable water and shall be nontoxic, impart no taste or smell to the water, have no harmful effect on the gasket or pipe material, and support or promote any bacterial growth. The lubricant containers shall be labeled with the manufacturer's name. In no case shall lubricant other than that supplied by the pipe manufacturer be used.

L. Joints shall be manufactured in accordance with ASTM D3139 except that the thickness of the bell shall be, as a minimum, equal to that of the barrel. Joints shall be either integral bell and ring joints with rubber compression gaskets as manufactured by the Clow Corporation, Johns-Manville, or Vulcan Plastic Corporation; twin gasket couplings as manufactured by the Certain-Teed Products Corporation; or equal. However, the pipe and bell must be made by the same manufacturer.

M. Standard and special fittings shall be gray iron or ductile iron. Use standard mechanical joint fittings. All fittings shall conform to the specifications of ANSI A21.10/AWWA C110. The gaskets shall be ducked tipped transition gaskets for use with PVC pipe.

N. Fittings shall be lines with enameline or a thin cement lining as specified in ANSI A21.4/AWWA C104. In addition, a bituminous seal coat or asphalt emulsion spray coat approximately 1 mil thick shall be applied to the cement lining in accordance with the pipe manufacturer's standard practices.

O. Fitting laying lengths shall conform to ANSI A21.10/AWWA C110.

P. Fittings shall be in accordance with the standard mechanical joint fittings manufactured by the U.S. Pipe and Foundry Company, American Cast Iron Pipe Company, Clow Corporation, or equal.

## PART 3. EXECUTION

### 3.1 INSTALLATION OF WATER LINES

A. Lay water lines to and maintain at the lines and grades required by the drawings. All fittings, valves, and hydrants shall be at the required locations, the spigots centered in the bells, and all valves and hydrant stems plumb.

B. Unless otherwise indicated by the drawings, all water pipes shall have at least 30 inches of cover. No departure from this policy shall be made except with the approval of the A/E.

C. Provide and use tools and facilities that are satisfactory to the A/E and that will allow the work to be done in a safe and convenient manner. All pipe, fittings, valves, and hydrants are to be unloaded from the trucks using suitable tools and equipment. Use a derrick, ropes, or other suitable tools or equipment to lower all pipe, fittings, valves, and hydrants into the trench one piece at a time. Lower each piece carefully so that neither it nor any protective coating or lining it may have will be damaged. Under no circumstances drop or dump water line materials into the trench.

D. Any pipes strung out along the route of the proposed lines before the actual installation of those lines is due to take place shall not be lowered into the trench until they have been swabbed to remove any mud, debris, etc., that may have accumulated within them. PVC pipe shall be strung out a maximum of one day ahead of pipe laying. Remove all unnecessary material from the bell and spigot end of each pipe. Before any pipe is laid, brush and wipe clean the outside of its spigot end and the inside of its bell, and leave dry and oil-free.

E. Take every precaution to keep foreign material from getting into the pipe while it is being placed in the line. If the crew laying the pipe cannot put it into the trench and in place without allowing earth to get inside, then put a heavy, tightly woven canvas bag of suitable size over each end of the pipe, and leave in place until it is time to connect that pipe to the one adjacent to it.

F. Place no debris, tools, clothing, or other materials in the pipe during laying operations.

G. After a length of pipe has been placed in the trench, center the spigot end in the bell of the adjacent pipe, and then insert to the depth specified by the manufacturer and bring to the correct line and grade. Secure the pipe in place by tamping an approved backfill material around it.

H. Bell holes shall be big enough so that there is ample room for the pipe joints to be properly made. Between bell holes, carefully grade the bottom of the trench so that each pipe barrel will rest on a solid foundation for its entire length.

I. Whenever pipe laying is not in progress, close the open ends of pipe either with a watertight plug or by other means approved by the A/E. If the joints of any pipe in the trench cannot be completed until a later time, caulk them with packing in order to make them as watertight as possible; this shall be done not only at the end of each working day but also before work is stopped for lunch periods, bad weather, or any other reason. If there is water in a trench, leave this seal in place until the trench has been pumped completely dry.

J. Cut pipe so that valves, fittings, or closure pieces can be inserted in a neat and workmanlike manner and without any damage to the pipe. Follow the manufacturer's recommendations concerning how to cut and machine the ends of the pipe in order to leave a smooth end at right angles to the pipe's axis.

K. Lay pipe with the bell ends facing in the direction of laying unless otherwise directed by the A/E.

L. Wherever pipe must be deflected from a straight line (in either the vertical or horizontal plane) in order to avoid obstructions or plumb stems, or wherever long radius curves are permitted, the amount of deflection shall not exceed that necessary for the joint to be satisfactorily made, nor that recommended by the pipe manufacturer, and shall be approved by the A/E.

M. Lay no pipe in water or when it is the A/E's opinion that trench conditions are unsuitable. If crushed stone is used to improve trench conditions or as backfill for bedding the pipe, its use is considered incidental to the project, and no separate payment will be made for its use.

N. Where a water line crosses over a sanitary sewer, use a full joint of pipe with a standard mechanical joint, and center over the sewer. Where a water line is to be parallel to a sanitary or storm sewer, lay it at least 10 feet from the sewer. If it is not practical for the water and sewer lines to be separated as described above, then lay the water line at least 18 inches above the top of the sewer.

O. Joint all pipe in the exact manner specified by the manufacturer of the pipe and jointing materials.

P. For detection purposes, a 14 gage solid strand copper tracing wire (shielded) or an approved metallic tape shall be installed as per the manufacturers instructions. Connections between wires shall be soldered or connected with wire nut fasteners and wrapped.

3.2 HYDROSTATIC TESTS

A. Pressure Test

1. After pipe has been laid and backfilled as specified above, subject all newly laid pipe or any valved section thereof to a pressure of 200 psi. All services are to be laid prior to testing the main and tested as part of the test of the main.

2. The duration of each pressure test shall be at least one hour.

3. Slowly fill each valved section of pipe with water, and apply the specified test pressure (based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge) with a pump connected to the pipe in a manner satisfactory to the A/E. Furnish the pump, pipe, connections, gauges, and all necessary apparatus.

4. Before applying the specified test pressure, expel all air from the pipe. If hydrants or blowoffs are not available at high places, make necessary taps at the points of highest elevation before testing, and insert plugs after the test has been completed.

5. Carefully examine all exposed pipes, fittings, valves, and hydrants during the test. Remove any cracked or defective pipes, fittings, valves, or hydrants discovered in consequence of this pressure test, and replace with sound material in the manner specified. Repeat the test until the results are satisfactory to the A/E.

B. Leakage Test

1. Conduct the leakage test after the pressure test has been satisfactorily completed. Furnish the pump, pipe, connections, gauges, measuring devices, and all other necessary apparatus as well as all necessary assistance to conduct the test.

2. The duration of each leakage test shall be two hours; during the test, subject the main to a pressure of 150 psi.

3. Leakage is defined as the amount of water which must be supplied to the newly laid pipe or any valved section in order to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

4. No pipe installation will be accepted until the pipe is complete with **NO WATER LOSS.**

5. Should any test of pipe laid disclosure leakage greater that specified, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.

## 3.3 DISINFECTION

A. During construction, take precautions to protect pipe interiors, fittings, and valves against contamination. When pipe laying is not in progress (e.g., at the end of the day's work), place watertight plugs in the ends of all pipe already in the trench; if water accumulates in the trench, leave the plugs in place until the trench is dry. Complete the joints of all pipe in the trench before stopping work for any reason.

B. If dirt or other foreign material that has gotten into a pipe will not, in the opinion of the A/E, be removed by flushing, clean the interior of the pipe, and swab with a disinfecting solution of 5% hypochlorite.

C. Make water flow from the existing distribution system or some other source approved by the A/E into the newly laid pipeline, and add NSF approved 65% HTH chlorine to it. Contact the Director of Public Works for the required amount of HTH solution to be added. Feed water into the pipe, and chlorine into the water, at constant, measured rates so proportioned that the chlorine concentration in the water in the pipe is kept at a minimum of 50 mg/l available chlorine. To ensure that this concentration is maintained, measure the chlorine residual at regular intervals.

D. Table I shows how much chlorine is needed for each 100 feet of line for pipes of various diameters. A 1% chlorine solution may be prepared either with 1 pound of calcium hypochlorite for each 8.5 gallons of water or with sodium hypochlorite.

TABLE I

CHLORINE REQUIRED TO PRODUCE A 50 MG/L CONCENTRATION IN 100 FEET OF PIPE, BY DIAMETER

| Pipe Size (Inches) | 100% Chlorine (Pounds) | 1% Chlorine Solutions (Gallons) |
|---|---|---|
| 4 | 0.027 | 0.33 |
| 6 | 0.061 | 0.73 |
| 8 | 0.108 | 1.30 |
| 10 | 0.170 | 2.04 |
| 12 | 0.240 | 2.88 |
| 14 | 0.328 | 3.96 |
| 16 | 0.428 | 5.12 |
| 18 | 0.540 | 6.48 |
| 20 | 0.680 | 8.00 |
| 24 | 0.980 | 11.52 |

E. While the chlorine is being applied, manipulate valves so that the treatment dosage will not flow back into the line that is supplying the water. Continue the application of chlorine until the entire line being treated is filled with the chlorine solution. Then retain the chlorinated water in the line for at least 24 hours, during which time all valves and hydrants in the line being treated shall be operated so that appurtenances can also be disinfected. After 24 hours, the treated water shall have a chlorine concentration of at least 25 mg/l throughout the line.

F. After the applicable retention period, flush the heavily chlorinated water from the line until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 mg/l. Perform such flushing only at sites where there is adequate drainage.

G. The velocity of the water used to flush a line shall be at least 2.5 fps. The flow rates required to produce this velocity in various sizes of pipe are shown in Table II.

TABLE II
REQUIRED OPENINGS TO FLUSH PIPELINES
(40 PSI RESIDUAL PRESSURE)

| Pipe Size (Inches) | Flow Required To Produce 2.5 fps Velocity (gpm) | Orifice Size (Inches) | Hydrant Outlet Nozzles | |
|---|---|---|---|---|
| | | | Number | Size (Inches) |
| 4 | 100 | 15/16 | 1 | 2-1/2 |
| 6 | 220 | 1- 3/8 | 1 | 2-1/2 |
| 8 | 390 | 1- 7/8 | 1 | 2-1/2 |
| 10 | 610 | 2-5/16 | 1 | 2-1/2 |
| 12 | 880 | 2-3/16 | 1 | 2-1/2 |
| 14 | 1,200 | 3-1/4 | 2 | 2-1/2 |
| 16 | 1,565 | 3-5/8 | 2 | 2-1/2 |
| 18 | 1,980 | 4-3/16 | 2 | 2-1/2 |
| 20 | 2,440 | --- | 2 | 2-1/2 |
| 24 | 3,470 | --- | 2 | 2-1/2 |

H. Once a line has been flushed, test to make certain that the residual chlorine in the water is within acceptable limits.

I. It must be noted that flushing is no substitute for taking preventative measures before and during the laying of water lines. Certain contaminants--especially those in caked deposits--are difficult or even impossible to remove by flushing, no matter how high the velocity. Further-more, in pipes with diameters of 16 inches or more, it can be difficult to achieve even the minimum recommended flushing velocity of 2.5 fps.

## 3.4 BACTERIOLOGICAL TESTS

A. After a water line has undergone final flushing but before it is placed into service, collect a sample for bacterio-logical testing from the end of that line. In the case of extremely long lines, take additional samples if the A/E so directs.

B. Collect these samples in sterile bottles treated with sodium thiosulfate. Do not use a hose or fire hydrant to collect samples. One suggested sampling method is to install a standard corporation cock in the line with a copper tube gooseneck assembly; after the samples have been taken, the gooseneck assembly can be removed and retained for later use.

C. Take the samples collected to an approved laboratory to be tested for bacteriological quality in order to determine if they contain any coliform organisms. If the initial disinfection fails to produce satisfactory samples, repeat disinfection until satisfactory samples are obtained.

D. When the samples tested are found to be satisfactory, the water line may be placed in service.

3.5 DISINFECTION PROCEDURE AFTER CUTTING INTO OR REPAIRING EXISTING LINES

A. The procedures outlined above apply primarily to cases in which the lines are wholly or partially dewatered.

B. However, leaks or breaks that are repaired with clamping devices while the lines remain full of water under pressure present little danger of contamination and require no disinfection.

C. When an existing line is opened, whether by accident or design, the excavated area could be wet and contaminated because of the presence of sewers nearby. The danger of contamination from such pollution can be lessened if liberal quantities of hypochlorite are applied to the open trenches. It is better to use tablets for disinfection in such cases because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation site.

D. Where practical, treat the lines by the slug method in accordance with AWWA C601.

E. The following disinfection procedure is considered the minimum that may be used when existing lines are repaired:

1. Swab the interior of all pipes and fittings (particularly couplings and tapping sleeves) that are to be used in repairing an existing line with a solution of 5% hypochlorite before installing them.

2. The most practical means of removing contamination introduced into a line during repairs is to give the line a thorough flushing. If the locations of valves and hydrants make it possible, flushing in both directions is recommended. Start flushing as soon as repairs are completed, and continue until all discolored water is eliminated.

3.6 CLEANUP

A. After completing each section of water line, remove all debris and all construction materials from the work site. Then grade and smooth over the surface of both sides of the line. Leave the entire area clean and in a condition satisfactory to the A/E.

END OF SECTION

## PART 1. GENERAL

1. Refer to other sections for work related to that specified under this heading.

## PART 2. PRODUCTS

2.1 The service assembly shall include a corporation cock, copper service pipe gooseneck, meter yoke, meter, meter box, compression to meter swivel curb stop and tapping saddle as required.

2.2 CORPORATION STOP: The corporation cock shall be of solid bronze suitable for a compression flange on the service pipe and for tapping into the water main at a vertical angle. This cock shall be a Mueller H-15000, or equal. The threads on the corporation cock shall be Mueller.

2.3 SERVICE PIPE: Service pipe shall be 3/4 inch or 1" Type K copper meeting ASTM B88. Goosenecks shall be a minimum of 3 feet long.

2.4 METER YOKES: Meter yokes 5/8 inch x 3/4 inch with compression fittings shall be Mueller H-1418 with H-14227 3/4 inch tailpiece, or equal, with integral angle stop and provisions for locking. Each assembly shall include a Mueller H-14240 angle meter check valve and shall have a compression to meter swivel curb stop installed before yoke. Both curb stops shall be visible inside meter box

2.5 WATER METERS: All meters shall be frostproof, sealed register, displacement type with bronze castings similar and equal to Invensys/Precision meter. Meters shall be straight reading in gallons. Meters 2 inch and larger shall have flanged connections and shall be similar and equal to Neptune Style 3. Water meters shall comply in all respects to AWWA C-700, latest revision.

2.6 METER BOXES: Meter boxes for 5/8 inch x 3/4 inch assemblies shall be plastic type box or as approved by owner, 16 inches deep with No. 36-H cast iron cover, The box shall be installed with one course of brick as a base.

2.7 TAPPING SADDLES: Tapping saddles shall be used for tapping all PVC pipe and shall be Mueller H-13400 series, or equal, and shall be threaded to accept the corporation cock specified above. No taps larger than one (1) inch shall be made in any size pipe without approval by the A/E.

## PART 3. EXECUTION

3.1 Make no taps on dry lines without approval from the A/E.

3.2 The service line shall have a minimum of 18 inches cover. After the line is installed and yoke set, turn water on service pipe between yoke and main, blowing any accumulated trash out of the pipe.

3.3 In general, install the meter box as near the property lines as possible in the street right-of-way. Set plumb approximately one (1) inch above the existing of proposed grade and so that surface drainage will not enter it. Fill from the existing or proposed grade to the top of the meter box at a slope of one (1) inch in 12 inches. When the cut or fill slopes on streets extend beyond the street right-of-way, install the meter box at the top or toe of slope, as applicable, or as directed by the A/E.

3.4 The service main shall not be taut from stop to cock.

3.5 Set the yoke plumb and level.

3.6 All service lines crossing state, county or city roads shall be bored or jacked. The service lines under paved roads shall be cased with a 2" diameter PVC Schedule 40 pipe.

END OF SECTION

## PART 1. GENERAL

1.1 The work to be performed hereunder shall consist of the installation of casing pipe and carrier pipe for water lines as shown on the drawings or as called for in these specifications. For the open cut casing pipes, it shall include the excavation of the trench, placing proper bedding material, furnishing and installing the casing pipe, furnishing and installing the carrier pipe, backfilling, and disposing of the excess excavated materials. For the boring and jacking of casing pipes, it shall include the excavation of a boring pit, auger boring between the point as specified on the drawings, furnishing and installing of the carrier pipe, and disposing of the excavated materials in the manner herein provided.

## PART 2. PRODUCTS

2.1 CASING PIPE

A. The casing pipe shall be of steel meeting the latest approved American Railway Engineering Association "Specifications" for Pipelines for Carrying Flammable and Nonflammable Substances." The steel casing pipe shall have a minimum yield strength of 35,000 PSI and shall have the minimum wall thickness shown in the following table:

TABLE OF MINIMUM WALL THICKNESS FOR STEEL CASING PIPE
FOR E72 LOADING

| Carrier Pipe Diameter | Casing Pipe Diameter | Nominal Thickness |
|---|---|---|
| 4 inches | 8 inches | 0.250 inches |
| 6 inches | 12 inches | 0.250 inches |
| 8 inches | 16 inches | 0.312 inches |
| 10 inches | 20 inches | 0.312 inches |
| 12 inches | 22 inches | 0.312 inches |
| 14 inches | 24 inches | 0.344 inches |
| 16 inches | 26 inches | 0.375 inches |
| 18 inches | 28 inches | 0.406 inches |

B. When the casing pipe is installed without benefit of a protective coating, the wall thickness shown above shall be increased to the nearest standard size, which is a minimum of 0.063 inches greater than the thickness shown.

2.2 CARRIER PIPE: The carrier pipe shall be PVC, SDR 21, unless otherwise noted on the drawings.

## PART 3. EXECUTION

3.1 BORING

A. The boring shall be accomplished by means of auguring to the size, line and grade shown on the drawings.

2.2 INSTALLATION OF CASING PIPE

A. For open cut of casing pipes, install the steel casing pipe into the open cut as the trench excavation proceeds. Weld sections of casing pipe together to provide watertight joints, and replace the protective coatings in areas where it is damaged by welding.

B. For boring casing pipes, jack the steel casing pipe into place as the boring proceeds. Weld sections of casing pipe together to provide watertight joints.

C. Do not remove unacceptable casing without prior approval from the A/E. If the removal of casing pipe is permitted, make proper provisions to prevent caving in of the earth surrounding the casing.

3.3 INSTALLATION OF CARRIER PIPE

A. The carrier pipe shall be furnished by the Contractor. Upon acceptance of the casing, install the carrier pipe in the casing by jacking it through the casing. If necessary to achieve proper line and grade on the carrier pipe, strap wood or other suitable blocking to the carrier pipe to offset any minor variations in the alignment of the casing. Casing Spacers shall be installed a minimum of 2 per 20' section of pipe and casing end caps shall be installed.

3.4 LAYOUT OF WORK

A. The Owner will provide the necessary control points required by the Contractor for this construction. The Contractor will provide the detailed layout required to keep the excavation and pipe installation on grade.

4. GUARANTEE OF WORK

4.1 Guarantee a usable completed casing between the points specified and to the line and grade specified. The allowable tolerance at the downstream end point of the casing shall be such that the invert of the carrier pipe may be positioned within a vertical area limited on the top by an elevation no higher than the elevation shown on the drawings and on the bottom by an elevation no lower than the existing inlet pipe invert.

4.2 The allowable tolerance at the upstream end point of the casing shall be such that the invert of the carrier pipe may be positioned at the elevation shown on the drawings.

END OF SECTION

## PART 1. GENERAL

1.1 This item shall include furnishing and installing concrete blocking, cradles, anchors, caps, pipe protection, and/or encasement at the locations shown on the drawings and/or directed by the A/E.

## PART 2. PRODUCTS

Not used.

## PART 3. EXECUTION

3.1 Concrete work shall conform to ACI 301-72 (as revised), as modified by the supplemental requirements below:

A. Strength

1. The strength of concrete shall be 3,000 psi unless otherwise shown on the drawings.

B. Durability

1. All concrete exposed to weather shall be air entrained.

C. Slump

1. Concrete shall be proportional and produced to have a slump of 3 inches with a 1 inch tolerance.

D. Admixtures

1. Air entrainment, mandatory for concrete exposed to weather, may be used. A water reducing admixture (retarding, normal, or accelerating, depending on placing temperature), may be used if approved by the A/E.

E. Reinforcing Steel

1. Yield strength of reinforcing steel shall be 60,000 psi.

END OF SECTION

## GENERAL PERMIT FOR ROAD CROSSINGS

Construction of road crossings of waters where the total length of stream encapsulation is 200 linear feet or less is hereby permitted provided the activity is done in accordance with the terms and conditions below.

### Exclusions

This general permit cannot be used to authorize work in the following circumstances:
(a) where the proposed activity will adversely affect wetlands;

(b) when the total length of stream encapsulation is more than 200 feet;

(c) where a portion of the proposed activity is located in a component of the National Wild and Scenic River System, a State Scenic River, or waters designated as Outstanding National Resource Waters;

(d) when a portion of the proposed activity is located in any waterway which is identified by the Department as having contaminated sediments, and where the proposed work will likely mobilize the contaminants;

(e) when the project will adversely affect a species formally listed on State or Federal lists of threatened, or endangered species; or

(f) when an individual permit is required.

Projects not qualifying for authorization by this general permit may be authorized by individual permit provided all requirements of the *Tennessee Water Quality Control Act of 1977* are met.

### Notification

1) Where the total width of fill or disturbance to the stream channel for construction of the road crossing is less than 25 feet, notification to the Division is required prior to commencing construction in accordance with this general permit. Work may commence without written authorization from the Division. However it is the applicant's responsibility to assure that all of the terms and conditions of this general permit are met.

2) Persons proposing to construct a minor road crossing in waters of State where the total width of fill or disturbance to the stream channel is greater than 25 feet shall notify the Division by submission of an application which includes the following minimum information:

(a) a map showing the exact location of the proposed construction site; and

(b) a single copy of construction plans which includes specifications for proposed stream channel alterations and pollution control methods or structures.

Stream alteration activities shall not commence until the Division issues written notification that the proposal may proceed in accordance with the terms of this general permit or issues an individual permit.

**General Terms and Conditions**

1) Only clean rock may be placed directly into waters. Clean rock is rock of various type and size, depending upon application, that contains no fines, soils, or other wastes or contaminants. Other fill materials to be discharged below ordinary high water must be free of fines, sediment, soil, pollutants, contaminants, toxic materials, trash, or other waste materials.

2) The width of the fill associated with the crossing shall be limited to the minimum necessary for the actual crossing.

3) Excavation and fill activities shall be separated from flowing waters. All surface water flowing toward the excavation or fill work shall be diverted through utilization of cofferdams, berms, or temporary channels. Temporary diversion channels must be protected by non-erodible material and lined to the expected high water level. Cofferdams must be constructed of sandbags, clean rock, steel sheeting or other non-erodible material. Clean rock is rock of various type and size, depending upon application, that contains no fines, soils, or other wastes or contaminants.

4) The crossing shall be culverted, bridged or otherwise designed to prevent the impoundment of normal or base flows. Base flow is that usual or normal flow of the stream that is supplied primarily by groundwater from springs and seeps, but not affected by rapid runoff during and after rainfall.

5) The crossing shall be designed and constructed so as not to disrupt the movement of aquatic life. Where practicable, the bottom of culverts should be constructed below the stream bed level, with natural substrate placed over the culvert bottom following construction.

6) Soil materials must be prevented from entering waters of the state. Erosion and sedimentation control measures to protect water quality must be maintained throughout the construction period. Erosion and sedimentation controls shall include, but are not limited to straw or hay bales and/or silt

fence, brush barriers, berms, sediment ponds and other proven devices. Hay bales and/or silt fence must be installed along the base of all fills and cuts, on the down hill side of stock piled soil, and along stream banks in cleared areas to prevent sedimentation to streams. They must be installed on the contour, entrenched and staked, and extend the width of the area to be cleared. Erosion and sedimentation controls must be repaired, if necessary, after rainfall.

7) In-stream sedimentation control devices are not approved as primary treatment devices. They may be used only as backup or fail-safe protection. Separate erosion and sedimentation controls and sediment treatment devices must be utilized.

8) Slurry water pumped from work areas and excavations must be held in settling basins or treated by filtration prior to its discharge into surface waters. Water must be held in settling basins until at least as clear as the receiving waters. Settling basins shall not be located closer than 20 feet from the top bank of a stream. Settling basins and traps shall be properly designed according to the size of the drainage areas or volume of water to be treated.

9) Check dams shall be utilized where runoff is concentrated. Clean rock, log, sandbag, or straw bale, check dams shall be properly constructed to detain runoff and trap sediment. Clean rock is rock of various type and size, depending upon application, that contains no fines, soils, or other wastes or contaminants.

10) Clearing, grubbing and other disturbance to riparian vegetation shall be limited to the minimum necessary for slope construction and equipment operations. Unnecessary vegetation removal is prohibited. All disturbed areas shall be properly stabilized as soon as practicable.

11) Streams shall not be used as transportation routes for heavy equipment. Crossings must be limited to one point and erosion control measures must be utilized where the stream banks are disturbed. Where the streambed is not composed of rock, a pad of clean rock must be used at the crossing point. Clean rock is rock of various type and size, depending upon application, that contains no fines, soils, or other wastes or contaminants. All temporary fill must be completely removed after the work is completed.

12) Construction debris must be kept from entering the stream channel.

13) Appropriate steps shall be taken to ensure that petroleum products or other chemical pollutants are prevented from entering waters of the state. All

spills must be reported to the appropriate emergency management agency, and measures shall be taken immediately to prevent the pollution of waters of the state, including groundwater.

14) Upon achievement of final grade, all disturbed areas must be stabilized and re-vegetated within 30 days by sodding or seeding and mulching. Seed to be utilized shall include a combination of annual grains and grasses, legumes, and perennial grasses. Lime and fertilizer shall be applied as needed to achieve a vegetative cover.

15) The project should be consistent with all applicable local floodplain regulations. The applicant should contact local government officials to determine what these regulations are at a particular location.

16) Adverse impact to formally listed state or federal threatened or endangered species or their critical habitat, or to cultural, historical or archeological features or sites is prohibited.

Effective Date July 1, 2000 APPROVED: _____
Expiration Date June 30, 2005 Paul Davis, Director

# S E W E R

## PART 1. GENERAL

1.1 The work called for by this section shall consist of clearing and grubbing, loosening, loading, removing, and disposing of, in the specified manner, all wet and dry materials (including rock) encountered that must be removed for construction purposes; furnishing, placing, and maintaining all sheeting, shoring, bracing, and timbering necessary for the proper protection and safety of the work; the workmen, the public, and adjacent property and improvements; the dewatering of trenches and other excavations; the preparation of satisfactory pipe beds; the backfilling and tamping of trenches, foundations, and other structures; the preparation of fills and embankments; the removal of unsuitable material from outside the normal limits of excavation and, where ordered by the A/E, their replacement with suitable materials; and all other grading or excavation work incidental to or necessary for the work. This work shall be performed as specified below.

## PART 2. PRODUCTS

Not Used.

## PART 3. EXECUTIONS

3.1 PREPARATION OF THE SITE

A. Before starting construction, remove from the work site all vegetable growth (except as hereinafter excluded), debris, and/or other objectionable matter as well as any buildings and/or other structures that the drawings and/or the A/E specifically indicate are to be removed. Dispose of this refuse material in a manner acceptable to the A/E.

B. In certain areas it may be desirable for existing trees, shrubs, or other vegetation on the site to be preserved for the permanent landscape. Such vegetation may be shown on the drawings, specifically listed in the specifications, marked on the site, or identified by the A/E. In no case damage or remove such growth without written permission from the Owner.

C. If the area to be excavated is occupied by trees, brush, or other vegetable growth, clear such growth, grub the excavated area, and remove all large roots to a depth of not less than 2 feet below the bottom of the proposed construction. Dispose of the growth removed in a manner satisfactory to the A/E. Fill all holes or cavities created during this work that extend below the subgrade elevation with suitable material, and compact to the same density as the surrounding material.

D. Trees, cultivated shrubs, etc., that are situated within public rights-of-way and/or construction easements through private property but not directly within the excavation area shall remain undisturbed unless it is necessary to remove them so that the work can be performed safely and unless their removal is specifically ordered by the A/E. Take special precautions to protect and preserve such growth throughout all stages of the construction.

E. Preparation of the site shall be considered an integral part of the excavation and one for which no separate payment shall be allowed.

3.2 UNSUITABLE MATERIALS

A. Wherever muck, quicksand, soft clay, swampy ground, or other material unsuitable for foundations, subgrade, or backfilling is encountered, remove it and continue excavation until suitable material is encountered. The material removed shall be disposed of in the manner described below. Then refill the areas excavated for this reason with 1 inch to 2 inch lifts of crushed stone up to the level of the lines, grades, and/or cross sections shown on the drawings. The top 6 inches of this refill shall be No. 67 (TDOT) crushed stone for bedding.

3.3 ROCKS AND BOULDERS

A. Any material that is encountered within the limits of the required excavation that cannot be removed except by drilling and/or blasting, including rock, boulders, masonry, hard pan, chert, shale, street and sidewalk pavements, and/or similar materials, shall be considered as unclassified excavation, and no separate payment will be made therefore.

B. Should rock be encountered in the excavation, remove it by blasting or otherwise. Where blasts are made, cover the excavation with enough excavation material and/or timber or steel matting to prevent danger to life and property. The Contractor shall secure, at his own expense, all permits required by law for blasting operations and the additional hazard insurance required. Observe all applicable laws and ordinances pertaining to blasting operations.

C. Excavate rock over the horizontal limits of excavation and to a depth of not less than 6 inches below the bottom of pipe up to 30 inches in diameter and not less than 12 inches below the bottom of larger pipes if rock extends to such depth. Then backfill the space below grade with No. 67 (TDOT) crushed stone or other approved material, tamp to the proper grade, and make ready for construction. For brick or monolithic concrete sewers and for structures, excavate rock to the outside bottom of the structure or sewer.

3.4 DISPOSAL OF MATERIALS

A. Whenever practicable, all materials removed by excavation that are suitable for backfilling pipe trenches or for other purposes shown on the drawings or directed by the A/E shall be used for these purposes. Any materials not so used shall be considered waste materials and disposed of by the Contractor as specified below.

B. Waste materials may be deposited in spoil areas at locations approved by the A/E. Do not leave in unsightly piles but instead spread in uniform layers, neatly level, and shape to drain. Seed as specified in Section 02485, Seeding.

C. Once any part of the work is completed, properly dispose of all surplus or unused materials (including waste materials) left within the construction limits of that work. Leave the surface of the work in a neat and workman like condition, as described below.

D. The disposal of waste materials shall be considered an integral part of the excavation work and one for which no separate payment shall be allowed.

## 3.5 EXCAVATION FOR TRENCHES AND STRUCTURES

A. Unclassified excavation for pipelines shall consist of the excavation necessary for the construction of water, sewer, and other pipes and their appurtenances (including manholes, inlets, outlets, headwalls, collars, concrete saddles, and pipe protection) that are called for by the drawings. It shall include clearing and grubbing where necessary, backfilling and tamping pipe trenches and around structures, and disposing of waste materials, all of which shall conform to the applicable provisions set forth elsewhere in these specifications.

B. The Contractor may, if he chooses, use a motor powered trenching machine. If he does, however, he shall be fully responsible for the preservation or repair of existing utility service connections.

C. Unless the construction of lines by tunneling, jacking, or boring is called for by the drawings or specifically authorized by the A/E, make excavation for pipelines in open cut and true to the lines and grades shown on the drawings or established by the A/E on the ground. Cut the banks of trenches between vertical parallel planes equidistant from the pipe centerline. The horizontal distance between the vertical planes (or, if sheeting is used, between the inside faces of that sheeting) shall vary with the size of the pipe to be installed, but shall not be more than the distance determined by the following formula: 4/3d + 15 inches, where "d" represents the internal diameter of the pipe in inches. When approved in writing by the A/E, the banks of trenches from the ground surface down to a depth not closer than 1 foot above the top of the pipe may be excavated to non-vertical and nonparallel planes, provided the excavation below that depth is made with vertical and parallel sides equidistant from the pipe centerline in accordance with the formula given above. Any cut made in excess of the formula 4/3d + 15 inches shall be at the expense of the Contractor and may be cause for the A/E to require that stronger pipe and/or a higher class of bedding be used at no cost to the Owner.

D. For rigid pipe, shape the bottom of all trenches to provide uniform bearing for the bottom of the pipe barrel. For plastic sewer lines, provide a minimum of 6 inches of No. 67 (TDOT) crushed stone for bedding.

E. Excavate bell holes for bell and spigot pipe at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper jointing of the pipe. Do not excavate bell holes more than 2 joints ahead of pipe laying.

F. Excavation for manholes, inlets, and other incidental structures shall not be greater in horizontal area than that required to allow a 2 foot clearance between the outer surface of the structure and the walls of the adjacent excavation or of the sheeting used to protect it. The bottom of the excavation shall be true to the required shape and elevation shown on the drawings. No earth backfilling will be permitted under manholes, inlets, headwalls, or similar structures. Should the Contractor excavate below the elevations shown or specified, he shall, at his own expense, fill the void with either concrete or granular material approved by the A/E.

G. Do not excavate pipe trenches more than 200 feet ahead of the pipe laying, and perform all work so as to cause the least possible inconvenience to the public. Construct temporary bridges or crossings when and where the A/E deems necessary to maintain vehicular or pedestrian traffic.

H. In all cases where materials are deposited along open trenches, place them so that in the event of rain no damage will result to the work and/or to adjacent property.

I. Excavation for other structures may be performed with non-vertical banks except beneath pavements or adjoining existing improvements. Do not permit the horizontal area of the excavation to exceed that required to allow a 2 foot clearance between the outer surface of the structure and the banks of the excavation or the sheeting used to protect the embankments. The bottom of the excavation shall be true to the required shape and elevation shown on the drawings.

3.6 SHEETING, SHORING, AND BRACING

A. Take special care to avoid damage wherever excavation is being done. Sufficiently sheet, shore, and brace the sides of all excavations to prevent slides, cave-ins, settlement, or movement of the banks and to maintain the specified trench widths. Use solid sheets in wet, saturated, or flowing ground. All sheeting, shoring, and bracing shall have enough strength and rigidity to withstand the pressures exerted, to keep the walls of the excavation properly in place, and to protect all persons and property from injury or damage.

Separate payment will not be made for sheeting, shoring, and bracing, which are considered an incidental part of the excavation work.

B. Wherever employees may be exposed to moving ground or cave-ins, shore and lay back exposed earth excavation surfaces more than 5 feet high to a stable slope, or else provide some equivalent means of protection. Effectively protect trenches less than 5 feet deep when examination of the ground indicates hazardous ground movement may be expected. Guard the walls and faces of all excavations in which employees are exposed to danger from moving ground by a shoring system, sloping of the ground, or some equivalent protection.

C. Comply with all OSHA standards in determining where and in what manner sheeting, shoring, and bracing are to be done. The sheeting, shoring, and bracing system shall be designed by a professional engineer licensed in the State of Tennessee and shall be subject to approval by the A/E. However, such approval does not relieve the Contractor of the sole responsibility for the safety of all employees, the effectiveness of the system, and any damages or injuries resulting from the lack or inadequacy of sheeting, shoring, and bracing.

D. Where excavations are made adjacent to existing buildings or structures or in paved streets or alleys, take particular care to sheet, shore, and brace the sides of the excavation so as to prevent any undermining of or settlement beneath such structures or pavement. Underpin adjacent structures wherever necessary, with the approval of the A/E.

E. Do not leave sheeting, shoring, or bracing materials in place unless this is called for by the drawings, ordered by the A/E, or deemed necessary or advisable for the safety or protection of the new or existing work or features. Remove these materials in such a manner that the new structure or any existing structures or property, whether public or private, will not be endangered or damaged and that cave-ins and slides are avoided.

F. Fill and compact all holes and voids left in the work by the removal of sheeting, shoring, or bracing as specified herein.

G. The Contractor may use a trench box, which is a pre-fabricated movable trench shield composed of steel plates welded to a heavy steel frame. The trench box shall be designed to provide protection equal to or greater than that of an appropriate shoring system.

## 3.7 THE DEWATERING OF EXCAVATION

A. Provide and keep in operation enough suitable pumping equipment whenever necessary or whenever directed to do so by the A/E. Give special attention to excavations for those structures that, prior to proper backfilling, are subject to flotation from hydrostatic uplift.

## 3.8 BORROW EXCAVATION

A. Whenever the backfill of excavated areas or the placement of embankments requires more material than is available from authorized excavations, or whenever the backfill material from such excavations is unsuitable, then obtain additional material from other sources. This may require the opening of borrow pits at points accessible to the work. In such cases, make suitable arrangements with the property owner and pay all incidental costs, including any royalties, for the use of the borrowed material. Before a borrow pit is opened, the quality and suitability of its material shall be approved by the A/E. All state and local regulations concerning borrow pits, drainage and erosion control shall be strictly followed.

B. Excavate borrow pits in such a way that the remaining surfaces and slopes are reasonably smooth and that adequate drainage is provided over the entire area. Construct drainage ditches wherever necessary to provide outlets for water to the nearest natural channel, thus preventing the formation of pools in the pit area. Leave the sides of borrow pit cuts at a maximum slope of 2:1 unless otherwise directed by the A/E.

C. Properly clear and grub borrow pits, and remove all objectionable matter from the borrow pit material before placing it in the backfill.

D. The taking of materials from borrow pits for use in the construction of backfill, fills, or embankments shall be considered an incidental part of the work; no separate payment shall be made for this.

## 3.9 BACKFILLING

A. Begin backfilling after the line construction is completed and then inspected and approved by the A/E. On each side of the line, from the bottom of barrel to 1 foot above the top of the pipe, the backfill material shall consist of **#67 CRUSHED STONE ONLY**. Place this backfill simultaneously on either side of

the pipe in even layers that before compaction are no more than 6 inches deep. Thoroughly and completely tamp each layer into place before placing additional layers. When shown on the drawings, this backfill shall, at locations beneath or closely adjacent to pavement, consist of No. 67 (TDOT) crushed stone.

B. From 1 foot above the pipe upward, the backfill material may contain broken stones that make up approximately 3/4 of the backfill's total volume. However, if this type of backfill is used, there must be enough spalls and earth materials to fill all voids completely. The maximum dimension of individual stones in such backfill shall not exceed 6 inches, and the backfill material shall be placed and spread in even layers not more than 12 inches deep. At locations beneath or closely adjacent to pavement or at locations of improvements subject to damage by dis-placement, tamp and thoroughly compact the backfill in layers that, before compaction, are 6 inches deep. In other areas, the backfill for the upper portion of the trenches may be placed without tamping but shall be compacted to a density equivalent to that of adjacent earth material as determined by laboratory tests. Use special care to prevent the operation of backfilling equipment from causing any damage to the pipe.

C. If earth material for backfill is, in the opinion of the A/E, too dry to allow thorough compaction, then add enough water so that the backfill can be properly compacted. Do not place earth material that the A/E considers too wet or otherwise unsuitable.

D. Wherever excavation has been made within easements across private property, the top 1 foot of backfill material shall consist of fine loose earth free from large clods, vegetable matter, debris, stone, and/or other objectionable materials.

E. Wherever trenches have been cut across or along existing pavement, temporarily pave the backfill of such trenches by placing Class A, Grade D base, crushed stone as the top 12 inches of the backfill. Maintain this temporary pavement either until the permanent pavement is restored or until the project is accepted by the Owner. On heavily traveled roadways, cold mix or leveling course binder 2 inches thick shall be installed and maintained until permanent pavement is installed.

F. Conduct backfilling around manholes, inlets, outfalls, and/or structures in the same manner as specified above for pipelines except that even greater care is necessary to prevent damage to the utility structure.

G. Wherever pipes have diameters of 15 inches or less, do not use power operated tampers to tamp that portion of the backfill around the pipe within 1 foot above the pipe.

H. Perform backfilling so as not to disturb or injure any pipe and/or structure against which the backfill is being placed. If any pipe or structure is damaged and/or displaced during backfilling, open up the backfill and make whatever repairs are necessary, whenever directed to do so by the A/E.

I. Backfilling and clean-up operations shall closely follow pipe laying; failure to comply with this provision will result in the A/E's requiring that the Contractor's other activities be suspended until backfilling and clean-up operations catch up with pipe laying.

J. Compaction Requirements: Unless specified otherwise elsewhere, under buildings and 2 times the depth of pipe beyond, and under roads and 2 times the depth beyond the shoulder, compact to 95% maximum density in accordance with ASTM D698. In all other locations, compact to 90% maximum density.

3.10 MAINTENANCE

A. Seed and maintain in good condition all excavated areas, trenches, fills, embankments, and channels until final acceptance by the Owner.

B. Maintain trench backfill at the approximate level of the original ground surface by periodically adding backfill material wherever necessary and whenever directed to do so by the A/E. Continue such maintenance until final acceptance of the project, or until the A/E issues a written release.

3.11 SLOPES

A. Neatly trim all open cut slopes, and finish to conform either with the slope lines shown on the drawings or the directions of the A/E. Leave the finished surfaces of bottom and sides in reasonably smooth and uniform planes like those normally obtainable with hand tools, though the Contractor will not be required to use hand methods if he is able to obtain the required degree of evenness with mechanical equipment. Conduct grading operations so that material is not removed or loosened beyond the required slope.

END OF SECTION

## PART 1. GENERAL

1.1 The work called for by this section shall include, but not necessarily be limited to, finish grading and the spreading any shaping of topsoil to the finished contour elevations indicated by the drawings.

1.2 Refer to other sections for work related to that specified under this heading. Coordinate this work with that specified by other sections for timely execution.

## PART 2. PRODUCTS

2.1 Topsoil: Use stripped topsoil that has been stockpiled as specified elsewhere. If the quantity of topsoil on the job is inadequate, furnish enough additional topsoil. Topsoil furnished shall be natural, fertile, friable soil possessing characteristics of representative productive soils in the vicinity. It shall be obtained from naturally well drained areas. It shall not be excessively acid or alkaline nor contain toxic substances that may be harmful to plant growth. Topsoil shall be without admixture of subsoil and shall be cleaned and reasonably free from clay lumps, stones, stumps, roots, or similar substances two (2) inches or more in diameter, debris, or other objects that are a hindrance to planting operations. Such material shall be subject to testing.

## PART 3. EXECUTION

3.1 Do not begin work until the earth is dry enough to be tillable.

3.2 Inspect subgrades to see that they generally conform to the standards called for elsewhere in these specifications, particularly with regard to the approximate depths required for the work. After work is completed, inspect it to ensure that all finish grading complies with design requirements.

3.3 Place finished grade stakes wherever necessary to bring the work accurately to the elevations required by the drawings.

3.4 Finish grade all areas outside the building line to the depths required for the work as follows:

A. Grade uniformly with rounded surfaces at the tops and bottom of abrupt changes of planes.

B. Hand grade steep slopes and areas that are inaccessible for machine work.

C. Protect graded areas from undue erosion, and repair and regrade areas where erosion does occur.

D. Refill areas where noticeable settlement has occurred.

E. Finish grade areas that are to receive topsoil up to four (4) inches below the finished contour elevations called for by the drawings or, over rock, to 12 inches below these elevations.

3.5 Place topsoil uniformly over disturbed areas that do not receive other work as follows:

A. Obtain approval of the finish grading from the A/E before starting to place topsoil.

B. Scarify subgrade to a depth of three (3) inches.

C. Place the topsoil to a depth of four (4) inches when lightly rolled or, on rock, to a depth of 12 inches.

D. Level the topsoil so that it slopes uniformly and has no water pockets.

E. Carefully rake the topsoil by hand to remove all clods, roots, sticks, stones over one (1) inch in diameter, and other foreign materials from the surface.

3.6 Dispose of excess excavated materials and debris away from the site.

END OF SECTION

## PART 1. GENERAL

1.1 This item consists of furnishing and placing riprap slope protection, subgrage stabilization and roadway fill with 6" surge stone or shotrock in accordance with the drawings and specifications.

## PART 2. PRODUCTS

2.1 The riprap material shall be durable and of hard natural stone or broken concrete. It shall be sound and dense, free from cracks, seams, or other defects that would tend to cause increased deterioration because of freezing and thawing or other natural causes. Riprap material shall be reasonably well graded from the minimum size stone and shall be Class "B" riprap consisting of clean machined stone ranging in size from 3"-27" and an installation layer thickness of 2.5' and containing no more than 20% by weight stone in size less than 6". Class "A-1" riprap consisting of clean machined stone ranging in size from 2"-15" and an installation of 1.5' and containing no more than 20% by weight stone in size less than 4". Fragments or spalls shall be used to fill the voids between the larger rocks. The inclusion of appreciable quantities of dirt, sand, clay, or rock fines will not be accepted. All materials considered for use as riprap shall be approved by the A/E.

## PART 3. EXECUTION

3.1 Earth surface on which riprap is to be placed shall be trimmed and graded so as to provide for the thickness of riprap shown on the drawings. Surfaces that are below grade shall be brought to grade by filling with well-compacted materials similar to the adjacent materials. Prior to placement of riprap, the prepared earth foundation will be inspected and no materials shall be placed thereon until approved by the A/E.

3.2 Place riprap to the full course thickness at one operation and in such a manner as to avoid serious displacement of the underlying materials. Deliver and spread the material so that the mass of pieces in place shall be reasonably well graded, with the larger pieces uniformly distributed and the smaller pieces and spalls filling the voids between the larger pieces. The finished riprap shall be free from objectionable concentrations of large or small pieces.

END OF SECTION

## PART 1. GENERAL

1.1 This work shall be performed in all disturbed areas not receiving such site improvements as buildings, roads, walks, sod, planting, etc., and shall include, but not necessarily be limited to, all seed bed preparation; the supplying and placing of soil additives, seed, and mulch wherever required by the drawings or directed by the A/E; and maintenance.

1.2 Unless otherwise approved in writing by the A/E, seeding operations shall be limited to the following planting periods:

A. Spring - March 1 through May 30
B. Fall - August 15 through October 31

1.3 Refer to other sections for items affecting seeding. Coordi-nate this work with that specified by other sections for timely execution.

## PART 2. PRODUCTS

2.1 GRASS SEED: Kentucky 31 Fescue (Festuca elatior) and/or annual rye meeting the requirements of the State Department of Agriculture and furnished in new bags or bags that are sound and not mended; no "below standard" seed will be accepted.

2.2 FERTILIZER: commercially manufactured; Grade 10-10-10; furnished in standard containers that are clearly marked with the name, weight, and guaranteed analysis of the contents and that ensure proper protection in transportation and handling; and in compliance with all local, state, and federal fertilizer laws.

2.3 AGRICULTURAL LIMESTONE: containing a minimum of 85% calcium carbonate and magnesium carbonate combined, 85% of which passes a No. 10 mesh sieve.

2.4 MULCH: stalks of rye, oats, wheat, or other approved grain crops properly cured prior to bailing, air dried, and reasonably free of noxious weeds and weed seeds or other material detrimental to plant growth.

## PART 3. EXECUTION

3.1 Perform all seeding and related work as a continuous operation. Sow seed as soon as the seed bed has been prepared, and perform subsequent work in a continuous manner.

3.2 Before beginning seeding operations in any area, complete the placing of topsoil and final grading, and have the work approved by the A/E.

3.3 Scarify, disk, harrow, rake, or otherwise work each area to be seeded until the soil has been loosened and pulverized to a depth of not less than 2 inches. Perform this work only when the soil is in a tillable and workable condition.

3.4 Apply fertilizer and agricultural limestone uniformly over the seed bed, and lightly harrow, rake, or otherwise incorporate them into the soil for a depth of approximately 1 inch at the following rates:

Fertilizer: 15 pounds per 1,000 square feet
Agricultural Limestone: 40 pounds per 1,000 square feet

3.5 Sow seed uniformly with a rotary seeder, wheelbarrow seeder, hydraulic equipment or by other satisfactory means.

3.6 The seeding rate shall be 5 pounds per 1,000 square feet for Kentucky 31 Fescue (Festuca elatior).

3.7 When seeding during March 1 through April 1 and October 1 through November 20, add an additional 3 pounds per 1,000 square feet of annual rye grass.

3.8 Perform no seeding during windy weather or when the ground surface is frozen, wet, or otherwise untillable.

3.9 Spread mulch material evenly over the seeded areas immediately following the seeding operation. Mulch Rate: 2 bales (100 pound minimum) per 1,000 square feet.

3.10 The mulch rate may be varied by the A/E, depending on the texture and condition of the mulch material and the characteristics of the area seeded. Cover all portions of the seeded areas with a uniform layer of mulch so that approximately 25% of the ground is visible.

3.11 No equipment, material storage, construction traffic, etc., will be permitted on newly seeded ground.

3.12 Dispose of all surplus materials as directed by the Owner.

## PART 4. INSPECTIONS

The A/E shall inspect the seeding within 60 days after planting and determine if it is acceptable.

## PART 5. GUARANTEE

5.1 Secure an acceptable growth of grass in all areas designated for seeding.

5.2 An area is considered acceptable if it is represented by a minimum of 100 seedlings per square foot of the permanent species of grass representative of the seed mixture. If an acceptable growth is not obtained on the first planting, reseeding and remulching will be required.

5.3 If the planting is less than 50% successful, rework the ground, refertilize, reseed, and remulch.

END OF SECTION

## PART 1. GENERAL

1.1 The work specified by this section shall consist of repairing or replacing all damaged pavement, whether public or private. Dirt shoulders, roads, streets, drives, and walks are to be restored to their original condition as an incidental part of the installation of utilities. Repair damaged base on either side of a trench wherever necessary. Trim the oxidation surface to neat lines outside of the trench wall, and repave the entire area as specified below and as shown on the drawings or on the standard drawings.

1.2 Both these specifications and the drawings make reference to the current edition of the standard specifications of the Tennessee Department of Transportation (TDOT). Even though the weather limitations, construction methods, and materials specifications contained in the TDOT specifications may not be explicitly repeated in these specifications, they shall, wherever applicable to the work called for by this section, be considered as implied and therefore adhered to. However, the various subsections "Basis for Payment" contained in the TDOT specifications shall not be considered applicable.

A. Refer to other sections for work related to that covered by this section.

## PART 2. PRODUCTS

2.1 MINERAL AGGREGATE BASE: Class A, Grading D crushed stone (TDOT specifications, Section 303, subsection 903.05)

2.2 BITUMINOUS PRIME COATS: cutback asphalt, Grade RC-250, or emulsified asphalt, Grade AE-P (Section 402, Subsections 904.02 and 904.03)

2.3 CRUSHED STONE CHIPS: Size 6 or Size 7 (Subsection 903.14)

2.4 DOUBLE BITUMINOUS SURFACE: for both courses, either cutback asphalt, Grade RC-800 or RC-3000, or emulsified asphalt, Grade RS-2 (Subsections 904.02 and 904.03)

2.5 ASPHALTIC CONCRETE BINDER: Grading B or C, as directed by the A/E (Section 307)

2.6 BITUMINOUS TACK COAT: Grade AE-3 (Section 403, Subsection 904.03)

2.7 ASPHALTIC CONCRETE SURFACE: Grading E (Section 411)

2.8 QUICK DRY TRAFFIC MARKING PAINT (WHITE AND YELLOW): Subsection 910.05.

PART 3. EXECUTION

3.1 SUBGRADE

A. Before any base material is installed, compact the subgrade of the area to be paved to 95% of optimum density as determined by ASTM D698 (Standard Proctor).

B. The backfill material shall contain no topsoil or organic matter. For all areas where subgrade has been prepared, test for uniformity of support by driving a loaded dump truck at a speed of 2 to 3 mph over the entire surface. Make further improvements on all areas that show a deflection of 1 inch or more. When completed, the finished subgrade shall be hard, smooth, stable, and constructed in reasonably close conformance with the lines and grades that existed prior to beginning construction.

C. When a base course is compacted, cut back the surface course of the existing pavement a minimum of 1 foot beyond the limit of the joint between the old and new base course or as shown on the standard drawings. Take special care to ensure good compaction of the new base course at the joint. Apply and compact the surface to conform to the existing pavement so that it will have no surface irregularity.

3.2 BASE

A. Install a mineral aggregate base of the type specified above in accordance with Section 303 of the TDOT specifications. The maximum compacted thickness of any one layer shall be 6 inches and the total thickness of the base shall be that indicated by the standard drawings or as shown on the plans.

3.3 SEAL COAT SURFACE

A. Uniformly apply a bituminous prime coat of either emulsified asphalt, Grade AE-P, or cutback asphalt, Grade RC-250, over the entire width of the area to be surfaced at a rate of 0.3 gallon per square yard. Immediately after

application, uniformly cover the entire area with Size 7 crushed stone chips at a rate of 12 pounds per square yard.

## 3.4 DOUBLE BITUMINOUS SURFACE

A. Apply the first course at a rate of 0.38 to 0.42 gallon per square yard with either emulsified asphalt, Grade RS-2, or cutback asphalt, Grade RC-800 or RC-3000, and then immediately cover with Size 6 crushed stone chips at a rate of 33 to 37 pounds per square yard. After this is rolled, apply the second course at a rate of 0.30 to 0.35 gallon per square yard, and at once uniformly cover with Size 7 chips at a rate of 20 to 25 pounds per square yard. Then roll the entire area.

B. After the application of the cove aggregate, lightly broom or otherwise maintain the surface for a period of 4 days, or as directed by the A/E. Maintenance of the surface shall include the distribution of cover aggregate over the surface to absorb any free bitumen and cover any areas deficient in aggregate. Sweep excess material from the entire surface with rotary brooms. Sweep the surface at the time determined by the A/E.

## 3.5 ASPHALTIC CONCRETE BINDER

A. Apply a bituminous prime coat of emulsified asphalt, Grade AE-P, or cutback asphalt, Grade RC-250, at a rate of 0.38 to 0.42 gallon per square yard. Take care to prevent the bituminous material's splashing on exposed faces of curbs and gutters, walls, walks, trees, etc; if such splashing does occur, remove it immediately. After the prime coat has been properly cured, apply an asphaltic concrete binder to the thickness shown on the standard drawings or the plans.

B. Carefully place the material to avoid segregation of the mix. Broadcasting of the material will not be permitted. Remove any lumps that do not readily break down.

## 3.6 ASPHALTIC CONCRETE SURFACE

A. If the asphaltic concrete surface course is to be placed directly on the mineral aggregate base, place a bituminous prime coat as described above. If, however, the surface course is to be placed on a binder course, then apply a bituminous tack coat of the sort specified above under PRODUCTS at a rate

of 0.05 to 0.10 gallon per square yard. Take care to prevent the bituminous material's splashing on exposed faces of curbs, gutters, walls, walks, trees, etc.; if such splashing does occur, remove it immediately. After the prime or tack coat has been properly cured, apply the asphaltic concrete to the thickness shown of the drawings or standard drawings.

Apply the surface course as described above for the binder course.

## 3.7 SMOOTHNESS

A. The finished surfaces shall conform to the lines and grades that existed prior to construction. No deviations, variations, or irregularities exceeding 1/4 inch in any direction when tested with a 12 foot straightedge will be permitted in the finished work, nor will any depressions that will not drain. Correct all such defects.

## 3.8 SAMPLING AND TESTING

A. Submit to the A/E test reports made by an independent testing laboratory on the crushed stone aggregate, bituminous materials, and asphaltic concrete design mixes, and obtain his approval of these reports before starting paving operations.

B. Tests shall be made of the completed elements of the pavement to ascertain the compacted thickness of the base and surface courses. If sections with deficient thicknesses are found, the full section for a reasonable distance on each side of the deficiency shall be refused. Remove and reinstall all such sections. Patch all test holes in connection with thickness tests.

C. When making surface tests, furnish one man to mark all surface defects for corrections.

END OF SECTION

## PART 1. GENERAL

1.1 Manholes shall be precast or monolithic concrete with concentric cones unless otherwise approved by the A/E.

1.2 Refer to other sections for items affecting manholes. Coordinate this work with that specified by other sections for timely execution.

1.3 Shop drawings are required for castings, plastic gaskets, and precast manholes specified in this section.

## PART 2. PRODUCTS

2.1 CONCRETE MASONRY: reinforced or plain, meeting the applicable requirements of Section 03303, Concrete for Utility Lines.

2.2 CLAY BRICK (FOR CASTING ADJUSTMENT): Clay brick shall be medium hard or better quality Grade SM sewer brick conforming to the requirements of ASTM C32. Brick shall be solid and not cored or frogged.

2.3 MORTAR: composed of one (1) part portland cement and two (2) parts sand (volumetric measure) thoroughly mixed in a tight box, with water added gradually and mixed continually until mortar has attained the proper consistency for use in brick masonry; prepared only in such quantities as needed for immediate use; mortar mixed for more than 30 minutes, retempered, or previously set will not be allowed. Xypex Admix C-1000 shall be added to the concrete at the time of batching. This admixture shall be in accordance with the manufacturer's instructions.

2.4 GRAY IRON CASTINGS: cast iron conforming to the requirements of Class 30, ASTM A48; made accurately to the required dimensions; sound, smooth, clean, and free from blisters and other defects; not plugged or otherwise treated to remedy defects; machined so that covers rest securely in the frames with no rocking and are in contact with frame flanges for the entire perimeter of the contact surfaces; thoroughly cleaned subsequent to machining and, before rusting begins, painted with a bituminous coating so as to present a smooth finish; tough and tenacious when cold, but not tacky and with no tendency to scale; and with the actual weight in pounds stenciled or printed by the manufacturer on each casting in white paint.

2.5 PLASTIC GASKET FOR PRECAST MANHOLES: Preformed plastic gasket shall meet or exceed all requirements of FS SS-S-00210, "Sealing Compound, Preformed Plastic for Pipe Joints," Type I, rope form. The sealing compound shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes, or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded rope form of suitable cross section and in such sizes as to seal the joint space when the pipes are laid. Use two (2) complete ropes at each joint. The sealing compound shall be protected by a suitable removable two (2) piece wrapper, which shall be designed so that half may be removed longitudinally without disturbing the other half in order to facilitate application of the sealing compound. The flexible plastic gasket shall also meet the requirements of the following table:

| Composition | Test Method | Minimum | Maximum |
|---|---|---|---|
| Bitumen (Petroleum Plastic Content) | ASTM D4 | 50 | 70 |
| Ash Inert Mineral Matter | AASHO T111 | 30 | 50 |
| Volatile Matter | ASTM D6 | -- | 2.0 |

| Property | Test Method | Minimum | Maximum |
|---|---|---|---|
| Specific Gravity at 77 degrees F | ASTM D71 | 1.20 | 1.30 |
| Ductility at 77 degrees F (cm) | ASTM D113 | 5.0 | --- |
| Softening Point | ASTM D36 | 320 degrees F | --- |
| Penetration at 77 degrees F (150 gms) 5 sec. | ASTM D217 | 50 | 120 |

2.6 LADDER BARS: an aluminum alloy weighing 2.2 pounds or 1/2 inch steel reinforced rod encapsulated in polypropylene plastic.

2.7 PRECAST MANHOLE COMPONENTS: meeting the requirements of the standard drawings and ASTM C478. The manhole sidewall shall be of a length such that a minimum of one course and a maximum of four (4) courses of brick shall be placed on top of the unit to bring the casting to grade. Minimum wall thickness shall be five (5) inches.

2.8 MATERIAL TESTING: All precast reinforced concrete manhole risers and tops specified herein shall be tested and inspected by a commercial testing laboratory approved by the A/E prior to delivery to the site, and all materials that fail to conform to these specifications shall be rejected. After delivery to the site, any materials that have been

damaged in transit or are otherwise unsuitable for use in the work shall be rejected and removed from the site. Supply certified copies in duplicate of the inspection and acceptance reports of the testing laboratory to the A/E before using the materials. The commercial testing laboratory shall be engaged and paid for by the Contractor. Submit a certificate from the manufacturer of the castings indicating that they meet all applicable requirements of these specifications.

## PART 3. EXECUTION

3.1 Dewater sufficiently to maintain the ground water level at or below the bottom of the manhole foundation prior to and during placement of the foundation.

3.2 Obtain an adequate foundation for all manhole structures by removing and replacing unsuitable material with well graded granular material, by tightening with coarse rock, or by such other means as provided for foundation preparation of the connected sewers or as directed by the A/E. Wherever water is encountered at the site, place all cast-in-place bases or monolithic structures on a one-piece waterproof membrane to prevent any movement of water into the fresh concrete.

3.3 When the foundation subgrade has been prepared and is approved by the A/E, carefully construct the concrete foundation for monolithic manholes to the line and grade required by the drawings. Construct the manholes after the concrete foundation has been allowed to set for a period of not less than 24 hours.

3.4 For precast manholes, carefully block the base section above the prepared surface so that it is fully and uniformly supported in true alignment; make sure that all entering pipe can be inserted at proper grade. Then place the concrete foundation and invert under and upon this base section as shown in the standard drawings. A base section with monolithic foundation (bottom) may be used when approved by the A/E.

3.5 Thoroughly wet and then completely fill all lift holes and all joints between precast elements with mortar. Smooth and paint them both inside and outside to ensure watertightness.

3.6 Construct monolithic concrete manholes and bases of 4,000 psi concrete in accordance with the provisions of this section and applicable provisions of Section 03303, Concrete for Utility Lines. The ladder bars shall be cast in place.

3.7 Carefully set the cast iron frame for the cover at the required elevation, and properly bond it to the masonry with cement grout and/or anchor bolts. Whenever manholes are constructed in paved areas, tilt the top surface of the frame and cover so as to conform to the exact slope, crown, and grade of the existing adjacent pavement.

3.8 Manhole inverts shall be constructed of concrete or Portland cement mortared masonry fill and may, at the Contractor's option, be covered with cement mortar to the approximate cross section of the sewers connected to them. Make any necessary changes in cross sections gradually from side to side of the manhole; make changes in direction of flow of the sewers to a true curve of as large a radius as is permitted by the size of the manhole. Construct brick inverts with the brick laid on edge and longitudinally with the invert channel. Inside face joints shall be not more than 1/4 inch thick.

3.9 All rigid unreinforced pipe entering or leaving the manhole shall be provided with flexible joints within 12 inches of the manhole structure, or encase the full joint in concrete. Place such pipe on firmly compacted bedding, particularly in the area of the manhole excavation, which is normally deeper than excavation for sewer trenches. Take special care to see that the openings through which pipes enter the structures are completely and firmly rammed full of shrinkproof mortar or otherwise constructed to ensure watertightness.

3.10 Use gasketed PVC manhole sleeve on all PVC pipe at connections to manholes. Sleeve shall be type as manufactured by Vasallo, or equal.

3.11 Where the difference in the invert elevation of two or more lines intersecting in one manhole is 24 inches or more, construct a drop manhole. Drop manholes shall be similar in construction to standard manholes except that a drop connection of pipe and fittings of the proper sizes and materials shall be constructed outside the manhole and supported by 3,000 psi concrete as indicated by the standard drawings.

3.12 Place backfill by hand around the manhole and to a distance of at least one (1) pipe length into each trench, and tamp with selected material up to an elevation of 12 inches above the crown of all entering pipes. Continue backfilling in accordance with the requirements for trench backfilling.

3.13 Each manhole shall be vacuum tested immediately after installation or rehabilitation and prior to backfilling. No standing water shall be allowed in the manhole excavation which may affect the accuracy of the test. All lifting holes and exterior joints shall be filled and pointed with an approved non-shrink mortar. All pipes and other openings into the manhole shall be suitably plugged in such a manner as to prevent

displacement of the plugs while the vacuum is drawn. Installation and operation of the vacuum equipment and indicating devices shall be in accordance with equipment specification and instructions provided by the manufacturer. The test head may be placed in the cone section of the manhole. The rim to cone joint is not usually tested. A vacuum of 7.5 inches of mercury shall be drawn. The time for the vacuum to drop to 6.5 inches shall be recorded. Acceptance for four (4) feet diameter manholes shall be defined as when the time to drop one (1) inch meets or exceeds the following:

| Manhole Depth | Time to Drop One (1) Inch |
|---|---|
| 10 feet or less | 75 seconds |
| 10 feet to 15 feet | 90 seconds |
| 15 feet to 25 feet | 105 seconds |

For manholes five (5) feet in diameter, add an additional 15 seconds. For manholes six (6) feet in diameter, add an additional 30 seconds. If the manhole fails the test, necessary repairs shall be made and the vacuum test repeated until the manhole passes the test. If the manhole joint mastic on gasket is displaced during the vacuum test, the manhole shall be disassembled, the seal replaced, and the manhole re-tested.

END OF SECTION

## PART 1. GENERAL

1.1 Pipe material for sewer lines 18 inches and smaller shall be PVC unless otherwise shown on the drawings. Ductile iron pipe shall be used only when so indicated on the drawings.

1.2 Pipe material for sewer lines 21 inches and larger shall be reinforced concrete, or PVC unless otherwise shown on the drawings. Ductile iron pipe shall be used only when so indicated on the drawings.

1.3 Shop drawings are required for all products specified in this section.

1.4 Refer to other sections for items affecting gravity sewers. Coordinate this work with that specified by others sections for timely execution.

## PART 2. PRODUCTS

2.1 PIPE

A. Reinforced Concrete: pipe to be of reinforced concrete pipe conforming to the requirements of ASTM C76, Class IV, with Wall Thickness B, unless otherwise authorized by the A/E in writing, and as specified on the drawings; circular concrete pipe with elliptical reinforcements will not be acceptable.

B. Laying lengths of reinforced concrete sewer pipe shall not exceed eight (8) feet unless written approval of the A/E is secured. Pipe shall be manufactured with machine bell pallets with a maximum slope of two (2) degrees.

C. Polyvinyl Chloride (PVC): to meet and/or exceed the requirements of ASTM D3034, SDR 21, **NO SDR 35 ALLOWED** suitable for use as a gravity sewer conduit with provisions for contraction and expansion at each joint; with a rubber ring and standard length 12.5 feet plus or minus one (1) inch; designed to pass all tests at 73 degrees F (plus or minus 3 degrees F); six (6) inches long sections of pipe to be subjected to impact from a free falling

type (20 pounds, Type A) in accordance with ASTM D2444 with no evident splitting or shattering (denting not considered a failure); and with a minimum envelope of four (4) inches of granular material around the pipe, but with all other bedding and backfilling requirements remaining the same as for other pipe material.

D. Ductile Iron: with push-on joints conforming to ASTM A746, Class 50 thickness unless otherwise shown on the drawings.

E. Lateral Branches: to be tees of the same material as the main sewer and have a six (6) inches inside diameter unless otherwise specified or noted; able to withstand all test pressures involved without leakage.

2.2 JOINTS AND JOINTING MATERIALS

A. Concrete Pipe Joints: Joints shall be compressive type in accordance with ASTM C361, Type R-4 (bell and spigot) with resilient seals embedded in both the bell and spigot ends. They shall be joints with O-ring gaskets.

B. All rubber end rings shall be extruded or molded and cured such that any cross section will be dense, homogenous and free of parasites, blisters, pitting, and other imperfections. The basic rubber material, EPDM, shall meet ASTM C443 with the exception of 40-60 duro hardness. The resilient interlocked end seals shall be duro A-40-70, plus or minus 2.

C. Polyvinyl Chloride (PVC) Pipe Joints: Joints for sewer plastic pipe shall meet all requirements of ASTM D3212 standard specifications. Joint design shall be tested and certified to result in no leakage under prescribed laboratory test conditions of joint alignment, load conditions, pressure and vacuum, and deflection. Pipe and fittings shall have integral bell with elastomeric seal joint.

D. Ductile Iron Pipe Joints: gasket type joints for bell and spigot ductile iron pipe designed to meet the infiltration requirements of these specifications; jointing to comply with the applicable provisions of ANSI A21.11.

2.3 COMPRESSION COUPLINGS

A. When dissimilar pipe materials like PVC and concrete pipe are joined, use compression couplings that are resistant to the corrosive action of soils and sewage and that will provide a permanent watertight joint. The compression couplings shall be of natural or synthetic rubber or rubber-like material and shall comply with the requirements and test methods specified in Table 2 of ASTM C425. The coupling shall meet the leak requirements specified in ASTM C425, and the bands for attaching the couplings to the dissimilar pipes shall be of stainless steel meeting ASTM A167 or A240. Each coupling shall bear the manufacturer's identifying mark and an indication of its size.

PART 3. EXECUTION

3.1 PIPE LAYING

A. Lay no pipe except in the presence of an inspector representing the A/E.

B. Before placing sewer pipe in position in the trench, carefully prepare the bottom and sides of the trench, and install any necessary bracing and sheeting as provided in Section 02221, Unclassified Excavation for Utilities.

C. Wherever necessary to provide satisfactory bearing surface, place concrete cradles as shown on the drawings or as directed by the A/E. Cradles shall be of concrete and conform to the dimensions shown on the drawings. Concrete placed outside the dimensions shown shall be at the Contractor's expense.

D. Tightly stretch a mason's line or wire above ground level, parallel to and directly above the axis of the pipe to be installed, supporting this line at intervals of no more than 50 feet for sewers being laid on a grade of 2% or more and of no more than 25 feet for grades of less than 2%. Determine the exact line and grade for each section of pipe by measuring down from this

line to the invert of the pipe in place, and accurately place each pipe to the exact line and grade called for on the drawings. Furnish all labor and materials necessary for erecting batterboards.

E. Lasers may be used after the type and procedures are approved by the A/E. When lasers are used, set reference points for both line and grade at each manhole. Where grades are 0.6% or less, check the elevation of the beam each 100 feet with an offset point or engineer's level.

F. Do not allow water to run or stand in the trench while pipe laying is in progress or before the trench has been backfilled. Do not at any time open up more trench than the available pumping facilities are able to dewater.

G. Correct trench bottoms found to be unsuitable for foundations after pipe laying operations have started, bringing them to exact line and grade with compacted earth as necessary.

H. Carefully inspect each piece of pipe and special fitting before it is placed, and lay no defective pipe in the trench. Pipe laying shall proceed upgrade, starting at the lower end of the grade and with the bells upgrade. When pipe laying is not in progress, keep the ends of the pipe tightly closed with an approved temporary plug.

I. Bell holes shall be large enough to allow ample room for the pipe joints to be properly made. Cut out bell holes no more than two (2) joints ahead of the pipe laying. Carefully grade the bottom of the trench between bell holes so that each pipe barrel rests on a solid foundation for its entire length. Lay each pipe joint so as to form a close concentric joint with adjoining pipe and to avoid sudden offsets or inequalities in the flow line.

J. Before constructing or placing any joints, demonstrate to the A/E, by completing at least one sample joint, that the methods to be used conform to the specifications and will provide a watertight joint and further that the workmen to be involved in this phase of work are thoroughly familiar and experienced with the type of joint proposed.

K. No other type of joint may be used unless authorized in writing by the A/E.

L. Install tee branches in sewer lines to serve properly each lot facing or abutting on the street or alley in which sewer is being laid and at such other locations as may be designated by the A/E. If tee branches are not to be used immediately, close them with approved stoppers that are held in place to prevent infiltration and withstand all test requirements.

M. For all tees that are plugged and laid in rock, blast a minimum of six (6) linear feet of ditch line in the direction and to the approximate grade of the future lateral as directed by the A/E, but do not excavate the material. This shall be done at no extra cost to the Owner. Furnish the A/E with a record of the exact location of each tee installed.

N. If the work consists of constructing a new sewer to replace an existing one, connect existing service lines to the new line. Sewer service lines shall be reconnected and/or replaced to extend to the customers property line or length of existing stub-out.

O. New service laterals shall conform to the standard drawings.

P. The Contractor shall provide above-ground markers at the property line to indicate the termination of new service laterals.

Q. As the work progresses, thoroughly clean the interior of the pipe in place. After each line of pipe has been laid, carefully inspect it, and remove all earth, trash, rags, and other foreign matter from its interior.

R. After the joints have been completed, they shall be inspected, tested, and accepted by the A/E before being covered. The pipe shall meet the test requirements for watertightness; immediately repair any leak or defect discovered at any time after completion of the work. Any pipe that has been disturbed after joints were formed shall be taken up, the joints cleaned and remade, and the pipe relaid at the Contractor's expense. Carefully protect all pipe in place from damage until backfilling operations are completed.

S. Do not begin the backfilling of trenches until the pipe in place has been inspected and approved by the A/E.

T. Lay sewers at least ten (10) feet horizontally from any existing or proposed water main. If this is not practical, the sewer may be laid closer than ten (10) feet to a water main provided it is laid in a separate trench and the elevation of the top of the sewer is at least 18 inches below the bottom of the water main.

U. Where a sewer crosses under water mains, the top of the sewer shall be at least 18 inches below the bottom of the water main. If the elevation of the sewer cannot be varied to meet the above requirements, relocate the water main to provide this separation, or else reconstruct it with mechanical joint ductile iron pipe for a distance of ten (10) feet on each side of the sewer with a full joint of the water main centered over the sewer.

V. If it is impossible to obtain proper horizontal and vertical separation as stipulated above, construct both the water main and the sewer of mechanical joint ductile iron pipe, and pressure test each.

W. Perform boring by means of auguring to the size, line, and grade shown on the drawings. Jack the steel casing pipe into place as the boring proceeds. Weld sections of casing pipe together to provide a watertight joint.

X. Make connections to all existing sewer lines as shown on the drawings or as directed by the A/E. Make connections either by removing a section of the sewer from the existing line and inserting a wye or tee branch of the proper size or by constructing a manhole, junction box, regulator chamber, or other structure as shown on the drawings.

Y. Make connections to existing manholes or inlets by cutting a hole in the wall of the existing structure, inserting a length of sewer pipe with PVC gasketed sleeve into the hole, filling around the pipe with concrete or mortar, and troweling the inside and outside surfaces of the joint to a neat finish. Shape

or reshape the bottom of the manholes as necessary to fit the invert of the sewer pipe.

Z. Joint dissimilar pipe by using suitable compression couplings. If compression couplings are not available, make jointing with a special fabricated coupling approved by the A/E.

AA. Provide concrete protection or concrete cap as shown on the drawings for pipe sewers that, when completed, have less than 2.5 feet of covering in nontraffic areas and four (4) feet of cover in traffic areas. If such protection is not shown on the drawings, place it in accordance with the typical section shown.

BB. Carefully protect from damage all existing sewers, water lines, gas lines, sidewalks, curbs, gutters, pavements, electrical lines, and other utilities or structures in the vicinity of the work at all times. If it is necessary to repair, remove, and/or replace any such utility or structure in order to complete the work properly, do so in compliance with the provisions set forth in other section of these specifications. Any such work shall be considered incidental to the construction of pipe sewers, and no additional payment will be allowed therefore.

CC. Water service connections will be repaired or replaced by the Contractor at his expense as an incidental part of the work.

DD. Service or house connections to existing sewers that are damaged or removed shall be repaired or replaced by the Contractor at his own expense as an incidental part of the work.

EE. All testing of concrete pipe and materials will be made by a commercial testing laboratory. Before beginning work, furnish the A/E with the name of the pipe materials supplier. No pipe shall be delivered to the job site which does not bear the testing laboratory's stenciled or other marked sign of acceptance. Furnish the A/E with 2 certified copies of the testing laboratory's report of inspection, testing, and acceptance on all pipe and specials.

FF. For PVC and ductile iron pipe, furnish a certificate from the pipe manufacturer indicating that the pipe meets all applicable requirements of these specifications.

GG. Reinforced concrete pipe shall be tested by and meet the requirements of the Permeability Test and Hydrostatic Test of ASTM C14.

HH. The minimum pipe stiffness for PVC pipe at 5% deflection shall be 46 for all sizes when tested in accordance with ASTM D2412; external loading properties of plastic pipe shall be by parallel plate loading.

II. A specimen of PVC pipe six (6) inches long shall be flattened between parallel plates in a suitable press until the distance between the plates is 40% of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is complete in two (2) to five (5) minutes.

JJ. After being immersed for two (2) hours in a sealed container of anhydrous acetone (99.5% pure), a sample ring of PVC pipe shall show no visible spalling or cracking when tested in accordance with ASTM D2152 (swelling or softening is not considered a failure).

KK. The Contractor shall provide a cut-off wall in the trench for the gravity sewer lines. The wall shall be constructed in accordance with the detail included in the Standard Drawings. The cutoff wall shall be provided for all gravity sewer lines. The maximum spacing of the walls shall be 400 feet, with at least one (1) cut-off wall between manholes and one (1) cut-off wall below each creek crossing.

## 3.2 TESTING OF GRAVITY SEWERS

A. Visual Tests

1. Upon completion of the construction or earlier if the A/E deems advisable, the A/E will make a visual inspection of the sewer and

construction site. Immediately repair all leaks and defects found by such inspection.

2. In addition to general cleanup and leakage, the following standards shall be used to determine failure or defects of this project.

3. Sewers shall be built so as to remain true to line and grade. The inclining grade of the bottom of the sewer after completion shall be such that, after flooding, the flood water drains off so that no remaining puddle of water is deeper than 1/2 inch on pipe 36 inches internal diameter or smaller and 3/4 inch on pipe larger than 36 inches internal diameter. Any section of pipe that does not comply with the specifications at any time previous to final acceptance of the work shall be replaced or relaid at the Contractor's expense.

4. The Contractor will be held strictly responsible that all parts of the work bear the load of the backfill. If cracks 1/100 inch develop in the pipe within one (1) year from the date of final acceptance of the work, the Contractor will be required to replace, at his expense, all such cracked pipe. To this end, the Contractor is advised to purchase pipe under a guarantee from the manufacturer, guaranteeing proper service of sewer pipe under conditions established by the drawings, specifications, and local conditioning at the site of the work.

B. Air Testing for Sewers 24 Inches and Smaller

1. Perform low pressure air testing as follows:

a. Furnish all equipment, facilities, and personnel necessary to conduct the test. The test shall be observed by a representative of the A/E.

b. Make the air test after all services have been installed and backfilling has been completed and compacted.

c. Perform the first series of air tests after 2,000 linear feet but before 4,000 linear feet of sewer has been laid. The purpose of this first series of tests is to assure both the Contractor and the A/E that the materials and methods of installation meet the intent of these specifications. Conduct the remainder of the tests after approximately each 10,000 linear feet has been laid.

d. Plug all tees and ends of sewer services with flexible joint plugs or caps securely fastened to withstand the internal test pressures. Such plugs or caps shall be readily removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

e. Prior to testing, check the pipe to see that it is clean. If not, clean it by passing a full-gauge squeegee through the pipe. It shall be the Contractor's responsibility to have the pipe cleaned.

f. Immediately following this check or cleaning, test the pipe installation with low pressure air. Supply the air slowly to the plugged pipe installation until the internal air pressure reaches 4.0 psi more than the average back pressure of any ground water that may submerge the pipe. Allow at least two (2) minutes for temperature stabilization.

g. The pipeline shall be considered acceptable when tested at an average pressure of 3.0 psi more than the average back pressure of any ground water that may submerge the pipe, if the section under test does not lose air at a rate greater than 0.0015 cfm per square foot of internal pipe surface area. Calculate the pressure drop as the number of seconds for the air pressure to drop from a stabilized pressure of 3.5 to 2.5 psi more than the average back pressure of any ground water that may submerge the pipe. Calculate time as described in ASTM C828.

h. The requirements of this specification shall be considered satisfied if the time required in seconds for the pressure to decrease from 3.5 to 2.5 psi more than the average back pressure of any ground water that may submerge the pipe is not less than that shown in the following table:

i. If the pipe installation fails to meet these requirements, the Contractor shall determine at his own expense the source or sources of leakage and repair or replace all defective materials or workmanship. The completed pipe installation shall meet the requirements of this test before being considered acceptable.

j. The newly installed sewer line shall hold the determined pressure for a minimum of two (2) hours with no pressure loss to be accepted.

2. The recommended procedures for conducting acceptance tests are as follows:

a. Clean pipe that is to be tested.

b. Plug all pipe outlets with suitable test plugs, and brace each plug securely.

c. Increase gauge pressure in the test by the amount of ground water pressure at the crown of the pipe.

d. Add air slowly to the portion of the pipe installation being tested until the internal air pressure is raised to 4.0 psi more than the average back pressure above the crown of the pipe.

e. After the above internal pressure is obtained, allow at least two (2) minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.

f. After two (2) minutes, disconnect the air supply.

g. When pressure decreases to 3.5 psig either by leaking down or by bleeding down with a release valve, start the stopwatch, and determine the time in seconds that is required for the internal air pressure to reach 2.5 psig.

Compare this time interval as calculated above. If the time is more than that calculated, the test shall be assumed to be acceptable.

3. Plugs used to close the sewer pipe for the air test must be securely braced to prevent the unintentional release of a plug, which can become a high velocity projectile. Locate gauges, air piping manifolds, and valves at the top of the ground. No one shall be permitted to enter a manhole where a plugged pipe is under pressure. Four pounds air pressure (gauge) develops a force against the plug in a 12 inch pipe of approximately 450 pounds. Pipes more than 30 inches in diameter shall not be air tested because of the difficulty of adequately blocking the plugs. Provide a safety release device set to release at ten (10) psi between the air supply and the sewer under test.

4. Regardless of the outcome of the tests, repair any noticeable leak.

C. Testing for Sewers Larger than 24 Inches

1. Using Existing High Ground Water

a. Where the natural ground water is 24 inches or more above the top of a section of pipe, measure the flow of water in the pipe and the rates of seepage and infiltration. Measure the flow rate by using a calibrated weir. Leave the weir in the line until the flow rate has stabilized. The Contractor is responsible for verifying the ground water level by providing sight gauges in manholes or digging test holes at suitable locations.

b. The total seepage and infiltration of ground water as determined by the test shall in no case exceed 25 gallons per 24 hours per inch-mile of pipe. Make infiltration tests on all sewer construction before placing the lines in service and before making any connections to other sewers. If the amount of infiltration into the sewer(s) is in excess of the maximum quantity specified above, then recaulk or remake the joints, relay the sewer (if necessary), or perform other remedial construction, at the Contractor's expense, in order to reduce ground water infiltration to within the specified limits.

c. In making infiltration tests, furnish the required equipment and labor and do the necessary pumping under the direction of the A/E. Tests must be repeated until each sewer individually meets the specifications for infiltration amounts as set out above.

2. Exfiltration Test

a. Where the ground water is not 24 inches or more above the top of the pipe section being tested, then perform an exfiltration test. Bulkhead the pipe below the lower manhole of the section being tested with a pneumatic plug or other device. Insert a vent pipe 48 inches long in the stopper of the upper end of that section. Then fill the lower manhole with water, or add water until there is a minimum of four (4) feet over the upper end; make certain that all air is forced out through the vent tube. Measure the drop in the level of the water in the manhole due to exfiltration over a specific time, and calculate the water loss due to exfiltration. The total exfiltration shall not exceed that specified above for infiltration. Conditions encountered in construction may vary this procedure slightly, but essentially this is the method to be used.

3. Repairs

   a. Regardless of the outcome of any tests, repair any noticeable leak.

## 3.3 VISUAL INSPECTION OF MISCELLANEOUS MATERIALS

A. All material used on this project will be visually inspected by the A/E at the site for conformance to the required specifications. When reasonable doubt exists that said material meets the specifications, the A/E may require certified mill tests, samples, and/or tests by an independent laboratory or other suitable form of verification that the material meets the required specifications.

## 3.4 DEFLECTION TESTING FOR PVC PIPE

A. Test deflection of the pipe by passing a 9-arm pin go/no-go mandrel sized to 95% of the pipe diameter of the actual pipe used with the pipe in place and covered. Make this acceptance test after backfill consolidation has occurred.

## 3.5 CLEANUP

A. After completing each section of the sewer line, remove all debris, construction materials, and equipment from the site of the work, grade and smooth over the surface on both sides of the line, and leave the entire area in a clean, neat, and serviceable condition.

END OF SECTION

## PART 1. GENERAL

1.1 Contractor shall be responsible for safely storing materials needed for the work that have been accepted by him until they have been incorporated into the completed project. Keep the interiors of all pipes, fittings, and other accessories free from dirt and foreign matter at all times.

1.2 Wherever reaction blocking is necessary, it shall be considered an integral part of the water line work, and no separate payment shall be made for it.

## PART 2. PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. Ductile cast iron pipe shall be made of good quality ductile iron that meets the requirements for nodular iron castings of ASTM E8-61T. It shall be plain end ductile iron pipe with push-on, single gasket joints. The design thickness shall be that specified by ANSI A21.50/AWWA C150 except that all pipe with a diameter of 12 inches or less shall have a wall thickness of 0.25 inches and all pipe with a diameter of 14 inches or more shall have a thickness of 0.28 inches or greater.

B. Ductile iron pipe shall be centrifugally cast in metal or sand-lined molds and shall conform to the specifications of ANSI A21.51/AWWA C151. It shall be made and tested in accordance with ASTM A339 and shall be subjected to and able to withstand a hydrostatic pressure of 500 psi. The maximum depth of pits shall be half that allowed in the AWWA specifications.

C. The length of each individual piece of ductile iron pipe shipped must be plainly marked on that piece of pipe.

D. The push-on, single gasket joints shall be either Fastite (manufactured by American Cast Iron Pipe Company), Tyton U. S. Pipe and Foundry Company), Super Bell-Tite (Clow Corporation), or other joints of similar type

and equal quality. They shall be UL approved and able to withstand 200 psi of operating pressure.

E. The bell of each pipe shall have a tapered annular opening and a cast or machined retaining groove for the gasket. The gasket groove shall have a flared design so that maximum deflection will be provided. The plain spigot end of the pipe shall be beveled in order to simplify its entry into and centering within the bell and the compression of the gasket.

F. The gasket shall be of high quality vulcanized rubber made in the form of a solid ring to exact dimensions. The design of the gasket groove in the bell of the pipe and the design, hardness, and other properties of the gasket itself shall be such that the joint is liquidtight for all pressures from a vacuum to a maximum rating of 350 psi of internal liquid pressure.

G. Enough lubricant shall be furnished with each order to provide a thin coat on the spigot end of each pipe. This lubricant shall be approved for being in contact with potable water and shall be nontoxic, impart no taste of smell to the water, and have no harmful effect on the rubber gasket. It shall have a consistency that will allow it to be easily applied to the pipe in either hot or cold weather and that will enable it to adhere to either wet or dry pipe. In no case shall lubricant other than that supplied by the pipe manufacturer be used.

H. Standard and special fittings shall be ductile iron. Use standard mechanical joint fittings. All fittings shall conform to the specifications of ANSI A21.10/AWWA C110.

I. Pipe and fittings shall be lined with enameline or a thin cement lining as specified in ANSI A21.4/AWWA C104. In addition, a bituminous seal coat or asphalt emulsion spray coat approximately 1 mil thick shall be applied to the cement lining in accordance with the pipe manufacturer's standard practices.

J. Fitting laying lengths shall conform to ANSI A21.10/AWWA C110, short body.

K. Fittings shall be in accordance with the standard mechanical joint fittings manufactured by the U.S. Pipe and Foundry Company, American Cast Iron Pipe Company, Clow Corporation, or equal.

L. The pipe manufacturer is to furnish the A/E a certificate of inspection, sworn to by the factory inspector in the presence of a notary public, stating that the pieces of pipe in the shipment were made and tested in accordance with ANSI A21.51 and that they were subjected to and with-stood a hydrostatic pressure of 500 psi. Each statement is to give the number of pieces of pipe in the shipment,

the length of each piece of pipe, and the serial number of each piece of pipe making up the shipment. In addition, the weight of each individual piece of pipe making up the shipment is to be listed opposite the serial number of each pipe length and attached to the certificate of inspection.

2.2 PVC PIPE

A. All plastic pipe shall be made from Class 12454-B polyvinyl chloride plastic (PVC 1120) as defined by ASTM D1784.

B. All Class 200, 250, or 315 pipe shall have NSF approval and be manufactured in accordance with ASTM D2241. The following tests shall be run for each machine on each size and type of pipe being produced, as specified below:

1. Flattening Test: once per shift in accordance with ASTM D2412. Upon completion of the test, the specimen shall not be split, cracked, or broken.

2. Acetone Test (Extrusion Quality Test): once per shift in accordance with ASTM D2152. There shall be no flaking, peeling, cracking, or visible deterioration on the inside or outside surface after completion of the test.

3. Quick Burst Test: once per 24 hours in accordance with ASTM D1599.

| SDR | Pressure Rating | Minimum Bursting Pressure, psi |
|---|---|---|
| 13.5 | 315 | 1,200 |
| 17 | 250 | 1,000 |
| 21 | 200 | 800 |

4. Impact Tests: for 6 inches and larger, once per shift in accordance with ASTM D2444; for 4 inches and smaller, once each two hours in accordance with ASTM D2444.

5. Wall Thickness and Outside Dimensions Tests: once per hour in accordance with ASTM D2122.

6. Bell Dimension Test: once per hour in accordance with ASTM D3139.

C. If any specimen fails to meet any of the above mentioned tests, all pipe of that size and type manufactured between the test periods must be scrapped and a full set of tests rerun.

D. Furnish a certificate from the pipe manufacturer stating that he is fully competent to manufacture PVC pipe of uniform texture and strength and in full compliance with these specifications and further stating that he has manufactured such pipe and done so in sufficient quantities to be certain that it will meet all normal field conditions. In addition, the manufacturer's equipment and quality control facilities must be adequate to ensure that each extrusion of pipe is uniform in texture, dimensions, and strength. Also furnish a certificate from the manufacturer certifying that the pipe furnished for this project meets the requirements of these specifications.

E. All pipe shall be manufactured in the United States of America. All pipe for any one project shall be made by the same manufacturer.

F. All 4 inches and 6 inches pipe may be furnished in the manufacturer's standard laying lengths of 20 feet, 38 feet, or 40 feet. Pipe 8 inches and

larger shall be furnished in 20 feet lengths. The Contractor's methods of storing and handling the pipe shall be approved by the A/E. All pipe shall be supported within 5 feet of each end; in between the end supports, there shall be additional supports at least every 15 feet. The pipe shall be stored away from heat or direct sunlight. The practice of stringing pipes out along the proposed water line routes will not be allowed.

G. Certain information shall be applied to each piece of pipe. At the least, this shall consist of:

1. Nominal size
2. Type of material
3. SDR or class
4. Manufacturer
5. NSF Seal of Approval

H. Pipe that fails to comply with the requirements set forth in these specifications shall be rejected.

I. The pipe shall have push-on joints designed with grooves in which continuous molded rubber ring gaskets can be placed. Gaskets shall be made of vulcanized natural or synthetic rubber; no reclaimed rubber will be allowed. Gasket materials shall meet the requirements of ASTM F477. The gaskets shall be of the manufacturer's standard design dimensions and of such size and shape as to provide a positive seal under all combinations of joint and gasket tolerance. The gasket and annular groove shall be designed and shaped so that when the joint is assembled, the gasket will be radically compressed to the pipe and locked in place against displacement, thus forming a positive seal.

J. The spigot end of each pipe shall be beveled so that it can be easily inserted into the gasket joint, which in turn shall be designed so that the spigot end may move in the socket as the pipe expands or contracts. The spigot end shall be striped to indicate the distance into which it is to be inserted into the socket. Each joint shall be able to accommodate the thermal expansions and contractions experienced with a temperature shift of at least 75 degrees F.

K. Enough lubricant shall be furnished with each order to provide a coat on the spigot end of each pipe. This lubricant shall be approved for being in contact with potable water and shall be nontoxic, impart no taste or smell to the water, have no harmful effect on the gasket or pipe material, and support or promote any bacterial growth. The lubricant containers shall be labeled with the manufacturer's name. In no case shall lubricant other than that supplied by the pipe manufacturer be used.

L. Joints shall be manufactured in accordance with ASTM D3139 except that the thickness of the bell shall be, as a minimum, equal to that of the barrel. Joints shall be either integral bell and ring joints with rubber compression gaskets as manufactured by the Clow Corporation, Johns-Manville, or Vulcan Plastic Corporation; twin gasket couplings as manufactured by the Certain-Teed Products Corporation; or equal. However, the pipe and bell must be made by the same manufacturer.

M. Standard and special fittings shall be gray iron or ductile iron. Use standard mechanical joint fittings. All fittings shall conform to the specifications of ANSI A21.10/AWWA C110. The gaskets shall be ducked tipped transition gaskets for use with PVC pipe.

N. Fittings shall be lines with enameline or a thin cement lining as specified in ANSI A21.4/AWWA C104. In addition, a bituminous seal coat or asphalt emulsion spray coat approximately 1 mil thick shall be applied to the cement lining in accordance with the pipe manufacturer's standard practices.

O. Fitting laying lengths shall conform to ANSI A21.10/AWWA C110.

P. Fittings shall be in accordance with the standard mechanical joint fittings manufactured by the U.S. Pipe and Foundry Company, American Cast Iron Pipe Company, Clow Corporation, or equal.

## PART 3. EXECUTION

### 3.1 INSTALLATION OF FORCE MAINS

A. Lay force mains to and maintain at the lines and grades required by the drawings. All fittings and valves shall be at the required locations, the spigots centered in the bells, and all valves stems plumb.

B. Unless otherwise indicated by the drawings, all force main pipes shall have at least 30 inches of cover. No departure from this policy shall be made except with the approval of the A/E.

C. Provide and use tools and facilities that are satisfactory to the A/E and that will allow the work to be done in a safe and convenient manner. All pipe, fittings, and valves are to be unloaded from the trucks using suitable tools and equipment. Use a derrick, ropes, or other suitable tools or equipment to lower all pipe, fittings, valves, and hydrants into the trench one piece at a time. Lower each piece carefully so that neither it nor any protective coating or lining it may have will be damaged. Under no circumstances drop or dump water line materials into the trench.

D. Any pipes strung out along the route of the proposed lines before the actual installation of those lines is due to take place shall not be lowered into the trench until they have been swabbed to remove any mud, debris, etc., that may have accumulated within them. PVC pipe shall be strung out a maximum of one day ahead of pipe laying. Remove all unnecessary material from the bell and spigot end of each pipe. Before any pipe is laid, brush and wipe clean the outside of its spigot end and the inside of its bell, and leave dry and oil-free.

E. Take every precaution to keep foreign material from getting into the pipe while it is being placed in the line. If the crew laying the pipe cannot put it into the trench and in place without allowing earth to get inside, then put a heavy, tightly woven canvas bag of suitable size over each end of the pipe, and leave in place until it is time to connect that pipe to the one adjacent to it.

F. Place no debris, tools, clothing, or other materials in the pipe during laying operations.

G. After a length of pipe has been placed in the trench, center the spigot end in the bell of the adjacent pipe, and then insert to the depth specified by the manufacturer and bring to the correct line and grade. Secure the pipe in place by tamping an approved backfill material around it.

H. Bell holes shall be big enough so that there is ample room for the pipe joints to be properly made. Between bell holes, carefully grade the bottom of the trench so that each pipe barrel will rest on a solid foundation for its entire length.

I. Whenever pipe laying is not in progress, close the open ends of pipe either with a watertight plug or by other means approved by the A/E. If the joints of any pipe in the trench cannot be completed until a later time, caulk them with packing in order to make them as watertight as possible; this shall be done not only at the end of each working day but also before work is stopped for lunch periods, bad weather, or any other reason. If there is water in a trench, leave this seal in place until the trench has been pumped completely dry.

J. Cut pipe so that valves, fittings, or closure pieces can be inserted in a neat and workmanlike manner and without any damage to the pipe. Follow the manufacturer's recommendations concerning how to cut and machine the ends of the pipe in order to leave a smooth end at right angles to the pipe's axis.

K. Lay pipe with the bell ends facing in the direction of laying unless otherwise directed by the A/E.

L. Wherever pipe must be deflected from a straight line (in either the vertical or horizontal plane) in order to avoid obstructions or plumb stems, or wherever long radius curves are permitted, the amount of deflection shall not exceed that necessary for the joint to be satisfactorily made, nor that recommended by the pipe manufacturer, and shall be approved by the A/E.

M. Lay no pipe in water or when it is the A/E's opinion that trench conditions are unsuitable. If crushed stone is used to improve trench conditions or as backfill for bedding the pipe, its use is considered incidental to the project, and no separate payment will be made for its use.

N. Where a force main crosses over a water line, use a full joint of pipe with a standard mechanical joint, and center over the sewer. Where a water line is to be parallel to a sanitary or storm sewer, lay it at least 10 feet from the sewer. If it is not practical for the water and sewer lines to be separated as described above, then lay the water line at least 18 inches above the top of the sewer.

O. Joint all pipe in the exact manner specified by the manufacturer of the pipe and jointing materials.

P. For detection purposes, a 14 gage solid strand copper tracing wire (shielded) or an approved metallic tape shall be installed as per the manufacturer's instructions. Connections between wires shall be soldered or connected with wire nut fasteners and wrapped.

## 3.2 HYDROSTATIC TESTS

A. Pressure Test

1. After pipe has been laid and backfilled as specified above, subject all newly laid pipe or any valved section thereof to a pressure of 200 psi. All services are to be laid prior to testing the main and tested as part of the test of the main.

2. The duration of each pressure test shall be at least **TWO** hours.

3. Slowly fill each valved section of pipe with water, and apply the specified test pressure (based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge) with a pump connected to the pipe in a manner satisfactory to the A/E. Furnish the pump, pipe, connections, gauges, and all necessary apparatus.

4. Before applying the specified test pressure, expel all air from the pipe. If air release valves are not available at high places, make the necessary taps at the points of highest elevation before testing, and insert plugs after the test has been completed.

5. Carefully examine all exposed pipes, fittings, valves, and hydrants during the test. Remove any cracked or defective pipes, fittings, valves, or hydrants discovered in consequence of this pressure test, and replace with sound material in the manner specified. Repeat the test until the results are satisfactory to the A/E.

B. Leakage Test

1. Conduct the leakage test after the pressure test has been satisfactorily completed. Furnish the pump, pipe, connections, gauges, measuring devices, and all other necessary apparatus as well as all necessary assistance to conduct the test.

2. The duration of each leakage test shall be two hours; during the test, subject the main to a pressure of 200 psi.

3. Leakage is defined as the amount of water which must be supplied to the newly laid pipe or any valved section in order to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

4. No pipe installation will be accepted until the pipe has NO PRESSURE LOSS per two hour.

5. Should any test of pipe laid disclosure leakage greater that specified, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.

3.3 VALVES

A. AIR RELEASE VALVES: air release valves for sewage force mains shall be similar and equal to APCO Model 400 or equal complete with 2" shut-off valve, all in accordance with the manufacturer's instructions and Standard Drawings.

B. Isolation valves shall be installed inline at intervals not to exceed 2000 linear feet, or as directed by A/E.

3.4 CLEANUP

A. After completing each section of water line, remove all debris and all construction materials from the work site. Then grade and smooth over the surface of both sides of the line. Leave the entire area clean and in a condition satisfactory to the A/E.

END OF SECTION

## PART 1. GENERAL

1.1 The work to be performed hereunder shall consist of the installation of casing pipe and carrier pipe for sewer lines as shown on the drawings or as called for in these specifications. For the open cut casing pipes, it shall include the excavation of the trench, placing proper bedding material, furnishing and installing the casing pipe, furnishing and installing the carrier pipe, backfilling, and disposing of the excess excavated materials. For the boring and jacking of casing pipes, it shall include the excavation of a boring pit, auger boring between the point as specified on the drawings, furnishing and installing of the carrier pipe, and disposing of the excavated materials in the manner herein provided.

## PART 2. PRODUCTS

2.1 CASING PIPE

A. The casing pipe shall be of steel meeting the latest approved American Railway Engineering Association "Specifications" for Pipelines for Carrying Flammable and Nonflammable Substances." The steel casing pipe shall have a minimum yield strength of 35,000 PSI and shall have the minimum wall thickness shown in the following table:

TABLE OF MINIMUM WALL THICKNESS FOR STEEL CASING PIPE
FOR E72 LOADING

| Carrier Pipe Diameter | Casing Pipe Diameter | Nominal Thickness |
|---|---|---|
| 4 inches | 8 inches | 0.250 inches |
| 6 inches | 12 inches | 0.250 inches |
| 8 inches | 16 inches | 0.312 inches |
| 10 inches | 20 inches | 0.312 inches |
| 12 inches | 22 inches | 0.312 inches |
| 14 inches | 24 inches | 0.344 inches |
| 16 inches | 26 inches | 0.375 inches |
| 18 inches | 28 inches | 0.406 inches |

B. When the casing pipe is installed without benefit of a protective coating, the wall thickness shown above shall be increased to the nearest standard size, which is a minimum of 0.063 inches greater than the thickness shown.

2.2 CARRIER PIPE: The carrier pipe shall be PVC, schedule 40, unless otherwise noted on the drawings.

## PART 3. EXECUTION

3.1 BORING

A. The boring shall be accomplished by means of auguring to the size, line and grade shown on the drawings.

2.2 INSTALLATION OF CASING PIPE

A. For open cut of casing pipes, install the steel casing pipe into the open cut as the trench excavation proceeds. Weld sections of casing pipe together to provide watertight joints, and replace the protective coatings in areas where it is damaged by welding.

B. For boring casing pipes, jack the steel casing pipe into place as the boring proceeds. Weld sections of casing pipe together to provide watertight joints.

C. Do not remove unacceptable casing without prior approval from the A/E. If the removal of casing pipe is permitted, make proper provisions to prevent caving in of the earth surrounding the casing.

3.3 INSTALLATION OF CARRIER PIPE

A. The carrier pipe shall be furnished by the Contractor. Upon acceptance of the casing, install the carrier pipe in the casing by jacking it through the casing. If necessary to achieve proper line and grade on the carrier pipe, strap wood or other suitable blocking to the carrier pipe to offset any minor variations in the alignment of the casing. Casing spacers shall be installed on the carrier pipe a minimum of 2 per 20' joint and casing end caps shall be installed.

3.4 LAYOUT OF WORK

A. The Owner will provide the necessary control points required by the Contractor for this construction. The Contractor will provide the detailed layout required to keep the excavation and pipe installation on grade.

4. GUARANTEE OF WORK

4.1 Guarantee a usable completed casing between the points specified and to the line and grade specified. The allowable tolerance at the downstream end point of the casing shall be such that the invert of the carrier pipe may be positioned within a vertical area limited on the top by an elevation no higher than the elevation shown on the drawings and on the bottom by an elevation no lower than the existing inlet pipe invert.

4.2 The allowable tolerance at the upstream end point of the casing shall be such that the invert of the carrier pipe may be positioned at the elevation shown on the drawings.

END OF SECTION

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section covers all service pipe and connections from an effluent sewer system.

1.2 GENERAL REQUIREMENTS

A. Furnish all materials and equipment and install the service pipe and connections to the sewage force main at the locations shown on the drawings.

B. The Contractor shall be responsible for safely storing materials needed for the work. Keep the interiors of all pipes, fittings, and other accessories free from dirt and foreign matter at all times.

C. Each service line shall include a ball valve and a check valve to ensure maximum protection against backflow in the event of a sewer main break.

D. Each service assembly shall be located at the property line of the property being serviced as shown in the Details unless directed otherwise by the Owner.

E. Refer to other sections for work related to that specified under this heading.

## PART 2 - PRODUCTS

2.1 MATERIALS

A. Ball Valve: The valve on the service line at the connection to the main shall be a PVC ball valve of true union design with permanently lubricated Teflon seats and elastomer "O"-ring seals and shall open to the left. The valves are to open and close with a quarter turn. Working pressure at 70 degrees F shall be 150 pounds per square inch. The valve shall be as manufactured by Asaki/Ameriea, GF Plastic System, Inc., Hayward Manufacturing Co., Inc., or Nibco Chemtrol. The valve shall be made of PVC with hub and socket compatible with 1-1/4 inch PVC solvent weld system. Dimensions for hub and socket shall be in accordance with Commercial Standards C5-272-65.

B. Check Valve: The valve shall be a true union ends or compression type valve as manufactured by Asaki/America, King Brothers, or Nibco Chemtrol.

C. Valve Wrench: The Contractor shall provide the Owner with a valve wrench compatible with the particular valve assembled.

D. Service Pipe: Service pipe shall be 1-1/4 inches, Schedule 80 PVC pressure pipe made from Type 1, Grade 1, Polyvinyl chloride plastic as set forth in ASTM D1784. The joints shall be of the solvent welded type and suitable for the pressure required of the pipe as manufactured by Napco, Vulcan, or Hawk.

E. Service Boxes: Service boxes for the redundant valve assemblies shall be concrete with cast iron lid, Brooks Products, Inc., No. 36. The box shall be installed with one course of brick as base.

2.2 COPPER WIRE FOR DETECTION

A. All non-metallic waterlines shall be installed with a 12 gage, green coated copper wire, installed 12 inches to 18 inches below finished grade directly above the service pipe. In cases where this cannot be accomplished as determined by the Owner, the wire shall be fastened to the outside of the pipe.

## PART 3 - EXECUTION

3.1 EXCAVATION FOR SERVICE PIPE

A. Unclassified excavation for service pipe shall consist of the excavation necessary for the installation of service pipe and their appurtenances (including valves, fittings, collars, saddles, and pipe protection). It shall include clearing and grubbing where necessary, backfilling and tamping pipe trenches and around structures, and disposing of waste materials, all of which shall conform to the applicable provisions set forth elsewhere in these specifications.

B. The Contractor may, if he chooses, use a motor powered trenching machine. If he does, however, he shall be fully responsible for the preservation or repair of existing utility service connections.

C. Unless the installation of service pipe by tunneling, jacking, or boring is called for or specifically authorized by the Owner, make excavation for pipe in open cut and true to the lines and grades.

D. For all pipe in non-rock trenches, shape the bottom of all trenches to provide uniform bearing for the service pipe. All pipe shall be installed with #67 crushed stone bedding.

E. For all pipe in rock trenches, bottom shall be shaped with No. 67 stone which shall provide uniform bearing for the service pipe.

F. All service pipe shall have a minimum 18 inches of cover. No departure from this policy shall be made without the approval of the Owner.

3.2 INSTALLATION OF SERVICE PIPE

A. All fittings, valves, collars, and saddles shall be at locations as shown in the Details.

B. Any pipes strung out along the route of the proposed installation before the actual installation shall not be lowered into the trench until they have been swabbed to remove any mud, debris, etc., that may have accumulated within them.

Remove ail unnecessary material from the bell and spigot end of each pipe. Before any pipe is laid, brush and wipe clean the outside of its spigot end and the inside of its bell, and leave dry and oil-free.

C. Take every precaution to keep foreign material from getting into the pipe while it is being placed in the trench.

D. Place no debris, tools, clothing, or other materials in the pipe during installation.

E. Cut pipe so that valves, fittings, or closure pieces can be inserted in a neat and workmanlike manner and without any damage to the pipe. Follow the manufacturer's recommendations concerning how to cut and machine the ends of the pipe in order to leave a smooth end at right angles to the pipe's axis.

F. Lay pipe with the bell ends facing in the direction away from the sewer main.

3.3 TESTING

A. All service pipe shall be tested at 100 psi for a 30 minute period separately from the sewage main. There will be no leakage allowed on the service pipe from the flexible hose connection at the effluent tank to the redundant valves.

END OF SECTION

# PART 1 - GENERAL

## 1.1 SECTION INCLUDES

A. Refer to other sections, Sewage Service Assemblies, Section 02733 and Unclassified Excavation for Utilities, Section 02222, for related work specified, furnished or installed under this heading.

# PART 2 - PRODUCTS

## 2.1 BALL VALVES

A. Valves on PVC sewage force main 1-1/2 inches through 4 inches shall be a true union PVC ball type with permanently lubricated Teflon seats and elastomer O-ring seals and shall open to the left. Working pressure at 70 degrees F shall be 150 pounds per square inch. The valve shall be as manufactured by Asaki/America, GF Plastic System, Inc., Hayward Manufacturing Company, Inc., King Brothers, or Nibco Chemtrol TU Series. The valve shall be made of PVC with hub and socket compatible with 1-1/4 inch PVC solvent weld system. Dimensions for hub and socket shall be in accordance with Commercial Standards C5-272-65.

## 2.2 AIR RELEASE VALVES

A. Air release valves for sewage force mains shall be similar and equal to APCO Sewage Valves, complete with shut off valve, all in accordance with the Standard Details. All floats shall be heavy stainless steel, hermetically sealed.

B. Piping for air release valves shall be of Schedule 80 PVC.

## 2.3 VALVE BOXES

A. In traffic areas, boxes shall be of a solid 1-piece cast iron cover as manufactured of polymer concrete and fiber reinforce polyester as manufactured by CDR. The boxes shall be heavy duty suitable for traffic and of the approximate size and depth as shown on the standard drawing. In non-traffic areas, boxes shall be of polyethylene and of the size and depth as shown on the standard drawings. A minimum 2-1/2 inches diameter 16 gage steel reflector shall be applied to the underside of the fiber cover for electronic detection.

# PART 3 - EXECUTION

## 3.1 LOCATION OF VALVES

A. Valves in sewage force mains shall be located according to the Owner's direction.

3.2 VALVE BOXES AND VALVE PITS

A. A valve box shall be provided for every valve and/or clean out.

B. The valve box shall not transmit shock or stress to the valve or pipe and shall be centered and plumb over the wrench nut of the valve or clean out, set the box cover flush with the surface of the finish pavement, or approximately 1/2 inch above the ground surface or such other level as may be directed.

END OF SECTION

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Specification covers the materials utilized in STEP Systems, as well as their construction and the installation methods to be employed.

1.2 GENERAL REQUIREMENTS

A. The Contractor shall furnish and install a water-tight septic tank and a simplex or duplex effluent pumping unit at the locations shown on the Drawings or as directed by the Engineer.

B. The Contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged on delivery. This shall include the furnishing of all material and labor required for the replacement of installed material discovered defective.

C. The Contractor shall be responsible for the safe storage of material furnished by him until it has been incorporated in the completed project. All electrical and mechanical components shall be stored in a dry environment. The interior of all pipes, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

## PART 2 - PRODUCTS

2.1 SEPTIC TANK

A. Septic tanks shall conform to Section 02745, with the exception that a single compartment tank will be allowed.

2.2 SCREENED PUMP VAULT

A. At a minimum, the pump vault shall have a diameter of 12 inches and a depth of 48 inches.

B. The vault shall be made of polyvinyl chloride (PVC).

C. The screen shall be made of polyethylene and have a mesh sieve passage of 1/8 inch.

D. A 4-inch diameter flow inducer shall be provided in order to accept an effluent pump.

E. The vault shall have evenly spaced holes around the perimeter at a height located for maximum sludge accumulation.

F. The pump vault shall be as manufactured by Orenco Systems, Inc., or approved equal.

2.3 EFFLUENT FILTER

A. The screened pump vault shall contain an effluent filter having a diameter of no less than 12 inches and a depth no less than 18 inches. The effective screen area shall be no less than 15 square feet.

B. The effluent filter shall be as manufactured by Orenco Systems, Inc., or approved equal.

2.4 DISCHARGE ASSEMBLY

A. The discharge assembly shall contain a PVC ball valve and PVC flex hose which extends at least 12 inches outside the riser.

B. The discharge assembly shall be as manufactured by Orenco Systems, Inc., or approved equal.

2.5 FLOAT SWITCH ASSEMBLY

A. The float switch assembly shall have two (2) mercury switch floats when used for simplex systems; and three (3) mercury switch floats when used for duplex systems. The floats shall be mounted on a PVC stem within the screened pump vault.

B. The switch shall be sealed in a polyurethane float.

C. The floats shall be adjustable and removable.

D. The support wiring shall have a heavy neoprene jacket.

E. The switch assembly shall be as manufactured by Orenco Systems, Inc., or approved equal.

2.6 EFFLUENT PUMP

A. The pump shall be of the high head effluent type.

B. The pump motor shall be no less than 1/2 hp, 115 v, single phase, 60 $H_z$, two-wire.

C. The pump shall be provided with 30 feet of extra heavy duty (SO) electrical cord with ground.

D. The pump shall be as manufactured by Orenco Systems, Inc., or approved equal.

2.7 ELECTRICAL SPLICE BOX

A. The splice box shall be made for installation in wet locations.

B. The box shall be equipped with an adequate number of cord grips, butt splice connectors, and outlet grommet fittings.

C. The splice box shall be U.L. listed as manufactured by Orenco Systems, Inc., or approved equal.

2.8 CONTROLS

A. Float Switches: One (1) switch shall be used to turn pump on/off. The remaining switch shall be used to signal a high-level alarm.

B. The enclosure shall be a NEMA 4X with stainless steel hinges and hardware. A lock hasp shall be provided. The enclosure shall have the following components at a minimum:
   1. Redundant-Off Relay: Provides secondary off and sounds an alarm at low-level condition.
   2. Audible Alarm: Panelmounted.
   3. Visual Alarm: Red oil-tight light with push silence feature.
   4. Audio Alarm Silence Relay: Automatic resetting; DIN rail mounted.
   5. Toggle Switch: Motor rated, double-throw with three positions: Manual, Off, and Automatic.
   6. Circuit Breaker: DIN rail mounted.
   7. Current-Limiting Circuit Breaker: DIN rail mounted.
   8. Alarm Circuit: Wired separately from pump circuit in the event of overload and circuit breaker trips.
   9. Motor Starter Contactor: 1 hp, single phase, 60 $H_z$, 120 v.
   10. Elapsed Time Meter: Non-resettable; limit of 99,999 hours; base mounted; one for each pump.
   11. Event Counter: Non-resettable; 6-digit; base mounted.

C. The control panel enclosure shall be mounted on an exterior wall nearest the septic tank. The panel shall be located within 50 feet and within sight of the septic tank. The panel shall be mounted at a vertical height of five (5) feet.

D. The control panel electrical supply shall be on a dedicated circuit breaker from the residence or business being served.

2.9 DUPLEX OR COMMERCIAL USE SYSTEMS

A. These systems shall be evaluated by the Owner on a case-by-case basis. Upon proposal by the Developer/Contractor to install a duplex or commercial use STEP System, the Owner shall review and make recommendations for additional pumps and controls to be added to the base specification herein.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the septic tank effluent pump system as shown on the Drawings and in accordance with the manufacturer's recommendations.

B. Obtain the services of the manufacturer's service engineer to check the installation of each septic tank effluent pump system and make any field adjustments necessary to ensure proper operation.

3.2 WARRANTY

A. The manufacturer shall warrant its product to be free from defects in material and factory workmanship for a period of 1 year from the date of acceptance. Repair of parts replacement required as a result of such defects shall be made free of charge during this period.

B. The manufacturer will provide the general contractor specific instruction on the assembly and installation of the pump system and related equipment.

C. The manufacturer will furnish, at his own expense, the services of a factory trained serviceman to instruct the Owner's personnel in the operation and maintenance of the pumps and related equipment. The individual performing the instruction to the Owner shall be trained and/or certified by the manufacturer as its authorized operation, maintenance, and service specialist. Allow a minimum of 3 days on at least 2 separate trips for this instruction. The schedules of the visits shall be subject to approval by the Owner.

END OF SECTION

## PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This specification covers the materials utilized in STEG Systems, as well as their construction methods to be employed.

1.2 GENERAL REQUIREMENTS

A. The Contractor shall furnish and install a water-tight monolithic built septic tank and an effluent filter
unit at the locations shown on the Drawings or as directed by the Engineer.

B. The Contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged on delivery. This shall include the furnishing of all material and labor required for the replacement of installed material discovered defective.

C. The Contractor shall be responsible for the safe storage of material furnished by him until it has been incorporated in the completed project. All electrical and mechanical components shall be stored in a dry environment. The interior of all pipes, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

## PART 2 - PRODUCTS

2.1 SEPTIC TANK

A. Septic tanks shall conform to Section 02745, with the exception that a single compartment tank will be allowed.

2.2 SCREENED FILTER VAULT

A. At a minimum, the pump vault shall have a diameter of 12 inches and a depth of 48 inches.

B. The vault shall be made of polyvinyl chloride (PVC).

C. The screen shall be made of polyethylene and have a mesh sieve passage of 1/8 inch.

D. A 4-inch outlet which connects to the discharge assembly shall be provided.

E. The vault shall have evenly spaced holes around the perimeter at a height located for maximum sludge accumulation.

F. The pump vault shall be as manufactured by Zabel, Orenco Systems, Inc., or approved equal.

2.3 EFFLUENT FILTER

A. The screened pump vault shall contain an effluent filter having a diameter of no less than 12 inches and a depth no less than 18 inches. The effective screen area shall be no less than 15 square feet.

B. The effluent filter shall be as manufactured by Zabel, Orenco Systems, Inc., or approved equal.

2.4 DISCHARGE ASSEMBLY

A. The discharge assembly shall contain a 4-inch Schedule 40 PVC pipe which extends at least 12 inches outside the septic tank outlet.

2.5 FLOAT SWITCH ASSEMBLY

A. The float switch assembly shall have one (1) mercury switch float mounted on a PVC stem outside the screened filter vault.

B. The switch shall be sealed in a polyurethane float.

C. The float shall be adjustable and removable.

D. The support wiring shall have a heavy neoprene jacket.

E. The switch assembly shall be as manufactured by Zabel, Orenco Systems, Inc., or approved equal.

2.6 ELECTRICAL SPLICE BOX

A. The splice box shall be made for installation in wet locations.

B. The box shall be equipped with an adequate number of cord grips, butt splice connectors, and outlet grommet fittings.

C. The splice box shall be U.L. listed as manufactured by Zabel, Orenco Systems, Inc., or approved equal.

2.7 CONTROLS

A. Float Switch: One (1) switch shall be used to signal a high-level alarm.

B. The enclosure shall be a NEMA 4X with stainless steel hinges and hardware. A lock hasp shall be provided. The enclosure shall have the following components at a minimum:
   1. Audible Alarm: Panel mounted.
   2. Visual Alarm: Red oil-tight light with push silence feature.
   3. Audio Alarm Silence Relay: Automatic resetting; DIN rail mounted.
   4. Circuit Breaker: DIN rail mounted.
   5. Current-Limiting Circuit Breaker: DIN rail mounted.
   6. Event Counter: Non-resettable; 6-digit; base mounted.

C. The control panel enclosure shall be mounted on an exterior wall nearest the septic tank. The panel shall be located within 50 feet and within sight of the septic tank. The panel shall be mounted at a vertical height of five (5) feet.

D. The control panel electrical supply shall be on a dedicated circuit breaker from the residence or business being served.

2.8 MULTIPLE OR COMMERCIAL USE SYSTEMS

A. These systems shall be evaluated by the Owner on a case-by-case basis. Upon proposal by the Developer/Contractor to install a multiple or commercial use STEG System, the Owner shall review and make recommendations for additional pumps and controls to be added to the base specification herein.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the septic tank effluent gravity system as shown on the Drawings and in accordance with the manufacturer's recommendations.

B. Obtain the services of the manufacturer's service engineer to check the installation of each septic tank effluent gravity system and make any field adjustments necessary to ensure proper operation.

3.2 WARRANTY

A. The manufacturer shall warrant its product to be free from defects in material and factory workmanship for a period of 1 year from the date of acceptance. Repair of parts replacement required as a result of such defects shall be made free of charge during this period.

B. The manufacturer will provide the general contractor specific instruction on the assembly and installation of the gravity system and related equipment.

The manufacturer will furnish, at his own expense, the services of a factory trained serviceman to instruct the Owner's personnel in the operation and maintenance of the filters and related equipment. The individual performing the instruction to the Owner shall be trained and/or certified by the manufacturer as its authorized operation, maintenance, and service specialist. Allow a minimum of 3 days on at least 2 separate trips for this instruction. The schedules of the visits shall be subject to approval by the Owner.

END OF SECTION

## PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The Contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged on delivery. This shall include the furnishing of all material and labor required for the replacement of installed material discovered defective.

B. The Contractor shall be responsible for the safe storage of material furnished by him until it has been incorporated in the completed project. All motors and electrical and mechanical components shall be stored in a dry environment. The interior of all pipes, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

C. Refer to other sections for work related to that specified by this section. Coordinate this work with that required by other sections for timely execution.

1.2 GENERAL DESIGN

A. Septic tank design shall meet Chapter 1200-1-6 of the Tennessee Department of Environment and Conservation, Division of Ground Water Protection, Regulations to Govern Subsurface Sewage Disposal Systems.

B. Septic tanks shall be watertight and of two (2) compartment design.

C. The inlet compartment shall be between two-thirds (2/3) and three-fourths (3/4) of the total tank capacity.

D. Tank volumes shall be as follows:

| | | |
|---|---|---|
| 1. | Residential | 1,000 gallons |
| 2. | Commercial | 750 gallons or greater |
| 3. | Parks and Recreation: | 5,000 gallons |

Commercial septic tanks shall be reviewed by Owner to determine adequate capacity.

E. The inlet invert shall enter the tank at feast one (1) inch above the liquid level of the tank.

F. Air space equal to at least twenty (20) percent of the liquid depth shall be provided between the top of the tank and the liquid level.

G. Access openings shall be provided for each compartment. Openings shall be no less than twenty (20) inches in diameter.

H. Tanks shall be labeled on the exterior of the outlet end wall identifying the manufacturer and address, capacity of the tank, and date of manufacture.

## PART 2 - PRODUCTS

### 2.1 CONCRETE TANKS

A. Concrete tanks shall be modified 1,000 and/or 1,500 gallon precast concrete tanks and shall have been designed by a registered engineer and approved by the local regulatory agencies. The manufacturer shall provide design and approval certificates to the Owner. The design shall be in accordance with accepted engineering practice.

B. The tanks shall be designed for the following loading conditions:
   1. Standard
      a. Top: 300 psf
      b. Lateral Loads: 62.4 psf
      c. Cold weather installations requiring deep burial will need special consideration.
   2. Traffic bearing
      a. No tanks shall be installed such as to be subjected to H20 loading.

C. Walls, bottom, and top of reinforced concrete tanks shall be designed across the shortest dimension using one-way slab analysis. Stresses in each face of monolithically-constructed tanks may be determined by analyzing the tank cross-section as a continuous fixed frame.

D. The walls and bottom slab shall be poured monolithically.

E. Reinforcing steel shall be ASTM A615, Grade 60, fy=60,000 psi. Details and placement shall be in accordance with ACI 315 and ACI 318.

F. Concrete shall be ready-mix with cement conforming to ASTM C150, Type II. It shall have a cement content of not less than 6 sacks per cubic yard and maximum aggregate size of 3/4 inch. Water/cement ratio shall be kept low (0.35 plus or minus), and concrete shall achieve a minimum compressive strength of 5,000 psi in 28 days.

G. Tanks shall be protected by applying a heavy cement base waterproofing coating on both the inside and outside surfaces.

H. Form release used on tank molds shall be Nox-Crete, or equal. Diesel or other petroleum products are not acceptable.

I. Tanks shall not be moved from the manufacturing site to the job site until the tank has cured for 7 days or has reached 2/3 of the design strength.

J. Tanks shall have a 1/2 inch wide by 1/2 inch deep groove, 21 inches, 24 inches or 30 inches in diameter, as required, surrounding the access opening. The groove shall be formed in the top of the tank at the time of manufacture to facilitate the installation of the riser.

K. The tank shall be vibrated and rodded during pouring to eliminate a honeycomb effect.

L. The top, bottom, ends, and sides of the tank must have a minimum thickness of two and one-half (2.5) inches except for blockouts.

M. After curing, the top slab and monolithically poured bottom section shall be joined and sealed by using a mastic sealant and/or pliable sealant that is waterproof and corrosion resistant.

2.2 RISERS AND LIDS

A. Inlet Risers: Inlet risers shall be made of ribbed PVC and have a minimum diameter of 21 inches.

B. Outlet Risers: Outlet risers shall be made of ribbed PVC and have a minimum diameter of 24 inches when used for simplex systems; 30 inches when used for duplex systems.
1. Outlet risers shall be equipped with EPDM synthetic rubber grommets for the discharge piping, vent piping, and electrical conduit to assure a watertight seal.

C. Lids: One (1) lid shall be provided for each riser. Lids shall be made of fiberglass and be secured utilizing a urethane gasket and stainless steel bolts. Color shall be green and have a non-skid finish.

D. Adhesives: Adhesives used to secure risers to the septic tank shall be an Owner-approved epoxy or adhesive.

E. Risers and lids shall be as manufactured by Orenco Systems, Inc., or approved equal.

2.3 INLET AND OUTLET PIPING

A. The inlet and outlet piping shall be secured and sealed using a EPDM synthetic rubber boot. The boot shall be fastened to the piping using a stainless steel band clamp.

B. A 4-inch Schedule 40 PVC inlet sanitary tee shall divert the sewage downward. The inlet plumbing shall extend at least eighteen (18) inches below the liquid level of the tank.

C. The outlet piping shall connect to a disposal field system or sanitary sewer service lateral. The outlet piping shall be installed to provide positive drainage.

2.4 FIELD SYSTEM

A. All disposal field systems shall be designed and installed according to the following local and state regulations:
   1. Local: Cheatham County Health Department.
   2. State: Division of Groundwater Protection, Chapter 1200-1-6.

## PART 3 - EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

A. The Contractor shall furnish all equipment necessary for testing including access sealing apparatus, gauges, pumps, plugs, water, and personnel.

B. The Contractor shall purchase water for testing purposes from the Town of Ashland City at a rate set by Municipal Code per thousand gallon.

C. Written documentation that all testing described herein has been performed and has passed satisfactorily shall be provided to the Owner for each tank installed.

D. All testing shall be performed in the presence of an Owner Representative.

E. No backfill shall be placed around the septic tank until testing requirements have been met.

F. If a tank fails to meet the testing requirements described herein, that tank shall be repaired or replaced in order to meet the requirements. After three (3) failed tests tank shall be replaced.

3.2 VACUUM TESTING

A. All tanks including the risers shall be subjected to a vacuum test of at least 2.5 inches mercury prior to acceptance by the City. The test shall be considered acceptable if the vacuum remains at 2.5 inches mercury or drops to no less than 2 inches mercury within 1 minute. If the tank fails the initial test, the manufacturer will be required to repair or replace the tank.

3.3 WATER TIGHT TESTING

A. Tanks shall be capable of successfully withstanding an above and below ground static hydraulic test.

B. Each tank shall be tested at the factory, prior to shipping, by filling the tank to the soffit and letting stand. After 24 hours, the tank shall be refilled to the soffit and the exfiltration rate shall be determined by measuring the water loss over a twenty four (24) hour period.

b.1 1000 Gallon Tank shall not loose more than 1" in a twenty four (24) hour period.

b.2 5000 Gallon Tank shall not loose more than 2" in a twenty four (24) hour period.

C. After installation and vacuum testing described in Section 3.01, the tank shall be filled and tested as described in Section 3.03B.

D. Water used for testing on-site shall be obtained from the Town of Ashland City. Under no circumstances shall the Contractor be allowed to use private home/property owner's water. In order for Contractor to obtain water, call 615/792-4211. An Owner Representative shall be present during transfer of any water in order to verify quantity.

3.4 INSTALLATION

A. All tanks and related appurtenances shall be installed in accordance with the manufacturer's recommended installation instructions.

B. All installation shall be performed in the presence of an Owner Representative.

3.5 WARRANTY

A. All tanks shall be guaranteed in writing by the tank manufacturer for a period of 2 years from the date of installation.

END OF SECTION

## PART 1. GENERAL

1.1 This item shall include furnishing and installing concrete blocking, cradles, anchors, caps, pipe protection, and/or encasement at the locations shown on the drawings and/or directed by the A/E.

## PART 2. PRODUCTS

Not used.

## PART 3. EXECUTION

3.1 Concrete work shall conform to ACI 301-72 (as revised), as modified by the supplemental requirements below:

A. Strength

1. The strength of concrete shall be 3,000 psi unless otherwise shown on the drawings.

B. Durability

1. All concrete exposed to weather shall be air entrained.

C. Slump

1. Concrete shall be proportional and produced to have a slump of 3 inches with a 1 inch tolerance.

D. Admixtures

1. Air entrainment, mandatory for concrete exposed to weather, may be used. A water reducing admixture (retarding, normal, or accelerating, depending on placing temperature), may be used if approved by the A/E.

E. Reinforcing Steel

1. Yield strength of reinforcing steel shall be 60,000 psi.

END OF SECTION

## GENERAL PERMIT FOR ROAD CROSSINGS

Construction of road crossings of waters where the total length of stream encapsulation is 200 linear feet or less is hereby permitted provided the activity is done in accordance with the terms and conditions below.

### Exclusions

This general permit cannot be used to authorize work in the following circumstances:
(a) where the proposed activity will adversely affect wetlands;

(b) when the total length of stream encapsulation is more than 200 feet;

(c) where a portion of the proposed activity is located in a component of the National Wild and Scenic River System, a State Scenic River, or waters designated as Outstanding National Resource Waters;

(d) when a portion of the proposed activity is located in any waterway which is identified by the Department as having contaminated sediments, and where the proposed work will likely mobilize the contaminants;

(e) when the project will adversely affect a species formally listed on State or Federal lists of threatened, or endangered species; or

(f) when an individual permit is required.

Projects not qualifying for authorization by this general permit may be authorized by individual permit provided all requirements of the *Tennessee Water Quality Control Act of 1977* are met.

### Notification

1) Where the total width of fill or disturbance to the stream channel for construction of the road crossing is less than 25 feet, notification to the Division is required prior to commencing construction in accordance with this general permit. Work may commence without written authorization from the Division. However it is the applicant's responsibility to assure that all of the terms and conditions of this general permit are met.

2) Persons proposing to construct a minor road crossing in waters of State where the total width of fill or disturbance to the stream channel is greater than 25 feet shall notify the Division by submission of an application which includes the following minimum information:

(a) a map showing the exact location of the proposed construction site; and

(b) a single copy of construction plans which includes specifications for proposed stream channel alterations and pollution control methods or structures.

Stream alteration activities shall not commence until the Division issues written notification that the proposal may proceed in accordance with the terms of this general permit or issues an individual permit.

**General Terms and Conditions**

1) Only clean rock may be placed directly into waters. Clean rock is rock of various type and size, depending upon application, that contains no fines, soils, or other wastes or contaminants. Other fill materials to be discharged below ordinary high water must be free of fines, sediment, soil, pollutants, contaminants, toxic materials, trash, or other waste materials.

2) The width of the fill associated with the crossing shall be limited to the minimum necessary for the actual crossing.

3) Excavation and fill activities shall be separated from flowing waters. All surface water flowing toward the excavation or fill work shall be diverted through utilization of cofferdams, berms, or temporary channels. Temporary diversion channels must be protected by non-erodible material and lined to the expected high water level. Cofferdams must be constructed of sandbags, clean rock, steel sheeting or other non-erodible material. Clean rock is rock of various type and size, depending upon application, that contains no fines, soils, or other wastes or contaminants.

4) The crossing shall be culverted, bridged or otherwise designed to prevent the impoundment of normal or base flows. Base flow is that usual or normal flow of the stream that is supplied primarily by groundwater from springs and seeps, but not affected by rapid runoff during and after rainfall.

5) The crossing shall be designed and constructed so as not to disrupt the movement of aquatic life. Where practicable, the bottom of culverts should be constructed below the stream bed level, with natural substrate placed over the culvert bottom following construction.

6) Soil materials must be prevented from entering waters of the state. Erosion and sedimentation control measures to protect water quality must be maintained throughout the construction period. Erosion and sedimentation controls shall include, but are not limited to straw or hay bales and/or silt

fence, brush barriers, berms, sediment ponds and other proven devices. Hay bales and/or silt fence must be installed along the base of all fills and cuts, on the down hill side of stock piled soil, and along stream banks in cleared areas to prevent sedimentation to streams. They must be installed on the contour, entrenched and staked, and extend the width of the area to be cleared. Erosion and sedimentation controls must be repaired, if necessary, after rainfall.

7) In-stream sedimentation control devices are not approved as primary treatment devices. They may be used only as backup or fail-safe protection. Separate erosion and sedimentation controls and sediment treatment devices must be utilized.

8) Slurry water pumped from work areas and excavations must be held in settling basins or treated by filtration prior to its discharge into surface waters. Water must be held in settling basins until at least as clear as the receiving waters. Settling basins shall not be located closer than 20 feet from the top bank of a stream. Settling basins and traps shall be properly designed according to the size of the drainage areas or volume of water to be treated.

9) Check dams shall be utilized where runoff is concentrated. Clean rock, log, sandbag, or straw bale, check dams shall be properly constructed to detain runoff and trap sediment. Clean rock is rock of various type and size, depending upon application, that contains no fines, soils, or other wastes or contaminants.

10) Clearing, grubbing and other disturbance to riparian vegetation shall be limited to the minimum necessary for slope construction and equipment operations. Unnecessary vegetation removal is prohibited. All disturbed areas shall be properly stabilized as soon as practicable.

11) Streams shall not be used as transportation routes for heavy equipment. Crossings must be limited to one point and erosion control measures must be utilized where the stream banks are disturbed. Where the streambed is not composed of rock, a pad of clean rock must be used at the crossing point. Clean rock is rock of various type and size, depending upon application, that contains no fines, soils, or other wastes or contaminants. All temporary fill must be completely removed after the work is completed.

12) Construction debris must be kept from entering the stream channel.

13) Appropriate steps shall be taken to ensure that petroleum products or other chemical pollutants are prevented from entering waters of the state. All

spills must be reported to the appropriate emergency management agency, and measures shall be taken immediately to prevent the pollution of waters of the state, including groundwater.

14) Upon achievement of final grade, all disturbed areas must be stabilized and re-vegetated within 30 days by sodding or seeding and mulching. Seed to be utilized shall include a combination of annual grains and grasses, legumes, and perennial grasses. Lime and fertilizer shall be applied as needed to achieve a vegetative cover.

15) The project should be consistent with all applicable local floodplain regulations. The applicant should contact local government officials to determine what these regulations are at a particular location.

16) Adverse impact to formally listed state or federal threatened or endangered species or their critical habitat, or to cultural, historical or archeological features or sites is prohibited.

Effective Date July 1, 2000 APPROVED: _____
Expiration Date June 30, 2005 Paul Davis, Director

# ROADWAYS

## PART 1. GENERAL

1.1 The work specified by this section shall consist of furnishing all plant, labor, equipment, appliances, and materials and performing all operations in connection with the installation of pavement.

1.2 Both these specifications and the drawings make reference to the current edition of the standard specifications of the Tennessee Department of Transportation (TDOT). Even though the weather limitations, construction methods, and materials specifications contained in the TDOT specifications may not be explicitly repeated in these specifications, they shall, wherever applicable to the work called for by this section, be considered as implied and therefore adhered to. However, the various subsections "Basis for Payment" contained in the TDOT specifications shall not be considered applicable.

1.3 Refer to other sections for items affecting paving.

## PART 2. PRODUCTS

2.1 MINERAL AGGREGATE BASE AND SHOULDER STONE: Class A, Grading D crushed stone (TDOT specifications, Section 303, Subsection 903.05)

2.2 BITUMINOUS PRIME COATS: cutback asphalt, Grade RC-250, or emulsified asphalt, Grade AE-P (Section 402, Subsections 904.02 and 904.03)

2.3 CRUSHED STONE CHIPS: Size 6 or Size 7 (Subsection 903.14)

2.4 DOUBLE BITUMINOUS SURFACE: for both courses, either cutback asphalt, Grade RC-800 or RC-3000, or emulsified asphalt, Grade RS-2 (Subsections 904.02 and 904.03)

2.5 ASPHALTIC CONCRETE LEVELING COURSE BINDER: Grading B or C, as directed by the A/E (Section 307)

2.6 BITUMINOUS TACK COAT: Grade AE-3 (Section 403, Subsection 904.03)

2.7 ASPHALTIC CONCRETE SURFACE: Grading E (Section 411)

## PART 3. EXECUTION

### 3.1 BASE

Install a mineral aggregate base of the type specified above in accordance with Section 303 of the TDOT specifications. The maximum compacted thickness of any one layer shall be 6 inch, and the total thickness of the base shall be that indicated by the drawings.

### 3.2 BITUMINOUS TACK AND PRIME COAT

Uniformly apply a bituminous tack coat of either emulsified asphalt, Grade AE-3 or cutback asphalt, Grade RC-250, over the entire width of the area to be surfaced at a rate of 0.02 gallon per square yard, or as directed by the A/E.

### 3.3 DOUBLE BITUMINOUS SURFACE

3.3.1 Apply the first course at a rate of 0.38 to 0.42 gallon per square yard with either emulsified asphalt, Grade RS-2, or cutback asphalt, Grade RC-800 or RC-3000, and then immediately cover with Size 6 crushed stone chips at a rate of 33 to 37 pounds per square yard. After this is rolled, apply the second course at a rate of 0.30 to 0.35 gallon per square yard, and at once uniformly cover with Size 7 chips at a rate of 20 to 25 pounds per square yard. Then roll the entire area.

3.3.2 After the application of the cover aggregate, lightly broom or otherwise maintain the surface for a period of four days, or as directed by the A/E. Maintenance of the surface shall include the distribution of cover aggregate over the surface to absorb any free bitumen and cover any areas deficient in aggregate. Sweep excess material from the entire surface with rotary brooms. Sweep the surface at the time determined by the A/E.

### 3.4 ASPHALTIC CONCRETE LEVELING COURSE BINDER

3.4.1 For all asphaltic concrete leveling course being applied on existing paved surfaces, cleaned off existing surface and apply bituminous tack coat as directed by the A/E. Then place 2 inch asphaltic concrete leveling course binder.

3.4.2 For all asphaltic concrete leveling course being applied on new stone base, apply bituminous prime coat at a rate of 0.30 gallon per square yard after prime coat has been properly cured. Place 2 inch asphaltic concrete leveling course binder.

3.4.3 For all areas of more than 1,000 square yards, spread and strike off the asphalt binder course with paver. Correct any irregularities in the surface of the pavement course directly behind the paver. Remove excess material forming high spots with a shovel or lute. Fill intended areas with hot mix, and smooth with a lute or the edge of a shovel being pulled over the surface. Casting of mix over such areas will not be permitted.

3.4.4 If it is impractical to use a paver or spread box in areas of 1,000 square yards or less, the asphalt binder course may be spread and finished by hand. Wood or steel forms that are rigidly supported to ensure correct grade and cross forms that are rigidly supported to ensure correct grade and cross section may be used. Carefully place by hand to avoid segregation of the mix. Broadcasting of the material not be permitted. Remove any lumps that do not readily break down.

3.5 ASPHALTIC CONCRETE SURFACE

3.5.1 For all paved surfaces with asphaltic concrete surface being applied, clean existing surface and apply bituminous tack coat as directed by the A/E. Then apply 2 inch asphaltic concrete surface. Apply the surface course as directed above for the binder course.

3.5.2 For all asphaltic concrete surface being applied to asphaltic concrete leveling course binder, allow leveling course binder to set one to two days or as directed by the A/E. Then apply 1-1/2 inch asphaltic concrete surface as directed by the A/E. Then apply 1-1/2 inch asphaltic concrete surface as described above for the binder court.

3.6 SMOOTHNESS

The finished surfaces shall conform to the lines and grades shown on the drawings. No deviations, variations, or irregularities exceeding 1/4 inch in any direction when tested with a 12 foot straightedge will be permitted in the finished work, nor will any depressions that will not drain. Correct all such defects.

## 3.7 SAMPLING AND TESTING

3.7.1 Submit to the A/E test reports made by an independent testing laboratory on the crushed stone aggregate, bituminous materials, and asphaltic concrete design mixes, and obtain his approval of these reports before starting paving operations.

3.7.2 Tests shall be made of the completed elements of the pavement to ascertain the compacted thickness of the base and surface courses. If sections with deficient thicknesses are found, the full section for a reasonable distance on each side of the deficiency shall be refused. Remove and reinstall all such sections. Patch all test holes in connection with thickness tests.

3.7.3 When making surface tests, furnish one man to mark all surface defects for corrections.

END OF SECTION

## PART 1. GENERAL

1.1 Description of Work

Provide all plant, labor, materials and equipment to install the concrete curbs and combination concrete curb and gutters as called for on the approved plans, as detailed on the Construction Standards, and as specified herein.

1.2 Related Work Specified Elsewhere

Section 02513 - Pavements, Curbs and Walks

Section 03301 - Concrete Work

1.3 Applicable Specifications

A. American Association of State Highway and Transportation Officials (AASHTO).

B. American Society for Testing and Materials (ASTM).

C. Tennessee Department of Transportation, Standard Specifications for Road and Bridge Construction (TDOT).

## PART 2. MATERIALS

2.1 Concrete

Concrete shall be Portland cement Class A in conformance with Section 03301.

2.2 Joint Filler

Joint filler shall be 1/2" preformed asphalt expansion joint material conforming to ASTM D994 or ASTM D1751.

2.3 Subbase

The subbase materials shall be in conformance with TDOT Section 303, Grading D.

## PART 3. EXECUTION

3.1 Construct the subgrade to the required elevation below the finished surface of the gutter in accordance with dimensions and design as shown on Construction Standards. Remove all soft and unsuitable material and replace with base material, which shall be compacted to 95% density in accordance with AASHTO T-99 and finished to a smooth surface. Moisten the base prior to placing the concrete.

3.2 Construct forms of wood or metal conforming to TDOT Section 701.03(a). Automatic machine may be used for curb and gutter placement at Contractor's option. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified.

END OF SECTION

## PART 1. GENERAL

1.1 The work performed under this section shall consist of the loosening, loading, drilling, blasting, and removing of any and all types of materials encountered; the preparation of fills and embankments; the furnishing of the material for the proposed site preparation; the removal of unsuitable material from outside the normal limits of grading or excavation and/or the replacement of same with suitable materials where so ordered; the furnishing of borrow material or the disposal of excess materials; the furnishing, placing, and maintenance of all sheeting, shoring, bracing, and timbering necessary for the proper protection and safety of the work, the workmen, the public and adjacent property and improvements; the dewatering of trenches and other excavation, and the re-spreading of topsoil on areas to be seeded.

1.2 All costs for items in this section shall be included in the lump sum amount for this Contract.

1.3 All excavation under this Section shall be considered as unclassified, and no additional payment will be made therefore.

## PART 2. PRODUCTS

2.1 EARTH

A. Embankments shall be formed from earth or friable materials free from roots or other organic material, trash, frozen material, and rock or stones having a maximum dimension greater than 6 inches unless otherwise approved.

2.2 ROCK

A. Waste from rock excavation may, if approved, be used for rip rap on this project. In the event that there is more rock to waste than is needed for rip rap on this project, dispose of the excess rock on site as described in Paragraph 3.2.E. Under no circumstances shall rock fragments or boulders having dimensions in excess of 6 inches be used in the impervious core section of the embankments. Unless otherwise directed by the A/E, do not place such rocks or boulders in any other area of the embankment section.

2.3 CLAY OR OTHER LOW PERMEABILITY FILL MATERIAL

A. Material shall be suitable for remolding on site, shall be free from rocks or debris, and shall be able to form an impervious layer as specified elsewhere in this section. Clay or other low permeability fill material that is available on site and approved by the A/E may be used for this purpose.

2.4 GRANULAR FILL

A. Granular fill, if called for on the drawings, shall be clean; free from rocks, wood, debris, etc., having characteristics of building grade sand.

## PART 3. EXECUTION

3.1 UNSUITABLE MATERIALS

A. Where muck, quicksand, soft clay, swampy, or other material unsuitable for foundation, subgrade or backfilling purposes is encountered, remove it to a depth where suitable material is encountered and dispose of in the manner herein provided for waste material. Backfill areas so excavated in successive compacted layers as specified to the lines, grades and/or cross sections shown on the drawings.

3.2 GRADING

A. Limits: Perform grading excavation of every description, regardless of the character of material encountered, to the lines and grades indicated on the drawings and/or as directed by the A/E. Grading shall be in conformity with the grading plans and typical sections shown on the drawings and shall be finished within a tolerance of 3 inches of the grades indicated.

B. Common Excavation:

1. Common excavation shall consist of and include all grass, sod, earth, clay, sand, silt, gravel, hard and compacted materials such as hardpan, loose cemented gravel, soft or disintegrated rock and similar materials that can be removed by hand, heavy ripping equipment, or common earth moving equipment such as tractor drawn scraper and push tractors. It shall also include all boulders and loose rock less than 1 cubic yard in volume.

C. Formation of Embankment:

1. General: The suitability of materials and their deposition in the fill will at all times be subject to approval by the A/E. Mixing of materials during the excavation process at the source may be required. Pockets of material of uniform particle size, such as sand, when encountered, shall be proportionally mixed with other material or shall be wasted when so directed by the A/E.

2. Preparing Ground Surface for Embankment:

   a. After completion of all required clearing and grubbing operations and the removal of topsoil and unsuitable foundation material, thoroughly loosen the foundation area by scarifying or plowing to a minimum depth of 6 inches, except in areas where this requirement is waived by the A/E. After removal of roots or other debris turned up in the process of loosening, compact the entire surface area of such section of embankment foundation to the same density as specified herein for the type of fill to be placed immediately above the foundation.

3. Placing the Embankment Materials:

   a. Construct embankment at the locations and to the lines and grades indicated on the drawings and cross sections within the limits of the site of the work.

   b. Place no fill material until the embankment foundation, subgrade, and/or cutoff trench areas have been inspected and approved by the A/E. Keep the embankment foundation subgrade and/or cutoff trench free from water or unacceptable materials after filling operations have started. During construction, keep the top surface of all earth fills crowned with grades of not less than 2% so the fill will drain freely toward the slopes.

   c. Construct the fill in approximately horizontal lifts extending the entire length of the fill unless notified in writing by the A/E that the construction of the fill in sections is permitted. The lengths of the sections and the end slopes will be determined by the A/E where operations are not continuous throughout the entire length of the fill.

   d. Construct foundation embankments in maximum 8-inch loose lifts. Add moisture to, or dry by aeration, each layer as may be

necessary to meet the requirements of this specification for compaction. Compact with sheepsfoot rollers, power rollers, or other equipment approved by the A/E. Add successive lifts, and compact to a dry density of at least 98% of the Standard Proctor maximum dry density determined by methods described herein. Use only select materials from the excavation or borrow as designated by the A/E in the portion of embankment designated as impervious core.

3.3 TESTS FOR DETERMINATION OF THE DEGREE OF COMPACTION

A. The Owner will provide laboratory testing services for this project. The Contractor will excavate for the soils testing laboratory adequate dirt samples for obtaining a moisture density curve.

1. A moisture density curve showing the compaction characteristics of the soil from each excavated area will be provided to the Contractor before compaction operations commence. The moisture density relations shall be determined according to ASTM D698.

2. Field density tests shall be performed using the Shelby Tube Method, ASTM D2937, or the Sand Cone Method, ASTM D1556, on the compacted areas on the average of not less than one test per 5,000 square feet per foot of embankment height. Said tests will be made concurrently with grading operation, and the results furnished to the Contractor on the same day as the test is made.

3. Enough moisture tests will be made to determine whether additional water is required for compaction or if the moisture content is suitable for compaction to the specified limits established by the above.

B. If tests indicate that the embankments are not being compacted to the density required herein, the A/E will direct that the placement of additional embankment material cease until the Contractor takes appropriate steps to compact the material to the required density. Grading operations shall not be in progress when the moisture content of the embankment material exceeds that shown by the moisture density curve for the degree of compaction required except upon specific written authority of the A/E.

C. The cost of any additional testing shall be at the expense of the Contractor, and the costs for these subsequent tests to be deducted from the contract amount, at the discretion of the Owner.

## 3.4 WATER FOR COMPACTION

A. The furnishing of water used for sprinkling and wetting the materials during construction operations in connection with the compaction of fills and embankments will be considered a subsidiary obligation of the Contractor, and no additional payment will be made therefore.

## 3.5 MAINTENANCE

A. Maintain all excavated areas, trenches, fills embankments, and channels by the Contractor in good condition at all times until final acceptance by the Owner.

B. Maintain trench backfill at the approximate original ground surface by periodically adding backfill material as necessary and as directed by the A/E. Continue such maintenance until final acceptance of the project or until issuance of written release by the A/E.

END OF SECTION

## PART 1. GENERAL

1.1 The work covered by this section shall consist of excavating and backfilling the trench and of furnishing, laying, and jointing precast concrete pipe and fittings. It shall not include the construction of manholes, inlets, outlets, and other structures incidental to the construction of storm sewers or drains, all of which are covered elsewhere in these specifications. Excavation for storm sewers or drains shall comply with all applicable provisions of Section 02221, Unclassified Excavation for Utilities.

## PART 2. PRODUCTS

2.1 GENERAL

A. The diameter of pipe culverts and storm drains shown on the project drawings and bid schedule are based on Manning's formula for pipe flowing full, using n = 0.012 and the slopes shown on the drawings and profiles. If alternative materials and types of pipe culverts and storm drains are used, alter the diameter of the pipe shown to accommodate the required flow.

B. All driveway culverts shall be a minimum diameter of 15" with concrete headwalls installed per the standard specifications.

2.2 Concrete Pipe

A. All concrete sewer pipe with an internal diameter of 15 inches or less shall be extra strength sewer pipe conforming to ASTM C14. All concrete pipe with an internal diameter of 18 inches or more shall be reinforced concrete pipe conforming to ASTM C76, Table IV.

B. Laying lengths of reinforced concrete sewer pipe shall not exceed 8 feet unless written approval of the A/E is secured by the Contractor. Pipe shall be manufactured with machine bell pallets with a maximum slope of 2 degrees.

C. Circular concrete pipe with elliptical reinforcement is not included in these specifications and will not be accepted.

D. All concrete pipe shall be a minimum of 3 feet long for pipe with an internal diameter of 6 inches or less and a minimum of 4 feet long for pipe with an internal diameter of 8 inches or more, unless otherwise indicated on the drawings. All concrete pipe with an internal diameter of 12 inches or less shall have bell and spigot joints. All concrete pipe larger than 15 inches in internal diameter shall have tongue and groove joints.

E. All pipe and specials shall be inspected and accepted by an approved commercial testing laboratory prior to delivery to the work site. Each joint and each special shall be stenciled or otherwise marked with the laboratory's mark of acceptance. Furnish the A/E with 2 certified copies of the laboratory's report of inspection, test, and acceptance on all pipe and specials prior to its incorporation in the work.

F. When rubber gasket joints are used, the pipe shall be manufactured in strict accordance with the recommendations and requirements of the manufacturer of the particular rubber gasket selected.

2.3 JOINT REINFORCEMENT - CONCRETE PIPE

A. In all machine made concrete pipe with an internal diameter of 18 inches or more, the tongue shall be reinforced with circumferential reinforcement equal in area to that of a single line within the barrel of the pipe. At the groove end, the top strand of the circumferential reinforcement shall not be below the shoulder of the groove.

B. In all cast concrete pipe with an internal diameter of 18 inches or more, both the tongue and groove ends of the pipe shall be reinforced with circumferential reinforcement equal in area to that of a single line within the barrel of the pipe.

2.4 JOINT MATERIALS

A. Joint material for each sewer pipe larger than 15 inches in internal diameter and each tongue and groove pipe shall be a rubber gasket. Joint material For bell and spigot pipe shall be either a cement mortar, an asphaltic jointing compound, or rubber gasket.

B. Cement mortar pipe joints shall consist of a mixture of 1 part standard portland cement, 2 parts sand, and enough water to produce a uniform mixture of proper consistency and workability that will adhere to the pipe. The cement, sand, and water shall be in conformity with the applicable provisions of Section 03302, Concrete Work. Do not use mortar that has been mixed longer than 30 minutes for making pipe joints.

C. Asphaltic jointing compounds shall be equivalent in quality and type to GK asphaltic jointing compound. The selection by the Contractor of an asphaltic jointing compound shall be approved by the A/E prior to the purchase or use of same. Furnish the A/E with complete technical and construction data on the jointing compound to be approved.

D. The gasket material for caulking joints shall be twisted jute or oakum that is free from oil, tar, or grease.

E. Rubber or neoprene joints shall be Tylox Type CR, Type C, O-ring, or equal; the bell and spigot and the tongue and groove of the pipe shall be specially manufactured and prepared for the use of the type of joint selected. The rubber gaskets shall meet the requirements of ASTM C443. Submit the shape and design to the A/E for his approval.

## PART 3. EXECUTION

### 3.1 PIPELINE CONSTRUCTION

A. Lay no pipe except in the presence of an inspector representing the A/E.

B. Before constructing or placing joints, demonstrate to the A/E, by completing at least one sample joint, that the methods employed conform to the specifications and will provide a watertight joint, and further that the workmen intended for use on this phase of the work are thoroughly familiar and experienced with the type of joint proposed.

C. Before placing sewer pipe in position in the trench, carefully prepare the bottom and sides of the trench, and install any necessary bracing and sheeting as provided in Section 02221, Unclassified Excavation for Utilities.

D. Wherever necessary to provide a satisfactory bearing surface, place concrete cradles as shown on the drawings or as directed by the A/E. Cradles shall be of concrete with f' = 3,000 psi, as defined by ACI standards, and shall conform to the dimensions shown on the detailed drawings.

E. Tightly stretch a mason's line or wire above the ground level, parallel to and directly above the axis of the pipe to be installed, this line is to be supported at intervals of no more that 50 feet on sewers being laid on a grade of 2% or more and not exceeding 25 feet for grades of less than 2%. Determine the exact line and grade for each section of pipe by measuring down from this line to the invert of the pipe in place. Accurately place each pipe to the exact line and grade called for on the drawings. Furnish all labor and materials necessary for erecting batterboards. The use of laser beams will be allowed.

F. Do not allow water to run or stand in the trench while pipe laying is in progress, before the joint has completely set, or before the trench has been backfilled. Do not at any time open up more trench than the available pumping facilities are able to dewater.

G. Correct trench bottoms found to be unsuitable for foundations after pipe laying operations have been started, and bring them to exact line and grade with compacted earth as necessary.

H. Carefully inspect each piece of pipe and special fitting before it is placed, and lay no defective pipe in the trench. Pipe laying shall proceed upgrade, starting at the lower end of the grade and with the bells upgrade.

I. Bell holes shall be large enough to allow ample room for the pipe joints to be properly made. Cut bell holes out not more than 10 joints ahead of the pipe laying. Carefully grade the bottom of the trench between bell holes so that each pipe barrel will rest on a solid foundation for its entire length. Lay each pipe joint so as to form a close concentric joint with adjoining pipe and to avoid sudden offsets or inequalities in the flow line.

J. Jointing operations shall follow pipe laying very closely; failure to comply with this provision will result in the A/E's stopping all pipe laying operations until jointing operations catch up.

3.2 JOINT CONSTRUCTION

A. Cement Mortar Joints

1. Roll a gasket of jute or oakum thick enough to fill completely the annular space between the bell of one pipe and the spigot of another. This gasket shall be thoroughly saturated in a cement grout composed of neat portland cement and clean water mixed to the heaviest fluid consistency that will thoroughly impregnate gasket material to the A/E's satisfaction. Then lay the gasket in the bell in the lower 1/3 of the circumference of the joint, and cover with mortar. Insert the spigot of the pipe, and carefully drive home; then insert a small amount of mortar into the annular space around the entire circumference of the pipe. Wrap the ends of the gasket around one pipe, and solidly ram into the joint with a caulking tool. The depth of caulking shall be such as will leave a space of approximately 1-1/2 inches in pipe 18 inches and less in diameter or of 2-1/4 inches in pipe 21 inches and larger in diameter, measured from the end of the bell. Drive the mortar previously placed ahead of the gasket. Then fill the joints with portland cement mortar. This mortar must be placed by hand; take care to fill the joint completely and entirely around the pipe by pushing the mortar in by hand, using a rubber glove with fingers and a wooden caulking tool. Bevel the joints off at an angle of 45 degrees with the outside of the pipe, and protect with a wetted strip of muslin placed completely around the joint.

B. Rubber Joints

1. Rubber gaskets and the method of joint construction shall be in strict accordance with the manufacturer's directions and requirements. Adequately lubricate the gaskets with special cement provided for this purpose, and pipe joints shall be adequately and thoroughly driven home or seated.

## 3.3 WYES AND TEES

A. Install wyes and tee branches in the sewer line as shown on the drawings and/or at such other locations as may be designated by the A/E. If such branches are not to be used immediately, close them with precast clay or concrete stoppers held in place with jointing compound.

B. As the work progresses, thoroughly clean the interior of all pipe in place. On small pipe, keep a swab or drag in the pipe line, and pull forward past each joint immediately after it has been made. After laying each line of pipe, carefully inspect it, and remove all earth, trash, rags and other foreign matter from its interior.

C. After the joints have been completed, they shall be inspected, tested, and accepted by the A/E before they can be covered. The pipe shall meet test requirements for watertightness; immediately repair any leaks or defects discovered at any time after completion of the work. Take up any pipe that has been disturbed after joints were formed; clean and remake the joints; and relay the pipe at the Contractor's expense. Carefully protect all pipe in place from damage until backfill operations are completed.

D. Do not begin the backfilling of trenches until the pipe in place has been inspected and approved by the A/E. Backfilling shall be performed in the manner provided in Section 02221, Unclassified Excavation for Utilities.

## 3.4 CONNECTIONS

A. Make connections to all existing sewer lines as shown on the drawings or as directed by the A/E. Make connections either by removing a section of the sewer from the existing line and inserting in the space a wye branch of the proper size or by constructing a manhole, junction box, regulator chamber, or other structure as shown on the drawings.

B. Make connections to existing manholes or inlets by cutting a hole in the wall of the existing structure, inserting a length of pipe into the hole, filling around the pipe with concrete or mortar, and troweling the inside and outside surfaces of the joint to a neat finish. Shape or reshape the bottoms of

manholes as necessary to fit the invert of the sewer pipe.

3.5 PIPE PROTECTION

A. If pipe sewer has less than 1-1/2 feet of cover when completed, provide concrete protection as shown on the drawings or required by the A/E. Place the protection in accordance with the standard drawings.

3.6 EXISTING UTILITIES

A. Carefully protect all existing sewers, water lines, gas lines, sidewalks, curbs, gutters, pavements, electric lines, or other utilities or structures in the vicinity of the work from damage at all times. Wherever it is necessary for the proper accomplishment of the work to repair, remove, and/or replace any utility or structure, do so in accordance with the provisions set forth in the General and Supplementary Conditions and in Division 1, General Requirements.

3.7 CLEAN-UP

A. After completing each section of sewer line, remove all debris and construction materials and equipment from the site of the work, grade and smooth over the surface on both sides of the line, and leave the entire right-of-way in a clean, neat, and serviceable condition.

END OF SECTION

## PART 1. GENERAL

1.1 EXTENT OF THE WORK

A. The extent of concrete work is shown on the drawings.

1.2 QUALITY ASSURANCE

A. Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI 301, Specifications for Structural Concrete for Buildings.

2. ACI 302, Guide for Concrete Floor and Slab Placement

3. ACI 304, Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete

4. ACI 305, Hot Weather Concreting

5. ACI 315, Detailing Manual

6. ACI 315, Detailing Manual

7. ACI 318, Building Code Requirements for Reinforced Concrete

8. ACI 347, Recommended Practice for Concrete Formwork

9. CRSI Manual of Standard Practice

B. The Contractor is responsible for correcting concrete work that does not conform to the specified requirements, including requirements for strength, tolerances, and finishes. Correct deficient concrete as directed by the A/E.

C. Employ at the Contractor's expense a testing laboratory acceptable to the A/E to perform material evaluation tests and to design and review concrete mixes.

D. Materials and installed work may require testing and retesting, as directed by the A/E, at any time during the progress of the work. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be done at the Owner's expense, including the retesting of rejected materials and installed work, shall be done at the Contractor's expense.

E. Test aggregates by the methods of sampling and testing outlined in ASTM C33.

F. For portland cement, sample the cement and determine the properties by the methods of testing outlined in ASTM C150.

1.3 SUBMITTALS

A. Comply with applicable requirements of Section 01302, Submittals and Substitutions.

B. For each material sampled and tested, submit written reports to the A/E prior to the start of work. Provide the project identification name and number, date of report, name of Contractor, name of concrete testing service, source of concrete aggregates, materials manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results. Indicate whether or not material is acceptable for the intended use.

C. Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing and sealing compounds, and others requested by the A/E.

D. Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with the ACI 315, Detailing Manual, showing Schedule stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Show on the shop drawings special reinforcement required and openings through concrete structures.

E. Submit 3 copies of laboratory test reports with standard deviation analysis or trial batch data. All concrete material shall be listed.

## PART 2. PRODUCTS

### 2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Unless otherwise specified or shown on the drawings, construct formwork for exposed concrete surfaces with plywood, metal, metal framed plywood, or other panel type materials acceptable to the A/E in order to provide exposed surfaces that are continuous, straight, and smooth. To minimize the number of joints and to conform to the joint system shown on the drawings, furnish panels in the largest practicable sizes. Provide form material that is thick enough to withstand pressure of newly placed concrete without bowing or deflection.

B. Forms for Unexposed Finish Concrete: For surfaces that will be unexposed in the finished structure, form concrete with plywood, lumber, metal, or other material acceptable to the A/E. If lumber is used, it shall be dressed on at least two edges and one side for tight fit.

C. Form Coatings: Provide commercial formulation form coating compounds that will not bond with, stain, or adversely affect concrete surface and that will not impair subsequent treatments of concrete surfaces to be cured with water or curing compound.

### 2.2 REINFORCING MATERIALS

A. Reinforcing Bar: ASTM A615, Grade 60

B. Welded Wire Fabric: ASTM A185, welded steel wire fabric

C. Welded Deformed Steel Wire Fabric: ASTM A497

D. Supports for Reinforcement: Provide supports for reinforcement, including bolsters, chairs, spacers, and other devices for spacing, supporting, and and fastening reinforcing bars and welded wire fabric in place. Unless otherwise indicated on the drawings, use wire type bar supports complying with CRSI recommendations. Wood, brick, and other devices will not be acceptable. Comply with the following:

1. For slabs on grade, where wetted base material will not support chair legs, use supports with sand plates or horizontal runners.

2. For concrete surfaces exposed to view, where leg supports are in contact with forms, provide supports with legs that are hot dip galvanized or protected by either plastic or stainless steel.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Type I. Use only one brand of cement throughout the project, unless otherwise acceptable to the A/E.

B. Normal Weight Aggregates: ASTM C33, and as specified below:

1. Local aggregates that do not comply with ASTM C33 but that have been shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the A/E.

2. Fine aggregate is to be clean, sharp, river sand or crushed gravel when used for vehicular wearing surfaces. Manufactured sand may be used elsewhere provided the percentage passing a No. 200 sieve is less than 3%.

C. Coarse Aggregate: Coarse aggregate shall consist of crushed stone that is clean, uncoated, and processed from natural rock or stone and that contains No clay, mud, loam, or foreign matter. Its maximum size shall be no longer than 1/5 of the narrowest dimension between sides of forms, 1/3 of the depth of slabs or 3/4 of the minimum clear spacing between individual reinforcing bars or bundles of bars.

D. Moisture Barrier: Provide moisture barrier cover over prepared base material where shown on the drawings. This barrier shall consist of polyethylene sheet that is not less than 6 mils thick, is resistant to decay when tested in accordance with ASTM E154, and has a certified water transmission rate of no more than 0.005 perms. Lap and tap all joints. Repair any tears. Note areas on the drawings where 3 inches of damp sand is required prior to concrete placement.

E. Water: clean, fresh, drinkable

F. Admixtures

1. Water Reducing Admixture: Eucon WR-75 by the Euclid Chemical Company, Pozzolith 200N by Master Builders, or Plastocrete 150 by Sika Chemical Corporation. The admixture shall conform to ASTM C494, Type A, and not contain more chloride ions that are present in municipal drinking water.

2. Water Reducing, Retarding Admixture: Eucon Retarder-75 by the Euclid Chemical Company, Pozzolith 100 XR by Master Builders, or Plastiment by Sika Chemical Corporation. The admixture shall conform to ASTM C494, Type D, and not contain more chloride ions than are present in municipal drinking water.

3. High Range Water Reducing Admixture (Superplasticizer): Eucon 37 by the Euclid Chemical Company or Sikament by Sika Chemical Corporation. The admixture shall conform to ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.

4. Nonchloride Accelerator: Accelguard 80 by the Euclid Chemical Company or Darex Set Accelerator by W.R. Grace. The admixture shall conform to ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water.

5. Air Entraining Admixture: ASTM C260

6. Calcium Chloride: Calcium chloride or admixtures containing more than 0.1% chloride ions are not permitted.

7. Pozzolanic Admixtures: ASTM C618

8. Certification: Written conformance to the above mentioned requirements and the chloride ion content will be required from the admixture manufacturer prior to mix design review by the A/E.

2.4 RELATED MATERIALS

A. Crushed Stone Beneath Floor Slabs: Stone shall be free draining limestone or river gravel meeting ASTM C33 size number 67.

B. Waterstops: Provide waterstops of either rubber or PVC. Rubber units shall comply with Corps of Engineers CRD-C513; PVC units, with CRD-C572. Locate waterstops at joints as shown on the drawings. Where waterstops are located between walls and foundations, use steel plate as detailed on the drawings.

C. Slab Control/Construction Joint Filler: MM-80, a semirigid epoxy manufactured by Metzger/McGuire Company, Contoocook, New Hampshire 03229, 603/746-4963 or EUCO 700 as manufactured by the Euclid Chemical Company, Cleveland, Ohio. Material shall have a cured Shore A hardness of approximately 80, tensile strength of approximately 400-500 psi, and adhesion to concrete of approximately 180-230 psi. It shall be 100% solid epoxy, require no primer under normal circumstances, and be a 2 component pour grade, gray color.

D. Moisture Retaining Covering: one of the following, complying with ASTM C171:

1. Waterproof paper
2. Polyethylene film
3. Polyethylene coated burlap

E. Curing and Sealing Compound: Super Floor Coat or Super Pliocure by the Euclid Chemical Company or Masterseal 66 by Master Builders. The compound shall conform to FS TT-C-800A, 30% solids content minimum, and have test data from an independent laboratory indicating a maximum moisture loss of 0.030 gram per square centimeter when applied at a coverage rate of 300 square feed per gallon. Manufacturer's certification is required.

F. Ashford Formula: Curing and surface hardening of exposed interior concrete floors throughout the treatment plant filter building shall be performed by applying Ashford Formula, as manufactured by Curecrete Chemical Company, Nashville. Contact: Jack Wehby Warehouse, 3607 Trousdale Drive, Telephone (615) 833-0500.

G. Bonding Compound: Euco Weld by Euclid Chemical Company or Weldcre by the Larsen Company. The compound shall be a polyvinyl acetate, rewettable type.

H. Epoxy Adhesive: Euco Epoxy No. 463 or No. 615 by Euclid Chemical Company or Sikadur Hi-Mod by Sika Chemical Corporation. The compound shall be a 2 component, 100% solids, 100% reactive compound suitable for use on dry or damp surfaces.

I. Nonshrink Grout: Firmix (metallic) or Euco NS (nonmetallic) by the Euclid chemical Company or Embeco 153 (metallic) or Masterflow 713 (nonmetallic) by Master Builders. The grout shall conform to CRD-C-621-80, "Corps of Engineers Specification for Nonshrink Grout."

2.5 MIX DESIGN

A. Preparation

1. Prepare design mixes for each type and strength of concrete in accordance with applicable provisions of ASTM C94. Use an independent testing facility acceptable to the A/E for preparing and reporting proposed mix designs. The testing facility shall not be the same one used for field quality control testing unless this is acceptable to the A/E. Submit to the A/E written reports of each proposed mix for each class of concrete at least 15 days before the start of work. Do not begin concrete production until the A/E's review of the mixes.

2. The design mix shall provide normal weight concrete with 4,000 psi, 28 day compressive strength, as indicated on the drawings and schedules.

B. Adjustments to Concrete Mixes: The Contractor may request adjustments to the mix design when warranted by the characteristics of the materials, job conditions, weather, test results, or similar circumstances. Such adjustments shall be made only if approved by the A/E and at no additional cost to the Owner. Laboratory test data for revised mix design and strength results must be submitted to and accepted by the A/E before the revised mix design is used in the work.

C. Admixtures

1. If required by the structural drawings, concrete shall contain the specified water reducing admixture and/or high range water reducing

admixture (superplasticizer). All concrete slabs placed at air temperatures below 50 degrees F shall contain the specified nonchloride accelerator. All concrete required to be air entrained shall contain an approved air entraining admixture. If required by the structural drawings, pumped concrete, architectural concrete, concrete for industrial slabs and parking decks, and concrete with a water/cement ratio below 0.50 shall contain the specified high range water reducing admixture (superplasticizer).

a. Use an air entraining admixture in all concrete structures and slabs exposed to freezing and thawing or subjected to hydraulic pressure:

2.5% to 5.5% for maximum 2 inches aggregate
4.5% to 7.5% for maximum 3/4 inch aggregate
5.5% to 8.5% for maximum 1/2 inch aggregate

2. Water/Cement Ratio: All concrete exposed to freezing and thawing shall have a maximum water/cement ratio of 0.50. All concrete subjected to deicers and/or required to be watertight shall have a maximum water/cement ratio of 0.45.

3. Use the amounts of admixtures recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities and types of admixtures as required to maintain quality control.

D. Slump Limits

1. All concrete containing the high range water reducing admixture (superplasticizer) shall have a maximum slump of 8 inches unless otherwise approved by the A/E. The concrete shall arrive a the job site at a slump of 2 inches to 3 inches and be verified; then the high range water reducing admixture shall be added to increase the slump to the approved level.

2. All other concrete shall have a maximum slump of 3 inches for slabs and 4 inches for other members.

2.6 PROPORTIONING

A. Job Site Mixing

1. Mix materials for concrete in an acceptable drum type batch machine mixer. For mixers with a capacity of one cubic yard or less, continue mixing at least 1-1/2 minutes but not more than 5 minutes after all ingredients are in the mixer before any part of the batch is released. For mixers with a capacity of more than one cubic yard, increase the minimum mixing time of 1-1/2 minutes by 15 seconds for each additional cubic yard of capacity or fraction thereof.

2. For each batch discharged and used in the work, provide a batch ticket indicating the project identification name and number, date, mix time, quantity, and amount of water introduced.

B. Ready Mix Concrete

1. Comply with the requirements of ASTM C94 and of these specifications.

2. During hot weather or under conditions that contribute to rapid settings of concrete a shorter mixing time than that specified in ASTM C94 may be required. When the air temperature is between 85 degrees and 90 degrees F, reduce the mixing and delivery time from 1-1/2 hours to 75 minutes; when the air temperature is above 90 degrees F, reduce the mixing and delivery time to 60 minutes.

3. Each load of concrete arriving at the job shall be accompanied by a delivery ticket that shall be collected by the Contractor and submitted to the A/E and shall contain the following information:

   a. The design mix and strength of mix of concrete being delivered.

   b. The exact time the cement, aggregate, and water were discharged into the delivery truck.

## PART 3. EXECUTION

### 3.1 FORMS

A. Design, erect, support, brace, and maintain formwork to support any vertical and lateral loads that may be applied until such loads can be supported by the concrete structure. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position.

B. Design formwork so that it can be readily removed without impact, shock, or damage to cast in place concrete surfaces and adjacent materials.

C. Construct forms complying with ACI 347 to the sizes, shapes, lines, and dimensions shown on the drawings so that in the finished structures the work will be level and plumb and have accurate alignment, location, and grade. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features that the work requires. Use selected materials to obtain the required finishes. Butt joints solidly, and provide backup at joints to prevent leakage of cement paste.

D. Fabricate forms so that they can be easily removed without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep for the concrete to be placed with bottom forms only. To form keyways, reglets, recesses, and the like, kerf wood inserts to prevent swelling and to permit easy removal.

E. Where the interior area of the formwork is not accessible for cleanout, provide temporary openings to permit concrete placement and inspection before the concrete is placed. Brace temporary openings securely and set them tightly to forms to prevent the loss of concrete mortar. Position temporary openings on forms at inconspicuous locations.

F. Chamfer exposed corners and edges as shown on the drawings, using wood, metal, PVC, or rubber chamfer strips fabricated to produce smooth, uniform lines and tight edge joints.

G. Use metal form ties that are factory made, adjustable in length, designed to prevent form deflection, and either removable or snap-off and that will

prevent the concrete surface's being spalled when the ties are removed. If snap-off ties are used, the portion remaining within the concrete after removal must be at least 1-1/2 inches inside the concrete unless the drawings indicate otherwise.

H. Unless the drawings indicate otherwise, provide form ties that will not leave holes larger than 1-1/2 inches in diameter in the concrete surface.

I. Provide openings in concrete formwork to accommodate the work of other trades. Determine the size and location of openings, recesses, and chases from the trades providing such work. Accurately place and securely support items built into forms.

J. Clean thoroughly forms and adjacent surfaces that are to receive concrete. Remove chips, wood, sawdust, dirt, and any other debris just before the concrete is placed. After concrete placement, retighten forms if necessary to eliminate mortar leaks.

3.2 PLACING REINFORCEMENT

A. For details and methods of placing reinforcement and supports, comply with the specified codes and standards and the recommended practices of the CRSI as outlined in "Placing Reinforcing Bars," and these specifications.

B. Clean reinforcement to remove loose rust and mill scale, earth, ice, and other materials that reduce or destroy the bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcement with metal chairs, runners, bolsters, spacers, and hangers as required for security.

D. Place reinforcement to obtain at least the minimum coverages for concrete protection as required by ACI 318. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so that ends are directed into the concrete, not toward exposed concrete surfaces.

E. Do not place reinforcing bars more than 2 inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment or similar construction loads.

F. Install welded wire fabric in lengths that are as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset end laps in adjustment widths to prevent continuous laps in either direction.

3.3 JOINTS

A. Locate and install construction joints (which are not shown on the drawings) as approved by the A/E so that the strength and appearance of the structure will not be impaired.

B. Provide keyways at least 1-1/2 inches deep in construction joints that are in walls and slabs or between walls and footings. Bulkheads designed for this purpose may be used if accepted by the A/E. Omit keyway where steel waterstops are shown between walls and footings.

C. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints of structural members.

D. Provide waterstops in construction joints as shown on the drawings. Install waterstops to form a continuous diaphragm in each joint. Make provisions to support and protect waterstops during the progress of the work. Fabricate field joints in waterstops in accordance with the manufacturer's printed instructions. Protect waterstop material from damage if it protrudes at any point.

E. Construct isolation joints in slabs on the ground wherever there is contact between slabs on the ground and vertical surfaces and wherever else indicated on the drawings.

F. Install joint filler and sealant materials as specified by the manufacturer.

G. Construct contraction (control) joints in slabs on ground to form panels of patterns as shown on the drawings. Use saw cuts or approved inserts creating a plane of 1/4 slab thickness.

H. Make saw cuts as soon as possible after final finishing without dislodging the aggregate.

I. Install joint sealant material as specified by manufacturer.

J. The maximum joint spacing of slabs on grade shall be 20 feet unless otherwise approved by the A/E.

## 3.4 INSTALLATION OF EMBEDDED ITEMS

A. Set and build into the work anchoring devices and other embedded items required for other work that are to be attached to or supported by cast in place concrete. Use setting drawings, diagrams, instructions, and directions provided by the suppliers of the items to be attached thereto.

B. Set edge forms or bulkheads and intermediate screed strips for slabs in order to provide the elevations and contours in the finished slab surface required by the drawings. Provide units strong enough to support the types of screed strips used, and secure with strike-off templates or compacting screeds accepted by the A/E.

## 3.5 PREPARATION OF FORM SURFACES

A. Before placing reinforcement, coat the contact surfaces of forms with a form coating compound.

B. Thin the form coating compound only with the amount and type of thinning agent and only under the conditions recommended by the compound manufacturer. Do not allow excess form coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply the form coating compound in compliance with the manufacturer's instructions.

C. Coat steel forms with a nonstaining, rust preventive form oil, or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

## 3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades that the formwork is complete so that they may then install their work; cooperate with other trades in setting such work. Wherever form coatings are not used, wet wood thoroughly just before placing concrete.

B. Coordinate the installation of joint materials and moisture barriers with the placement of forms and reinforcing steel.

C. Deposit concrete either continuously or in layers thick enough to prevent its being placed on concrete that has hardened enough to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as close to its final location as practicable in order to avoid segregation due to rehandling or flowing.

D. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner that avoids inclined construction joints. Where placement consists of several layers, avoid cold joints by placing each layer while the preceding one is still plastic.

E. Use mechanical vibrating equipment supplemented by hand spading, rodding, or tamping to consolidate placed concrete. The equipment and procedures used to consolidate the concrete shall comply with the recommended practices of ACI 309 and suit both the type of concrete and project conditions.

F. Do not use vibrators to transport concrete once it is inside the forms. Insert and withdraw vibrators vertically at uniformly spaced locations no further apart than the visible horizontal effectiveness of the machine. Limit layer heights so that the vibrator is effective into 6 inches of the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete, and complete embedment of reinforcement and other embedded items without causing segregation of the mix. Lower frequency vibrators may be used with "flowing" concrete.

G. Until the placing of a panel or section is completed, deposit and consolidate concrete slabs in a continuous operation within construction joints.

H. Consolidate concrete during placing operations so that it is thoroughly worked around reinforcement and other embedded items and into corners.

I. Bring slab surfaces to the correct level with a straightedge and strike off. Use bull floats or darbies to smooth the surface, leaving it free from humps and hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces before starting finishing operation.

J. Maintain reinforcement in the proper position during placement operations.

K. Cold Weather Placement

1. Comply with ACI 306 and the requirements herein specified to protect concrete work from physical damage or reduced strength due to frost, freezing, or low temperatures.

2. When the air temperature has fallen or is expected to fall below 40 degrees F, heat all water and aggregates uniformly before mixing so that the concrete, at point of placement, will have a temperature of not less than 50 degrees nor more than 80 degrees F.

3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

4. Use only the specified nonchloride accelerator. Do not use calcium chloride or admixtures containing more than 0.1% chloride ions.

L. Hot Weather Placement

1. When the weather is hot enough to impair seriously the concrete's quality and strength, place the concrete as specified herein and in ACI 305.

2. Cool ingredients before mixing so that when the concrete is placed, its temperature is below 90 degrees F. Mixing water may be chilled, or else a portion of the water may be in the form of chopped ice.

3. If reinforcing steel becomes hotter than the ambient air temperature, cool it with water soaked burlap so that its temperature will not exceed the ambient air temperature.

4. When high temperatures and/or placing or humidity conditions dictate, the mix may be initially retarded by use of the water reducing, retarding formulation (Type D) of the specified water reducing admixture (Type A).

## 3.7 FINISH OF FORMED SURFACES

A. Rough Form Finishes: For formed concrete surfaces not exposed to view in the finished work or covered by other construction, use a rough form finish unless otherwise indicated by the drawings. Repair and patch tie holes and defective areas, and rub down or chip off fins and other projections more than 1/4 inch high.

B. Smooth Form Finish: For formed concrete surfaces that are exposed to view or to be covered with a coating or covering material applied directly to the concrete or a covering material bonded to the concrete (e.g., waterproofing, dampproofing, painting, etc.), use a smooth form finish. This is the as-cast finish obtained on the concrete surface when the selected form facing material is regularly and symmetrically arranged with a minimum of seams. Repair and patch defective areas so that all fins and other projections are completely removed and smoothed.

C. Rubbed Finish

At all formed surfaces exposed inside and outside the building, apply rubbed finish as follows:

1. Surface irregularities shall not exceed 1/8 inch in 5 feet for gradual irregularities nor 1/16 inch for abrupt irregularities. Fill over any air pockets or voids over 1/8 inch in width, and surface smoothly.

2. Perform finishing after all required patching and corrections of major imperfections have been completed, and complete within 24 hours after forms are stripped.

3. Thoroughly wet the surfaces, and begin finishing while they are still damp.

4. The mortar shall consist of 1 part cement, 2 parts sand (by dry volume) passing a No. 16 screen, the bonding admixture SBR Latex by the Euclid Chemical Company, and enough water to produce a mortar the consistency of thick paint.

5. Apply the mortar by rubbing thoroughly over the surface, using burlap or a sponge rubber float, to fill all pits thoroughly. While the mortar in

the pits is still plastic, rub over the surface with a dry mix of the above proportions and material to remove the excess material and to stiffen the mortar in the pits. After the mortar has thoroughly hardened, wipe it with clean burlap to remove all surface mortar completely. The entire operation for any area must be completed the day it is started.

D. Related Uniform Finishes:

1. At the tops of walls, horizontal offsets, and similar unformed surfaces that are next to formed surfaces, strike off smooth and finish with a texture that matches the adjacent formed surfaces. Unless otherwise shown on the drawings, continue the final surface treatment of formed surfaces uniformly across adjacent unformed finishes.

E. Float Finish

1. Apply float finish to monolithic slap surfaces that are to receive a trowel finish or other finished specified hereinafter; to slab surfaces that are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand bed terrazzo; and as otherwise indicated by the drawings or schedules.

2. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened enough to permit the operation of power driven floats or by hand floating if the area is small or inaccessible to power units. Check and level the surface plane so that depressions between high spots do not exceed 5/16 inch under a ten-foot straightedge.

F. Trowel Finish

1. Apply a trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise indicated by the drawings, and to slab surfaces that are to be covered with resilient flooring, paint, and other thin film finish coating.

2. After the slab has received a floated finish, begin first trowel finish operation using a power driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over it.

Consolidate the concrete surface by a final hand troweling until it is free of trowel marks, is uniform in texture and appearance, and has a level surface so that depressions between high spots do not exceed 3/16 inch under a ten-foot straightedge. Grind smooth any surface defects that would telegraph through the applied floor covering.

G. Nonslip Broom Finish

1. Apply nonslip broom finish to exterior concrete platforms, steps, and ramps and elsewhere as indicated by the drawings or schedules.
2. Immediately after float finishing, roughen the concrete surface slightly by brooming perpendicular to the main traffic route with a fiber bristle broom.

H. "Dry Shake" Finish: If a "dry shake" application of a selected metallic or mineral aggregate is specified, blend the aggregate, selected or approved by the A/E, with portland cement in the proportions recommended by the manufacturer of the aggregate. Give the surface a float finish as specified above. Apply approximately 2/3 of the blended material for required coverage to the surface by a method that ensures even coverage without segregation. Floating shall begin immediately after application of the first "dry shake." After this material has been embedded by floating, apply the rest of the blended material to the surface at right angles to the previous application. The second application shall be heavier in any areas not sufficiently covered by the first application. A second floating shall follow immediately. After the selected material has been embedded by the 2 floatings, complete the operation with a broomed, floated, or troweled finish, as designated in the contract documents.

I. Nonslip Finish: Where the contract documents require a nonslip finish, give the surface a "dry shake" application, as specified above, of crushed ceramically bonded aluminum oxide or other specified selected abrasive particles. The rate of application of such material shall be not less the 25 pounds per 100 SF.

J. Sealed Finish: Apply a second coat of the specified curing and sealing compound to interior concrete floors. The compound shall be applied in strict accordance with the directions of the manufacturer and just prior completion of construction and shall be compatible with the initial curing and sealing compound.

3.8 CURING

A. After placing and finishing the concrete, start initial curing as soon as free water has disappeared from concrete surface. Keep continuously moist for not less than 7 days.

B. Begin final curing immediately after initial curing and before the concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301. Avoid rapid drying at the end of the final curing period.

C. Cure concrete by moist curing, moisture retaining cover curing, membrane curing, or combinations of these methods, as specified herein.

D. Provide moisture curing by one of the following methods:

1. Keep concrete surface continuously wet by covering with water.

2. Spray it continuously with a water fog.

3. Cover the concrete surface with the specified absorptive cover, thoroughly saturating the cover with water and keeping it wet; position the absorptive cover so that it covers the concrete surface and edges and laps adjacent absorptive covers by 4 inches.

E. Provide moisture cover curing by covering concrete surfaces with a moisture retaining cover designed for curing concrete. Place the cover in the widest practicable width of material with sides and ends of the material lapped at least 3 inches and sealed by waterproof tape or adhesive. Repair immediately any holes or tears that occur during the curing period with identical cover material and waterproof tape.

F. Provide membrane curing to slabs as follows: All interior slabs that have resilient tile or carpet or are left exposed and all exterior slabs, sidewalls, curbs, etc., shall be cured with the specified clear curing and sealing compound. The compound shall be applied immediately after final finishing operations are completed. Apply uniformly in a continuous operation by power spray or roller in accordance with the manufacturer's directions. Areas that are subjected to heavy rainfall within 3 hours after initial application shall be recoated. Maintain continuity of coating, and repair damage during the curing period.

G. Cure formed concrete surfaces (including undersides of beams, supported slabs, and other similar surfaces) by moist curing with forms in place for the full curing period or until the forms are removed. If forms are removed, continue curing by the methods specified above as applicable.

H. Cure unformed surfaces such as slabs, floor topping, and other flat surfaces by the application of the specified curing and sealing compound, Ashford Formula, or by a moist curing method approved by the A/E.

I. Apply Ashford Formula to floor slabs after placing and finishing in accordance with manufacturer's recommendations and flush with clear water after application as required.

3.9 REMOVAL AND REUSE OF FORMS

A. Formwork not supporting weight of concrete (e.g., sides of beams, walls, columns, and similar parts of the work) may be removed after curing at a temperature of not less than 50 degrees F 24 hours after the concrete is placed, provided the concrete is hard enough not to be damaged by form removal operations and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete (e.g., beam soffits, joints, slabs, and other structural elements) may not be removed for at least 14 days nor until the concrete has attained a design minimum compressive strength of 28 days. Determine the potential compressive strength of in-place concrete by testing the field cured specimens representative of the concrete location members.

C. Form facing material may be removed 4 days after concrete placement only if shores and other vertical supports have been arranged to permit it to be removed without loosening or disturbing shores and supports.

D. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact form surfaces as specified above for new formwork.

E. When forms are extended for successive concrete placement, clean surfaces thoroughly, remove fins and latency, and tighten forms to close

joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces, except as acceptable to the A/E.

## 3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Unless the drawings show otherwise or the A/E directs, fill in holes and openings left in concrete structures for the work of other trades once that work is in place. Mix, place, and cure concrete as specified herein to blend with in-place construction. Provide other miscellaneous concrete filling shown on the drawings or necessary to complete the work.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on the drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with the certified diagrams or templates of the manufacturer furnishing the machines and equipment.

C. Nonshrink Grout: All column base plates, equipment bases, and other locations noted on the structural drawings shall be grouted with the specified nonshrink grout. All exposed grout shall be of the specified nonmetallic type.

D. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams where indicated on the drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

## 3.11 CONCRETE SURFACE REPAIRS

A. Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to the A/E.

B. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete, but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Before placing cement mortar, thoroughly clean, dampen with water, and apply the specified bonding compound. The cement mortar shall be placed after the bonding compound has dried.

C. Remove and replace concrete with defective surfaces if these effects cannot be repaired to the satisfaction of the A/E. Such surface defects include irregularities of color and texture, cracks, spalls, air bubbles, honeycomb,

rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, and fill with dry pack mortar or with precast cement cone plugs secured in place with bonding agent.

D. Where possible, repair concealed formed surfaces that contain defects which adversely affect the durability of the concrete. If such defects cannot be repaired, remove and replace the concrete.

E. Test unformed surfaces such as monolithic slabs for smoothness and to verify that the surface plane meets the tolerances specified for each surface and finish. Correct low and high areas as specified herein. Test unformed surfaces sloped to provide drainage for both trueness of slope and smoothness with a template of the slope specified above.

F. Repair finished unformed surfaces that contain defects which adversely affect durability of the concrete. Such surface defects include crazing, spalling, pop-outs, honeycomb, rock pockets, cracks that are more than 0.01

G. After the concrete has cured at least 14 days, correct high areas in unformed surfaces by grinding.

H. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting them out and refilling with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the A/E.

I. Repair defective areas (except for random cracks and single holes not more than 1 inch in diameter) by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete, and apply the specified bonding compound. Place patching concrete after the bonding compound inch wide or that, regardless of width, penetrate either to reinforcement or completely through unreinforced sections, and other objectionable conditions. has dried. Mix patching concrete of the same materials to provide concrete of the same type or class as the original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

J. Repair isolated random cracks and single holes not over 1 inch in diameter by the dry pack method. Groove top of cracks, cut out holes until sound concrete is reached, and clean to remove dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply the specified bonding compound. Place dry pack after the bonding compound has dried. Dry pack shall consist of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve. Mix with no more water than is necessary for handling and placing. Compact dry pack mixture in place, and finish to match adjacent concrete. Keep patched area continuously moist for no less than 72 hours.

K. All structural repairs shall be made, with prior approval of the A/E as to the method and procedure, using the specified epoxy adhesive and/or epoxy mortar.

L. Repair methods not specified above may be used, subject to acceptance by the A/E.

3.12 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. The Contractor shall employ a testing laboratory to perform any or all of the tests specified below and to submit reports on these tests. Sampling and testing for quality control during the placement of concrete may include the following, as directed by the A/E:

1. Sampling Fresh Concrete: ASTM C172, but modified for slump to comply with ASTM C94.

2. Slump: ASTM C143; one test for each concrete load at point of discharge and one test of each set of compressive strength test specimens.

3. Air Content: ASTM C173 volumetric method for lightweight concrete; ASTM C231 pressure method for normal weight concrete; one test for each set of compressive strength test specimens.

4. Concrete Temperature: Test hourly when air temperature is 40 degrees F and below or when 80 degrees F and above and each time a set of compression test specimens is made.

5. Compression Test Specimen: ASTM C31; one set of 6 standard cylinders for each compressive strength test, unless otherwise directed by the A/E. Mold and store cylinders of laboratory cured test specimens except when the A/E requires field cured test specimens.

6. Compressive Strength Tests: ASTM C39; one set for each 100 cubic yards or fraction thereof of each concrete class placed in any one day or one set for each 5,000 square feet of surface area placed; 2 specmens tested at 7 days, 3 specimens tested at 28 days, and 1 specimen retained in reserve for later testing, if needed.

B. When the frequency of testing provides less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or, if fewer than 5 are used, from each batch.

C. When the total quantity of a given class of concrete is less than 50 cubic yards, the strength test may be waived by the A/E if, in his judgment, adequate evidence of satisfactory strength is provided.

D. The strength level shall be considered satisfactory as long as the average of all sets of 3 consecutive strength test results equal or exceed the specified strength f'c, and no individual test result falls below the specified strength f'c by more than 500 psi.

E. When the strength of field cured cylinders is less than 85% of companion laboratory cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

F. Test results will be reported to the A/E and Contractor in writing on the same day that the test is made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete placement, concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials, and compressive breaking strength and type of break for both 7 day tests and 28 day tests.

G. The testing service will make additional tests of in-place concrete when the test results indicate that the required strength level has not been achieved and other characteristics have not been attained in the structure, as directed by the A/E. The testing service may conduct tests to determine the

adequacy of concrete by cored cylinders that comply with ASTM C42 or by such other methods as are directed by the A/E. The Contractor shall pay for such tests and any additional testing that may be required when concrete is verified to be unacceptable.

H. Hydrostatic Testing: Concrete structures that are to contain water, sludge, or other liquids, such as settling or digestion tanks, sumps, clearwells, coagulation basins, reservoirs, filter basins, and similar structures, shall be hydrostatically tested for leakage. Testing shall consist of filling each structure with water so that the A/E can inspect and observe any leaks when the structure has been full of water from 24 to 48 hours. When practical, make such tests before backfill is placed around the structure. If the test is made after backfilling is complete, mark the water level in the structure and monitor for 72 hours to see if there is any loss of water. Repair all leaks in the structure in an approved manner. Patching or caulking or any other method of repair on the outside of the dry side of walls will not be permitted. Damp areas or spots on permanently exposed walls will be considered leaks.

END OF SECTION

## PART 1. GENERAL

1.1 ACI Standard 301-72, Specifications for Structural Concrete for Buildings (as revised), forms a part of these specifications and is supplemented as follows:

A. Strength

1. The minimum compressive strength of concrete in 28 day shall be 4,000 psi.

B. Durability

1. All concrete exposed to weather shall be air entrained with Master Builders MB-AE10, or approved substitute.

C. Admixtures

1. Air entrainment, which is mandatory for concrete exposed to weather, may also be used for all other concrete except interior floor slabs.

2. Use a water reducing admixture such as Master Builders Pozzolith or approved equal that is (depending on placing temperatures) retarding, normal, or accelerating.

D. Reinforcing Steel

1. The yield strength of reinforcing steel shall be 60,000 psi.

E. Expansion Joint Filler

1. ASTM D994

F. Smooth Rubbed Finish

1. Apply to all exposed formed surfaces.

G. Troweled Finish

1. Apply to all floors except as noted on the drawings.

H. Broom or Belt Finish

1. Apply to exterior walks, steps, and slabs.

I. Curing

1. The curing compound shall conform to ASTM C309, Type I.

J. Testing

1. Furnish and pay for all testing services described in Chapter 16 of ACI 301-72 (revised, 1975).

1.2 One copy of ACI 301-72 (revised, 1975) shall be kept on the project site. If requested, the A/E will furnish a copy for this purpose.

1.3 SEALER: Master Builders Masterseal, applied according to the manufacturer's recommendations at 450 square feet per gallon.

## PART 2. PRODUCTS

Not used.

## PART 3. EXECUTION

Not used.

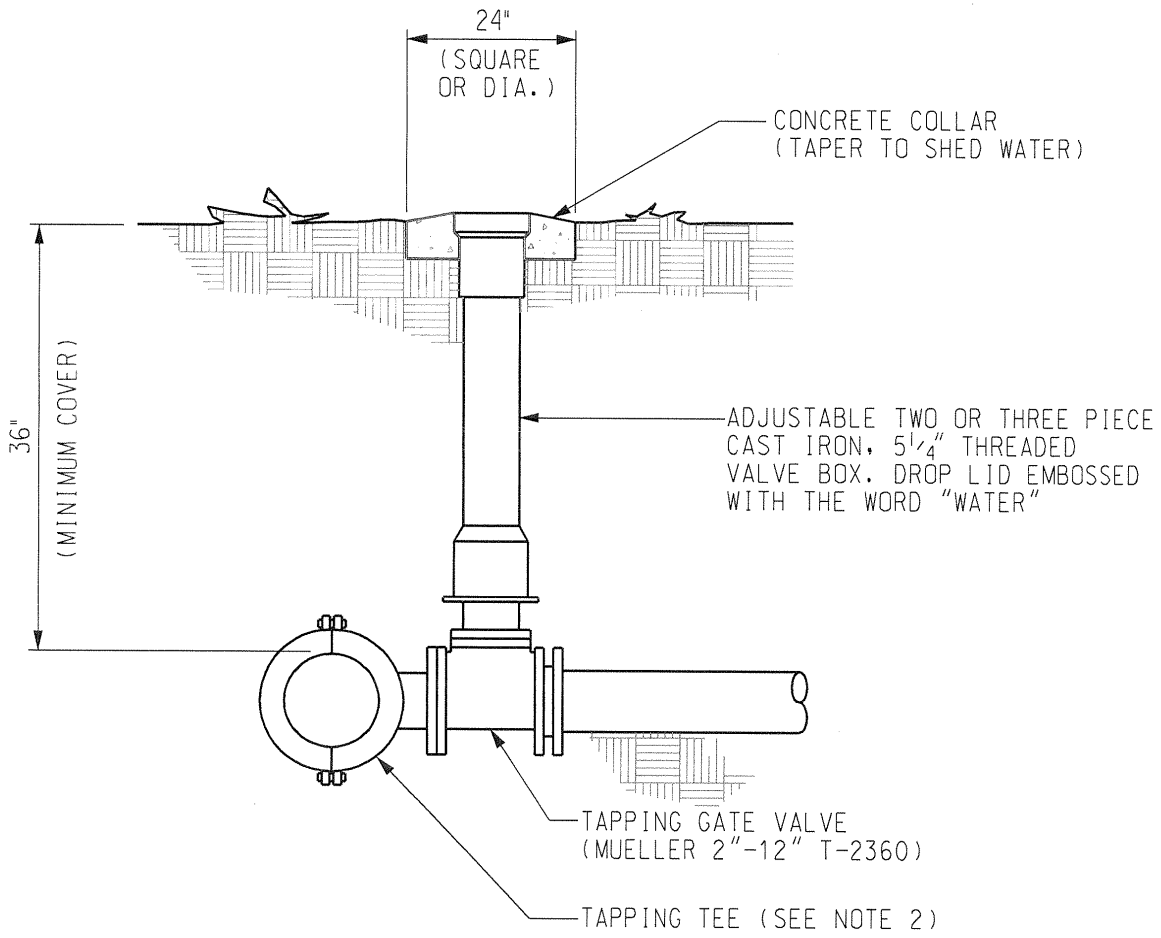
END OF SECTION

# STANDARD DRAWINGS

NOTES:

1. OPERATING NUT, DIRECTION OF OPENING CAP NUT AND THREAD AND CONNECTIONS MUST BE APPROVED IN WRITING BY THE OWNER AS CONFORMING TO THEIR STANDARDS.

2. USE MUELLER H-612 TAPPING TEES FOR 4"-8" PVC WATER LINES OR MUELLER H-615 TAPPING TEES FOR 4"-24" PVC AND DUCTILE IRON WATER LINES.



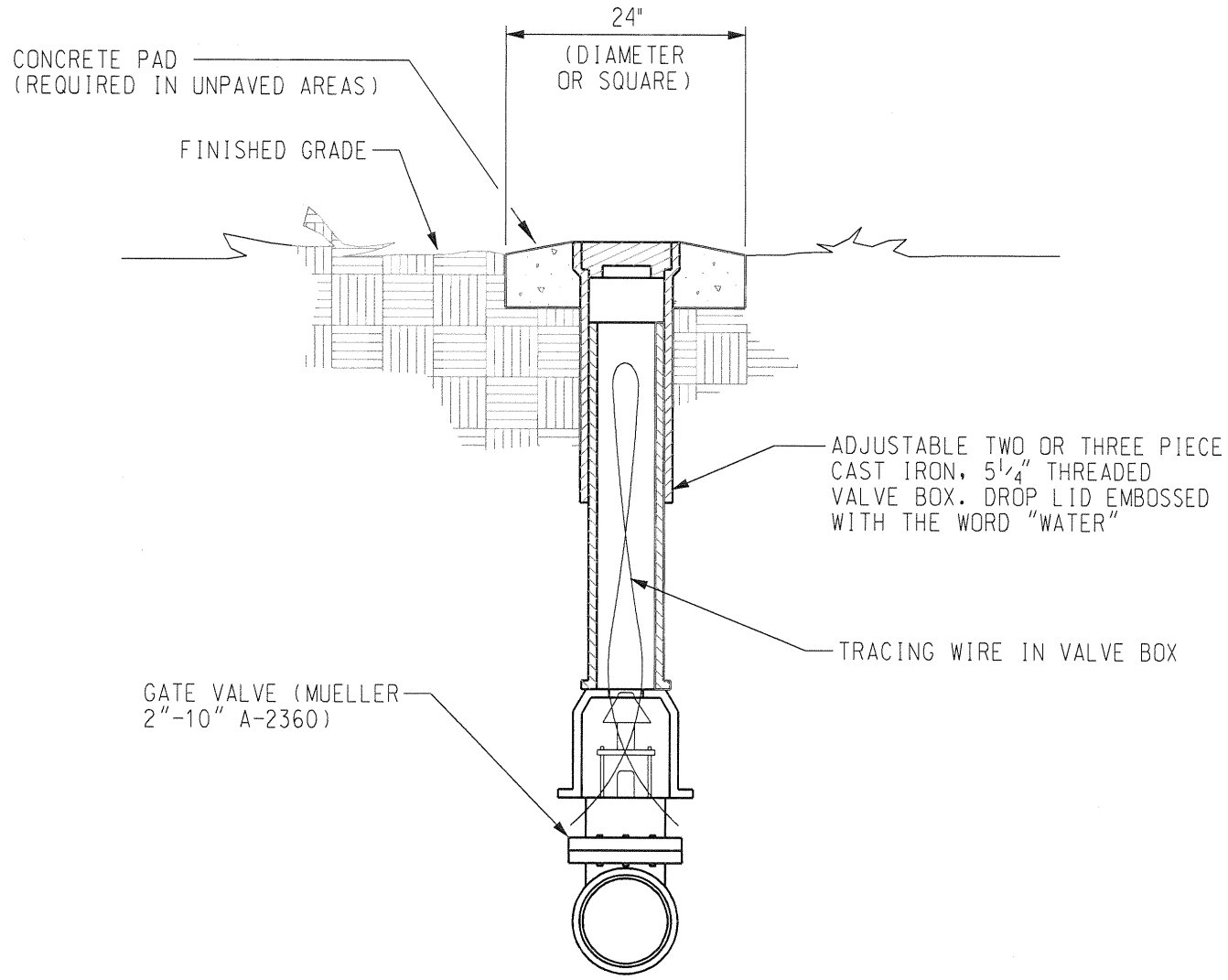

# TAPPING SLEEVE & VALVE DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

**ASHLAND CITY, TENNESSEE**

HKA
HIGHERS, KOONCE & ASSOCIATES, INC.
Civil and Environmental Engineering
3343 Perimeter Hill Drive Suite 212
Nashville, Tennessee 37211 (615) 333-7200




# TYPICAL VALVE BOX SETTING

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

**ASHLAND CITY, TENNESSEE**

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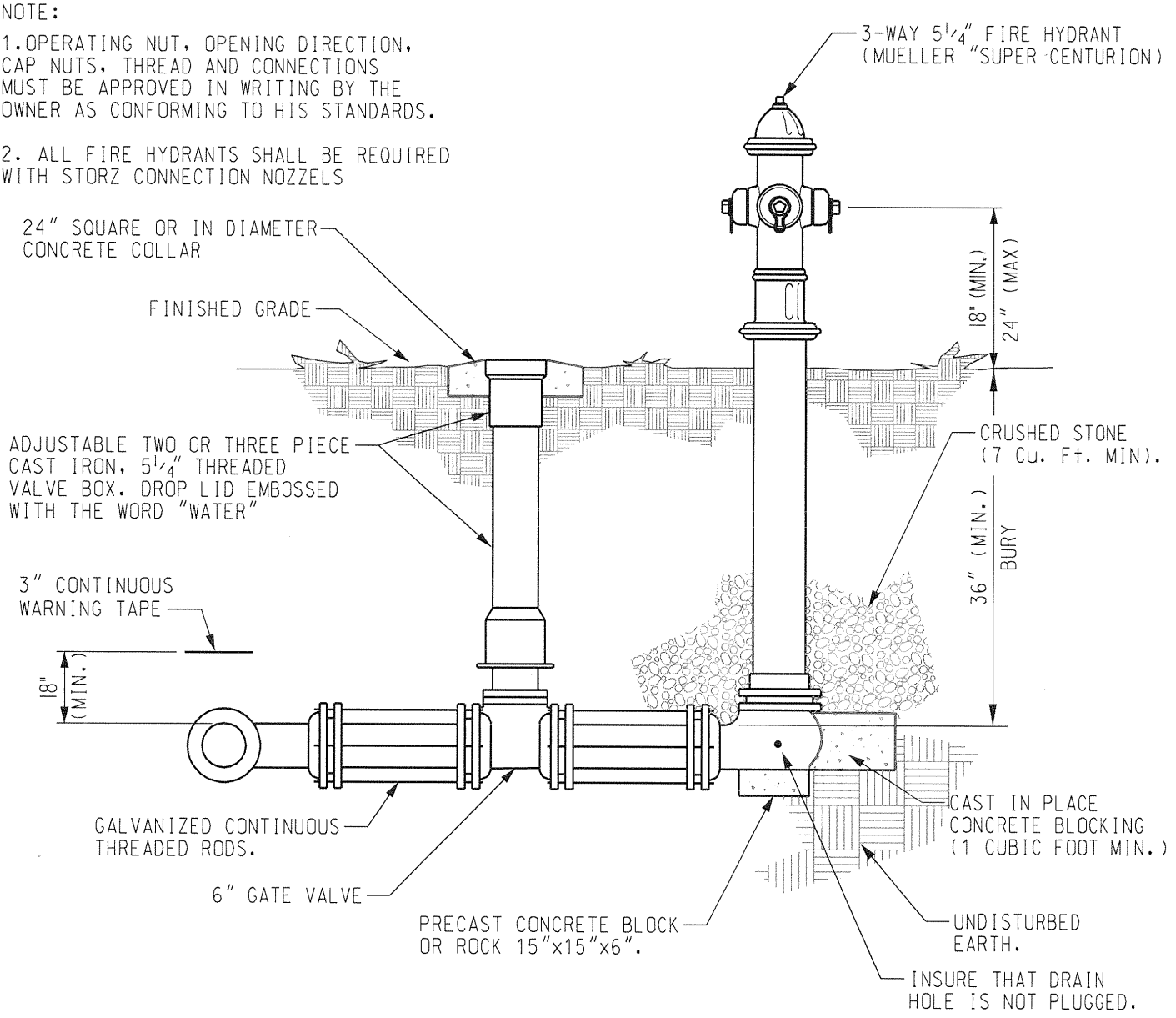
HIGHERS, KOONCE & ASSOCIATES, INC.
Civil and Environmental Engineering
3343 Perimeter Hill Drive Suite 212
Nashville, Tennessee 37211 (615) 333-7200

NOTE:

1. OPERATING NUT, OPENING DIRECTION, CAP NUTS, THREAD AND CONNECTIONS MUST BE APPROVED IN WRITING BY THE OWNER AS CONFORMING TO HIS STANDARDS.

2. ALL FIRE HYDRANTS SHALL BE REQUIRED WITH STORZ CONNECTION NOZZELS




# FIRE HYDRANT WITH VALVE DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

**ASHLAND CITY, TENNESSEE**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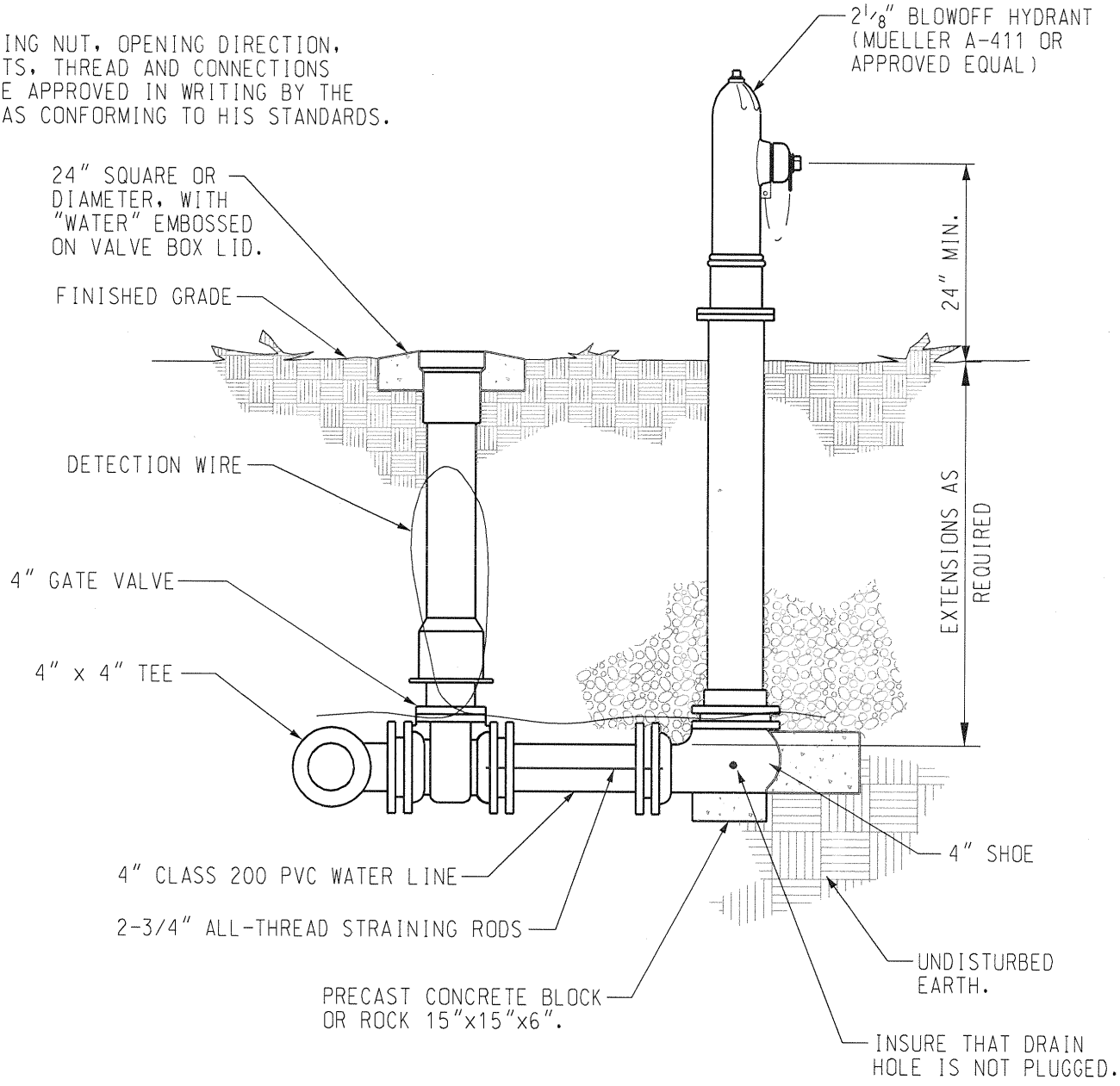
HIGHERS, KOONCE & ASSOCIATES, INC.
Civil and Environmental Engineering
3343 Perimeter Hill Drive Suite 212
Nashville, Tennessee 37211 (615) 333-7200

**NOTE:**

OPERATING NUT, OPENING DIRECTION, CAP NUTS, THREAD AND CONNECTIONS MUST BE APPROVED IN WRITING BY THE OWNER AS CONFORMING TO HIS STANDARDS.




# BLOWOFF HYDRANT DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

**ASHLAND CITY, TENNESSEE**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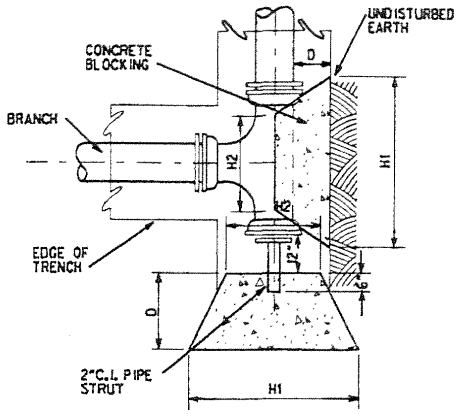
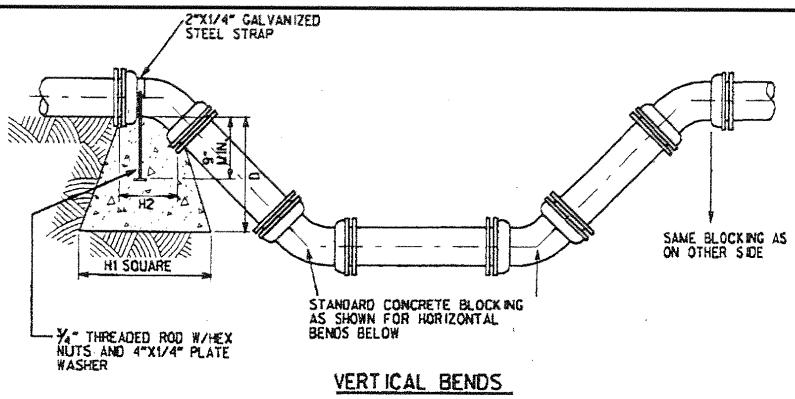
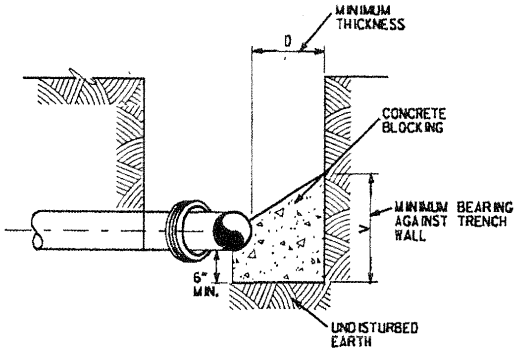



TEES, CROSSES AND PLUGS

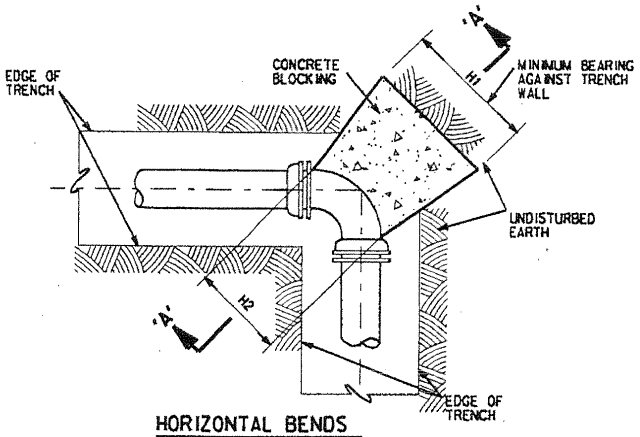
NOTE: DIMENSIONS ARE CONTROLLED BY DIAMETER OF BRANCH MAIN.




VERTICAL BENDS




SECTION 'A-A'




HORIZONTAL BENDS

TABLE OF DIMENSIONS FOR CONCRETE BLOCKERS

| TEES, CROSSES & PLUGS | | | | | 90° BENDS | | | | | 45° BENDS | | | | | 22-1/2° BENDS | | | | | 11-1/4° BENDS | | | | | PIPE SIZE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H1 | H2 | V | D | C.F. | H1 | H2 | V | D | C.F. | H1 | H2 | V | D | C.F. | H1 | H2 | V | D | C.F. | H1 | H2 | V | D | C.F. | |
| 18" | 10" | 12" | 18" | 1.90 | 18" | 10" | 12" | 18" | 1.90 | 18" | 6" | 12" | 18" | 1.50 | 18" | 6" | 12" | 18" | 1.50 | 18" | 6" | 12" | 18" | 1.50 | 2" & 2-1/4" |
| 24" | 12" | 12" | 18" | 2.25 | 24" | 12" | 12" | 18" | 2.25 | 18" | 8" | 12" | 18" | 1.60 | 18" | 8" | 12" | 18" | 1.60 | 18" | 8" | 12" | 18" | 1.60 | 3" & 4" |
| 24" | 16" | 18" | 18" | 3.50 | 30" | 16" | 18" | 18" | 4.05 | 24" | 10" | 16" | 18" | 3.20 | 24" | 10" | 16" | 18" | 3.20 | 24" | 10" | 16" | 18" | 3.20 | 6" |
| 36" | 18" | 18" | 18" | 5.05 | 39" | 18" | 24" | 18" | 7.30 | 30" | 11" | 18" | 18" | 3.95 | 30" | 11" | 18" | 18" | 3.95 | 24" | 11" | 16" | 18" | 3.40 | 8" |
| 48" | 24" | 18" | 24" | 7.15 | 54" | 32" | 24" | 18" | 10.25 | 24" | 18" | 21" | 18" | 4.60 | 24" | 18" | 21" | 18" | 4.60 | 24" | 18" | 21" | 18" | 4.60 | 10" |
| 54" | 30" | 24" | 24" | 13.4 | 54" | 32" | 36" | 24" | 18.15 | 42" | 18" | 24" | 24" | 9.60 | 24" | 18" | 24" | 24" | 6.60 | 24" | 18" | 21" | 24' | 6.10 | 12" |
| 60" | 32" | 30" | 24" | 17.9 | 60" | 40" | 42" | 24" | 25.00 | 44" | 24" | 30" | 24" | 13.2 | 30" | 24" | 24" | 24" | 9.20 | 27" | 21" | 24" | 24' | 7.90 | 14" |
| 66" | 34" | 36" | 24" | 22.5 | 69" | 48" | 48" | 24" | 29.00 | 48" | 30" | 36" | 24" | 17.0 | 36" | 30" | 27" | 24" | 11.80 | 27" | 24" | 27" | 24" | 9.10 | 16" |
| 66" | 36" | 40" | 24" | 27.5 | 69" | 48" | 48" | 24" | 33.00 | 48" | 30" | 36" | 24" | 17.0 | 36" | 30" | 29" | 24" | 13.0 | 27" | 30" | 29" | 24" | 11.0 | 18" |
| | 38" | | 24" | | | 48" | | 24" | | | 40" | | 24" | | | 36" | | 24" | | 30" | 40" | | 28" | | 20" |
| | 42" | | 24" | | | 60" | | 24" | | | 48" | | 24" | | | 42" | | 24" | | | 42" | | 32" | | 24" |
| | 58" | | 24" | | | 96" | | 24" | | | 72" | | 24" | | | 72' | | 24" | | | 48" | | 36" | | 36" |

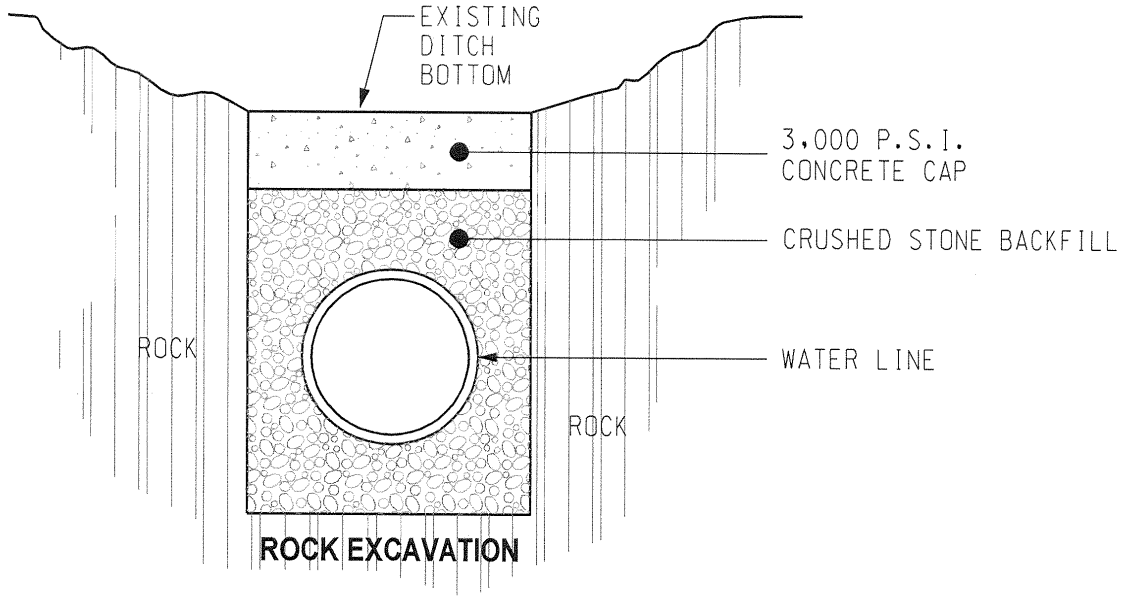
# TYPICAL CONCRETE THRUST BLOCKING DETAILS

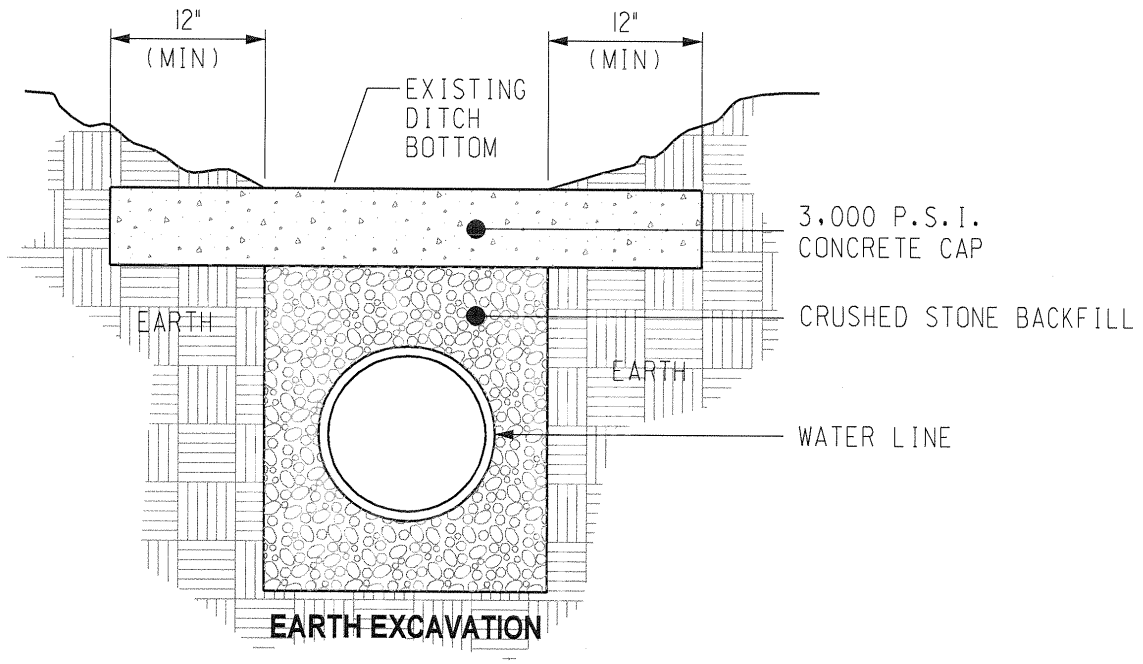
STANDARD WATER AND SEWER SYSTEM DETAILS

## THE TOWN OF

## ASHLAND CITY, TENNESSEE

HKA
HIGHERS, KOONCE & ASSOCIATES, INC.
Civil and Environmental Engineering
3343 Perimeter Hill Drive Suite 212
Nashville, Tennessee 37211 (615) 333-7200




# CONCRETE CAP FOR WATER LINES

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

**ASHLAND CITY, TENNESSEE**

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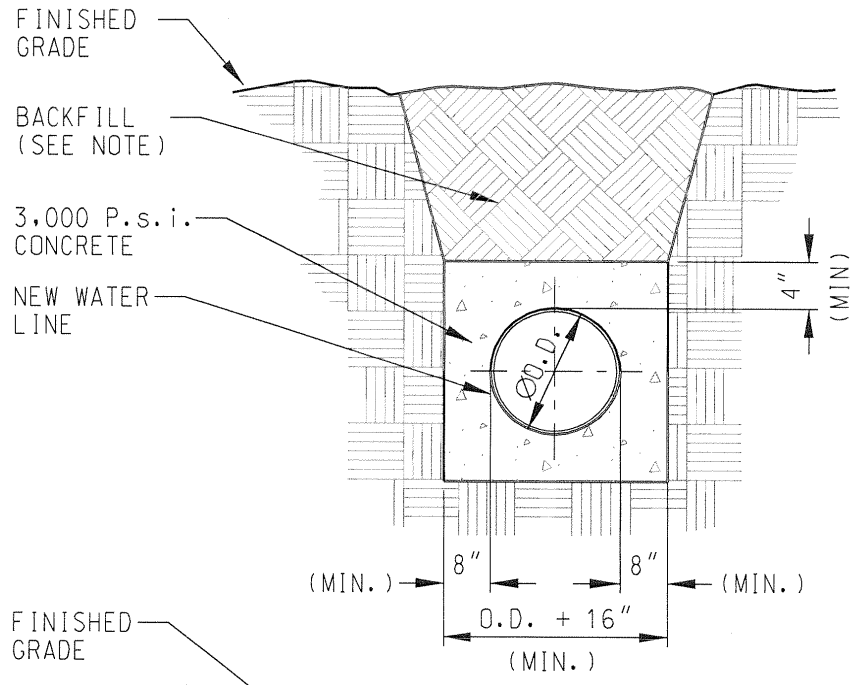
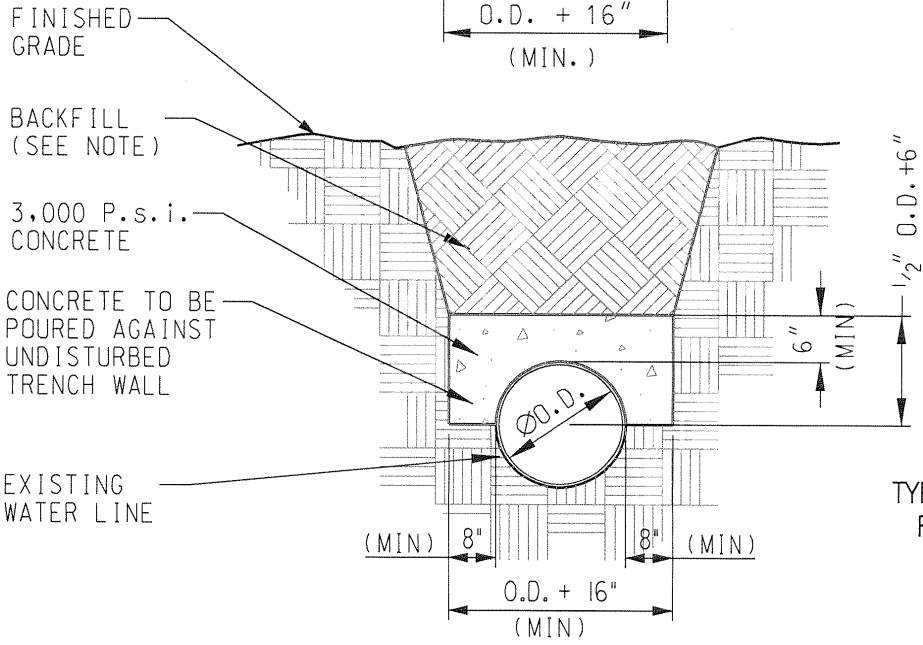



TYPICAL CONCRETE PROTECTION FOR NEW WATER LINES




TYPICAL CONCRETE PROTECTION FOR EXISTING WATER LINES

# CONCRETE ENCASEMENT FOR WATER LINES

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

**ASHLAND CITY, TENNESSEE**

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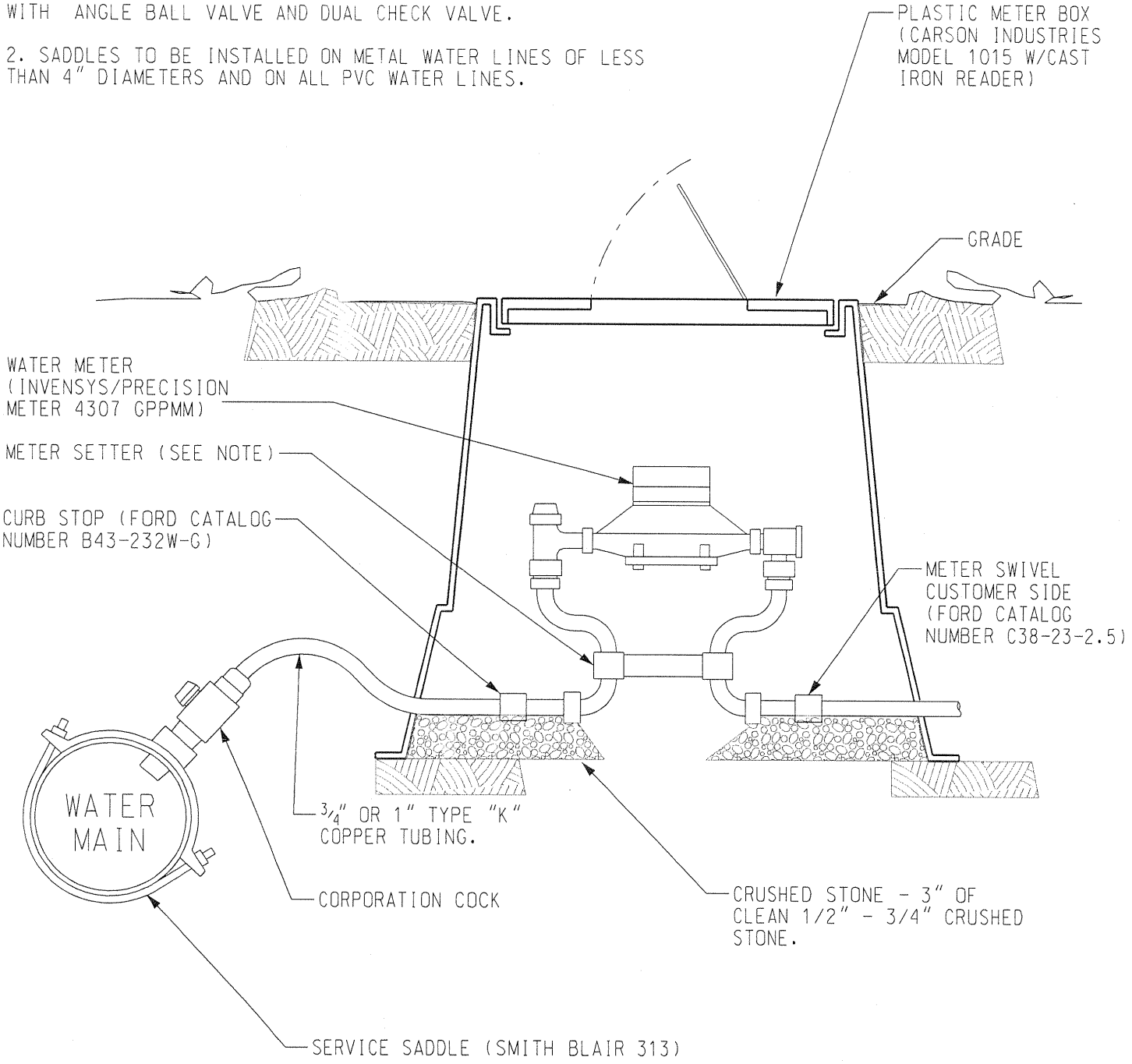
HIGHERS, KOONCE & ASSOCIATES, INC.
Civil and Environmental Engineering
3343 Perimeter Hill Drive Suite 212
Nashville, Tennessee 37211 (615) 333-7200

NOTES:

1. THE 3/4" SETTER TO BE FORD VBHH42 WITH DUALCHECK AND BALL VALVE. THE 1" SETTER TO BE FORD VBHH44-1OW WITH ANGLE BALL VALVE AND DUAL CHECK VALVE.

2. SADDLES TO BE INSTALLED ON METAL WATER LINES OF LESS THAN 4" DIAMETERS AND ON ALL PVC WATER LINES.




# 3/4" AND 1" SERVICE ASSEMBLY (NON-TRAFFIC AREAS)

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

**ASHLAND CITY, TENNESSEE**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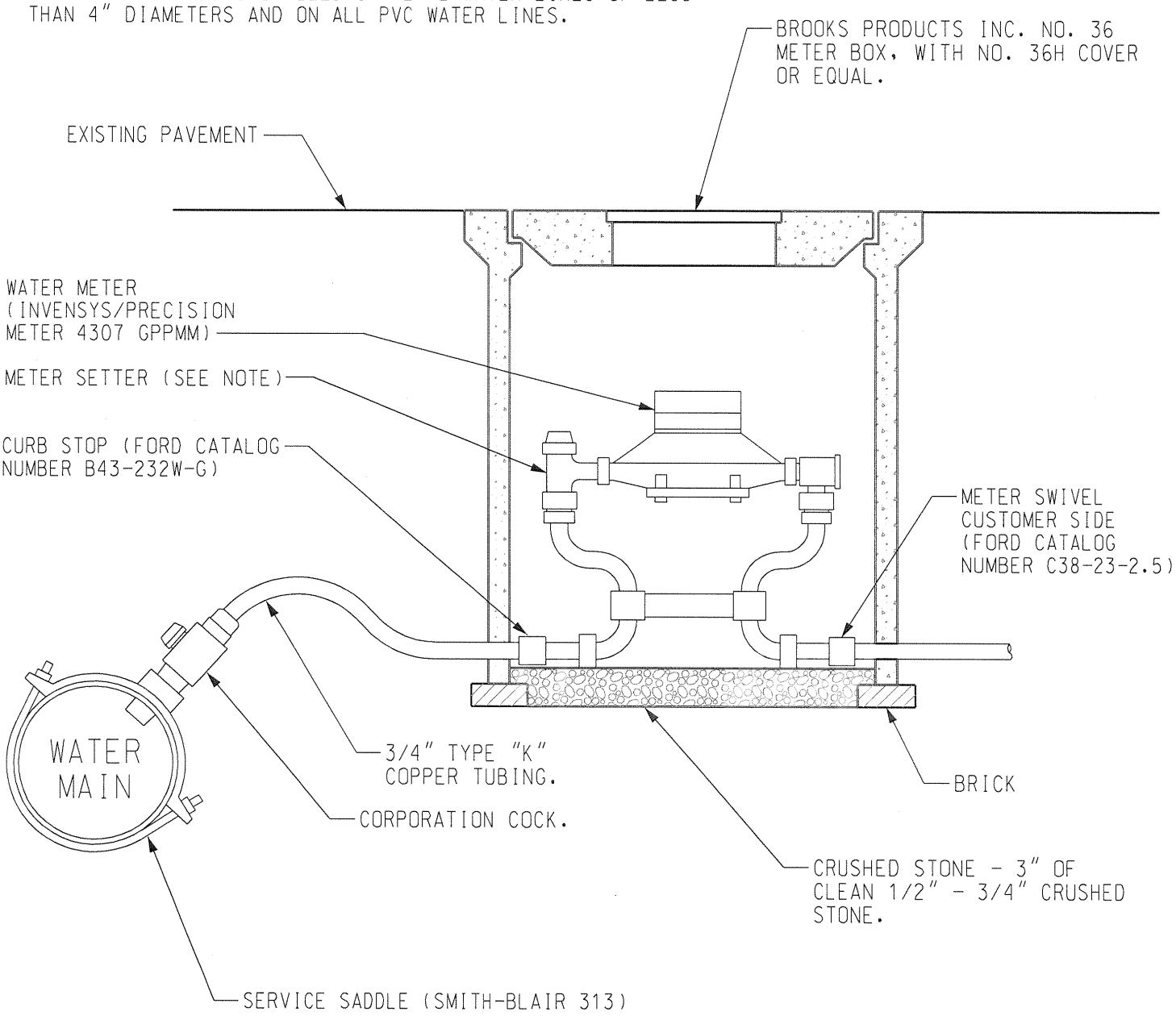
Civil and Environmental Engineering
3343 Perimeter Hill Drive Suite 212
Nashville, Tennessee 37211 (615) 333-7200

NOTES:

1. THE 3/4" SETTER TO BE FORD VBHH42 WITH DUALCHECK AND BALL VALVE. THE 1" SETTER TO BE FORD VBHH44-10W WITH ANGLE BALL VALVE AND DUAL CHECK VALVE.

2. SADDLES TO BE INSTALLED ON METAL WATER LINES OF LESS THAN 4" DIAMETERS AND ON ALL PVC WATER LINES.




# 3/4" AND 1" SERVICE ASSEMBLY (TRAFFIC AREAS)

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

**ASHLAND CITY, TENNESSEE**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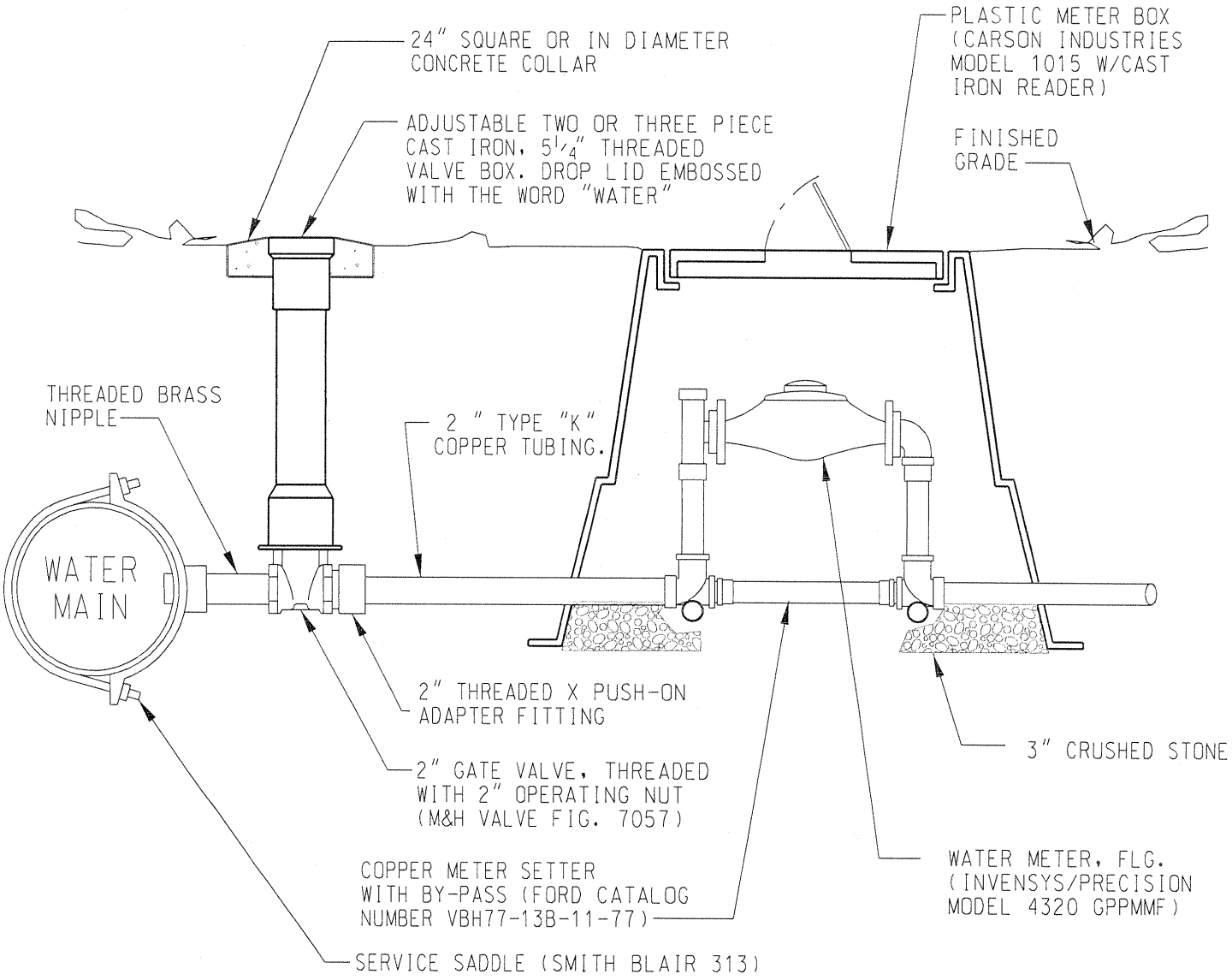
HIGHERS, KOONCE & ASSOCIATES, INC.
Civil and Environmental Engineering
3343 Perimeter Hill Drive Suite 212
Nashville, Tennessee 37211 (615) 333-7200

NOTE:

SADDLES TO BE INSTALLED ON METAL WATER LINES OF LESS THAN 4" DIAMETERS AND ON ALL PVC WATER LINES.




# 2" SERVICE ASSEMBLY DETAIL (NON-TRAFFIC AREAS)

STANDARD WATER AND SEWER SYSTEM DETAILS

## THE TOWN OF

## ASHLAND CITY, TENNESSEE

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HIGHERS, KOONCE & ASSOCIATES, INC.
Civil and Environmental Engineering
3343 Perimeter Hill Drive Suite 212
Nashville, Tennessee 37211 (615) 333-7200

NOTE:

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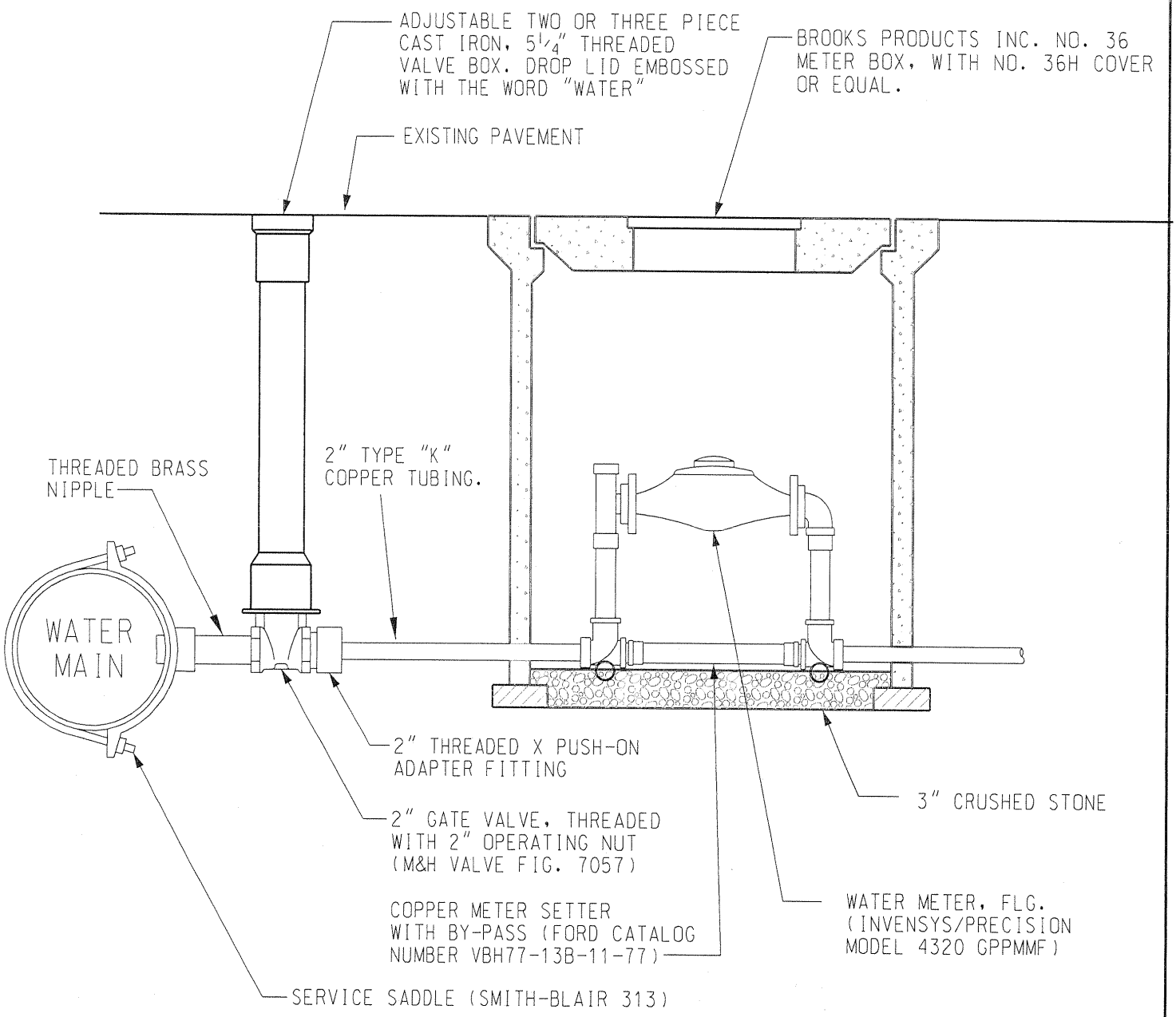


# 2" SERVICE ASSEMBLY DETAIL (TRAFFIC AREAS)

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

**ASHLAND CITY, TENNESSEE**


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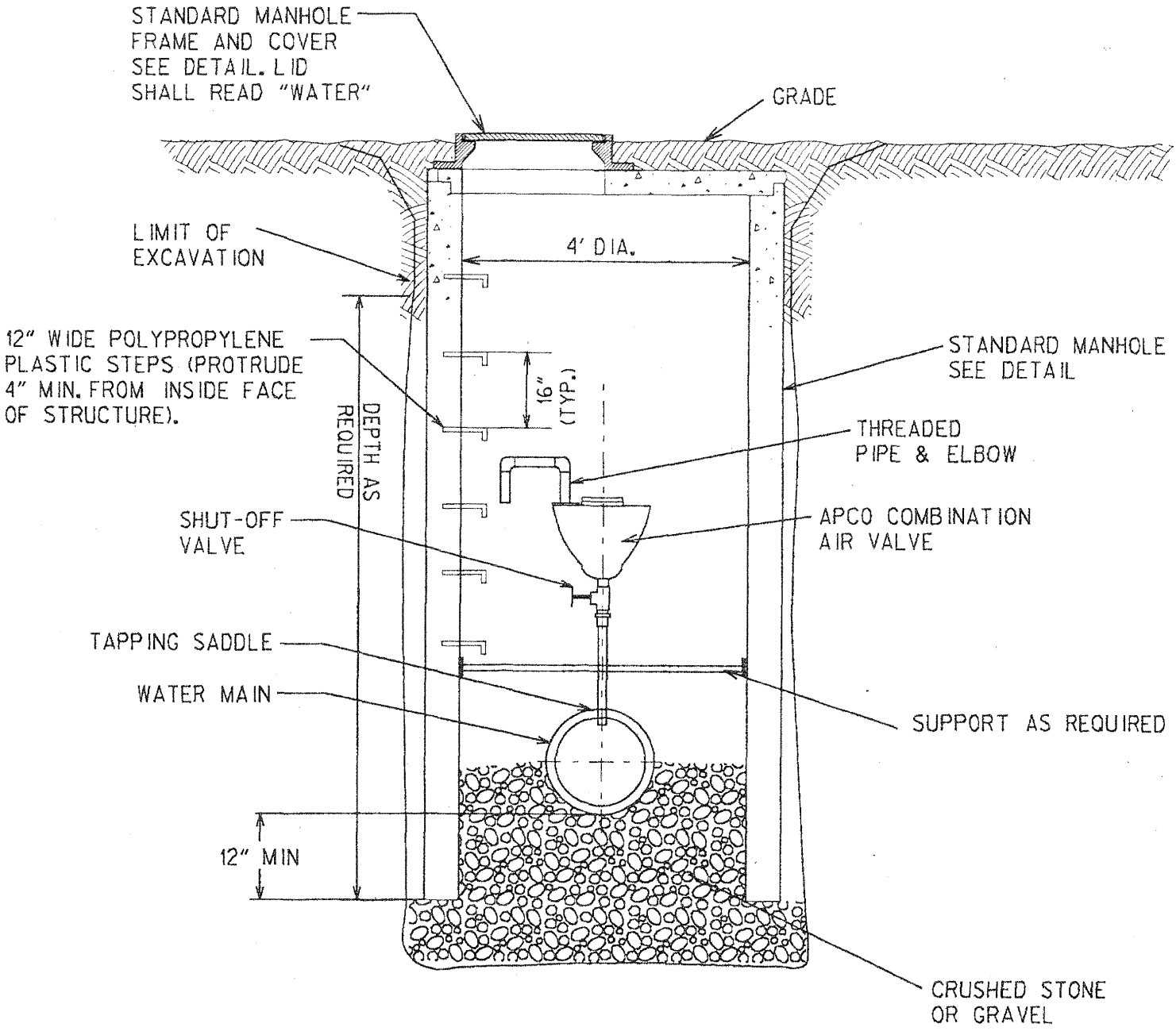


NOTE: VALVE IS TO BE SIZED FOR CONDITIONS.

# COMBINATION AIR VALVE

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

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Civil and Environmental Engineering
3343 Perimeter Hill Drive Suite 212
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NOTE:

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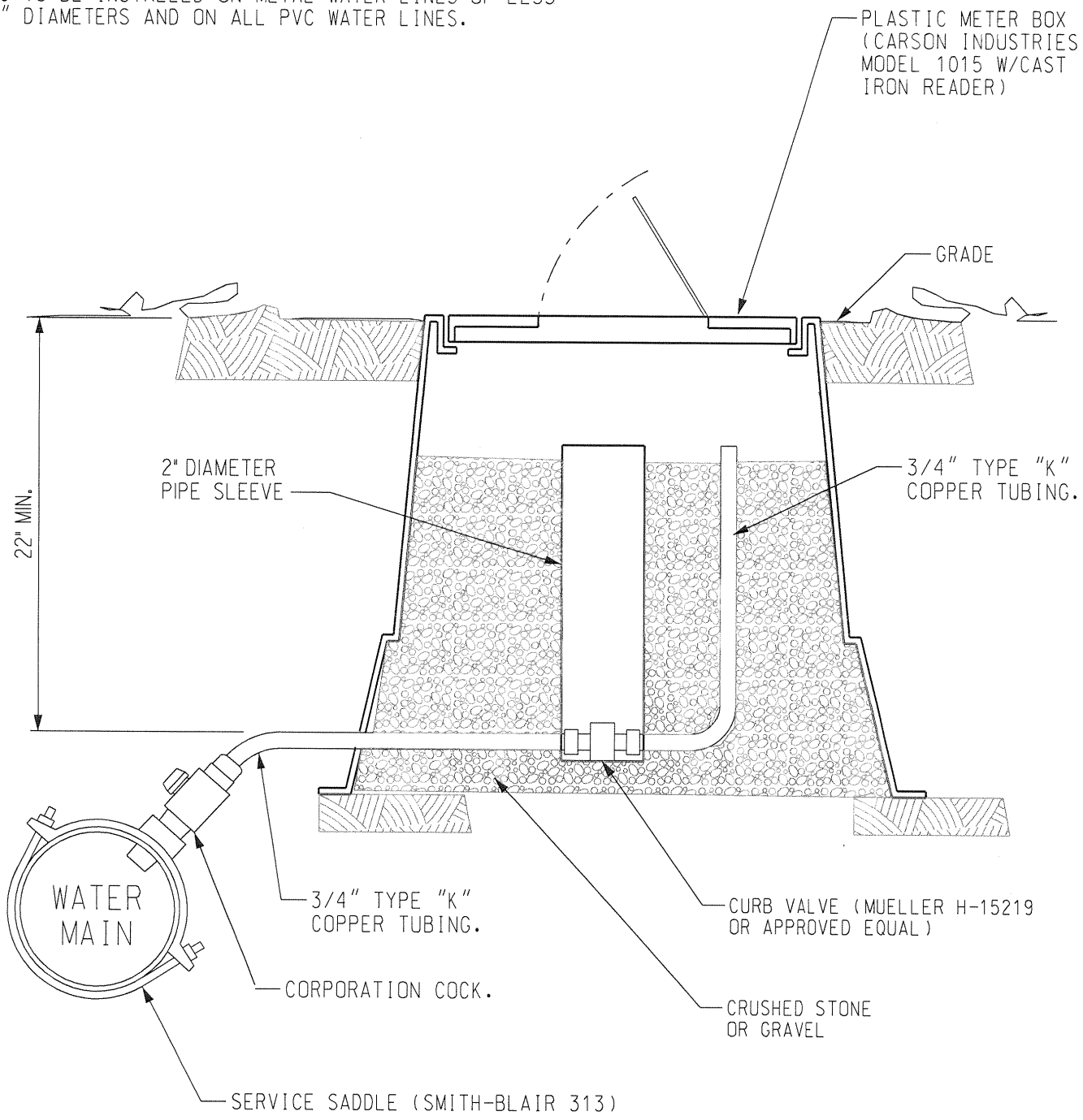


# MANUAL AIR RELEASE ASSEMBLY DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

**ASHLAND CITY, TENNESSEE**

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HIGHERS, KOONCE & ASSOCIATES, INC.
Civil and Environmental Engineering
3343 Perimeter Hill Drive Suite 212
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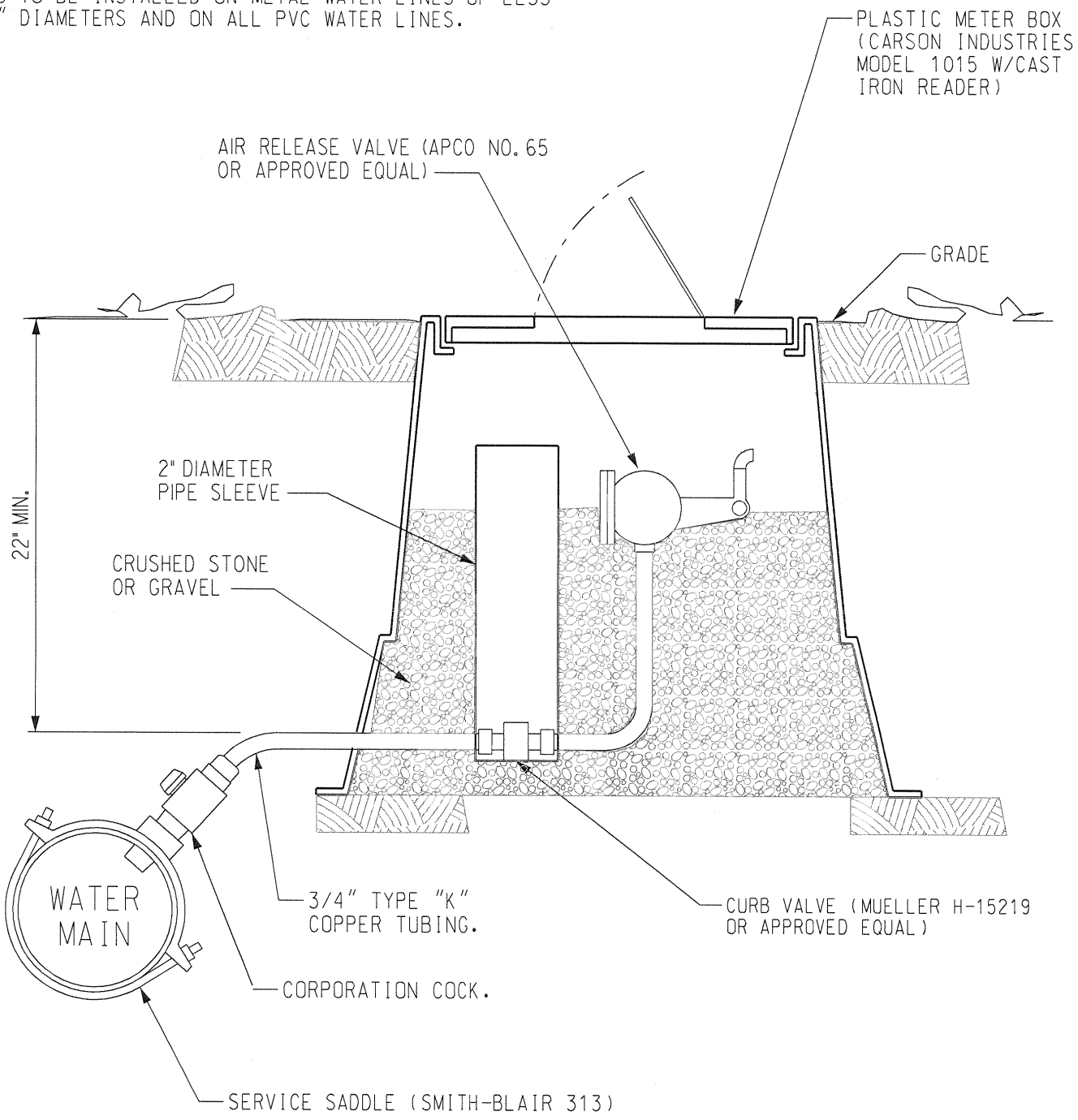
NOTE:

SADDLES TO BE INSTALLED ON METAL WATER LINES OF LESS THAN 4" DIAMETERS AND ON ALL PVC WATER LINES.




# AUTOMATIC AIR RELEASE ASSEMBLY DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

**ASHLAND CITY, TENNESSEE**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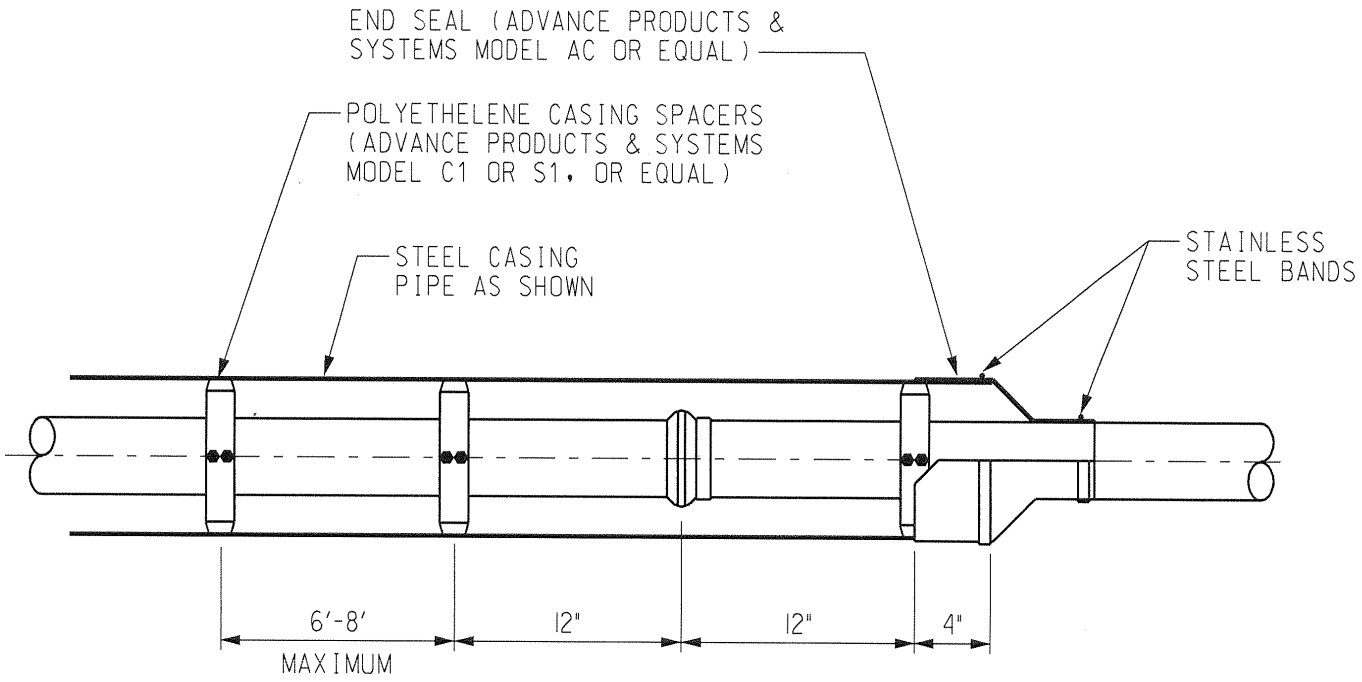
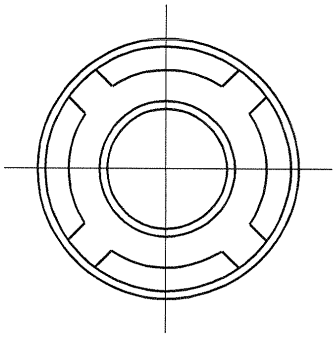
HIGHERS, KOONCE & ASSOCIATES, INC.
Civil and Environmental Engineering
3343 Perimeter Hill Drive Suite 212
Nashville, Tennessee 37211 (615) 333-7200




SECTION VIEW



NOTE:
SPACERS MUST PREVENT PIPE BELL FROM RESTING ON CASING PIPE

SECTION VIEW

# CASING PIPE SPACER DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

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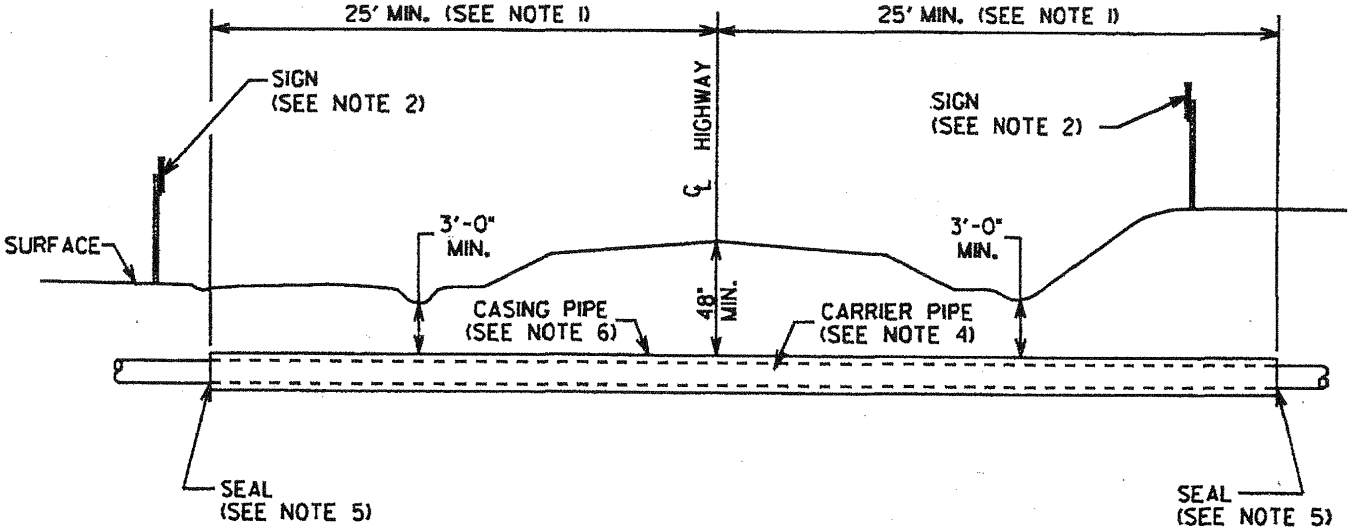


## NOTES:

1. CASING SHALL EXTEND TO THE GREATER OF THE FOLLOWING DISTANCES:
   - A. 2' BEYOND TOE OF SLOPE
   - B. 5' BEYOND CENTERLINE OF DITCH
   - C. MIN. OF 25' WHEN CASING IS SEALED AT BOTH ENDS
   - D. AS NOTED ON PLANS.
2. SIGN TO INDICATE LOCATION OF PIPE LINE AT R.O.W. LINE, KIND OWNERSHIP, AND DEPTH OF PIPE LINE.
3. BORED CROSSINGS SHALL BE PERMITTED AND INSTALLED TO MEET THE REQUIREMENTS OF TENNESSEE DEPARTMENT OF TRANSPORTATION AND/OR CHEATHAM COUNTY HIGHWAY DEPT.
4. CARRIER PIPE SHALL BE DUCTILE IRON PIPE OR PVC AS SHOWN ON DRAWINGS. CARRIER PIPE SHALL BE CENTERED IN THE CASING PIPE. CARRIER PIPE SHALL BE INSTALLED USING CARBON STEEL CASING SPACERS. SPACERS SHALL BE PLACED AT PIPE JOINT MIDPOINT AND 1' FROM EACH END OF PIPE JOINT.
5. ENDS OF CASING PIPE SHALL BE SEALED UTILIZING SYNTHETIC RUBBER SEALS WITH STAINLESS STEEL BINDING STRAPS.
6. REFER TO SPECIFICATION SECTION 02725 FOR CASING PIPE THICKNESS.

# PIPE LINE CROSSING UNDER HIGHWAY

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

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3343 Perimeter Hill Drive Suite 212
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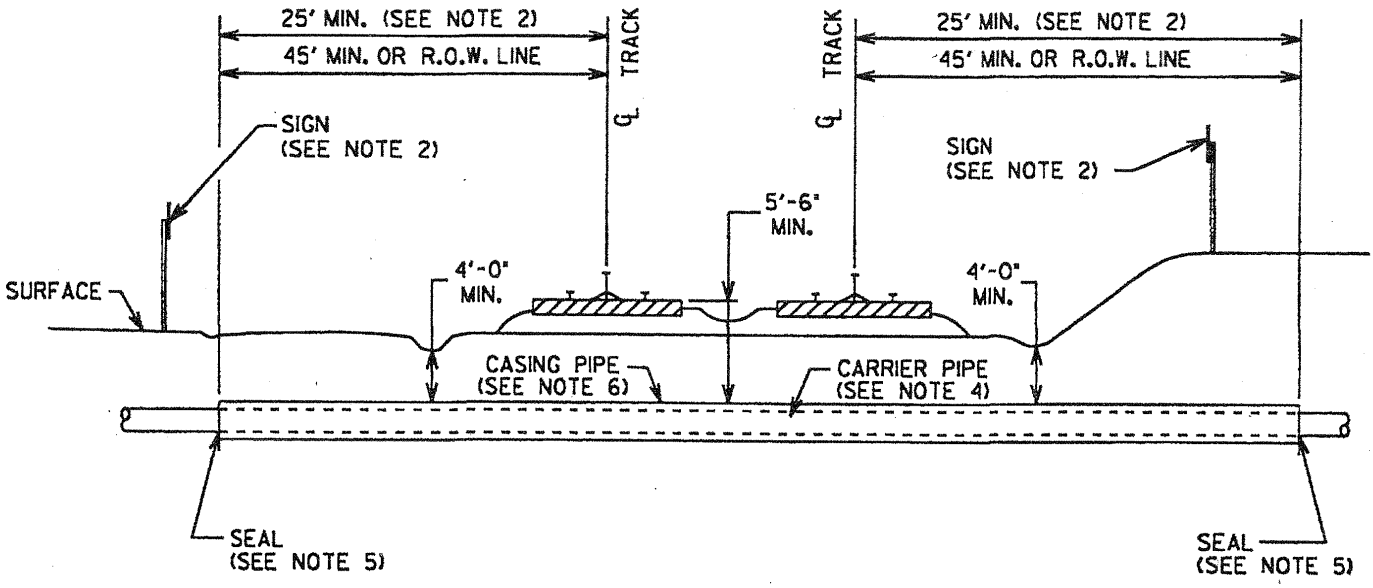


## NOTES:

1. CASING SHALL EXTEND TO THE GREATER OF THE FOLLOWING DISTANCES:

   A. 2' BEYOND TOE OF SLOPE
   B. 3' BEYOND CENTERLINE OF DITCH
   C. MIN. OF 25' WHEN CASING IS SEALED AT BOTH ENDS.

2. SIGN TO INDICATE LOCATION OF PIPE LINE AT R.O.W. LINE, KIND OWNERSHIP, AND DEPTH OF PIPE LINE.

3. PIPE LINE LAID LONGITUDINALLY ON RAILWAY R.O.W. SHALL BE ENCASED IF LOCATED WITHIN 15' OF CENTER LINE OF ANY TRACK OR CLOSER THAN 45' TO ANY IMPORTANT STRUCTURE.

4. CARRIER PIPE SHALL BE DUCTILE IRON PIPE OR PVC AS SHOWN ON DRAWINGS. CARRIER PIPE SHALL BE CENTERED IN THE CASING PIPE. CARRIER PIPE SHALL BE INSTALLED USING CARBON STEEL CASING SPACERS. SPACERS SHALL BE PLACED AT PIPE JOINT MIDPOINT AND 1' FROM EACH END OF PIPE JOINT.

5. ENDS OF CASING PIPE SHALL BE SEALED UTILIZING SYNTHETIC RUBBER SEALS WITH STAINLESS STEEL BINDING STRAPS.

6. REFER TO SPECIFICATION SECTION 02725 FOR CASING PIPE THICKNESS.

# PIPE LINE CROSSING UNDER RAILROAD

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

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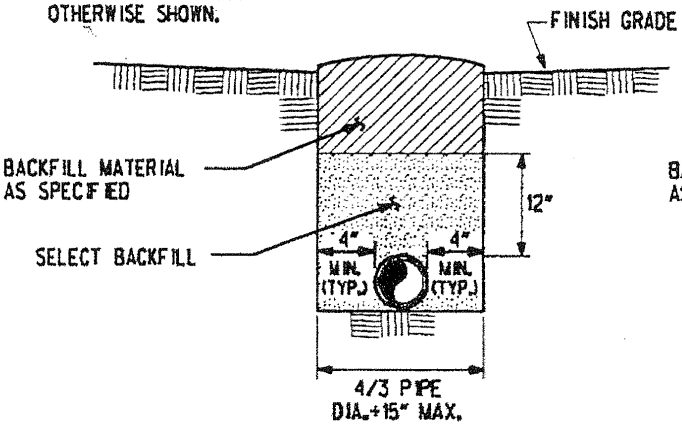
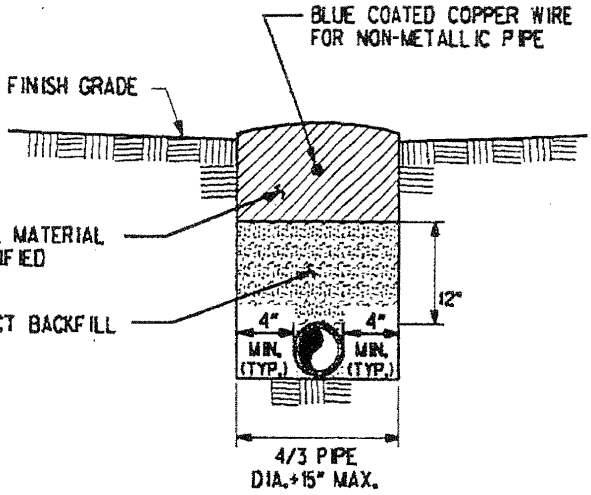
NOTE:
30" MIN. COVER FOR ALL WATER LINES UNLESS OTHERWISE SHOWN.




DUCTILE IRON PIPE

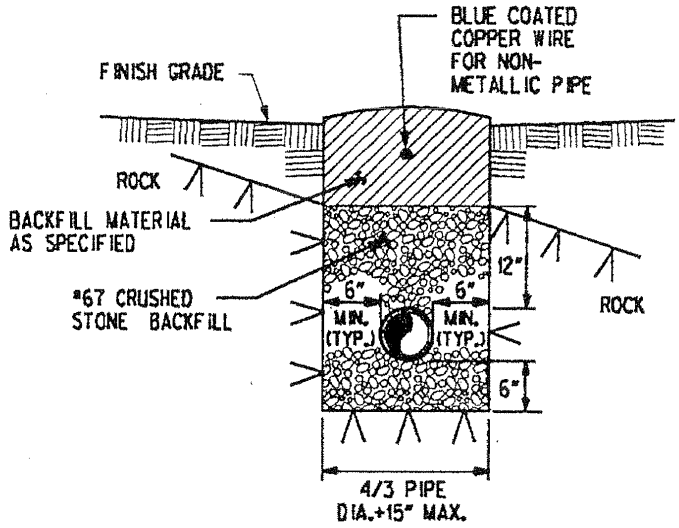
IN EARTH




P.V.C. PIPE

IN EARTH

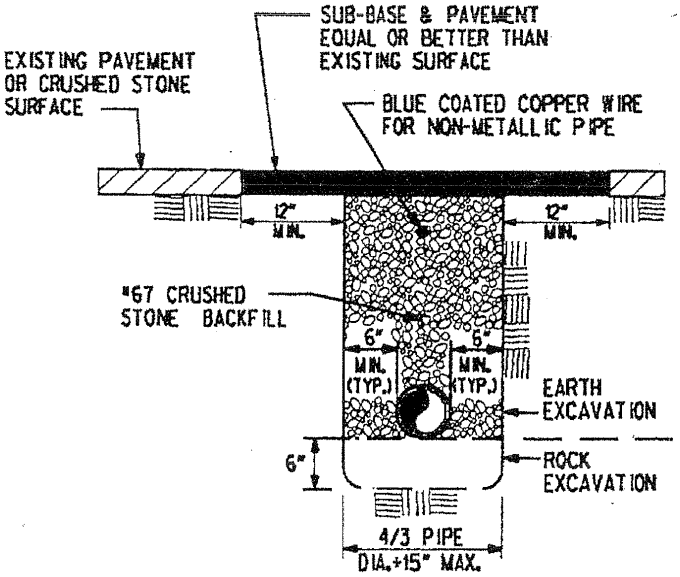
NOTE:
UNTIL REPAVING IS COMPLETED USE A DENSE GRADED STONE FOR THE TOP 6" FOR TEMPORARY SURFACE




ALL PIPE

IN ROCK

CRUSHED STONE SURFACE EQUAL TO EXISTING SURFACE OR 6" MIN.




ALL PIPE

IN TRAFFIC AREAS

# STANDARD WATER MAIN BEDDING AND BACKFILLING

STANDARD WATER AND SEWER SYSTEM DETAILS

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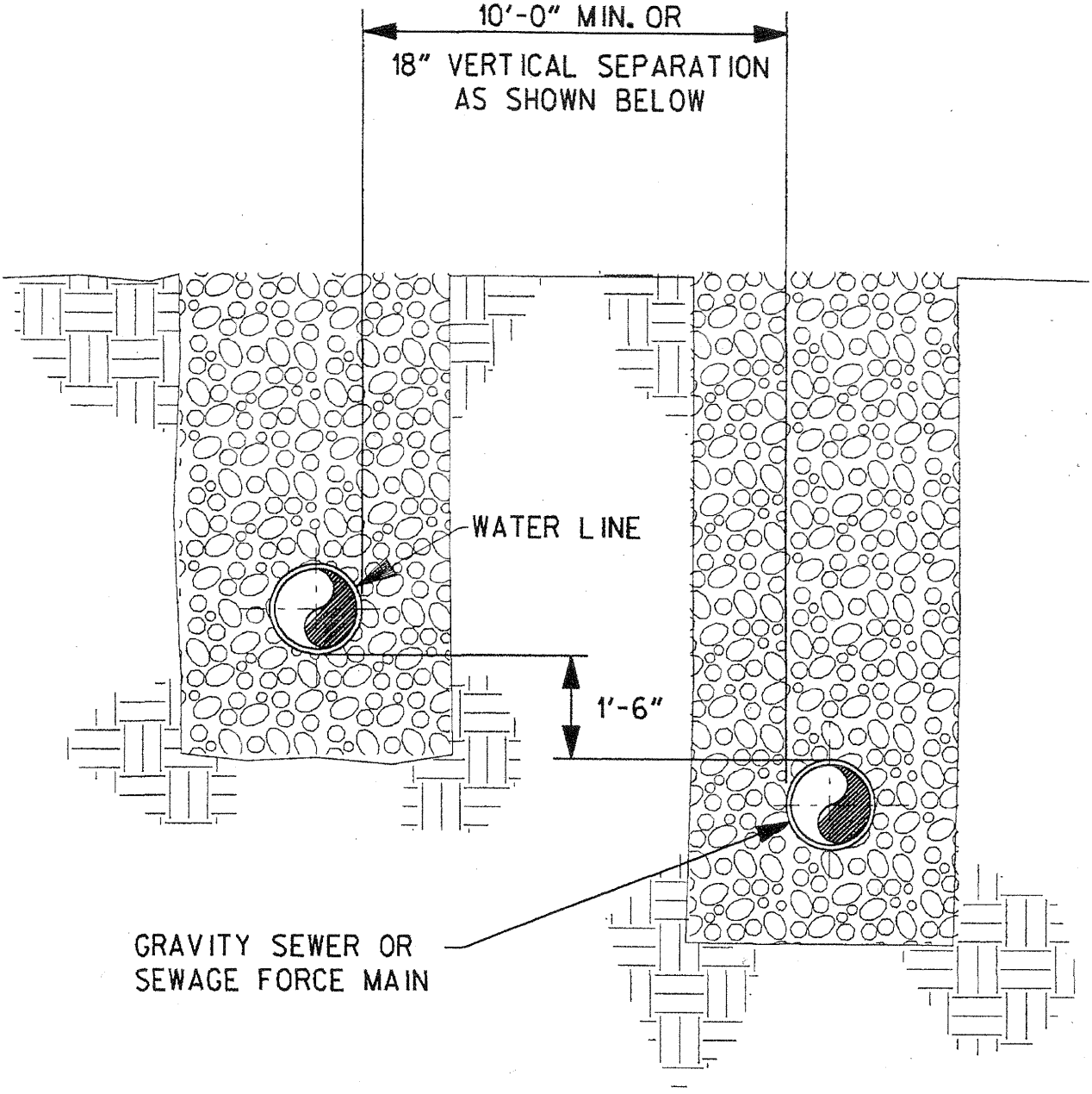


# PIPELINE SEPARATION DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

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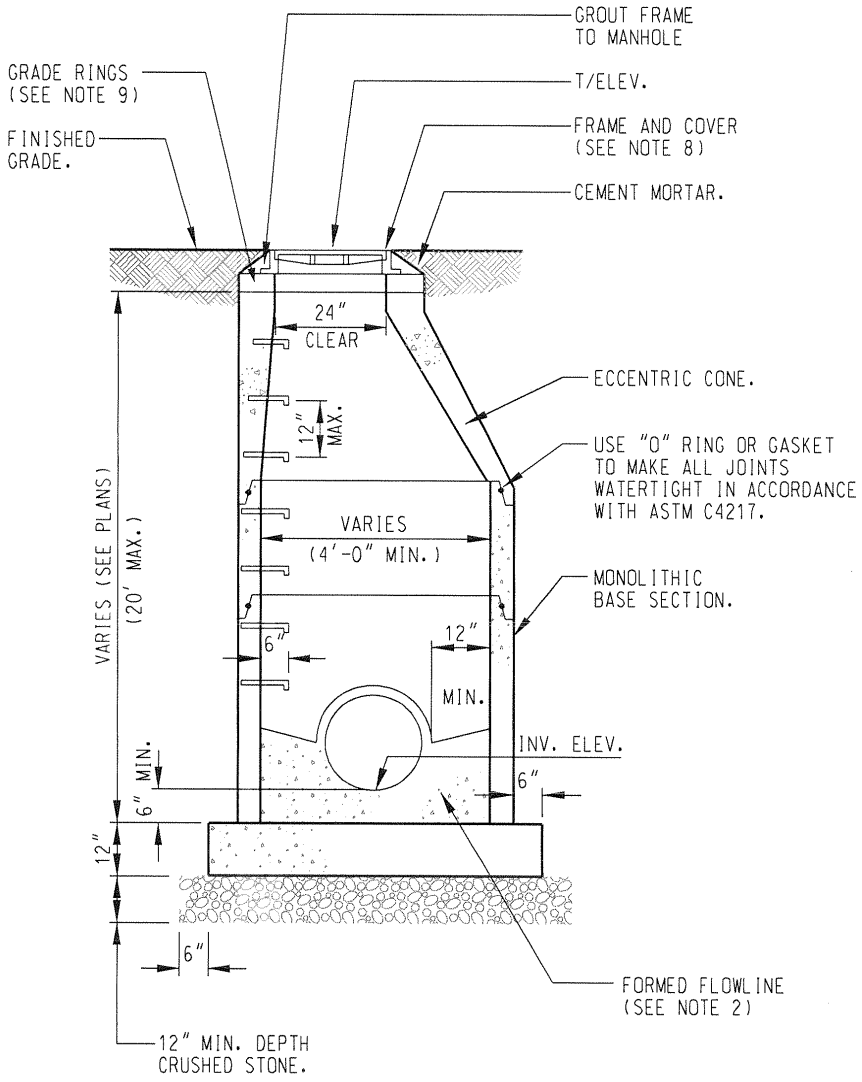


NOTES:

1. SEE PLAN FOR LOCATION, ELEVATION AND PIPE INFORMATION.
2. FLOWLINE OF MANHOLE MAY BE FORMED IN CONCRETE, BUILT UP WITH MORTAR, OR BY LAYING A PIPE THROUGH MANHOLE. THE TOP BEING BROKEN OUT LATER.
3. GROUT ANNULAR SPACE BETWEEN WALL AND PIPE WITH NON-SHRINK MORTAR TO INSURE WATERTIGHT SEAL.
4. ALL CONCRETE TO COMPLY WITH ACI 318 WITH A MIN. STRENGTH OF 4,000 Psi AT 28 DAY TEST.
5. ALL PRECAST RISERS AND TOPS TO CONFORM TO ASTM C479.
6. MANHOLE TO BE CONSTRUCTED OF SUFFICIENT SIZE TO ACCOMMODATE INLET AND OULET PIPES.
7. MANHOLE STEPS TO BE M.A. INDUSTRIES, PROVIDED WITHIN 12" OF TOP, 12" O.C.
8. SANITARY MANHOLE COVERS TO HAVE "SANITARY SEWER" CAST ON THE COVER AND BE JOHN BOUCHARD & SONS NO. 1150. STORM MANHOLE COVERS TO HAVE "STORM" CAST ON THE COVER AND BE JOHN BOUCHARD & SONS NO. 1155.
9. GRADE RINGS ARE REQUIRED TO ADJUST TOP ELEVATION PRIOR TO FINAL PAVING.

# STANDARD PRECAST CONCRETE MANHOLE

STANDARD WATER AND SEWER SYSTEM DETAILS

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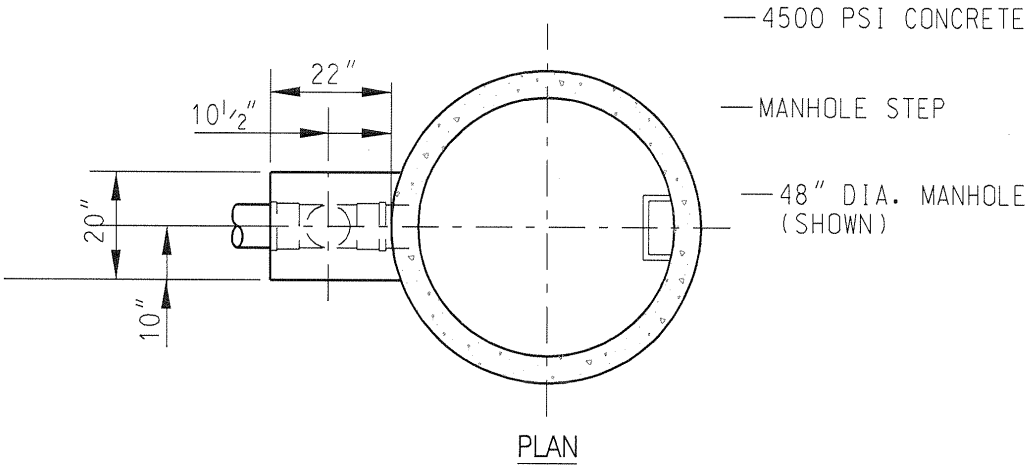
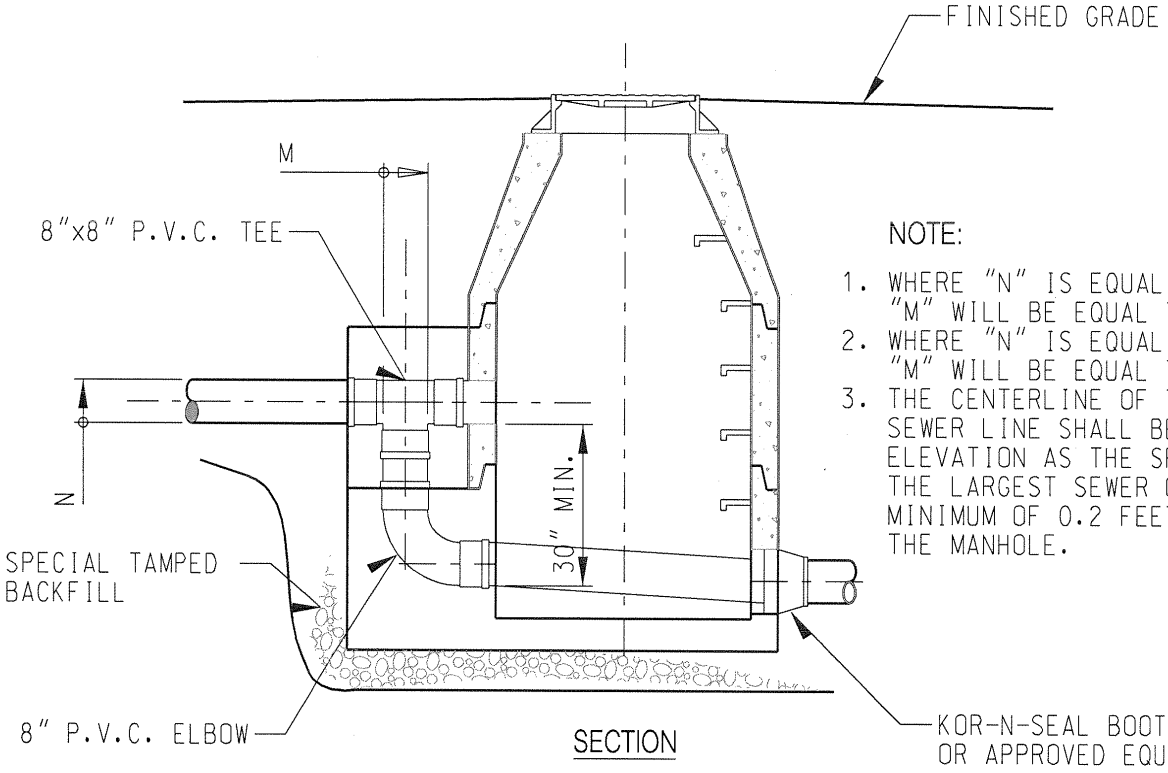



PLAN




SECTION

NOTE:

1. WHERE "N" IS EQUAL TO 8"-18", "M" WILL BE EQUAL TO 8".
2. WHERE "N" IS EQUAL TO 21"-30", "M" WILL BE EQUAL TO 12".
3. THE CENTERLINE OF THE DROP SEWER LINE SHALL BE AT THE SAME ELEVATION AS THE SPRING LINE OF THE LARGEST SEWER OR PROVIDE A MINIMUM OF 0.2 FEET DROP ACROSS THE MANHOLE.

# PRECAST CONCRETE DROP MANHOLE

STANDARD WATER AND SEWER SYSTEM DETAILS

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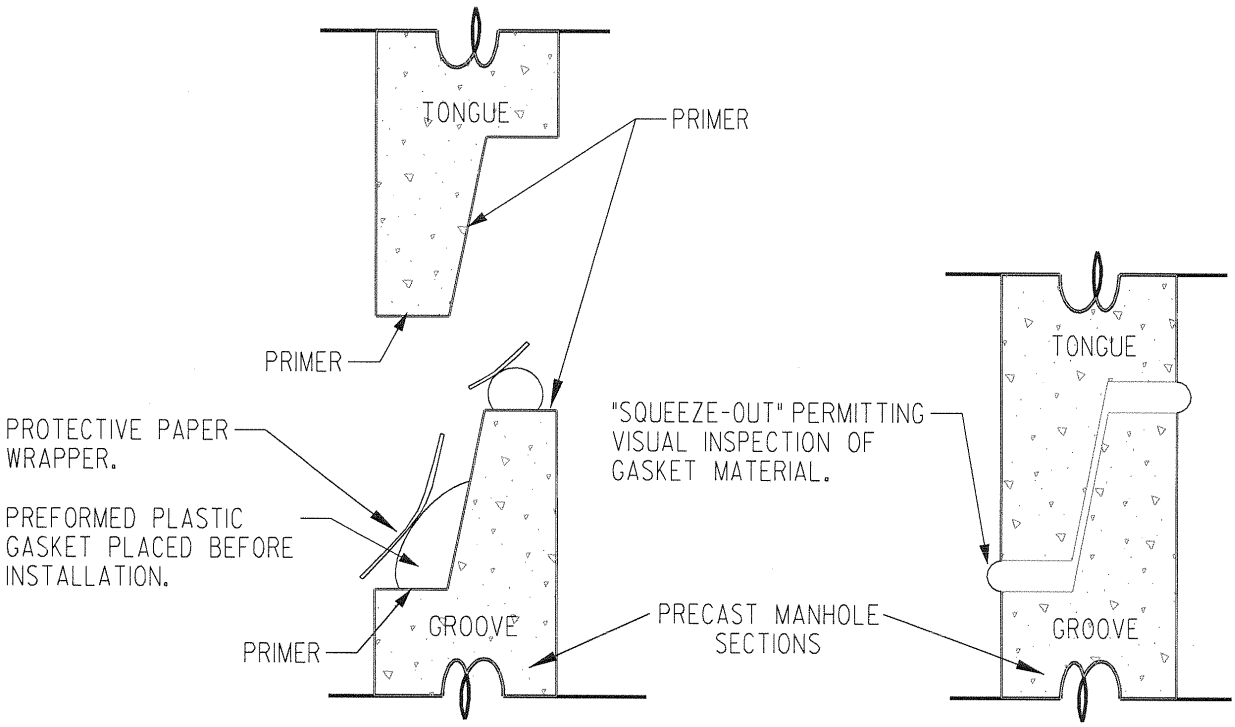


NOTE:

WHERE GASKET MATERIAL DOES NOT PROTRUDE FROM JOINTS, POINT UP JOINT WITH GROUT, WHETHER INSIDE OR OUTSIDE.

# PLASTIC GASKET JOINT FOR PRECAST MANHOLES

STANDARD WATER AND SEWER SYSTEM DETAILS

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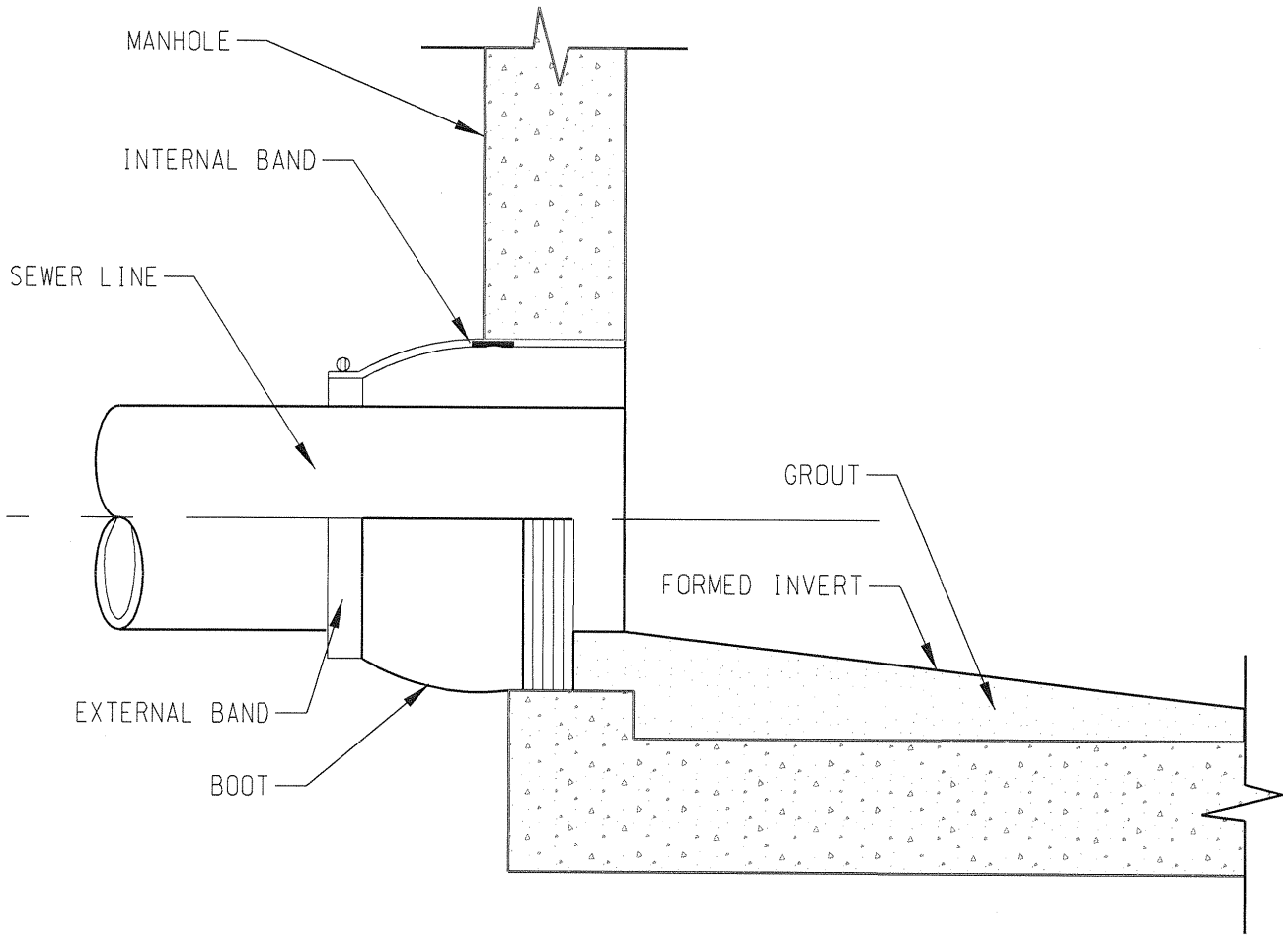


NOTES:

1. BOOT TO BE KOR-N-SEAL OR APPROVED EQUAL.
2. EXISTING MANHOLES SHALL BE CORE DRILLED FOR SEWER CONNECTION.

# SEWER LINE-TO-MANHOLE CONNECTION

STANDARD WATER AND SEWER SYSTEM DETAILS

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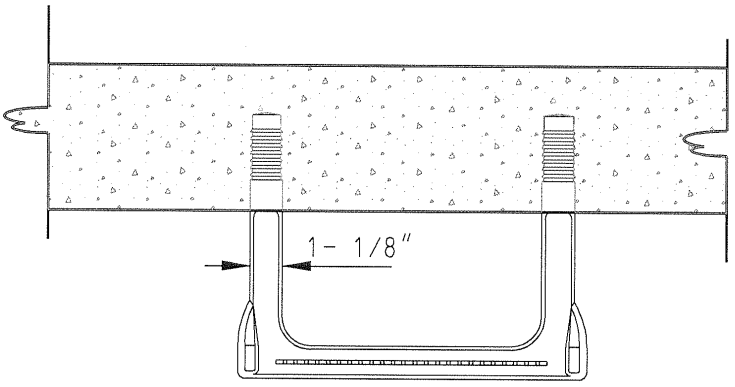
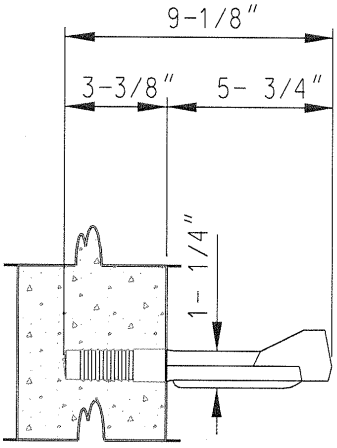
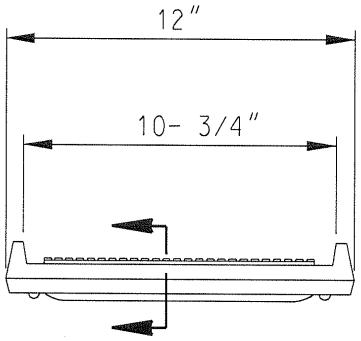



PLAN




SIDE




END

NOTES:

1. MANHOLE STEPS SHALL BE M.A. INDUSTRIES, INC. OR APPROVED EQUL.
2. STEP SHALL BE STEEL REINFORCED AND SHALL BE ENCAPSULATED IN POLYPROPYLENE PLASTTIC.
3. 1/2" DIAMETER STEEL REINFORCEMENT (GRADE 60).

SECTION "A-A"

# MANHOLE STEP DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

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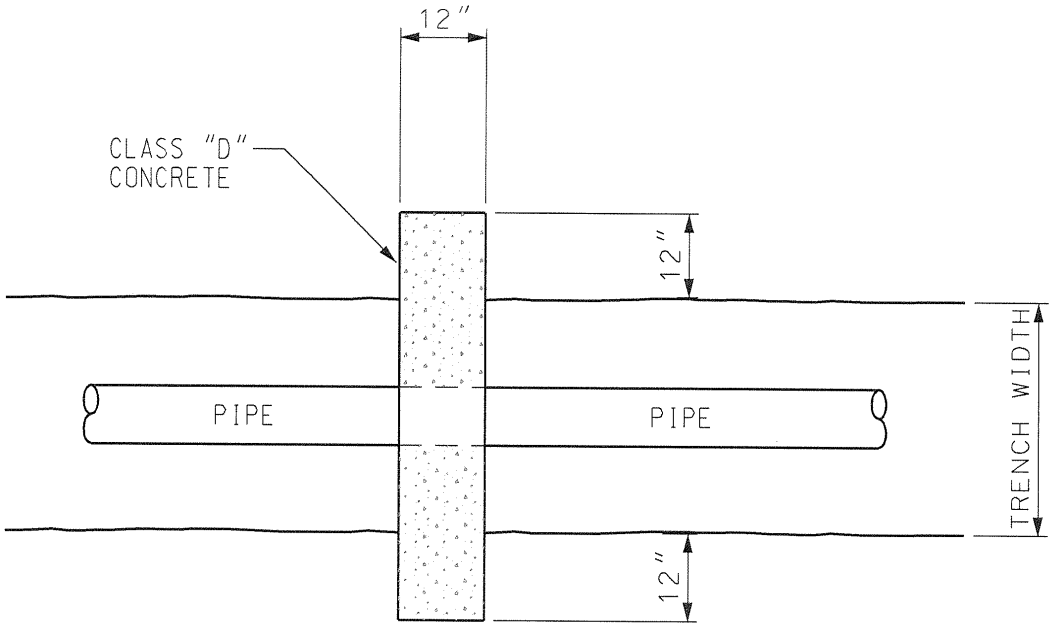
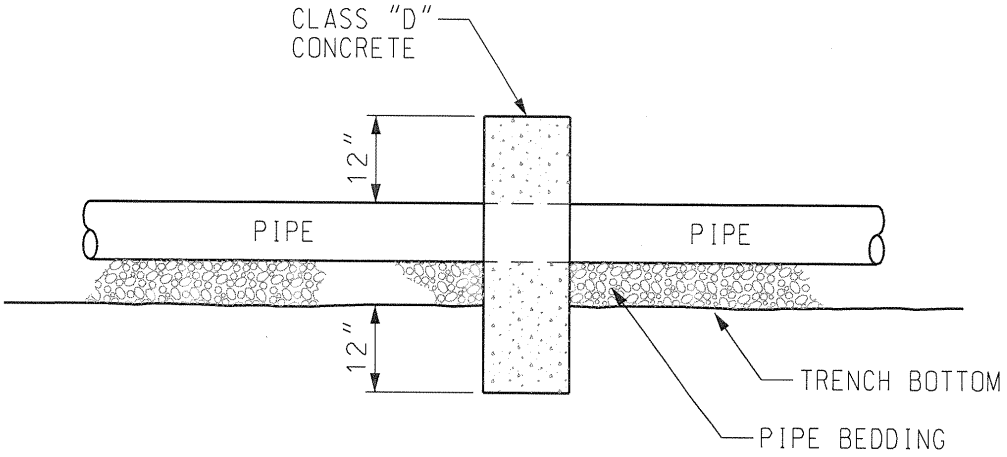



PLAN




SECTION

# CONCRETE WATERSTOP FOR GRAVITY SEWER LINES DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

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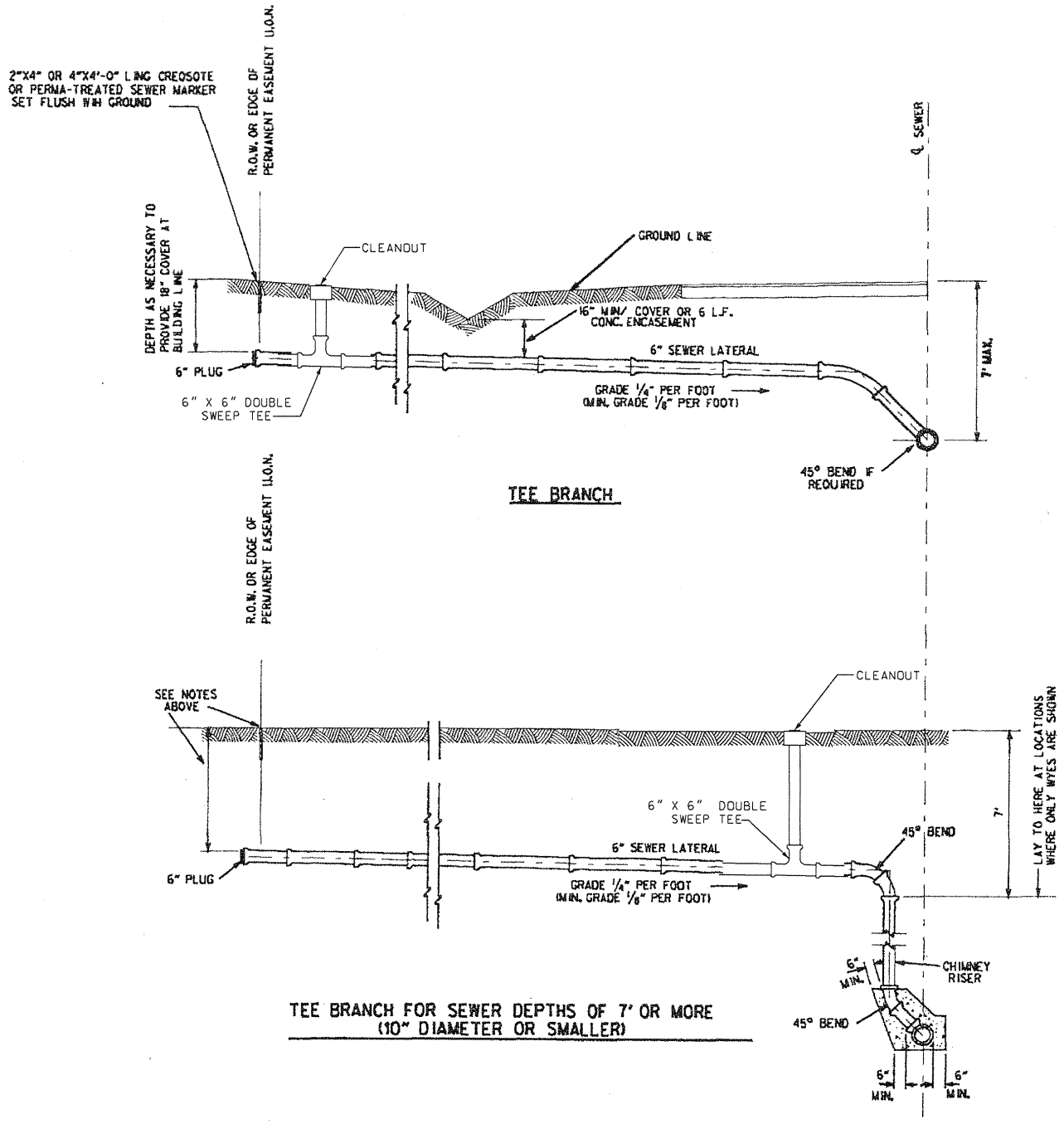


# SANITARY SEWER LATERALS

STANDARD WATER AND SEWER SYSTEM DETAILS

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## ASHLAND CITY, TENNESSEE

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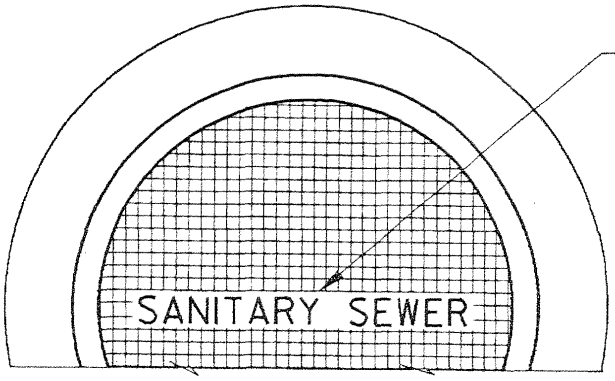
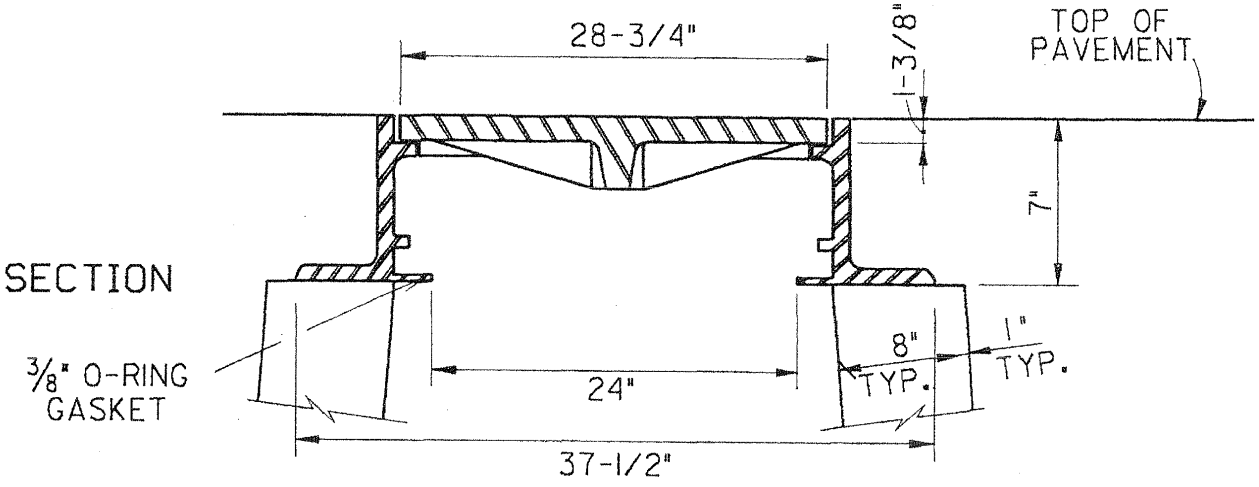
HALF
PLAN




SECTION




NOTES:

1. USE VULCAN FOUNDRY INC. #V-2150-3 OR APPROVED EQUAL.
2. APPROXIMATE WEIGHT OF FRAME AND COVER 575 LBS.

# STANDARD MANHOLE FRAME AND COVER

STANDARD WATER AND SEWER SYSTEM DETAILS

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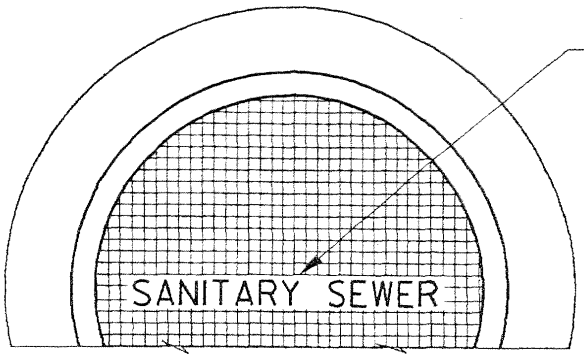


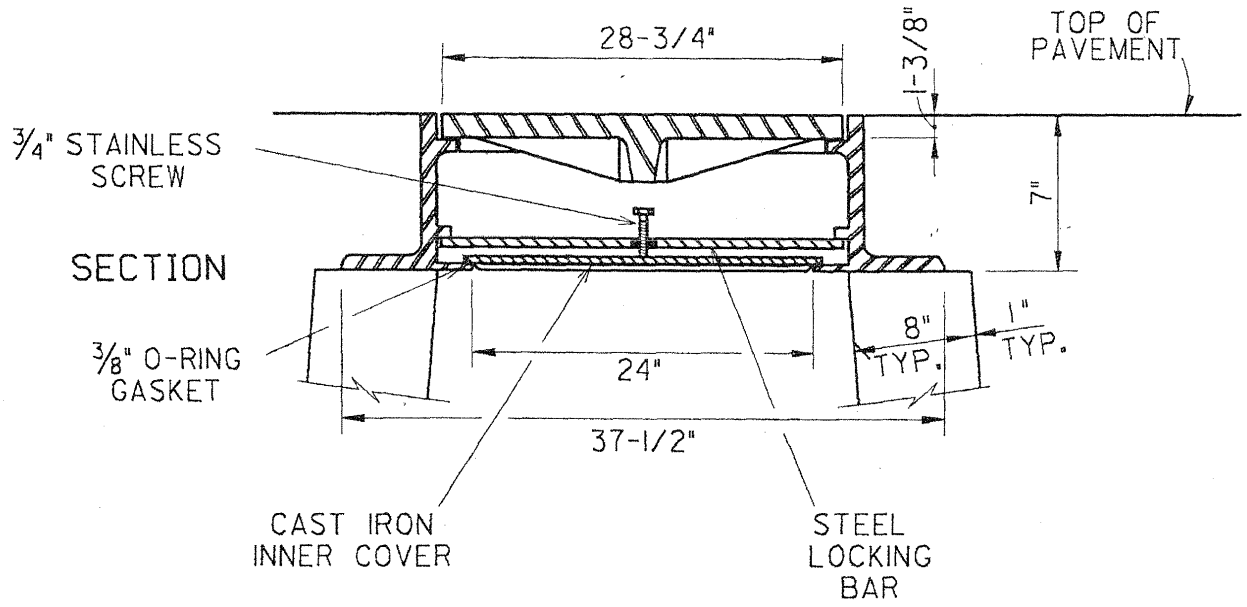


NOTES:

1. USE VULCAN FOUNDRY INC. #V-2150-3 OR APPROVED EQUAL.
2. APPROXIMATE WEIGHT OF FRAME AND COVER 575 LBS.

# WATERTIGHT MANHOLE FRAME AND COVER

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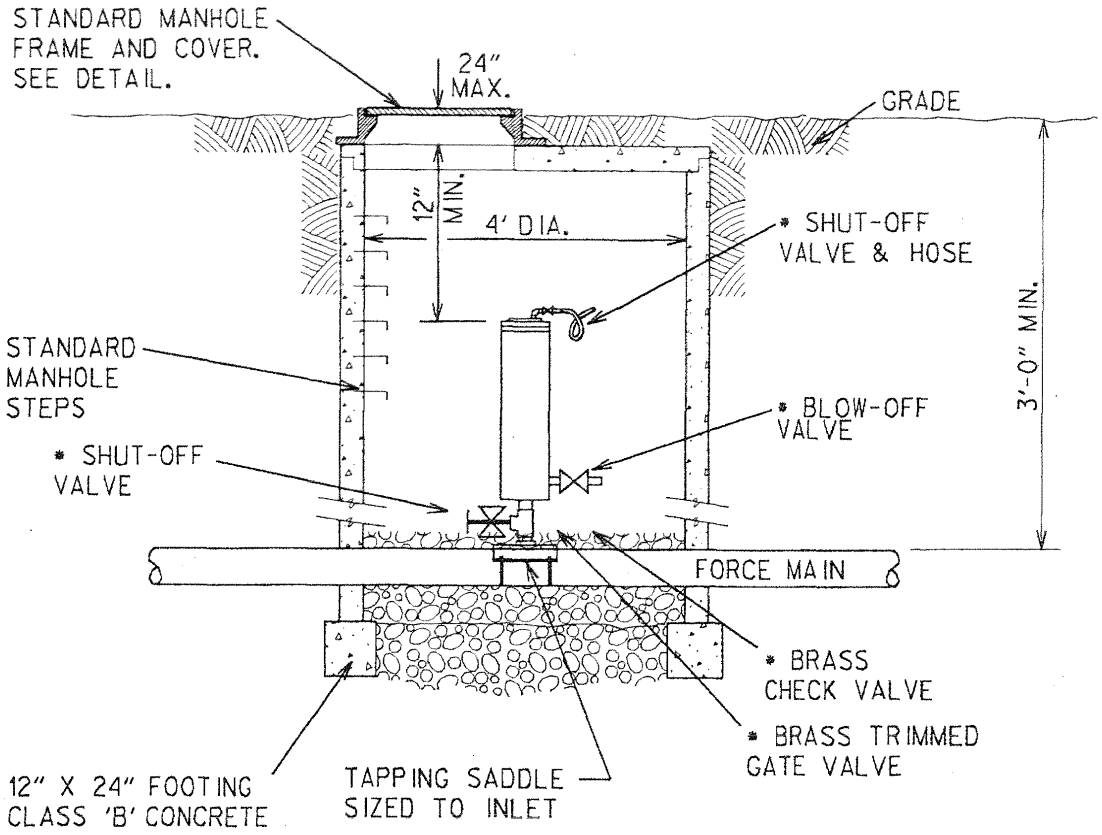


NOTES:

*1. VALVE IS TO BE THE SAME SIZE AS THE INLET

2. SEWAGE AIR AND VACUUM VALVES SHALL ALLOW UNRESTRICTED VENTING OR RE-ENTRY OF AIR THROUGH IT, DURING FILLING OR DRAINING OF THE FORCE MAIN, TO PREVENT VACUUM. THE SEWAGE AIR AND VACUUM VALVE SHALL INCORPORATE (2) STAINLESS STEEL FLOATS DIRECTLY CONNECTED BY A STAINLESS STEEL FLOAT GUIDE, TO MAINTAIN AN AIR GAP BETWEEN THE BOTTOM FLOAT AND TOP SHUT-OFF FLOAT. THE AIR GAP SHALL RETARD WASTE SOLIDS FROM FOULING OR CLOGGING THE TOP SHUT-OFF FLOAT. THE INTERNAL BAFFLE SHALL BE FITTED WITH A GUIDE BUSHING AND ACT TO PROTECT THE SHUTOFF FLOAT FROM DIRECT AIR FLOW. THE BAFFLE SHALL RETAIN THE 45° DUROMETER BUNA-N SEAT IN PLACE, WITHOUT DISTORTION, FOR TIGHT SHUT-OFF. VALVE SHALL BE APCO SERIES 400 AS MANUFACTURED BY VALVE AND PRIMER CORPORATION, OR APPROVED EQUAL.
ALL INTERNALS SHALL BE EASILY REMOVED THROUGH THE TOP COVER WITHOUT REMOVING THE MAIN VALVE FROM THE LINES. THE COMPLETE VALVE SHALL WITHSTAND 500 P.S.I. TEST. INLET AND BLOW-OFF VALVES, QUICK-DISCONNECT COUPLINGS AND MINIMUM 5' HOSE FOR FLUSHING.

3. ADJUST SEWER LINE GRADE AS NECESSARY SO THAT THE VALVE IS INSTALLED AT THE HIGH POINT OF THE LINE.

# SANITARY FORCE MAIN AIR RELEASE VALVE

STANDARD WATER AND SEWER SYSTEM DETAILS

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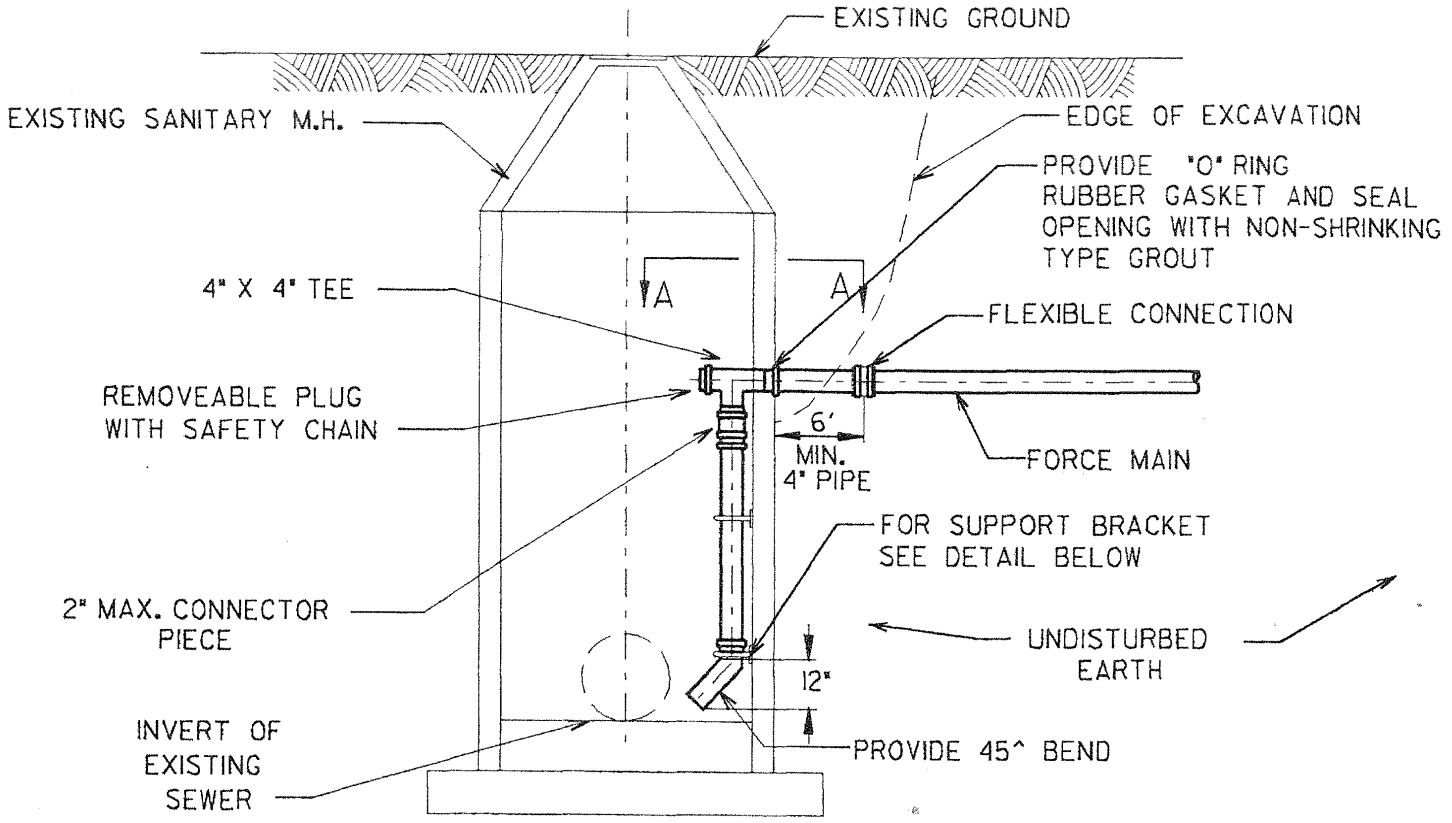
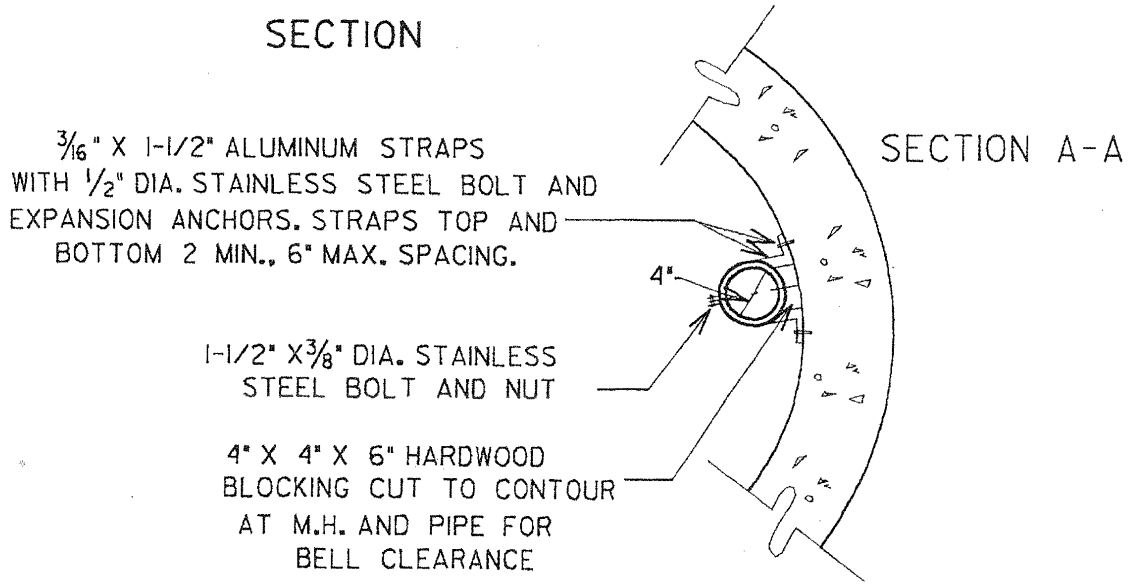



SECTION




# FORCE MAIN-TO-MANHOLE CONNECTION

STANDARD WATER AND SEWER SYSTEM DETAILS

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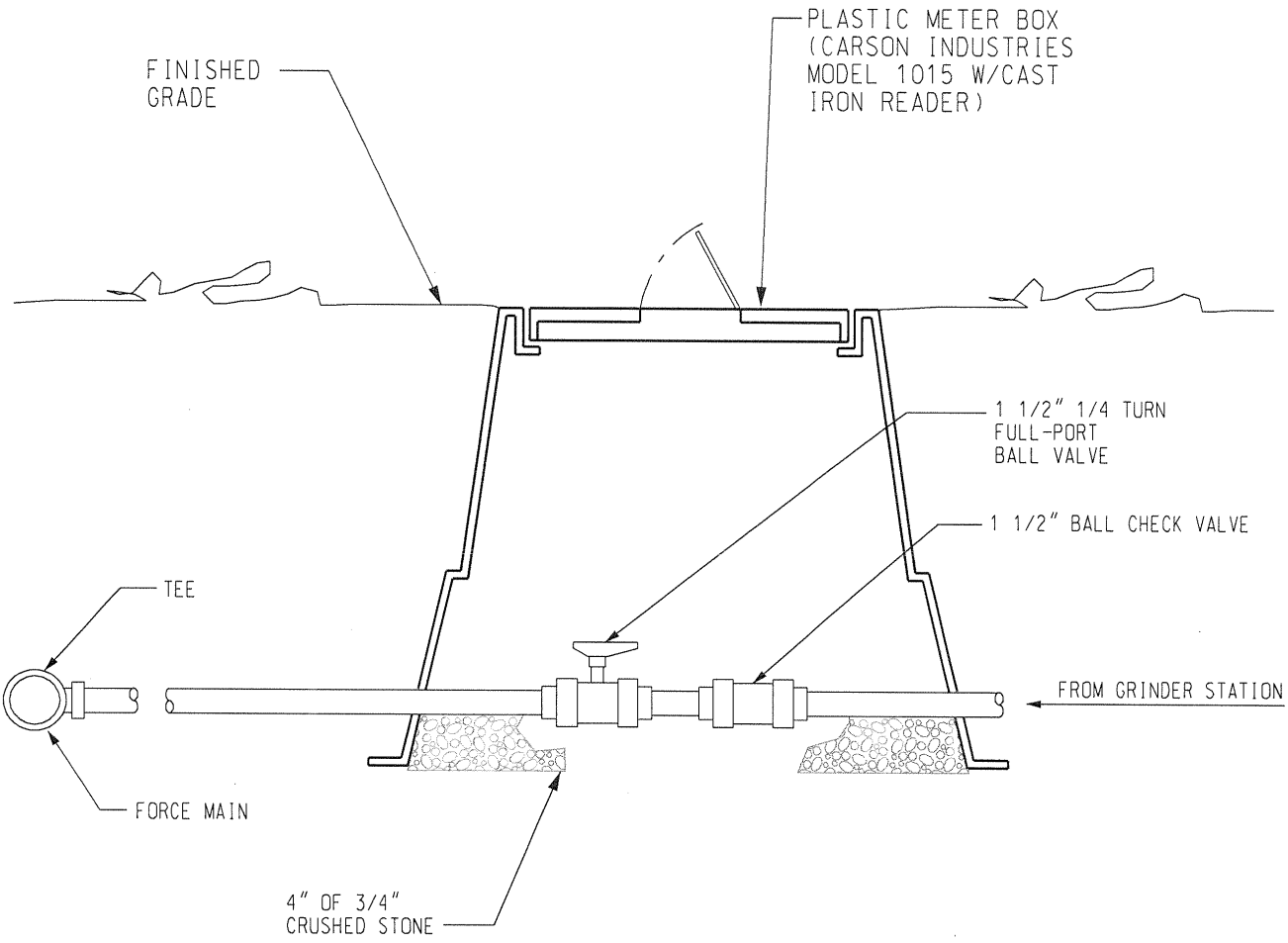


NOTES:

1. FORCE MAIN SHALL BE CLASS 200 PVC-SEE PLAN FOR FORCE MAIN SIZE.

2. ALL FITTINGS SHALL BE SCHEDULE 80 PVC SOLVENT WELDED UNLESS NOTED OTHERWISE.

3. CAST IRON LID TO BE EMBOSSED WITH THE WORD "SEWER".

# FORCE MAIN SERVICE CONNECTION

STANDARD WATER AND SEWER SYSTEM DETAILS

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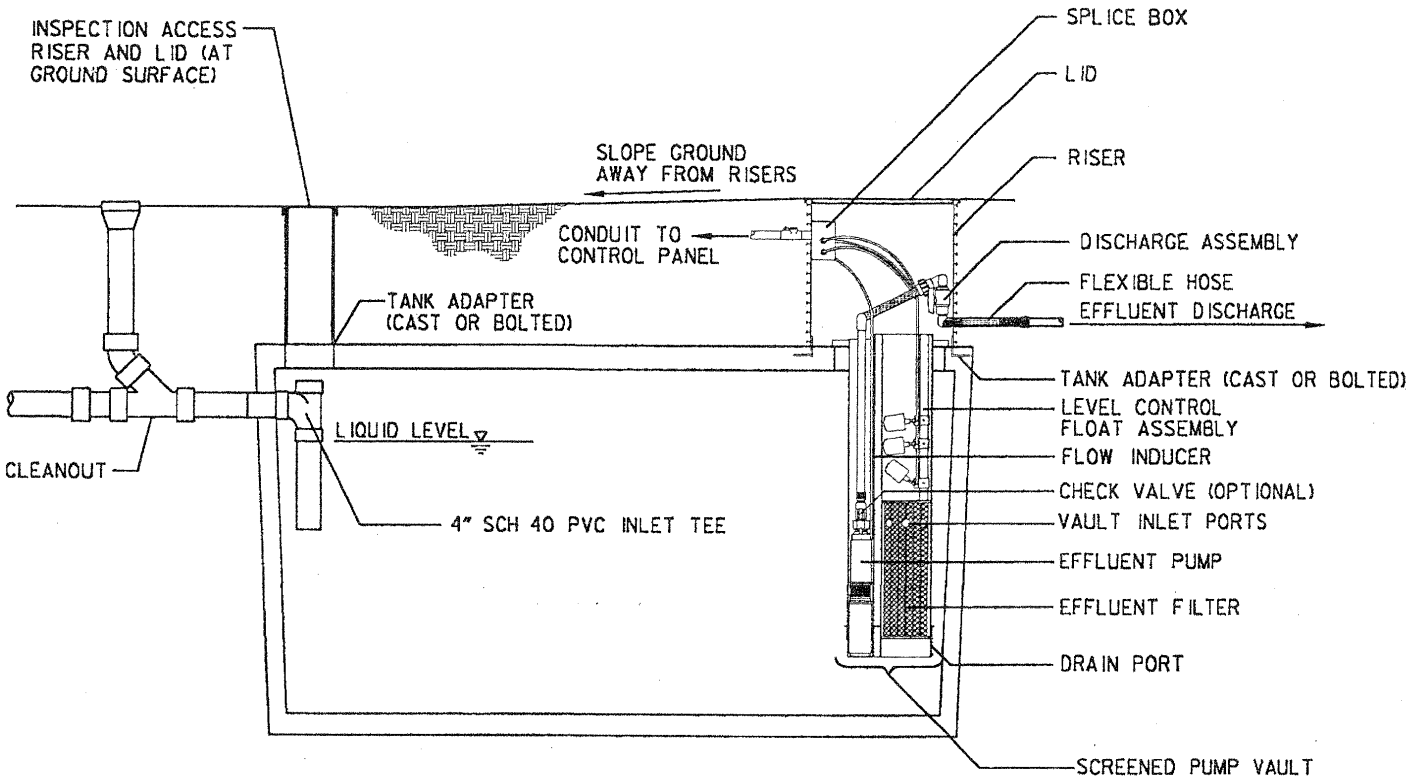


# SEPTIC TANK EFFLUENT PUMPING (STEP) SYSTEM

STANDARD WATER AND SEWER SYSTEM DETAILS

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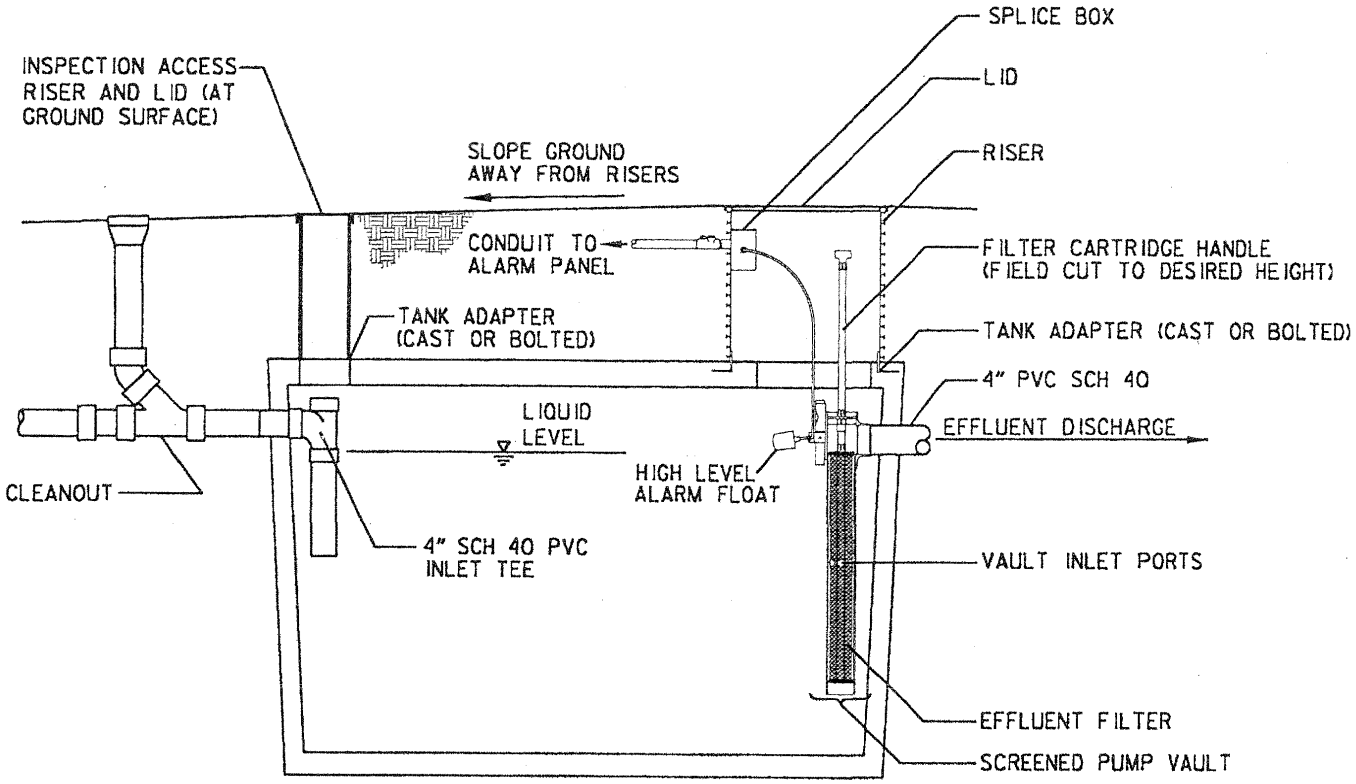


# SEPTIC TANK EFFLUENT GRAVITY (STEG) SYSTEM

STANDARD WATER AND SEWER SYSTEM DETAILS

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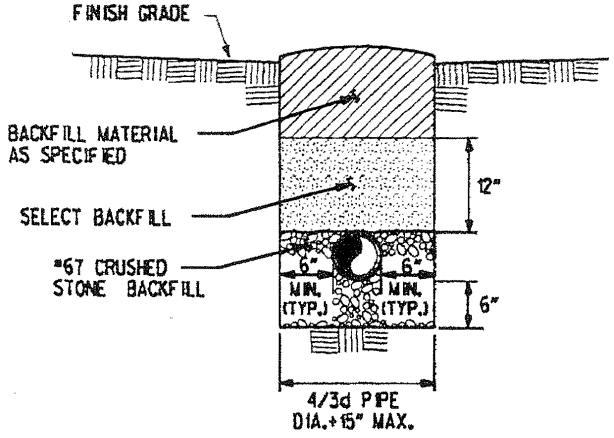
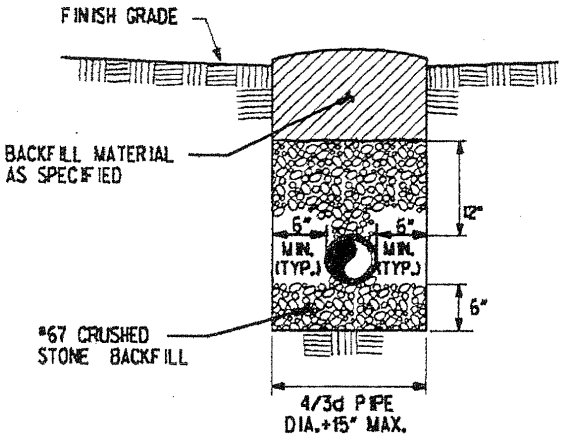
NOTE:
SEE SPECIFICATIONS FOR DEPTH
REQUIREMENT OF SEWER PIPE



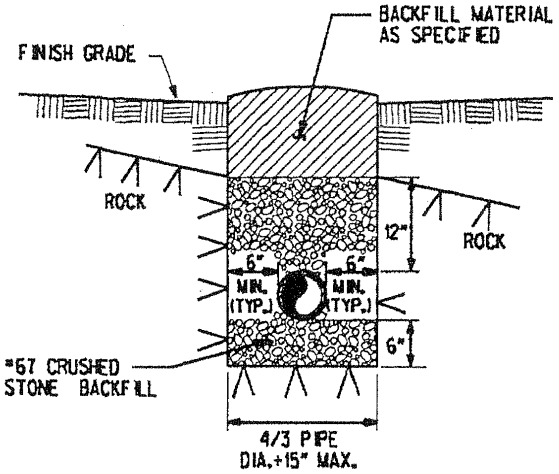

DUCTILE IRON PIPE




P.V.C. PIPE

## IN EARTH

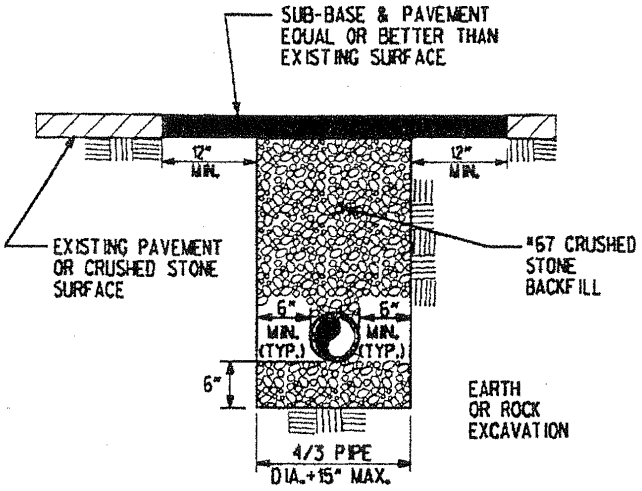
NOTE:
UNTIL REPAVING IS COMPLETED USE A DENSE GRADED
STONE FOR THE TOP 6" FOR TEMPORARY SURFACE




ALL PIPE

## IN ROCK

CRUSHED STONE SURFACE
EQUAL TO EXISTING SURFACE
OR 6" MIN.




ALL PIPE

## IN TRAFFIC AREAS

# STANDARD GRAVITY SEWER BEDDING AND BACKFILLING

STANDARD WATER AND SEWER SYSTEM DETAILS

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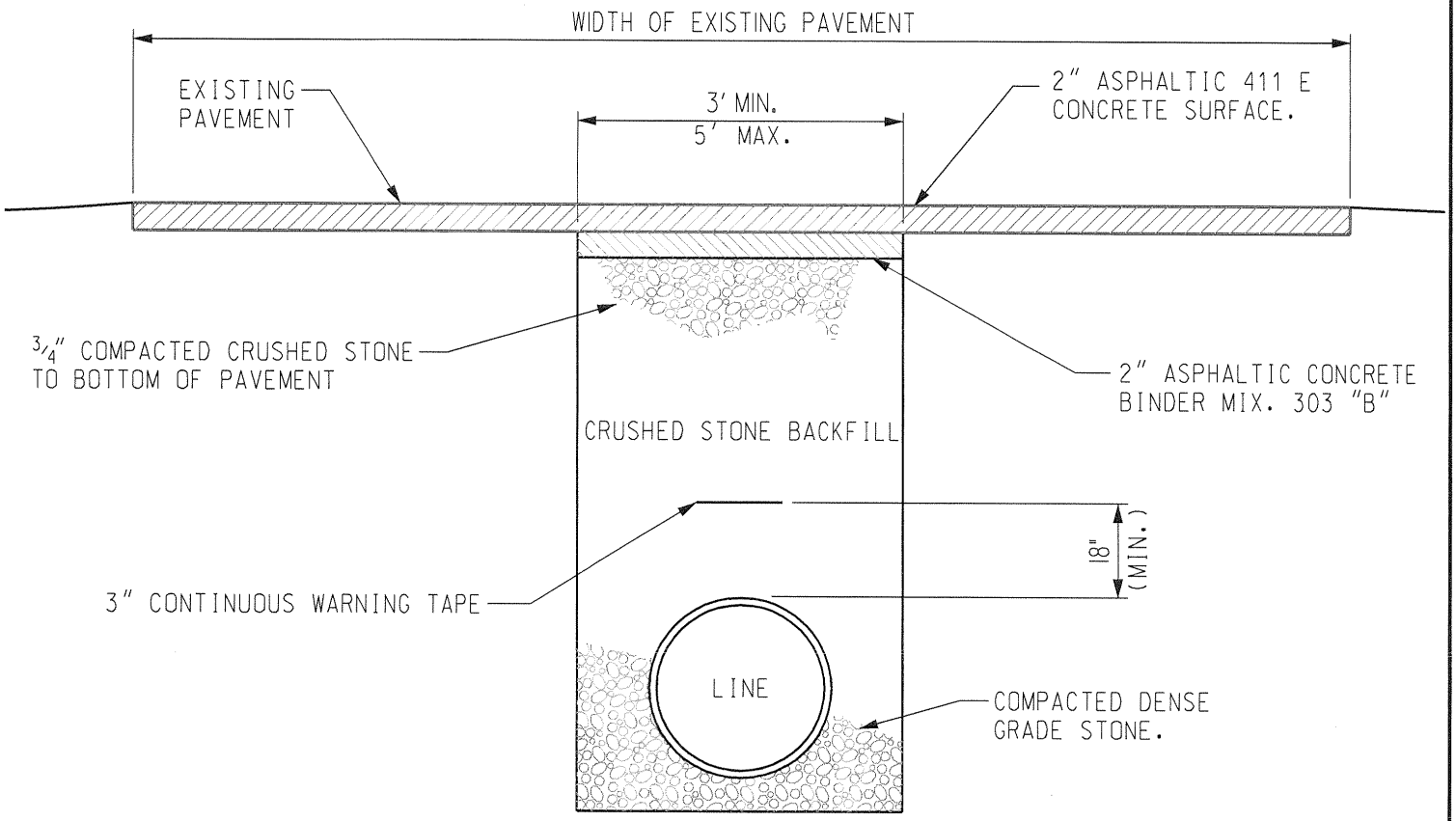


NOTE:

EDGE OF PAVEMENT TO BE TRIMMED A MINIMUM OF 12" BEYOND EACH SIDE OF TRENCH WIDTH TO OBTAIN NEAT LINES. BINDER MIX TO BE PLACED AS A TEMPORARY SURFACE WITHIN 48 HOURS OF MAKING ROAD CROSSING.

# ASPHALT PAVEMENT REPLACEMENT DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

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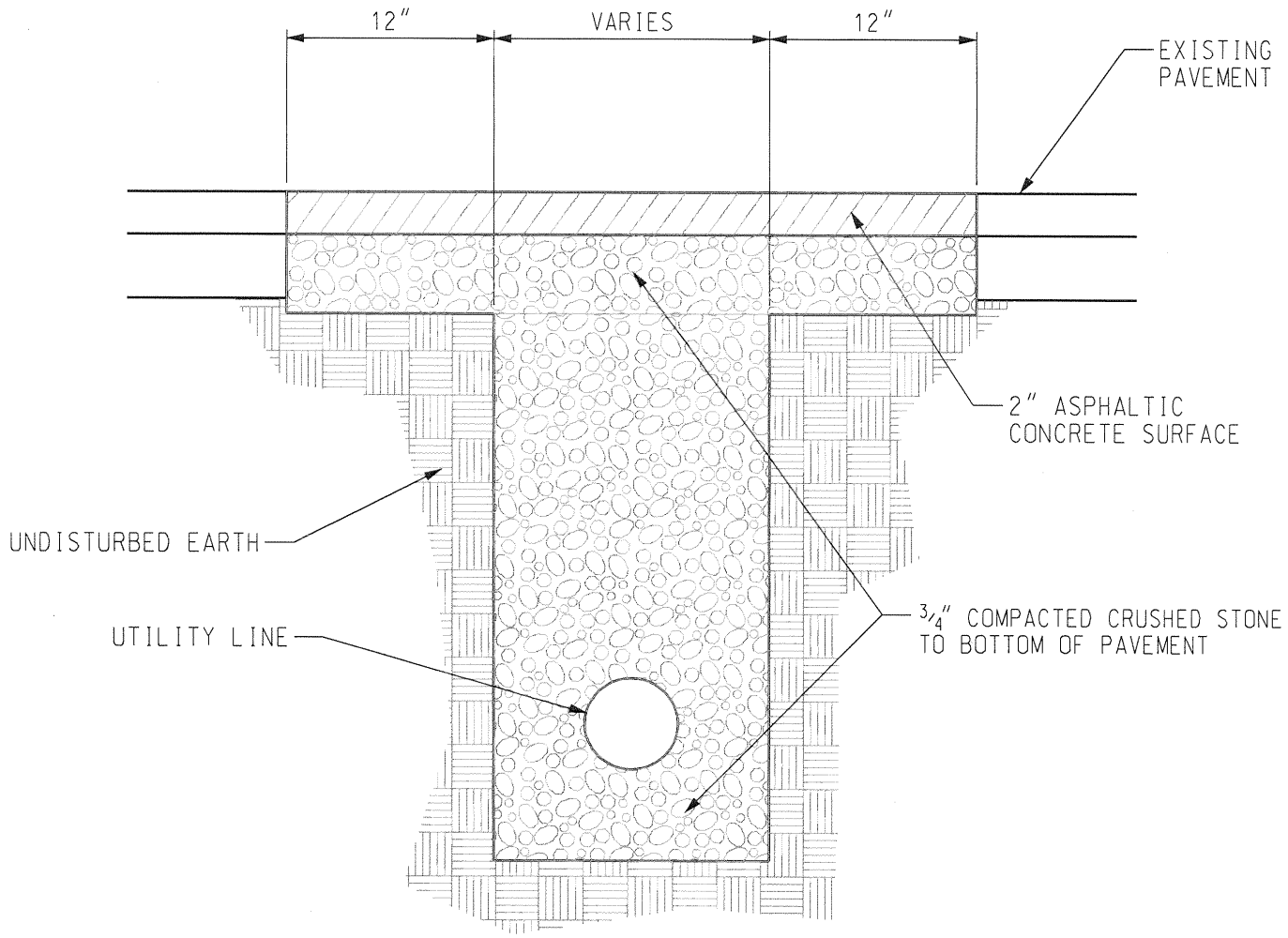


NOTES:

1. EDGE OF PAVEMENT TO BE SAW-CUT MIN. 12" PAST TRENCH WIDTH AS NECESSARY TO OBTAIN NEAT LINES.

2. REPAINT PAVEMENT STRIPING DISTURBED BY CONSTRUCTION.

# ASPHALT PAVEMENT REPAIR

STANDARD WATER AND SEWER SYSTEM DETAILS

**THE TOWN OF**

**ASHLAND CITY, TENNESSEE**

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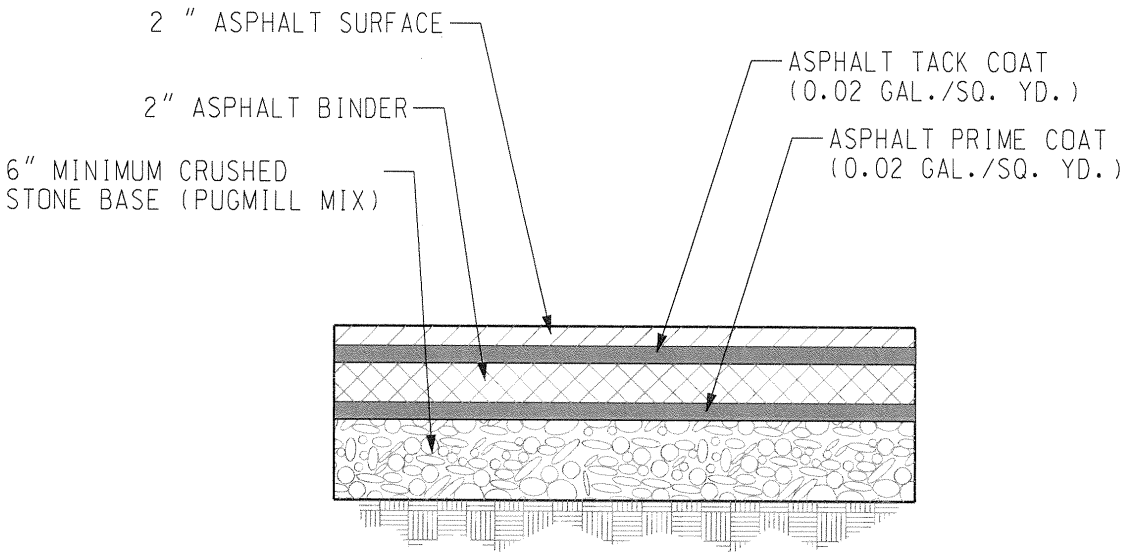


# TYPICAL PAVEMENT DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

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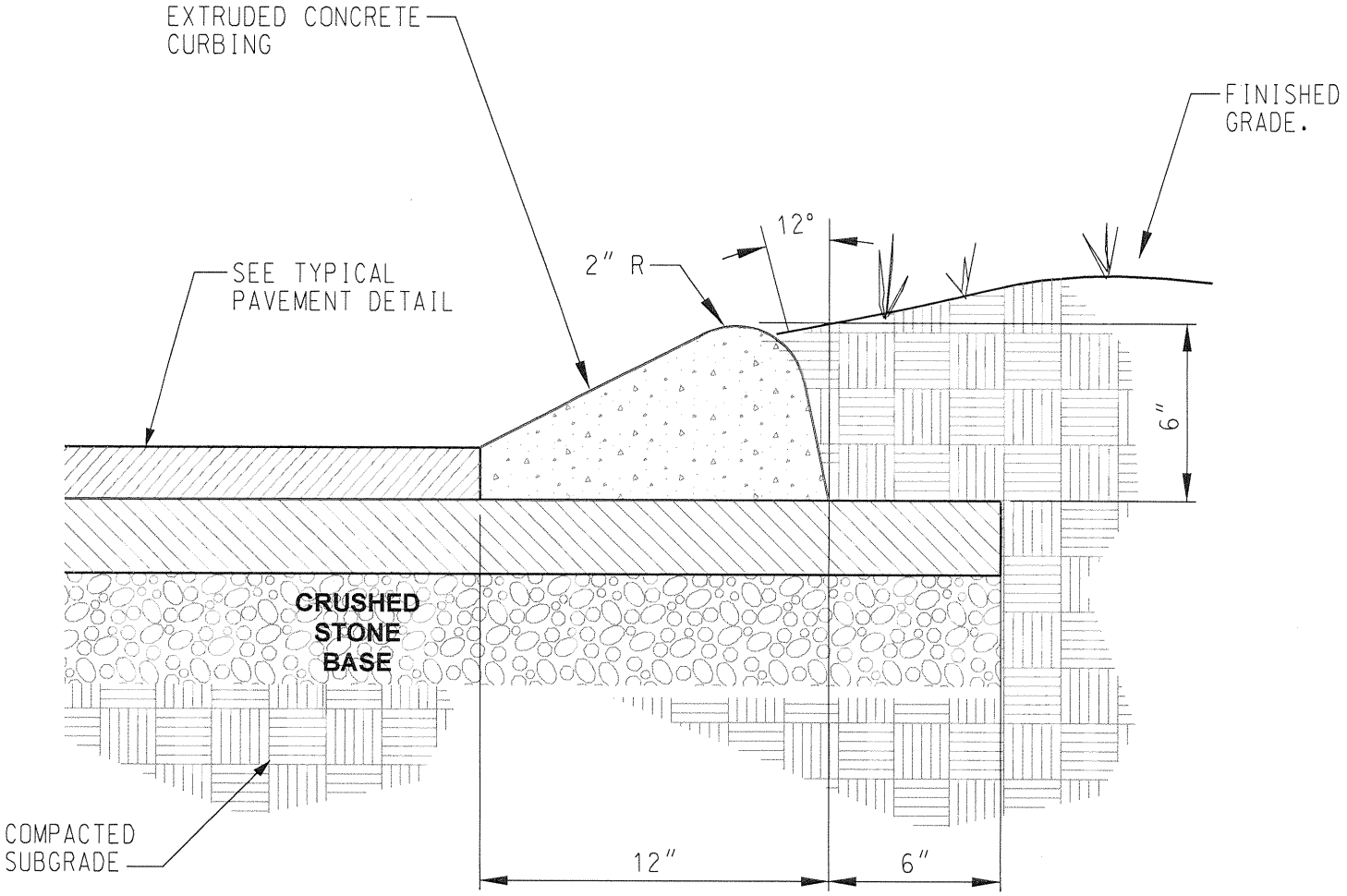


# EXTRUDED CONCRETE CURB DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

## THE TOWN OF

## ASHLAND CITY, TENNESSEE

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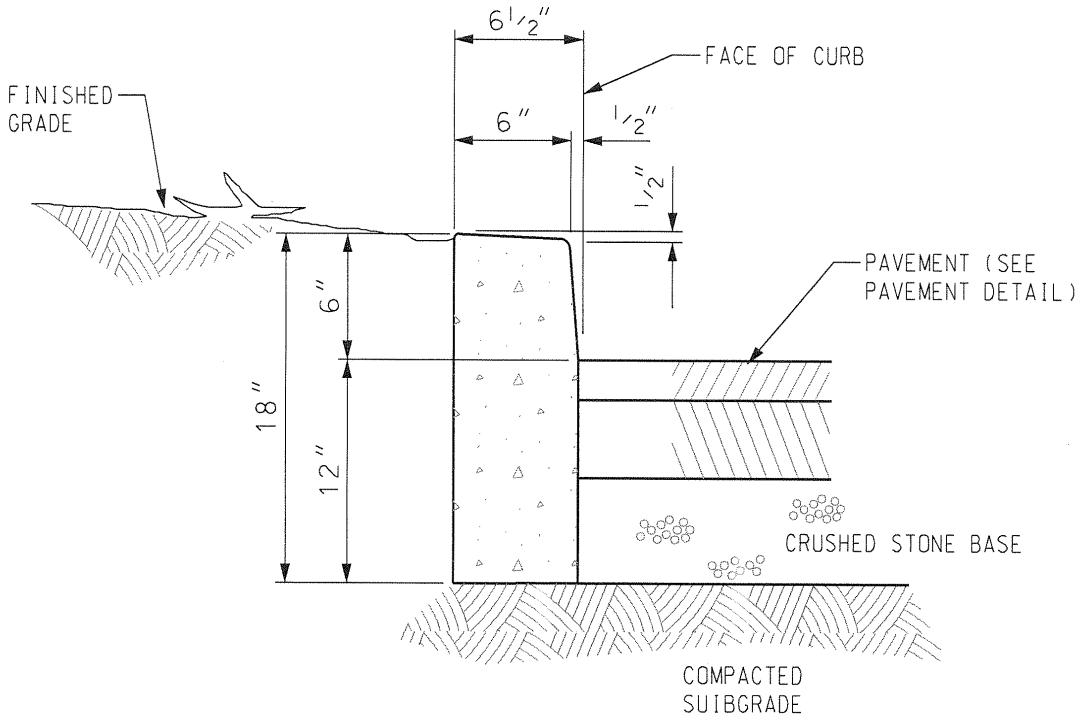


**NOTES:**

1. EXPANSION JOINTS: 1/2" WIDE, FULL DEPTH, AT MAXIMUM OF 50' LONGITUDINAL INTERVALS, AT ALL ABUTTING STRUCTURES, DRIVEWAYS AND TANGENT POINTS OF RADIUS RETURNS.
2. TOOLED CURB CONTROL JOINTS: 1/4" WIDE, 1" DEEP, 5' O.C.
3. ALL CONCRETE TO COMPLY WITH ACI 318 WITH A MINIMUM COMPRESSIVE STRENGTH OF 4,000 Psi. AT 28 DAY TEST.
4. CONCRETE TO BE AIR-ENTRAINED WITH AN AIR CONTENT OF 4-6%.
5. JOINTS TO BE FILLED WITH BITUMINOUS EXPANSION MATERIAL.

# POST-TYPE CURB DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

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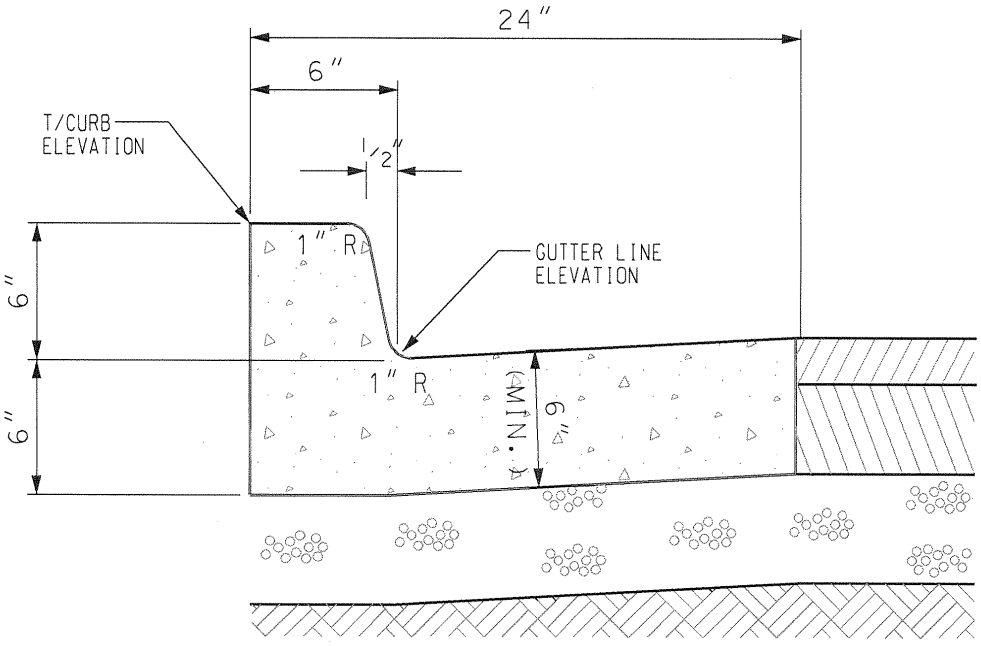


**NOTES:**

1. EXPANSION JOINTS: 1/2" WIDE, FULL DEPTH, AT MAXIMUM OF 50' LONGITUDINAL INTERVALS, AT ALL ABUTTING STRUCTURES, DRIVEWAYS AND TANGENT POINTS OF RADIUS RETURNS.

2. TOOLED CURB CONTROL JOINTS: 1/4" WIDE, 1" DEEP, 5' O.C.

3. ALL CONCRETE TO COMPLY WITH ACI 318 WITH A MINIMUM COMPRESSIVE STRENGTH OF 4,000 Psi. AT 28 DAY TEST.

4. CONCRETE TO BE AIR-ENTRAINED WITH AN AIR CONTENT OF 4-6%.

5. JOINTS TO BE FILLED WITH BITUMINOUS EXPANSION MATERIAL.

# CURB AND GUTTER DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

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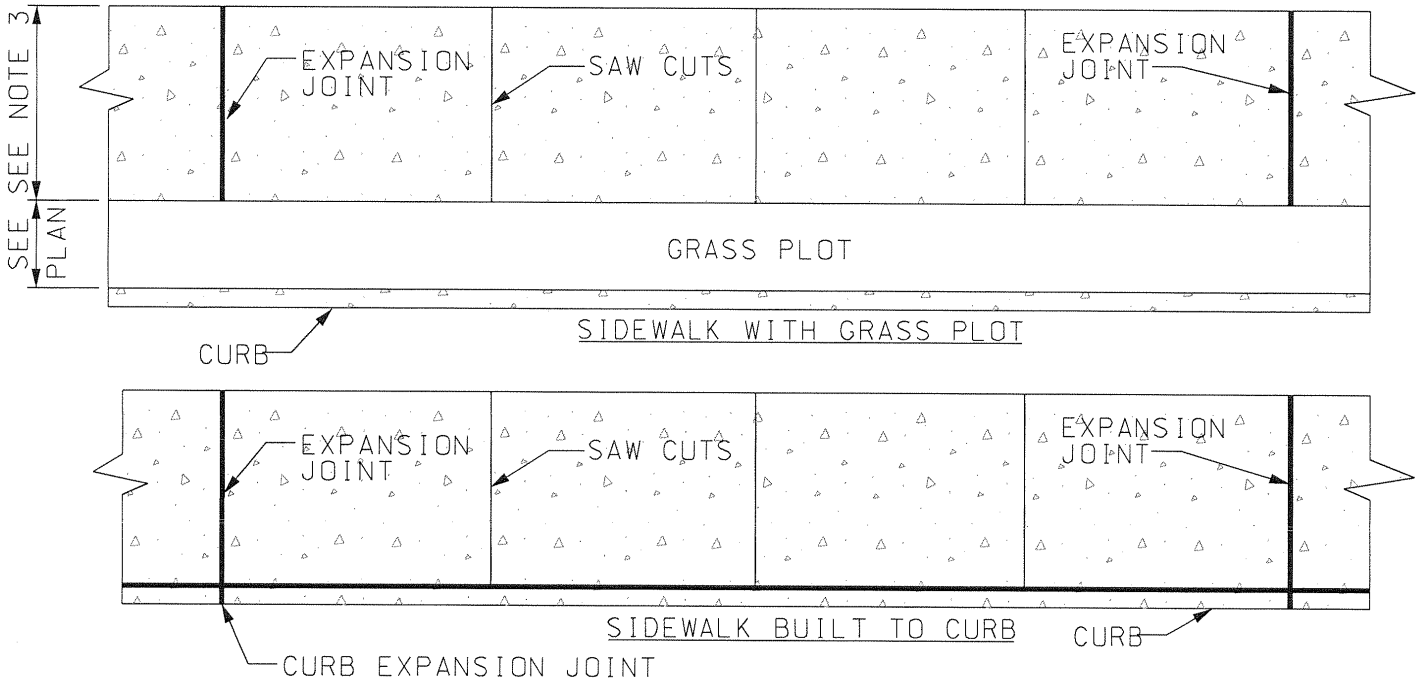
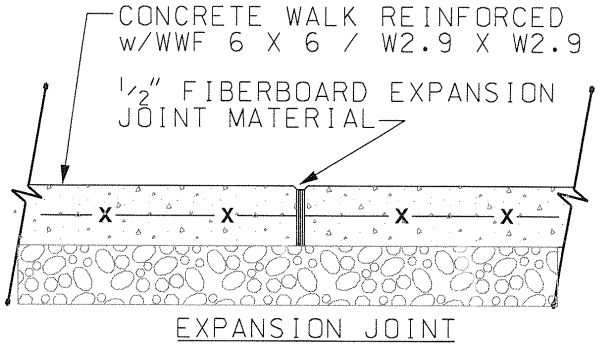
NOTES:

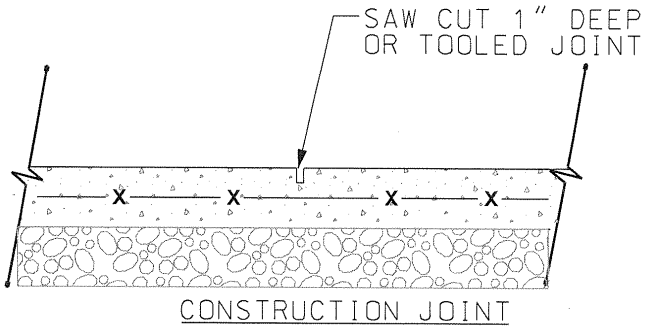
1. EXPANSION JOINTS TO BE SPACED FROM 25' - 30' APART.

2. SAW CUTS TO BE EVENLY SPACED BETWEEN EXPANSION JOINTS. SPACING TO BE APPROXIMATELY SIDEWALK WIDTH BUT NO GREATER THAN 6 FEET.

3. SIDEWALKS SHALL BE 4'-6' IN WIDTH DEPENDING ON THE STREET CLASSIFICATION ALONG WHICH THEY ARE TO BE INSTALLED AND AS APPROVED BY THE TOWN OF ASHLAND CITY.




# CONCRETE SIDEWALK DETAILS

STANDARD WATER AND SEWER SYSTEM DETAILS

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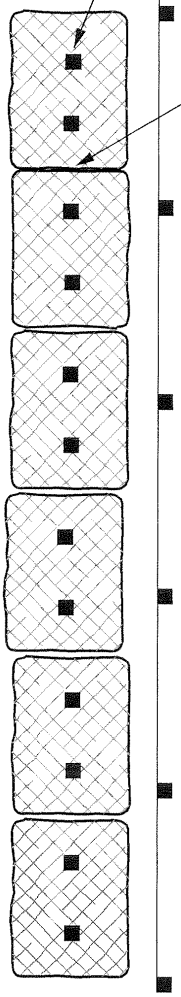
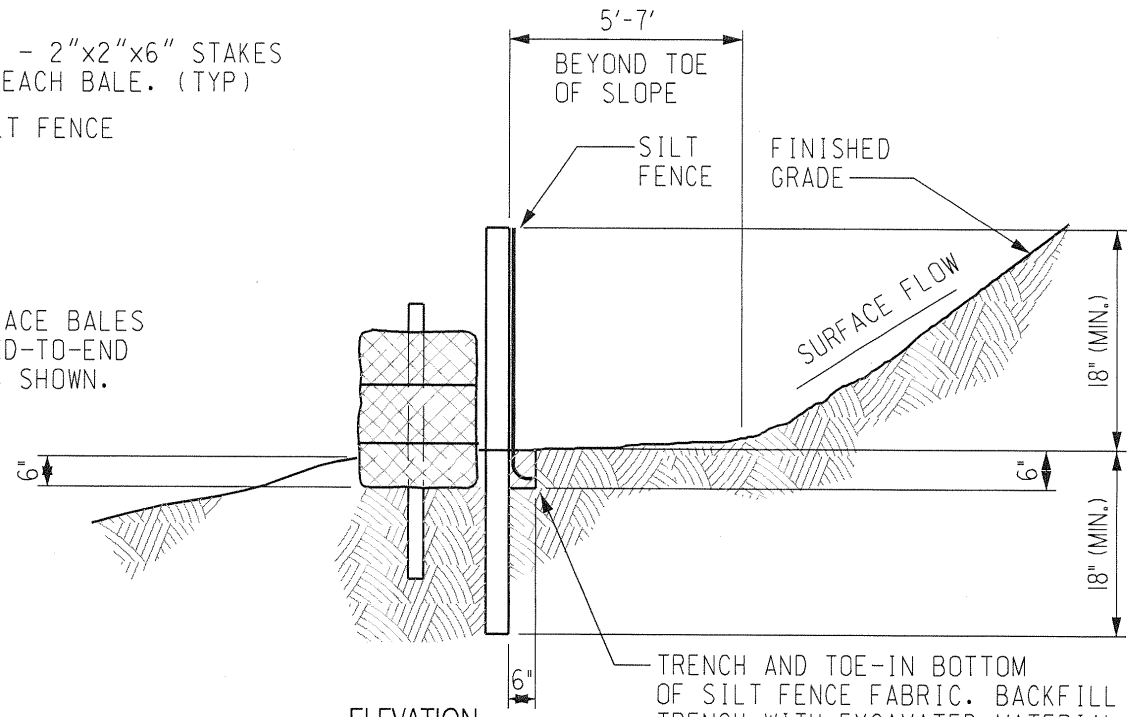



PLAN




ELEVATION

NOTES:

1. SILT FENCE TO BE PLACED PRIOR TO COMMENCING GRADING OPERATIONS AND LEFT IN-PLACE UNTIL A STABLE STAND OF GRASS IS ESTABLISHED OVER ALL DISTURBED AREAS.
2. STEEL POSTS SHALL BE 1.3 LBS./FT MINIMUM.
3. WOOD POSTS SHALL BE 2"x2" MIN., OAK OR SIMILAR HARDWOOD.
4. POSTS SHALL BE SPACED AT 4' INTERVALS.
5. FILTER FABRIC SHALL HAVE AN APPARENT OPENING SIZE (AOS) OF NO. 30 SIEVE. FILTER FABRIC SHALL BE SECURELY BOUND TO POSTS WITH EITHER STAPLES OR WIRE TIES.
6. STRAW BALE SHALL BE PERIODICALLY INSPECTED AND REPLACED AS NECESSARY IN ORDER TO MAINTAIN THE BARRIER'S INTEGRITY.
7. STRAW BALES SHALL BE ENTRENCHED INTO THE GROUND BY 6 INCHES AND PLACED WITH BINDING PARALLEL WITH THE GROUND SURFACE.

# TEMPORARY STRAW BALE DETAIL

STANDARD WATER AND SEWER SYSTEM DETAILS

## THE TOWN OF

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