

PROJECT MANUAL

STANDARD WATER SPECIFICATIONS

**West Overton Utility District
Rickman, TN**


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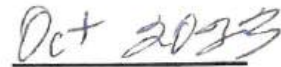
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APPROVED WATER SPECIFICATIONS
THE DOCUMENT BEARING THIS STAMP HAS BEEN RECEIVED AND REVIEWED BY THE
TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION
DIVISION OF WATER RESOURCES
AND IS HEREBY APPROVED FOR USE IN CONSTRUCTION BY THE COMMISSIONER


11/20/2023

THIS APPROVAL SHALL NOT BE CONSTRUED AS CREATING A
PRESUMPTION OF CORRECT OPERATION OR AS WARRANTING BY THE
COMMISSIONER THAT THE APPROVED FACILITIES WILL REACH THE
DESIGNED GOALS.

APPROVAL EXPIRES FIVE YEARS FROM ABOVE DATE




Date

**Barge NO.: 33163-00
DATE: October 2023**

Water System Design Standards

The following outline and the following standard specifications reflect the general policies of the West Overton Utility District with respect to the design and construction of water projects other than major pump stations and tanks. Departure from these standards by design agents must be authorized by the General Manager of the Utility District. Development of specifications, technical project documents, and selection of equipment should reflect the standards and preferences herein. As new equipment or construction methods are evaluated, the standard specifications and outline policies will inevitably be changed as reflected in the latest individual project construction documents approved by the General Manager; if these changes are deemed to be in the Utility's best interests to become policy, this document will be revised and submitted to the State of Tennessee, Department of Environment and Conservation, Division of Water Resources for review and approval. In any event, at a minimum frequency, the approval of these specifications will be renewed on a 5-year basis by the Division of Water Pollution Control or when there are significant changes in the Division's *Design Criteria*. Departure from the State *Design Criteria* policies or these standards must be specifically approved by the Division.

Decisions on the actual procurement of design or construction services must also comply with State law for procurement by public entities and policies of the West Overton Utility District.

The following areas are not addressed in these design policies or specifications:

- Flanged piping (generally above ground or within structures)
- Documents Defining Design Standards
 - a. Various Systems:
 - i. TDEC: Community Public Water Systems Design Criteria
 - ii. American Water Works Association Standards
 - b. Industry Product Association Guidelines
 - i. Ductile Iron: Ductile Iron Pipe Research Association (DIPRA)
 - ii. HDPE: Plastic Pipe Institute (PPI)
 - iii. PVC: PVC Pipe Association
 - c. Individual manufacturer recommended specifications and installation instructions especially for fittings, fuse or cement welding/joining processes.

DESIGN GUIDANCE

WATER SYSTEM DESIGN STANDARDS

TECHNICAL SPECIFICATIONS

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APPENDIX 1: STANDARD DRAWINGS

DETAIL 1	BLOWOFF ASSEMBLY
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DETAIL 8	PAVEMENT REPLACEMENT DETAIL

Part 1 General

1.1 Scope

- A. Work under this Section includes all scheduling and administering of pre-construction and progress meetings as herein specified and necessary for the proper and complete performance of this work.
- B. Scheduling and Administration by Engineer:
 - 1. Prepare agenda.
 - 2. Make physical arrangements for the meetings.
 - 3. Preside at meetings.
 - 4. Record minutes and include significant proceedings and decisions.
 - 5. Distribute copies of the minutes to participants.

1.2 Preconstruction Conference

- A. The Engineer shall schedule the preconstruction conference prior to the issuance of the Notice to Proceed.
- B. Representatives of the following parties are to be in attendance at the meeting:
 - 1. WOUD.
 - 2. Engineer.
 - 3. Contractor and superintendent.
 - 4. Major subcontractors.
 - 5. Representatives of governmental or regulatory agencies when appropriate.
- C. The agenda for the preconstruction conference shall consist of the following as a minimum:
 - 1. Distribute and discuss a list of major subcontractors and a tentative construction schedule.
 - 2. Critical work sequencing.
 - 3. Designation of responsible personnel and emergency telephone numbers.
 - 4. Processing of field decisions and change orders.

Project Meetings

5. Adequacy of distribution of Contract Documents.
6. Schedule and submittal of shop drawings, product data and samples.
7. Pay request format, submittal cutoff date, pay date and retainage.
8. Procedures for maintaining record documents.
9. Use of premises, including office and storage areas and WOULD's requirements.
10. Major equipment deliveries and priorities.
11. Safety and first aid procedures.
12. Security procedures.
13. Housekeeping procedures.
14. Work hours.

1.3 Project Coordination Meetings

- A. Attend regular monthly meetings as directed by the Engineer.
- B. Hold called meetings as the progress of the work dictates.
- C. The meetings shall be held at the location indicated by the Engineer.
- D. Representatives of the following parties are to be in attendance at the meetings:
 1. Engineer.
 2. Contractor and superintendent.
 3. Major subcontractors as pertinent to the agenda.
 4. WOULD's representative as appropriate.
 5. Representatives of governmental or other regulatory agencies as appropriate.
- E. The minimum agenda for progress meetings shall consist of the following:
 1. Review and approve minutes of previous meetings.
 2. Review work progress since last meeting.
 3. Note field observations, problems and decisions.

4. Identify problems which impede planned progress.
5. Review off-site fabrication problems.
6. Review Contractor's corrective measures and procedures to regain plan schedule.
7. Review Contractor's revision to the construction schedule as outlined in the Supplementary Conditions.
8. Review submittal schedule; expedite as required to maintain schedule.
9. Maintenance of quality and work standards.
10. Review changes proposed by WOUD for their effect on the construction schedule and completion date.
11. Complete other current business.

Part 2 Products

(NOT USED)

Part 3 Execution

(NOT USED)

END OF SECTION

Part 1 General

1.1 Scope

- A. Preparing, furnishing, distributing, and periodic updating of the construction schedules as specified herein.
- B. The purpose of the schedule is to demonstrate that the Contractor can complete the overall Project within the Contract Time and meet all required interim milestones.

1.2 Submittals

- A. Overall Project Schedule (OPS)
 - 1. Submit the schedule within 10 days after date of the Notice to Proceed.
 - 2. The Engineer will review the schedule and return it within 10 days after receipt.
 - 3. If required, resubmit within 10 days after receipt of a returned copy.
- B. Near Term Schedule (NTS)
 - 1. Submit the first Near Term Schedule within 10 days of the Notice to Proceed.
 - 2. The Engineer will review the schedule and return it within 10 days after receipt.
- C. Submit an update of the OPS and NTS with each progress payment request.
- D. Submit the number of copies required by the Contractor, plus four copies to be retained by the Engineer.

1.3 Approval

- A. Approval of the Contractor's detailed construction program and revisions thereto shall in no way relieve the Contractor of any of Contractor's duties and obligations under the Contract. Approval is limited to the format of the schedule and does not in any way indicate approval of, or concurrence with, the Contractor's means, methods and ability to carry out the work.

1.4 Overall Project Schedule (OPS)

- A. The Contractor shall submit to WOOD for approval a detailed Overall Project Schedule of the Contractor's proposed operations for the duration of the Project. The OPS shall be in the form of a Gantt/bar chart.

B. Gantt/Bar Chart Schedule

1. Each activity with a duration of five or more days shall be identified by a separate bar. Activities with a duration of more than 20 days shall be subdivided into separate activities.
2. The schedule shall include activities for shop drawing preparation and review, fabrication, delivery, and installation of major or critical path materials and equipment items.
3. The schedule shall show the proposed start and completion date for each activity. A separate listing of activity start and stop dates and working day requirements shall be provided unless the information is shown in text form on the Gantt/bar chart.
4. The schedule shall identify the Notice to Proceed date, the Contract Completion date, major milestone dates, and a critical path.
5. The schedule shall be printed on a maximum 11 x 17-inch size paper. If the OPS needs to be shown on multiple sheets, a simplified, one page, summary bar chart showing the entire Project shall be provided.
6. The schedule shall have a horizontal time scale based on calendar days and shall identify the Monday of each week.
7. The schedule shall show the precedence relationship for each activity.

1.5 Near Term Schedule (NTS)

- A. The Contractor shall develop and refine a detailed Near Term Schedule showing the day to day activities with committed completion dates which must be performed during the upcoming 30-day period. The detailed schedule shall represent the Contractor's best approach to the Work which must be accomplished to maintain progress consistent with the Overall Project Schedule.
- B. The Near Term Schedule shall be in the form of Gantt/bar chart and shall include a written narrative description of all activities to be performed and describe corrective action to be taken for items that are behind schedule.

1.6 Updating

- A. Show all changes occurring since previous submission of the updated schedule.
- B. Indicate progress of each activity and show actual completion dates.
- C. The Contractor shall be prepared to provide a narrative report at the Project Coordination Meetings. The report shall include the following:
 1. A description of the overall Project status and comparison to the OPS.

2. Identify activities which are behind schedule and describe corrective action to be taken.
3. A description of changes or revisions to the Project and their effect on the OPS.
4. A description of the Near Term Schedule of the activities to be completed during the next 30 days. The report shall include a description of all activities requiring participation by the Engineer and/or WOULD.

Part 2 Products

(NOT USED)

Part 3 Execution

(NOT USED)

END OF SECTION

Part 1 General

1.1 Scope

- A. The Contractor shall furnish all equipment and labor materials required to provide WOULD with digital construction videos and photographs of the Project. The requirements of this section are independent of and in addition to the requirements in Division 33 of the Specifications.
- B. Photo and video files shall become the property of WOULD and none of the videos or photographs shall be published without express permission of WOULD.

1.2 Pre and Post Construction Videos and Photographs

- A. Prior to the beginning of any work, the Contractor shall take videos and photographs of the work area to record existing conditions.
- B. Following completion of the work, another set of videos and photographs shall be made showing the same areas and features as in the pre-construction videos and photographs.
- C. All conditions which might later be subject to disagreement shall be shown in sufficient detail to provide a basis for decisions.

1.3 File Format, Media and Submittals

- A. Photographs shall be in “jpg” format.
- B. Videos shall be in a format viewable by Microsoft Windows Media Player or Apple QuickTime Player. Audio narration is desirable.
- C. Files shall be named such that what is being viewed is self evident.
- D. Files shall be submitted on a flash drive, compact disk (CD) or a digital video disk (DVD). If submitted on DVD, disk shall be recorded in “Minus R” format.
- E. The pre-construction videos and photographs shall be submitted to the Engineer within 25 calendar days after the date of receipt by the Contractor of Notice to Proceed. Post-construction videos and photographs shall be provided prior to final acceptance of the Project.

Part 2 Products

(NOT USED)

Part 3 Execution

(NOT USED)

END OF SECTION

Part 1 General

1.1 Scope

- A. The work under this Section includes submittal to the Engineer of shop drawings, product data and samples required by the various Sections of these Specifications.
- B. Submittal Contents: The submittal contents required are specified in each Section.
- C. Definitions: Submittals are categorized as follows:
 - 1. Shop Drawings
 - a. Shop drawings shall include technical data, drawings, diagrams, procedure and methodology, performance curves, schedules, templates, patterns, test reports, calculations, instructions, measurements and similar information as applicable to the specific item for which the shop drawing is prepared.
 - b. Provide newly-prepared information with graphic information at accurate scale (except as otherwise indicated) with name or preparer (firm name) indicated. The Contract Drawings shall not be reproduced by any method for use as or in lieu of detail shop drawings. Show dimensions and note dimensions that are based on field measurement. Identify materials and products in the work shown. Indicate compliance with standards and special coordination requirements. Do not allow shop drawings to be used in connection with the Work without appropriate final "Action" markings by the Engineer.
 - c. Drawings shall be presented in a clear and thorough manner. Details shall be identified by reference to sheet and detail, Specification Section, schedule or room numbers shown on the Contract Drawings.
 - d. Minimum assembly drawings sheet size shall be 11 x 17-inches.
 - e. Minimum detail sheet size shall be 8-1/2 x 11-inches.
 - f. Minimum Scale:
 - i. Assembly Drawings Sheet, Scale: 1-inch = 30 feet.
 - ii. Detail Sheet, Scale: 1/4-inch = 1 foot.
 - 2. Product Data
 - a. Product data includes standard published information on materials, products and systems, not specially prepared for this Project, other than the designation of selections from among available choices printed therein.

- b. Collect required data into one submittal for each unit of work or system, and mark each copy to show which choices and options are applicable to the Project. Include manufacturer's standard published recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements which have been checked and special coordination requirements.
3. Samples
 - a. Samples include both fabricated and un-fabricated physical examples of materials, products and units of work, both as complete units and as smaller portions of units of work, either for limited visual inspection or, where indicated, for more detailed testing and analysis.
 - b. Provide units identical with final condition of proposed materials or products for the work. Include "range" samples, not less than three units, where unavoidable variations must be expected, and describe or identify variations between units of each set. Provide full set of optional samples where the Engineer's selection is required. Prepare samples to match the Engineer's sample where indicated. Include information with each sample to show generic description, source or product name and manufacturer, limitations and compliance with standards. Samples are submitted for review and confirmation of color, pattern, texture and "kind" by the Engineer. Engineer will note "test" samples, except as otherwise indicated, for other requirements, which are the exclusive responsibility of the Contractor.
4. Miscellaneous submittals related directly to the work (non-administrative) include warranties, maintenance agreements, workmanship bonds, project photographs, survey data and reports, physical work records, statements of applicability, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, operating and maintenance materials, overrun stock, security/protection/safety keys and similar information, devices and materials applicable to the work but not processed as shop drawings, product data or samples.

1.2 Specific Category Requirements

- A. General: Except as otherwise indicated in the individual work sections, comply with general requirements specified herein for each indicated category of submittal. Submittals shall contain:
 1. The date of submittal and the dates of any previous submittals.
 2. The Project title.
 3. Unless indicated otherwise by the Engineer's submittal management software, provide numerical submittal numbers, starting with 1.0, 2.0, etc. Revisions to be numbered 1.1, 1.2, etc.

4. The Names of:
 - a. Contractor
 - b. Supplier
 - c. Manufacturer
5. Identification of the product, with the Specification Section number, permanent equipment tag numbers and applicable Drawing No.
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features of the work or materials.
8. Applicable standards, such as ASTM .
9. Notification to the Engineer in writing, at time of submissions, of any deviations on the submittals from requirements of the Contract Documents.
10. Identification of revisions on resubmittals.
12. Contractor's stamp, initialed or signed or affirmatively indicated on submittal, certifying to review of submittal, verification of products, field measurements and field construction criteria and coordination of the information within the submittal with requirements of the work and of Contract Documents.
13. Submittals showing more than the particular item under consideration shall have all but the pertinent description of the item for which review is requested crossed out.

1.3 Routing of Submittals

- A. Submittals and routine correspondence shall be routed as follows:
 1. Supplier to Contractor (through representative if applicable)
 2. Contractor to Engineer
 3. Engineer to Contractor and WOULD
 4. Contractor to Supplier

Part 2 Products

2.1 Shop Drawings

- A. Unless otherwise specifically directed by the Engineer, make all shop drawings accurately to a scale sufficiently large to show all pertinent features of the item and its

Submittal Procedures

method of connection to the work.

- B. Submit all shop assembly drawings, as a digital image, pdf format, scanned at the original scale.
- C. Submit all shop drawings as a digital image, pdf format, scanned at the original scale.

2.2 Manufacturer's Literature

- A. Where content of submitted literature from manufacturers includes data not pertinent to this submittal, clearly indicate which portion of the contents is being submitted for the Engineer's review.

2.3 Samples

- A. Samples shall illustrate materials, equipment or workmanship and established standards by which completed work is judged.
- B. Unless otherwise specifically directed by the Engineer, all samples shall be of the precise article proposed to be furnished.
- C. Submit all samples in the quantity which is required to be returned plus one sample which will be retained by the Engineer.

2.4 Colors

- A. Unless the precise color and pattern is specifically described in the Contract Documents, wherever a choice of color or pattern is available in a specified product, submit accurate color charts and pattern charts to the Engineer for review and selection.
- B. Unless all available colors and patterns have identical costs and identical wearing capabilities, and are identically suited to the installation, completely describe the relative costs and capabilities of each.

Part 3 Execution

3.1 Contractor's Coordination of Submittals

- A. Prior to submittal for the Engineer's review, the Contractor shall use all means necessary to fully coordinate all material, including the following procedures:
 - 1. Determine and verify all field dimensions and conditions, catalog numbers and similar data.
 - 2. Coordinate as required with all trades and all public agencies involved.
 - 3. Submit a written statement of review and compliance with the requirements of all applicable technical Specifications as well as the requirements of this Section.

4. Clearly indicate in a letter or memorandum on the manufacturer's or fabricator's letterhead, all deviations from the Contract Documents.
- B. Each and every shop drawing and data sheet submittal shall bear the Contractor's stamp showing that they have been so checked. Shop drawings submitted to the Engineer without the Contractor's stamp will be returned to the Contractor for conformance with this requirement.
 - C. WOULD may backcharge the Contractor for costs associated with having to review a particular shop drawing, product data or sample more than two times to receive a "No Exceptions Taken" mark.
 - D. Grouping of Submittals
 1. Unless otherwise specifically permitted by the Engineer, make all submittals in groups containing all associated items.
 2. No review will be given to partial submittals of shop drawings for items which interconnect and/or are interdependent. It is the Contractor's responsibility to assemble the shop drawings for all such interconnecting and/or interdependent items, check them and then make one submittal to the Engineer along with Contractor's comments as to compliance, non-compliance or features requiring special attention.
 - E. Schedule of Submittals
 1. Within 30 days of Contract award and prior to any shop drawing submittal, the Contractor shall submit a schedule showing the estimated date of submittal and the desired approval date for each shop drawing anticipated. A reasonable period shall be scheduled for review and comments. Time lost due to unacceptable submittals shall be the Contractor's responsibility and some time allowance for resubmittal shall be provided. The schedule shall provide for submittal of items which relate to one another to be submitted concurrently.

3.2 Timing of Submittals

- A. Make all submittals far enough in advance of scheduled dates for installation to provide all required time for reviews, for securing necessary approvals, for possible revision and resubmittal, and for placing orders and securing delivery.
- B. In scheduling, allow sufficient time for the Engineer's review following the receipt of the submittal.

3.3 Reviewed Shop Drawings

- A. Engineer Review
 1. Allow a minimum of 30 days for the Engineer's initial processing of each submittal requiring review and response, except allow longer periods where

processing must be delayed for coordination with subsequent submittals. The Engineer will advise the Contractor promptly when it is determined that a submittal being processed must be delayed for coordination. Allow a minimum of two weeks for reprocessing each submittal. Advise the Engineer on each submittal as to whether processing time is critical to progress of the work, and therefore the work would be expedited if processing time could be foreshortened.

2. Acceptable submittals without any comments will be marked "No Exceptions Taken".
 3. Submittals containing comments for clarification will be marked "Exceptions Noted". .
 4. Submittals marked "Revise and Resubmit" must be revised to reflect required changes and the initial review procedure repeated.
 5. The "Rejected" notation is used to indicate products which are not acceptable. Upon return of a submittal so marked, the Contractor shall repeat the initial review procedure utilizing acceptable products.
- B. No work or products shall be installed without a drawing or submittal bearing the "No Exceptions Taken" notation. The Contractor shall maintain at the job site a complete set of shop drawings bearing the Engineer's stamp.
- C. Substitutions: In the event the Contractor obtains the Engineer's approval for the use of products other than those which are listed first in the Contract Documents, the Contractor shall, at the Contractor's own expense and using methods approved by the Engineer, make any changes to structures, piping and electrical work that may be necessary to accommodate these products.
- D. Use of the "No Exceptions Taken" notation on shop drawings or other submittals is general and shall not relieve the Contractor of the responsibility of furnishing products of the proper dimension, size, quality, quantity, materials and all performance characteristics, to efficiently perform the requirements and intent of the Contract Documents. The Engineer's review shall not relieve the Contractor of responsibility for errors of any kind on the shop drawings. Review is intended only to assure conformance with the design concept of the Project and compliance with the information given in the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site. The Contractor is also responsible for information that pertains solely to the fabrication processes or to the technique of construction and for the coordination of the work of all trades.

3.4 Resubmission Requirements

- A. Shop Drawings
1. Revise initial Drawings as required and resubmit as specified for initial submittal, with the resubmittal number shown.
 2. Indicate on Drawings all changes which have been made other than those

requested by the Engineer.

- B. Project Data and Samples: Resubmit new data and samples as specified for initial submittal, with the resubmittal number shown.

END OF SECTION

Part 1 General

1.1 Scope

- A. Permits and Responsibilities: The Contractor shall, without additional expense to WOOD, be responsible for obtaining all necessary licenses and permits, including building permits, and for complying with any applicable federal, state, county and municipal laws, codes and regulations, in connection with the prosecution of the work.
- B. The Contractor shall take proper safety and health precautions to protect the work, the workers, the public and the property of others.
- C. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the work, except for any completed unit of construction thereof which may heretofore have been accepted.

Part 2 Products

(NOT USED)

Part 3 Execution

(NOT USED)

END OF SECTION

Part 1 General

1.1 Description

- A. Whenever reference is made to conforming to the standards of any technical society, organization, body, code or standard, it shall be construed to mean the latest standard, code, specification or tentative specification adopted and published at the time of advertisement for bids. This shall include the furnishing of materials, testing of materials, fabrication and installation practices. In those cases where the Contractor's quality standards establish more stringent quality requirements, the more stringent requirement shall prevail. Such standards are made a part hereof to the extent which is indicated or intended.
- B. The inclusion of an organization under one category does not preclude that organization's standards from applying to another category.
- C. In addition, all work shall comply with the applicable requirements of local codes, utilities and other authorities having jurisdiction.
- D. All material and equipment, for which a UL Standard, an AGA or NSF approval or an ASME requirement is established, shall be so approved and labeled or stamped. The label or stamp shall be conspicuous and not covered, painted, or otherwise obscured from visual inspection.
- E. The standards which apply to this Project are not necessarily restricted to those from organizations which are listed in Article 1.2.

1.2 Standard Organizations

A. Piping and Valves

ACPA	American Concrete Pipe Association
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
DIPRA	Ductile Iron Pipe Research Association
FCI	Fluid Controls Institute
MSS	Manufacturers Standardization Society
NCPI	National Clay Pipe Institute
NSF	National Sanitation Foundation
PPI	Plastic Pipe Institute
Uni-Bell	PVC Pipe Association

B. Materials

AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute

Codes and Standards

- ASTM American Society for Testing and Materials
- C. Painting and Surface Preparation
- NACE National Association of Corrosion Engineers
 SSPC Steel Structures Painting Council
- D. Electrical and Instrumentation
- AEIC Association of Edison Illuminating Companies
 AIEE American Institute of Electrical Engineers
 EIA Electronic Industries Association
 ICEA Insulated Cable Engineers Association
 IEC International Electrotechnical Commission
 IEEE Institute of Electrical and Electronic Engineers
 IES Illuminating Engineering Society
 IPC Institute of Printed Circuits
 IPCEA Insulated Power Cable Engineers Association
 ISA The Instrumentation, Systems, and Automation Society
 NEC National Electric Code
 NEMA National Electrical Manufacturers Association
 NFPA National Fire Protection Association
 REA Rural Electrification Administration
 TIA Telecommunications Industries Association
 UL Underwriter's Laboratories
 VRCI Variable Resistive Components Institute
- E. Aluminum
- AA Aluminum Association
 AAMA American Architectural Manufacturers Association
- F. Steel and Concrete
- ACI American Concrete Institute
 AISC American Institute of Steel Construction, Inc.
 AISI American Iron and Steel Institute
 CRSI Concrete Reinforcing Steel Institute
 NRMA National Ready-Mix Association
 PCA Portland Cement Association
 PCI Prestressed Concrete Institute
- G. Welding
- ASME American Society of Mechanical Engineers
 AWS American Welding Society
- H. Government and Technical Organizations
- AIA American Institute of Architects
 APHA American Public Health Association

APWA	American Public Works Association
ASA	American Standards Association
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASQC	American Society of Quality Control
ASSE	American Society of Sanitary Engineers
CFR	Code of Federal Regulations
CSI	Construction Specifications Institute
EDA	Economic Development Administration
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
FmHA	Farmers Home Administration
FS	Federal Specifications
IAI	International Association of Identification
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
NBFU	National Board of Fire Underwriters
(NFPA)	National Fire Protection Association
NBS	National Bureau of Standards
NISO	National Information Standards Organization
OSHA	Occupational Safety and Health Administration
SI	Salt Institute
SPI	The Society of the Plastics Industry, Inc.
USDC	United States Department of Commerce
WEF	Water Environment Federation

I. General Building Construction

AHA	American Hardboard Association
AHAM	Association of Home Appliance Manufacturers
AITC	American Institute of Timber Construction
APA	American Parquet Association, Inc.
APA	American Plywood Association
BHMA	Builders Hardware Manufacturers Association
BIFMA	Business and Institutional Furniture Manufacturers Association
DHI	Door and Hardware Institute
FM	Factory Mutual Fire Insurance Company
HPMA	Hardwood Plywood Manufacturers Association
HTI	Hand Tools Institute
IME	Institute of Makers of Explosives
ISANTA	International Staple, Nail and Tool Association
ISDSI	Insulated Steel Door Systems Institute
IWS	Insect Screening Weavers Association
MBMA	Metal Building Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NAGDM	National Association of Garage Door Manufacturers
NCCLS	National Committee for Clinical Laboratory Standards
NFPA	National Fire Protection Association
NFSA	National Fertilizer Solutions Association
NKCA	National Kitchen Cabinet Association

Codes and Standards

- | | |
|-------|---|
| NWMA | National Woodwork Manufacturers Association |
| NWWDA | National Wood Window and Door Association |
| RMA | Rubber Manufacturers Association |
| SBC | SBCC Standard Building Code |
| SDI | Steel Door Institute |
| SIA | Scaffold Industry Association |
| SMA | Screen Manufacturers Association |
| SPRI | Single-Ply Roofing Institute |
| TCA | Tile Council of America |
| UBC | Uniform Building Code |
- J. Roadways
- | | |
|------|--|
| AREA | American Railway Engineering Association |
| DOT | Department of Transportation |
- K. Plumbing
- | | |
|-----|--------------------------------|
| AGA | American Gas Association |
| NSF | National Sanitation Foundation |
| PDI | Plumbing Drainage Institute |
| SPC | SBCC Standard Plumbing Code |
- L. Refrigeration, Heating, and Air Conditioning
- | | |
|--------|--|
| AMCA | Air Movement and Control Association |
| ARI | American Refrigeration Institute |
| ASHRAE | American Society of Heating, Refrigeration, and Air Conditioning Engineers |
| ASME | American Society of Mechanical Engineers |
| CGA | Compressed Gas Association |
| CTI | Cooling Tower Institute |
| HEI | Heat Exchange Institute |
| IIAR | International Institute of Ammonia Refrigeration |
| NB | National Board of Boilers and Pressure Vessel Inspectors |
| PFMA | Power Fan Manufacturers Association |
| SAE | Society of Automotive Engineers |
| SMACNA | Sheet Metal and Air Conditioning Contractors National Association |
| SMC | SBCC Standard Mechanical Code |
| TEMA | Tubular Exchangers Manufacturers Association |
- M. Equipment
- | | |
|-------|---|
| AFBMA | Anti-Friction Bearing Manufacturers Association, Inc. |
| AGMA | American Gear Manufacturers Association |
| ALI | Automotive Lift Institute |
| CEMA | Conveyor Equipment Manufacturers Association |
| CMAA | Crane Manufacturers Association of America |
| DEMA | Diesel Engine Manufacturers Association |
| MMA | Monorail Manufacturers Association |
| OPEI | Outdoor Power Equipment Institute, Inc. |

PTI	Power Tool Institute, Inc.
RIA	Robotic Industries Association
SAMA	Scientific Apparatus Makers Association

1.3 Symbols

Symbols and material legends shall be as scheduled on the Drawings.

Part 2 Products

(NOT USED)

Part 3 Execution

(NOT USED)

END OF SECTION

Part 1 General

1.1 Scope

- A. Temporary facilities required for this work include, but are not necessarily limited to:
 - 1. Temporary utilities such as water and electricity.
 - 2. First aid facilities.
 - 3. Sanitary facilities.
 - 4. Potable water.
 - 5. Temporary enclosures and construction facilities.

1.2 General

- A. First aid facilities, sanitary facilities and potable water shall be available on the Project site on the first day that any activities are conducted on site. The other facilities shall be provided as the schedule of the Project warrants.
- B. Maintenance: Use all means necessary to maintain temporary facilities in proper and safe condition throughout progress of the work. In the event of loss or damage, immediately make all repairs and replacements necessary, at no additional cost to WOOD.
- C. Removal: Remove all such temporary facilities and controls as rapidly as progress of the Work will permit.

1.3 Quality Assurance

- A. Temporary Electric: Installation of all temporary electric facilities shall comply with NECA, NEMA and UL standards and regulations for such facilities. Install service to comply with NFPA 70.

1.4 Temporary Utilities

- A. General
 - 1. Provide and pay all costs for all water, electricity and other utilities required for the performance of the work.
 - 2. Pay all costs for temporary utilities until Project completion.
 - 3. Costs for temporary utilities shall include all power, water and the like necessary for testing equipment as required by the Contract Documents.

Temporary Facilities and Controls

B. Temporary Water:

1. Connect to public water system. Provide reduced pressure backflow prevention.
2. Provide all necessary temporary piping. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing, as necessary.
3. Upon completion of the Work, remove all such temporary piping.
4. Provide and remove water meters, as required by governing authority.

C. Temporary Electricity:

1. Provide all necessary wiring for the Contractor's use.
2. Provide main service disconnect and over-current protection at convenient location.
3. Furnish, locate and install area distribution boxes such that the individual trades may use their own construction type extension cords to obtain adequate power, and artificial lighting at all points where required by inspectors and for safety.
4. Existing receptacles may not be utilized during construction unless approved by WOUD.
5. If existing site lighting is disabled during construction, provide and maintain temporary lighting to exterior work areas for routine operations.

D. Temporary Ventilation:

1. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors or gases. Provide temperature or humidity control, if required to meet required installation conditions.

E. Temporary Heating:

1. Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed equipment.
2. Permanent heating systems shall not be utilized.

F. Temporary Sewer Facilities:

1. Prior to starting the work, the Contractor shall furnish, for use of Contractor's personnel on the job, all necessary toilet facilities which shall be secluded from public observation. These facilities shall be chemical toilets.
2. Existing sanitary facilities may not be used.
3. All facilities, regardless of type, shall be kept in a clean and sanitary condition and shall comply with the requirements and regulations of the area in which the

work is performed. Adequacy of these facilities will be subject to WOULD's review and maintenance of same must be satisfactory to WOULD at all times.

1.5 First Aid Facilities

- A. The Contractor shall provide a suitable first aid station, equipped with all facilities and medical supplies necessary to administer emergency first aid treatment. The Contractor shall have standing arrangements for the removal and hospital treatment of any injured person. All first aid facilities and emergency ambulance service shall be made available by the Contractor to WOULD and the WOULD's personnel.

1.6 Potable Water

- A. The Contractor shall be responsible for furnishing a supply of potable drinking water for employees, subcontractors, inspectors, engineers and WOULD who are associated with the work.

1.7 Enclosures and Construction Facilities

- A. Furnish, install and maintain for the duration of construction, all required scaffolds, tarpaulins, canopies, steps, bridges, platforms and other temporary construction necessary for proper completion of the work in compliance with all pertinent safety and other regulations.
- B. All temporary enclosures and sheds located within construction areas or within 30 feet of existing building lines shall be noncombustible, in accordance with ASTM E136. Comply with NFPA 241.

1.8 Parking Facilities

- A. Arrange for temporary surface parking areas for the Contractor's and Contractor's subcontractors' personnel. Existing facilities provided by the Owner shall not be used for parking by the Contractor's or subcontractor's personnel.
- B. When site space is not adequate, provide additional off-site parking.
- C. Maintain all roads, both temporary and permanent, in passable condition for all traffic. Any road blockage shall be coordinated with Engineer, WOULD, and governing authorities.

1.9 Removal

- A. Remove temporary above-ground or buried utilities, materials, equipment, services, and construction prior to Substantial Completion inspection.
- B. Clean and repair damage caused by installation or use of temporary facilities.
- C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

Part 2 Products

(NOT USED)

Part 3 Execution

(NOT USED)

END OF SECTION

Part 1 General

1.1 Work Included

- A. This Section includes the provisions for the installation and the removal of soil erosion protection and sediment control measures in compliance with the requirements of the Tennessee Department of Environment and Conservation (TDEC) National Pollutant Discharge Elimination System (NPDES) program.
- B. The temporary pollution control provisions contained herein shall be coordinated with the permanent erosion control measures, to ensure economical, effective, and continuous erosion control throughout the construction and post- construction period.
- C. It is the intent of this section to provide a written plan to ensure that PL 100 4, Section 319, TCA 69 3 101, et seq., Subsection 69 3 108 and Subsection 69 3 114, and Division of Water Pollution Control General Permit for Utility Line Crossings, Chapter 1200 4 7.08 and for Bank Stabilization Chapter 1200 4 7.09 are met. Since the Contractor is responsible for the construction means and methods which in turn are responsible for ensuring that construction activities do not harm the Waters of Tennessee, the Contractor is solely responsible for ensuring that the above-mentioned laws and regulations are met.
- D. Any required land disturbance permit(s) shall be obtained and paid for by the Contractor.

1.2 Related Sections

- A. Section 31 23 33 – Trenching and Backfilling
- B. Section 32 92 19 – Seeding
- C. Section 32 92 23 – Sodding

1.3 Reference Standards

- A. ASTM C88 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- B. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units
- C. ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- D. ASTM C535 – Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

Temporary Storm Water Pollution Control

- E. ASTM D448 – Standard Classification for Sizes of Aggregate for Road and Bridge Construction
- F. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³).
- G. ASTM D-1682 – Standard Test Methods for Breaking Load and Elongation of Textile Fabrics.
- H. ASTM D-177 – Methods of Testing Rubber Hose (Withdrawn 1933)
- I. Tennessee Erosion and Sediment Control Handbook, latest edition, as issued by TDEC
- J. AASHTO M-288 – Geotextile Specification for Highway Applications
- K. Tennessee Department of Transportation (TDOT) Erosion Prevention and Sediment Control Standard Drawings

1.4 Quality Assurance

- A. CONTRACTOR is responsible for and must implement all stormwater controls prior to any site work within the project area. Controls must remain in place until after the completion final site stabilization as defined in TNR100000.
- B. Referenced Standards:
 - 1. TDEC General Permit Number TNR100000 – General Permit for Stormwater Discharges from Construction Activities, Issued by the Tennessee Department of Environment and Conservation, Effective May 24, 2011.
 - 2. Erosion control standards specified in the TDEC General Permit relating to discharges of storm water from construction activities.
 - 3. Refer to the permit for a complete discussion of the associated requirements.
- C. Comply with applicable requirements of all governing authorities having jurisdiction. The Specifications and the Plans are not represented as being comprehensive, but rather to convey the intent to provide complete slope and erosion protection with sediment control for both WOUD's and adjacent property. Any additional erosion and sedimentation control measures required by the Contractor's means, methods, techniques and sequence of operation will be installed by the Contractor at no additional cost to WOUD. Where provisions of pertinent rules and regulations conflict with these Specifications, the more stringent provisions shall govern.
- D. Erosion control measures shall be established before commencing any earth disturbing activities and maintained during the entire duration of construction activities. On-site areas which are subject to severe erosion and off-site areas which are especially vulnerable to damage from erosion and/or sedimentation are to be identified and receive additional erosion protection and sediment control measures.

E. Basic Principles

1. Coordinate the land disturbance activities to fit the topography, soil types and conditions.
2. Minimize the disturbed area and the duration of exposure to erosive elements.
3. Provide temporary or permanent stabilization to disturbed areas immediately after rough grading is complete.
4. Safely convey run off from the site to a stable outlet to prevent flooding and damage to downstream facilities resulting from increased runoff from the site.
5. Retain sediment on site that was generated on site.
6. Minimize encroachment upon watercourses.

F. Implementation

1. The Contractor is solely responsible for the control of erosion within the Project site and the prevention of sedimentation from leaving the Project site or entering waterways.
2. The Contractor shall install temporary and permanent erosion and sedimentation controls which will ensure that runoff from the disturbed area of the Project site shall pass through a filter system before exiting the Project site.
3. The Contractor shall provide temporary and permanent erosion and sedimentation control measures to prevent silt and sediment from entering the waterways. Where required by regulatory authorities, the Contractor shall obtain a Land Disturbance Permit that allows encroachments on the 60 foot vegetative buffer in specific areas. The Contractor shall exercise extreme care during land disturbance operations within the 60 foot vegetative buffer to prevent degradation of the stream.
4. The Contractor shall limit land disturbance activity to those areas shown on the Drawings.
5. The Contractor shall maintain erosion and sedimentation control measures within disturbed areas on the entire site at no additional cost to WOULD until the acceptance of the Project. Maintenance shall include mulching, reseeding, clean out of sediment barriers and sediment ponds, replacement of washed out or undermined rip rap and erosion control materials, to the satisfaction of the Engineer.
6. All fines imposed for improper erosion and sedimentation control shall be paid by the Contractor.
7. The Contractor shall use all means necessary to control dust on and near the work and all off-site borrow areas, in accordance to the Tennessee Erosion

and Sediment Control Handbook, latest edition. The Contractor should thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public, neighbors and concurrent performance of work on the site.

8. Surface water runoff originating upgrade of exposed area shall be controlled to reduce erosion and sediment migration during the period of exposure.
- G. All land-disturbing activities shall be done in accordance with specific regional requirements as to the time of year that clearing can occur on a project due to the presence of endangered or threatened species.

1.5 Submittals

- A. Submittals shall be in accordance with Section 01 33 00 and shall include:
- B. Stormwater Pollution Prevention Plan (SWPPP) following the EPA SWPPP template, Version 1.1 signed and sealed by an engineer licensed in the State of Tennessee.
- C. Record data for the erosion and sediment control devices.
- D. Joint Notice of Intent with WOULD for NPDES permitting.
- E. Joint Notice of Change with WOULD (if necessary)
- F. NPDES General permit number for the project.
- G. Record Data – Inspection Reports: Provide inspection procedure and example inspection form to be used on twice weekly basis. Inspections are required to be performed seventy-two (72) hours or more apart each week the site is active. Provide inspection form to document any major grading activities or periods when construction activity ceases for fourteen (14) calendar days or more.
- H. Certification of Completed Plan
- I. Joint Notice of Termination with WOULD for NPDES permitting.

Part 2 Products

2.1 Sediment Control Fence

- A. Type A silt fence shall meet the requirements of Tennessee Erosion and Sediment Control Handbook, latest edition.
- B. Type C silt fence is a combination of Type A silt fence fabric with woven wire reinforcement. Type C silt fence woven wire reinforcement shall meet the requirements of Tennessee Erosion and Sediment Control Handbook, latest edition.

- C. Silt Fence Posts: For silt fence without backing, posts shall be hardwood posts that are 2.25" (nominal) x 2.25" (nominal) x 58". T-type steel posts also may be used. Silt fence with backing shall be installed on painted or galvanized steel TEE or Y-posts with anchor plates, not less than five (5') feet in length with a minimum weight of 1.3 pounds per foot and a minimum Brinell Hardness of 143. Ensure that steel posts have projections for fastening the fabric.
- D. Fasteners for wood posts shall be wire staples or nails. Wire staples shall be minimum 17 gauge, $\frac{3}{4}$ " width, with $\frac{1}{2}$ " leg length. Nails shall be minimum 14 gauge, with $\frac{3}{4}$ " button head, and 1" minimum length.

2.2 Pipe Riser and Barrel

- A. 16 GA corrugated metal pipe (CMP) of size indicated. Riser pipe shall have perforations/dewatering holes and an anti-vortex device and trash rack/debris screen attached to the top of the riser.

2.3 Grass Seed

- A. See Section 32 92 19 – SEEDING.

2.4 Sand Bags

- A. Sand bag material shall be polypropylene, polyethylene, polyamide or cotton burlap woven fabric, minimum unit weight four (4) ounces per square yard, mullen burst strength exceeding 300 psi and ultraviolet stability exceeding 70%. Length shall be 24 to 30 inches, width shall be 16 to 18 inches and thickness shall be six (6) to eight (8) inches and having an approximate weight of 40 pounds. Sand bags shall be filled with coarse grade sand, free from deleterious material. All sand shall pass through a No. 10 sieve.

2.5 PVC Pipe

- A. Pipe shall be SDR-35 polyvinyl chloride having a minimum nominal internal diameter of 4". Pipes shall be sized for anticipated flows.

2.6 Rolled Erosion Control Products (RECPS)

- A. Mat to hold seed and soil in place until vegetation is established on disturbed areas are subject to the following design criteria:
 1. The type and class of erosion control mat must be specified as appropriate for the slope of the area to be protected and the anticipated length of service.
 2. Erosion control mat must meet the applicable Tennessee Department of Transportation (TDOT) Minimum Performance Standards for TDOT and/or be listed on the most current annual Approved Products List for TDOT applicable to TDOT Item QPL.17.013 Soil Retention Blanket.

- B. Temporary Erosion Control Blankets: Use in concentrated flow areas, all slopes steeper than 3:1 and with a height of ten feet or greater, and cuts and fills within stream buffers, shall be stabilized with the appropriate erosion control matting or blankets.
1. Straw blankets: Shall consist of weed-free straw from agricultural crops formed into a blanket. Blankets shall have a top side of photodegradable plastic mesh with a maximum mesh size of 5/16 x 5/16 inch sewn to the straw with biodegradable thread that is appropriate for slopes. The blanket shall have a minimum thickness of 3/8 inch and minimum dry weight of 0.5 pounds per square yard.
 2. Excelsior blankets: Shall consist of curled wood excelsior (80% of fibers are six inches or longer) formed into a blanket. The blanket shall have clear markings indicating the top side of the blanket and be smolder resistant. Blankets shall have photodegradable plastic mesh having a maximum mesh size of 1- 1/2½ x 3 inches. The blanket shall have a minimum thickness of 1/4 of an inch and a minimum dry weight of 0.8 pounds per square yard. Slopes require excelsior matting with the top side of the blanket covered in the plastic mesh, and for waterways, both sides of the blanket require plastic mesh.
 3. Coconut fiber blankets: Shall consist of 100% coconut fiber formed into a blanket. The minimum thickness of the blanket shall be 1/4 of an inch with a minimum dry weight of 0.5 pounds per square yard. Blankets shall have photodegradable plastic mesh, with a maximum mesh size of 5/8 x 5/8 inch and sewn to the fiber with a breakdown resistant synthetic yarn. Plastic mesh is required on both sides of the blanket if used in waterways. A maximum of two inches is allowable for the stitch pattern and row spacing.
 4. Wood fiber blankets: Shall consist of reprocessed wood fibers that does not possess or contain any growth or germination inhibiting factors. The blanket shall have a photodegradable plastic mesh, with a maximum mesh size of 5/8 x 3/4 inch, securely bonded to the top of the mat. The blanket shall have a minimum dry weight of 0.35 pounds per square yard. A maximum of two inches is allowable for the stitch pattern and row spacing. This practice shall be applied only to slopes.
 5. Jute Mesh: To be applied to slopes. Jute mesh with a 48 inch width shall show between 76 and 80 warpings and a one yard length shall show between 39 to 43 weftings. The woven mesh shall be at least 45 inches wide. Yarn shall have a unit weight of at least 0.9 pounds per square yard, but not more than 1.5 pounds per square yard.
 6. Anchoring Devices: 11 gauge, at least 6 inches length by 1 inch width, staples or 12 inch minimum length wooden stakes for anchoring the blanket to the ground.
- C. Permanent Matting: Use in concentrated flow areas, all slopes steeper than 3:1 and with a height of ten feet or greater, and cuts and fills within stream buffers, shall be stabilized with the appropriate erosion control matting or blankets.

1. Permanent matting shall consist of a lofty web of mechanically or melt bonded polymer nettings, monofilaments or fibers which are entangled to form a strong and dimensionally stable matrix. Polymer welding, thermal or polymer fusion, or the placement of fibers between two high strength, bi-axially oriented nets bound securely together by parallel lock stitching with polyolefin, nylon or polyester threads are all appropriate bonding methods. Mats shall maintain their shape before, during, and after installation, under dry or water saturated conditions. Mats must be stabilized against ultraviolet degradation and shall be inert to chemicals normally encountered in a natural soil environment.
2. The mat shall conform to the following physical properties:

Property	Minimum Value
Thickness (inches)	0.5
Weight (#/SY)	0.6
Roll Width (inches)	38
Tensile Strength (lbs./in.) (ASTM D 1682-6" strip)	
Length (50% elongation)	15
Length (ultimate)	20
Width (50% elongation)	5
Width (ultimate)	10
Ultraviolet Stability, % (1,000 hrs. in an Atlas ARC Weatherometer, ASTM G 23, Type D in accordance with ASTM D 822)	80

3. Anchoring Materials: Sound wood stakes, 1 x 3 inches stock sawn in a triangular shape, shall be used. Depending on the compaction of the soil, select stakes with a length from 12 to 18 inches. U-shaped staples shall be 11 gauge steel or greater, with legs at a minimum of 8 inches length with a 2 inch crown.

2.7 Filter Ring

A. Stone Size:

1. When utilized at inlets/outlets with diameters less than 12-inches, the filter ring shall be constructed of small rip rap, such as TDOT Class A-3 (clean from fines), with stone sizes ranging from 2- to 6-inches.
2. When utilized at inlets with diameters greater than 12-inches, the filter ring shall be constructed of small rip rap, such as TDOT Class A-1 (clean from fines), with stone sizes from 2- to 15-inches.
3. For added sediment filtering capabilities, the upstream side of the rip rap can be faced with smaller coarse aggregate, such as TDOT #57 (clean from fines) with a minimum stone size of $\frac{3}{4}$ -inch.

2.8 Channel Stabilization

- A. **Vegetated Lining:** Vegetated lining shall be designed to resist erosion when the channel is flowing at the 25-year frequency discharge. Temporary erosion control blankets or sod shall be used on all channels and concentrated flow areas to aid in the establishment of the vegetated lining. If a vegetated lining is desired in a channel with velocities between 5- 10 ft./sec., permanent soil reinforcement matting shall be used.
- B. **Rock Rip- Rap Lining:** Rock rip rap shall be designed to resist displacement when the channel is flowing at the 25-year frequency discharge. Rock rip rap lining should be used when channel velocities are between 5 and 10 ft./sec.
- C. **Concrete Lining**
1. Concrete shall be constructed in accordance with the plan and details in the Drawings.
 2. A separation geotextile should be placed under concrete linings to prevent undermining in the event of stress cracks due to settlement of the base material. Geotextiles shall be in accordance with AASHTO M288 Section 7.5, Permanent Erosion Control Requirements.

2.9 Geotextile - Erosion Control

- A. Geotextile shall be in accordance with the following criteria:
- B. The geotextile fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew and rot resistant, resistant to ultraviolet light exposure, insect and rodent resistant, and conform to the properties in the following table.
- C. The geotextile fabric should meet the requirements of the standard specifications for geotextiles, AASHTO designated M-288, erosion control.
- D. The average roll minimum value (weakest principal direction) for strength properties of any individual roll tested from the manufacturing lot or lots of a particular shipment shall be in excess of the average roll minimum value (weakest principal direction) stipulated herein.

Physical Properties	Standard	Average Roll Minimum Value (Weakest Principal Direction)
Grab Tensile Strength (lbs.)	ASTM D4632	200
Elongation at Failure (%)	ASTM D4632	15
Mullen Burst Strength (psi)	ASTM D3786	320
Water Flow Rate (gal/min/ft ²)	ASTM D4491	60
AOS(095) mm	ASTM D4751	0.25
Trapezoid Tear Strength (lbs.)	ASTM D4533	50
Permeability – k (cm/sec)	ASTM D4491	0.1
Puncture Resistance (lbs.)	ASTM D4833 (modified)	90

2.10 Filter Sock

- A. Furnish materials as follows, unless otherwise shown on the plans.
1. Posts. Furnish metal or wooden posts to be installed for anchoring the mulch socks in place.
 2. Filter Sock. Furnish sock material that is 100% biodegradable, photodegradable, or recyclable such as burlap, twine, UV photodegradable plastic, polyester, or any other acceptable material.
 3. Mulch. Furnish wood chips produced from a 2 (two) inch minus screening process (equivalent to material shown on TDOT EC-STR-8)
 - a. Mulch consists primarily of organic material, separated at the point of generation, and may include shredded bark or stump grindings. No compost will be accepted.
 - b. Mulch material must be free of refuse, physical contaminants, and material toxic to plant growth; it is not acceptable for the mulch material to contain ground construction debris, biosolids, or manure.
 - c. Large portions of silt, clays, or fine sands are not acceptable in the mulch.

2.11 Straw Bales

- A. The straw in the bales shall be stalks from oats, wheat, rye, barley, rice, or from grasses such as Bahia, Bermuda, etc., furnished in air dry condition. Provide bales with a standard cross section of 14 by 18 inches. Wire-bound or string-tie all bales. Use either wooden stakes or steel posts to secure the straw bales to the ground. Wooden stakes utilized for this purpose, shall have minimum dimensions of 2 by 2 inches in cross section and have a minimum length of 3 feet. Steel posts (standard "U" or "T" section) utilized for securing straw bales, shall have a minimum mass of 1.33 pounds/linear foot and a minimum length of 3 feet.

2.12 Check Dams

- A. Stone Check Dams
1. Stone check dams shall be constructed of graded size 2-10 inch stone.
 2. The geotextile shall be in accordance with AASHTO M288 Section 7.3, Separation Requirements, Table 3.
- B. Rock Check Dams
1. Stone sizing: The stone size shall be determined by the design criteria established in the Rip Rap section – Tennessee Erosion and Sediment

Control Handbook, latest edition. The rock dam can be faced with smaller stone on the upstream side for additional filtering effect.

2. Geotextile: Geotextiles shall be used as a separator between the graded stone, the soil base, and the abutments. The geotextile shall be specified in accordance with AASHTO M288 Section 7.5, Permanent Erosion Control Recommendations.

2.13 Dewatering Treatment Practices

- A. Portable Sediment Tank: The sediment tank may be constructed with steel drums, sturdy wood or other materials suitable for handling the pressure exerted by the volume of water. The structure should have a minimum depth of two feet. See TDOT Erosion Control Standard Drawing EC-STR-1 and EC-STR-2.
- B. Straw Bale/Silt Fence: The straw bale/silt fence pit should consist of straw bales, silt fence, washed stone (TDOT size 57) and an optional excavated wet storage pit.
- C. Sediment Filter Bag: The filter back should be constructed of non-woven geotextile material that will provide adequate filtering ability to capture the larger soil particles from the pumped water. The bag should be constructed so that there is an inlet neck that may be clamped around the dewatering pump discharge hose so that all of the pumped water passes through the bag.

2.14 Slope Drains

- A. Temporary Slope Drain:
 1. Pipe: Design the slope drain using heavy-duty, flexible materials such as non-perforated, corrugated plastic pipe or specially designed flexible tubing. Use reinforced, hold-down grommets or stakes to anchor the pipe at intervals not to exceed 10 feet with the outlet end securely fastened in place. The pipe must extend beyond the toe of the slope.
 2. Filter Ring: A stone filter ring shall be placed at the inlet for added sediment filtering capacity.
 3. Storm Drain Outlet Protection: Rock rip rap shall be placed at the outlet for energy dissipation. A Tee outlet, flared end section, or other suitable device may be used in conjunction with the rip rap for additional protection.
- B. Permanent Slope Drain:
 1. Pipe: Design the slope drain using heavy-duty, flexible materials such as non-perforated, corrugated plastic or steel pipe or specially designed flexible tubing. Use reinforced, hold-down grommets or stakes to anchor the pipe at intervals not to exceed 10 feet with the outlet end securely fastened in place. The pipe must extend beyond the toe of the slope.

2. Paved Flume: The paved flume may have a parabolic, rectangular or trapezoidal cross-section and shall consist of reinforced concrete or asphalt paving.
3. Filter Ring: A stone filter ring shall be placed at the inlet for added sediment filtering capacity.
4. Storm Drain Outlet Protection: Rock rip rap shall be placed at the outlet for energy dissipation. A Tee outlet, flared end section, or other suitable device may be used in conjunction with the rip rap for additional protection.

2.15 Outlet Protection

- A. The apron shall be lined with rip rap, grouted rip rap, or concrete. Stone size as indicated for each outlet in the Storm Drain Outlet Protection detail shown in the Drawings.
- B. Select stone for rip rap from field stone or quarry stone. The stone should be hard, angular, and highly weather resistant. The specific gravity for the individual stones should be at least 2.5.
- C. A separator must be provided between the rip rap and natural ground. Geotextiles shall be used as a separator between the graded stone, the soil base, and the abutments. The geotextile shall be specified in accordance with AASHTO M288-96 Section 7.5, Permanent Erosion Control Recommendations.

2.16 Gradient Treatment

- A. Contour Furrow: Contour furrows may be used for slopes which are 3:1 (H:V) or less..
- B. Serrated Slope: A serrated slope may be used for slopes which are 2:1 (H:V) or less.
- C. Stepped Slope: Graded areas steeper than 3:1 (H:V), which will not be mowed, should preferably have a stepped slope.
- D. Terraced Slope: Should be used on most slopes which are longer than those allowed for other methods.

2.17 Temporary Mulching

- A. Dry straw or hay: Shall be applied at a depth of 2 to 4 inches providing complete soil coverage. Material shall be clean, seed free cereal hay or straw.
- B. Wood waste (chips, sawdust or bark): Shall be applied at a depth of 2 to 3 inches. Organic material from the clearing stage of development should remain on site, be chipped, and applied as mulch.

- C. Mulch Binder: Mulch on slopes exceeding 3 (horizontal) to 1 (vertical) shall be held in place by the use of a mulch binder, as approved by the Engineer. The mulch binder shall be non-toxic to plant and animal life and shall be approved by the Engineer.

2.18 Sediment Traps

- A. The area under the embankment should be cleared, grubbed, and stripped of any vegetation and root mat.
- B. Fill material for the embankment should be free of roots or other woody vegetation, organic material, large stones, and other objectionable material.

2.19 Construction Exit

- A. Stone: Use sound, tough, durable stone resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Aggregate size shall be TDOT #1 or #2 stone (1.5 to 3.5 inch stone).
- B. Geotextile: The geotextile underliner must be placed the full length and width of the entrance. Geotextile selection shall be based on AASHTO M288-98 specification:
 - 1. For subgrades with a CBR greater than or equal to 3 or shear strength greater than 90 kPa, geotextile must meet requirements of section AASHTO M288 Section 7.3, Separation Requirements.
 - 2. For subgrades with a CBR between 1 and 3 or sheer strength between 30 and 90 kPa, geotextile must meet requirements of AASHTO M288 Section 7.4, Stabilization Requirements.

2.20 Rip Rap

- A. Stone Rip Rap: Use sound, tough, durable stones resistant to the action of air and water. Slabby or shaley pieces will not be acceptable. Sizes are shown in the Drawings for each design requiring rip rap construction. The following classifications shall be used in the construction of slope or channels as shown on the Drawings:
 - 1. Graded Rip Rap - durable, dense, specifically selected and graded, quarried stone, placed to prevent erosion. Sizes shall be in accordance to the Tennessee Erosion and Sediment Control Handbook, latest edition.
 - 2. Filter Bedding Stone - stone generally less than 6 inches in size, that may be placed under graded rip rap stone in a layer or combination of layers, designed and installed in such a manner as to prevent loss of underlying soil or finer materials because of moving water. Sizes shall be in accordance to the Tennessee Erosion and Sediment Control Handbook, latest edition.
 - 3. Surge Stone - a quarry run ungraded, unscreened material which may or may not have fines.

2.21 Miscellaneous

- A. Concrete Masonry Units (CMU): Nominal 8" x 8" x 16" hollow concrete masonry units unless indicated otherwise. CMU shall meet the requirements of ASTM C-90, Grade N.
- B. Fasteners: Fasteners shall conform to the requirements of the various soil retention blanket manufacturers.

Part 3 Execution

3.1 Preparation

- A. Where required, according to construction best management practices, prior to General Stripping of Topsoil and Excavating:
 - 1. Install perimeter dikes and swales.
 - 2. Excavate and shape sediment basins and traps.
 - 3. Construct pipe spillways and install stone filter where required.
 - 4. Install erosion protection and sediment control measures including rock filter dams and silt fence.
 - 5. Machine compact all berms, dikes and embankments for basins and traps.
- B. Construct sediment basins and traps where indicated on Drawings during rough grading as grading progresses. If no sediment basin is on site, maintain minimum disturbance area requirements for BMP measures.
- C. Temporarily seed basin slopes and topsoil stockpiles.
 - 1. Rate: ½ lb./1000 SF
 - 2. Application of temporary stabilization must be initiated within fourteen (14) days to disturbed areas of a site where construction activities have temporarily or permanently ceased.
 - 3. Reseed as required until good stand of grass is achieved.
- D. Install stabilized construction entrance(s).

3.2 Installation

- A. Silt Fence (With And Without Backing)
 - 1. Sediment barriers shall not be used in any flowing stream, creek or river.

2. Sediment barriers shall be installed where shown on the Drawings and as directed by the Engineer.
 3. Along stream buffers and other sensitive areas, two rows of Type C silt fence or one row of Type C silt fence backed by hay bales shall be used.
 4. Sediment barriers shall be maintained to ensure the depth of impounded sediment is no more than one half of the original height of the barrier or as directed by the Engineer. Torn, damaged, destroyed or washed out barriers shall be repaired, reinforced or replaced with new material and installed as shown on the Drawings and as directed by the Engineer.
 5. Sediment Barrier Removal
 - a. Sediment barrier shall be removed once the disturbed area has been stabilized with a permanent vegetative cover and the sediment barrier is no longer required as directed by the Engineer.
 - b. Accumulated sediment shall be removed from the barrier and spread over the site.
 - c. All non-biodegradable parts of the barrier shall be disposed of properly.
 - d. The disturbed area created by barrier removal shall be permanently stabilized.
- B. Check Dams
1. Check dams shall be installed to minimize the erosion rate by reducing the velocity of stormwater in areas of concentrated flow. This practice is applicable for use in ditches and small open channels and is not to be used in a stream. The dams should only be used while permanent stabilization measures are being installed.
 2. Check and rock dams shall be installed as shown on the Drawings and as directed by the Engineer. Spacing: Maximum spacing between dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam. Two or more check dams in a series should be used when the drainage area exceeds the limitation for one dam.
 3. Height: The height of the check dam from the bottom of the channel to the bottom of the weir should be a minimum of 1 foot above the ditch bottom. The center of the check dam must be at least 9 inches lower than outer edges. Dam height should be 2 feet maximum measured to center of check dam.
 4. Weir: The depth of flow on the center of the structure (weir) shall be computed for the peak flow rate generated by a 2-year, 24-hour storm in order to ensure that the top of the structure will not be overtopped. For sites draining to high quality streams or streams listed as impaired by sediment, the depth must be determined for the 5-year, 24-hour peak flow rate. The weir must be at least 9 inches deep.

5. Side Slopes: Side slopes shall be 2:1 or flatter.
6. Stone check dams: Mechanical or hand placement shall be required to ensure complete coverage of entire width of ditch or swale and that center of dam is lower than edges.
7. Rock dams: Mechanical or hand placement will be required to ensure that the rock dam extends completely across the channel and securely ties into both channel banks. The center of the dam must be no less than six inches lower than the lowest side, to serve as a type of weir.
8. A geotextile should be used as a separator between the graded stone and the soil base and abutments. The geotextile shall be placed immediately adjacent to the subgrade without any voids and extend five feet beyond the downstream toe of the dam to prevent scour.
9. Check and rock dams shall be maintained to ensure the depth of impounded sediment is no more than one half of the original height of the check dam or as directed by the Engineer. Damaged, destroyed or washed out check dams shall be repaired, reinforced or replaced with new material and installed as shown on the Drawings and as directed by the Engineer.
10. Check and Rock Dams removal
 - a. Check and rock dams shall be removed once the disturbed area has been stabilized with a permanent vegetative cover and the sediment barrier is no longer required as directed by the Engineer.
 - b. Accumulated sediment shall be removed from the check and rock dams when it reaches a depth of one-half of the original height of the dam and removed from the site.
 - c. All non-biodegradable parts of the barrier shall be disposed of properly.
 - d. The disturbed area created by check or rock dam removal shall be permanently stabilized.

C. Sand Bag Berm

1. The purpose of a sand bag berm is to intercept sediment-laden water from disturbed areas. Sand bags shall be used for construction in streambeds or channels. In addition, sand bags shall be used to create a retention pond or detain sediment and release water in sheet flow.
2. A temporary sand bag berm shall be installed across a channel (only when construction activities are occurring in a streambed or channel) or outside of the right of way in a developing or disturbed area and should be used when the contributing drainage area is greater than 5 acres. The berm shall be a minimum height of 18", measured from the top of the existing ground at the upslope toe to the top of the berm. The berm shall be sized to have a

minimum width of 48" measured at the bottom of the berm and 18" measured at the top of the berm.

3. The sand bag berm shall be inspected after each rain. The sand bags shall be reshaped or replaced as needed during inspection. Additional inspections shall be made daily by the responsible party and when the silt reaches 6"; the accumulated silt shall be removed and disposed of at an approved site in a manner that will not contribute to additional siltation. The sand bag berm shall be left in place until all upstream areas are stabilized and accumulated silt removed; removal must be done by hand to avoid damage to the sand bags.

D. Erosion Control Matting and Blankets

1. Erosion Control Matting and Blankets be placed as shown on the Drawings and as directed by the Engineer.
2. After the site has been shaped and graded to the approved design, prepare a friable seedbed relatively free from clods and rocks more than one inch in diameter, and any foreign material that will prevent contact of the soil stabilization mat with the soil surface. Surface must be smooth to ensure proper contact of blankets or matting to the soil surface. If necessary, redirect any runoff from the ditch or slope during installation.
3. Follow manufacturer's recommendations for laying and stapling.
4. All erosion control blankets and matting should be inspected periodically following installation, particularly after rainstorms to check for erosion and undermining. Any dislocation or failure should be repaired immediately. If washouts or breakage occurs, reinstall the material after repairing damage to the slope or ditch. Continue to monitor these areas until they become permanently stabilized.

E. Protection Of Bare Areas

1. Apply seeding and soil retention blanket to bare areas including new embankment areas, fills, stripped areas, graded areas or otherwise disturbed areas, which have a grade greater than 5% or which will be exposed for more than 14 days.
2. Bare working areas on which it is not practical or desirable to install seeding and soil retention blankets shall be temporarily sloped to drain at a minimum of 0.2% and a maximum of 5% grade. These areas shall then be "trackwalked" with a crawler dozer traveling up and down the slope to form the effect of small "terraces" with the tracks of the dozer. Apply a minimum of three (3) coverages to each area with the dozer tracks.
3. Route runoff from the areas through the appropriate silt fence system and other controls as necessary.
4. Protect earth spoil areas by "trackwalking" and silt fences.

F. Slope Drains

1. Place slope drains on undisturbed soil or well compacted fill at locations and elevations shown on the Drawings.
2. Slightly slope the section of pipe under the dike toward its outlet.
3. Hand tamp the soil under and around the entrance section in lifts not to exceed 6 inches.
4. Ensure that fill over the drain at the top of the slope has minimum dimensions of 1.5 ft. depth, 4 ft. top width, and 3:1 side slopes.
5. Ensure that all slope drain connections are watertight.
6. Ensure that all fill material is well-compacted. Securely fasten the exposed section of the drain with grommets or stakes spaced no more than 10 feet apart.
7. Place the drain slightly diagonally across the slope, extending the drain beyond the toe of the slope. Curve the outlet uphill and adequately protect the outlet from erosion.
8. If the drain is conveying sediment-laden runoff, direct all flows into a sediment trap or sediment basin.
9. Make the settled, compacted dike ridge no less than one foot above the top of the pipe at every point.
10. Immediately stabilize all disturbed areas following construction.
11. Install Storm Drain Outlet Protection as specified in this Part.
12. Maintenance: Inspect the slope drain and supporting diversion after every rainfall and promptly make necessary repairs. When the protected area has been permanently stabilized and the permanent stormwater disposal system is fully functional, temporary measures may be removed, materials disposed of properly, and all disturbed areas stabilized appropriately.

G. Dewatering Treatment Practices

1. Portable Sediment Tank
 - a. The location for the sediment tank should be chosen for easy clean-out and disposal of the trapped sediment, and to minimize the interference with construction activities.
 - b. The following formula should be used to determine the storage volume of the sediment tank:
pump discharge rate (gpm) x 16 = cubic feet of storage required.

H. Once the water level nears the top of the tank, the pump must be shut off while the tank drains and additional capacity is made available. The tank should be designed to allow for emergency flow over the top of the tank. Clean-out of the tank is required once one-third of the original capacity is depleted due to sediment accumulation. The tank should be clearly marked showing the clean-out point.

1. Straw Bale/Silt Fence Pit

- a. The following formula should be used to determine the storage volume of the sediment pit:
$$\text{pump discharge rate (gpm)} \times 16 = \text{cubic feet of storage required}$$

2. Sediment Filter Bag

- a. A temporary sediment filter bag may be used whenever sediment laden water is removed from an area by means of pumping and where there is insufficient room to use a temporary dewatering structure. A temporary sediment filter bag should not be placed within a jurisdictional wetland, a stream buffer, or within 20 feet of a stabilized outlet, stream or ditch line.
- b. A temporary sediment filter bag shall be placed on a level pad a minimum of 6 inches thick composed of mineral aggregate (size 57). This pad shall be constructed on an area with sufficient slope to allow water entering the pad to drain away from the project work area. However, it is necessary for the pad to be level in order to prevent the bag from rolling along the slope as water is pumped into the structure. The upper surface of the pad, including the slopes, shall be lined with geotextile fabric. In addition, it shall be separated from the existing ground by a layer of polyethylene sheeting. Off-site stormwater runoff should be diverted around the temporary dewatering filter bag location.
- c. The capacity of the sediment filter bag should be adequate to handle the dewatering pump discharge and should be based upon the manufacturer's recommendation on pump sizing.
- d. The filter bag must be equipped with a sleeve to receive the pump hose. Slitting the bag to make the hose connection is not acceptable.
- e. Pumping into the bag can only occur when being supervised. Unsupervised pumping is not allowed. Discharge from the filter bag cannot cause an objectionable color contrast with the receiving stream. Additional treatment may be necessary if an objectionable color contrast is observed.
3. Maintenance: the filtering devices must be inspected frequently and repaired or replaced once the sediment build-up prevents the structure from functioning as designed. The accumulated sediment which is removed from a dewatering device must be spread on-site and stabilized or disposed of at an approved disposal site as per the SWPPP.

I. Interceptor Swale

1. Interceptor swales may have a v-shape or be trapezoidal with a flat bottom and side slopes of 2:1 or flatter. These are used to shorten the length of exposed slope by intercepting runoff and can also serve as perimeter swales preventing off-site runoff from entering the disturbed area or prevent sediment-laden runoff from leaving the construction site or disturbed area. Minimum compaction for the swale shall be 90% of maximum density as determined by Standard Proctor compaction test (ASTM D698). The swales should remain in place until the disturbed area is permanently stabilized.
2. Stone Stabilization shall be used when grades exceed 2% or velocities exceed 4 feet per second and shall consist of a layer of crushed stone 3" thick, or flexible channel liner soil retention blankets. Stabilization shall extend across the bottom of the swale and up both sides of the channel to minimum height of 3" above the design water surface elevation based on a two year storm.
3. Interceptor swale shall be installed across exposed slopes during construction and should intercept no more than five (5) acres of runoff. Swales shall have a minimum bottom width of 2'-0" and a maximum depth of 1'-6" with side slopes of 3:1 or flatter. Swale must have positive drainage for its entire length to an outlet.
4. Swales should be inspected on a weekly basis during wet weather and repairs should be made promptly to maintain a consistent cross section.
5. All trees, brush, stumps, obstructions and other material shall be removed and disposed of so as not to interfere with the proper functioning of the swale.
6. Outlet: Each swale must have an adequate outlet. The outlet may be a constructed or natural waterway, a stabilized vegetated area or another energy dissipation device. In all cases, the outlet must discharge in such a manner as to not cause erosion or sedimentation problems. Protected outlets should be constructed and stabilized prior to construction of the swale.

J. Diversion Dike

1. A diversion dike intercepts runoff from small upland areas and diverts it away from exposed slopes to a stabilized outlet, such as a rock berm, sandbag berm, or stone outlet structure. Drainage area shall be 5 acres or less.
2. Design: The dike should be compacted and designed to have stable side slopes, which should not be steeper than 2:1. When maintenance by machine mowing is planned, side slopes should be no steeper than 3:1. The ridge should be a minimum width of 4 feet at the design water elevation after settlement. Its design should allow for ten percent settlement.
3. Stone Stabilization (required for velocities in excess of 6 fps) shall consist of Class 4 aggregate fill and shall be placed in a layer of at least 3" thickness and shall extend a minimum height of 3" above the design water surface up the existing slope and the upstream face of the dike.

4. Geotextile shall be placed under the stone stabilization.
5. Diversion dikes shall be installed prior to and maintained for the duration of construction. Dikes shall have a minimum top width of 2'-0" and a minimum height of compacted fill of 18" measured from the top of the existing ground at the upslope toe to top of the dike. The soil for the dike shall be placed in lifts of 8" or less and be compacted to 95% standard proctor density. The channel which is formed by dike must have positive drainage for its entire length to an outlet.
6. Diverted runoff from a protected or stabilized area shall have its outlet flow directed to an undisturbed stabilized area or into a level spreader or grade stabilization structure.
7. Diverted runoff from a disturbed or exposed area shall be conveyed to sediment trap such as a rock berm, temporary sediment trap or sediment basin or to an area protected by any of these measures.

K. Temporary Stabilized Construction Entrance/Exit

1. Construction exit(s) shall be placed as shown on the Drawings and as directed by the Engineer. A construction exit shall be located at any point traffic will be leaving a disturbed area to a public right of way, street, alley, sidewalk or parking area.
2. Placement of Construction Exit Material: The ground surface upon which the construction exit material is to be placed shall be prepared to a smooth condition free from obstructions, depressions or debris. The geotextile underliner shall be placed to provide a minimum number of overlaps and a minimum width of one foot of overlap at each joint. The stone shall be placed with its top elevation conforming to the surrounding roadway elevations. The stone shall be dropped no more than three feet during construction.
3. Construction Exit Maintenance: The Contractor shall regularly maintain the exit with the top dressing of stone to prevent tracking or flow of soil onto public rights of way and paved surfaces as directed by the Engineer. This shall require periodic top dressing with 1.5-3.5 inch stone, as conditions demand.
4. Construction Exit Removal: Construction exit(s) shall be removed and properly disposed of when the disturbed area has been properly stabilized, the tracking or flow of soil onto public rights of way or paved surfaces has ceased and as directed by the Engineer.
5. When necessary, vehicles must be cleaned to remove sediment prior to entry onto public right-of-way. When washing is required, it shall be done on an area stabilized with crushed stone which drains into an approved sediment trap or sediment basin or other sedimentation/filtration device. All sediment shall be prevented from entering any storm drain, ditch or watercourse using approved methods.

L. Outlet Protection

1. Ensure that the subgrade for the filter and rip rap follows the required lines and grades shown in the plan. Compact any fill required in the subgrade to the density of the surrounding undisturbed material. Low areas in the subgrade on undisturbed soil may also be filled by increasing the rip rap thickness.
2. The rip rap and gravel filter must conform to the specified grading limits shown in the plans.
3. Geotextile must meet design requirements and be properly protected from punching or tearing during installation. Repair any damage by removing the rip rap and placing another piece of filter fabric over the damaged area. All connecting joints should overlap a minimum of 1 foot. If the damage is extensive, replace the entire filter fabric.
4. Rip rap may be placed by equipment, but take care to avoid damaging the filter.
5. The minimum thickness of the rip rap should be 1.5 times the maximum stone diameter.
6. Construct the apron on zero grade with no overfall at the end. Make the top of the rip rap at the downstream end level with the receiving area or slightly below it.
7. Ensure that the apron is properly aligned with the receiving stream and preferably straight throughout its length. If a curve is needed to fit site conditions, place it in the upper section of the apron.
8. Immediately after construction, stabilize all disturbed areas with vegetation.
9. Filter: Install a filter to prevent soil movement through the openings in the rip rap. The filter should consist of a graded gravel layer or a synthetic filter cloth.
10. Maintenance: Inspect rip rap outlet structures after heavy rains to see if any erosion around or below the rip rap has taken place or if stones have been dislodged. Immediately make all needed repairs to prevent further damage.

M. Surface Roughening And Tracking

1. All construction slopes require surface roughening to facilitate stabilization with vegetation, particularly slopes steeper than 3:1. Slopes to be covered with rolled erosion control products need not be roughened.
2. Cut Slope Roughening For Areas To Be Mowed:
 - a. Stair-step grade slopes with a gradient steeper than 3:1.
 - b. Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Slopes consisting of soft rock with some subsoil are particularly suited to stair-step grading.

- c. Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the “step” in toward the vertical wall.
 - d. Do not make individual vertical cuts more than 2 feet in soft materials or more than 3 feet in rocky materials.
 - 3. Fill Slope Roughening For Areas Not To Be Mowed
 - a. Place fill slopes with a gradient steeper than 3:1 in lifts not to exceed 9 inches, and make sure each lift is properly compacted. Ensure that the face of the slope consists of loose, uncompacted fill 4 to 6 inches deep.
 - b. Do not blade or scrape the final slope.
 - 4. Cuts, Fills, And Graded Areas That Will Be Mowed
 - a. Make mowed slopes no steeper than 3:1.
 - b. Roughen these areas to shallow grooves by normal tilling, disking, harrowing, or use of cultipacker-seeder. Make the final pass of any such tillage implement on the contour.
 - c. Make grooves, formed by such implements, close together (less than 10 inches) and not less than 1 inch deep.
 - 5. Roughening With Tracked Machinery
 - a. Limit roughening with tracked machinery to sandy soils to avoid undue compaction of the soil surface.
 - b. Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during final grading operations.
 - c. Seeding – immediately seed and mulch roughened areas to obtain optimum seed germination and growth.
 - 6. Periodically check the seeded slopes for rills and washes. Fill these areas slightly above the original grade, then reseed and mulch as soon as possible.
 - 7. If roughening is washed away in a storm, the surface will have to be re-roughened and new seed laid.
- N. Tire Washing Facility
- 1. Tire washing requires a supply of water either by overhead tank, pressurized tank or by water pipeline. All wash water should drain into a sediment-trapping device such as a sediment basin or sediment trap before discharging off the construction project.

2. If chlorinated water (such as ordinary tap water or hydrant water) is used, allow the water to sit for 24 hours, to allow chlorine to dissipate into the air, prior to discharging effluent to a stream. Effluent may be checked by a standard pool test kit to verify that it is chlorine-free.
 3. Prevent entering vehicles from driving through the tire wash rack area.
 4. Wash racks should be designed and constructed/manufactured for anticipated traffic loads.
 5. Provide a drainage ditch that will convey the runoff from the wash area to a sediment trapping device. The drainage ditch should be of sufficient grade, width, and depth to carry the wash runoff.
 6. Incorporate with a stabilized construction entrance/exit.
 7. Construct on level ground when possible, on a pad of coarse aggregate greater than 3 in. But smaller than 6 in. A geotextile fabric should be placed below the aggregate.
 8. Use hoses with automatic shutoff nozzles to prevent hoses from being left on.
 9. Require that all employees, subcontractors, and others that leave the site with mud caked tires and undercarriages to use the wash facility.
 10. Post signage at tire washing facilities or designate personnel to oversee traffic exiting the construction site at tire washing facility locations.
 11. Remove accumulated sediment in tire wash rack and sediment traps as necessary to maintain system performance. Inspect routinely for damage and repair as needed.
- O. Concrete Truck Wash-Out Facility
1. Install sand filter bed of at least fifty (50 ft²) square feet in area and at least twelve (12") inches in depth. Bottom of filter bed shall allow filtered wash water to percolate into the subgrade.
 2. Install twelve (12") inch high berm around periphery of filter bed to prevent stormwater runoff contamination of the filter sand.
 3. Remove, dispose, and replace filter sand that becomes clogged to such a degree that wash water does not immediately percolate down into the filter bed.
 4. Maintain sand filter bed until all concrete has been placed on the project site.
 5. Upon completion of all concrete placements on the project site remove and dispose of filter sand, backfill bed with compacted select fill to 90% Standard Proctor Density and restore the disturbed surface.

P. Stream Buffer

1. All construction sites containing and/or adjacent to receiving streams or waters are required to have stream buffers between the top of the stream bank and the disturbance area.
2. Stream buffers consist of undisturbed natural vegetation, including maintaining the original tree line along the stream or channel banks. Promptly stabilize disturbed buffers with a dense cover of strong rooted grasses, native plants and native trees.
3. Construction related materials and equipment must be stored outside the buffer area.
4. For sites that contain and/or are adjacent to a receiving stream designated as impaired or Exceptional Tennessee waters a 60-foot natural riparian buffer zone adjacent to the receiving stream shall be preserved, to the maximum extent practicable, during construction activities at the site. The natural buffer zone should be established between the top of stream bank and the disturbed construction area. The 60-foot criterion for the width of the buffer zone can be established on an average width basis at a project, as long as the minimum width of the buffer zone is more than 30 feet at any measured location.
5. A 30-foot natural riparian buffer zone adjacent to all streams at the construction site shall be preserved, to the maximum extent practicable, during construction activities at the site. The riparian buffer zone should be preserved between the top of stream bank and the disturbed construction area. The 30-foot criterion for the width of the buffer zone can be established on an average width basis at a project, as long as the minimum width of the buffer zone is more than 15 feet at any measured location.
6. Install controls along the outer upstream edge of the stream buffer to prevent inadvertent disturbance to the buffer. Consider high visibility controls, such as fencing.
7. Where a stream crossing is necessary, comply with the conditions of the Aquatic Resource Alteration Permit for the amount of stream buffer that can be disturbed.
8. Ensure that sediment controls are installed upgradient from the buffer to protect it from sediment-laden runoff.
9. Install level spreaders to convert concentrated flow into sheet flow prior to discharging across the buffer.
10. If a buffer is disturbed, the buffer should be restored as follows:
 - a. All areas of the buffer being restored must be planted with native or natural vegetation that is appropriate to achieve a stable stream protection corridor, including tree canopy.

- b. All areas of the buffer being restored must be stabilized against erosion.
- c. During restoration activities, erosion prevention and sediment control measures must be installed to protect the stream. These measures can include turf reinforcement mats, erosion control blankets, wattles, etc., to stabilize the area in the short- and long-term.
- d. To increase the chances for the success and health of the buffer, the plant species, density, placement, and diversity in the buffer restoration plan must be appropriate for stream buffers. Proposed planting and long-term maintenance practices must also be appropriate and properly performed.
- e. Vegetation mortality must be included in the planting densities in buffer restoration plans.

Q. Stream Diversion

1. Stream diversion channels are required by Aquatic Resource Alteration Permits in order to perform in-stream work separate from flowing water.
2. Disturbance within the confines of stream banks are required to be conducted "in the dry" or separate from flowing water. No excavation equipment should ever be operated in flowing waters.
3. To limit land-disturbance, overland pumping of the stream should be considered in low-flow conditions whenever possible. Temporary pipes can also convey smaller stream flows.
4. Where stream flow is to construct a diversion pipe, consider the use of alternative structures, such as cofferdams and geotextile tubes, in order for work to be conducted in dry conditions.
5. The duration of the instream work should be minimized to the shortest period possible. Clearing of the streambed and banks should be kept to a minimum.
6. Work that requires a stream diversion channel requires authorization from the TDEC Division of Water Resources and United States Army Corps of Engineers. All conditions of the ARAP and COE permit must be followed.
7. The impervious dikes used to divert normal stream flow or expected flow path around a construction site must be constructed of non-erodible material. Acceptable materials for impervious dikes include, but are not limited to, sheet piles, sandbags, and/or the placement of an acceptable size stone lined with polypropylene, or other impervious fabric. Earthen material should not be used to construct an impervious dike when it is in direct contact with the stream. Dewatering devices include stilling basins and sediment filter bags.
8. Bypass Pumping:

- a. A bypass pump and an impervious dike divert the flow of the watercourse from the inlet of the pipe to the outlet of the pipe. Care should be taken that the discharge is at a low flow rate to minimize turbidity and/or potential erosion of the stream channel at the outlet of the bypass pipe or hose. Do not use this practice when the discharge location cannot be adequately stabilized; when ponding of the stream to adequately submerge the pump suction line is not allowed or not practical; or when the normal flow of the stream cannot be handled by the typical bypass pump.
 - b. Place outlet of temporary pipe to minimize erosion at discharge site or provide temporary energy dissipation measures. Firmly anchor pump and piping.
 - c. Construct outlet protection if needed.
 - d. Construct impervious dike upstream of work area to impound water for bypass pump intake. Use a floating intake for pumps where possible.
 - e. Construct an impervious dike downstream, if necessary, to isolate work area.
 - f. Check operation of pump and piping system.
 - g. Upon completion of construction, remove impervious dike, bypass pump, and temporary pipe and stabilize disturbed area.
 - h. Inspect bypass pump and temporary piping daily to ensure proper operation.
 - i. Inspect impervious dike for leaks and repair any damage.
 - j. Inspect discharge point for potential erosion.
 - k. Ensure flow is adequately diverted through pipe.
9. Suspended Bypass Pumping:
- a. The suspended bypass pipe is used where an existing pipe or culvert is extended. This bypass pipe is constructed inside the existing pipe or culvert to divert the watercourse through the work area while allowing the work area to remain dry. Use this practice when a pipe or culvert is being extended and is large enough to accommodate the bypass pipe or when space limitations do not allow for a fabric lined diversion channel (for example, widening grade and drain projects). Do not use this practice when the upstream ponding required to enter the suspended pipe inlet is unacceptable.
 - b. Install sediment controls.

- c. Install temporary pipe through the existing pipe or culvert to be extended. Place outlet of temporary pipe to minimize erosion at discharge site or provide temporary energy dissipation measures.
 - d. Construct an impervious dike upstream of the work area to divert flow through the temporary pipe. Anchor and seal temporary pipe securely at inlet.
 - e. Construct an impervious dike at the downstream side of the bypass pipe to isolate work area.
 - f. Upon completion of the culvert or pipe extension, remove the impervious dike and temporary pipe and stabilize disturbed area.
 - g. Inspect the inlet regularly and impervious dike for damage and/or leakage and to ensure flow is adequately diverted through pipe.
 - h. Remove sediment and trash that accumulate behind the dike and at the inlet on a regular basis.
 - i. Inspect the outlet regularly for potential erosion and to ensure flow is adequately diverted through the system.
 - j. Ensure that the inlet is properly anchored and sealed.
10. Piped Diversion:
- a. Install a temporary pipe to divert the flow of the watercourse around the work area without the use of pumping operations. Use this practice where adequate slope and space exist between the upstream and downstream ends of the diversion. Do not use this practice where adequate space is unavailable, such as at pipe extensions, headwall installations and some pipe/culvert replacements.
 - b. Install sediment controls.
 - c. Install temporary pipe adjacent to work area. Excavation may be required to provide a positive drainage slope from the upstream to downstream side.
 - d. Connect the downstream temporary pipe into the downstream existing channel. Place outlet of pipe to minimize erosion at the discharge site or provide temporary energy dissipation measures.
 - e. Connect the upstream temporary pipe into the upstream existing channel.
 - f. Construct an impervious dike at the upstream side of the existing channel to divert the existing channel into the temporary pipe.

- g. Construct an impervious dike at the downstream side of the bypass pipe to isolate work area.
 - h. Upon completion of construction, remove the impervious dike and temporary pipe and stabilize the disturbed area.
 - i. Inspect diversion berm and piping for damage.
 - j. Remove accumulated sediment and debris from berm and inlet.
 - k. Inspect outlet for potential erosion.
 - l. Inspect for diverted flow that bypasses the temporary pipe and causes erosion as surface flow.
11. Fabric Line Diversion Channel:
- a. A fabric lined temporary diversion channel is used to divert normal stream flow and small storm events around the work area without the use of pumping operations. The temporary diversion channel is typically constructed adjacent to the work area and is lined with a poly-fabric to minimize the potential for erosion within the temporary diversion channel. Use this practice where adequate space and slopes exist adjacent to the work area. Do not use this practice where adequate space is unavailable such as at pipe extensions, headwall installations and some pipe/culvert replacements.
 - b. Install sediment control measures.
 - c. Excavate the diversion channel without disturbing the existing channel.
 - d. Place poly-fabric liner in diversion channel with a minimum of 4 feet of material overlapping the channel banks. Secure the overlapped material using at least 1 foot of fill material.
 - e. Connect the downstream diversion channel into the downstream existing channel and secure the poly-fabric liner at the connection.
 - f. Connect the upstream diversion channel into the upstream existing channel and secure the poly fabric liner at the connection.
 - g. Construct an impervious dike in the existing channel at the upstream side to divert the flow into the diversion channel.
 - h. Construct an impervious dike in the existing channel at the downstream side to isolate the work area.
 - i. Upon completion of the culvert construction, remove the impervious dikes and divert the channel back into the culvert.
 - j. Remove the poly-fabric liner and fill in the diversion channel.

- k. Establish vegetation on fill section and all other bare areas.
 - l. Check the poly-fabric liner for stability during normal flow.
 - m. Check the liner for stability after each rainfall event.
 - n. Do not allow earthen material to contact the water body.
12. The stream diversion shall be inspected at the end of each day to make sure that the stream flow control measures and construction material are positioned securely. This will ensure that the work area stays dry and that no construction materials float downstream. Inspect impounded work area to ensure water is not contaminated with construction materials or chemicals and that dewatering/treatment is adequate. All repairs should be made immediately.]

R. TEMPORARY STREAM CROSSING

1. This standard provides a means for construction vehicles to cross streams or watercourses without moving sediment into the stream, damaging the streambed or channel, or causing flooding.
2. All work in a stream must have prior approval from TDEC through the Aquatic Resource Alteration Permit (ARAP) process and all conditions of the ARAP must be followed.
3. Structures may include bridges, round pipes, or pipe arches. Temporary stream crossings should be in place for less than one year and should not be accessible to the public.
4. The structure may be sized large enough to convey the bankfull flow of the stream, typically flows produced by a 2-year, 24-hour frequency storm, with normal high water protection since the flood plain will become effective at the bankfull elevation. However, if the crossing is designed as a low-water crossing, provision must be made for additional overflow protection of the structure, to prevent washout during high flow events.
5. The temporary stream crossing should be perpendicular to the stream. Where approach conditions dictate, the crossing may vary up to 15° from the perpendicular.
6. Structures should be protected from washout during periods of peak discharges by diverting high flows around or over the structures. Methods to be considered for washout protection may include elevation of bridges above adjacent flood plain lands, crowning of fills over pipes or by the use of diversions, dikes or island type structures. Frequency and intended use, stream channel conditions, overflow areas, potential flood damage, and surface runoff control should be considered when selecting the type of temporary stream crossing to be used.
7. Temporary Bridge Crossing: A temporary access bridge causes the least erosion of the stream channel crossing when the bridge is installed and

removed. It also provides the least obstruction to flow and fish migration. If the bridge is properly designed and appropriate materials are used, a temporary access bridge typically is long lasting and requires little maintenance. It may also be salvaged at project's end and used again in the future. However, a temporary bridge crossing is generally the most expensive crossing to design and construct. It also creates the greatest safety hazard if not adequately designed, installed and maintained.

8. **Temporary Culvert Crossing:** A temporary access culvert is the most common stream crossing. It can control erosion effectively but can cause erosion when it is installed and removed. A temporary culvert can be easily constructed and enables heavy equipment loads to be used. However, culverts create the greatest obstruction to flood flows and are subject to blockage and washout. The crossing may be designed based on the stream flows resulting from a 2-year 24-hour frequency storm, in which case, Class A or B rip rap may be used for normal erosion protection of the aggregate fill, and the roadbed would be at the elevation of the top of the banks. For temporary crossings of streams with large watersheds, the crossing may also be designed based on the low-flow channel conditions as a low water crossing. The culvert size would be adequate to convey base flows, but high water events would overtop the structure and make the crossing temporarily unusable. Additional erosion protection of the fill would be necessary for this design, in the form of Class C or larger rip rap to prevent the washout of the culverts.
9. **All Crossings:**
 - a. In-stream work should be performed in dry conditions. Utilize a stream diversion or cofferdams to provide dry conditions for conducting the work. Clearing of the streambed and banks should be kept to a minimum.
 - b. All surface water from the construction site should be diverted onto undisturbed areas adjoining the stream. Unstable stream banks should be lined with rip rap or otherwise be appropriately stabilized.
 - c. The crossing alignment shall be at right angles to the stream. Where approach conditions dictate, the crossing may vary up to 15° from a line drawn perpendicular to the centerline of the stream at the intended crossing location.
 - d. The centerline of both roadway approaches should coincide with the crossing alignment centerline for a minimum distance of 50 feet from each bank of the waterway being crossed. If physical or right-of-way restraints preclude the 50 feet minimum, a shorter distance may be provided. All fill materials associated with the roadway approach shall be limited to a maximum height of 2 feet above the existing flood plain elevation.
 - e. A water diverting structure such as a waterbar diversion should be constructed (across the roadway on both roadway approaches) 50 feet (maximum) on either side of the waterway crossing. This will prevent

roadway surface runoff from directly entering the waterway. The 50 feet distance is measured from the top of the waterway bank. If the roadway approach is constructed with a reverse grade away from the waterway, a separate diverting structure is not required.

- f. The crossing structure should be removed as soon as it is no longer necessary for access. During structure removal, utilize a stream diversion channel or cofferdams to provide dry conditions for conducting the work.
 - g. Upon removal of the crossing structure, the stream shall immediately be restored to its original cross-section and properly stabilized.
10. Temporary Bridge Crossing:
- a. The temporary bridge should be constructed at or above bank elevation to prevent the entrapment of floating materials and debris.
 - b. Abutments should be placed parallel to the stream and on stable banks.
 - c. Bridges should be constructed to span the entire channel. If the channel width exceeds eight feet (as measured from the tops of the banks), a temporary footing, pier, or bridge support may be constructed within the waterway.
 - d. Decking materials should be of sufficient strength to support the anticipated load. Decking materials must be butted tightly to prevent any soil material tracked onto the bridge from falling into the waterway below.
 - e. Bridges should be securely anchored at only one end using steel cable or chain. This will prevent channel obstruction in the event that floodwaters float the bridge. Large trees, large boulders or driven steel anchors can serve as anchors.
11. Temporary Culvert Crossing:
- a. All culverts must be strong enough to support their cross-sectioned area under maximum expected loads.
 - b. The invert elevation of the culvert should be installed on the natural streambed grade at both ends.
 - c. A geotextile should be placed on the streambed and stream banks prior to the placement of the pipe culvert(s) and aggregate. The geotextile will prevent the migration of soil particles from the subgrade into the graded stone. The geotextile should cover the streambed and extend a minimum of six inches and a maximum of one foot beyond the end of the culvert and bedding material.

- d. The culverts should extend a minimum of one foot beyond the upstream and downstream toe of the aggregate placed around the culvert.
 - e. The culvert(s) should be covered with small rip rap, such as TDOT Class A-1. The depth of rip rap above the top of the culvert should be one-half the diameter of the culvert or 18", whichever is greater.
 - f. Multiple culverts should be separated by one-half the diameter of the culvert or 12" whichever distance is greater. A final layer of coarse aggregate, such as TDOT #57, should be applied to minimum depth of 6 inches.
12. The structure should be inspected after every rainfall and at least twice a week, and all damages repaired immediately. Any material lost to the stream shall be removed but only after discussion with TDEC staff. The structure should be removed immediately after construction is finished, and the streambed and banks must be stabilized and restored to pre-construction conditions.

S. Temporary Sediment Basin

1. Sediment basins, or equivalent measures, are required where:
 - a. The total drainage area at an outfall from a construction site is ten (10) acres or greater for sites draining into unimpaired streams and waters.
 - b. The total drainage area at an outfall from a construction site that discharges into Impaired or Exceptional TN Waters, as defined by TDEC, where the total drainage area is five (5) acres or more.
 - c. Sediment basins should also be installed at outfall points that do not meet the criteria above, but where treatment of sediment-laden runoff is necessary.
2. Sediment basins must be designed by either a professional engineer or a landscape architect, trained in the design of impoundment structures, and in accordance with good engineering practices. Sediment basins must be designed and constructed in accordance with all applicable state and local laws, ordinances, permit requirements, rules, and regulations. Tennessee dam safety regulations apply if the dam height and/or pond volume meet or exceed specified limits provided below.
3. Embankments must comply with the Tennessee Safe Dams Act of 1973, as amended, if either of the following two conditions exist:
 - a. the embankment is twenty feet or more in height, or,
 - b. the impoundment will have a capacity, at maximum water storage elevation, of thirty (30) acre-feet (48,400 CY) or more.

4. **Site Preparation:** Areas under the embankment and under structural works shall be cleared, grubbed, and stripped of topsoil. All trees, vegetation, roots and other objectionable material shall be removed and disposed of by approved methods. In order to facilitate clean-out or restoration, the pool area (measured at the top of the pipe spillway) will be cleared of all brush and trees.
5. **Cut-off Trench:** A cut-off trench will be excavated along the centerline of earth fill embankments. The minimum depth shall be 2 feet. The cut-off trench shall extend up both abutments to the riser crest elevation. The minimum bottom width shall be 4 feet, but wide enough to permit operation of compaction equipment. The side slopes shall be no steeper than 1:1. Compaction requirements shall be the same as those for the embankment. The trench shall be drained during the backfilling and compaction operations.
6. **Embankment:** The fill material shall be taken from approved areas shown on the Drawings. It shall be clean mineral soil free of roots, woody vegetation, oversized stones, rocks or other objectionable material. Relatively pervious materials such as sand or gravel (Unified Soil Classes GW, GP, SW & SP) shall be placed in the downstream section of the embankment. Areas on which fills are to be placed shall be scarified prior to placement of fill. The fill material shall contain sufficient moisture so that it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction. Fill material shall be placed in six-inch to eight-inch thick continuous layers over the entire length of the fill. Compaction shall be obtained by routing and hauling the construction equipment over the fill so that the entire surface of the fill is traversed by at least one wheel or tread track of the equipment or by the use of a compactor. The embankment shall be constructed to an elevation 5 percent higher than the design height to allow for settlement.
7. **Principal Spillway:** The riser shall be securely attached to the pipe or pipe stub by welding the full circumference making a watertight structural connection. The pipe stub must be attached to the riser at the same percent (angle) of grade as the outlet conduit. The connection between the riser and the riser base shall be watertight. All connections between pipe sections must be achieved by approved watertight band assemblies. The pipe and riser shall be placed on a firm, smooth foundation of impervious soil as the embankment is constructed. Breaching the embankment is unacceptable. Pervious materials such as sand, gravel, or crushed stone shall not be used as backfill around the pipe or anti-seep collar. The fill material around the pipe spillway shall be placed in four inch layers and compacted under and around the pipe to at least the same density as the adjacent embankment. Care must be taken not to raise the pipe from firm contact with its foundation when compacting under the pipe haunches. A minimum depth of two feet of hand compacted backfill shall be placed over the pipe spillway before crossing it with construction equipment.
8. **Emergency Spillway:** The emergency spillway shall be installed in undisturbed ground. The achievement of planned elevations, grades, design width, entrance and exit channel slopes are critical to the successful operation

of the emergency spillway and must be constructed within a tolerance of ± 0.2 feet. If the emergency spillway requires erosion protection other than vegetation, the lining shall not compromise the capacity of the emergency spillway, e.g. the emergency spillway shall be over-excavated so that the lining will be flush with the slope surface.

9. Vegetative Treatment: Stabilize the embankment and all other disturbed areas in accordance with the appropriate permanent vegetative measure immediately following construction. In no case shall the embankment remain unstabilized for more than seven days.
10. Erosion and Pollution Control: Construction operations will be carried out in such a manner that erosion and water pollution will be minimized. State and local law concerning pollution abatement shall be complied with.
11. Maintenance: Repair all damages caused by soil erosion or construction equipment at or before the end of each working day. Sediment shall be removed from the basin when it reaches the specified distance below the top of the riser. Sediment shall not enter adjacent streams or drainage ways during sediment removal or disposal. The sediment shall not be deposited downstream from the embankment, adjacent to a stream or floodplain.
12. Final Disposal: When temporary structures have served their intended purpose and the contributing drainage area has been properly stabilized, the embankment and resulting sediment deposits are to be leveled or otherwise disposed of in accordance with approved sediment control plan. The proposed use of a sediment basin site will often dictate final disposition of the basin and any sediment contained therein. If the site is scheduled for future construction, then the embankment and trapped sediment must be removed, safely disposed of, and backfilled with a structural fill. When the basin area is to remain open space, the pond may be pumped dry, graded and backfilled.

3.3 During Construction Period

- A. Inspect at least twice every 7 days, at least 72 hours apart, and no more than 24 hours after a rainfall event of one-half inch or greater.
- B. All erosion and sediment control measures and other protective measures identified in the SWPPP must be maintained in effective operating condition.
- C. The Contractor shall ensure that sedimentation and erosion that occur due to work activities are minimized and contained within the designated project work areas. Erosion and sedimentation occurring outside the work area will be resolved by and coordinated by Contractor with impacted landowners as required.
- D. Maintain Basins, Dikes, Traps, Stone Filters, Etc.:
 1. Inspect according to the schedule outlined in Item "A" above.
 2. Repair or replace damaged or missing items.

- E. After rough grading, sow temporary grass cover over all exposed earth areas not draining into sediment basin or trap.
- F. Construct inlets as soon as possible. Install protective measures around inlets as described in this specification.
- G. Provide necessary swales and dikes to direct all stormwater towards and into sediment basins and traps.
- H. Do not unnecessarily disturb existing vegetation (grass and trees).
- I. Take appropriate measures to minimize materials transported or tracked by construction vehicles onto any roadway.
- J. Excavate sediment out of basins and traps when capacity has been reduced by 50 percent.
- K. Topsoil and Fine Grade Slopes and Swales, Etc. Seed and mulch per project specifications as soon as areas become ready.

3.4 Near Completion of Construction

- A. Eliminate basins, dikes, traps, etc.
- B. Grade to finished or existing grades.
- C. Fine grade all remaining earth areas, then seed and mulch.
- D. Remove remaining sediment controls (silt fence, rock berms, etc.) once final stabilization, meeting TNR100000 requirements, has been achieved.

END OF SECTION

Part 1 General

1.1 Scope

- A. The Contractor shall provide transportation of all equipment, materials and products furnished under these Contract Documents to the work site. In addition, the Contractor shall provide preparation for shipment, loading, unloading, handling and preparation for installation and all other work and incidental items necessary or convenient to the Contractor for the satisfactory prosecution and completion of the work.
- B. All equipment, materials and products damaged during transportation or handling shall be repaired or replaced by the Contractor at no additional cost to WOULD prior to being incorporated into the work.

1.2 Transportation

- A. All equipment shall be suitably boxed, crated or otherwise protected during transportation.
- B. Where equipment will be installed using existing cranes or hoisting equipment, the Contractor shall ensure that the weights of the assembled sections do not exceed the capacity of the cranes or hoisting equipment.
- C. Small items and appurtenances such as gauges, valves, switches, instruments and probes which could be damaged during shipment shall be removed from the equipment prior to shipment, packaged and shipped separately. All openings shall be plugged or sealed to prevent the entrance of water or dirt.

1.3 Handling

- A. All equipment, materials and products shall be carefully handled to prevent damage or excessive deflections during unloading or transportation.
- B. Lifting and handling drawings and instructions furnished by the manufacturer or supplier shall be strictly followed. Eyebolts or lifting lugs furnished on the equipment shall be used in handling the equipment. Spreader bars or lifting beams shall be used when the distance between lifting points exceeds that permitted by standard industry practice.
- C. Under no circumstances shall equipment or products such as pipe, structural steel, castings, reinforcement, lumber, piles, poles, etc., be thrown or rolled off of trucks onto the ground.
- D. Slings and chains shall be padded as required to prevent damage to protective coatings and finishes.

Part 2 Products

(NOT USED)

Part 3 Execution

(NOT USED)

END OF SECTION

Product Storage and Handling Requirements

Part 1 General

1.1 Scope

- A. The work under this Section includes, but is not necessarily limited to, the furnishing of all labor, tools and materials necessary to properly store and protect all materials, equipment, products and the like, as necessary for the proper and complete performance of the work.

1.2 Storage and Protection

A. Storage

1. Maintain ample way for foot traffic at all times, except as otherwise approved by the Owner.
2. All property damaged by reason of storing of material shall be properly replaced at no additional cost to WOULD.
3. Packaged materials shall be delivered in original unopened containers and so stored until ready for use.
4. All materials shall meet the requirements of these Specifications at the time that they are used in the work.
5. Store products in accordance with manufacturer's recommendations.

B. Protection

1. Use all means necessary to protect the materials, equipment and products in accordance with manufacturer's recommendations of every section before, during and after installation and to protect the installed work and materials of all other trades.
2. All materials shall be delivered, stored and handled to prevent the inclusion of foreign materials and damage by water, breakage, vandalism or other causes.
3. Substantially constructed weather-tight storage sheds, with raised floors, shall be provided and maintained as may be required to adequately protect those materials and products stored on the site which may require protection from damage by the elements.

- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary for the approval of the Owner and at no additional cost to the Owner.

- D. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending

between supports. Items such as pipe, structural steel and sheet construction products shall be stored with one end elevated to facilitate drainage.

- E. Unless otherwise permitted in writing by the Owner, building products and materials such as cement, grout, plaster, gypsumboard, particleboard, resilient flooring, acoustical tile, paneling, finish lumber, insulation, wiring, etc., shall be stored indoors in a dry location. Building products such as rough lumber, plywood, concrete block and structural tile may be stored outdoors under a properly secured waterproof covering.
- F. Tarps and other coverings shall be supported above the stored equipment or materials on wooden strips to provide ventilation under the cover and minimize condensation. Tarps and covers shall be arranged to prevent ponding of water.

1.3 Extended Storage

- A. In the event that certain items of major equipment such as air compressors, pumps and mechanical aerators have to be stored for an extended period of time, the Contractor shall provide satisfactory long-term storage facilities which are acceptable to the Owner. The Contractor shall provide all special packaging, protective coverings, protective coatings, power, nitrogen purge, desiccants, lubricants and exercising necessary or recommended by the manufacturer to properly maintain and protect the equipment during the period of extended storage.

1.4 Owner Furnished Equipment

- A. The Contractor shall provide storage and protection for all WOULD furnished equipment and materials, including extended storage as specified above.

Part 2 Products

(NOT USED)

Part 3 Execution

(NOT USED)

END OF SECTION

Part 1 General

1.1 Work Included

- A. Section includes requirements for cleanup, re-stabilization, restoration, and disposal to maintain a safe and well-kept job site and properly repair disturbed areas.

1.2 Quality Assurance

- A. Daily, and more often if necessary, conduct inspections verifying that requirements of cleanliness are being met.
- B. In addition to the standards described in this Section, comply with all pertinent requirements of governmental agencies having jurisdiction.

1.3 Cleaning Materials and Equipment

- A. Provide all required personnel, equipment and materials needed to maintain the specified standard of cleanliness.
- B. Use only the cleaning materials, methods and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material or as approved by the Engineer.

1.4 Cleaning During Construction

- A. (For Interior Areas) Proceed with construction cleanup concurrently with construction progress.
 - 1. Remove mud, oil, grease, soil, gravel, trash, scrap, debris, and excess materials that are unsightly or may cause accidents to persons or properties.
 - 2. Remove water from floor areas where electrical power tools are to be used, and prevent stains on concrete that will be exposed in finish work.
 - 3. Select and employ cleaning materials and equipment with care to avoid scratching, marring, defacing, staining, or discoloring surfaces cleaned.
- B. (For Exterior Areas) Throughout all phases of construction, including suspension of work, and until the Final Acceptance, the Contractor shall keep the site clean and free from rubbish and debris. The Contractor shall also abate dust nuisance by cleaning, sweeping and sprinkling with water, or other means as necessary. The use of water resulting in mud on driveways, parking lots or streets will not be permitted as a substitute for sweeping or other methods.
 - 1. The road(s) on the construction site shall be paved immediately after the installation of underground utilities and the construction and underground/final

inspection of storm drainage, curbs, and gutters. The exit road on the construction site shall be paved first.

2. Vehicles exiting the construction site shall have all dirt clods and mud removed from their tires.
 3. Materials and equipment shall be removed from the site as soon as they are no longer necessary. Before the final inspection, the site shall be cleared of equipment, unused materials and rubbish so as to present a satisfactory clean and neat appearance. All cleanup costs shall be included in the Contractor's Bid.
 4. Care shall be taken to prevent spillage on haul routes. Any such spillage shall be removed immediately and the area cleaned.
 5. Excess excavated material from catch basins or similar structures shall be removed from the site immediately. Sufficient material may remain for use as backfill if permitted by the Specifications. Forms and form lumber shall be removed from the site as soon as practicable after stripping.
- C. Failure of the Contractor to comply with the Engineer's cleanup orders may result in an order to suspend work until the condition is corrected. No additional compensation will be allowed as a result of such suspension.

1.5 Final Cleaning

- A. Upon completion of the work, the Contractor shall remove from the site all plant, materials, tools and equipment belonging to him, and leave the site with an appearance acceptable to WOULD.
- B. Thoroughly clean all equipment and materials installed and deliver over such materials and equipment in a bright, clean, polished and new appearing condition.
- C. Restore or replace all landscape features scarred or damaged by the Contractor's equipment or operations as nearly as possible to original condition, at the Contractor's expense. WOULD will approve the method of restoration to be used.
- D. The Contractor shall remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction, as directed by WOULD. It is anticipated that excavation, filling and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The restored areas shall be filled, graded, and spread with sufficient topsoil to provide a minimum depth of four inches of suitable soil for the growth of grass, and the entire area shall be seeded or sodded with the original type of grass. Areas shall be restored to original contours as shown on the Plans. If the Plans do not cover the specific areas to be restored, the areas shall be graded to drain and give a smooth transition to the surroundings.

1.6 Measurement and Payment

- A. No separate payment will be made for any items of work, materials, parts, equipment, supplies, or related items required to perform and complete the requirements of this section. The costs for all such items required shall be considered subsidiary to other items of this Contract and shall not be paid for separately.

1.7 Disposal of Waste

- A. Except for items or materials to be salvaged, recycled, or otherwise reused, and except for options available below for vegetative waste generated by clearing and grubbing operations, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
- B. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
- C. Remove and transport waste in a manner that will prevent spillage on adjacent surfaces and areas.
- C. Vegetative waste generated by clearing and grubbing operations may be disposed of by mulching. Timber within the areas cleared shall become the property of the Contractor. The Contractor may cut, trim, hew, saw or otherwise dress felled timber within the limits of the work area, provided all timber and all waste materials are disposed of as specified. All residual matter from mulching operations shall be removed from the Project site as waste in accordance with the provisions of this section of the Specifications.
- D. Burning: Do not burn waste materials on site.
- E. Waste removed from the Project site shall be disposed of in sites permitted by the Tennessee Department of Environment and Conservation (TDEC) for the acceptance of type of waste being disposed in accordance with Rules of TDEC Solid Waste Management, including Chapter 0400-11-01. Landfill types include
 - 1. Class I Landfills - municipal solid waste, household waste, shredded/waste tires
 - 2. Class II Landfills - industrial waste
 - 3. Class III Landfills - farming wastes, landscaping and land clearing wastes
 - 4. Class IV Landfills - construction and demolition waste
- F. Exceptions to Paragraph E are as follows:
 - 1. Certain other wastes (such as medical/infectious waste, dead animals, sludges, pesticides wastes, hazardous wastes, asbestos) require special waste approval prior to disposal. See the TDEC Environmental Permitting Handbook for more information.

2. Hazardous waste shall be disposed of in accordance with Rules of TDEC Solid Waste Management, including but not limited to Chapter 0400-12-01 and the rules and regulations of the United States Environment Protection Agency (EPA).
 2. Asbestos-containing waste shall also be handled and disposed in accordance with TCA 68-201-101 et seq, Rules of the Tennessee Department of Health, and TDEC Bureau of Environmental Health Services, Division of Air Pollution, including Chapter 1200-3-11-.02 and 40 CFR 61.
 3. Excess earth material and excess excavated rock material may be placed on sites for which the Contractor provides to the Owner a signed affidavit from the property owner that the placement of such material is acceptable to the property owner. The Contractor and property owner shall be responsible for all permitting of such disposal.
- G. No waste shall be placed at a transfer station facility.
- H. The Contractor shall maintain records related to all waste removed from the Project site so as to allow the Owner or the Engineer to readily determine the following:
1. Date waste removed from Project site.
 2. Name of hauler (company and driver) transporting such waste.
 3. General description of waste transported.
 4. "Truck tickets" indicating the waste disposal site and amount of waste disposed therein.

Part 2 Products

(NOT USED)

Part 3 Execution

(NOT USED)

END OF SECTION

Part 1 General

1.1 Scope

- A. The work under this Section includes, but is not necessarily limited to, the compiling, maintaining, recording and submitting of Project record documents as herein specified.
- B. Record documents include, but are not limited to:
 - 1. Drawings;
 - 2. Specifications;
 - 3. Change orders and other modifications to the Contract;
 - 4. Engineer field orders or written instructions, including Requests for Information (RFI) and Clarification Memorandums;
 - 5. Reviewed shop drawings, product data and samples;
 - 6. Test records.
- C. The Contractor shall maintain on the Project site throughout the Contract Time an up to date set of Record Drawings.

1.2 Maintenance of Documents and Samples

- A. Storage
 - 1. Store documents and samples in the Contractor's field office, apart from documents used for construction.
- B. File documents and samples in accordance with format of these Specifications.
- C. Maintenance
 - 1. Maintain documents in a clean, dry, legible condition and in good order.
 - 2. Do not use record documents for construction purposes.
 - 3. Maintain at the site for WOULD one copy of all record documents.
- D. Make documents and samples available at all times for inspection by Engineer.
- E. Failure to maintain the Record Documents in a satisfactory manner may be cause for withholding of a certificate for payment.

Record Documents

1.3 Quality Assurance

- A. Unless noted otherwise, Record Drawings shall provide dimensions, distances and coordinates to the nearest 0.1 foot.
- B. Unless noted otherwise, Record Drawings shall provide elevations to the nearest 0.01 foot for all pertinent items constructed by the Contractor.

1.4 Recording

- A. Label each document "Project Record" in neat, large printed letters.
- B. Recording
 - 1. Record information concurrently with construction progress.
 - 2. Do not conceal any work until required information is recorded.

1.5 Record Drawings

- A. Record Drawings shall be reproducible, shall have a title block indicating that the drawings are Record Drawings, the name of the company preparing the Record Drawings, and the date the Record Drawings were prepared.
- B. Legibly mark drawings to record actual construction, including:
 - 1. All Construction
 - a. Changes of dimension and detail.
 - b. Changes made by Requests for Information (RFI), field order, clarification memorandums or by change order.
 - c. Details not on original Drawings.
 - 2. Site Improvements, Including Underground Utilities
 - a. Horizontal and vertical locations of all exposed and underground utilities and appurtenances, both new facilities constructed and those utilities encountered, referenced to permanent surface improvements.
 - b. Location of and dimensions of roadways and parking areas, providing dimensions to back of curb when present.
 - c. The locations shall be referenced to at least two easily identifiable, permanent landmarks (e.g., power poles, valve markers, etc.) or benchmarks.
 - 3. Structures

- a. Depths of various elements of foundation in relation to finish first floor datum or top of wall.
- b. Location of internal and buried utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.

1.6 Specifications

- A. Legibly mark each section to record:
 1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 2. Changes made by Requests for Information (RFI), field order, clarification memorandums, or by change order.

1.7 Submittal

- A. At contract closeout, deliver Record Documents to the Engineer for the Owner.
- B. Accompany submittal with transmittal letter, in duplicate, containing:
 1. Date
 2. Project title and number
 3. Contractor's name and address
 4. Title and number of each record document
 5. Signature of Contractor or Contractor's authorized representative

Part 2 Products

(NOT USED)

Part 3 Execution

(NOT USED)

END OF SECTION

Part 1 General

1.1 Work Included

- A. Provide labor, materials, equipment and incidentals necessary to perform operations in connection with clearing, grubbing, and disposal of cleared and grubbed materials.

1.2 Definitions

- A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.
- B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.
- C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2 inches caliper to a depth of 6 inches below subgrade.
- D. Scalping: Removal of sod without removing more than upper 3 inches of topsoil.
- E. Stripping: Removal of topsoil remaining after applicable scalping is completed.
- F. Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.3 Submittals

- A. Submit work plan in accordance with Section 01 33 00.
- B. The limits of clearing, grubbing and stripping are defined in Section 3.3 and detailed on the project plans.

1.4 Quality Assurance

- A. Obtain WOOD's approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

1.5 Scheduling and Sequencing

- A. Prepare site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls.

Part 2 Products

(NOT USED)

Part 3 Execution

3.1 General

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Clear, grub, and strip areas actually needed for staging area or site improvements within limits shown or specified. Do not injure or deface vegetation that is not designated for removal.

3.2 Preparation

- A. Mark areas to be cleared and grubbed prior to commencing clearing operations. WOULD shall approve clearing and grubbing limits prior to commencement of clearing operations.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place. Excavate for, and remove, underground utilities indicated to be removed.
 - 1. Arrange with utility owners to shut off indicated utilities.
- C. Trees and shrubs outside of the clearing limits, which are within 10' of the clearing limits, shall be clearly marked to avoid damage during clearing and grubbing operations.
- D. Remove trees and brush outside the clearing limits, but within the immediate vicinity of the work, upon receipt of approval by WOULD, when the trees or brush interfere with the progress of construction operations.
- E. Clearly mark trees and shrubs within the clearing limits, which are to remain, and protect the trees and shrubs from damage during the clearing and grubbing operations.
- F. The clearing limits shall not extend beyond the project limits.

3.3 Limits

- A. As follows, but not to extend beyond Project limits.
 - 1. Excavation Including Trenches: 5 feet beyond top of cut slopes.
 - 2. Fill:
 - a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
 - b. Stripping and Scalping: 5 feet beyond toe of permanent fill.
 - 3. Staging Area:

- a. Clearing: 5 feet beyond perimeter.
 - b. Scalping and Stripping: As shown.
 - c. Grubbing: Around perimeter as necessary for neat, finished appearance.
4. Other Areas: As shown.
- B. Remove rubbish, trash, and junk from entire area within project limits.

3.4 Clearing

- A. Clear areas within limits of construction.
- B. Fell trees so that they fall away from facilities and vegetation not designated for removal.
- C. Cut stumps not designated for grubbing flush with ground surface.
- D. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.

3.5 Site Improvements

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.6 Grubbing

- A. Grub areas within limits of construction.

3.7 Scalping

- A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.
- B. Scalp areas within limits shown or specified.

3.8 Stripping

- A. Do not remove topsoil until after scalping is completed.

Clearing and Grubbing

- B. Strip areas within limits to minimum depths shown or specified. Do not remove subsoil with topsoil.
- C. Stockpile strippings meeting requirements for topsoil separately from other excavated material.

3.9 Tree Removal Outside Clearing Limits

- A. Remove Trees Within Project Limits:
 - 1. Dead, dying, leaning, or otherwise unsound trees that may strike and damage Project facilities in falling.
 - 2. Trees designated by WOULD for removal.
- B. Remove stumps and debris, and if disturbed, restore surrounding area to its original condition.

3.10 Pruning

- A. Remove branches below the following heights: 20 feet above proposed ground level.
- B. Prune as indicated in local ordinances and the tree protection plans.

3.11 Salvage

- A. Saleable logs and timber may be sold to Contractor's benefit. Promptly remove from Project site.
- B. Sod with commercial value may be sold to Contractor's benefit. Promptly remove from Project site.

3.12 Disposal

- A. Clearing and Grubbing Debris:
 - 1. Dispose of debris offsite.
 - 2. Burning of debris onsite will not be allowed.
 - 3. Woody debris may be chipped. Chips may be sold to Contractor's benefit or used for landscaping onsite as mulch or uniformly mixed with topsoil, provided that resulting mix will be fertile and not support combustion. Maximum dimensions of chipped material used onsite shall be 1/4-inch by 2 inches. Dispose of chips that are unsaleable or unsuitable for landscaping or other uses with unchipped debris.
 - 4. Limit offsite disposal of clearing and grubbing debris to locations that are approved by federal, state, and local authorities, and that will not be visible from Project.

- B. Scalpings: As specified for clearing and grubbing debris.
- C. Strippings:
 - 1. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil offsite.
 - 2. Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.
- D. Completely remove timber, logs, roots, brush, rotten wood, and other refuse from WOUD's property. Disposal of materials in streams shall not be permitted and no materials shall be piled in stream channels or in areas where it might be washed away by floods. Timber within the area to be cleared shall become the property of the Contractor, and the Contractor may cut, trim, hew, saw, or otherwise dress felled timber within the limits of WOUD's property, provided timber and waste material is disposed of in a satisfactory manner. Materials shall be removed from the site daily, unless permission is granted by WOUD to store the materials for longer periods.

END OF SECTION

Part 1 General

1.1 Section Includes

- A. Clearing and grubbing.
- B. Excavation and disposal of all wet and dry materials (including rock) encountered that must be removed for construction purposes.
- C. Sheeting, shoring, bracing, and timbering.
- D. Dewatering of trenches and other excavations.
- E. Pipe bedding.
- F. Backfilling and tamping of trenches, foundations, and other structures.

1.2 Definitions

- A. Degree of Compaction: Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D698, for general soil types, abbreviated as percent laboratory maximum density.
- B. Hard Materials: Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.
- C. Rock: Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement.

1.3 Submittals

- A. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:
 - 1. Preconstruction Submittals - Submit 15 days prior to starting work:
 - a. Shoring and Sheeting Plan.
 - b. Dewatering work plan.
 - c. Blasting work plan.
 - 2. Test Reports – Submit copies of all laboratory and field test reports within 24

Trenching and Backfilling

hours of the completion of the test.

- a. Borrow Site Testing: Fill and backfill test.
- b. Select material test.
- c. Porous fill test for capillary water barrier.
- d. Density tests.

1.4 Delivery, Storage, and Handling

- A. Perform in a manner to prevent contamination or segregation of materials.

1.5 Requirements for Off Site Soil

- A. Soils brought in from off site for use as backfill shall be tested for petroleum hydrocarbons, BTEX, PCBs and HW characteristics (including toxicity, ignitability, corrosivity, and reactivity). Backfill shall not contain concentrations of these analytes above the appropriate State and/or EPA criteria, and shall pass the tests for HW characteristics. Determine petroleum hydrocarbon concentrations by using appropriate State protocols. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5035/8260B. Perform complete TCLP in accordance with EPA SW-846.3-3 Method 1311. Perform HW characteristic tests for ignitability, corrosivity, and reactivity in accordance with accepted standard methods. Perform PCB testing in accordance with accepted standard methods for sampling and analysis of bulk solid samples. Provide borrow site testing for petroleum hydrocarbons and BTEX from a grab sample of material from the area most likely to be contaminated at the borrow site (as indicated by visual or olfactory evidence), with at least one test from each borrow site. For each borrow site, provide borrow site testing for HW characteristics from a composite sample of material, collected in accordance with standard soil sampling techniques. Do not bring material onsite until tests results have been received and approved by WOULD.

1.6 Field Measurements

- A. Verify that survey bench mark and intended elevations for the Work are as shown on the drawings.

1.7 Coordination

- A. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.

1.8 Quality Assurance

- A. Shoring and Sheeting Plan: Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal. Calculations shall include data and references used.
- B. Dewatering Work Plan: Submit procedures for accomplishing dewatering work.
- C. Utilities: Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform work adjacent to non-WOUD utilities as indicated in accordance with procedures outlined by utility company. Report damage to utility lines or subsurface construction immediately to the Engineer.

Part 2 Products

2.1 Soil Materials

- A. Satisfactory Materials: Any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, or SP, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.
- B. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Engineer shall be notified of any contaminated materials.
- C. Backfill and Fill Material: Provide ASTM D2321 materials as listed in Tables 1 and 2.
- D. Topsoil: Provide as specified in Section 32 92 19 - Seeding.

2.2 Utility Bedding Material

- A. Provide ASTM D2321 materials as listed in Tables 1 and 2.

2.3 Borrow

- A. Obtain borrow materials required in excess of those furnished from excavations from sources outside of WOUD's property.

Part 3 Execution

3.1 Protection

A. Shoring and Sheeting

1. 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.
2. 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.
3. Trench excavation safety protection shall be accomplished as required by the most recent provisions of Part 1926, Subpart P - Excavations, Trenching, and Shoring of the Occupational Safety and Health Administration (OSHA) Standards and Interpretations, as may be amended. 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 Engineer. 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.
4. 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 Engineer.
5. Do not leave sheeting, shoring, or bracing materials in place unless this is called for by the Drawings, ordered by the Engineer, 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.
6. Fill and compact all holes and voids left in the work by the removal of sheeting, shoring, or bracing as specified herein.
7. The Contractor may use a trench box, which is a prefabricated 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.

8. A "Qualified Person", as defined by OSHA regulations, shall be on-site at all times during activities requiring trench safety provisions.

B. Drainage and Dewatering

1. Provide for the collection and disposal of surface and subsurface water encountered during construction.
2. Drainage: So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. Where applicable, the Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.
3. Dewatering:
 - a. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 2 feet below the working level.

C. Underground Utilities

1. Location of the existing utilities indicated on the Drawings is approximate. The Contractor shall physically verify the location and elevation of all existing utilities prior to starting construction. The Contractor shall contact the State One-Call Service and affected utilities for assistance in locating existing utilities.

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- D. Machinery and Equipment: Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.2 Surface Preparation

- A. Clear and grub project area in accordance with Section 31 11 00 - Clearing and Grubbing.
- B. Identify required lines, levels, contours, and datum.
- C. Protect plant life, lawns, and other features remaining as part of final landscaping.
- D. Maintain and protect above and below grade utilities which are to remain.

3.3 Excavation

- A. Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material.
 - 1. Blasting: Where permitted and allowed by WOOD and Engineer as an acceptable trenching option, blasting shall be performed in accordance with appropriate criteria established by the National Fire Protection Association 37 TAC PART 13 and all Local, County, State, and Federal codes and ordinances. The Contractor shall be responsible for obtaining all permits at no cost to WOOD. Blasting for utility excavation must be done in such a manner as to minimize the fracturing of rock beyond the required excavation. The Contractor shall consider the elevation of utilities in relation to the blasting charge and the relative alignment of existing and proposed trenches. Blasting within such areas shall be accomplished only by qualified Contractors who hold blasting licenses from a qualified agency. Any damage to existing utilities resulting from blasting shall be repaired at the Contractor's expense. Sand shall not be used for bedding for backfill in trenches that have been blasted.
- B. 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 sized 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.
- C. Unless specified otherwise, refill excavations cut below indicated depth with bedding material and compact to 95 percent of ASTM D698 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Engineer, shall be replaced with satisfactory materials to the indicated excavation

grade. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Engineer.

D. Pipe Trenches:

1. Unless the construction of lines by tunneling, jacking, or boring is called for by the Drawings or specifically authorized by the Engineer, make excavation for pipelines in open cut and true to the lines and grades shown on the Drawings or established by the Engineer 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 Engineer, 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 nonvertical 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 Engineer to require that stronger pipe and/or a higher class of bedding be used at no cost to WOULD.
2. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that the pipe will be uniformly supported for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe.
3. 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.
4. Provide minimum depths of "Bedding Material" as defined in Tables 1 and 2.
5. 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 Engineer deems necessary to maintain vehicular or pedestrian traffic.
6. 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.

E. Hard Material and Rock

1. 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 therefor.

2. Should rock be encountered in the excavation, remove it by blasting or other methods. 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.
3. 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.

F. Excavated Materials

1. Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.4 Filling and Backfilling

- A. Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.
- B. Backfill and Fill Material Placement for Utilities
 1. Begin backfilling after the line construction is completed and then inspected and approved by the Engineer. 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.
- C. At locations of improvements subject to damage by displacement, 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.
- D. If earth material for backfill is, in the opinion of the Engineer, 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 Engineer considers too wet or otherwise unsuitable.
- E. Wherever excavation has been made within easements across private property, the top 1 foot of backfill material shall consist of topsoil, as defined in Section 32 92 19 -

Seeding.

- F. Wherever trenches have been cut across or along existing pavement and driveways, including gravel or dirt drives, temporarily pave the backfill of such trenches by placing TDOT Class A, Grade D 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 WOULD.
- G. 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.
- H. Do not use power operated tampers to tamp that portion of the backfill around the pipe within 1 foot above the pipe.
- I. 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 Engineer.
- J. Backfilling and clean-up operations shall closely follow pipe laying; failure to comply with this provision will result in the Engineer's requiring that the Contractor's other activities be suspended until backfilling and clean-up operations catch up with pipe laying.
- K. Compaction Requirements: Under buildings and 2 times the depth of pipe beyond, and under roads and 2 times the depth beyond the shoulder, compact to 95 percent maximum density in accordance with ASTM D698. In all other locations, compact to 90 percent maximum density.

3.5 Borrow

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

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- 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.

3.6 Finish Operations

- A. Grading: Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.
- B. Protection of Surfaces: Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.7 Disposition of Surplus Material

- 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 Engineer 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. 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. The Contractor shall dispose of these surplus and waste materials off-site in an appropriate manner in conformity with pertinent codes and ordinances. Leave the surface of the work in a neat and workmanlike condition, as described below.
- C. 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.

3.8 Field Quality Control

- A. Sampling: Take the number and size of samples required to perform the following tests.
- B. Testing: Perform one of each of the following tests for each material used. Provide additional tests for each source change.
 - 1. Bedding Material and Fill and Backfill Material Testing: Test fill and backfill material in accordance with ASTM C136 for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D4318 for liquid limit and for plastic limit; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

Density Tests: Test density in accordance with ASTM D1556, or ASTM D6938. When ASTM D6938 density tests are used, verify density test results by performing an ASTM D1556 density test at a location already ASTM D6938 tested as specified herein. Perform an ASTM D1556 density test at the start of the job, and for every 10 ASTM D6938 density tests thereafter. Test each lift at randomly selected locations with one test per 500 linear feet in each lift.

Table 1: Backfilling and Compaction of Trenches for Pressure Pipes in Unimproved Areas

Layer*	Depth			Material**			
	≤15" Ø	18"-38" Ø	>38" Ø	DIP	PVC	HDPE	Conc
A	4" min	6" min	12" min	I B	II	II	I B
B1	½ OD			III	II	II	III
B2	½ OD			III	II	II	III
C	6"			III	II	II	III
D	6"			IV A	II	II	IV A
E	Varies			IV A	IV A	IV A	IV A
F	12"			As specified in Section 32 92 19			

*See Figure 1.

**Bedding material to be used in wet conditions for all layers.

Table 2: Backfilling and Compaction of Trenches in Paved Areas

Layer*	Depth			Material			
	≤15" Ø	18"-38" Ø	>38" Ø	DIP	PVC	HDPE	Conc
A	4" min	6" min	12" min	I B	II	II	I B
B1	½ OD			I B	II	II	I B
B2	½ OD			I B	II	II	I B
C	6"			I B	II	II	I B
D	6"			I B	II	II	I B
E	Varies			I B	II	II	I B
F	12"			As required for pavement base			

*See Figure 1.

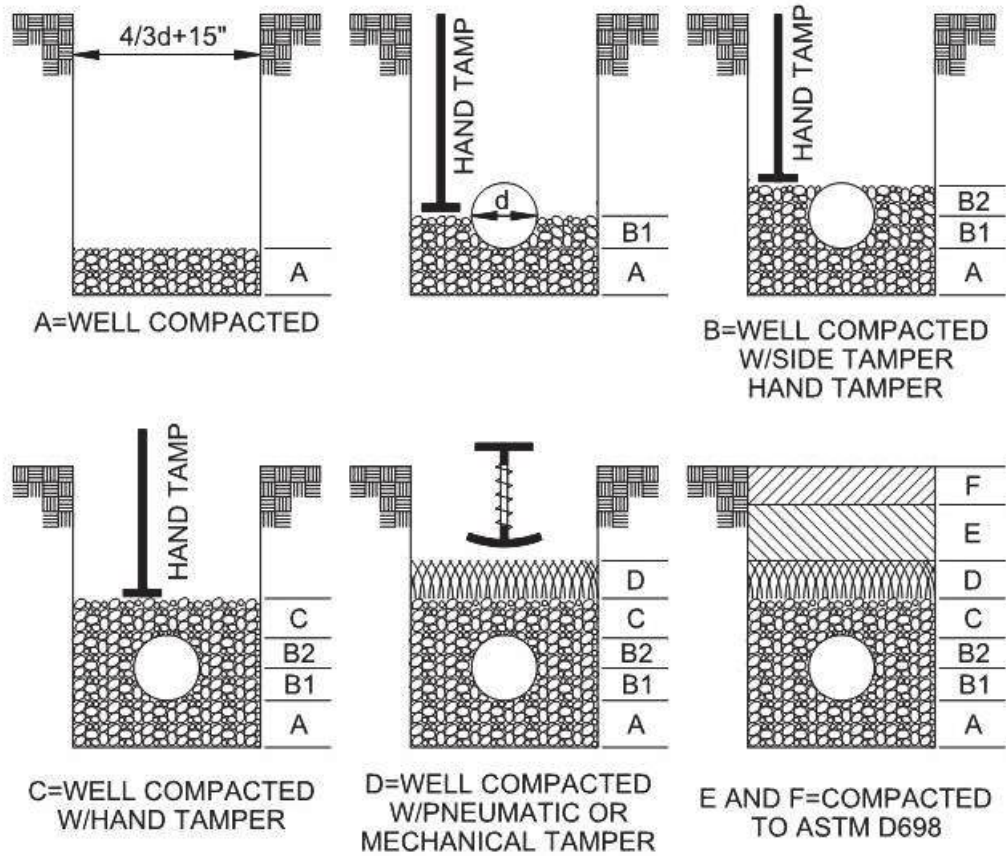


Figure 1: Backfilling and Compaction of Trenches

END OF SECTION

Part 1 General

1.1 Section Includes

- A. Furnishing and placing riprap slope protection in accordance with the Drawings and Specifications.

1.2 Submittals

- A. Submit in accordance with Section 01 33 00.
- B. For Machine Riprap (Class A-1), submit results of gradation testing demonstrating compliance with requirements.

Part 2 Products

2.1 Material for Riprap

- A. Provide bedding material, filter fabric and rock conforming to these requirements for construction indicated.
- B. Bedding Material: Provide bedding material consisting of sand, gravel, or crushed rock, well graded with a maximum particle size of 2 inches. Compose material of tough, durable particles. Allow fines passing the No. 200 standard sieve with a plasticity index less than six.
- C. Rock Riprap:
 - 1. Machined riprap shall be clean shot rock containing no sand, dust or organic materials and be the size designated for the class specified. The stone shall be uniformly distributed throughout the size range. The thickness of the stone layer shall be that designated for the specified class below unless otherwise noted on the Drawings. All materials considered for use as riprap shall be approved by the A/E. Shot rock is acceptable provided the size from the site excavation is acceptable provided the size requirements are met.
 - 2. Machine Riprap (Class A-1) shall vary in size from 2 inches to 1.25 feet with no more than 20 percent by weight being less than 4 inches. The thickness of the stone layer shall be 1.5 feet with a tolerance of 3 inches.
 - 3. Machined Riprap (Class B) shall vary in size from 3 inches to 2.25 feet with no more than 20 percent by weight being less than 6 inches. The thickness of the layer shall be 2.5 feet with a tolerance of 4 inches.

Part 3 Execution

3.1 Riprap Construction

- A. Construct riprap on filter fabric in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot 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.
- B. Bedding Placement: Spread filter fabric and bedding material uniformly to a thickness of at least 3 inches on prepared subgrade as indicated. Compaction of bedding is not required. Finish bedding to present even surface free from mounds and windrows.
- C. Place riprap to the full course thickness in 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 large pieces uniformly distributed and the smaller pieces and spalls filling the voids between the larger pieces. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

END OF SECTION

Part 1 General

1.1 Work Included

- A. Provide the necessary plant, labor, materials and equipment to restore and maintain the various streets and driveway surfaces of all type, pavement and driveway bases, curbs, curb and gutter, and sidewalks disturbed, damaged, or demolished during the performance of the work.
- B. Dirt shoulders, roads, streets, drives, and walks are to be restored to their original condition as an incidental part of the installation of utilities.
- C. 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 References

- A. Tennessee Department of Transportation, Standard Specifications for Road and Bridge Construction (TDOT).

1.3 Quality Assurance

- A. 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.

Part 2 Products

2.1 Concrete

- A. Concrete shall be Class A air-entrained Portland cement type as specified in TDOT Standard Specifications, Section 604. Excavatable flowable fill shall conform to TDOT Standard Specifications, Subsection 204.06.

2.2 Mineral Aggregate Base

- A. Type A Base, Grading D, pugmill mix per TDOT Specification Section 303.

2.3 Bituminous Materials

- A. Prime Coats: Cutback asphalt, Grade RC-250, or emulsified asphalt, Grade AE-P, as specified in TDOT Specification Section 402.
- B. Crushed Stone Chips: Size 7 or 8, or as specified below and in TDOT Standard Specifications, Subsection 903.14.
- C. Double Bituminous Surface: For both courses, emulsified asphalt, Grade CRS-2p (TDOT Specification Section 904.03).
- D. Bituminous Plant Mix Base (Hot Mix): Grading A, B or C, AS or CW, as shown on the drawings or directed by the Engineer, in accordance with TDOT Specification Section 307.
- E. Asphaltic Concrete Binder: Grading B, BM, BM-s, or CW as shown on the drawings or directed by the Engineer, in accordance with TDOT Standard Specifications, Section 307.
- F. Tack Coat: Grade AE-3 (TDOT Specification Section 403)
- G. Asphaltic Concrete Surface: Grading D or E as specified in TDOT Specification Section 411

2.4 Pavement Marking Paint

- A. White and Yellow (TDOT Specification Section 716)

Part 3 Execution

3.1 Excavation

- A. Where trenches have been opened in any roadway or street that is a part of the State of Tennessee Highway system, restore surfaces in accordance with the requirements of TDOT. All other restoration shall be done in accordance with applicable local standards and these specifications.
- B. Excavations in the pavement area shall require that pavement surface edges be saw-cut or cold plane milled to provide a straight and smooth edge.
- C. Flowable fill will be required on all arterials, collectors, and downtown streets. Excavatable flowable fill shall meet the requirements in TDOT Standard Specifications, Section 204. Flowable fill may also be required in areas of special significance as determined by Engineer or WOULD's Representative.
- D. Upon completion of installation of utility or other work, if a temporary patch is to be used, mineral aggregate base (6" layers) and temporary asphalt patch (2" cold mix) shall be placed and rolled or mechanically compacted until such time that the permanent repair will be constructed.

- E. Full lane or roadway width milling and paving shall be required for all excavations. If two (2) or more excavations are made within a street block less than or equal to 1500 feet, the entire roadway lane impacted shall be milled and paved for the entire block. If a street block is greater than 1500 feet, for any excavations made less than 500 feet apart, the entire roadway lane impacted shall be milled and paved from patch to patch and 50' beyond each patch. If a continuous longitudinal trench is made in the roadway, the entire length of the trench shall be milled and paved the width of the lane impacted. If an excavation is within 100 feet of an intersection, the restoration limits shall extend to the radius points of the intersection. If an excavation falls between the edge of pavement and a construction joint, milling and paving can be completed to the existing construction joint. New utility cuts shall be milled and paved to any existing cuts or damaged pavement within 50 feet to eliminate checker boarding. If the existing cut or damaged pavement is less than 50 feet in length, the existing cut shall also be milled and paved.
- F. Asphalt repairs adjacent to curb and gutter work encroaching more than 24-inches into the roadway shall require full lane width paving. If a construction joint falls within the road centerline and the edge of pavement, the milling and paving can be completed to the existing construction joint.

3.2 Subgrade

- A. Before any base material is installed, compact the subgrade of the area to be paved to 98 percent 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, except at the edge of pavement and except where a flowable fill application is used to fill the trench, 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.
- D. Where flowable fill is required it shall conform to TDOT Standard Specifications Section 204.06, Excavatable Flowable Fill (EFF). 28 day compressive strength shall be 30 psi.

3.3 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 match the existing base thickness unless indicated otherwise on the Drawings.

3.4 Prime Coat

- A. Uniformly apply a bituminous prime coat 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 crushed stone chips at a rate of 12 pounds per square yard.

3.5 Cover Coat

- A. Use only if traffic is expected on base stone or if base stone will not receive asphalt for an extreme period.

3.6 Double Bituminous Surface

- A. Apply the first course at a rate of 0.30 to 0.38 gallon per square yard with emulsified asphalt, Grade CRS-2p, and then immediately cover with Size 7 crushed stone chips at a rate of 30 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 8 chips at a rate of 20 to 25 pounds per square yard.
- B. After the application of the cover aggregate, lightly broom or otherwise maintain the surface for a period of 4 days. 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.
- C. Brooming, rolling and maintenance to be done in accordance with TDOT Section 404.

3.7 Bituminous Plant Mix Base

- A. For all areas of more than 1,000 square yards, spread and strike off the asphalt binder course with a 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 indented 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.
- B. If it is impracticable 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. Carefully place by hand to avoid segregation of the mix. Broadcasting of the material will not be permitted. Remove any lumps that do not readily break down.

3.8 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 0.10 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 and width shown on the Drawings. Apply the surface course as described above for the binder course.

3.9 Concrete Pavement

- A. Concrete Pavement: Concrete pavement or base courses shall be replaced with concrete. The surface finish of the replaced concrete pavement shall conform to that of the existing pavement. The surface of the replaced concrete base course shall be left rough. The slab depth shall be equivalent to the existing concrete pavement or base course, but in no case less than 6-inches thick. Transverse and longitudinal joints removed from concrete pavement shall be replaced at the same locations and to the same types and dimensions as those removed. Concrete pavements or concrete base courses shall be reinforced, and shall be constructed in accordance with TDOT Section 501.

3.10 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.

3.11 Sampling and Testing

- A. Submit to WOULD's Representative a certification that the crushed mineral aggregate, bituminous materials, and asphaltic concrete design mixes meet requirements of TDOT, and obtain his approval of these reports before starting paving operations.
- B. WOULD has the right but not the obligation to make tests on 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 deficiency shall be refused. Remove and reinstall all such sections. Patch all test holes in connection with thickness tests. WOULD will pay for initial test. If test results in failure, any additional testing is at the Contractor's expense.
- C. When making surface tests, furnish one man to mark all surface defects for corrections.

3.12 Other Work

- A. Any disturbed pavement markings must be restored to current local or TDOT standards.
- B. Curb and gutter, sidewalk, and shoulders, shall be restored as required to match existing construction. Replace damaged sections with complete new sections from expansion joint to expansion joint. Patching curb, gutter, or sidewalk will not be permitted.
- C. When a manhole top or other utility casting requires adjustment to an elevation one inch or more above the existing pavement grade a temporary ramp shall be constructed by feathering bituminous concrete 360 degrees around the casting. A taper slope of not less than two feet per inch shall be used. Taper shall be removed prior to placement of bituminous concrete surface course.

3.13 Warranty

- A. All repairs within the right of way shall be warranted for a period of one (1) years following the date of final acceptance. Evidence of settling, pumping, or cracking represents a warranty violation. Construction Requirements of TDOT Standard Specifications Section 407 shall apply.

END OF SECTION

Part 1 General

1.1 Section Includes

- A. Seeding of disturbed areas.
- B. Fertilizing and soil amendments, as necessary.
- C. Maintenance.

1.2 References

- A. U.S. Department of Agriculture (USDA)
 - 1. AMS Seed Act - Federal Seed Act.
 - 2. DOA SSIR 42 - Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0.

1.3 Definitions

- A. Acceptable Stand of Turf: 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.

1.4 Submittals

- A. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:
 - 1. Product Data:
 - a. Wood cellulose fiber mulch.
 - b. Fertilizer: Include physical characteristics, and recommendations.
 - 2. Certificates:
 - a. Contractor shall furnish labels or certified laboratory reports from an accredited commercial seed laboratory or a state seed laboratory showing the analysis and germination of the seed to be furnished. Acceptance of the seed test reports shall not relieve the Contractor of any responsibility or liability for furnishing seed meeting the requirements of this section.
 - 3. Test Results:

Seeding

- a. The Contractor shall obtain representative samples and furnish soil test certificates including textural, pH, and organic ignition analysis from the State University Agricultural Extension Service or other certified testing laboratory.

1.5 System Description

- A. 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 Engineer; and maintenance.
- B. All existing lawns encountered shall be replaced with topsoil and seeding of the same type and quality as that existing prior to construction and shall be restored to original condition or better.
- C. Unless otherwise approved in writing by the Engineer, seeding operations shall be limited to the following planting periods:
 1. Spring - March 1 through May 30.
 2. Fall - August 15 through October 31.
- D. Seeding Requirements Table:

Area	Species	Seed Rate	Fertilizer	Limestone
Flat to Rolling Terrain with Slopes Less than 3:1	Kentucky Fescue 31	5 lbs/1000 SF	15 lbs/1000 SF	40 lbs/1000 SF

1. 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.
- E. Refer to other sections for items affecting seeding. Coordinate this work with that specified by other sections for timely execution.

1.6 Delivery, Storage, and Handling

- A. Delivery
 1. Seed Protection: Protect from drying out and from contamination during delivery, on-site storage, and handling.
 2. Fertilizer and Other Agricultural Chemicals Delivery: Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer, gypsum, sulfur, iron, and lime may be furnished in bulk with certificate indicating the above information.

- B. Storage
1. Seed, Fertilizer, Gypsum, Sulfur, Iron, and Lime Storage: Store in cool, dry locations away from contaminants.
 2. Topsoil: Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.
- C. Handling: Do not drop or dump materials from vehicles.

Part 2 Products

2.1 Topsoil

- A. On-Site Topsoil: Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph entitled "Composition." When available, topsoil shall be existing surface soil stripped and stockpiled on-site in accordance with Section 31 23 33 Trenching and Backfilling.
- B. Off-Site Topsoil: Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by the Contractor.
- C. Composition: Containing from 5 to 20 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH shall be tested in accordance with ASTM D4972. Topsoil shall be free of sticks, stones, roots, and other debris and objectionable materials. Other components shall conform to the following limits:

Silt	25-50 percent.
Clay	10-30 percent.
Sand	20-35 percent.
pH	5.5 to 7.0.
Soluble Salts	600 ppm maximum.

2.2 Grass Seed

- A. Seed shall be delivered in new bags or bags that are sound and labeled in accordance with the U.S. Department of Agriculture Federal Seed Act.
- B. All seed shall be from the last crop available at time of purchase and shall not be moldy, wet, or otherwise damaged in transit or storage.
- C. Seed shall bear the growers analysis testing to 98% for purity and 90% for germination. At the discretion of the Engineer, samples of seed may be taken for check against the grower's analysis.

Seeding

- D. Species, rate of seeding, fertilization, and other requirements are shown in the Seeding Requirements Table.

2.3 Fertilizer Materials

- A. Fertilizer materials shall comply with applicable state, local, and federal laws concerned with their production and use.
- B. Commercial fertilizer shall be a ready mixed material and shall be equivalent to the grade or grades specified in the Seeding Requirements Table. Container bags shall have the name and address of the manufacturer, the brand name, net weight, and chemical composition.

2.4 Agricultural Limestone

- A. Containing a minimum of 85 percent calcium carbonate and magnesium carbonate combined, 85 percent of which passes a No. 10 mesh sieve, and 40 percent passing a No. 40 mesh sieve.

2.5 Mulch

- A. Mulch shall be free from noxious weeds, mold, and other deleterious materials.
- B. Straw: Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw shall contain no fertile seed.

2.6 Mulch Binder

- A. Mulch on slopes exceeding 3 to 1 ratio shall be held in place by the use of an approved mulch binder. The mulch binder shall be non-toxic to plant life and shall be acceptable to the Engineer.
- B. Emulsified asphalt binder shall be Grade SS-1, ASTM D 977. Cut-back asphalt binder shall be Grade RC 70 or RC 250.

2.7 Inoculants for Legumes

- A. All leguminous seed shall be inoculated prior to seeding with a standard culture of nitrogen-fixing bacteria that is adapted to the particular seed involved.

2.8 Water

- A. Water shall be clean, clear water free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.

Part 3 Execution

3.1 Preparation

- A. Extent Of Work: Provide soil preparation (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.
- B. Topsoil: Provide 4 inches of off-site topsoil or on-site topsoil to meet indicated finish grade. Over rock, provide minimum of 12 inches of topsoil. After areas have been brought to indicated finish grade, incorporate fertilizer into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Engineer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.
- C. Before beginning seeding operations in any area, complete the placing of topsoil and final grading, and have the work approved by the WOULD's Representative.

3.2 Seeding

- A. Seed Application and Conditions
 - 1. Immediately before seeding, restore soil to proper grade.
 - 2. Do not seed when ground is muddy, frozen, snow covered, or in an unsatisfactory condition for seeding.
 - 3. Apply seed within twenty four hours after seedbed preparation.
 - 4. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.
- B. Seed of the specified group shall be sown as soon as preparation of the seedbed has been completed. No seed shall be sown during high winds, nor until the surface is suitable for working and is in a proper condition. Seeding shall be performed during the dates shown in the Seeding Requirements Table unless otherwise approved by the Engineer. Seed mixtures may be sown together provided they are kept in a thoroughly mixed condition during the seeding operation. Copies of all weight tickets shall be furnished to the Engineer.
- C. Seeds shall be uniformly sown by any approved mechanical method to suit the slope and size of the areas to be seeded, preferably with a broadcast type seeder, windmill hand seeder, or approved mechanical power drawn seed drills. Hydro-seeding and hydro-mulching may be used on steep embankments, provided full coverage is obtained. Care shall be taken to adjust the seeder for seeding at the proper rate before seeding operations are started and to maintain their adjustment

Seeding

during seeding. Seed in hoppers shall be agitated to prevent segregation of the various seeds in a seeding mixture.

- D. Immediately after sowing, the seeds shall be covered and compacted to a depth of 1/8 to 3/8 inch by a cultipacker or suitable roller.
- E. Leguminous seeds shall be inoculated prior to seeding with an approved and compatible nitrogen-fixing inoculated in accordance with the manufacturer's mixing instructions.

3.3 Mulching

- A. All seeded areas shall be uniformly mulched in a continuous blanket immediately after seeding. The mulch shall be applied so as to permit some sunlight to penetrate and the air to circulate and at the same time shade the ground, reduce erosion, and conserve soil moisture. Approximately 25 percent of the ground shall be visible through the mulch blanket.
- B. One of the following mulches shall be spread evenly over the seeded areas at the following application rates:
 - 1. Wood Cellulose Fiber 1,400 lbs./acre
 - 2. Stalks 4,000 lbs./acre
 - 3. Straw 4,000 lbs./acre

These rates may be adjusted at the discretion of the Engineer at no additional cost to WOUD, depending on the texture and condition of the mulch material and the characteristics of the seeded area.

- C. Mulch on slopes greater than 3 to 1 ratio shall be held in place by the use of an approved mulch binder. Binder shall be thoroughly mixed and applied with the mulch. Emulsified asphalt or cutback asphalt shall be applied at the approximate rate of 5 gallons per 1,000 square feet as required to hold the mulch in place.
- D. The Contractor shall cover structures, poles, fence, and appurtenances if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.
- E. Mulch and binder shall be applied by suitable blowing equipment at closely controlled application rates.

3.4 Watering

- A. Contractor shall be responsible for maintaining the proper moisture content of the soil to ensure adequate plant growth until a satisfactory stand is obtained. If necessary, watering shall be performed to maintain adequate water content in the soil.

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- B. Watering shall be accomplished by hoses, tank trucks, or sprinklers in such a way to prevent erosion, excessive runoff, and overwatered spots.

3.5 Maintenance and Bond

- A. Upon completion of seeding operations, the Contractor shall clear the area of all equipment, debris, and excess material and the premises shall be left in a neat and orderly condition.
- B. No equipment, material storage, construction traffic, etc., will be permitted on newly seeded ground.
- C. The Contractor shall maintain all seeded areas without additional payment until final acceptance of the work by WOOD. Seeding work shall be repeated on defective areas until a satisfactory uniform stand is accomplished. Damage resulting from erosion, gullies, washouts, or other causes shall be repaired by filling with topsoil, compacting, and repeating the seeding work at contractor's expense.
- D. A grassing bond will be required to cover all grassed area, solid sod areas, and erosion control for one year after the time of planting seed or placing sod.

3.6 Field Quality Control

- A. WOOD's Representative shall inspect the seeding within 60 days after planting and determine if an acceptable stand of grass has been produced.
- B. If an acceptable growth is not obtained on the first planting, reseeding and remulching will be required.
- C. If the planting is less than 50 percent successful, rework the ground, refertilize, reseed, and remulch.

END OF SECTION

Part 1 General

1.1 Work Included

- A. Furnishing and installing sod.
- B. Preparation of Ground.
- C. Placement of Sod and Fertilization.
- D. Maintenance of Sod.

1.2 Related Sections

- A. Section 32 92 19 Seeding
- B. Coordinate this work with that specified by other sections for timely execution. The Contractor shall be wholly responsible for the scheduling, ordering, receiving, storing, and installing of all sodding materials.

1.3 Definitions

- A. Stand of Turf: 100 percent ground cover of the established species.

1.4 Submittals

- A. The following shall be submitted in accordance with Section 01 33 00 Submittal Procedures:
 - 1. Product Data Fertilizer: Include physical characteristics, and recommendations.
 - 2. Test Reports: Topsoil composition tests (reports and recommendations).
 - 3. Certificates: Sod farm certification for sods. Indicate type of sod in accordance with TPI GSS.

1.5 Delivery, Storage, and Handling

- A. Delivery
 - 1. Sod Protection: Protect from drying out and from contamination during delivery, on-site storage, and handling.
 - 2. Fertilizer, Gypsum, Sulfur, Iron, and Lime Delivery: Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, Fertilizer, Gypsum, Sulfur, Iron, and Lime may be furnished

in bulk with certificate indicating the above information.

B. Storage

1. Sod Storage: Lightly sprinkle with water, cover with moist burlap, straw, or other approved covering; and protect from exposure to wind and direct sunlight until planted. Provide covering that will allow air to circulate so that internal heat will not develop. Do not store sod longer than 24 hours. Do not store directly on concrete or bituminous surfaces.
2. Topsoil: Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.
3. Handling: Do not drop or dump materials from vehicles.

1.6 Time Restrictions and Planting Conditions

- A. Restrictions: Do not plant when the ground is frozen, snow covered, or muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 Time Limitations

- A. Sod: Place sod a maximum of thirty six hours after initial harvesting, in accordance with TPI GSS as modified herein.

Part 2 Products

2.1 Sods

- A. Classification: Nursery grown, certified as classified in the TPI GSS. Machine cut sod at a uniform soil thickness of not less than one inch, excluding top growth and thatch. Each individual sod piece shall be strong enough to support its own weight when lifted by the ends. Broken pads, irregularly shaped pieces, and torn or uneven ends will be rejected. Wood pegs and wire staples for anchorage shall be as recommended by sod supplier.
- B. Purity: Sod species shall be genetically pure, free of weeds, pests, and disease.
- C. Set sod between March 1 and October 15 and when the soil is in a workable condition.
- D. Kentucky 31 Fescue (*Festuca Elatior*); new sod consisting of live, dense, well rooted growth; well suited for the intended purpose and soil conditions; completely free of noxious weeds and grasses (Bermuda grass, quack grass, Johnson grass, Canada thistle); and containing less than 5 plants of objectionable weeds per 100 square feet if nursery grown or 10 such plants if field grown.
1. Sod Farm Overseeding: At the sod farm provide sod with overseeding of annual rye grass seed.

2.2 Topsoil

- A. See Specification 32 92 19 Seeding.

2.3 Fertilizer

- A. Granular Fertilizer: Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:
 - 1. 10 percent available nitrogen
 - 2. 10 percent available phosphorus
 - 3. 10 percent available potassium

2.4 Water

- A. Source of water shall be approved by WOULD and of suitable quality for irrigation containing no element toxic to plant life.

Part 3 Execution

3.1 Preparation

- A. Provide 4 inches of off-site topsoil or on-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Engineer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.
- B. Apply fertilizer and agricultural limestone uniformly over the sod bed at the rates shown below.
 - 1. Fertilizer: 15 pounds per 1,000 square feet of 10-10-10
 - 2. Agricultural Limestone: 40 pounds per 1,000 square feet

3.2 Sodding

- A. Finished Grade and Topsoil
 - 1. Prior to the commencement of the sodding operation, the Contractor shall verify that finished grades are as indicated on drawings; the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 31 23 33 Trenching and Backfilling.
 - 2. The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The

Sodding

prepared surface shall be completed with a light raking to remove from the surface debris and stones over a minimum 5/8 inch in any dimension.

- B. **Placing:** Place sod a maximum of 36 hours after initial harvesting, in accordance with TPI GSS as modified herein.
 - 1. Place sod by hand so that the edges are in close contact and in a position to break joints with the long dimension perpendicular to the slope. Fit and pound the sod into place with a 10 inches x 10 inches wood tamp or other similar implements.
- C. **Sodding Slopes and Ditches:** For slopes 2:1 and greater, lay sod with long edge perpendicular to the contour. For V-ditches and flat bottomed ditches, lay sod with long edge perpendicular to flow of water. Anchor each piece of sod with wood pegs or wire staples maximum 2 feet on center. On slope areas, start sodding at bottom of the slope.
- D. **Finishing:** After completing sodding, blend edges of sodded area smoothly into surrounding area. Air pockets shall be eliminated and a true and even surface shall be provided. Frayed edges shall be trimmed and holes and missing corners shall be patched with sod.
- E. **Rolling:** Immediately after sodding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width.
- F. **Watering:** Start watering areas sodded as required by daily temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to minimum depth of 6 inches. Run-off, puddling, and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven over turf areas. Watering of other adjacent areas or plant material shall be prevented.
- G. **Two weeks after the sod is installed, top dress and thoroughly water it. Top dressing shall consist of the following:**
 - 1. 1/2 to 1 pound of 38 percent urea formaldehyde per 1,000 square feet
 - 2. 20 pounds of 6 12 12 fertilizer per 1,000 square feet
- H. **Dispose of all surplus material as directed by WOULD.**
- I. **WOUD will review the sod for acceptance 30 days after installation, at which time the maintenance period will begin as stated in these specifications. This acceptance by WOULD is for the purposes of payment only.**

3.3 Protection of Turf Areas

- A. **Immediately after turfing, protect area against traffic and other use.**

3.4 Restoration

- A. **Restore to original condition existing turf areas which have been damaged during turf**

installation operations. Clean other paving when work in adjacent areas is complete.

3.5 Inspections

- A. The WOUD's Representative shall inspect the sod within 30 days after installation and determine if it is acceptable.
- B. Establish an acceptable stand of turf, as defined herein, on all areas indicated on the Drawings.

END OF SECTION

General

1.1 Work Included

- A. Requirements for performing Horizontal Directional Drilling (HDD) for installation of underground utility lines.
- B. HDD shall consist of the drilling of a small diameter pilot hole in an arc from the entry point to the exit point followed by an enlarged diameter hole for the insertion of the pipeline. The exact method and techniques for completing the HDD holes and accomplishing the work will be determined by the Contractor, subject to the requirements of these specifications.

1.2 Submittals

- A. Submit the following in accordance with Section 01 33 00 - Submittal Procedures.
- B. Documentation: Contractor shall at all times provide the following information to the Engineer, as it becomes available:
 - 1. Copies of drilling logs, drill head location plots, mud logs, and a log of equipment operating parameters taken during drilling, reaming, and pipeline installation as described herein at not less than one data point for every 10 feet or 5 minutes, whichever is more frequent, of advancement. The pipe log shall include the profile and trajectory data (horizontal and vertical position) along the pipe to confirm conformance with the depth and line shown on the Drawings.
 - 2. Horizontal Directional Drilling (HDD) equipment operating parameters including and not limited to torque and pull back forces.
 - 3. Drilling fluid density, gel strength, viscosity, sand content and make-up taken at the beginning and end of shift during all phases of pilot drilling, enlargement, and pullback operations.
 - 4. Record of the geotechnical instrumentation readings taken during the HDD operation.
- C. Data
 - 1. Pipe Material: The Contractor shall submit HDPE pipe manufacturer's recommendation of allowance load and factor of safety. Specify the minimum Dimension Ratio (DR) that will be required.
 - 2. Written approval from the pipe manufacturer verifying that the maximum calculated pulling force will not exceed the manufacturer's pipe material and fused joints.

D. Shop Drawings: Submit for Engineer's review:

1. Construction Plan - Complete working descriptions and drawings of the proposed method of construction and the sequence of operations to be performed in the ground conditions as described in the Geotechnical Baseline Report (GBR) during construction.
 - a. The construction plan shall include the proposed HDD procedures, crossing configurations, pit locations, dimensions and site layout, entry and exit angles, radius of curvature, entry pit/point preparation and restoration, HDD equipment, directional control methods, hydro test pipe prior to and after pipe pulling into HDD drill holes, sequence of operations, work site/staging area locations and layout and traffic control, proposed pipe lay-down corridor(s) and other pertinent procedures.
 - b. The plan shall indicate the diameter of the pilot hole, rig pulling capacity, torque, penetration rates, and mud pumping capabilities. Included shall be a description of the methods and precautions the Contractor proposes to use to prevent exceeding the pipe manufacturer's approved safe yield tensile strength during pullback and precautions to prevent inadvertent returns of drilling fluid.
 - c. Proposed method to address and mitigate difficult ground conditions as described in the GBR during drilling, enlargement and pullback, and potential problems of product pipe becoming stuck during pipe pull back, special provisions or emergency procedures when drilling adjacent to or through existing underground utilities or other events that lead to work stoppage.
 - d. Drilling Fluid management plan – Including proposed type(s) and quantities of drilling fluids, additives, manufacturers' catalogue cut sheets, volume of water used, performance requirements (as measured in terms of viscosity, gel strength, fluid density and sand content), targeted flow volume for the various phases of the HDD operations.
 - e. Drilling fluids system - Drilling fluids sampling locations and testing methods, method of slurry containment, estimated fluid pressure at the heading, mixing tank, method and estimated volume of recycling drilling fluids and spoils, or method of containing drilling fluids or spoils and transporting drilling and spoils off-site (including contaminated soils and groundwater), and identify method and disposal site for fluids and spoils.
 - f. Preventative measure(s) to minimize potential of spills, inadvertent returns, frac-outs, and loss of drilling fluids, especially in low overburden coverage, deep fill areas, or along reaches where the HDD alignment is in close proximity to utilities.
 - g. Mitigation plan(s) for cleanup and disposal of drilling fluids and hydraulic fluid(s) including measures to contain and clean the affected area.

- h. Contingency plan to address and mitigate heaving, collapse or subsidence of surface roadways during drilling, reaming and installation of the pipe.
2. The Contractor, prior to beginning any HDD entry or exit pit/point excavation five (5) feet deep or more, shall submit Contractor's detailed plan showing design of all shoring, bracing, sloping of sides of, excavation, or other provisions for worker protection against the hazard of caving ground for such excavation. All plans shall be prepared by a licensed civil or structural engineer.
3. Plan for Protection of Existing Utilities - Procedures for potholing, supporting and/or protecting such facilities.
4. Guidance, Tracking & Monitoring Systems: A plan for accurately locating the alignment of the drill path during HDD operations, and the accuracy of the proposed system as stated by the manufacturer of the system, including the type and manufacturer of guidance, tracking equipment used, display, date of most recent shop calibration record, and the method to ensure the data was captured and the specified tolerances are satisfied.
5. Schedule: Prepare a schedule for the work to include all major tasks including pipe fabrication, pipe delivery, HDD rig mobilization and set-up, pipe assembly, pilothole drilling, pre-reaming, pipe testing, pipe pulling, restoration of disturbed areas and demobilization.

E. Test Reports

1. Pipe Joint Testing Methods, Procedures, and Apparatus
 - a. Description of pipe joint testing methods, procedures, apparatus, and sample report.
 - b. Copies of all test reports
2. Mix design for the annular grout and testing results.
3. Mix design of the bentonite concrete plug and the testing results.
4. Mix design of the drilling fluids for HDD and for advancing the impermeable plug for special maintenance holes.

F. Records

1. Driller Log Book
 - a. Including drill pipe number, pitch, depth, steering commands, ground conditions, obstructions, and information required to be provided as described in Part 3.2.A.
2. Record Drawings

- a. During progress of the Work, the Contractor shall keep an up to date set of drawings showing field and shop drawing modifications. The drawings shall show all piping in plan and profile with all reference dimensions and elevations required for complete record drawings of the piping systems. The updated record drawing shall be posted and submitted on a daily basis summarizing the work performed within the past 24 hours.
 - b. As built drawings and surveys. Submit as-built locations and installation details drawings of all pre-excavation maintenance holes.
 - c. Video Tape of Closed Circuit TV Inspection - Two copies of videotape from closed circuit television inspection (CCTV) performed after installation of the pipe. The tape (or DVD) shall be submitted to the Engineer with any specialized software required to view.
3. Subcontract
- a. Contact name and number for vacuum truck subcontractor responsible for performing emergency responses to spillage and leakage of drilling fluids.
4. Field Testing Results
- a. Drilling Fluids
 - 1) Viscosity – measured with a Marsh Viscosity Funnel in seconds per quart.
 - 2) Gel Strength – measured with a rheometer or shearometer in psf.
 - 3) Fluid Density – measured with a mud balance in pounds per gallon.
 - 4) Sand Content – measured with a sand content kit and expressed in percent solid larger than No. 200 sieve in the drilling fluid.
 - 5) Any incidents resulting in sudden changes in flow volumes or when flow volume is significantly different from targeted quantity.
5. Qualifications: In accordance with paragraph entitled "Quality Assurance" herein below and shall be included, but not limited to the following:
- a. The name and address of the on-the-job individual(s) qualified and proposed to perform the HDD work.
 - b. Data to substantiate compliance with the project experience requirements of the paragraph entitled "Quality Assurance" herein below.
 - 1) Contact person and phone number

- 2) Location of installation
 - 3) Date and Type of Installation
 - 4) Type, size and length of pipe
6. Notification
 - a. Written notification at least 48-hour ahead of the pullback operation.
- G. Contingency plans:
1. Inadvertent returns
 2. Excessive loss of slurry
 3. HDD fails to advance or fails to respond to steering actions.
 4. Failure to maintain grade and when alignment derivations are more than allowable limits.
 5. Installation (pull back) forces reach 80% of the maximum allowable forces including manufacturer's recommended allowable factor of safety (at least 2.0).
 6. Hydrolock during pullback operation.
 7. Ground settlement/heaving exceeds allowable limits.

1.3 Commencement, Delivery, Storage, and Handling of Materials

- A. Inspect materials delivered to the site for damage.
- B. All materials found during inspection or during the progress of work to have cracks, flaws, surface abrasions, or other defects will be rejected.
- C. Remove defective materials from the job site.

1.4 Quality Assurance

- A. Qualifications: Ensure that Contractor and his field supervisor assigned to this project are experienced in work of this nature and have successfully completed similar projects of similar length, pipe type, pipe size, and soil type using directional drilling in the last three (3) years.
- B. As part of the bid submission, submit a description of such project(s) which include, at a minimum, a listing of the location(s), date of project(s), owner, pipe type, size installed, length of installation, type, and manufacturer of equipment used, and other information relevant to the successful completion of the project.

Part 2 Products

2.1 Equipment

- A. The HDD equipment shall be sized properly to complete the installation of the proposed alignment with due considerations of the ground conditions, downhole tools, drilling fluid additives, drilling technologies, size of final product pipe, and length of bore. HDD shall be sized with a pullback capacity not exceeding the pipe tensile strength for this project. The Contractor shall be able to retrieve their equipment without leaving the drill rod in the hole.
- B. Provide a mixing tank with sufficient volume to supply at least 30 minutes of full pumping capacity. The HDD equipment shall maintain a minimum pumping capacity to provide sufficient quantity of drilling fluids exceeding the targeted flow volume for all phases of the operation. Provide an in-line flow meter to determine the drilling fluid discharge.
- C. HDD machine safety requirements will include a common grounding system to prevent electrical shock in the event of a high voltage underground cable strike. The grounding system shall connect all pieces of interconnecting machinery including the HDD rig, mud mixing system, drill power unit, drill rod trailer, operator's booth, worker grounding mats, and any other interconnected equipment to a common ground.
- D. HDD directional control methods shall be employed which will ensure the location of the bore with the required accuracy. The pipeline alignment shall be established, maintained and tracked by an in-hole steering tool with referencing magnetometers and a surface tracking system. Provide automatic guidance, mapping and tracking system to allow as-built data to be recorded and stored for documentation and visual inspection to be performed during construction.
- E. A swivel shall be used to connect the pull section to the drill steel to minimize torsional stress imposed on the pulled pipe. The pull section shall be supported as it proceeds during the pull back so that it moves freely and the pipe and coating are not damaged.

2.2 Materials

- A. Pipe: Pipe shall be restrained joint or fusible PVC pipe, HDPE pipe with ductile iron pipe outside diameters in accordance with AWWA C900, C905, or C906 respectively, or restrained joint DI pipe. The dimension ratio shall be verified by the CONTRACTOR based on the pipe, joint and material pull strength required for the directional drilling.
 - 1. HDPE Pipe
 - a. HDPE pipe shall be in accordance with AWWA C906 and shall have an outside diameter equal to ductile iron pipe for the same size. Pipe shall have a minimum dimension ratio of 11 for use with ductile iron pipe fittings and have a minimum working pressure of 150 psi.
 - b. HDPE pipe and related fittings shall be made with prime virgin resins exhibiting a minimum cell classification as defined in ASTM D3350 and

- meeting the PE 4710 code designation.
- c. HDPE pipe 4-inch and larger nominal diameter shall be joined by means of zero leak-rate butt (thermal heat) fusion welds and/or approved flanged joints. Joints shall provide axial pullout resistance. Pipe shall meet the requirements of ANSI/AWWA C906 and have an outside diameter dimension of ductile iron pipe. Flanged joints shall not be used below finished grade for horizontal directional drilling applications.
 - d. HDPE pipe shall have been continuously marked by the manufacturer with permanent printing indicating at a minimum the following.
 - 1) Nominal size (inches);
 - 2) Dimension ratio (DR);
 - 3) Pressure rating (psi);
 - 4) Trade name;
 - 5) Material classification (PE 4710);
 - 6) Plant, extruder and operator codes;
 - 7) Resin supplier code;
 - 8) Date produced; and
 - 9) HDPE pipe used for portable water mains shall bear the NSF Seal of Approval.
 - e. HDPE pipe shall be black in color with permanent colored stripes extruded into the pipe along its entire length, a single painted stripe along its entire length, or shall be one solid color, per the applicable service.
 - f. Fittings used with HDPE pipe shall be mechanical joint ductile iron compact fittings in accordance with ANSI/AWWA A21.53/C153.
 - g. Installation Curvature: The pipeline curvature shall not have a radius less than shown in the following table:

HDPE Pipe Deflection Information.

Pipe Diameter (inches)	Minimum Radius of Curvature (feet)	Offset per 20-ft Length (inches)
4	23	9.3
6	34	6.1
8	44	4.6

10	56	3.5
12	67	3.0
16	88	2.3

Note: Deflections for pipe diameters larger than 16" shall be in accordance with the pipe manufacturer's recommendations.

2. Ductile Iron Pipe

- a. DI restrained joint pipe shall be Class 350, have appropriate joints specified for directional drill applications, and be in accordance with the recommendations set forth in manufacturer's "Guidelines for use Ductile Iron Pipe for Horizontal Directional Drilling applications".

3. PVC Pipe

- a. PVC restrained joint and Fusible PVC pipe shall have maximum dimension ratios equal to the following table.

Maximum Dimension Ratios for PVC Pipe.

Type of Pipe System	Maximum Dimension Ratio
Wastewater	25 (4"-12"), 25 (16"+)
Reclaimed Water	18 (4"-12"), 25 (16"+)
Water	18 (4"-12"), 25 (16"+)

- b. PVC pipe shall meet the requirements of AWWA C900. The pipe shall either be fused jointed or joined using separate couplings that have beveled edges, built-in sealing gaskets and restraining grooves or steel ring-and-pin gasketed joints. The restraining splines shall be square and made from Nylon 101. Pipe and couplings shall be Underwriters Laboratory and Factory Mutual approved.
- c. Installation Curvature: The pipeline curvature shall not have a radius less than as shown in the following table.

PVC Pipe Deflection Information.

Pipe Diameter (inches)	Minimum Radius of Curvature (feet)	Offset per 20-ft Length (inches)	Deflection per 20-ft Length (degrees)
4	133	17.25	8.6
6	200	12.00	5.7

8	266	9.00	4.3
10	333	6.75	3.5
12	400	6.00	2.9
16	532	4.50	1.5

Note: Deflections for pipe diameters larger than 16" shall be in accordance with the pipe manufacturer's recommendations.

B. Drilling Fluids

1. Disposal of fluids is the responsibility of the Contractor.
 - a. Dispose of fluids in a manner that is in compliance with all permits and applicable Federal, State, and local regulations.
2. Use a high quality bentonite drilling fluid to ensure hole stability, cuttings transport, bit and electronics cooling, and hole lubrication to reduce drag on the drill pipe and the product pipe.
 - a. Use only fluid with a composition which complies with all Federal, State, and local environmental regulations.
3. Mix the bentonite drilling fluid with potable water (of proper pH) to ensure no contamination is introduced into the soil during the drilling, reaming, or pipe installation process. The Contractor is responsible for any required pH adjustments.
4. Collect drilling fluid returns in the entrance pit, exit pit, or spoils recovery pit. Immediately clean up any drilling fluid spills or overflows from these pits.

Part 3 Execution

3.1 Installation

- A. Ensure all utilities are located and clearly marked prior to start of excavation or drilling.
- B. Drill Set-Up: Design and construct the drill entrance and exit pits.
- C. Drill Entrance and Exit Pits
 1. Drill entrance and exit pits are required.
 - a. Maintain at minimum size to allow only the minimum amount of drilling fluid storage prior to transfer to mud recycling or processing system or removal from the site.

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2. Do not allow drilling mud to flow freely on the site or around the entrance or exit pits.
 - a. Remove spilled mud and restore ground to original condition.
 - b. Provide shoring for pits in compliance with OSHA Standards, 29 CFR 1926.652.
 3. When drilling near wetlands or watercourses, provide secondary containment to prevent drilling fluids from entering the wetlands, and secure written approval of secondary containment plan from the Engineer.
- D. Drill Entrance and Exit Angle: Ensure entrance and exit angles and elevation profile maintains adequate cover to reduce risk of drilling fluid breakouts and ground exit occurs as specified herein.
1. Ensure that entrance and exit angles generate pullback forces that do not exceed 5 percent strain on the polyethylene pipe.
- E. Pilot Hole
1. The type and size of the pilot string cutting head and the diameter of the drill pipe is at the Contractor's discretion.
 2. Drill the pilot hole along the path shown on the plan and profile drawings.
 3. Pilot hole tolerances are as follows:
 - a. Vertical Tolerance: Provide minimum cover as specified on the plans. Pilot hole may go deeper if necessary to prevent breakout.
 - b. Horizontal Tolerance: Plus/minus – 60-inches from the centerline of the product pipe.
 - c. Curve Radius: No curve is acceptable with a radius less than 1,000-feet.
 - d. Entry Point Location: Make pilot hole entry point within plus/minus – 60-inches of the location shown on the drawings or as directed by the Engineer in the field.
 - e. Exit Point Location: Make the exit point location within plus/minus – 60-inches of the location shown on the drawings or as directed by the Engineer in the field.
 - f. Mandatory pipeline cover requirements are as shown on the drawings or as specified.
- F. Guidance Systems: Walkover guidance systems are not acceptable for this project; use a magnetic survey tool locator installed behind the pilot string cutting head and an electric grid (tru-tracker) system for this project.

- G. Reaming: Conduct reaming operations at the Contractor's discretion.
1. Determine the type of back reamer to be utilized by the type of subsurface soil conditions that are encountered during the pilot hole drilling operation. The reamer type is at the Contractor's discretion.
- H. Pull Back:
1. Fully assemble the entire pipeline to be installed via directional drill prior to commencement of pull back operations.
 2. Support the pipeline during pullback operations in a manner to enable it to move freely and prevent damage.
 3. Install the pipeline in one continuous pull.
 4. Minimize torsion stress by using a swivel to connect the pull section to the reaming assembly.
 5. Maximum allowable tensile force imposed on the pull section is not to exceed 90 percent of the pipe manufacturer's safe pull (or tensile) strength. If the pull section is made up of multiple pipe size or materials, the lowest safe pull strength value governs and the maximum allowable tensile force is not to exceed 90 percent of this value.
 6. Minimize external pressure during installation of the pullback section in the reamed hole. Replace damaged pipe resulting from external pressure at no cost to WOUD. Buoyancy modification is at the discretion of the Contractor.
- I. Locating wire shall be installed along the length of all directional drill mains. Two insulated 14 gauge locating wires or one single insulated 10 gauge wire specifically designed for locating directional bored mains shall be utilized. The insulation of the wire shall be color coded for the type of pipe being installed. Continuous continuity must be maintained in the wire along the entire length of the pipe run. Permanent splices must be made in the length of the wire using waterproof wire connectors approved for underground applications. The wire shall extend to the surface and be connected to a test station box at valve locations.
- J. Connection of Product Pipe to Pipeline: After the product pipe has been successfully installed, allow the product pipe to recover for 24 hours prior to connection of the pipeline. Ensure that a sufficient length of the product pipe has been pulled through the hole so that the pull-nose is not pulled back into bore hole due to stretch recovery of the product pipe.
- K. When HDPE pipe is to be connected to PVC or DI Pipe, mechanical joint adapters shall be utilized.
- L. When HDPE or Fusible PVC pipe connects to either push-on joint DI or PVC pipes, the DI or PVC pipes shall be restrained on either side of the HDPE section of pipe as specified in the table below:

Minimum Length to Be Restrained At HDPE Connection (ft)									
	Pipe Size								
Pipe Material	4"	6"	8"	10"	12"	16"	20"	24"	30"
DIP	40	40	40	40	40	40	40	40	60
PVC/HDPE	40	40	40	40	40	40	40	60	60

3.2 Field Quality Control

- A. Maintain drilling logs that accurately provide drill bit location (both horizontally and vertically) at least every 2-inches along the drill path. In addition, keep logs that record, as a minimum the following, every 15 minutes throughout each drill pass, back ream pass, or pipe installation pass:
1. Drilling Fluid Pressure
 2. Drilling Fluid Flow Rate
 3. Drill Thrust Pressure
 4. Drill Pullback Pressure
 5. Drill Head Torque
- B. Make all instrumentation, readings, and logs available to the Engineer at all times during operation.

3.3 Closeout Activities

- A. Immediately upon completion of work, remove all rubbish and debris from the job site. Remove all construction equipment and implements of service leaving the entire area involved in a neat condition acceptable to WOULD.
- B. Immediately clean "blow holes" or "breakouts" of drilling fluid to the surface and return the surface area to its original condition.
- C. Dispose of all drilling fluids, soils, and separated materials in compliance with Federal, State, and local environmental regulations.
- D. Submit an electronic copy and three hard copies of the record drawings to the Engineer within five days after completing the pull back. Include in the record drawings a plan, profile, and all information recorded during the progress of the work.

1. Clearly tie the record drawings to the project's survey control.
2. Maintain and submit upon completion signed complete work logs of guided directional drill operations.

END OF SECTION

Part 1 General

1.1 Section Includes

- A. This Section describes products to be incorporated into the water mains and requirements for the installation and use of these items. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.
- B. Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), National Science Foundation (NSF) Standard 61, or other recognized standards. Latest revisions of all standards are applicable. Additionally, products shall meet the Federal lead-free requirements as stated in the Reduction of Lead in Drinking Water Act.

1.2 Qualifications

- A. If requested by the Engineer, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two years.

1.3 Submittals

- A. Submit in accordance with Section 01 33 00 - Submittal Procedures.
- B. Submit to the Engineer shop drawings and product data for all products.
- C. Submit O&M manuals for valves and hydrants.
- D. Manufacturer's written certification of compliance with NSF 61, NSF 372, and lead-free requirements of U.S. State and Federal laws.

1.4 Delivery and Handling

- A. Unloading: Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Do not drop or dump materials. Any materials dropped or dumped will be subject to rejection without additional justification. Pipe handled on skids shall not be rolled or skidded against the pipe on the ground.

- B. Handling: Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front end loader. Do not use material damaged in handling. Slings, hooks or pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior coatings or internal lining of the pipe.

1.5 Storage and Protection

- A. Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas. Store PVC pipe away from non-solar heat and direct sunlight.
- B. Stored materials shall be kept safe from damage. Store materials on site in enclosures or under protective covering. The interior of all pipe, fittings, valves and other appurtenances shall be kept free from dirt or foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.
- C. Pipe shall not be stacked higher than the limits recommended by the manufacturer. The bottom tier shall be kept off the ground on timbers, rails or concrete. Pipe in tiers shall be alternated: bell, plain end; bell, plain end. At least two rows of timbers shall be placed between tiers and chocks affixed to each other in order to prevent movement. The timbers shall be large enough to prevent contact between the pipe in adjacent tiers.
- D. Stored gaskets shall be placed in a location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first in, first out basis.

1.6 WOULD Furnished Materials

- A. The Contractor shall submit, in conjunction with the construction progress schedule, a schedule of required deliveries for materials furnished by WOULD. The Contractor shall coordinate material shipments with WOULD and the material suppliers.
- B. The Contractor shall establish a delivery schedule with WOULD's material suppliers, subject to the requirements below and subject to the supplier's reasonable ability to accommodate such delivery schedule. The Contractor shall coordinate directly with the material suppliers the shipment, delivery and unloading of all WOULD furnished materials.
- C. Materials furnished by WOULD will be delivered by truck. The Contractor shall be responsible for unloading the pipe.
- D. The Contractor shall maintain communication with the material suppliers, and WOULD as necessary, to keep informed as to scheduled shipment and upon notice to the Contractor of the delivery of materials, the Contractor shall proceed without delay to unload such materials.
- E. Upon receipt of materials from the manufacturer, the Contractor shall make an inspection of such materials, checking and certifying the bill of lading, noting any

discrepancies and obtaining a proper memorandum signed by the agent of the carrier for any shortage in the shipment, or for any damaged materials received. All bills of lading and any memorandum for shortage or damage of material in the shipment shall be promptly submitted to WOULD. The Contractor shall be responsible for distribution of all materials as required to complete the work. Materials furnished to the Contractor shall be in the custody of the Contractor from the time of receipt by the Contractor of such materials from the carrier until final acceptance of the completed Work. The Contractor shall be responsible for any loss or damage to materials furnished by WOULD.

Part 2 Products

2.1 Ductile Iron Pipe (DIP)

- A. Ductile iron pipe shall be manufactured in accordance with AWWA C151. All pipe, except specials, shall be furnished in nominal lengths of 18 to 20 feet. Sizes shall be as shown on the Drawings. All pipe shall have a minimum pressure rating as indicated in the following table, and corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings:

Pipe Sizes (inches)	Pressure Class (psi)
4 - 12	350
14 - 20	250
24	200
30 - 64	150

- B. Flanged pipe minimum wall thickness shall be equal to Special Class 53.
- C. Pipe shall be cement lined in accordance with AWWA C104. Pipe shall be furnished with a bituminous outside coating. Seal coat over the cement lining is not required.
- D. Fittings shall be ductile iron and shall conform to AWWA C110 or AWWA C153 with a minimum rated working pressure of 250 psi. Fittings shall be cement lined in accordance with AWWA C104 and shall be furnished with a bituminous outside coating. Seal coat over the cement lining is not required. In lieu of cement lining and bituminous coating, fittings may be provided with a fusion bonded coating and lining meeting the requirements of AWWA C116.
- E. Joints
1. Unless shown or specified otherwise, joints for buried service shall be push-on or restrained joint type for pipe and standard mechanical or restrained joints for fittings. Joints for exposed service shall be flanged for pipe and fittings, unless otherwise shown. Push-on and mechanical joints shall conform to AWWA C111.
 2. Restrained joints: Where restrained joint pipe (RJP) is shown on the

Drawings, restrained joints for pipe diameters 16-inch and less shall be manufactured restrained joint, mechanical joint fitting with retainer gland or restraining gasket joint as specified below. For pipe diameters 18-inch or greater restrained joints shall be manufactured restrained joint as specified below.

Manufactured restrained joints shall be American "Flex-Ring" or "Lok-Ring"; U.S. Pipe "TR FLEX" or "HP LOK"; or McWane Ductile "TR FLEX" or "THRUST-LOCK." No field welding of restrained joint pipe will be permitted.

- a. Restraining gasket joints shall be assembled with American Fast-Grip gaskets or U.S. Pipe FIELD LOK gaskets but may only be used in lieu of manufactured restrained joints where approved by the Engineer.
 - b. Retainer glands on a mechanical joint may be used as a restrained joint only where approved by WOULD.
 - c. Where retainer glands are allowed, in lieu of retainer glands specified elsewhere, the joint may be assembled with US Pipe MJ FIELD LOK gasket.
 - d. No field welding for manufactured restrained joint pipe assembly will be permitted. Where field cutting of restrained joint pipe is required, the joint may be assembled with American Field Flex-Rings or US Pipe TR FLEX GRIPPER Rings.
3. Flanged joints shall meet the requirements of AWWA C115, except that flanges shall be solid and not hollow-back type. Flanges shall be of ductile iron material. Flange adaptors shall not be allowed in lieu of manufactured flanged joints.
 4. Provide the appropriate gaskets for mechanical and flange joints. Flange gaskets shall be bulb type and shall be ACIPCO Toruseal Flange Gasket or U.S. Pipe RING FLANGE-TYTE Gasket. Gaskets shall be plain rubber (styrene butadiene copolymer – SBR).
 5. Bolts and Nuts
 - a. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit.
 - b. Bolts and nuts for mechanical joints shall be Tee Head Bolts and nuts of high strength low-alloy steel in accordance with ASTM A242 to the dimensions shown in AWWA C111/ANSI A21.11.
 - c. Flanged joints shall be bolted with through, stud, or tap bolts of required size as directed. Bolt length and diameter shall conform to AWWA C115.
 - d. Bolts for exposed service shall be zinc plated, cold pressed, steel

machine bolts conforming to ASTM A 307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A 563. Zinc plating shall conform to ASTM B 633, Type II.

- e. Bolts for submerged service shall be stainless steel machine bolts conforming to ASTM A 193, Grade B8. Nuts shall be heavy hex, stainless steel conforming to ASTM A 194, Grade 8.

6. Mechanical joint glands shall be ductile iron.

- F. Flexible, restrained joint pipe shall be minimum Class 250. Joints shall be ball and socket type providing restraint and leak tight connections for up to 15 degrees of joint deflection. Flexible, restrained joint pipe shall be equal to American "FLEX-LOK", U.S. Pipe "USIFLEX", or Ball and Socket Joint pipe as manufactured by McWane Ductile. Appropriate transition pieces shall be utilized on each end of run of flexible joint pipe. All joint material required for proper installation shall be furnished by the pipe manufacturer.
- G. Pipe boss outlets shall be welded-on ductile iron pipe. Outlets shall be plain end, push-on, mechanical joint or flanged joint as shown on the Drawings. Outlets shall be free of burrs. Sizes shall be as indicated on the Drawings. The outlets and parent pipe shall be minimum Class 53 ductile iron pipe for parent pipe 54-inches and smaller. For pipe larger than 54-inches, parent pipe shall be Pressure Class 350.
- H. Thrust collars shall be welded-on ductile iron body type designed to withstand thrust due to 250 psi internal pressure on a dead end.
- I. Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.
- J. Ductile iron pipe shall be manufactured by American Cast Iron Pipe Company, U.S. Pipe or McWane Ductile.

2.2 Polyvinyl Chloride (PVC) Piping – AWWA Type

- A. Pipe 4-Inches Through 48-Inches in Diameter:
 - 1. Pipe shall have gasket belled ends for push-on type jointing and shall conform to AWWA C900, ductile iron pipe equivalent outside diameters. The pipe shall have a Dimension Ratio (DR) of 25, 18, or 14 and shall be capable of withstanding a working pressure of 165, 235, or 305 psi as dictated by the design. Pipe shall be supplied in minimum lengths of 20 feet. Each length of pipe furnished shall bear identification markings in conformance with AWWA Standard C900.
- B. Fittings for PVC Pipe: Fittings shall be ductile iron and shall conform to AWWA C110 or AWWA C153 with a minimum rated working pressure of 250 psi. Fittings shall be cement lined in accordance with AWWA C104 and shall be furnished with a bituminous outside coating. Seal coat over the cement lining is not required. In lieu of

cement lining and bituminous coating, fittings may be provided with a fusion bonded coating and lining meeting the requirements of AWWA C116.

- C. Joints and Jointing Material: Joints for pipe shall be gasketed push-on joints, meeting the requirements of ASTM D3139. Joints between pipe and fittings, valves, and other accessories shall be mechanical joints, meeting the requirements of ASTM D3139 or AWWA C111. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, shall comply with ASTM F477. Gaskets for mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories shall comply with AWWA C111.
- D. Restrained Joints: Restrained joints shall be made with a spline and O-ring system, equal to Certa-Lok pipe by North American Pipe Company. Pipe shall meet all requirements of AWWA C900. High strength, flexible thermoplastic splines shall be inserted into mating, precision-machined grooves in the pipe and coupling to provide full 360 degree restraint with evenly distributed loading. Couplings shall be designed for use at or above the rated pressures of the pipe and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477.
- E. Restrained Joints at Fittings: Where shown on the Drawings and approved by WOOD, retainer glands shall be used to restrain pipe to fittings.
- F. Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards, including the National Sanitation Foundation (NSF). Additionally, each piece of pipe shall be stamped "NSF Approved".

2.3 Detection Tape

- A. Detection Tape: Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket. Tapes shall be color coded in accordance with APWA color codes with the following legends: Potable water, Safety Precaution Blue, "Caution Water Line Buried Below". Colors may be solid or striped. Tape shall be permanently printed with no surface printing allowed. Tape width shall be a minimum of 2 inches when buried less than 10 inches below the surface. Tape width shall be a minimum of 3 inches when buried greater than 10 inches and less than 20 inches.

2.4 Tracer Wire

- A. Tracer wire shall be a #12 AWG (minimum) copper conductor, insulated with a minimum 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use. HDPE insulation shall be RoHS compliant and utilize virgin grade material.

2.5 Valves

- A. General: All external nuts, bolts, studs, fasteners or accessories shall be of stainless steel or other corrosion-resistant material.

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- B. Gate Valves - Less than 3-Inches in Diameter: See Section 33 12 13 of these Specifications.
- C. Gate Valves - 3-Inches in Diameter and Larger: Gate valves shall be resilient wedge type conforming to the requirements of AWWA C509 (sizes 3-inches to 12-inches) or AWWA C515 (sizes 3-inches to 48-inches) rated for 200 psi working pressure.
1. Valves shall be provided with two O-ring stem seals with one O-ring located above and one O-ring below the stem collar. The area between the O-rings shall be filled with lubricant to provide lubrication to the thrust collar bearing surfaces each time the valve is operated. At least one anti-friction washer shall be utilized to further minimize operating torque. All seals between valve parts, such as body and bonnet, bonnet and bonnet cover, shall be flat gaskets or O-rings.
 2. The valve gate shall be made of cast or ductile iron having a vulcanized, synthetic rubber coating, or a seat ring attached to the disc with retaining screws. Sliding of the rubber on the seating surfaces to compress the rubber will not be allowed. The design shall be such that compression-set of the rubber shall not affect the ability of the valve to seal when pressure is applied to either side of the gate. The sealing mechanism shall provide zero leakage at the water working pressure when installed with the line flow in either direction.
 3. All internal ferrous surfaces shall be coated with epoxy to a minimum thickness of 4 mils. The epoxy shall be non-toxic, impart no taste to the water and shall conform to AWWA C550.
 4. Valves shall be mechanical joint type except where shown otherwise on the Drawings.
 5. Valves shall have 2-inch square operating nuts, be non-rising stem type and shall open left.
 6. Gate valves shall be manufactured by American Flow Control, Mueller or M & H Valve.
- D. Butterfly Valves
1. Butterfly valves shall be resilient seated, short or long body design, and shall be designed, manufactured, and tested in accordance with all requirements of AWWA C504 for Class 150B.
 2. Valve bodies shall be ductile iron conforming to ASTM A 536, Grade 65 45 12 or ASTM A 126, Grade B cast iron. Shafts shall be ASTM A 276, Type 304 stainless steel, machined and polished. Valve discs shall be ductile iron, ASTM A 536, Grade 65 45 12 or ASTM A 126, Grade B cast iron. The valve shall have a resilient seat.
 3. Valves shall be installed with the valve shafts horizontal. Valves and

actuators shall have seals on all shafts and gaskets on valve actuator covers to prevent the entry of water. Actuator mounting brackets shall be totally enclosed and shall have gasket seals.

4. Actuators

- a. Valves shall be equipped with traveling nut, self-locking type actuators designed, manufactured and tested in accordance with AWWA C504. Actuators shall be capable of holding the disc in any position between full open and full closed without any movement or fluttering of the disc.
 - b. Actuators shall be furnished with fully adjustable mechanical stop limiting devices. Actuators that utilize the sides of the actuator housing to limit disc travel are unacceptable.
 - c. Valve actuators shall be capable of withstanding a minimum of 450 foot pounds of input torque in either the open or closed position without damage.
5. Operators: Valves for buried service shall have a nut type operator and shall be equipped with a valve box and stem extension, as required.
6. Valve ends shall be mechanical joint type, except where flanged or restrained joint ends are shown. Flange joints shall meet the requirements of ANSI B16.1, Class 125.
7. Butterfly valves shall be manufactured by Mueller, M & H Valve, DeZurik, Val-Matic, or Pratt.

2.6 Fire Hydrants

- A. All fire hydrants shall conform to the requirements of AWWA C502 for 250 psi working pressure. Hydrants shall be the compression type, closing with line pressure. The valve opening shall not be less than 5 1/4 inches.
- B. In the event of a traffic accident, the hydrant barrel shall break away from the standpipe at a point above grade and in a manner which will prevent damage to the barrel and stem, preclude opening of the valve, and permit rapid and inexpensive restoration without digging or cutting off the water.
- C. The means for attaching the barrel to the standpipe shall permit facing the hydrant a minimum of eight different directions.
- D. Hydrants shall be fully bronze mounted with all working parts of bronze. Valve seat ring shall be bronze and shall screw into a bronze retainer. All external nuts, bolts, studs, fasteners or accessories shall be of stainless steel or other corrosion-resistant material.
- E. All working parts, including the seat ring shall be removable through the top without disturbing the barrel of the hydrant.

- F. Hydrants shall have a 1-1/2-inch Hex head operating nut and shall open left. The operating threads shall be totally enclosed in an operating chamber, separated from the hydrant barrel by a rubber O ring stem seal and lubricated by a grease or an oil reservoir.
- G. Hydrant shall be a non-freezing design and be provided with a simple, positive, and automatic drain which shall be fully closed whenever the main valve is opened.
- H. Hose and pumper connections shall be breech locked, pinned, or threaded and pinned to seal them into the hydrant barrel. Each hydrant shall have two 2 1/2 inch hose connections and one 4 1/2 inch pumper connection, all with National Standard threads and each equipped with cap and non-kinking chain.
- I. Hydrants shall be furnished with a mechanical joint connection to the spigot of the 6 inch hydrant lead.
- J. Minimum depth of bury shall be 4.0 feet. Provide extension section where necessary for proper vertical installation and in accordance with manufacturer's recommendations.
- K. All outside surfaces of the barrel above grade shall be painted in a color to be selected by the WOULD with a coating system per the manufacturer's recommendations.
- L. Hydrants shall be traffic model and shall be American Flow Control B 84 B, Mueller Super Centurion or M & H Valve 929.

2.7 Valve Boxes and Extension Stems

- A. All valves shall be equipped with valve boxes. The valve boxes shall be cast iron two piece screw type with drop covers. Valve boxes shall have a 5.25 inch inside diameter. Valve box covers shall weigh a minimum of 13 pounds. The valve boxes shall be adjustable to 6 inches up or down from the nominal required cover over the pipe. Valve boxes shall be of sufficient length that bottom flange of the lower belled portion of the box is below the valve operating nut. Ductile or cast iron extensions shall be provided as necessary. Covers shall have "WATER VALVE" or "WATER" cast into them.
- B. All valves shall be furnished with extension stems, as necessary, to bring the operating nut to within 30 inches of the top of the valve box. Connection to the valve shall be with a wrench nut coupling and a set screw to secure the coupling to the valve's operating nut. The coupling and square wrench nut shall be welded to the extension stem. Extension stems shall be equal to Mueller A 26441 or M & H Valve Style 3801.

2.8 Tapping Sleeves and Valves

- A. Tapping sleeves shall be cast or ductile iron of the split sleeve, mechanical joint type. The Contractor shall be responsible for determining the outside diameter of the pipe to be connected to prior to ordering the sleeve. Valves shall be gate valves furnished as specified elsewhere in this Section, with flanged connection to the

tapping sleeve and mechanical joint connection to the branch pipe. The tapping sleeve and valve shall be supplied by the valve manufacturer. Tapping sleeves shall be equal to American Flow Control, Mueller or M & H Valve.

2.9 Tapping Service Saddles

- A. See Section 33 12 13 of these Specifications.

2.10 Corporation Cocks and Curb Stops

- A. See Section 33 12 13 of these Specifications.

2.11 Air Valves for Water Service

- A. Air Release Valves: Air release valves shall be one of the following types:

1. The air release valve shall automatically release air accumulations from the pipeline due to the action of the float. When the air valve body fills with air, the float falls freely from the orifice to allow the air to escape to the atmosphere. When all the air has been exhausted from the valve body, the float will be buoyed up to seat against the orifice and prevent water from being exhausted from the valve. The valve body and cover shall be constructed of cast iron (ASTM A 126 B). A synthetic orifice button shall be affixed to the valve cover to provide a non-corrosive seat for the float. The float shall be constructed of stainless steel. A resilient, Buna N seat shall be attached to the float for drop tight closure. The float shall be free floating within the valve body. Valve orifice size shall be as shown on the Drawings.

- B. Air/Vacuum Valve: The air/vacuum valve shall discharge large amounts of air as the pipeline fills and allow air to enter the pipeline as it drains or in the event of vacuum conditions. The valve shall operate by means of a non-collapsible stainless steel float which seals an orifice. As air enters the valve the float shall drop from the orifice and allow the air to escape. As water rises in the valve, the float will again seal the orifice. The valve will be of such design that the float cannot blow shut at any air velocity. All working parts shall be of stainless steel. The inside of the valve body shall be epoxy coated. Valve inlet size shall be as shown on the Drawings.

- C. Combination Air Valves: Combination air valves shall combine the features of an air release valve and an air/vacuum valve and shall be of one of the following types:

1. Valve shall consist of an air/vacuum valve described in Paragraph B. above, with an air release valve described in Paragraph A. above, tapped into its body. The valve shall be of two piece body design with an isolation gate valve separating the two valves.
2. Valve shall be single body, double orifice, allowing large volumes of air to escape out the larger diameter air and vacuum orifice when filling a pipeline and closes watertight when the liquid enters the valve. During large orifice closure, the smaller diameter air release orifice will open to allow small pockets of air to escape automatically and independently of the large orifice.

The large air/vacuum orifice shall also allow large volumes of air to enter through the orifice during pipeline drainage to break the vacuum. The Buna N seats must be fastened to the valve, without distortion, for drop tight shut off. The float shall be stainless steel. Valve sizes shall be as shown on the Drawings.

- D. All air valves and accessories shall be supplied by a single manufacturer and shall be G.A. Industries, APCO Valve Corporation, Vent-O-Mat or Val-Matic.

2.12 Manholes and Precast Concrete Products

- A. Provide precast concrete products in accordance with the following:

1. Precast Concrete Sections

- a. Precast concrete sections shall meet the requirements of ASTM C 478 for round shaped and ASTM C913 for rectangular shaped concrete products. The minimum compressive strength of the concrete in precast sections shall be 4,000 psi. The minimum wall thickness shall be one twelfth of the inside diameter of the base, riser or the largest cone diameter.
- b. Transition slabs which convert bases larger than four feet in diameter to four foot diameter risers shall be designed by the precast concrete manufacturer to carry the live and dead loads exerted on the slab.
- c. Seal joints between precast sections by means of rubber O ring gaskets or flexible butyl rubber sealant. Butyl rubber sealants shall meet the requirements of AASHTO M 198. Sealant shall be pre-formed type with a minimum nominal diameter of 1 inch.
- d. Butyl rubber sealant shall be equal to Kent Seal No. 2 or Concrete Sealants CS 202.

2. Brick and Mortar: Brick shall be whole and hard-burned, conforming to ASTM C 32, Grade MS. Mortar shall be made of one part Portland cement and two parts clean sharp sand. Cement shall be Type 1 and shall conform to ASTM C 150. Sand shall meet ASTM C 144.

3. Iron Castings

- a. Cast iron manhole frames, covers and steps shall meet the requirements of ASTM A 48 for Class 30 gray iron and all applicable local standards. All castings shall be tough, close grained, smooth and free from blow holes, blisters, shrinkage, strains, cracks, cold shots and other imperfections. No casting will be accepted which weighs less than 95 percent of the design weight. Shop drawings must indicate the design weight and provide sufficient dimensions to permit checking. All castings shall be thoroughly cleaned in the shop and given two coats of approved bituminous paint before rusting begins.

- b. All frames and covers shall have machined horizontal bearing surfaces.
 - c. Bolt down covers shall be equipped with four 1/2-inch stainless steel bolts and a 1/8 inch red rubber or rubber O ring gasket. Covers shall be rotatable and interchangeable. Bolt holes shall be bored through so that debris entering the bolt hole will fall into the manhole. Bolt holes shall have the full 360 degree circle within the cover's radius when bored through the cover.
4. Plastic Steps: Manhole steps of polypropylene, molded around a steel rod, equal to products of M.A. Industries may be used.
5. Floor Door
- a. Door shall be single or double leaf type as shown on the Drawings.
 - b. The frame shall be 1/4-inch extruded aluminum alloy 6063 T6, with built in neoprene cushion and with strap anchors bolted to the exterior. Door leaf shall be 1/4-inch aluminum diamond plate, alloy 6061 T6, reinforced with aluminum stiffeners as required. Stainless steel hinges shall be bolted to the underside and pivot on torsion bars that counterbalance the door for easy operation. The door shall open to 90 degrees and lock automatically in that position. A vinyl grip handle shall be provided to release the cover for closing. The door shall be built to withstand a live load of 150 pounds per square foot and shall be equipped with a snap lock and removable handle. Bituminous coating shall be applied to exterior of frame by the manufacturer.
 - c. The floor door shall be as manufactured by The Bilco Company or Washington Aluminum Company, Thomson Fabricating, USF Fabricators, or Halliday Products.
6. Where vent pipes are shown on the Drawings, vents shall be of one piece, welded steel construction. Vent pipes shall equal air valve size, but no less than 4 inches. The vent pipe shall be grouted into a precast hole in the vault. The discharge of the vent pipe shall be provided with a 3/16-inch PVC coated mesh screen.
7. Where vent pipes are not shown on the Drawings, the frame and cover or floor door shall be provided with 1 inch holes to provide equivalent opening as in air valve, but not less than two. The quantity for each valve size is as follows: 2 inch, 4; 3 inch, 9; 4 inch, 16; 6 inch, 36; 8 inch, 64.

2.13 Retainer Glands

- A. Retainer glands shall be provided at all mechanical joints, including fittings, valves, hydrants and other locations as shown on the Drawings.
- B. Retainer glands for ductile iron pipe shall be Megalug Series 1100, as manufactured by EBAA Iron, Uni-Flange Series 1400, as manufactured by Ford Meter Box Company, Star Pipe Products Star-Grip Series 3000, or Sigma One-Lok Series

SLD.

- C. Retainer glands for PVC pipe shall be Megalug Series 200PV, as manufactured by EBAA Iron, Uni-Flange Series 1300, Star Pipe Products Star-Grip Series 4000, or Sigma One-Lok Series SLCE.

2.14 Hydrant Tees

- A. Hydrant tees shall be equal to ACIPCO A10180 or U.S. Pipe U 592.

2.15 Anchor Couplings

- A. Lengths and sizes shall be as shown on the Drawings. Anchor couplings shall be equal to ACIPCO A 10895 or U.S. Pipe U 591.

2.16 Valve Keys

- A. The Contractor shall provide to WOULD one valve key for every five valves provided, but no more than three and not less than one valve key. Valve keys shall be 72 inches long with a tee handle and a 2 inch square wrench nut. Valve keys shall be furnished by the valve manufacturer. Valve keys shall be equal to Mueller A 24610 or ACIPCO No. 1303.

2.17 Concrete

- A. Concrete shall have a compressive strength of not less than 3,000 psi, with not less than 5.5 bags of cement per cubic yard and a slump between 3 and 5 inches. For job mixed concrete, submit the concrete mix design for approval by the Engineer. Ready mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.

2.18 Flowable Fill

- A. Flowable fill shall meet the specifications of the Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction, Section 204.06.B.

2.19 Polyethylene Encasement

- A. Polyethylene encasement for use with ductile iron pipe shall meet all the requirements for ANSI/AWWA C105/A21.5, Polyethylene Encasement for Ductile Iron Pipe Systems. Polyethylene encasement shall consist of three layers of co-extruded linear low density polyethylene (LLDPE), fused into a single thickness of not less than 8 mils.
- B. The inside surface of the polyethylene wrap to be in contact with the pipe exterior shall be infused with a blend of anti-microbial biocide to mitigate microbiologically influenced corrosion and a volatile corrosion inhibitor to control galvanic corrosion.

Part 3 Execution

3.1 Existing Utilities and Obstructions

- A. The Drawings indicate utilities or obstructions that are known to exist according to the best information available to WOUD. The Contractor shall contact, by dialing 811, the Tennessee Utilities Protection Center, as applicable, and all utilities, agencies or departments that own and/or operate utilities in the vicinity of the construction work site at least 72 hours (three business days) prior to construction to verify the location of the existing utilities.
- B. Existing Utility Location: The following steps shall be exercised to avoid interruption of existing utility service.
 - 1. Provide the required notice to the utility owners and allow them to locate their facilities according to applicable local and state law. Field utility locations are valid for only 10 days after original notice. The Contractor shall ensure, at the time of any excavation that a valid utility location exists at the point of excavation.
 - 2. Expose the facility, for a distance of at least 200 feet in advance of pipeline construction, to verify its true location and grade. Repair, or have repaired, any damage to utilities resulting from locating or exposing their true location.
 - 3. Avoid utility damage and interruption by protection with means or methods recommended by the utility owner.
 - 4. Maintain a log identifying when phone calls were made, who was called, area for which utility relocation was requested and work order number issued, if any. The Contractor shall provide the Engineer an updated copy of the log bi-weekly, or more frequently if required.
- C. Conflict with Existing Utilities
 - 1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed water main does not permit installation of the water main by the use of sheeting, shoring, tying back, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the water main to avoid horizontal conflicts if the new alignment remains within the available right of way or easement, complies with regulatory agency requirements and after a written request to and subsequent approval by the Engineer. Where such relocation of the water main is denied by the Engineer, the Contractor shall arrange to have the utility, main, or service relocated.
 - 2. Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between a utility, main, or service and the proposed water main does not permit the crossing without immediate or potential future damage to the utility, main, service, or the water main. The Contractor may change the

proposed grade of the water main to avoid vertical conflicts if the changed grade maintains adequate cover and complies with regulatory agencies requirements after written request to and subsequent approval by the Engineer. Where such relocation of the water main is denied by the Engineer, the Contractor shall arrange to have the utility, main, or service relocated.

D. Water and Sewer Separation

1. Water mains should maintain a minimum 10 foot edge to edge separation from sewer lines, whether gravity or pressure. If the main cannot be installed in the prescribed easement or right of way and provide the 10 foot separation, the separation may be reduced, provided the bottom of the water main is a minimum of 18 inches above the top of the sewer. Should neither of these two separation criteria be possible, the water main shall be installed below the sewer with a minimum vertical separation of 18 inches.
2. The water main, when installed below the sewer, shall be encased in concrete with a minimum 6 inch concrete depth to the first joint in each direction. Where water mains cross the sewer, the pipe joint adjacent to the pipe crossing the sewer shall be cut to provide maximum separation of the pipe joints from the sewer.
3. No water main shall pass through, or come in contact with, any part of a sanitary sewer manhole.

3.2 Construction Along Highways, Streets and Roadways

- A. Install pipe lines and appurtenances along highways, streets and roadways in accordance with the applicable regulations of, and permits issued by the Tennessee Department of Transportation (TDOT), Overton County and the City with reference to construction operations, safety, traffic control, road maintenance and repair.
- B. Traffic Control
 1. The Contractor shall provide, erect and maintain all necessary barricades, suitable and sufficient lights and other traffic control devices; provide qualified flagmen where necessary to direct traffic; take all necessary precautions for the protection of the work and the safety of the public. Flagmen shall be certified by a Tennessee DOT (as applicable) approved flagman training program.
 2. Construction traffic control devices and their installation shall be in accordance with the Manual On Uniform Traffic Control Devices for Streets and Highways and permits issued for this Project.
 3. Placement and removal of construction traffic control devices shall be coordinated with the permitting agencies as required by the permitting agencies.
 4. Placement of construction traffic control devices shall be scheduled ahead of associated construction activities. Construction time in street right of way

shall be conducted to minimize the length of time traffic is disrupted. Construction traffic control devices shall be removed immediately following their useful purpose. Traffic control devices used intermittently, such as "Flagmen Ahead", shall be removed and replaced when needed.

5. Existing traffic control devices within the construction work zone shall be protected from damage. Traffic control devices requiring temporary relocation shall be located as near as possible to their original vertical and horizontal locations. Original locations shall be measured from reference points and recorded in a log prior to relocation. Temporary locations shall provide the same visibility to affected traffic as the original location. Relocated traffic control devices shall be reinstalled in their original locations as soon as practical following construction.
6. Construction traffic control devices shall be maintained in good repair and shall be clean and visible to affected traffic for daytime and nighttime operation. Traffic control devices affected by the construction work zone shall be inspected daily.
7. Construction warning signs shall be black legend on an orange background. Regulatory signs shall be black legend on a white background. Construction sign panels shall meet the minimum reflective requirements of the permitting agencies. Sign panels shall be of durable materials capable of maintaining their color, reflective character and legibility during the period of construction.
8. Channelization devices shall be positioned preceding an obstruction at a taper length as required by the Manual on Uniform Traffic Control Devices for Streets and Highways, as appropriate for the speed limit at that location. Channelization devices shall be patrolled to ensure that they are maintained in the proper position throughout their period of use.

C. Construction Operations

1. Perform all work along highways, streets and roadways to minimize interference with traffic.
2. Stripping: Where the pipeline is laid along road right of way, strip and stockpile all sod, topsoil and other material suitable for right of way restoration.
3. Trenching, Laying and Backfilling: Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.
4. Shaping: Reshape damaged slopes, side ditches, and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.

- D. Excavated Materials: Do not place excavated material along highways, streets and roadways in a manner which obstructs traffic. Sweep all scattered excavated material off of the pavement in a timely manner.

- E. Drainage Structures: Keep all side ditches, culverts, cross drains, and other drainage structures clear of excavated material. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.
- F. Landscaping Features: Landscaping features shall include, but are not necessarily limited to: fences; property corners; cultivated trees and shrubbery; manmade improvements; subdivision and other signs within the right of way and easement. The Contractor shall take extreme care in moving landscape features and promptly re-establishing these features.
- G. Maintaining Highways, Streets, Roadways and Driveways
 - 1. Maintain streets, highways, roadways and driveways in suitable condition for movement of traffic until completion and final acceptance of the work.
 - 2. During the time period between pavement removal and completing permanent pavement replacement, maintain highways, streets and roadways by the use of steel running plates. Running plate edges shall have asphalt placed around their periphery to minimize vehicular impact. The backfill above the pipe shall be compacted as specified elsewhere up to the existing pavement surface to provide support for the steel running plates.
 - 3. Furnish a road grader or front end loader for maintaining highways, streets, and roadways. The grader or front end loader shall be available at all times.
 - 4. Immediately repair all driveways that are cut or damaged. Maintain them in a suitable condition for use until completion and final acceptance of the work.

3.3 Pipe Distribution

- A. Pipe shall be distributed and placed in such a manner that will not interfere with traffic.
- B. No pipe shall be strung further along the route than 1,000 feet beyond the area in which the Contractor is actually working without written permission from WOULD. WOULD reserves the right to reduce this distance to a maximum distance of 200 feet in residential, commercial or otherwise congested areas based on the effects of the distribution to the adjacent property owners.
- C. No street or roadway may be closed for unloading of pipe without first obtaining permission from the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets and roadways upon which pipe is distributed.
- D. No distributed pipe shall be placed inside drainage ditches.
- E. Distributed pipe shall be placed as far as possible from the roadway pavement, but no closer than five feet from the roadway pavement, as measured edge to edge.

3.4 Location and Grade

- A. The Drawings show the alignment and grade of the water main and the location of valves, hydrants and other appurtenances.
- B. Prior to clearing and grubbing, the Engineer will provide a temporary bench mark along the water main route [a hub at the center line of each bend] and at all other locations where the alignment of the water main changes significantly.
- C. Construction Staking
 - 1. The base lines for locating the principal components of the work are shown on the Drawings. Base lines shall be defined as the line to which the location of the water main is referenced, i.e., edge of pavement, road centerline, property line, right of way or survey line. The Contractor shall be responsible for performing all survey work required for constructing the water main, including the establishment of base lines and any detail surveys needed for construction. This work shall include the staking out of permanent and temporary easements to ensure that the Contractor is not deviating from the designated easements.
 - 2. The level of detail of survey required shall be that which the correct location of the water main can be established for construction and verified by the Engineer. Where the location of components of the water main, e.g. casings, hydrants and fittings, are not dimensioned, the establishment on the location of these components shall be based upon scaling these locations from the Drawings with relation to readily identifiable land marks, e.g., survey reference points, power poles, manholes, etc.
- D. Reference Points
 - 1. The Contractor shall take all precautions necessary, which includes, but is not necessarily limited to, installing reference points, in order to protect and preserve the centerline or baseline established by the Engineer.
 - 2. Reference points shall be placed, at or no more than three feet, from the outside of the construction easement or right of way. The location of the reference points shall be recorded in a log with a copy provided to the Engineer for use, prior to verifying reference point locations.
 - 3. The Contractor shall give the Engineer reasonable notice that reference points are set. The reference point locations must be verified by the Engineer prior to commencing clearing and grubbing operations.
- E. After the Contractor locates and marks the water main centerline or baseline, the Contractor shall perform clearing and grubbing.
- F. Construction shall begin at a connection location and proceed without interruption. Multiple construction sites shall not be permitted without written authorization from the Engineer for each site.

- G. The Contractor shall be responsible for any damage done to reference points, base lines, center lines and temporary bench marks, and shall be responsible for the cost of re-establishment of reference points, base lines, center lines and temporary bench marks as a result of the operations.

3.5 Laying and Jointing Pipe and Accessories

- A. Lay all pipe and fittings to accurately conform to the lines and grades established by the Engineer.
- B. Pipe Installation
 1. Proper implements, tools and facilities shall be provided for the safe performance of the work. All pipe, fittings, valves and hydrants shall be lowered carefully into the trench by means of slings, ropes or other suitable tools or equipment in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.
 2. All pipe, fittings, valves, hydrants and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.
 3. All lumps, blisters and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and free from dirt, sand, grit or any foreign materials before the pipe is laid. No pipe containing dirt shall be laid.
 4. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing or other materials shall be placed in the pipe at any time.
 5. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
 6. It is not mandatory to lay pipe with the bells facing the direction in which work is progressing.
 7. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade, shall not be permitted.
 8. Provide detection tape for all pipe. Detection tape shall be buried 4 to 10 inches deep. Should detection tape need to be installed deeper, the Contractor shall provide 3 inch wide tape. In no case shall detection tape be buried greater than 20 inches from the finish grade surface.
 9. Provide tracer wire for all pipe.
 10. Where pipes of dissimilar materials are joined together, provide adapters as

shown on the Drawings.

C. Alignment and Gradient

1. Lay pipe straight in alignment and gradient or follow true curves as nearly as practicable.
2. Offset: Maximum offset in alignment between adjacent pipe joints shall no more than 75% of value recommended by the manufacturer and approved by the Engineer but shall not exceed 5 degrees.
3. Maintain a transit, level and accessories on the job to lay out angles and ensure that deflection allowances are not exceeded.

D. Expediting of Work: Excavate, lay the pipe, and backfill as closely together as possible. Do not leave unjointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of the installed pipe each day at the close of work and at all other times when work is not in progress. If necessary to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either push on, mechanical joint, restrained joint or as approved by the Engineer.

E. Joint Assembly

1. Push on, mechanical, flange and restrained type joints shall be assembled in accordance with the manufacturer's recommendations.
2. The Contractor shall inspect each pipe joint within 1,000 feet on either side of main line valves to ensure 100 percent seating of the pipe spigot, except as noted otherwise.
3. Unless noted otherwise, each restrained joint shall be inspected by the Contractor to ensure that it has been "homed" 100 percent.
4. The Contractor shall internally inspect each pipe joint to ensure proper assembly for pipe 30 inches in diameter and larger after the pipe has been brought to final alignment.

F. Cutting Pipe: Cut ductile iron pipe using an abrasive wheel saw. Cut PVC pipe using a suitable saw; remove all burrs and smooth the end before jointing. The Contractor shall cut the pipe and bevel the end, as recommended by the manufacturer, to provide the correct length of pipe necessary for installing the fittings, valves, accessories and closure pieces in the correct location. Only push-on joint pipe shall be cut.

G. Polyethylene Encasement: Ductile iron pipe, fittings, and valves shall be encased in polyethylene film where shown on the Drawings, where specified, or where ordered by the Engineer. Installation shall be in accordance with AWWA C105 and the manufacturer's instructions. All ends shall be securely closed with tape and all damaged areas shall be completely repaired to the satisfaction of the Engineer.

H. Valve and Fitting Installation

1. Prior to installation, valves shall be inspected for direction of opening, number of turns to open, freedom of operation, tightness of pressure containing bolting and test plugs, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Defective valves shall be corrected or held for inspection by the Engineer. Valves shall be closed before being installed.
2. Valves, fittings, plugs and caps shall be set and joined to the pipe in the manner specified in this section for cleaning, laying and joining pipe, except that 12 inch and larger valves shall be provided with special support, such as treated timbers, crushed stone, concrete pads or a sufficiently tamped trench bottom so that the pipe will not be required to support the weight of the valve. Valves shall be installed plumb.
3. A valve box shall be provided on each underground valve. They shall be carefully set, centered exactly over the operating nut and truly plumbed. The valve box shall not transmit shock or stress to the valve. The bottom flange of the lower belled portion of the box shall be placed below the valve operating nut. This flange shall be set on brick, so arranged that the weight of the valve box and superimposed loads will bear on the base and not on the valve or pipe. Extension stems shall be installed where depth of bury places the operating nut in excess of 30 inches beneath finished grade so as to set the top of the operating nut 30 inches below finished grade. The valve box cover shall be flush with the surface of the finished area or such other level as directed by the Engineer.
4. In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve.

I. Hydrant Installation

1. Prior to installation, inspect all hydrants for direction of opening, nozzle threading, operating nut and cap nut dimensions, tightness of pressure containing bolting, cleanliness of inlet elbow, handling damage and cracks. Defective hydrants shall be corrected or held for inspection by the Engineer.
2. All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the roadway, with pumper nozzle facing the roadway, except that hydrants having two hose nozzles 90 degrees apart shall be set with each nozzle facing the roadway at an angle of 45 degrees.
3. Hydrants shall be set to the established grade, with the centerline of the lowest nozzle at approximately 18 inches above the ground or as directed by the Engineer.
4. Each hydrant shall be connected to the main with a 6-inch branch controlled by an independent 6-inch gate valve. When a hydrant is set in soil that is pervious, drainage shall be provided at the base of the hydrant by placing coarse gravel or crushed stone mixed with coarse sand from the bottom of the

trench to at least 6 inches above the drain port opening in the hydrant to a distance of 12 inches around the elbow.

5. When a hydrant is set in clay or other impervious soil, a drainage pit 2 x 2 x 2 feet shall be excavated below each hydrant and filled with coarse gravel or crushed stone mixed with coarse sand under and around the elbow of the hydrant and to a level of 6 inches above the drain port.
6. Hydrants shall be located as shown on the Drawings or as directed by the Engineer. For hydrants that are intended to fail at the ground line joint upon vehicle impact, specific care must be taken to provide adequate soil resistance to avoid transmitting shock moment to the lower barrel and inlet connection. In loose or poor load bearing soil, this may be accomplished by pouring a concrete collar approximately 6 inches thick to a diameter of 24 inches at or near the ground line around the hydrant barrel.

J. Air Valve Manholes and Water Meter Vaults

1. Construct the vault or manhole as detailed on the Drawings.
2. The frame and cover shall be cast into the top slab or cone.
3. The floor door shall be cast into the top slab. The floor door drain shall be piped to vault exterior.
4. Manholes and vaults shall be constructed such that their walls are plumb.

3.6 Connections to Water Mains

- A. Make connections to existing pipe lines with tapping sleeves and valves, unless specifically shown otherwise on the Drawings.
- B. Location: Before laying pipe, locate the points of connection to existing water mains and uncover as necessary for the Engineer to confirm the nature of the connection to be made.
- C. Interruption of Services: Make connections to existing water mains only when system operations permit. Operate existing valves only with the specific authorization and direct supervision of WOULD.
- D. Tapping Sleeves
 1. Holes in the new pipe shall be machine cut, either in the field or at the factory. No torch cutting of holes shall be permitted.
 2. Prior to attaching the saddle or sleeve, the pipe shall be thoroughly cleaned, utilizing a brush and rag, as required.
 3. Before performing field machine cut, the water-tightness of the sleeve assembly shall be pressure tested. The interior of the assembly shall be filled with water. An air compressor shall be attached, which will induce a test

pressure as specified in this Section. No leakage shall be permitted for a period of five minutes.

4. After attaching the sleeve to an existing main, but prior to making the tap, the interior of the assembly shall be disinfected. All surfaces to be exposed to potable water shall be swabbed or sprayed with a one percent hypochlorite solution. See also Article Disinfecting Pipeline of this Section of these Specifications.
- E. Connections Using Solid Sleeves or Couplings: Where connections are shown on the Drawings using solid sleeves, the Contractor shall furnish materials and labor necessary to make the connection to the existing pipeline.

3.7 Valve Box Adjustment

- A. Immediately prior to the Tennessee Department of Transportation road contractor installing finish pavement, all valve boxes (both new and existing to remain in service) shall be adjusted to finished pavement grade. After completing all water main work, there may be an interval of time before the Tennessee Department of Transportation road contractor is prepared to install finish pavement. During such interval or intervals, it may not be necessary for the Contractor to have personnel working on the Project. The Contractor shall be responsible for ascertaining and coordinating with the Tennessee Department of Transportation paving schedule. It may be necessary for the Contractor to mobilize one or more times to adjust valve boxes ahead of the installation of finish paving. The Contractor shall also be responsible for adjusting valve boxes to finished grade outside paved areas once the TDOT road contractor has performed finished grading.

3.8 Polyethylene Encasement

- A. Ductile iron pipe and the polyethylene encasement used to protect it shall be installed in accordance with AWWA C600 and ANSI/AWWA C105/A21.5 and also in accordance with all recommendations and practices of the AWWA M41, Manual of Water Supply Practices – Ductile Iron Pipe and Fittings. Specifically, the wrap shall be overlapped one foot in each direction at joints and secured in place around the pipe and any wrap at tap locations shall be taped tightly prior to tapping and inspected for any needed repairs following the tap.
- B. All installations shall be carried out by personnel trained and equipped to meet these various requirements.
- C. The installing contractor shall submit an affidavit stating compliance with the requirements and practices of ANSI/AWWA C150/A21.50, ANSI/AWWA C151/A21.51, ANSI/AWWA C105/A21.5, AWWA C600, and M41.

3.9 Water Main and Accessory Abandonment

- B. Water mains and accessories shall be removed from the site where specifically indicated on the Drawings or as required for new water main and accessories to be installed.

- C. Pipelines 6-inches in diameter or greater that are shown on the Drawings or otherwise specified to be abandoned shall be filled completely with flowable fill and plugged at all ends by use of concrete, a plug, a cap or other suitable means approved by the Engineer, in order to prevent flowable fill from escaping the pipe during flowable fill installation.
- D. Pipelines less than 6-inches but 2-inches or greater in diameter that are shown on the Drawings or otherwise specified to be abandoned shall be plugged at all ends by use of a plug or cap suitable for the pipe material, as approved by the Engineer, but are not required to be filled with flowable fill.
- E. Pipelines less than 2-inches in diameter that are shown on the Drawings or otherwise specified to be abandoned shall not require any plugging of ends or filling with flowable fill.

3.10 Thrust Restraint

- A. Provide restraint at all points where hydraulic thrust may develop.
- B. Retainer Glands: Provide retainer glands where shown on the Drawings and on fire hydrants and all associated fittings, valves and related piping. Retainer glands shall be installed in accordance with the manufacturer's recommendations.
- C. Harnessing
 - 1. Provide harness rods only where specifically shown on the Drawings or directed by the Engineer.
 - 2. Harness rods shall be manufactured in accordance with ASTM A 36 and shall have an allowable tensile stress of no less than 22,000 psi. Harness rods shall be hot dip galvanized or field coated with bitumastic before backfilling.
 - 3. Where possible, harness rods shall be installed through the mechanical joint bolt holes. Where it is not possible, provide 90 degree bend eye bolts.
 - 4. Eye bolts shall be of the same diameter as specified in AWWA C111 for that pipe size. The eye shall be welded closed. Where eye bolts are used in conjunction with harness rods, an appropriate size washer shall be utilized with a nut on each end of the harness rod. Eye bolts shall be of the same material and coating as the harness rods.
- D. Hydrants: Hydrants shall be attached to the water main by the following method:
 - 1. For mains 12 inches and smaller, the isolation valve shall be attached to the main by connecting the valve to the hydrant tee.
 - 2. For mains larger than 12 inches, the isolation valve shall be attached to the main by providing an anchor coupling between the valve and welded outlet.
 - 3. The isolation valve shall be attached to the hydrant by providing an anchor coupling between the valve and hydrant, if the hydrant and valve are less than

two feet apart. Otherwise, provide ductile iron pipe with retainer glands on the hydrant and valve.

- E. Thrust Collars: Collars shall be constructed as shown on the Drawings. Concrete and reinforcing steel shall meet the requirements as specified in Section 31 23 33 – Trench Excavation and Backfill; however, concrete shall have a compressive strength of not less than 4,000 psi. Welded on collars shall be attached to the pipe by the pipe manufacturer. Where thrust collars are to be installed on existing pipe, retainer glands shall be used in lieu of a welded-on collar. For use with thrust collars, retainer glands shall be of a split style as specified elsewhere in this Section. The retainer glands, as shown on the Drawings, shall be installed in opposite orientations from each other in order to account for differences in flow direction.
- F. Concrete Blocking
 - 1. Provide concrete blocking for all bends, tees, valves, and other points where thrust may develop, except where other exclusive means of thrust restraint are specifically shown on the Drawings.
 - 2. Concrete shall be as specified in this Section of these Specifications.
 - 3. Form and pour concrete blocking at fittings as shown on the Drawings and as directed by the Engineer. Pour blocking against undisturbed earth. Increase dimensions when required by over excavation.

3.11 Inspection and Testing

- A. Pressure and Leakage Test
 - 1. All sections of the water main shall be pressure tested in accordance with AWWA C600 for DIP or AWWA C605 for PVC. A section of main will be considered ready for testing after completion of all thrust restraint and backfilling.
 - 2. Each segment of water main between main valves shall be tested individually.
 - 3. Test Preparation
 - a. For water mains less than 24 inches in diameter, flush sections thoroughly at flow velocities, greater than 3.0 feet per second, adequate to remove debris from pipe and valve seats. For water mains 24 inches in diameter and larger, the main shall be carefully swept clean, and mopped if directed by the Engineer. Partially open valves to allow the water to flush the valve seat. WOULD shall be notified and given the opportunity to be present during flushing operations.
 - b. Partially operate valves and hydrants to clean out seats.
 - c. Provide temporary blocking, bulkheads, flanges and plugs as necessary, to assure all new pipe, valves, and appurtenances will be pressure tested.

- d. Before applying test pressure, air shall be completely expelled from the pipeline and all appurtenances. Insert corporation cocks at highpoints to expel air as main is filled with water as necessary to supplement automatic air valves. Corporation stops shall be constructed as detailed on the Drawings with a meter box.
 4. Fill pipeline slowly with water. Provide a suitable pump with an accurate water meter to pump the line to the specified pressure.
 5. The differential pressure across a valve or hydrant shall equal the maximum possible, but not exceed the rated working pressure. Where necessary, provide temporary backpressure to meet the differential pressure restrictions.
 6. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure.
 7. Test Pressure: Test the pipeline at 1.5 times the working pressure for at least two hours. Maintain the test pressure within 5 psi of the specified test pressure for the test duration. Should the pressure drop more than 5 psi at any time during the test period, the pressure shall be restored to the specified test pressure. Provide an accurate pressure gage with graduation not greater than 5 psi.
 8. Maintain the test pressure within 5 psi of the specified test pressure for the test duration. Should the pressure drop more than 5 psi at any time during the test period, the pressure shall be restored to the specified test pressure. The Columbus Water Works will supply the pressure gauge.
- B. Make-up Water Allowance
1. Make-up water allowance shall be defined as the sum of the quantity of water that must be pumped into the test section, to maintain pressure within 5 psi of the specified test pressure for the test duration plus water required to return line to test pressure at the end of the test. Make-up Water Allowance shall be the total cumulative amount measured on a water meter.
 2. WOOD assumes no responsibility for leakage occurring through existing valves.
 3. Test Results:
 - a. Ductile Iron Pipe: No test section shall be accepted if the make-up water required exceeds the limits determined by the following formula:

$$L = (S * D\sqrt{P})/148,000$$

Where:

L = allowable make-up water, in gallons per hour
 S = length of pipe tested, in feet

- D = nominal diameter of the pipe, in inches
 P = average test pressure during the leakage test, in pounds per square inch (gauge)

As determined under Section 5 of AWWA C600.

- b. PVC Pipe: No test section shall be accepted if the make-up water required exceeds the limits determined by the following formula:

$$L = (N * D\sqrt{P})/7,400$$

Where:

- L = allowable make-up water, in gallons per hour
 N = number of pipe joints in tested section
 D = nominal diameter of the pipe, in inches
 P = average test pressure during the leakage test, in pounds per square inch (gauge)

As determined under AWWA C605.

4. If the water main section being tested contains lengths of various pipe diameters, the allowable leakage shall be the sum of the computed leakage for each diameter. The leakage test shall be repeated until the test section is accepted. All visible leaks shall be repaired regardless of leakage test results.
- C. Completion: After a pipeline section has been accepted, relieve test pressure. Record the type, size and location of all outlets on record drawings.

3.12 Disinfecting Pipeline

- A. After successfully pressure testing each pipeline section, disinfect in accordance with AWWA C651 for the continuous feed method and these Specifications.
- B. Specialty Contractor: Disinfection shall be performed by an approved specialty contractor. Before disinfection is performed, the Contractor shall submit a written procedure for approval before being permitted to proceed with the disinfection. This plan shall also include the steps to be taken for the neutralization of the chlorinated water.
- C. Chlorination
1. Apply chlorine solution to achieve a concentration of at least 25 milligrams per liter free chlorine in new line. Retain chlorinated water for 24 hours.
 2. Chlorine concentration shall be recorded at every outlet along the line at the beginning and end of the 24 hour period.
 3. After 24 hours, all samples of water shall contain at least 10 milligrams per liter free chlorine. Rechlorinate if required results are not obtained on all

samples.

D. Disposal of Chlorinated Water:

1. Dechlorination and disposal of heavily chlorinated water shall be in accordance with AWWA C655.
2. Reduce chlorine residual of disinfection water to less than one milligram per liter if discharged directly to a body of water or to less than two milligrams per liter if discharged onto the ground prior to disposal. Treat water with sulfur dioxide or other reducing chemicals to neutralize chlorine residual. Flush all lines until residual is equal to existing system.

E. Bacteriological Testing: After flushing of heavily chlorinated water and before the water main is placed in service, the Contractor shall collect samples from the main and have samples tested for bacteriological quality in accordance with the rules of the Tennessee Department of Environment and Conservation and AWWA C651. The bacteriological samples shall be analyzed for both coliform and non-coliform growth. Testing shall be performed by a laboratory certified by the State of Tennessee. Rechlorinate mains until required results are obtained.

3.13 Protection and Restoration of Work Area

A. General: Return all items and all areas disturbed, directly or indirectly by work under these Specifications, to their original condition or better, as quickly as possible after work is started.

1. The Contractor shall plan, coordinate, and prosecute the work such that disruption to personal property and business is held to a practical minimum.
2. All construction areas abutting lawns and yards of residential or commercial property shall be restored promptly. Backfilling of underground facilities, ditches, and disturbed areas shall be accomplished on a daily basis as work is completed. Finishing, dressing, and grassing shall be accomplished immediately thereafter, as a continuous operation within each area being constructed and with emphasis placed on completing each individual yard or business frontage. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.
3. Handwork, including raking and smoothing, shall be required to ensure the removal of roots, sticks, rocks, and other debris in order to provide a neat and pleasing appearance.

B. Man-Made Improvements: Protect, or remove and replace with the Engineer's approval, all fences, walkways, mailboxes, pipe lines, drain culverts, power and telephone lines and cables, property pins and other improvements that may be encountered in the work.

C. Disposal of Rubbish: Dispose of all materials cleared and grubbed during the construction of the Project in accordance with the applicable codes and rules of the appropriate county, state and federal regulatory agencies.

END OF SECTION

Part 1 General

1.1 Work Included

- A. The Contractor shall furnish and install bored or jacked steel casing, complete and in place, all in accordance with the requirements of the Contract Documents. Carrier pipe installation within the steel casing shall be in accordance with the requirements contained within this Section.
- B. In the performance of the work, the Contractor shall comply with the lawful requirements of the affected railway companies, public agencies, and owners of public utilities or other facilities respecting the safeguarding of traffic and improvements which might be endangered by the boring and jacking operations. Approach trenches in public streets will not be permitted to remain open for extended periods of time.
- C. If the Contractor is not ready to place the pipe in the casing at the time of completion of boring and jacking operations, the ends shall be bulkheaded, and the approach trenches in public streets shall be backfilled, temporary surfacing placed thereon, and the affected portion of the street reopened to traffic.
- D. The Contractor shall be responsible for maintaining the specified line and grade, and for preventing settlement of overlying structures, or other damage due to the boring and jacking operations.

1.2 Related Sections

- A. Section 31 23 33 – Trenching and Backfilling.
- B. Section 33 11 00 - Water Utility Distribution Piping.

1.3 Definitions

- A. Boring – the method of excavating soil to create a conduit between two points without disturbing the surface between the sending and receiving pits. Methods included herein, but are not limited to, are auger boring, tunnel boring, and micro tunneling.

1.4 Submittals

- A. Submit in accordance with Section 01 33 00.
- B. The Contractor, prior to beginning any trench or structure excavation 5 feet deep or over, shall submit to the Engineer a detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or

structure excavation. Such design shall be signed and sealed by a professional engineer.

C. Submittals:

1. Casing installation schedules which include schedules of excavation, pipeline installation and backfill operations.
2. Material list including diameter, thickness, and class of steel casing.
3. Detailed locations and sizes of all boring or jacking and receiving pits.
4. The method of transporting the pipe in the casing and the method of "tugging" the pipe into the joints.
5. Details of concrete support blocks and bracing to prevent the carrier pipe from shifting or floating.
6. All permits associated with the boring or jacking operations.

D. Certifications: The Contractor shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section. Provide certification of physical and chemical properties of all steel.

1.5 Quality Assurance

- A. All boring or jacking operations shall be done by a qualified Contractor with at least 5 years' experience involving work of a similar nature.
- B. The Contractor shall give the Engineer and WOULD a minimum of 3 days advance notices of the start of an excavation or boring operation.
- C. All work shall be performed in the presence of the ENGINEER and WOULD.
- D. Welding Requirements: All welding procedures used to fabricate steel casings shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or special welds for pipe cylinders, casing joint welds, reinforcing plates and grout coupling connections.
- E. All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the type of materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the casing or pipeline. Machines and electrodes similar to those used in the work shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders.

Part 2 Products

2.1 Casing Pipe

- A. The casing pipe shall be of steel meeting the latest approved American Railway Engineering Association "Specification 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 COATED OR CATHODICALLY PROTECTED STEEL CASING PIPE FOR RAILROADS

CARRIER PIPE	CASING PIPE	NOMINAL THICKNESS
4	8	0.188 inch
6	12	0.188 inch
8	16	0.219 inch
10	20	0.281 inch
12	22	0.281 inch
14	24	0.312 inch
16	26	0.344 inch
18	28	0.375 inch

TABLE OF MINIMUM WALL THICKNESS FOR STEEL CASING PIPE

CARRIER PIPE	CASING PIPE	NOMINAL THICKNESS
4	8	0.250 inch
6	12	0.250 inch
8	16	0.250 inch
10	20	0.250 inch
12	22	0.250 inch
14	24	0.250 inch
16	30	0.312 inch
18	30	0.312 inch

- B. When the casing pipe is installed under a railroad 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 inch greater than the thickness shown.

2.2 Carrier Pipe

- A. The carrier pipe shall be as shown on the drawings.
- B. The carrier pipe shall conform with the requirements of Section 33 11 00 - Water Utility Distribution Piping.
- C. All joints within the casing shall be restrained.

2.3 Materials

- A. Grout: Grout shall consist of one part Portland cement, three parts sand and the minimum amount of water necessary to obtain the desired consistency and all grout mixtures shall contain 2 percent of bentonite by weight of the cement. Portland cement, water and sand shall conform to the applicable requirements of the

specification section except that sand to be used shall be of such fineness that 100 percent will pass a Standard No. 8 sieve and at least 45 percent, by weight, will pass a Standard No. 40 sieve. Bentonite shall be a commercial-processed powdered bentonite, Wyoming type, such as Imacco-gel, Black Hills, or equal.

- B. Grout Connections: The Contractor shall provide grout connections on the interior of the steel casing pipe as specified. Longitudinal spacing between the grout connections may be decreased to provide more frequent grouting, but in no case shall the spacings shown or specified be exceeded.
- C. Casing Spacers:
 - 1. The casing spacers shall be constructed of circular stainless steel bands, which bolt together forming a shell around the carrier pipe. The casing spacer shall be lined with a ribbed EPDM extrusion with a retaining section that overlaps the edges of the shell and prevents slippage. The spacer shall be designed with risers and runners to support the carrier pipe within the casing and maintain a minimum clearance of 1.0 in. between the casing ID and the carrier pipe OD.
 - 2. The runners shall be Glass Filled Polymer with ends of the runners beveled to facilitate installation over rough weld beads or the weld ends of misaligned or deformed casing pipe. The runners shall be attached to support structures (risers) at appropriate positions to properly support the carrier pipe within the casing and to ease installation. They shall have a minimum length of 8.0 in. and a minimum width of 2.0 in.
 - 3. The shell shall be manufactured of 14-gauge T-304 stainless steel. The riser shall be constructed of 10-gauge T-304 stainless steel, with a height to be determined based on the annular space between the carrier pipe OD and the casing ID.
 - 4. Unless otherwise shown, spacers shall be placed 1-2 feet on either side of the bell joint and one every 6-8 feet apart thereafter for a total of three casing spacers per joint of pipe.
- D. Casing End Seals
 - 1. End seals shall be pull-on or wrap-around seals.
 - 2. The Wrap-Around and Pull-On end seals shall be manufactured of 1/8" thick neoprene rubber. Provide minimum 2" wide T-304 stainless steel banding with 100% non-magnetic worm gear mechanism.

Part 3 Execution

3.1 General

- A. Interpretation of soil investigation reports and data, investigating the site and determination of the site soil conditions prior to bidding is the sole responsibility of

the Contractor. Any subsurface investigation by the Bidder or Contractor must be approved by the appropriate authority having jurisdiction over the site. Rock and/or water, if encountered, shall not entitle the Contractor to additional compensation.

- B. Casing construction shall be performed so as not to interfere with, interrupt or endanger roadway surface and activity thereon, and minimize subsidence of the surface, structures, and utilities above and in the vicinity of the casing. Support the ground continuously in a manner that will prevent loss of ground and keep the perimeters and face of the casing, passages and shafts stable. The Contractor shall be responsible for all settlement resulting from casing operations and shall repair and restore damaged property to its original or better condition at no cost to WOULD
- C. Face Protection: The face of the excavation shall be protected from the collapse of the soil into the casing.
- D. Bore Pit Design: Design of the bore pit and required bearing to resist installation forces are the responsibility of the Contractor. The excavation method selected shall be compatible with expected ground conditions. The lengths of the casing shown on the Drawings are the minimum lengths required. The length of the casing may be extended for the convenience of the Contractor, at no additional cost to WOULD. Due to restrictive right of way and construction easements, casing lengths less than the nominal 20 foot length may be necessary.

3.2 Highway Crossings

- A. The Contractor shall be held responsible and accountable for the coordinating and scheduling of all construction work within the highway right of way.
- B. Work along or across the highway department rights of way shall be subject to inspection by such highway department.
- C. All installations shall be performed to leave free flows in drainage ditches, pipes, culverts or other surface drainage facilities of the highway, street or its connections.
- D. No excavated material or equipment shall be placed on the pavement or shoulders of the roadway without the express approval of the highway department.
- E. In no instance will the Contractor be permitted to leave equipment (trucks, backhoes, etc.) on the pavement or shoulder overnight. Construction materials to be installed, which are placed on the right of way in advance of construction, shall be placed in such a manner as not to interfere with the safe operation of the roadway.
- F. The Contractor shall be responsible for providing WOULD sufficient information to obtain a blasting permit, if required, in a timely manner.

3.3 Groundwater Control

- A. The Contractor shall control the groundwater throughout the construction of the casing.

- B. Methods of dewatering shall be at the option and responsibility of the Contractor. Maintain close observation to detect settlement or displacement of surface facilities due to dewatering. Should settlement or displacement be detected, notify the Engineer immediately and take such action as necessary to maintain safe conditions and prevent damage.
- C. When water is encountered, provide and maintain a dewatering system of sufficient capacity to remove water on a 24 hour basis keeping excavations free of water until the backfill operation is in progress. Dewatering shall be performed in such a manner that removal of soil particles is held to a minimum.

3.4 Safety

- A. Provide all necessary bracing, bulkheads and shields to ensure complete safety to all traffic, persons and property at all times during the work. Perform the work in such a manner as to not permanently damage the roadbed or interfere with normal traffic over it.
- B. Observe all applicable requirements of the regulations of the authorities having jurisdiction over this site. Conduct the operations in such a manner that all work will be performed below the level of the roadbed.
- C. Perform all activities in accordance with the Occupational Safety and Health Act of 1970 (PL 596), as amended, applicable regulations of the Federal Government, OSHA 29CFR 1926 and applicable criteria of ANSI A10.16 81, "Safety Requirements for Construction of Tunnel Shafts and Caissons".

3.5 Surface Settlement Monitoring

- A. Provide surface settlement markers, placed as specified and as directed by the Engineer. The Contractor shall place settlement markers outside of pavement area, along the centerline of the casing at 20 foot intervals and offset 10 feet each way from the centerline of the tunnel. Markers shall also be placed at each shoulder of the roadway, at each edge of pavement, at the centerline of the pavement and at 10 and 25 feet in each direction from the centerline of the casing. Tie settlement markers to bench marks and indices sufficiently removed as not to be affected by the casing operations.
- B. Make observations of surface settlement markers, placed as required herein, at regular time intervals acceptable to the Engineer. In the event settlement or heave on any marker exceeds 1 inch, the Contractor shall immediately cease work and using a method approved by the Engineer and the authority having jurisdiction over the project site, take immediate action to restore surface elevations to that existing prior to start of casing operations.
- C. Take readings and permanently record surface elevations prior to start of dewatering operations and/or shaft excavation. The following schedule shall be used for obtaining and recording elevation readings: all settlement markers, once a week; all settlement markers within 50 feet of the casing heading, at the beginning

of each day; more frequently at the Engineer's direction if settlement is identified. Make all elevation measurements to the nearest 0.01 foot.

- D. The Contractor shall cooperate fully with jurisdictional personnel. Any settlement shall be corrected by, and at the expense of, the Contractor.
- E. Promptly report any settlement and horizontal movement immediately to the Engineer and take immediate remedial action.

3.6 Boring

- A. The boring shall be accomplished to the size, line, and grade shown on the Drawings.

3.7 Installation of Casing Pipe

- A. **Jacking Head:** A steel jacking head shall be fitted to the lead section of the casing in such a manner that it extends around the entire outer surface of the steel casing and projects at least 18 inches beyond the driving end of the casing. The jacking head shall not protrude more than 0.5 inches outside of the outer casing surface. The head shall be securely anchored to prevent any wobble or alignment variation during the boring or jacking operations. To minimize voids outside the casing, excavation shall be carried out entirely within the jacking head and not in advance of the head. Excavated materials shall be removed from the casing as the boring or jacking operation progresses and no accumulation of excavated materials within the casing shall be permitted.
- B. **Jacking Pit:** The excavations for the boring or jacking operations shall be adequately shored to safeguard existing substructures and surface improvements and to ensure against ground movement in the vicinity of the jack supports. Heavy guide timber, structural steel, or concrete cradles of sufficient length shall be provided to assure accurate control of boring or jacking alignment. The Contractor shall provide adequate space within the excavation to permit the insertion of the lengths of casing to be bored or jacked. Timbers and structural steel sections shall be anchored to ensure action of the jacks in line with the axis of the casing. A bearing block, consisting of a timber or structural steel framework, shall be constructed between the jacks and the end of the casing to provide uniform end bearing over the perimeter of the casing and distribute the jacking pressure evenly.
- C. **Control of Alignment and Grade:** The Contractor shall control the application of the jacking pressure and excavation of materials ahead of the casing as it advances to prevent the casing from becoming earthbound or deviating from the required line and grade. The Contractor shall restrict the excavation of the materials to the least clearance necessary to prevent binding in order to avoid loss of ground and consequential settlement or possible damage to overlying structures. Allowable grade deviations in horizontal and vertical alignments shall be no greater than 0.2 feet per 100 feet in any direction over the length of the jacking or boring to a maximum deviation of 0.5 feet.

- D. Exterior Grouting: Immediately after completion of the boring or jacking operations, the Contractor shall inject grout through the grout connections in such a manner as to completely fill all voids outside the casing pipe resulting from the boring or jacking operations. Grout pressure shall be controlled so as to avoid deformation of the steel casing and avoid movement of the surrounding ground. After completion of the grouting operations, the Contractor shall close the grout connections with cast-iron threaded plugs.
- E. Installation: The installation of the casing shall be in accordance with the Contract Documents and subject to the approval of the agency having jurisdiction over the area containing the boring or jacking operations.
- F. Should appreciable loss of ground occur during the jacking operation, the voids shall be backpacted promptly to the extent practical with soil cement consisting of a slightly moistened mixture of one part cement to five parts granular material. Where the soil is not suitable for this purpose, the Contractor shall import, at the Contractor's expense, suitable material. The soil cement shall be thoroughly mixed and rammed into place as soon as possible after the loss of ground.

3.8 Tunneling Alternative

- A. General: In the event boring and jacking is impossible because of pipe size, rock, or other factors and the highway department or railroad will not permit open cutting, make crossings by tunneling using liner plates. Conduct tunneling operations as approved by the railroad or highway department. If voids are caused by the tunneling operations, fill by pressure grouting or by other approved methods that will provide proper support.
- B. Galvanized Plates
 - 1. After the plates are formed to shape, the plates shall be galvanized on both sides by the hot dip process. A coating of prime western spelter, or equal, shall be applied at the rate of not less than 2 ounces per square foot of double exposed surface. If the average spelter coating as determined from the required sample is less than the amount specified above, or if any 1 specimen shows a deficiency of 0.2 ounce, the lot shall be rejected. Spelter coating shall be of the first class commercial quality free from injurious defects such as blisters, flux, and uncoated spots.
 - 2. The outside of the plates shall be given a bituminous coating meeting the AASHTO M-190 specifications for bituminous protected corrugated metal pipe.
- C. Design and Construction
 - 1. Construct the tunnel by the tunnel method, and completely line on the inside with structural steel liner plates meeting all requirements specified hereinafter. The dimensions of the tunnel shall be as shown on the Drawings.
 - 2. The tunneling operation is to commence from a pit that is a minimum of 12 feet long and 4 feet wider than the diameter of the tunnel, bottom to grade, and sheeted and shored, if necessary. Furnish line and grade stakes.

3. All excavation for the entire length of the tunnel shall be done by tunneling, and the work may be done from either or both ends of the conduit. Trim the periphery of the tunnel smooth to fit the outside of the steel liner plates as nearly as is practical, and fill all space outside of the steel liner plate with a sand cement grout mixture.
4. Install the steel liner plates immediately after the excavated material has been removed. Do not remove material more than 24 inches ahead of the installed liner plates.
5. Provide all necessary bracing, bulkheads, and/or shields to ensure complete safety to all traffic at all times during the progress of the work, and perform the work in such a manner as to not interfere with normal traffic over the work.
6. The steel lining shall consist of plates 16 inches wide, and each circumferential ring shall be composed of the number and length plates necessary to complete the required diameter.
7. The inside diameter of the completed ring shall be as shown on the Drawings, and no part of the plate or reinforcing ribs will be allowed to extend inside this net diameter.
8. The strength of the tunnel lining will be determined by its section modulus. In no case shall it be less than 0.0590 inch cubed per inch of plate width based on the average for 1 ring of plates. Thickness of the metal for these steel plates shall be not less than 10 gauge, allowing for standard mill tolerances. The tunnel strength shall be equal to AASHO railroad E80 loading at the depth of cover obtaining.
9. All plates shall be punched for bolting on both longitudinal and circumferential seams and shall be fabricated so as to permit complete erection from the inside of the tunnel. The longitudinal seam shall be of the lap type with offset equal to gauge of metal for the full width of the plate, including flanges, and shall have staggered bolt construction fabricated so as to allow the cross section of the plate to be continuous through the seam. All plates shall be of uniform fabrication, and those intended for the same size tunnel shall be interchangeable.
10. The material used for the construction of these plates shall be new and unused and suitable for the purpose intended. Workmanship shall be first class in every respect.
11. Install the carrier pipe to the line and grade shown on the Drawings. After the carrier pipe is installed adequately block it and backfill the space between the carrier pipe and the tunnel liner with 2,000 psi concrete. The method of placing this concrete shall be approved by the Engineer.

3.9 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.

- B. Joints: All joints of the carrier pipe within the casing shall be joined in accordance with the specification Sections for the type of pipe material installed.
- C. Application of Coatings: Application of coatings to the exterior of the carrier pipe shall be performed in accordance with the requirements of the specification Sections for the type of pipe materials installed and as provided for in these Specifications.
- D. Testing of the Carrier Pipe: Hydrostatic testing of the carrier pipe shall be completed prior to the filling of the annular space between the casing and carrier pipe with sand. Hydrostatic testing shall be performed in accordance with the appropriate specification Section.
- E. Closing of Pits: After jacking equipment and excavated materials from the boring or jacking operations have been removed from the jacking pit, the Contractor shall prepare the bottom of the jacking pit as a pipe foundation. The Contractor shall remove all loose and disturbed materials below pipe grade to undisturbed earth and recompact the material in accordance with the specification Section 31 23 33 – Trenching and Backfilling.

3.10 Layout of Work

- A. WOOD will provide the necessary control points required by the Contractor for this construction. The Contractor will provide the detailed layout required to keep the tunnel or bore on the grade.

3.11 Insurance for Railroad Crossing

- A. The Contractor shall, at his expense, secure and maintain throughout the construction period the following kinds and amounts of insurance, a certificate of which will be furnished to the railroad in duplicate.
 - 1. Public Liability and Property Damage Liability Insurance
 - a. Such insurance shall have a combined single limit of \$2,000,000.00. A Comprehensive General Liability policy, which will include contractual liability coverage and have no exclusion for the “Railroad Operations Exposure”, is preferred. The certificate of insurance should, in all instances, give evidence of:
 - 1) \$2,000,000.00 General Liability (as indicated above);
 - 2) Assumption of contractual liability for the installation in question;
 - 3) A 30 day unconditional notice of cancellation to the owning railroad.
 - 2. Naming the owning railroad as an additional insured.

- a. This insurance is subject to approval by the Railroad's Law and Casualty Insurance Departments prior to any work being performed on Seaboard System right-of-way.
3. Add additional insurance required by railroad, as appropriate.

3.12 Guarantee of Work

- A. 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 bore 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. For sewers, the sides shall be a minimum of 8 inches inside the interior face of the manhole at the end of the bore.
- B. The allowable tolerance at the upstream end point of the bore 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 Summary

A. Section Includes:

1. Pipe and fittings for domestic water service connections to buildings.
2. Corporation stop assembly.
3. Curb stop assembly.
4. Water meters.
5. Meter boxes.
6. Compression connections.
7. Communications.
8. Backflow preventers.
9. Bedding and cover materials.

- B. Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), National Science Foundation (NSF) Standard 61, or other recognized standards. Latest revisions of all standards are applicable. Additionally, products shall meet the Federal lead-free requirements as stated in the Reduction of Lead in Drinking Water Act.

1.2 Related Sections:

- A. Section 31 23 33 – Trenching and Backfilling: Excavating backfilling and compacting for Work of this section.

1.3 Definitions

- A. Utility Company: West Overton Utility District

1.4 Submittals

- A. Submit in accordance with Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit data on pipe materials, pipe fittings, corporation stop assemblies, curb stop assemblies, meters, meter setting equipment, service saddles, backflow preventer, and accessories.

- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- D. Submit Project Record Documents in accordance with Section 01 78 23. Record actual locations of piping mains, curb stops, connections, thrust restraints, and invert elevations.
- E. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 Quality Assurance

- A. Perform Work in accordance with utility company standards, state and local laws, and the DOT Standard Specifications.
- B. Maintain one copy of referenced documents on site.

1.6 Delivery, Storage, and Handling

- A. Section 01 65 00 – Transportation and Handling and Section 01 66 00 – Storage and Protection: Requirements for transporting, handling, storing, and protecting products.
- B. During loading, transporting, and unloading of materials and products, exercise care to prevent any damage.
- C. Store products and materials off ground and under protective coverings and custody, away from walls and in manner to keep these clean and in good condition until used.

Part 2 Products

2.1 Water Piping and Fittings

- A. General: All pipe and fittings shall comply with NSF 61 and Federal lead free requirements.
- B. Copper Tubing: ASTM B88, Type K, annealed:
 - 1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
 - 2. Joints: Compression connection.

2.2 Corporation Stop Assembly

- A. Corporation Stops:
 - 1. Brass body conforming to Federal No-Lead requirements.
 - 2. Inlet end threaded for tapping according to AWWA C800.
 - 3. Outlet end shall be a compression flange suitable for service pipe specified.

4. Corporation Stop shall be Ford F1000-3-NL.

- B. Service Saddles: Designed to hold pressures in excess of pipe working pressure. Tapping saddles shall be used for tapping all PVC pipe and shall be Ford S-70 Series. Saddle shall be threaded to accept the corporation cock specified above.

2.3 Curb Stop Assembly

A. Manufacturers:

1. Ford Meter Box Company Model BL43-232W-3-9-NL.

B. Curb Stops:

1. Brass body conforming to Federal No-Lead requirements.

2.4 Water Meters

A. Cold-Water Meters - 5/8-inch x 3/4-inch

1. Badger M25, 5/8"x3/4" Disc Meter, Cast Iron Bottom, HR-E Encoder (8-dial, USG, TX, PL/s) with 5' Itron ILC connections.

B. Cold-Water Meters – 1-inch

1. Badger M70, 1" Disc Meter, Cast Iron Bottom, HR-E Encoder (8-dial, USG, TX, PL/s) with 5' Itron ILC connections.

2.5 Meter Boxes

A. 3/4" Meter Boxes shall be:

1. 10x15x12 Raven Heavy Wall Meter Box RMB101512NSW-W with Brooks plastic lid with CI flip; OR
2. Brooks Concrete Meter Box and Lid – 36H15

B. 1" Meter Boxes shall be:

1. Carson Heavy Wall Meter Box – MSBCF1118-18XL and MSCBC-1118R-11x18 DI reader cover with max-view or approved equivalent.

2.6 Compression Connections

- A. The compression connector shall be of solid bronze suitable for connecting the existing service line to the new service line. This connector shall be Ford C44-33.
- B. Old-style Mueller 110 compression fittings are present in the system. New, compatible nuts and washers shall be provided on existing services where necessary.

2.7 Communications

- A. Energy Monitoring and Control (EMCS) or Automatic Meter Reading Interfaces
 - 1. Water meters shall be capable of interfacing (output signal equivalent to flow rate) with the existing Energy Management Control System (EMCS) and Automatic Meter Reading systems for data gathering in units of GPM.
 - 2. Meters shall not require power to function and deliver data. Output signal shall be either a voltage or amperage signal which can be converted to a flow rate specification.
 - 3. Communication protocols used must be OPC-compliant, such as MODBUS, LonWorks, and BACnet. System must be nonproprietary open architecture and able to interface with third-party vendor software.
 - 4. Meter shall be equipped with one pulse output channel ("Pulse" in Metering Systems Schedule) that can be configured for operation.

2.8 Backflow Preventers

- A. 3/4-inch
 - 1. Ford Meter Box Company Model HHS38-323-NL
- B. 1-inch
 - 1. Ford Meter Box Company Model HHS31-344-NL

2.9 Bedding and Cover Materials

- A. Backfill around pipe and above pipe: As specified in Section 31 23 33 –Trenching and Backfilling.

Part 3 Execution

3.1 Preparation

- A. Verify building service connection and municipal utility water main size, location, and invert are as indicated on Drawings.
- B. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare pipe connections to equipment with flanges or unions.

3.2 Installation - Corporation Stop Assembly

- A. Make connection for each different kind of water main using suitable materials, equipment and methods approved by the Engineer.
- B. Provide service clamps for mains other than of cast iron or ductile iron mains.
- C. Screw corporation stops directly into tapped and threaded iron main at 10 and 2 o'clock position on main's circumference; locate corporation stops at least 12 inches apart longitudinally and staggered.
- D. For plastic pipe water mains, provide full support for service clamp for full circumference of pipe, with minimum 2-inch width of bearing area; exercise care against crushing or causing other damage to water mains at time of tapping or installing service clamp or corporation stop.
- E. Use proper seals or other devices so no leaks are left in water mains at points of tapping; do not backfill and cover service connection until approved by the Engineer.

3.3 Excavation, Bedding and Backfill

- A. Excavate pipe trench in accordance with Section 31 23 33 for Work of this Section.
- B. Place bedding material at trench bottom, level in one continuous layer not exceeding 6-inch loose thickness; compact to 95 percent in accordance with Section 31 23 33.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact to 95 percent in accordance with Section 31 23 33.
- D. Maintain optimum moisture content of fill material to attain required compaction density.

3.4 Installation - Pipe and Fittings

- A. Maintain separation of water main from sewer piping in accordance with state and local codes or a minimum of 10 feet horizontal and 18 inches vertical distance, whichever is more stringent.
- B. Group piping with other site piping work whenever practical.
- C. Install pipe to indicated elevation to within tolerance of 5/8 inch.
- D. Route pipe in straight line.
- E. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- F. Backfill trench in accordance with Section 31 23 33.

3.5 Installation - Curb Stop Assembly

- A. Set curb stops on solid bearing of compacted soil.
- B. Center and plumb curb box over curb stops. Set box cover flush with finished grade.

3.6 Installation - Backflow Preventers and Water Meters

- A. Install backflow preventer where indicated on Drawings and in accordance with manufacturer's instructions.
- B. Comply with local water company requirements and plumbing codes regarding testing and installation requirements.

3.7 Disinfection of Domestic Water Piping System

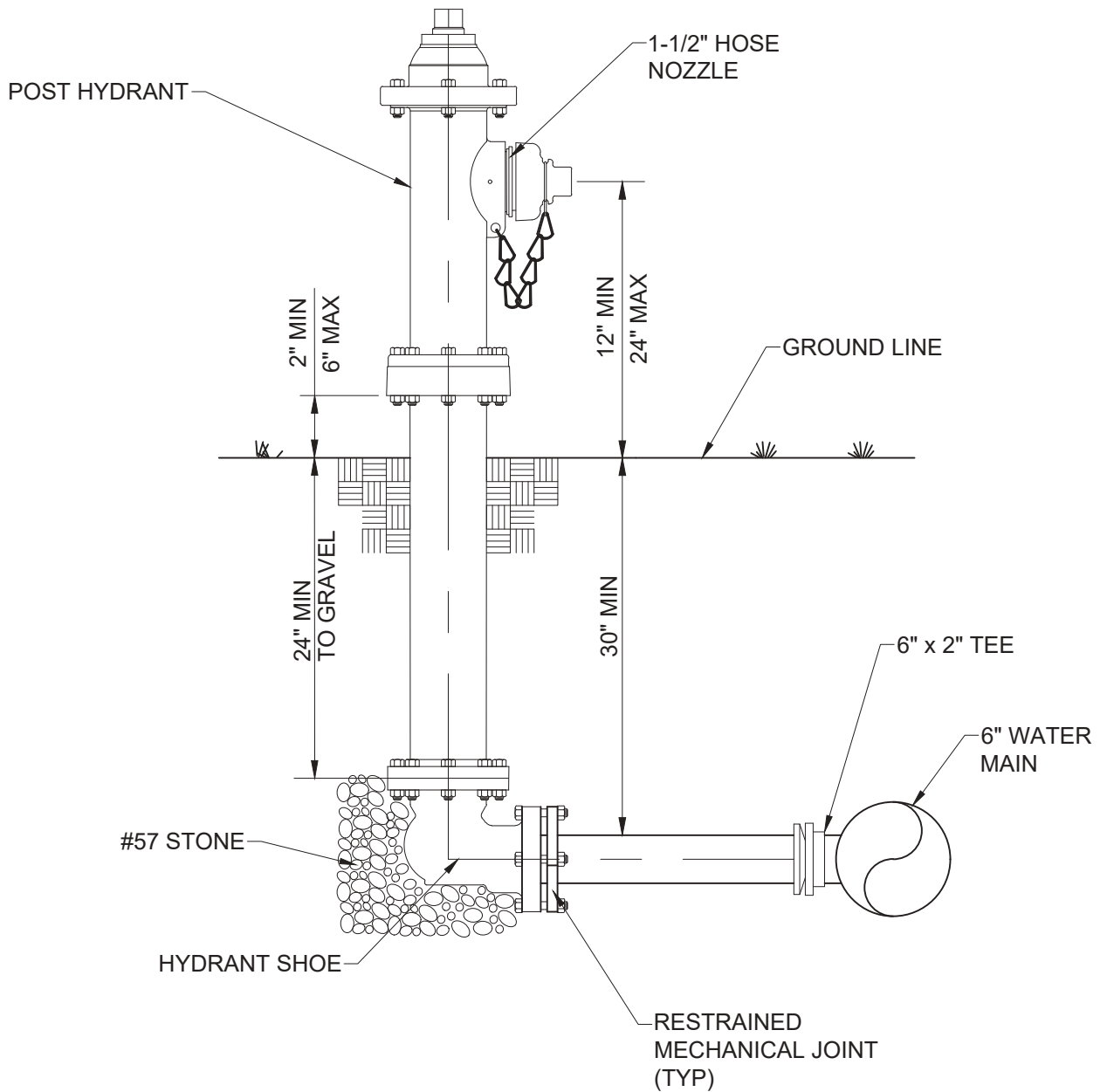
- A. Flush and disinfect system in accordance with Section 33 13 00.

3.8 Field Quality Control

- A. Compaction testing for bedding and backfill: Conform to Section 31 23 33.
- B. Pressure testing: Perform pressure test on water service connections in accordance with AWWA C600.
- C. Notification: Notify Engineer and WOULD 72 hours in advance of test and have them witness test.
- D. Test Pressure: Not less than 50 psi in excess of maximum static pressure.

END OF SECTION

APPENDIX 1



NOTE:

1. HYDRANT SHALL BE STYLE 133 BY M & H VALVE, OR EQUAL.

*West Overton
Utility District*

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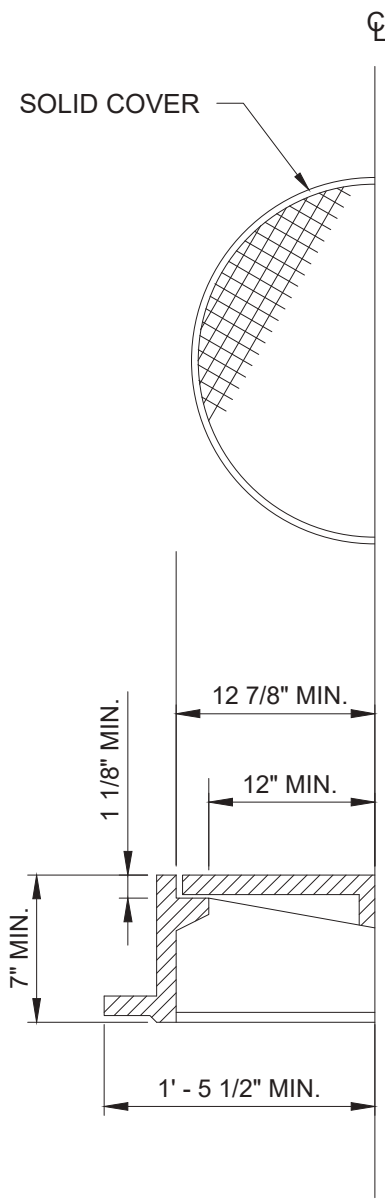
BLOWOFF ASSEMBLY

WEST OVERTON UTILITY DISTRICT
STANDARD WATER SPECIFICATIONS
RICKMAN, TENNESSEE

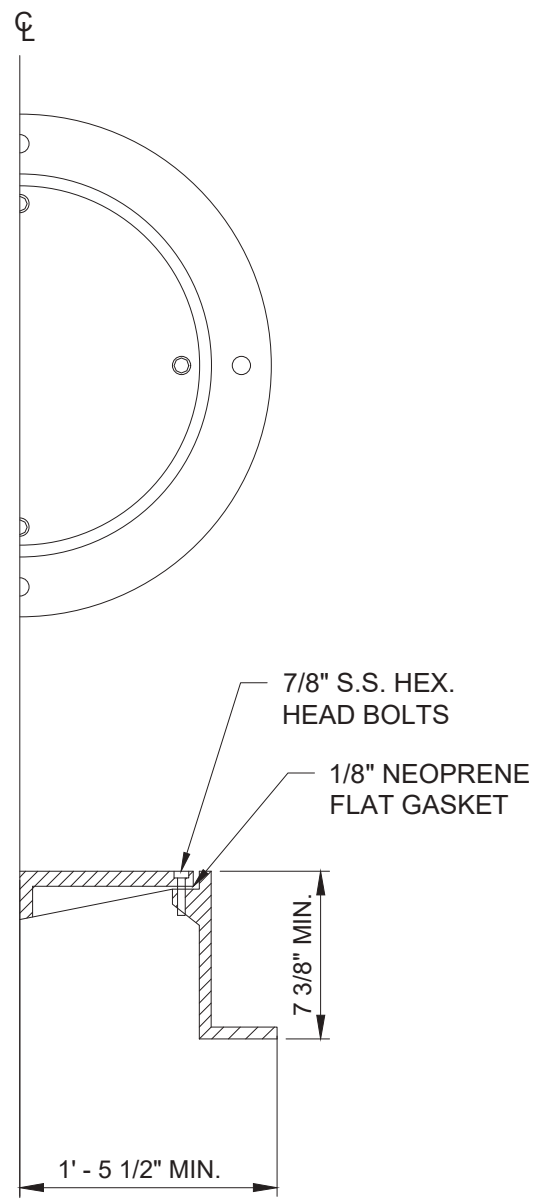
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CHECKED BY: MDN

DRAWING NO.:
DETAIL 1

PROJECT NO.: 33163-00
DATE: 11/17/2023



STANDARD



WATERTIGHT

NOTES:

1. ANCHOR W.T. CASTINGS TO TOP CONE W/4 -3/4" BOLTS.
2. ANCHOR BOLTS TO BE CAST WITH CONCRETE CONE.

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FRAME AND COVER

WEST OVERTON UTILITY DISTRICT
STANDARD WATER SPECIFICATIONS

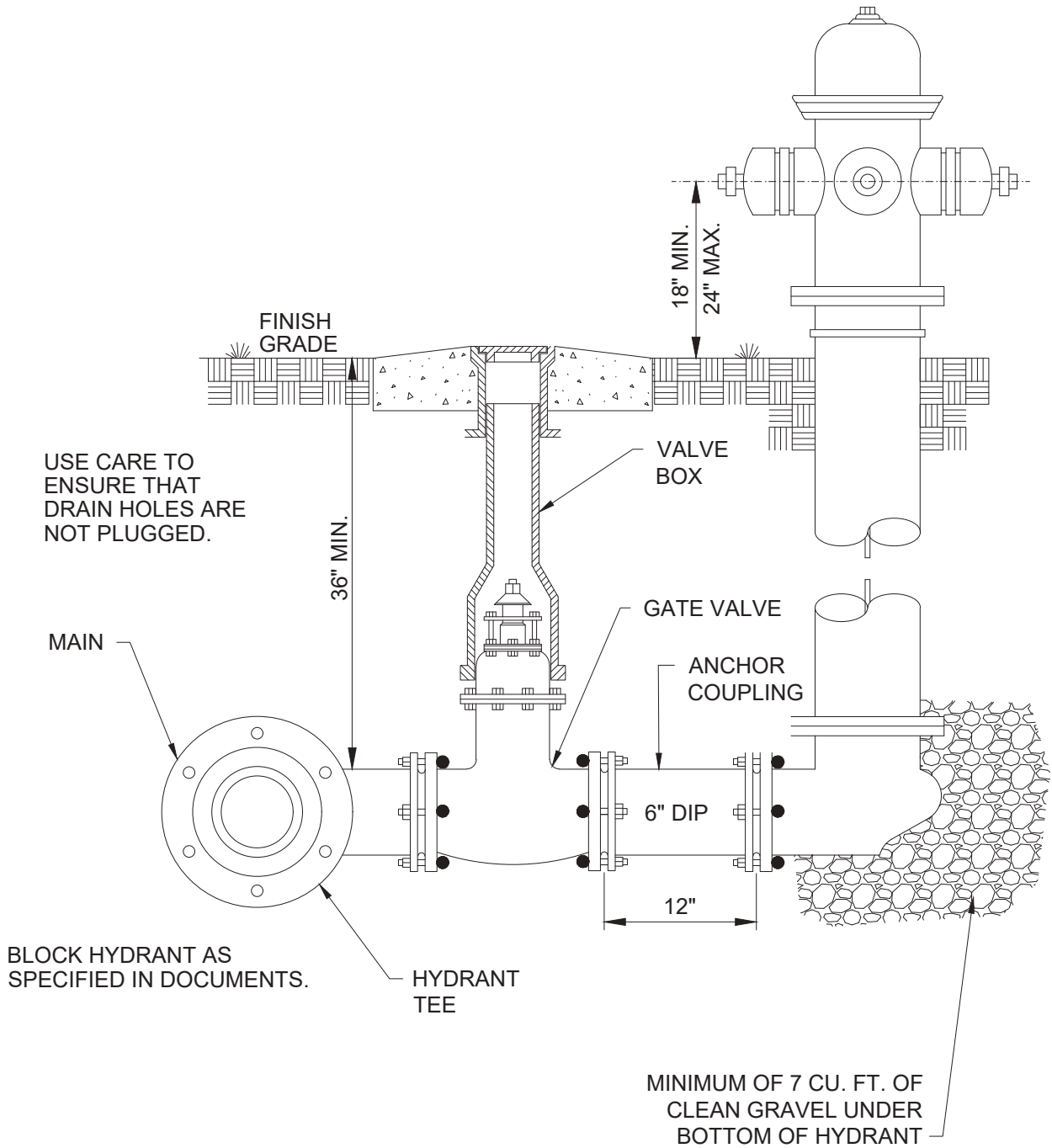
RICKMAN, TENNESSEE

DRAWN BY: CDS
CHECKED BY: MDN

DRAWING NO.:
DETAIL 2

PROJECT NO.: 33163-00
DATE: 11/17/2023

OPERATING NUT, DIRECTION OF
OPENING, CAP NUT AND THREAD AND
CONNECTIONS MUST BE APPROVED IN
WRITING BY THE OWNER AS
CONFORMING TO THEIR STANDARDS.



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HYDRANT ASSEMBLY

WEST OVERTON UTILITY DISTRICT
STANDARD WATER SPECIFICATIONS

RICKMAN, TENNESSEE

DRAWN BY:

CDS

CHECKED BY:

MDN

DRAWING NO.:

DETAIL 3

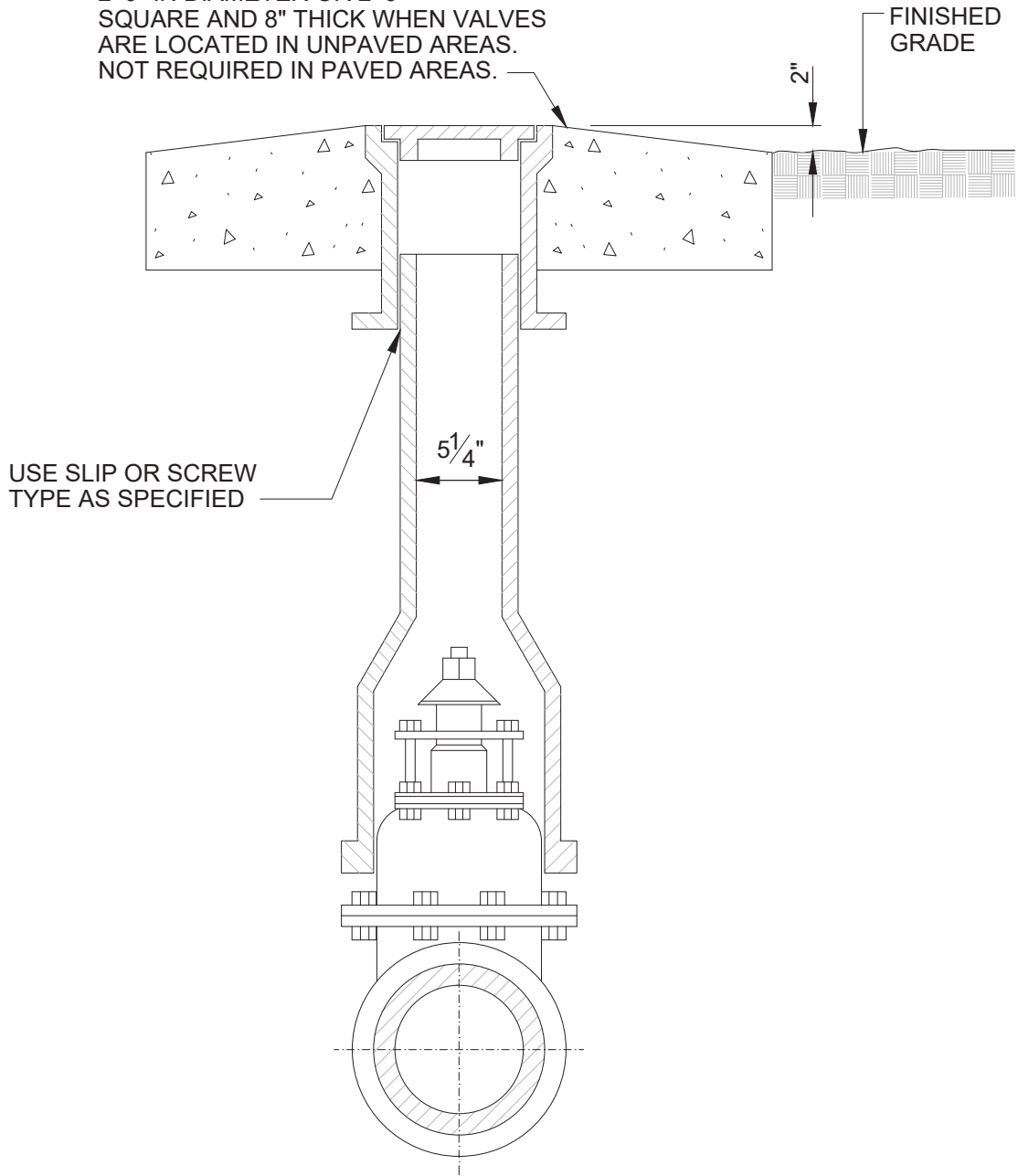
PROJECT NO.:

33163-00

DATE:

11/17/2023

CAST AROUND THE TOP OF EACH
 VALVE BOX A CONCRETE DISK
 2'-0" IN DIAMETER OR 2'-0"
 SQUARE AND 8" THICK WHEN VALVES
 ARE LOCATED IN UNPAVED AREAS.
 NOT REQUIRED IN PAVED AREAS.



*West Overton
 Utility District*

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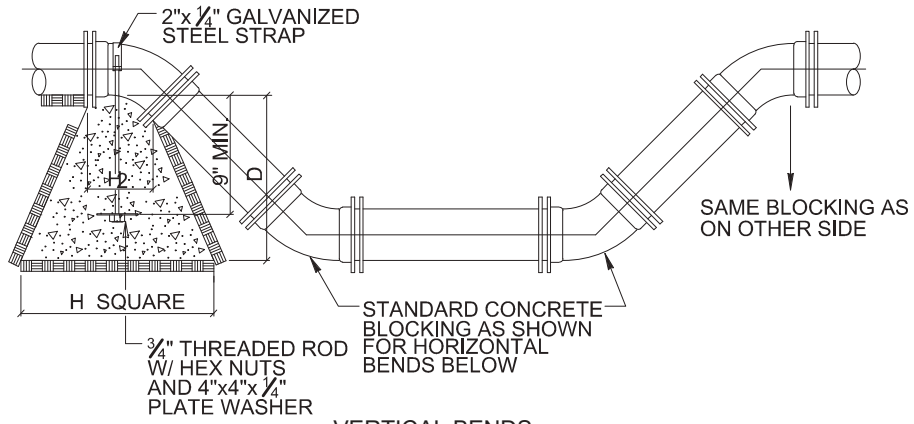
VALVE BOX DETAIL

WEST OVERTON UTILITY DISTRICT
 STANDARD WATER SPECIFICATIONS
 RICKMAN, TENNESSEE

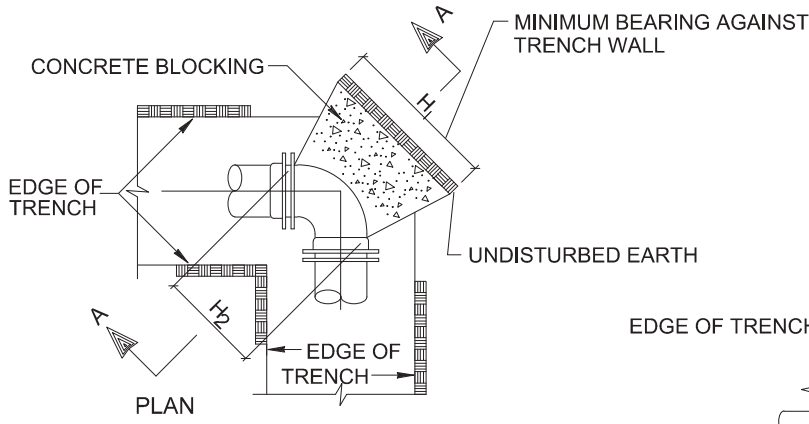
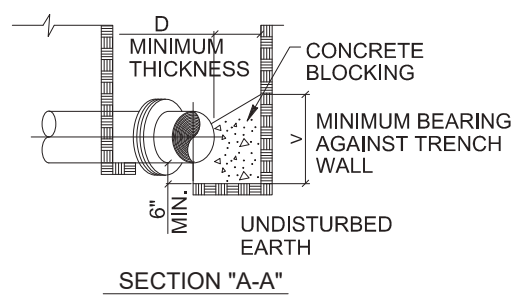
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DRAWING NO.:
DETAIL 4

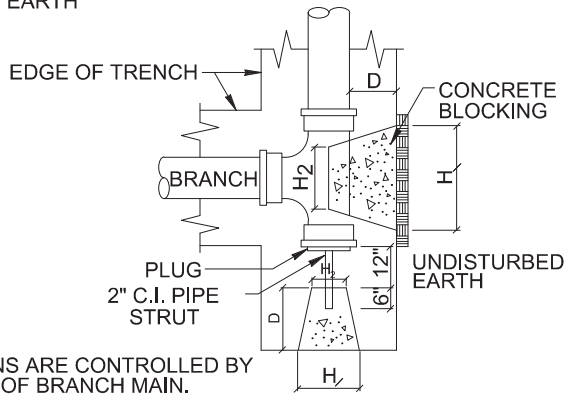
PROJECT NO.: 33163-00
 DATE: 11/17/2023



VERTICAL BENDS



HORIZONTAL BENDS



NOTE:
DIMENSIONS ARE CONTROLLED BY
DIAMETER OF BRANCH MAIN.

SEE DETAIL 6 (THRUST BLOCKING TABLE, FOR DIMENSIONS

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PHONE (931) 498-4144

TYPICAL THRUST BLOCKING
WEST OVERTON UTILITY DISTRICT
STANDARD WATER SPECIFICATIONS
RICKMAN, TENNESSEE

DRAWN BY: CDS	CHECKED BY: MDN
DRAWING NO.: DETAIL 5	
PROJECT NO.: 33163-00	DATE: 11/17/2023

TABLE OF DIMENSIONS FOR CONCRETE BLOCKING

SIZE	TEES, PLUGS AND CROSSES					90° BENDS					45° BENDS					22½° BENDS					11¼° BENDS					SIZE
PIPE	H ₁	H ₂	V	D	CU FT	H ₁	H ₂	V	D	CU FT	H ₁	H ₂	V	D	CU FT	H ₁	H ₂	V	D	CU FT	H ₁	H ₂	V	D	CU FT	PIPE
4"	24"	16"	18"	18"	3.5	30"	16"	18"	18"	4.1	24"	10"	16"	18"	3.2	24"	10"	16"	18"	3.2	24"	10"	16"	18"	3.2	4"
6"	24"	16"	18"	18"	3.5	30"	16"	18"	18"	4.1	24"	10"	16"	18"	3.2	24"	10"	16"	18"	3.2	24"	10"	16"	18"	3.2	6"
8"	36"	18"	18"	18"	5.1	39"	18"	24"	18"	7.3	30"	11"	18"	18"	4.0	24"	11"	18"	18"	3.5	24"	11"	16"	18"	3.4	8"
10"	48"	24"	18"	24"	7.2	54"	32"	24"	18"	10.3	24"	18"	21"	18"	4.6	24"	18"	21"	18"	4.6	24"	18"	21"	18"	4.6	10"
12"	54"	30"	24"	24"	13.4	54"	32"	36"	24"	18.2	42"	18"	24"	24"	9.6	24"	18"	24"	24"	6.6	24"	18"	21"	24"	6.1	12"
14"	60"	32"	30"	24"	17.9	60"	40"	42"	24"	25.0	44"	24"	30"	24"	13.2	30"	24"	24"	24"	9.2	27"	21"	24"	24"	7.9	14"
16"	66"	34"	36"	24"	22.5	69"	48"	48"	24"	29.0	48"	30"	36"	24"	17.0	36"	30"	27"	24"	11.8	27"	24"	27"	24"	9.1	16"
18"	72"	36"	40"	24"	30.0	72"	48"	60"	24"	38.0	48"	30"	42"	24"	21.0	42"	30"	30"	24"	15.0	30"	30"	36"	24"	13.0	18"
20"	84"	38"	42"	24"	36.0	84"	48"	66"	24"	48.0	54"	40"	46"	24"	27.0	48"	36"	36"	24"	19.0	42"	40"	36"	24"	18.0	20"
24"	108"	42"	48"	24"	45.0	108"	60"	72"	24"	68.0	60"	48"	56"	24"	41.0	54"	42"	42"	24"	25.0	48"	42"	42"	24"	23.0	24"
30"	132"	52"	60"	24"	70.0	132"	72"	92"	24"	104.0	72"	48"	76"	24"	58.0	60"	48"	48"	24"	32.0	54"	48"	54"	24"	32.0	30"
36"	162"	58"	72"	24"	100.0	162"	96"	108"	24"	150.0	84"	72"	84"	24"	85.0	66"	72"	60"	24"	50.0	60"	48"	60"	24"	40.0	36"

**West Overton
Utility District**

684 Rickman Monterey Hwy // Rickman, Tennessee 38580
PHONE (931) 498-4144

THRUST BLOCKING TABLE

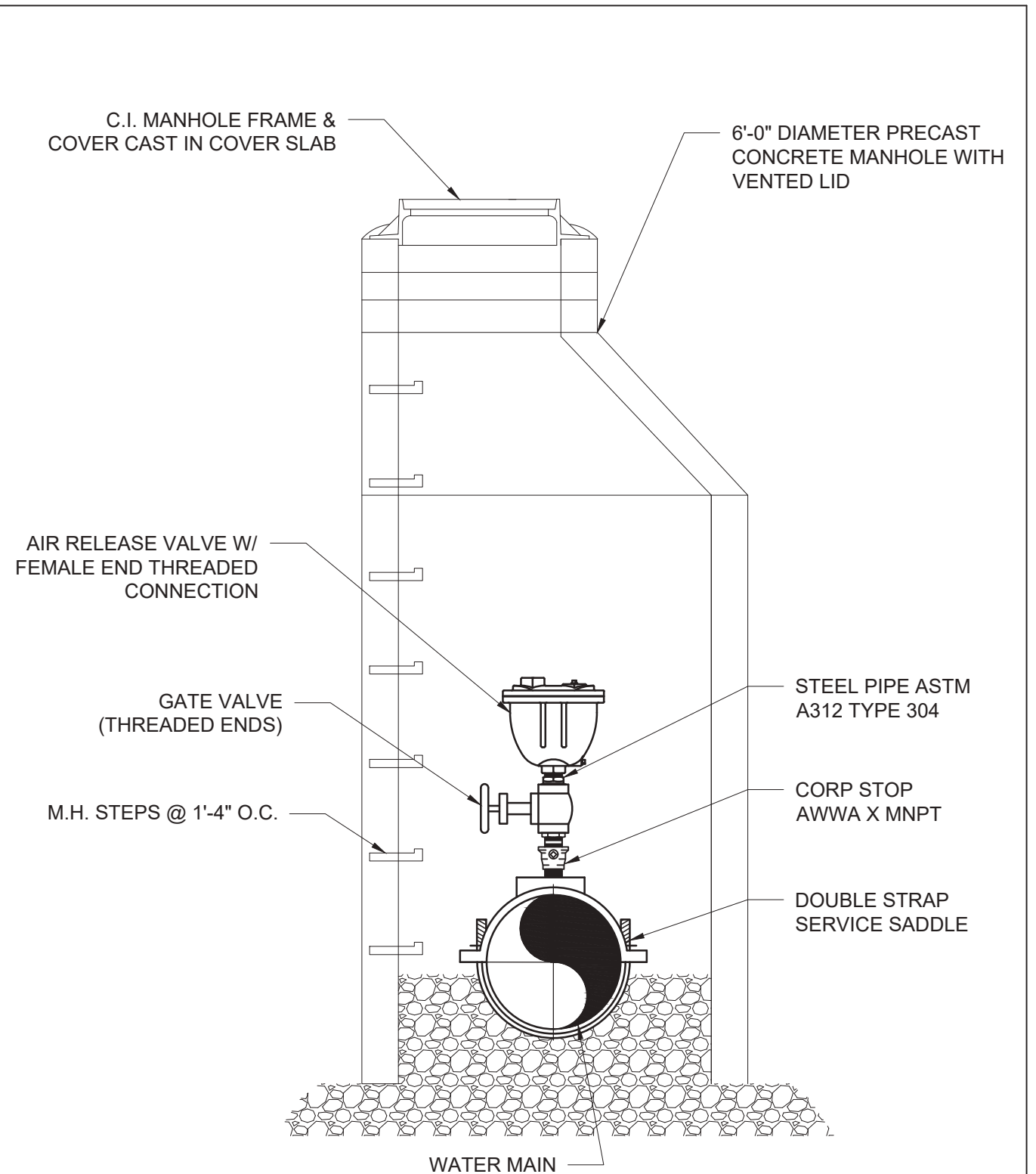
WEST OVERTON UTILITY DISTRICT
STANDARD WATER SPECIFICATIONS

RICKMAN, TENNESSEE

DRAWN BY: CDS
CHECKED BY: MDN

DRAWING NO.:
DETAIL 6

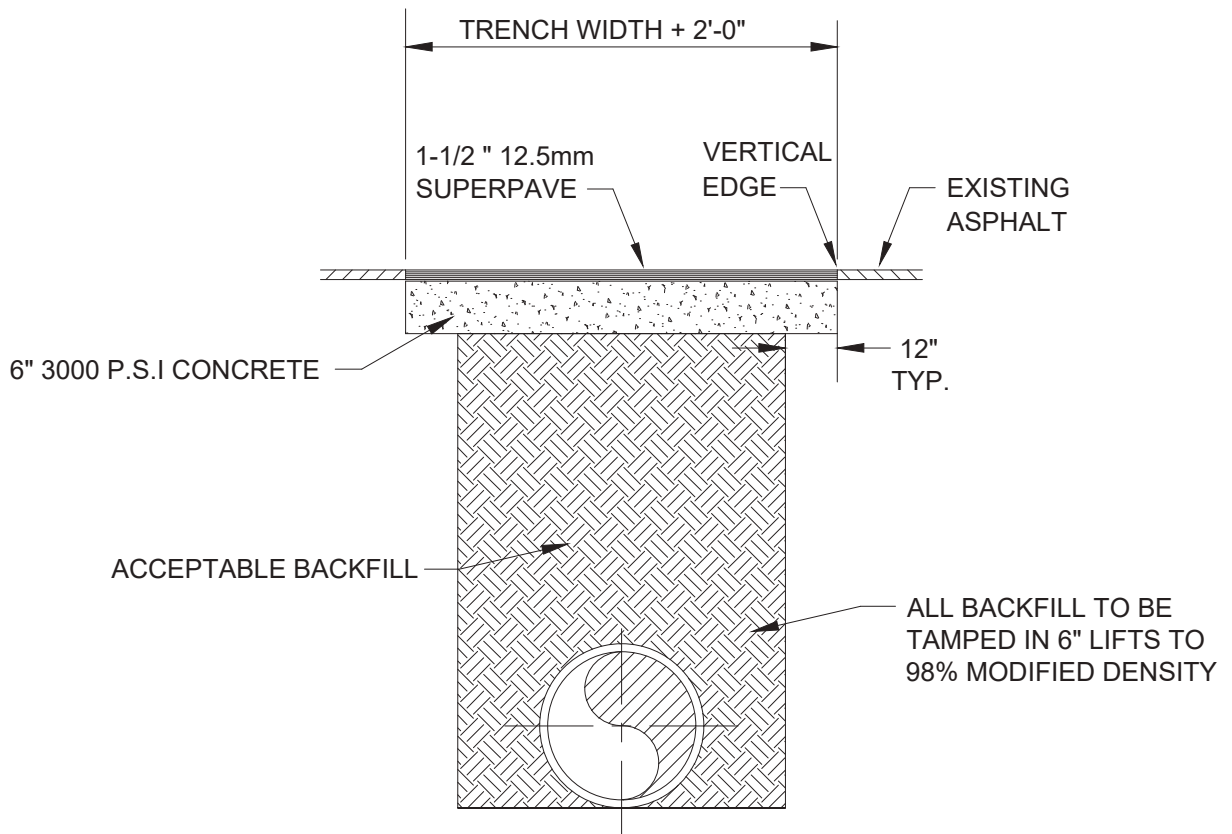
PROJECT NO.: 33163-00
DATE: 11/17/2023



NOTES:

1. THREAD CORP STOP DIRECTLY TO SERVICE SADDLE AND THREAD CORP STOP DIRECTLY TO GATE VALVE.

<p>West Overton Utility District</p> <p><small>684 Rickman Monterey Hwy // Rickman, Tennessee 38580 PHONE (931) 498-4144</small></p>	<p>WATER AIR RELEASE VALVE MANHOLE</p>	<p>DRAWN BY: CDS</p>	<p>CHECKED BY: MDN</p>
	<p>WEST OVERTON UTILITY DISTRICT STANDARD WATER SPECIFICATIONS</p> <p><small>RICKMAN, TENNESSEE</small></p>	<p>DRAWING NO.: DETAIL 7</p>	
		<p>PROJECT NO.: 33163-00</p>	<p>DATE: 11/17/2023</p>



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Utility District*

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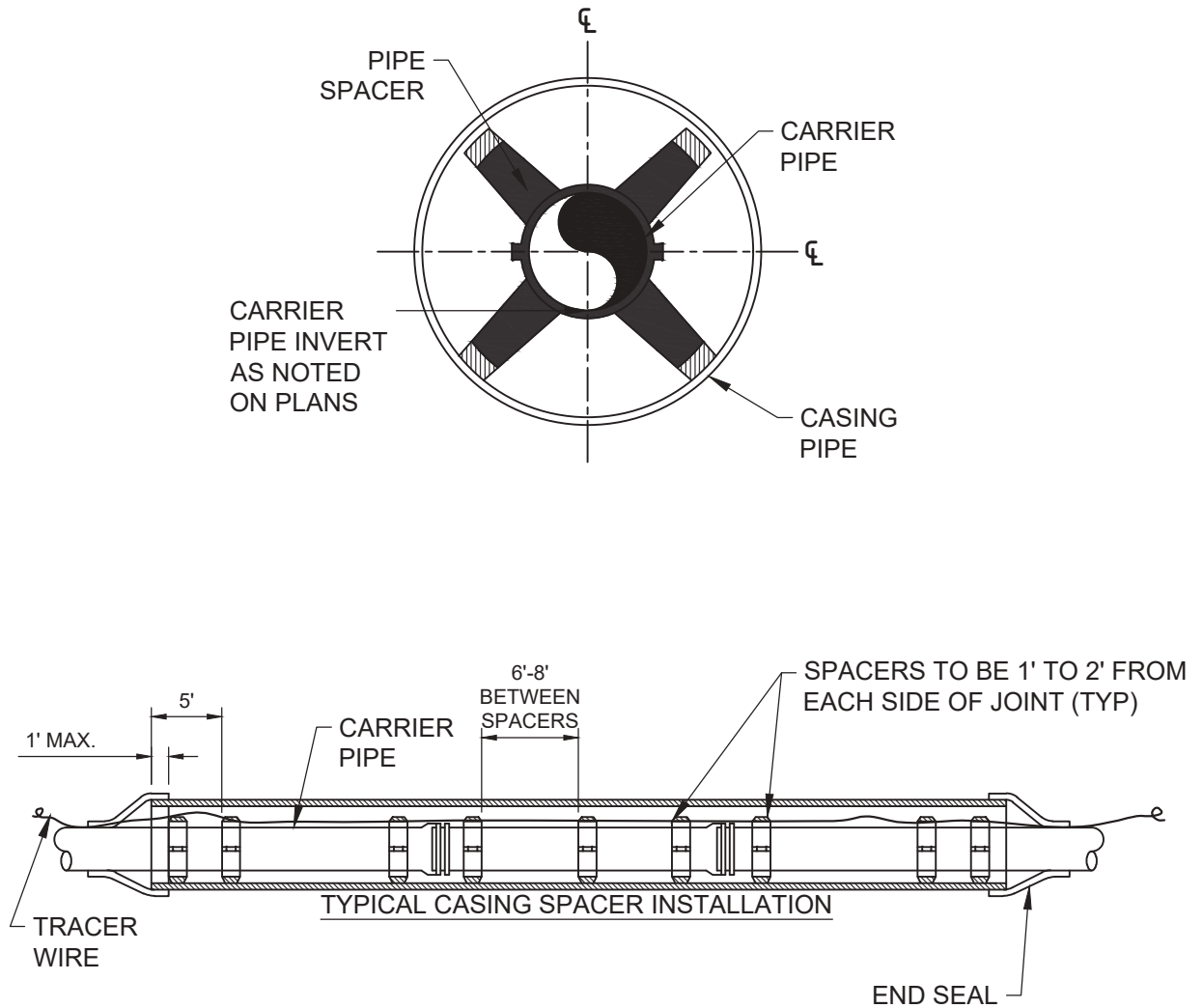
PAVEMENT REPLACEMENT DETAIL

WEST OVERTON UTILITY DISTRICT
STANDARD WATER SPECIFICATIONS
RICKMAN, TENNESSEE

DRAWN BY: CDS
CHECKED BY: MDN

DRAWING NO.:
DETAIL 8

PROJECT NO.: 33163-00
DATE: 11/17/2023



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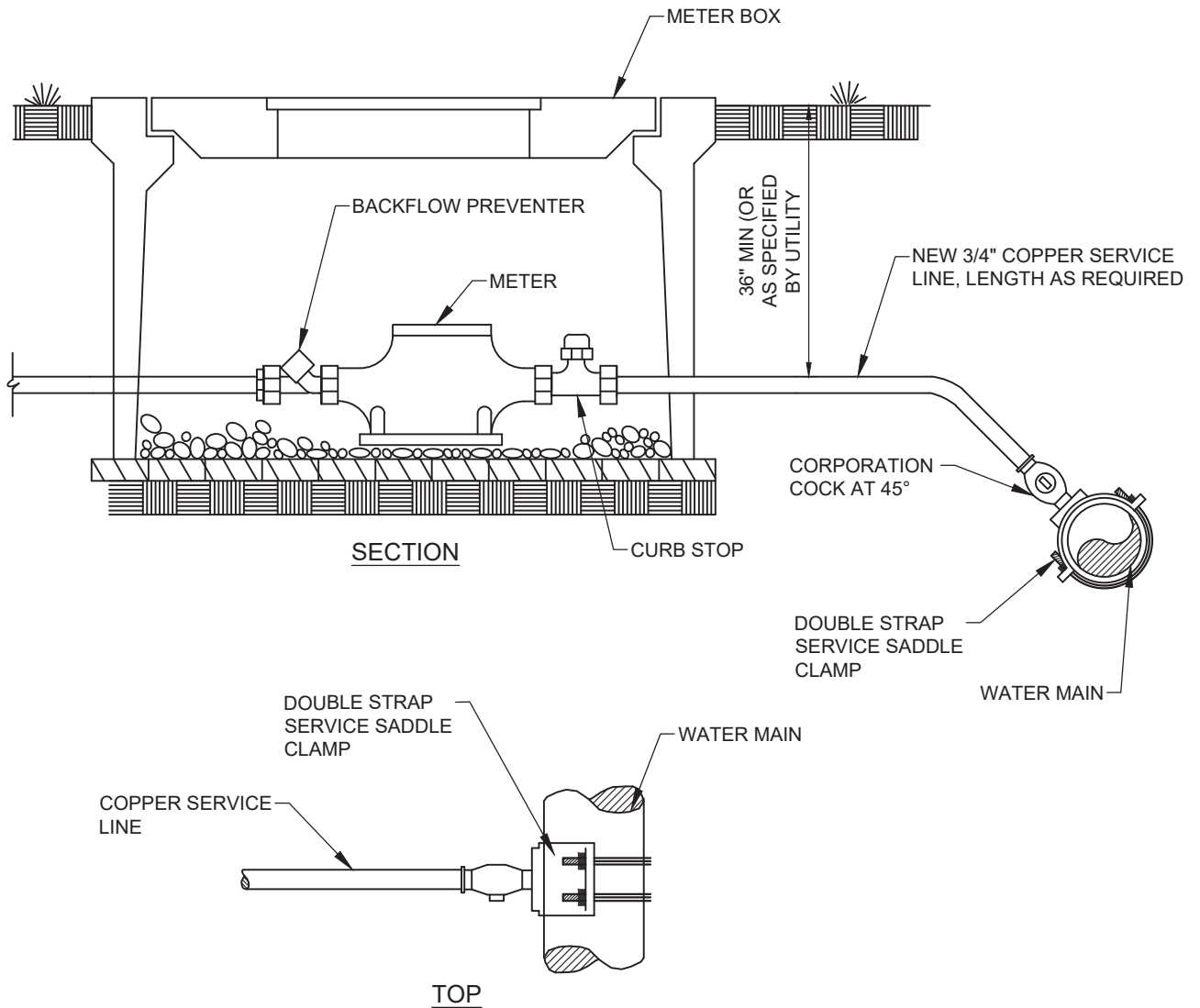
UTILITY CASING DETAIL

WEST OVERTON UTILITY DISTRICT
STANDARD WATER SPECIFICATIONS
RICKMAN, TENNESSEE

DRAWN BY: CDS
CHECKED BY: MDN

DRAWING NO.:
DETAIL 9

PROJECT NO.: 33163-00
DATE: 11/17/2023



NOTES:

1. USE SADDLE FOR TAPS ON METAL PIPE LESS THAN 4" IN DIAMETER.
2. USE SADDLE FOR TAPS ON PVC PIPE.

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Utility District*

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WATER SERVICE DETAIL

WEST OVERTON UTILITY DISTRICT
STANDARD WATER SPECIFICATIONS
RICKMAN, TENNESSEE

DRAWN BY: CDS
CHECKED BY: MDN

DRAWING NO.:
DETAIL 10

PROJECT NO.: 33163-00
DATE: 11/17/2023