

# STANDARD SEWER SPECIFICATIONS

For:

**TELLICO AREA SERVICES SYSTEM (TASS)  
505 CLEARVIEW ROAD  
MARYVILLE, TN 37801**

September 13, 2017

Prepared By:

WPN 23.0158

Tellico Area Services System (TASS) Sewer Specifications  
**APPROVED FOR CONSTRUCTION**

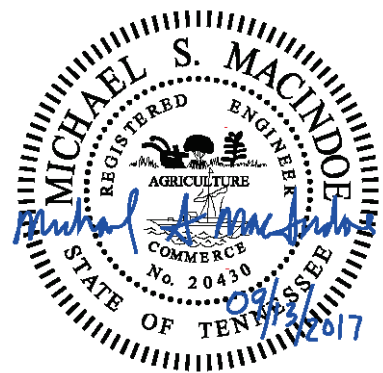
TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION  
DIVISION OF WATER RESOURCES  
AND IS HEREBY APPROVED FOR CONSTRUCTION BY THE COMMISSIONER

*Adnan Bahou*

09/07/2023

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



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These Standard Specifications follows the CSI Master Format Document Identifying System and Cost Accounting Numbers.

Non applicable division and section references have been omitted.

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**SECTION 01031  
SPECIAL PROJECT PROCEDURES**

1. GENERAL

1.1 ACCESS TO PROJECT

- A. The project shall be accessible at all times to representatives of the Tennessee Department of Environment and Conservation, Tennessee Department of Transportation, Tellico Areas Services System, and any other state, local, or federal regulatory agencies.

1.2 MANUFACTURERS' QUALIFICATIONS

- A. The manufacturers of all materials and equipment used must be reputable and regularly engaged in the manufacture of the particular material or equipment for the use and service to which it will be subjected.

1.3 CONTRACTOR SHALL PAY FOR ALL LABORATORY INSPECTION SERVICE

- A. All materials and equipment used in the construction of the project shall be subject to adequate inspection and testing in accordance with accepted standards. The laboratory or inspection agency shall be selected by the Contractor and approved by the Owner. Pay for all laboratory inspection services as a part of the Contract. Submit all material test reports to the Owner in triplicate.

1.4 COMPLIANCE WITH STATE AND LOCAL LAWS

- A. Comply with all applicable requirements of state and local laws and ordinances to the extent that such requirements do not conflict with federal laws or regulations.
- B. The Contractor will secure any and all permits. The Owner will provide bond as required by the Tennessee Department of Transportation for the installation of permanent facilities on the highway rights-of-way.

1.5 PROTECTION OF PUBLIC AND PRIVATE PROPERTY

- A. Take special care in working areas to protect public and private property. The Contractor shall replace or repair at his own expense any damaged water pipes, power and communication lines, or other public utilities, roads, curbs, gutters, sidewalks, drain pipes, sewer drainage ditches, and all plantings, including grass or sod on the site of the work. Leave the site in original or better condition after all cleanup work has been done.

1.6 MARKERS

- A. Preserve all USGS, TVA, State of Tennessee, and private markers; do not remove or disturb any such markers without prior approval from the Owner. Any removal and replacement of such markers shall be at the expense of the Contractor.

## 1.7 PAVEMENT REPAIR AND/OR REPLACEMENT

- A. Repair and/or replace asphalt and concrete driveways, walks, parking areas, shoulders, crushed stone or gravel streets and roads, etc. damaged and/or disturbed during construction.
- B. Whenever pipe trenches are cut across or along existing pavement or shoulders, backfill same and restore traffic over the cuts as quickly as possible by constructing a temporary six-inch (6") surface of crushed stone. Add material and otherwise maintain such surface until the permanent pavement is restored or until the entire project is accepted.

## 1.8 APPROVED CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant, or of other classification, must show approval of either EPA or USDA. The use of all such chemicals and the disposal of residues shall be in strict conformance with instructions.

## 1.9 DRAWINGS OF RECORD

- A. Provide and keep up-to-date a complete record set of record drawing prints, which shall be corrected daily to show every change, and the approved shop drawings. Keep this set of prints at the job site, and use only as a record set. This shall not be construed as authorization for the Contractor to make changes in the approved layout without definite instructions in each case. Turn the set over to the Owner upon completion of the project.

## 1.10 PRESERVATION OF EXISTING VEGETATION

- A. Take reasonable care during construction to avoid damage to vegetation. Where the area to be excavated is occupied by trees, brush, or other uncultivated vegetable growth, clear such growth from the area, and dispose of it in a satisfactory manner. Leave undisturbed any trees, cultivated shrubs, flowers, etc., situated within public rights-of-way and/or easements through private property but not located directly within excavation limits. Transplant small ornamental trees, cultivated shrubs, flowers, etc., located directly within excavation limits so they may be replaced during property restoration operations. Do not remove or disturb any tree larger than 6 inches in diameter without the permission of the Owner. Take special precautions (including the provision of barricades and the temporary tying back of shrubbery and tree branches) for the protection and preservation of such objects throughout all stages of construction; the Contractor will be held liable for any damage that may result to said objects from excavation or construction operations. Trim any limbs or branches of trees broken during construction operations with a clean cut, and paint with an approved tree pruning compound. Treat tree trunks receiving damage from equipment with a tree dressing.

## 1.11 UTILITIES

- A. The Contractor is to contact the Owner of all underground utilities before beginning construction in the area. Carefully protect from damage all utilities in the vicinity of the work at all times. If it is necessary to repair, remove, and/or replace any such utility in order to complete the work properly, do so in compliance with the rules and regulations of the particular utility involved. Any such work shall be considered incidental to the construction or repairs of utility lines, and no additional payment will be allowed.

#### 1.12 CATALOG DATA FOR OWNERS

- A. Provide duplicate complete, bound sets of a compilation of catalog data of each manufactured item of mechanical and electrical equipment used in the work, and present this compilation to the Design Engineer for transmittal to the Owner before payment of more than ninety-five percent (95%) is made. Include descriptive data and printed installation, operating, and maintenance instructions (including a parts list for each item of equipment). Provide a complete double index as follows.
- B. Listing the products alphabetically by name.
- C. Listing alphabetically the names of manufacturers whose products have been incorporated in the work, together with their addresses and the names and addresses of the local sales representative.

#### 1.13 PRECONSTRUCTION SURVEY

- A. The Contractor shall video tape existing site prior to construction. Document existing damage to structures and slopes located along project route. Preconstruction survey shall be considered incidental to the project, and no additional payment will be allowed.

#### 1.14 PROTECTION OF LIVES AND HEALTH

- A. In accordance with generally accepted construction practices, the Contractor will be solely and completely responsible for conditions at the job site, including the safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours.
- B. The Contractor shall comply with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-54). The duty of the Design Engineer to conduct construction review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures in, on, or near the construction site, nor to relieve the Contractor of his obligation to conduct comprehensive inspection of the work sufficient to ensure conformance with the intent of the contract documents.

### 1.15 SAFETY AND CONVENIENCE

- A. The Contractor shall do all work necessary to protect the general public from hazards, including but not limited to surface irregularities or un-ramped grade changes in pedestrian sidewalks and trenches or excavations in roadway. Barricades with warning lights, lanterns, and proper signs shall be furnished in sufficient amount to safeguard the public and the Work. All barricades and signs shall be clean and serviceable.
- B. During construction, the Contractor shall construct, and at all times maintain satisfactory and substantial temporary safety fencing, chain link fencing, solid fencing, railing barricades and/or steel plates as applicable at all excavations, obstructions or other hazards in streets, sidewalks, and walkways. All such barricades shall have adequate painted or flagged markings and warning lights as necessary or required for safety.
- C. The Contractor shall provide flagmen or other personnel who shall be responsible for supporting safety and local resident convenience issues.

### 2. PRODUCTS

NOT USED

### 3. EXECUTION

NOT USED

End of Section

**SECTION 01050  
FIELD ENGINEERING**

1. GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Contractor shall provide field engineering services and establish grades, lines, and levels, by use of recognized engineering survey practices.
- B. Control datum for survey is established by Contractor.

2. PRODUCTS

NOT USED

3. EXECUTION

3.1 INSPECTION

- A. Verify locations of survey control points prior to starting work. Promptly notify Owner of any discrepancies discovered.

3.2 SURVEY REFERENCE POINTS

- A. Protect survey control points prior to starting site work; preserve permanent reference points during construction. Make no changes without prior written notice to Owner.
- B. Promptly report to Owner the loss or destruction of any reference point or relocation required because of changes in grades or other reasons. Replace dislocated survey control points based on original survey control.
- C. The Contractor shall preserve all USGS, TVA, State of Tennessee, and private markers; do not remove or disturb any such markers without prior approval from the Owner. Any removal and replacement of such markers shall be at the expense of the Contractor. The re-establishment of these markers shall be performed by a surveyor licensed by the State of Tennessee, with a letter indicating the completion of work.

3.3 STAKING

- A. The Contractor shall be responsible for staking the project and preparing cut sheets as needed.

End of Section



**SECTION 01090  
STANDARDS**

1. GENERAL

1.1 Meet the requirements and recommendations of all Standards, Institutes, Associations, etc., referred to throughout these documents and specifications as if they were fully reproduced herein. Unless otherwise noted, the latest editions shall apply.

1.2 ABBREVIATIONS

|        |  |
|--------|--|
| AAMA   | Architectural Aluminum Manufacturers' Association                          |
| AASHTO | American Association of State Highway and Transportation Officials         |
| ABMA   | American Boiler Manufacturers' Association                                 |
| ACI    | American Concrete Institute  |
| AFBMA  | Anti-Friction Bearing Manufacturers' Association                           |
| AGA    | American Gas Association   |
| AGC    | Association of General Contractors   |
| AGMA   | American Gear Manufacturers' Association                                   |
| AIA    | American Institute of Architects   |
| AIEE   | American Institute of Electrical Engineers                                 |
| AIMA   | Acoustical and Insulating Materials Association                            |
| AISC   | American Institute of Steel Construction                                   |
| AISI   | American Iron and Steel Institute  |
| AITC   | American Institute of Timber Construction                                  |
| AMCA   | Air Moving and Conditioning Association                                    |
| ANSI   | American National Standards Institute                                      |
| APA    | American Plywood Association   |
| API    | American Petroleum Institute   |
| ARI    | Air Conditioning and Refrigeration Institute                               |
| ASA    | American Standards Association   |
| ASAE   | American Society of Automotive Engineers                                   |
| ASC    | Association of Specialty Contractors                                       |
| ASCII  | American Standard Code for Information Interchange                         |
| ASHRAE | American Society of Heating, Refrigerating, and Air Conditioning Engineers |
| ASME   | American Society of Mechanical Engineers                                   |
| ASTM   | American Society for Testing and Materials                                 |
| AWI    | Architectural Woodwork Institute   |
| AWPB   | American Wood Preservers Bureau  |
| AWPI   | American Wood Preservers Institute   |
| AWS    | American Welding Society   |
| AWWA   | American Water Works Association   |
| BIA    | Brick Institute of America   |
| CMAA   | Crane Manufacturer's Association of America                                |
| CRSI   | Concrete Reinforcing Steel Institute                                       |
| CS     | Commercial Standards   |
| CSI    | Construction Specifications Institute                                      |
| EPA    | Environmental Protection Agency  |
| FAA    | Federal Aviation Administration  |

|        |  |
|--------|--|
| FGMA   | Flat Glass Marketing Association   |
| FM     | Associated Factory Mutual Laboratories                                       |
| FS     | Federal Specifications   |
| IEEE   | Institute of Electrical and Electronic Engineers                             |
| IRI    | Industrial Risk Insurers   |
| ISA    | Instrument Society of America  |
| JIC    | Joint Industrial Council   |
| MBMA   | Metal Building Manufacturers' Association                                    |
| MMA    | Monorail Manufacturers' Association  |
| NAAMM  | National Association of Architectural Metal Manufacturers                    |
| NBS    | National Bureau of Standards   |
| NEC    | National Electrical Code   |
| NEMA   | National Electrical Manufacturers' Association                               |
| NFPA   | National Fire Protection Association or National Forest Products Association |
| NKCA   | National Kitchen Cabinet Association   |
| NPT    | National Pipe Thread   |
| NRCA   | National Roofing Contractors' Association                                    |
| NSF    | National Sanitation Foundation   |
| NSWMA  | National Solid Waste Manufacturers' Association                              |
| NWMA   | National Woodwork Manufacturing Association                                  |
| OSHA   | Occupational Safety and Health Administration                                |
| PPI    | Plastics Pipe Institute  |
| RIS    | Redwood Inspection Service   |
| SAE    | Society of Automotive Engineers  |
| SBCC   | Standard Building Code Congress  |
| SDI    | Steel Deck Institute   |
| SJI    | Steel Joist Institute  |
| SMACNA | Sheet Metal and Air Conditioning Contractors' National Association           |
| SPII   | Southern Pine Inspection Institute   |
| SSBC   | Southern Standard Building Code  |
| SSPC   | Steel Structures Painting Council  |
| TCA    | Tile Council of America  |
| TDOT   | Tennessee Department of Transportation                                       |
| TIMA   | Thermal Insulation Manufacturers' Association                                |
| UL     | Underwriters' Laboratories   |
| USG    | United States Gypsum   |
| WCLIB  | West Coast Lumber Inspection Bureau  |
| WWPA   | Western Wood Products Association  |

## 2. PRODUCTS

NOT USED

## 3. EXECUTION

NOT USED

End of Section

**SECTION 01302**  
**SUBMITTALS AND SUBSTITUTIONS**

1. GENERAL

1.1 SUMMARY

A. Work Included

1. Wherever possible throughout the contract documents, the minimum acceptable quality of workmanship and materials has been defined by a manufacturer's name and catalogue number, reference to recognized industry and government standards, or description of required attributes and performance.
2. To ensure that the specified products are furnished and installed in accordance with the design intent, procedures have been established for advance submittal of design data and for their review by the Owner.
3. Make all submittals required by the Contract Documents, and revise and resubmit as necessary to establish compliance with the specified requirements.

B. Related Work Described Elsewhere

1. Individual requirements for submittals are described in other pertinent sections of these specifications.

1.2 SUBMITTALS

A. Identification of Submittals

1. General: Consecutively number all submittals.
2. Internal Identification: On at least the first page of each copy of each submittal, clearly indicate the submittal number in which the item was included.
3. Resubmittals: When material is resubmitted for any reason, transmit under a new letter of transmittal utilizing the original submittal number followed by an A, B, C, etc., depending on the number of resubmittals of the original submittal required.

B. Shop Drawings and Coordination of Drawings

1. Deliver or mail all submittals to:

Tellico Area Services System (TASS)  
505 Clearview Road  
Maryville, TN 37801

Attention: Mark Clinton, Superintendent  
Telephone: (865) 856-3530  
(423) 884-6400

3. Make submittals in strict accordance with the provisions of this section.

## 1.1 QUALITY ASSURANCE

### A. Coordination of Submittals

1. Prior to each submittal, carefully review and coordinate all aspects of each item being submitted, and verify that each item and the submittal for it conforms in all respects with the requirements of the bidding instruments.
2. Shop drawings and submittals shall bear the stamp of approval of the Contractor as evidence that this coordination has been performed.

## 1.4 SUBMITTAL SCHEDULE

### A. Timing Of Submittals

1. General:
  - a. Make all submittals far enough in advance of scheduled dates for installation to provide all time required for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery.
  - b. Submit shop drawings in accordance with the approved schedule of shop drawing submittals.
2. Owner's Review Time: In scheduling, allow at least 20 calendar days for review by the Owner following his receipt of the submittal.
3. Delays: Delays caused by tardiness in receipt of submittals will not be an acceptable basis for extension of the contract completion date.

## 1.5 SUBSTITUTIONS

### A. Approval Required

1. The contract is based on the standards of quality established in the contract documents.
2. All products proposed for use, including those specified by required attributes and performance shall require approval by the Owner before being incorporated into the work.

3. Do not substitute materials, equipment, or methods unless such substitution has been specifically approved for this work by the Owner.

B. "Or Equal"

1. Where the phrase "or equal" or "or approved equal" occurs in the contract documents do not assume that materials, equipment, or methods will be approved as equal unless the item has been specifically approved for this work by the Owner.
2. The decision of the Owner shall be final.
3. See pertinent portions of the contract documents for additional information relating to substitutions.

2. PRODUCTS

NOT USED

3. EXECUTION

NOT USED

End of Section

**SECTION 01400**  
**QUALITY CONTROL**

1. GENERAL

1.1 REQUIREMENTS INCLUDED

A. General Quality Control.

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

B. Workmanship.

1. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
2. Perform work by persons qualified to produce workmanship of specified quality.
3. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

C. Manufacturers' Instructions.

1. Comply with instructions in full detail, including each step in sequence. Should instructions conflict with contract documents, request clarification from Owner before proceeding.

D. Manufacturers' Certificates.

1. When required by individual specifications section, submit manufacturers' certificate, in duplicate, that products meet or exceed specified requirements.

E. Manufacturers' Field Services.

1. When specified in respective specification sections, require supplier or manufacturer to provide qualified personnel to observe field conditions; conditions of surfaces and installation; quality of workmanship; start-up of equipment; test, adjust, and balance of equipment; and as applicable, to make appropriate recommendations.
2. A representative shall submit a written report to Owner listing observations and recommendations.

F. Testing Laboratory Services.

1. Contractor shall employ and pay for services of an Independent Testing Laboratory to perform inspections, tests, and other services required by individual specification sections.

2. Services will be performed in accordance with requirements of governing authorities and with specified standards.
3. Reports will be submitted to Owner in duplicate giving observations and results of tests, indicating compliance or non-compliance with specified standards and with contract documents.
4. Contractor shall cooperate with testing laboratory personnel, furnish tools, samples of materials, design mix, equipment, storage, and assistance as requested.
  - a. Notify Owner and testing laboratory 24 hours prior to expected time for operations requiring testing services.
  - b. Make arrangements with testing laboratory and pay for additional samples and tests for Contractors' convenience.

## 2. PRODUCTS

NOT USED

## 3. EXECUTION

NOT USED

End of Section

**SECTION 01568  
EROSION CONTROL**

1. GENERAL

1.1 DESCRIPTION

- A. This work shall consist of erosion control on all cut and fill operations, excavation, backfill, or other construction activities within the limits of the construction site, within any temporary or permanent easements, and within any borrow site used during the period of construction. The protection of these sites shall continue throughout the construction period. During flood seasons, protect the sites by sandbagging, pumping water, and any other means appropriate to restrain flooding of neighboring streets and properties. During dry weather, sprinkle the sites with water and/or other means as necessary to provide dust control.
- B. The temporary pollution control provisions contained herein shall be coordinated with the permanent erosion control features, 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. Seg., Subsection 69-3-108 and Subsection 69-3-114, and Division of Construction Grants and Loans General Permit for Utility Line Crossings, 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 does not harm the Waters of Tennessee, the Contractor is solely responsible for ensuring that the above-mentioned laws and regulations are met. **It shall be the CONTRACTOR'S sole responsibility for payment of any fines or penalties Tellico Area Services System may receive as a result of Tennessee Department of Environment and Conservation (TDEC) enforcement due to a notice of noncompliance.**
- D. Loudon or Monroe County Grading Permit, issued by the Loudon or Monroe County Stormwater Department, is required. If the land activity is equal to or greater than one tenth (1/10) of one acre in size, an engineer designed erosion control plan must be submitted with the application. Grading permit must be issued prior to any land disturbing activity. Also note, a permit will be required from the Tennessee Department of Environment and Conservation (TDEC) prior to release of the Loudon or Monroe County Grading Permit for land activity equal or greater than one (1.0) acre in size.

2. PRODUCTS

2.1 TEMPORARY BERMS

- A. These berms are used temporarily at the top or base of newly constructed slopes to prevent excessive erosion until permanent controls are installed or slopes stabilized.



## 2.2 TEMPORARY SLOPE DRAINS

- A. A temporary slope drain is a facility consisting of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half round pipe, metal pipe, plastic pipe, sod, or other material that may be used to carry water down slopes to reduce erosion.

## 2.3 SEDIMENT STRUCTURES

- A. Sediment basins, ponds, and traps are prepared storage areas constructed to trap and store sediment from erodible areas in order to protect properties and stream channels below the construction areas from excessive siltation.

## 2.4 CHECK DAMS

- A. Check dams are barriers composed of large stones, sand bags, or other noncorrodible materials placed across or partially crossing a natural or constructed drainway.

## 2.5 CHECK DAM (ALTERNATE): ENVIROBERM SYNTHETIC POROUS SEDIMENT CONTROL STRUCTURES

- A. EnviroBerm Synthetic Porous Sediment Control Structures are barriers composed of synthetic porous material placed across or partially crossing a natural or constructed drainway.

## 2.6 TEMPORARY SEEDING AND MULCHING

- A. Temporary seeding and mulching are measures consisting of seeding, mulching, fertilizing, and matting utilized to reduce siltation and erosion. All cut and fill slopes including waste sites and borrow pits shall be seeded when and where necessary to eliminate erosion.

## 2.7 BALED HAY

- A. Baled hay is a temporary measure to control erosion and prevent siltation. Bales shall be either hay or straw containing 5 cubic feet or more of material. Bales shall be staked.

## 2.8 TEMPORARY SILT FENCES

- A. Silt fences are temporary sediment barriers consisting of a filter fabric stretched across and attached to supporting posts and entrenched. The silt fence is constructed of synthetic filter fabric, posts, and depending upon the strength of the fabric used, wire fence for support. The filter barrier is constructed of stakes and burlap or synthetic filter fabric.

## 2.9 TEMPORARY CONSTRUCTION ENTRANCE

- A. A temporary construction entrance consisting of crushed stone with a geotextile filter fabric underlining is utilized to reduce or eliminate tracking of material by construction vehicles onto public streets.

## 2.10 TEMPORARY INLET PROTECTION

- A. Temporary inlet protection consisting of washed stone, filter fabric, wire mesh, and concrete blocks is utilized to prevent sediment from entering the storm drainage system, prior to temporary or permanent stabilization of the construction area.

## 2.11 RIP-RAP APRON

- A. A rip-rap apron consisting of large, loose, angular stone with a geotextile filter fabric underlining is utilized to reduce stormwater velocity and dissipate the energy of flow leaving a storm drain before it empties into receiving channels, and to armor erodible materials.

## 2.12 PERMANENT SEEDING AND MULCHING

- A. Permanent seeding and mulching are measures consisting of seeding, mulching, fertilizing, hydroseeding, and matting utilized to reduce siltation and erosion. All disturbed areas shall be stabilized upon completion of construction operations.

## 3. EXECUTION

### 3.1 PROJECT REVIEW

- A. It is the responsibility of the Contractor to prepare an approved Stormwater Pollution Prevention Plan (SWPPP) and to develop additional erosion controls as necessary that are acceptable to the Owner and to applicable regulatory agencies. If at any time the Owner deems it necessary, the Contractor shall provide additional erosion devices. The site shall be provided with maximum protection from erosion at all times.
- B. If the Contractor desires to stockpile construction materials, stone, earth, etc., the location of same and the protection thereof shall be defined and incorporated into the SWPPP and Loudon or Monroe County Grading Permit application.

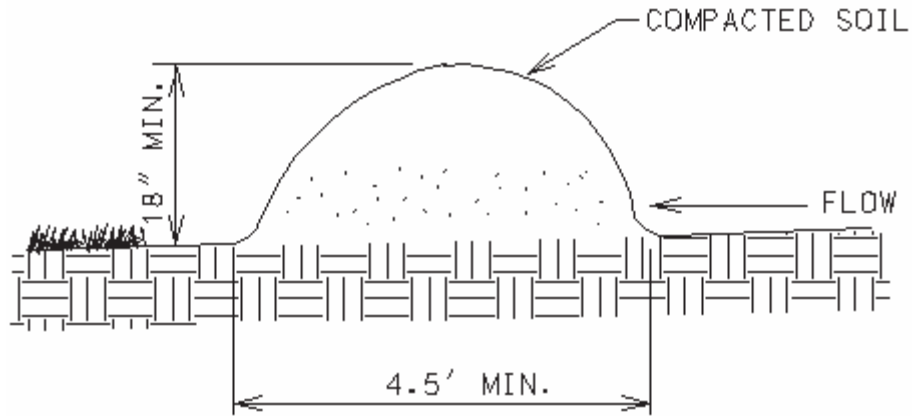
### 3.2 CONSTRUCTION REQUIREMENTS

- A. In the event of conflict between these requirements and pollution control laws, rules or regulations, or other Federal, State, or Local agencies, the more restrictive laws, rules, or regulations shall apply.
- B. In streets and other paved areas, remove excavated material from the site as construction progresses to prevent any erosion of this material.

- C. In other areas, place the excavated material so as not to block any drainage areas. Replace excavated material in the trench immediately after work has been completed and approved by the Owner.
- D. Retain natural vegetation whenever feasible.
- E. Restore and cover exposed areas subject to erosion as quickly as possible by means of seeding and mulching. Use diversion ditches or other methods as appropriate to prevent storm water from running over the exposed area until seeding is established as specified. Erosion control matting may be necessary as required by the Owner.
- F. Take particular care along drainage ditches so that fallen trees, debris, and excavated material will not adversely affect the stream flow. Exercise care to minimize the destruction of drainage ditches. Wherever the drainage ditches are affected by construction, the contractor must repair the drainage ditches to provide a suitable condition for vegetative protection. Minimize land exposure in terms of area and time.
- G. Take care during the placing of pavement, hauling of materials, etc., to keep vehicles from creating a severe erosion problem. Proper scheduling of operations and prompt repair of ruts created during this operation is necessary from this source.

### 3.3 CONSTRUCTION OF STRUCTURES

- A. Temporary Berm (See Figure 1)
  - 1. The maximum allowable drainage area is 5 acres.
  - 2. The minimum allowable height measured from the upslope side of the berm is 18 inches.
  - 3. Side slopes should be 1.5:1 or flatter. (Minimum base width of 4.5 feet).
  - 4. The channel behind the berm shall have a positive grade to a stabilized outlet. If the channel slope is less than or equal to 2 percent, the channel shall be stabilized.

**NOTE:**

1. SIDE SLOPES SHALL BE 1.5:1 OR FLATTER.

**Figure 1** (Temporary Berm)

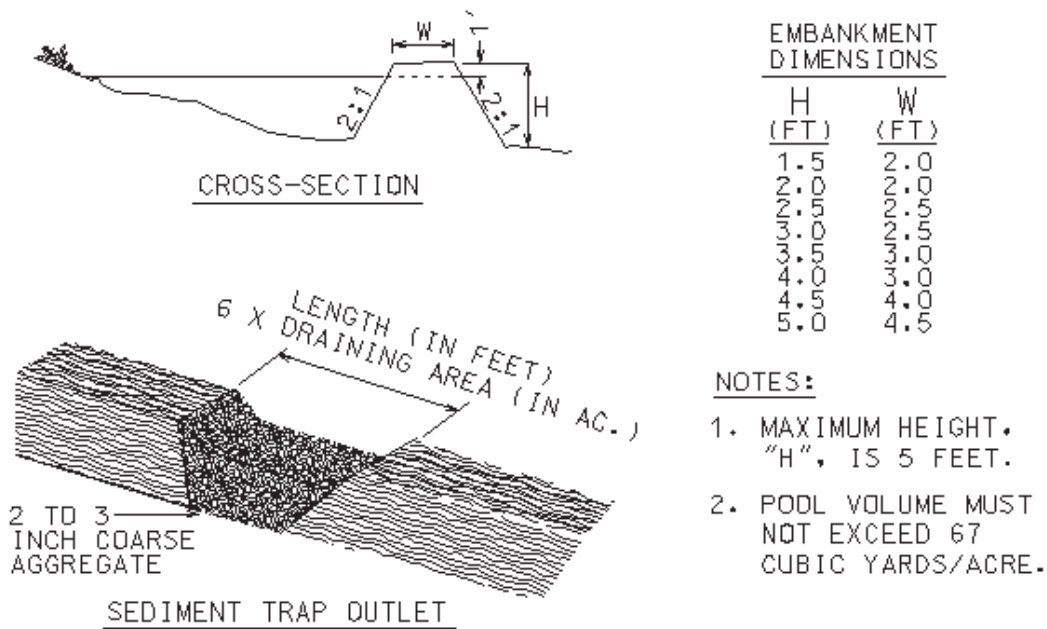
**B.** Temporary Slope Drains

1. Temporary slope drains shall consist of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half round pipe, metal pipe, plastic pipe, flexible rubber, or other materials which can be used as temporary measures to carry water accumulating in the cuts and on the fills down the slopes prior to installation of permanent facilities or growth of adequate ground cover on the slopes.
2. Plastic sheeting shall not be used on slopes steeper than 4:1 except for short distances of 20 feet or less.
3. All temporary slope drains shall be adequately anchored to the slope to prevent disruption by the force of the water flowing in the drains. The base for temporary slope drains shall be compacted and concavely formed to channel the water or hold the slope drain in place. The inlet end shall be properly constructed to channel water into the temporary slope drain. Energy dissipaters, sediment basins, or other approved devices shall be constructed at the outlet end of the slope drains to reduce erosion downstream. An ideal dissipater would be dumped rock or a small sediment basin which would slow the water as well as pick up some sediment. All temporary slope drains shall be removed when no longer necessary.

**C.** Sediment Structures (See Figure 2)

1. The area under the embankment shall be cleared, grubbed, and stripped of any vegetation and root mat. To facilitate cleanout the pool area should be cleared.

2. Fill material for the embankment shall be free of roots or other woody vegetation, organic material, large stones, and other objectionable material. The embankment should be compacted in 8-inch layers by traversing with construction equipment.
3. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.
4. The structure shall be removed and the area stabilized when the upslope drainage has been stabilized.
5. All cut and fill slopes shall be 2:1 or flatter.



**Figure 2** (Sediment Structure)

**D. Check Dams**

1. Check dams shall be utilized to retard stream flow or restrict stream flow within the channel. Check dams can be constructed of stone.
  - a. All check dams shall be keyed into the sides and bottom of the channel. The contractor shall see the design plans for further information regarding installation and placement.

**E. Check Dam (Alternate): EnviroBerm Synthetic Porous Sediment Control Structures**

1. All materials to be used in the construction of synthetic porous sediment control structures shall meet the following specifications:

**Synthetic Porous Sediment Control Structures:**

|                              |   |                 |
|------------------------------|---|-----------------|
| Polymer:                     | UV Resistant High Density Polyethylene  |                 |
| Size:                        | 10 in high x 43 in long with a 2 in lip |                 |
| Single Rib Thickness:        | Top: 5/32 in                            | Bottom: 5/32 in |
| Distance Between Ribs:       | Top: 1/2 in                             | Bottom: 1/2 in  |
| Apparent Opening Size (AOS): | US Sieve No.4 (Average Value)           |                 |
| Percent Open Area:           | 30% (Average Value)                     |                 |
| Weight:                      | 3.70 lb/yd <sup>2</sup>                 |                 |
| Tensile Strength:            | MD = 1800 lb/ft                         | TD = 500lb/ft   |

Tensile Strength Method: ASTM D4595

Velocity Reductions: \* 10% to 74%

Kinetic Energy Reduction: \* 40% to 85%

\* Based on test results with various velocities and volumes:

T. Blench Hydraulics Laboratory, University of Alberta, Department of Civil and Environmental Engineering

| "M" Pins:         | Regular:           | Heavy Duty:        |
|-------------------|--------------------|--------------------|
| Size:             | 3 in x 27 in       | 3 in x 21 in       |
| Product:          | Deformed D 3.5 Rod | Deformed D 4.5 Rod |
| Diameter:         | .211 in            | .240 in            |
| Tensile Strength: | 80000 psi          | 80000 psi          |
| Grade:            | C1008              | C1008              |

**Erosion Matting:**

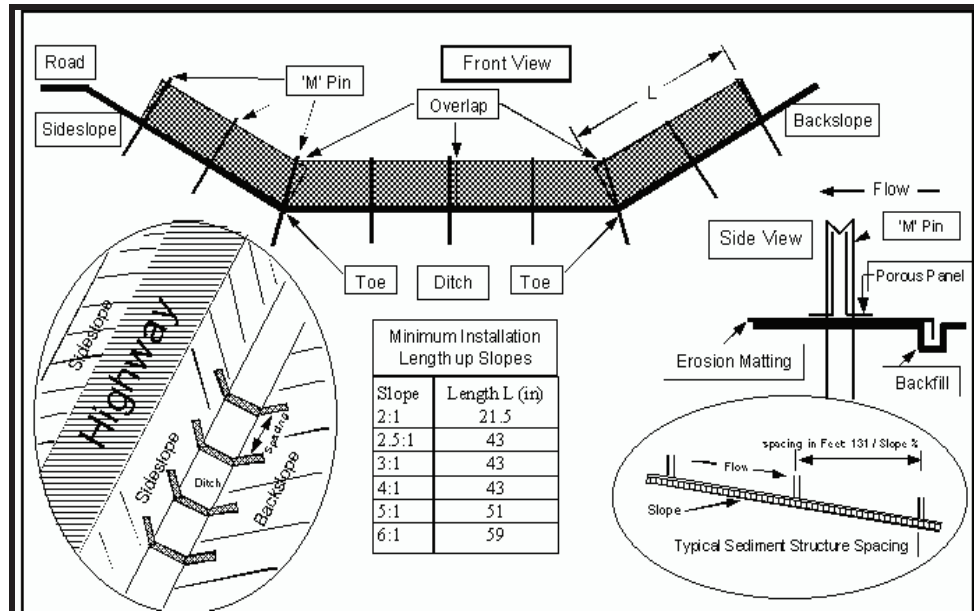
(AS SPECIFIED ON PLANS)

- The Contractor shall construct synthetic porous sediment control structures at the locations and spacings as shown on the Plans. When required, additional structures shall be constructed as directed by the Owner.
- Synthetic Porous Sediment Control Structures shall be of the type specified, constructed to the specifications shown on the drawings and as directed by the Owner. The Control Structures shall be placed perpendicular to the direction of water flow.
- Porous Sediment Control Structures shall be constructed of two panels of high density, extruded UV resistant polyethylene pinned down with "M" pins in a single row complete with a biodegradable or permanent erosion control matting on the under side.
- Each synthetic porous sediment control structure shall comprise a central portion forming a horizontal porous weir and two inclined portions which extend from the weir up the embankment and the backslope as shown on the drawing. The structures shall have the capability to shape to the contour of the channel bottom and side slopes to ensure firm contact between the

entire bottoms of the structures and the soil. No breach shall occur along the integrity of the structure.

6. The anchoring system shall be able to endure minimum flow rates as set by the Owner. To validate specified flow rates; the Contractor shall supply a certificate from the supplier of actual field test results. The performance of the Porous Sediment Control Structures integrity shall endure freeze thaw cycles without failure; as per specified geographical areas.
7. Installation (See Figure 3)
  1. Panel Spacing: As specified on plans
  2. Starting at the top of the channel, mark each sediment control structure site with a stake.
  3. Seed the soil area where structures are to be placed. Lay an erosion mat strip across ditch at each sediment structure site. The mat should extend up the sideslope and backslope the length of the panel.
  4. Trench in the upstream edge of the mat about 4 inches deep. Staple the mat in the trench with 8 inch staples, placed about 12 inches apart. Manually backfill and compact the trench.
  5. Staple the other edge of the mat to the ground with 8 inch staples, approx. 12 inches apart.
  6. Starting at either the toe of the backslope or sideslope, place the porous panel strips on the bottom of the ditch along the center of the erosion mat. Place the spacing guide along the ground between the panels. The bottom panel lips should face outward.
  7. Put an 'M' pin in the installation tool, place the pin over the panels about half way down the strips, (in the middle), so a pin leg is against the outside of each panel, and drive the pin through the panel lips into the ground. The panels should be wedged into the 'M' pins at the top and ensure firm contact between the entire bottoms of the Porous Sediment Control Structure and the soil. Pull the installation tool off the installed pin.
  8. From the installed panel, extend a second pair of panels, overlapping the first panels at the toe a minimum of 2 inches up the side or backslope. Place the next 'M' pin over both sets of panels at the toe, and drive the pin into the ground with the installation tool and ensure firm contact between the entire bottoms of the Porous Sediment Control Structure and the soil.
  9. Install the next pins in the middle and at the upper end of the second set of panels, again using both the spacing strip and the driving tool. Third panel set is placed, extending across the ditch from the first installed panels, overlapped a minimum of 2 inches and the next pin placed at the overlap.
  10. This sequence is continued until the sediment structure is installed and firm contact between the entire bottoms of the Porous Sediment Control Structure and the soil are established. The last panel installed is the one extending up the opposite slope from the starting panels. No breach shall occur along the integrity of the structure.

11. This sequence is continued until the sediment structure is installed and firm contact between the entire bottoms of the Porous Sediment Control Structure and the soil are established. The last panel installed is the one extending up the opposite slope from the starting panels. No breach shall occur along the integrity of the structure.



**Figure 3** (EnviroBerm Porous Sediment Control Structure)

**Maintenance:**

Silt deposited in front of the sediment control structures shall be removed regularly and at no time shall it be allowed to build up to a height exceeding half the height of the structure.

- F. Temporary Seeding and Mulching: Seeding and mulching shall be performed in accordance with section 02485, Seeding.
- G. Baled Hay: Hay or straw bales shall be embedded in the ground 4 to 6 inches to prevent water flowing under them. The bales shall also be anchored securely to the ground by at least two wooden stakes driven through each bale into the ground. Bales can remain in place until they rot, or be removed after they have served their purpose, as determined by the Owner. The Contractor shall keep the bales in good condition by replacing broken or damaged bales immediately after damage occurs. Normal debris cleanout will be considered maintenance.



#### H. Temporary Silt Fences

1. Temporary silt fences shall be placed on the natural ground, at the bottom of fill slopes, in ditches, or other areas where siltation is a problem.
2. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, and polyester or ethylene yarn and shall be certified by the manufacturer or supplier.
3. Burlap shall be 10-ounce per square yard fabric.
4. Posts for silt fences shall be either 2-inch by 2-inch diameter wood or 1.33 pounds per linear foot steel with a minimum length of 4 feet. Steel posts shall have projections for fastening wire to them.
5. Stakes for filter barriers shall be 1" x 2" wood (preferred) or equivalent metal with minimum length of 3 feet.
6. Wire fence reinforcement for silt fences using standard strength filter cloth shall be a minimum of 42 inches in height, a minimum of 14 gauge and shall have a maximum mesh spacing of 6 inches.
7. The height of a filter barrier shall be a minimum of 24 inches and shall not exceed 26 inches.
8. The stakes shall be spaced a maximum of 3 feet apart at the barrier location and driven securely into the ground (minimum of 8 inches).
9. A trench shall be excavated approximately 4 inches wide and 4 inches deep along the line of stakes and upslope from the barrier.
10. The filter material shall be stapled to the wooden stakes, and 8 inches of the fabric shall be extended into the trench. Heavy duty wire staples at least ½ inch long shall be used. Filter material shall not be stapled to existing trees.
11. The trench shall be backfilled and the soil compacted over the filter material.
12. The Contractor shall be required to maintain the silt fence in a satisfactory condition for the duration of the project or until its removal is requested by the Owner. The silt accumulation at the fence may be left in place and seeded, removed, etc., as directed by the Owner. The silt fence becomes the property of the Contractor whenever the fence is removed.

#### I. Temporary Construction Entrance

1. Crushed stone shall be 2" to 3" (TDOT #1 or #2) with a minimum pad thickness of 6".
2. The width of the temporary construction entrance shall be 20 ft. for one-way traffic and 30 ft. for two-way traffic.
3. The geotextile filter fabric underlining must be placed the full length and width of the crushed stone pad.
4. If the action of the vehicle traveling over the crushed stone pad does not sufficiently remove the material, the tires shall be washed before entering onto public streets. A wash rack shall be incorporated into the crushed stone pad and be in compliance with all TDEC standards.

- J. Temporary Inlet Protection
  - 1. Crushed stone shall be ¾" to 3" (TDOT #3, #357, or #5) up to 2" below top of concrete block.
  - 2. Place concrete blocks lengthwise on their sides in a single row around the perimeter of the inlet, so that the open ends face outward, not upward.
- K. Rip-Rap Apron: Rip-rap aprons shall be utilized to reduce stormwater velocity and dissipate the energy of flow leaving a storm drain before it empties into receiving channels, and to armor erodible materials
  - a. The contractor shall see the design plans for further information regarding installation and placement.
- L. Permanent Seeding and Mulching: Seeding and mulching shall be performed in accordance with section 02485, Seeding.

### 3.4 MAINTENANCE

- A. The temporary erosion control features installed by the Contractor shall be acceptably maintained by the Contractor until no longer needed or permanent erosion control methods are installed. The temporary erosion control materials shall be moved and become the property of the Contractor.
- B. As described in the SWPPP, the Contractor shall inspect the erosion control measures weekly and as required due to upcoming rain events and after recent rain events. The Contractor shall maintain all records of inspections and improvements as required.

### 3.5 EROSION CONTROL OUTSIDE PROJECT AREA

- A. Temporary pollution control shall include construction work outside the project area where such work is necessary as a result of construction such as borrow pit operations, haul roads, and equipment storage sites.

End of Section

**SECTION 01570  
WORK ZONE TRAFFIC CONTROL**

1. GENERAL

- 1.1 The Work to be performed shall consist of providing, installing, maintaining, relocating, and removing temporary traffic control devices and services as ordered by the traffic control plan (TCP) and as required for the control and protection of public traffic through the Project work zone.
- 1.2 Notification of the Work commence date and application for permission from the governing body having jurisdiction over the right-of-way is the responsibility of the Contractor.
- 1.3 The Work to be performed under this Section will conform to Part VI of the Manual on Uniform Traffic Control Devices (MUTCD) and shall be subject to local codes, policies, and regulations of the agency having jurisdiction over the area where the Work is performed.
- 1.4 If the Work is contained within a Tennessee Department of Transportation (TDOT) right of way, a traffic control plan shall be submitted for approval by TDOT.

2. PRODUCTS

- 2.1 All signage, channeling devices, arrow displays, lighting devices, and other traffic control devices shall conform to the design requirements contained in the MUTCD which specifically govern such features as size, contrast, colors, shape, composition, use of symbols, etc. Use of "home made" or contractor-fabricated devices are prohibited.

3. EXECUTION

3.1 TRAFFIC CONTROL PLAN (TCP)

- A. The Contractor shall submit the TCP along with a request for approval noting the date of proposed construction and the duration to the agency having jurisdiction.
- B. The Contractor shall obtain any and all necessary permits required for performance and execution of the TCP in coordination with the appropriate agencies.
- C. The Contractor shall install and maintain temporary traffic control devices adjacent to and within the Project work zone in accordance with the approved TCP and the MUTCD. Installation of the traffic control devices shall proceed in accordance with MUTCD phasing and shall be performed prior to the start of construction operations.

3.2 TRAFFIC CONTROL DEVICES (TCD)

- A. Furnish and place Traffic Control Devices before the start of construction operations.
- B. Install only those Traffic Control Devices needed for each stage or phase of construction as required by the TCP and the MUTCD.

- C. Relocate temporary or permanent Traffic Control Devices as required by the phasing of the Work. Remove devices that no longer apply to the Work in progress. Temporarily cover signs when they are not applicable to current conditions.
- D. Immediately clean, service, or replace any Traffic Control Device that is defaced, damaged, or when its retro reflectivity is reduced by 50% due to fading, dirt, etc. Keep all temporary Traffic Control Devices clean and serviceable.
- E. If required by the work in progress, maintain Traffic Control Devices 24 hours a day with adequate barricades, lights, arrows, etc. to protect the public from traffic hazards and accidents.
- F. Use flares and/or lights during times of low visibility to delineate traffic lanes and to guide traffic.
- G. Remove all temporary Traffic Control Devices upon completion of the Work and repair all damage caused by their installation.

### 3.3 CONSTRUCTION PARKING CONTROL

- A. Control parking of construction personnel's vehicles and construction equipment to prevent interference with public traffic and public access to private drives, parking areas, sidewalks, residences, etc.
- B. Prevent parking on or adjacent to side streets or in non-designated areas. The Contractor at his expense will repair vehicle damage caused by the Contractor or his personnel to residential or private property.
- C. Schedule and coordinate delivery and off-loading of materials so as to not interfere with traffic outside of the Contractor's designated work zone or storage yard.

### 3.4 FLAGMEN

- A. When the TCP requires, provide flagmen or traffic control officers who are trained and equipped in accordance with the requirements of Part VI of the MUTCD.
- B. Flaggers shall use Type III or Type IV retro reflective Stop/Slow paddles. Use of flags is prohibited unless it is an emergency situation in low-speed, low-volume locations which can best be controlled by a single flagger.
- C. The flagger or traffic control officer shall wear a retro reflective vest at all times during traffic control operations.
- D. Flaggers shall maintain sight visibility of each other at all times during traffic control operations or shall communicate utilizing radio devices.

End of Section

**SECTION 01600**  
**MATERIAL AND EQUIPMENT**

1. GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Products.
- B. Transportation and Handling.
- C. Storage and Protection.
- D. Product Options.
- E. Products List.
- F. Substitutions.
- G. Systems Demonstration.

1.2 QUALITY ASSURANCE

- A. Approval Required
  - 1. The contract is based on the standards of quality established in the contract documents.
  - 2. All products proposed for use, including those specified by required attributes and performance, shall require approval by the Owner before being incorporated into the work.
  - 3. Do not substitute materials, equipment, or methods unless such substitution has been specifically approved for this work by the Owner.
- B. "Or Equal"
  - 1. Where the phrase "or equal" or "or approved equal" occurs in the contract documents do not assume that materials, equipment, or methods will be approved as equal unless the item has been specifically approved for this work by the Owner.
  - 2. The decision of the Owner shall be final.
  - 3. See pertinent portions of the contract documents for additional information relating to substitutions.

1.3 PRODUCTS

- A. Products include material, equipment, and systems.
- B. Comply with specifications and referenced standards as minimum requirements.

- C. Components required to be supplied in quantity within a specification section shall be the same, and shall be interchangeable.

#### 1.4 TRANSPORTATION AND HANDLING

- A. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging, dry.
- B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.
- C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

#### 1.5 STORAGE AND PROTECTION

- A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.
- B. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
- C. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.
- D. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.

#### 1.6 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards.
- B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not specifically named.
- C. Products Specified by Naming Several Manufacturers: Products of named manufacturers meeting specifications: No options, no substitutions allowed.
- D. Products Specified by Naming Only One Manufacturer: No options, no substitutions allowed.

#### 1.7 PRODUCTS LIST

- A. Submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

## 1.8 SUBSTITUTIONS

- A. Concurrent with submission of product list, the Owner will consider requests from Contractor for substitutions. Subsequently, substitutions will be considered only when a product becomes unavailable due to no fault of Contractor. Confirmation of unavailable products must be in writing and certified by the manufacturer that the product is no longer available.
- B. Submit separate request for each substitution. Document each request with complete data substantiating compliance of proposed substitution with contract documents.
- C. Request for substitution constitutes a representation that Contractor:
  - 1. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product.
  - 2. Will provide the same warranty for substitution as for specified product.
  - 3. Will coordinate installation and make other changes which may be required for work to be complete in all respects.
  - 4. Waives claims for additional costs which may subsequently become apparent.
- D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals. Separate written request must be submitted for any proposed substitutions or deviation from the contract documents.
- E. Owner will determine acceptability of proposed substitution, and will notify Contractor of acceptance or rejection in writing within a reasonable time.
- F. Substitute products shall not be ordered or installed without written acceptance.
- G. Only one request for substitution will be considered for each product. When substitution is not accepted, provide specified product.
- H. Owner will determine acceptability of substitutions.

## 1.9 SUBMITTAL PROCEDURES

- A. Owner will review Contractor's requests for substitutions with reasonable promptness.
- B. Upon proper submission, Owner will notify Contractor, in writing, of decision to accept or reject requested substitution within 15 days.
- C. For accepted products, submit shop drawings, product data, and samples under provisions of Section 01302 - Submittals and Substitutions.

## 2. PRODUCTS

NOT USED

3. EXECUTION

NOT USED

End of Section



**SECTION 01710  
CLEANING**

## 1. GENERAL

## 1.1 DESCRIPTION

- A. Work Included: Throughout the construction period, maintain the site in a standard of cleanliness as described in this section.
- B. Related Work Described Elsewhere: In addition to standards described in this section, comply with all requirements for cleaning up as described in various other sections of these specifications.

## 1.2 QUALITY ASSURANCE

- A. Inspection: Conduct inspection daily, and more often if necessary, to verify that requirements for cleanliness are being met.
- B. Codes and Standards: In addition to the standards described in this section, comply with all pertinent requirements of government agencies having jurisdiction.

## 2. PRODUCTS

## 2.1 CLEANING MATERIALS AND EQUIPMENT

- A. Provide all required personnel, equipment, and materials needed to maintain the specified standard of cleanliness.

## 3. EXECUTION

## 3.1 PROGRESS CLEANING

- A. General:
  - 1. Retain all stored items in an orderly arrangement allowing maximum access, not impeding drainage or traffic, and providing the required protection of materials.
  - 2. Do not allow the accumulation of scrap, debris, waste material, and other items not required for the construction of this work.
  - 3. At least twice each month, and more often if necessary, completely remove all scrap, debris, and waste material from the job site.
  - 4. Provide adequate storage for all items awaiting removal from the job site, observing all requirements for fire protection and protection of the ecology.

- B. Site:
  - 1. Daily, and more often if necessary, inspect the site and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage.
  - 2. Weekly, and more often if necessary, inspect all arrangements of materials stored on the site. Restack, tidy, or otherwise service all arrangements to meet the requirements of paragraph 3.1.A.1, above.
  - 3. Maintain the site in a neat and orderly condition at all times.

### 3.2 FINAL CLEANING

- A. Definition: Except as otherwise specifically provided, "clean" (for the purpose of all paragraphs under paragraph 3.2 shall be interpreted as meaning the level of cleanliness generally provided by skilled cleaners using commercial quality building maintenance equipment and materials.
- B. General: Prior to the completion of the work, remove from the job site all tools, surplus materials, equipment, scrap, debris, and waste. Conduct final progress cleaning as described under paragraph 3.1, above.
- C. Site: Unless otherwise specifically directed by the Owner, broom clean all paved areas on the site and all public paved areas directly adjacent to the site. Completely remove all resultant debris.
- D. Timing: Schedule final cleaning as approved by the Owner to accept a completely clean project.

End of Section

**SECTION 01720**  
**PROJECT RECORD DOCUMENTS**

1. GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Maintenance of Record Documents and Samples.
- B. Submittal of Record Documents and Samples.

1.2 RELATED REQUIREMENTS

- A. Section 01302 - Submittals and Substitutions: Shop drawings, product data, and samples.
- B. Individual Specifications Sections: Manufacturer's certificates and certificates of inspection.

1.3 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Maintain at the site for Owner one record copy of:
  - 1. Contract Drawings.
  - 2. Specifications.
  - 3. Reviewed shop drawings, product data, and samples.
  - 4. Field test records.
  - 5. Inspection certificates.
  - 6. Manufacturer's certificates.
- B. Maintain Record Documents in a clean, dry, and legible condition. Do not use Record Documents for construction purposes.
- C. Keep Record Documents and samples available for inspection by Owner.

1.4 RECORDING

- A. Record information concurrently with construction progress. Do not conceal any work until required information is recorded.
- B. Contract Drawings and Shop Drawings: Legibly mark each item to record actual construction, including:
  - 1. The Contractor shall submit to the Superintendent for review five copies of shop drawings on all products to be supplied for the project.
  - 2. Two reviewed copies shall be retained by the Owner, and three shall be returned to the Contractor.
  - 3. Resubmittals of shop drawings shall be required until the drawings are approved by the utility.
  - 4. Submittals shall include, but are not limited to, pipe, valves, fittings, meters, boxes, and hydrants.

5. Any purchasing of materials prior to receiving approved shop drawings shall be at the Contractor's own risk.
  6. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  7. Field changes of dimension and detail.
  8. Changes made by modifications.
  9. Details not on original contract drawings.
  10. References to related shop drawings and modifications.
- C. Specifications: Legibly mark each item to record actual construction, including:
1. Manufacturer, trade name, and catalog number of each product actually installed, particularly optional items and substitute items.
  2. Changes made by addenda and modifications.

### 1.5 SUBMITTALS

- A. At Contract closeout, deliver Record Documents and samples to Owner. Record documents shall be in accordance with the requirements presented in the Developers Agreement.
- B. Transmit with cover letter in duplicate, listing:
1. Date.
  2. Project title and number.
  3. Contractor's name, address, and telephone number.
  4. Number and title of each Record Document.
  5. Signature of Contractor or authorized representative.

### 2. PRODUCTS

NOT USED

### 3. EXECUTION

NOT USED

End of Section

**SECTION 02110  
CLEARING AND GRUBBING**

1. GENERAL

1.1 This work consists of clearing, grubbing, removing, and disposing of all debris and of all vegetation, buildings, and foundations not removed by others that are within the designated construction areas. The work shall also include preserving and protecting from injury or defacement all vegetation and objects designated to remain.

1.2 The contractor shall work only in the areas designated on the plans. No vegetation shall be destroyed outside the limits of the work.

2. PRODUCTS

NOT USED

3. EXECUTION

3.1 The Contractor is solely responsible for the removal, hauling, and disposal of waste material. Completely dispose of all materials resulting from clearing and grubbing off the site, all at the Contractor's expense. The Owner shall not be liable for the improper disposal of waste material.

3.2 Secure in writing any approval from a property Owner desiring disposal of debris on their private property.

End of Section

**SECTION 02221**  
**UNCLASSIFIED EXCAVATION FOR UTILITIES**

1. GENERAL

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

2. PRODUCTS

NOT USED

3. EXECUTION

3.1 PREPARATION OF THE SITE

- A. Before starting construction, remove from the work site all vegetable growth (except as hereinafter excluded), debris, and/or other objectionable matter as well as any buildings and/or other structures that the drawings and/or the Owner specifically indicate are to be removed. Dispose of this refuse material in a manner acceptable to the Owner.
- B. In certain areas it may be desirable for existing trees, shrubs, or other vegetation on the site to be preserved for the permanent landscape. Such vegetation may be shown on the drawings, specifically listed in the specifications, marked on the site, or identified by the Owner. In no case damage or remove such growth without written permission from the Owner.
- C. If the area to be excavated is occupied by trees, brush, or other vegetable growth, clear such growth and grub the excavated area, and remove all large roots to a depth of not less than 2 feet below the bottom of the proposed construction. Dispose of the growth removed in a manner satisfactory to the Owner. Fill all holes or cavities created during this work that extend below the subgrade elevation with suitable material and compact to the same density as the surrounding material.
- D. Trees, cultivated shrubs, etc., that are situated within public rights-of-way and/or construction easements through private property but not directly within the excavation area shall remain undisturbed unless it is necessary to remove them so that the work can be performed safely and unless their removal is specifically ordered by the Owner. Take special precautions to protect and preserve such growth throughout all stages of the construction.

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

### 3.2 UNSUITABLE MATERIALS

- A. Wherever muck, quicksand, soft clay, swampy ground, or other material unsuitable for foundations, subgrade, or backfilling is encountered, remove it and continue excavation until suitable material is encountered. The material removed shall be disposed of in the manner described below. Then refill the areas excavated for this reason with 1- to 2-inches 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 Class A, Grade D aggregate crushed stone for bedding.

### 3.3 ROCKS AND BOULDERS

- A. Should rock be encountered in the excavation, remove it by blasting or otherwise. Where blasts are made, cover the excavation with enough excavation material and/or timber or steel matting to prevent danger to life and property. The Contractor shall secure, at his own expense, all permits required by law for blasting operations and the additional hazard insurance required. Observe all applicable laws and ordinances pertaining to blasting operations.
- B. Excavate rock over the horizontal limits of excavation and to a depth of not less than 6 inches below the outside bottom of pipe up to 30 inches in diameter and not less than 12 inches below the outside bottom of larger pipes if rock extends to such depth. Then backfill the space below grade with Class A, Grade D aggregate or other approved material, tamp to the proper grade, and make ready for construction. For monolithic concrete sewers or culverts and for structures, excavate rock to the outside bottom of the structure or sewer.

### 3.4 DISPOSAL OF MATERIALS

- A. Whenever practicable, all materials removed by excavation that are suitable for backfilling pipe trenches or for other purposes shown on the drawings or directed by the Owner shall be used for these purposes. Any materials not so used shall be considered waste materials and disposed of at the Contractor's expense.
- B. Waste materials may be deposited in spoil areas at locations approved by the Owner. Do not leave in unsightly piles but instead spread in uniform layers, neatly level, and shape to drain. Seed as specified in Section 02485 - Seeding.
- C. Once any part of the work is completed, properly dispose of all surplus or unused materials (including waste materials) left within the construction limits of that work. Leave the surface of the work in a neat, workmanlike condition, as described below.
- D. The disposal of waste materials shall be considered an integral part of the excavation work and one for which no separate payment shall be allowed.

### 3.5 EXCAVATION FOR TRENCHES, MANHOLES, AND STRUCTURES

- A. Unclassified excavation for pipelines shall consist of the excavation necessary for the construction of water, sewer, and other pipes and their appurtenances (including manholes, inlets, outlets, headwalls, collars, concrete saddles, and pipe protection) that are called for by the drawings. It shall include clearing and grubbing where necessary, backfilling and tamping pipe trenches and around structures, and disposing of waste materials; all of which shall conform to the applicable provisions set forth elsewhere in these specifications.
- B. The Contractor may, if he chooses, use a motor powered trenching machine. If he does; however, he shall be fully responsible for the preservation or repair of existing utilities.
- C. Unless the construction of lines by tunneling, jacking, or boring is called for by the drawings or specifically authorized by the Owner, make excavation for pipelines in open cut and true to the lines and grades shown on the drawings or established by the Owner 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 Owner, 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 Owner to require that stronger pipe and/or a higher class of bedding be used at no cost to the Owner.
- D. Shape the bottom of all trenches to provide uniform bearing for the bottom of the pipe barrel.
- E. Excavate bell holes for bell and spigot pipe at proper intervals so that the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper jointing of the pipe. Do not excavate bell holes more than two joints ahead of pipe laying.
- F. Excavation for manholes, inlets, and other incidental structures shall not be greater in horizontal area than that required to allow a 2-foot clearance between the outer surface of the structure and the walls of the adjacent excavation or of the sheeting used to protect it. The bottom of the excavation shall be true to the required shape and elevation shown on the drawings. No earth backfilling will be permitted under manholes, inlets, headwalls, or similar structures. Should the Contractor excavate below the elevations shown or specified, he shall, at his own expense, fill the void with either concrete or granular material approved by the Owner.



- G. Do not excavate pipe trenches more than 200 feet ahead of the pipe laying. Perform all work so as to cause the least possible inconvenience to the public. Construct temporary bridges or crossings when and where the Owner deems necessary to maintain vehicular or pedestrian traffic.
- H. In all cases where materials are deposited along open trenches, place them so that in the event of rain or surcharge loading from such deposits no damage will result to the work and/or to adjacent property.
- I. Excavation for manholes and other structures may be performed with nonvertical banks except beneath pavements or adjoining existing improvements. Do not permit the horizontal area of the excavation to exceed that required to allow a 2-foot clearance between the outer surface of the structure and the banks of the excavation or the sheeting used to protect the embankments. The bottom of the excavation shall be true to the required shape and elevation shown on the drawings.
- J. The Contractor shall be responsible for all safety issues relating to the trenching operations including those concerning the public and passerby. All excavation shall be performed in accordance with any and all applicable safety laws and regulations. The Developer, Utility, and Owner assume NO responsibility of any sort for acts of the Contractor.
- K. The requirements of the local governing body and the Tennessee State Highway Department shall apply regarding the length of open trench of water line that may be left open overnight along streets and roads.

### 3.6 DEWATERING OF EXCAVATION

- A. Provide and keep in operation enough suitable pumping equipment whenever necessary or whenever directed to do so by the Owner. Give special attention to excavations for those structures that, prior to proper backfilling, are subject to flotation from hydrostatic uplift.
- B. All water pumped or drained from the work shall be disposed of in a manner satisfactory to the Owner without damage to adjacent property or other areas.
- C. If necessary, due to the volume of water containing sediment, or due to the location of pumping activities, construct a sediment trap (structure) to pump ground water into until sediment is no longer being removed with the water. Sediment shall not be discharged to the waters of the State. The pump shall remain on the job site at all times during construction.

### 3.7 BORROW EXCAVATION

- A. Whenever the backfill of excavated areas or the placement of embankments requires more material than is available from authorized excavations or whenever the backfill material from such excavations is unsuitable, then obtain additional material from other sources. This may require the opening of borrow pits at points accessible to the work. In such cases, make suitable arrangements with the property owner and pay all incidental costs, including any royalties, for the use of the borrowed material. Before a borrow pit is opened, the quality and suitability of its material shall be approved by the Owner. All state and local regulation concerning borrow pits, drainage, and erosion control shall be strictly followed.
- B. Excavate borrow pits in such a way that the remaining surfaces and slopes are reasonably smooth and that adequate drainage is provided over the entire area. Construct drainage ditches wherever necessary to provide outlets for water to the nearest natural channel, thus preventing the formation of pools in the pit area. Leave the sides of borrow pit cuts at a maximum slope of 2:1 unless otherwise directed by the Owner.
- C. Properly clear and grub borrow pits. Remove all objectionable matter from the borrow pit material before placing it in the backfill.
- D. The taking of materials from borrow pits for use in the construction of backfill, fills, or embankments shall be considered an incidental part of the work. No separate payment shall be made for this.

### 3.8 BACKFILLING

- A. Begin backfilling after the line construction is completed and then inspected and approved by the Owner. On each side of the line, from the bottom of barrel to 1 foot above the top of the pipe, the backfill material shall consist either of fine, loose earth like sandy soil or loam or of granular material that is free from clods, vegetable matter, debris, stone, and/or other objectionable materials and that has a size of no more than 2 inches. Place this backfill simultaneously on either side of the pipe in even layers that before compaction are no more than 6-inches deep. Thoroughly and completely tamp each layer into place before placing additional layers. When shown on the drawings, this backfill shall, at locations beneath concrete and asphalt driveways, roadways, sidewalks, parking areas, etc. or closely adjacent to pavement, consist of Class A, Grade D aggregate. Use of aggregate backfill shall be at the direction of the Owner.
- B. From 1 foot above the pipe upward, the backfill material may contain broken stones that make up approximately 1/2 of the backfill's total volume. However, if this type of backfill is used, there must be enough spalls and earth materials to fill all voids completely. The maximum dimension of individual stones in such backfill shall not exceed 6 inches, and the backfill material shall be placed and spread in even layers not more than 12 inches deep. At locations beneath or closely adjacent to pavement or at locations of improvements subject to damage by 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.

- C. If earth material for backfill is, in the opinion of the Owner, 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 Owner considers too wet or otherwise unsuitable.
- D. Wherever excavation has been made within easements across private property, the top 1 foot of backfill material shall consist of fine loose earth free from large clods, vegetable matter, debris, stone, and/or other objectionable materials. Top soil shall be placed a minimum of 6 inches on top of this backfill material to final contours.
- E. Wherever trenches have been cut across or along existing pavement, temporarily pave the backfill of such trenches by placing 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 the Owner. On heavy-traveled roadways or as directed by the Owner, cold mix or leveling course binder 3 inches thick shall be installed and maintained until permanent pavement is installed.
- F. Conduct backfilling around manholes, inlets, outfalls, and/or structures in the same manner as specified above for pipelines except that even greater care is necessary to prevent damage to the utility structure.
- G. Wherever pipes have diameters of 12 inches or less, do not use power-operated tampers to tamp that portion of the backfill around the pipe within 1 foot above the pipe.
- H. Perform backfilling so as not to disturb or injure any pipe and/or structure against which the backfill is being placed. If any pipe or structure is damaged and/or displaced during backfilling, open up the backfill and make whatever repairs are necessary, whenever directed to do so by the Owner.
- I. Backfilling and clean-up operations shall closely follow pipe laying. Failure to comply with this provision will result in the Owner's requiring that the Contractor's other activities be suspended until backfilling and clean-up operations catch up with pipe laying.
- J. Compaction Requirements: Under buildings and two times the depth of pipe beyond, and under roads and two 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.
- K. Before final acceptance, the Contractor shall be required to level off all trenches where backfill material has been piled up, or to bring the trench up to the level of the surrounding street, roadway, or terrain. The Contractor will be required to remove from the streets, roadways, and private property all excess earth or other materials.

### 3.9 MAINTENANCE

- A. Seed and maintain in good condition all excavated areas, trenches, fills, embankments, and channels until final acceptance by the Owner.
- B. Maintain trench backfill at the approximate level of the original ground surface by periodically adding backfill material wherever necessary and whenever directed to do so by the Owner. Continue such maintenance until final acceptance of the project or until the Owner issues a written release.

### 3.10 SLOPES

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

### 3.11 SHORING, SHEETING, AND BRACING OF EXCAVATION

- A. Where unstable materials are encountered or as required by law or Government regulations, such as OSHA, the sides of the trench or excavation shall be supported by substantial sheeting, bracing, and shoring, or the sides sloped to the angle of repose. Adequate and proper shoring of all excavation shall be the entire responsibility of the Contractor.
- B. Foundations, adjacent to where the excavation is to be made below the depth of the foundation, shall be supported by shoring, bracing, or underpinning of a temporary or a permanent nature as may be required to assure the integrity of the structure. The Contractor will be held strictly responsible for any damage to adjoining foundations or structures.
- C. No timber sheeting less than two inches in thickness and timber bracing cross bracing of struts less than six inches in thickness will be acceptable.
- D. Solid sheeting will be required for wet or unstable material. It shall consist of continuous vertical sheet piling of timber two inches thick or of steel with suitable shores and braces. All sheeting to be left in place shall be two inch thick timber.
- E. Care shall be taken to avoid excessive backfill loads on the completed pipelines and the requirements that the width of the ditch at the level of the crown of the pipe not exceed that specified herein.

- F. Trench sheeting shall not be removed until sufficient backfill has been placed to protect the pipe.
- G. All sheeting, planking, timbering, bracing, and bridging shall be placed, renewed, and maintained as long as necessary.

End of Section

**SECTION 02223  
ROCK EXCAVATION FOR UTILITIES**

1. GENERAL

1.1 This work covered by this section shall consist of the removal of all rock materials (as defined herein) that must be removed from their original beds so that construction can be performed as indicated by the drawings or by these specifications. It shall include the drilling and blasting incidental to excavation and the disposal of the excavated materials as specified below.

1.2 Refer to other sections for work related to that discussed in this section.

1.3 DESCRIPTION OF ROCK EXCAVATION

- A. Rock excavation shall consist of the removal of all sound, solid rock which is in its original position in ledges, bedded deposits, or unstratified masses and which is of such hardness and texture that, in the opinion of the Owner, it cannot be loosed or broken down and removed without drilling and blasting.
- B. In addition, if any boulders, stones, or pieces of masonry with a volume of ½ cubic yard or more are encountered within the limits of excavation, their removal shall be considered as rock excavation.
- C. The removal of all other materials, however, shall be classified as common excavation and subject to the provisions set forth in Section 02221, Unclassified Excavation for Utilities. For instance, hard pan, small boulders with a volume of less than ½ cubic yard, chert, clay, soft shale, soft and disintegrated rock, and similar material shall not be considered as rock, although the Contractor may elect to excavate them by drilling and blasting.

2. PRODUCTS

NOT USED

3. EXECUTION

3.1 Excavate rock in trenches over the horizontal limits of excavation and to a depth of not less than 6 inches below where the bottom of pipelines will be. Where pipelines are to be constructed on concrete cradles, excavate rock to the bottom of the cradles, then backfill the space below grade for pipelines with fine earth or other approved material, and tamp to the proper grade and make ready for construction. For structures, excavate rock to the outside bottom of the structure.

3.2 Conduct drilling and blasting with due respect for the safety of persons and property in the vicinity and in strict conformance with all ordinances and regulations governing blasting and use of explosives. Conduct rock excavation near existing pipe or other structures with the utmost care so as to avoid damage. Damage to other structures and properties shall be promptly repaired by the Contractor at his own expense. Rock excavation shall be subject to all applicable provisions specified in Section 02221, Unclassified Excavation for Utilities,

including those concerning site preparation; the disposal of materials; slopes; compacting and tamping; sheeting, shoring, and bracing; and pipeline excavation.

3.3 At the location of tees or laterals, blast a minimum of 6 linear feet of ditch line beyond the end of the lateral and in the direction and to the appropriate grade of the future lateral as indicated by the Owner, but do not excavate the material.

3.4 DISPOSAL OF MATERIALS

- A. Whenever practicable, use all suitable material removed by excavation to backfill pipe trenches (i.e., material whose maximum size meets the requirements for backfilling specified in Section 02221, Unclassified Excavation for Utilities), or use it for other purposes shown on the drawings or as directed by the Owner. Any material not used shall be considered waste material and disposed of by the Contractor as specified below.
- B. Waste material may be deposited in spoil areas at locations approved by the Owner or removed from the site when no suitable areas are available. Do not leave waste materials in unsightly piles, but instead spread in reasonably uniform layers.
- C. Once any part of the work is completed, properly dispose of all surplus or unused materials (including waste materials) left within the construction limits of the work. Leave the surface of the work in a neat and workmanlike condition.

End of Section

**SECTION 02240  
DEWATERING****PART 1 GENERAL**

## 1.01 SUBMITTALS

## A. Informational Submittals:

1. Water control plan.
2. Well permits.
3. Discharge permits.
4. Water Level Elevations Observed in Observation Wells: Submit same day measured.
5. Settlement Benchmark Elevations: Submit weekly record.
6. Inflow Measurements: Submit weekly record.

## 1.02 WATER CONTROL PLAN

## A. As a minimum, include:

1. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply, **means of measuring inflow to excavations**, pollution control facilities, discharge locations to be utilized, and provisions for immediate temporary water supply as required by this section.
2. Drawings showing locations, dimensions, and relationships of elements of each system.
3. Design calculations demonstrating adequacy of proposed dewatering systems and components.

- B. If system is modified during installation or operation revise or amend and resubmit Water Control Plan.

**PART 2 PRODUCTS**

- A. Not Applicable

**PART 3 EXECUTION**

## 3.01 GENERAL

- A. Continuously control water during course of construction, including weekends and holidays and during periods of work stoppages, and provide adequate backup systems to maintain control of water.



### 3.02 SURFACE WATER CONTROL

- A. See Section 01500, Construction Facilities and Temporary Controls, Article Temporary Controls.
- B. Remove surface runoff controls when no longer needed.

### 3.03 DEWATERING SYSTEMS

- A. Provide, operate, and maintain dewatering systems of sufficient size and capacity to permit excavation and subsequent construction in dry and to lower and maintain groundwater level a minimum of **two** feet below the lowest point of excavation. Continuously maintain excavations free of water, regardless of source, and until backfilled to final grade.
- B. For **construction**, dewatering systems shall include wells or well points, and other equipment and appurtenances installed outside **limits of excavations** and sufficiently below lowest point of excavation, or to maintain specified groundwater elevation.
- C. Design and Operate Dewatering Systems:
  - 1. To prevent loss of ground as water is removed.
  - 2. To avoid inducing settlement or damage to existing facilities, completed Work, or adjacent property.
  - 3. To relieve artesian pressures and resultant uplift of excavation bottom.
- D. Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.
- E. Provide 100 percent emergency power backup with automatic startup and switchover in event of electrical power failure.
- F. Provide supplemental ditches and sumps only as necessary to collect water from local seeps. Do not use ditches and sumps as primary means of dewatering.

### 3.04 MONITORING WELLS

- A. Monitoring Groundwater Levels: Install and monitor observation wells at locations **selected by Owner** Measure water levels observed in each observation well at **frequency stated in Contractor's Dewatering Plan** and whenever system or component failures are discovered **and whenever any event, including but not limited to flood, storms, changes in water surface elevation of nearby water bodies, may have caused a change in the groundwater elevation.**

- B. After groundwater level observation wells are no longer needed for monitoring groundwater levels, abandon observation wells, as **required by regulations**.

### 3.05 SETTLEMENT

- A. Monitoring Dewatering-Induced Settlement: Establish monuments for monitoring settlement at **selected by Engineer**. Monitor vertical movement of each settlement monument, relative to remote benchmark selected by Engineer, at **frequency stated in Contractor's Dewatering Plan**.

### 3.06 MONITORING FLOWS

- A. Monitor volume of water pumped per calendar day from excavations, as Work progresses. Also monitor volume of water introduced each day into excavations for performance of Work. Monitor flows using measuring devices acceptable to Engineer.

### 3.07 DISPOSAL OF WATER

- A. Obtain discharge permit for water disposal from authorities having jurisdiction.
- B. Treat water collected by dewatering operations, as required by regulatory agencies, prior to discharge.
- C. Discharge water as required by discharge permit and in manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed Work, or adjacent property.
- D. Remove solids from treatment facilities and perform other maintenance of treatment facilities as necessary to maintain their efficiency.

### 3.08 PROTECTION OF PROPERTY

- A. Make assessment of potential for dewatering induced settlement. Provide and operate devices or systems, including but not limited to reinjection wells, infiltration trenches and cutoff walls, necessary to prevent damage to existing facilities, completed Work, and adjacent property.
- B. Securely support existing facilities, completed Work, and adjacent property vulnerable to settlement due to dewatering operations. Support shall include, but not be limited to, bracing, underpinning, or compaction grouting.

3.09 REMEDIATION OF GROUNDWATER DEPLETION

- A. If dewatering reduces quantity or quality of water produced by existing wells, temporarily supply water to affected well owners from other sources. Furnish water of a quality and quantity equal to or exceeding the quality and quantity available to well owner prior to beginning the Work or as satisfactory to each well owner.

**END OF SECTION**

**SECTION 02271  
RIP-RAP**

## 1. GENERAL

1.1 This item consists of furnishing and placing riprap slope/ditch protection.

## 2. PRODUCTS

## 2.1 Riprap

The riprap material shall be durable and of hard natural stone, free from cracks, seams, or other defects that would tend to cause increased deterioration because of freezing and thawing or other natural causes. Riprap material shall be reasonably well graded from the minimum size stone. At least 90% of the riprap stone shall be not less than 8 inches wide by 12 inches long by 12 inches deep and shall be approximately rectangular in shape. Fragments or spalls shall be used to fill the voids between the larger rocks. The inclusion of appreciable quantities of dirt, sand, clay, or rock fines will not be accepted. All materials considered for use as riprap shall be approved by the Owner.

## 3. EXECUTION

3.1 Earth surface on which riprap is to be placed shall be trimmed and graded so as to provide for the thickness of riprap shown on the drawings. Surfaces that are below grade shall be brought to grade by fillings 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 Owner.

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

3.3 A tolerance of + 12 inches or -6 inches from slope lines and grades shown on the drawings will be permitted on the finished surface of the riprap, except that the extreme negative tolerance shall not be continuous over an area exceeding 200 square feet.

End of Section

**SECTION 02311  
CONTROL BLASTING**

1. GENERAL

- 1.1 This section covers the method, responsibilities, and required protection techniques for blasting.
- 1.2 At Contractor's option, blasting may be used as an alternative to nonexplosive methods of excavation. Blasting shall be performed in accordance with the Tennessee Blasting Standards Act of 1975 TCA Section 68-105, local ordinances, regulations, and as specified herein.
- 1.3 The Contractor shall employ blasting techniques at this own discretion given the limits and conditions stated herein.
- 1.4 Blasting shall be performed by a qualified, licensed blaster, who has specific experience on similar sized projects, and is knowledgeable of the Tennessee Blasting Standards Act of 1975, including additions and amendments.

2. PRODUCTS

NOT USED

3. EXECUTION

3.1 PREBLAST SURVEY AND BLAST MONITORING

- A. The Contractor shall conduct a preblast survey of the surrounding structures within a minimum of 300 feet of any blasting operation and document their condition before any blasting begins. The documentation will include written descriptions, photographs of the structures, and measures of obvious signs of structural distress such as cracks.
- B. Gauge marks will be located over existing cracks at selected locations to be measured before and after blasting to determine if widening or displacement has taken place.
- C. Before carrying out the inspection, the Contractor shall notify the owners of the buildings or structures to be inspected and request permission to carry out the inspection. Should any building owner refuse permission to carry out this inspection, the Contractor shall notify the Owner in writing, giving the building owner's reason for refusal.
- D. The Owner shall require the Contractor to monitor all blasts by an approved method and/or by a Subcontractor at the Contractor's expense. Vibration monitoring will be required on all blasts.
- E. The Contractor must obtain all necessary blasting permits prior to blasting. Notification must be given to the Owner prior to blasting. Such notification shall be given no less than 24 hours prior to the scheduled blast.

### 3.2 SAFETY

- A. Blasting shall be conducted in the conformance with all local and state safety codes. The Contractor shall secure at his own expense all required blasting permits and additional hazard insurance.
- B. The Contractor shall cover the blasting area with enough excavation material and/or matting to prevent danger to lives and property.
- C. It is the sole responsibility of the Contractor to properly handle, use, and store explosives. Any damages to persons or property, as a result of blasting operations, is the responsibility of the Contractor.

### 3.3 RECORD KEEPING

- A. The Owner's representative must be present during all blasting operations.
- B. The Contractor shall provide an itemized blasting log to the Owner on a daily basis.

### 3.4 BLASTING LIMITS

- A. The Contractor shall avoid shattering rock beyond the required limits of the trench or excavation.
- B. Charge holes shall be properly located and drilled to the correct depth for the charges used.
- C. Charges shall be limited in size to permit reasonable removal of material by excavating equipment. Overbreak effects shall be corrected by removing the broken rock and replacing it with approved material.

End of Section

**SECTION 02320  
TRENCH BACKFILL****PART 1 GENERAL**

## 1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Public Works Association (APWA): Uniform Color Code for Temporary Marking of Underground Utility Locations.
  2. ASTM International (ASTM):
    - a. C33, Standard Specification for Concrete Aggregates.
    - b. C94/C94M, Standard Specification for Ready-Mixed Concrete.
    - c. C117, Standard Test Method for Materials Finer than 75 Micrometer (No. 200) Sieve in Mineral Aggregates by Washing.
    - d. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
    - e. C150, Standard Specification for Portland Cement.
    - f. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
    - g. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>))
    - h. D1140, Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75 micrometer) Sieve.
    - i. D1557, Standard Test Method for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
    - j. D3776, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.
    - k. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
    - l. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
    - m. D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
    - n. D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
    - o. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
    - p. D4991, Standard Test Method for Leakage Testing of Empty Rigid Containers by Vacuum Method.
    - q. D5034, Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).

3. National Electrical Manufacturers Association (NEMA): Z535.1, Safety Color Code.

## 1.02 DEFINITIONS

- A. Base Rock: Granular material upon which manhole bases and other structures are placed.
- B. Bedding Material: Granular material upon which pipes, conduits, cables, or duct banks are placed.
- C. Imported Material: Material obtained by Contractor from source(s) offsite.
- D. Lift: Loose (uncompacted) layer of material.
- E. Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable or duct bank.
- F. Prepared Trench Bottom: Graded trench bottom after excavation and installation of stabilization material, if required, but before installation of bedding material.
- G. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D698. Corrections for oversize material may be applied to either as-compacted field dry density or maximum dry density, as determined by Engineer.
- H. Relative Density: As defined by ASTM D4253 and ASTM D4254.
- I. Selected Backfill Material: Material available onsite that Engineer determines to be suitable for a specific use.
- J. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes producing a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids. Well-graded does not define any numerical value that must be placed on the coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.

## 1.03 SUBMITTALS

- A. Action Submittals:
  1. Shop Drawings: Manufacturer's descriptive literature for marking tapes.
  2. Samples:
    - a. Trench stabilization material.
    - b. Bedding and pipe zone material.
    - c. Granular drain.



- d. Granular backfill.
- e. Earth backfill.
- f. Sand(s).
- g. Geotextile.

B. Informational Submittals:

1. Catalog and manufacturer's data sheets for compaction equipment.
2. Certified Gradation Analysis: Submit not less than 30 days prior to delivery for imported materials or anticipated use for excavated materials, except for trench stabilization material that will be submitted prior to material delivery to Site.
3. Controlled Low Strength Material: Certified mix design and test results. Include material types and weight per cubic yard for each component of mix.

## PART 2 PRODUCTS

### 2.01 MARKING TAPE

A. Nondetectable:

1. Inert polyethylene, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.
2. Thickness: Minimum 5 mils.
3. Width: **3** inches.
4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
5. Manufacturers and Products:
  - a. Reef Industries; Terra Tape.
  - b. Mutual Industries; Non-detectable Tape.
  - c. Presco; Non-detectable Tape.

B. Detectable:

1. Solid aluminum foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.
2. Foil Thickness: Minimum 0.35 mils.
3. Laminate Thickness: Minimum 5 mils.
4. Width: **3** inches.
5. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
6. Joining Clips: Tin or nickel-coated furnished by tape manufacturer.
7. Manufacturers and Products:
  - a. Reef Industries; Terra Tape, Sentry Line Detectable.
  - b. Mutual Industries; Detectable Tape.
  - c. Presco; Detectable Tape.

- C. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities.

| Color*   | Facility  |
|--|---|
| Red  | Electric power lines, cables, conduit, and lightning cables |
| Orange   | Communicating alarm or signal lines, cables, or conduit     |
| Yellow   | Gas, oil, steam, petroleum, or gaseous materials            |
| Green  | Sewers and drain lines                                      |
| Blue   | Potable water   |
| Purple   | Reclaimed water, irrigation, and slurry lines               |
| *As specified in NEMA Z535.1, Safety Color Code. |   |

- D. Locating Wire: No. 12 AWG copper wire shall be laid in full length of all non-metallic lines.

## 2.02 TRENCH STABILIZATION MATERIAL

### A. Base Rock

- Clean, hard, durable 3-inch minus crushed rock or gravel, or pit run, free from clay balls, other organic materials, or debris.
- Uniformly graded from coarse to fine, less than 8 percent by weight passing the 1/4-inch sieve.

### B. Granular Backfill:

- Clean gravel or crushed rock, reasonably well-graded from coarse to fine.
- Maximum Particle Size: 1-inch

## 2.03 BEDDING MATERIAL AND PIPE ZONE MATERIAL

### A. Unfrozen, friable, and no clay balls, roots, or other organic material.

- B. Clean or gravelly sand with less than 5 percent passing No. 200 sieve, as determined in accordance with ASTM D1140, or gravel or crushed rock within maximum particle size and other requirements as follows unless otherwise specified.

- Duct Banks: 3/4-inch maximum particle size.
- PVC Irrigation System Piping and Ductile Iron Pipe with Polyethylene Wrap: 3/8-inch maximum particle size.
- Pipe Under 18-Inch Diameter: 3/4-inch maximum particle size, except 1/4 inch for stainless steel pipe, copper pipe, tubing, and plastic pipe under 3-inch diameter.

4. Pipe Greater than 18-Inch Diameter: 1-1/2-inch maximum particle size for ductile iron pipe, concrete pipe, welded steel pipe, and pretensioned or prestressed concrete cylinder pipe.
5. Perforated Pipe: Granular drain material.
6. Conduit and Direct-Buried Cable:
  - a. Sand, clean or clean to silty, less than 12 percent passing No. 200 sieve.
  - b. Individual Particles: Free of sharp edges.
  - c. Maximum Size Particle: Pass a No. 4 sieve.
  - d. If more than 5 percent passes No. 200 sieve, the fraction that passes No. 40 sieve shall be nonplastic as determined in accordance with ASTM D4318.

#### 2.04 EARTH BACKFILL

- A. Soil, loam, or other excavated material suitable for use as backfill.
- B. Free from roots or organic matter, refuse, boulders and material larger than 1/2 cubic foot, or other deleterious materials.

#### 2.05 PROCESSED EARTH BACKFILL

- A. Class A Backfill: Earth backfill, meeting the following additional requirement.
  1. Free of boulders and cobbles that would be retained on a 3-inch sieve.

#### 2.06 FLOWABLE FILL

- A. Select and proportion ingredients to obtain compressive strength between 50 and 150 psi at 28 days in accordance with ASTM D4832.
- B. Materials:
  1. Cement: ASTM C150, Type I or Type II.
  2. Aggregate: ASTM C33, Size 7.
  3. Fly Ash (if used): ASTM C618, Class C.
  4. Water: Clean, potable, containing less than 500 ppm of chlorides.

#### 2.07 CONCRETE BACKFILL

- A. Provide as specified in Section 03300, Cast-in-Place Concrete.
- B. Mix: ASTM C94/C94M, Option A.
  1. Cement: ASTM C150, Type I or Type II.
  2. Coarse Aggregate Size: 3/4 inch(es).
  3. Design for Minimum Compressive Strength at 28 Days: 3,000 psi.

## 2.08 SOURCE QUALITY CONTROL

- A. Perform gradation analysis in accordance with ASTM C136 for:
  - 1. Earth backfill, including specified class.
  - 2. Trench stabilization material.
  - 3. Bedding and pipe zone material.
- B. Certify Laboratory Performance of Mix Designs:
  - 1. Controlled low strength fill.
  - 2. Concrete.

## PART 3 EXECUTION

### 3.01 TRENCH PREPARATION

- A. Water Control:
  - 1. Promptly remove and dispose of water entering trench as necessary to grade trench bottom and to compact backfill and install manholes, pipe, conduit, direct-buried cable, or duct bank. Do not place concrete, lay pipe, conduit, direct-buried cable, or duct bank in water as specified in Section 02240, Dewatering.
  - 2. Remove water in a manner that minimizes soil erosion from trench sides and bottom.
  - 3. Provide continuous water control until trench backfill is complete.
- B. Remove foreign material and backfill contaminated with foreign material that falls into trench.

### 3.02 TRENCH BOTTOM

- A. Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for bedding material if shown or specified.
- B. Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify Engineer. Engineer will determine depth of over excavation, if any required.

### 3.03 TRENCH STABILIZATION MATERIAL INSTALLATION

- A. Rebuild trench bottom with trench stabilization material.
- B. Place material over full width of trench in 6-inch lifts to required grade, providing allowance for bedding thickness.
- C. Compact each lift so as to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts.

### 3.04 BEDDING

- A. Furnish imported bedding material where, in the opinion of Engineer, excavated material is unsuitable for bedding or insufficient in quantity.
- B. Place over the full width of the prepared trench bottom in two equal lifts when the required depth exceeds 8 inches.
- C. Hand grade and compact each lift to provide a firm, unyielding surface.
- D. Minimum Thickness as follows:
  - 1. Pipe 15 Inches and Smaller: 4 inches.
  - 2. Pipe 18 Inches to 36 Inches: 6 inches.
  - 3. Pipe 42 Inches and Larger: 8 inches.
- E. Check grade and correct irregularities in bedding material. Loosen top 1 inch to 2 inches of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe, conduit, direct-buried cable, or duct bank.
- F. Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.
- G. Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.

### 3.05 BACKFILL PIPE ZONE

- A. Upper limit of pipe zone shall not be less than following:
  - 1. Pipe: 12 inches, unless shown otherwise.
- B. Restrain pipe, conduit, cables, and duct banks as necessary to prevent their movement during backfill operations.
- C. Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes, conduit, cables, and duct banks installed in same trench.
  - 1. Pipe 10-Inch and Smaller Diameter: First lift less than or equal to 1/2 pipe diameter.
  - 2. Pipe Over 10-Inch Diameter: Maximum 6-inch lifts.

- D. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift.
- E. After the full depth of the pipe zone material has been placed as specified, compact the material by a minimum of three passes with a vibratory plate compactor only over the area between the sides of the pipe and the trench walls.
- F. Do not use power-driven impact compactors to compact pipe zone material.

### 3.06 MARKING TAPE INSTALLATION

- A. Continuously install marking tape along centerline of all buried piping, on top of last lift of pipe zone material. Coordinate with piping installation drawings.
  - 1. Detectable Marking Tape: Install with nonmetallic piping and waterlines.
  - 2. Nondetectable Marking Tape: Install with metallic piping.
  - 3. No. 12 AWG copper wire shall be laid in full length of all non-metallic lines.

### 3.07 BACKFILL ABOVE PIPE ZONE

- A. General:
  - 1. Process excavated material to meet specified gradation requirements.
  - 2. Adjust moisture content as necessary to obtain specified compaction.
  - 4. Do not allow backfill to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.
  - 5. Do not use power driven impact type compactors for compaction until at least 4 feet of backfill is placed over top of pipe.
  - 6. Backfill to grade with proper allowances for topsoil, crushed rock surfacing, and pavement thicknesses, wherever applicable.
  - 7. Backfill around structures with same class backfill as specified for adjacent trench unless otherwise shown or specified.
- B. Class A Backfill:
  - 1. Place in lifts not exceeding thickness of 9 inches.
  - 2. Mechanically compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.
- C. Class B Backfill:
  - 1. Place in lifts of suitable thickness.
  - 2. Mechanically compact each lift prior to placing succeeding lifts.

3. Determine proper lift thickness, type of compaction equipment, method to use, and amount of compaction necessary to prevent settlement.
- D. Class C Backfill:
1. Backfill with earth backfill.
  2. Leave trench with backfill material neatly mounded across the entire trench width, but not more than 6 inches above the adjacent ground surface.
  3. In lawn, garden, or similar type areas, maintain trench level with the existing adjacent grade.
  4. At Other Locations:
    - a. Estimate and provide amount of backfill material required so that after normal settlement, the settled surface will match the adjacent ground surface.
    - b. Neatly windrow material over trench, and remove excess.
    - c. Correct excess or deficiency of backfill material apparent after settlement and within correction period by regrading, and disposing of excess material or adding additional material where deficient.
- E. Class D Backfill: Backfill with granular backfill. Determine thickness of lift, type of equipment and method to use, and amount of compaction required to prevent settlement. Backfill trench above the pipe zone with granular backfill in lifts not exceeding 8 inches. Compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.
- F. Class E Backfill:
1. Backfill trench above pipe zone with **earth backfill 12** inches below original ground surface.
  2. Fill remainder of trench with gravel surfacing rock over entire trench width.
  3. Compact gravel surfacing rock by at least five passes with the wheels of a loaded 10-yard dump truck or other approved equipment over entire trench surface as necessary to prevent settlement.
  4. Finish completed backfilled surface at same level as original surface.
- G. Concrete Backfill:
1. Place above bedding.
  2. Minimum Concrete Thickness: 6 inches on top and sides of pipe.
  3. Do not allow dirt or foreign material to become mixed with concrete during placement.
  4. Allow sufficient time for concrete to reach initial set before additional backfill material is placed in trench.
  5. Prevent flotation of pipe.
  6. Begin and end concrete backfill within 4 inches of a pipe joint on each end.
  7. Do not encase pipe joints except within the limits of the concrete backfill.
- H. Controlled Low Strength Fill:

1. Discharge from truck mounted drum type mixer into trench.
2. Place in lifts as necessary to prevent uplift (flotation) of new and existing facilities.
3. In traveled areas fill entire trench section to pavement finish grade for a temporary driving surface, and screed off excess and finish with a float.
4. In other areas fill the trench section as shown.

### 3.08 REPLACEMENT OF TOPSOIL

- A. Replace topsoil in top 12 inches of backfilled trench.
- B. Maintain the finished grade of topsoil even with adjacent area and grade as necessary to restore drainage.

### 3.09 MAINTENANCE OF TRENCH BACKFILL

- A. After each section of trench is backfilled, maintain the surface of the backfilled trench even with the adjacent ground surface until final surface restoration is completed.
- B. Gravel Surfacing Rock: Add gravel surfacing rock where applicable and as necessary to keep the surface of the backfilled trench even with the adjacent ground surface, and grade and compact as necessary to keep the surface of backfilled trenches smooth, free from ruts and potholes, and suitable for normal traffic flow.
- D. Topsoil: Add topsoil where applicable and as necessary to maintain the surface of the backfilled trench level with the adjacent ground surface.
- E. Asphaltic Pavement: Replace settled areas or fill with asphalt as specified in Section 02575, Pavement.
- F. Other Areas: Add excavated material where applicable and keep the surface of the backfilled trench level with the adjacent ground surface.

### 3.10 SETTLEMENT OF BACKFILL

- A. Settlement of trench backfill, or of fill, or facilities constructed over trench backfill will be considered as result of defective compaction of trench backfill.

**END OF SECTION**



**SECTION 02485  
SEEDING****1. GENERAL**

- 1.1 This work shall be performed in all disturbed areas not receiving such site improvements as buildings, roads, walks, sod, planting, etc., and shall include, but not necessarily be limited to, all seed bed preparation; the supplying and placing of soil additives, seed, and mulch wherever required by the drawings or directed by the Owner; and maintenance.
- 1.2 Unless otherwise approved in writing by the Owner, seeding operations shall be limited to the following planting periods:
- A. Spring - March 1 through May 30
  - B. Fall - August 15 through October 31
- 1.3 Temporary seeding/strawing to support erosion minimization (and as required by the Stormwater Pollution Prevention Plan) shall be done with the project regardless of the season. Re-seeding for final stabilization shall occur during the specified planting period.
- 1.4 Refer to other sections for items affecting seeding. Coordinate this work with that specified by other sections for timely execution.

**2. PRODUCTS****2.1 GRASS SEED**

- A. Kentucky 31 Fescue (*Festuca Elatior*) and/or annual rye meeting the requirements of the State Department of Agriculture and furnished in new bags or bags that are sound and not mended. No "below standard" seed accepted. Where lawns and fields have special grass, replace in kind.

**2.2 FERTILIZER**

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

**2.3 AGRICULTURAL LIMESTONE**

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

## 2.4 MULCH

- A. Stalks of rye, oats, wheat, or other approved grain crops properly cured prior to baling, air dried, and reasonably free of noxious weeds and weed seeds or other material detrimental to plant growth.

2.5 Sod shall comply with all TDOT requirements.

## 3. EXECUTION

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

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

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

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

Fertilizer: 15 pounds/1,000 square feet

Agricultural Limestone: 40 pounds/1,000 square feet

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

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

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

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

3.9 When seeding with mulch is specified, spread the mulch material evenly over the seeded areas immediately following the seeding operation.

Mulch Rate: 2 bales (100-pound minimum)/1,000 square feet

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

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

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

3.13 INSPECTIONS

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

3.14 GUARANTEE

- A. Secure an acceptable growth of grass in all areas designated for seeding.
- B. An area is considered acceptable if it is represented by a minimum of 100 seedlings/ square foot of the permanent species of grass representative of the seed mixture. If an acceptable growth is not obtained on the first planting, reseeding and remulching will be required.
- C. If the planting is less than 50 percent successful, rework the ground, refertilize, reseed, and remulch.
- D. The Contractor shall be responsible for guaranteeing and maintaining all seeding for a twelve month period from the date of initial acceptance of the seeding as stated above.

End of Section

**SECTION 02532****SANITARY SEWERS****PART 1 GENERAL**

## 1.01 SECTION INCLUDES

- A. The work to be performed herein shall consist of the installation of wastewater gravity lines and lateral connections according to the Specifications and the Standard Drawings herein.

**PART 2 PRODUCTS**

## 2.01 PIPE

- A. Polyvinyl chloride (PVC) pipes and fittings shall meet or exceed the requirements of ASTM D3034, SDR 26 for pipe from 4" to 15" in diameter, suitable for use as a gravity sewer conduit. Lengths shall be standard 12.5 feet plus or minus 1 inch and provided with a rubber ring. Minimum pipe stiffness at 5% deflection shall be 46 psi when tested in accordance with ASTM D2412.
- B. Ductile iron pipe shall be made of good quality ductile iron in conformance with the latest revision of ANSI/AWWA C151/A21.51 Standard. The pipe shall be push-on joint with a minimum pressure class of 150 psi, cement-lined according to ANSI 21.4/AWWA C-104, and coated inside and outside with an asphaltic coating.
- C. New sewer laterals shall include 6-inch tees of the same material as the sewer main, which are able to withstand all test pressures without leakage.

## 2.02 FLEXIBLE COUPLINGS

- A. Flexible couplings are designed to join sewer pipes of the same or different material or sizes. Flexible couplings shall fit over the end of plain end or spigot pipe to form a positive seal against infiltration and exfiltration in non-pressure applications. Flexible couplings shall flex with normal earth movement to maintain integrity of seal. Use of flexible couplings shall be at the Owner's discretion.
- B. Flexible couplings shall be manufactured from elastomeric Polyvinyl chloride (PVC) which is unaffected by soil conditions and resistant to chemical, ultraviolet rays, and normal sewer gases. The PVC material shall contain bactericide and fungicide to inhibit growth of bacteria and fungus. The PVC material shall be 55 minimum to 65 maximum Shore A durometer hardness. Couplings shall conform to the applicable parts of ASTM C-443, C-425, C-564, and D-1869.
- C. Each flexible coupling shall be supplied with two corrosion resistant series 300 stainless steel clamps, which when tightened to 60 inch-pounds torque, seal the joint.

- D. Flexible couplings shall be approved and listed by all of the following code agencies: SBCCI (southern Building Code Congress International, Inc.), BOCA (Building Officials & Code Administrators International, Inc.), IAPMO (International Association of Plumbing and Mechanical Officials), and CSA (Canadian Standards Association).

### 2.03 SADDLE TEES

- A. Saddle tees shall consist of a gasketed skirt sized to fit the existing pipe and an integral 6-inch branch connection. The saddle shall include two stainless steel straps or a single 3-1/2" wide stainless steel strap to attach it to the existing pipe. Saddle tees shall meet the requirements of ASTM 3034 and F-477.

## PART 3 EXECUTION

### 3.01 GENERAL REQUIREMENTS

- A. Sewers shall be designed with a 10-foot horizontal separation from any existing or proposed water main. If this is not practical, the sewer may be placed closer than 10 feet to a water main, provided it is laid in a separate trench and the elevation of the top of the sewer is at least 18 inches below the bottom of the water main, or as directed by the Owner.
- B. Where a sewer crosses under a water main, the top of the sewer shall be at least 18 inches below the bottom of the water main. If the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation, or the water main shall be reconstructed with ductile iron pipe for a distance of 10 feet on each side of the sewer with a full pipe section of the water main centered over the sewer, or as directed by the Owner.
- C. Minimum slope for sanitary sewers shall be as follows:

| <u>Pipe Size</u> |               | <u>Min. % Slope</u> |
|------------------|---------------|---------------------|
| 6"               | Laterals only | 0.62%               |
| 8"               |               | 0.40%               |
| 10"              |               | 0.28%               |
| 12"              |               | 0.22%               |
| 15"              |               | 0.15%               |
| 18"              |               | 0.12%               |
| 21"              |               | 0.10%               |
| 24"              |               | 0.08%               |

Minimum slope for other diameters shall be such that a minimum velocity of 2 ft/sec is maintained while the pipe is flowing full.

- D. Where the slope of a sewer line is in excess of 20%, the line shall be constructed of mechanical joint ductile iron pipe with concrete anchors at each joint or as specified by the Owner.

- E. Minimum cover in roadways and other traffic-bearing areas is 48 inches for PVC pipe and 30 inches for ductile iron pipe. In non-traffic-bearing areas, the minimum cover is 30 inches for either type of pipe.
- F. Maximum depth for standard PVC pipe is 17 feet. Depths greater than 17 feet will generally require ductile iron pipe and shall be approved by the Owner.
- G. Ductile iron pipe shall be used beneath waterways which have a continuous flow of water. Concrete encasement shall be provided when joints on the ductile iron pipe are located beneath waterways, or as directed by the Owner.
- H. The maximum spacing for manholes shall be 400 feet for pipe diameters of 21 inches and smaller and 500 feet for larger pipes.
- I. Where the difference in the invert elevations of two sewers intersecting in a manhole is 2 feet or more, a drop manhole shall be provided.
- J. When ductile iron pipe must be used on a portion of a new sewer line segment due to minimum or maximum cover, water line proximity, or waterway crossing, the entire length of sewer must be installed with ductile iron pipe. No flexible couplings will be permitted on new construction to convert to PVC between manholes.

### 3.02 PIPE INSTALLATION

- A. All pipe shall be installed in the presence of the Owner. Do not begin the backfilling of trenches until the pipe in place has been visually inspected by the Owner. Pipe installation shall begin at the lowest elevation, unless otherwise approved by the Owner.
- B. Before placing sewer pipe in position in the trench, carefully prepare the bottom and sides of the trench, and install any necessary bracing and sheeting as provided in Section 02221, Unclassified Excavation for Utilities.
- C. Lasers shall be used to install sewer lines, and the type and procedures shall be approved by the Owner. Reference points for both line and grade shall be set at each manhole. Where grades are 0.6% or less, check the elevation of the beam each 100 feet with an offset point or engineer's level.
- D. Do not allow water to run or stand in the trench while pipe laying is in progress or before the trench has been backfilled. Do not at any time open up more trenches than the available pumping facilities are able to dewater.
- E. Trench bottoms that are found to be unsuitable for foundations after pipe laying operations have started shall be corrected by bringing them to exact line and grade with material approved by the Owner.
- F. Carefully inspect each piece of pipe and special fitting before it is placed, and lay no defective pipe in the trench. Pipelaying shall proceed upgrade, starting at the

lower end of the grade and with the bells upgrade. When pipe laying is not in progress, keep the ends of the pipe tightly closed with an approved temporary plug.

- G. Excavation for bell holes shall be large enough to allow ample room for the pipe joints to be properly made. Excavate out bell holes no more than 2 joints ahead of the pipe laying. Carefully grade the bottom of the trench between bell holes so that each pipe barrel rests on a solid foundation as specified in Section 02221. Install each pipe with a close concentric joint to avoid sudden offsets or inequalities in the flow line.
- H. As the work progresses thoroughly clean the interior of the pipe in place. After each line of pipe has been laid, carefully inspect it, and remove and, in accordance with all laws and regulations, dispose of all earth, trash, rags, and other foreign matter from its interior.
- I. Install tee branches in sewer lines to serve properly each lot adjoining the sewer and at such other locations as may be designated by the Owner. If tee branches are not to be used immediately, close them with approved plugs that are held in place to prevent infiltration and withstand all test requirements.
- J. For all tees that are plugged and laid in rock, blast a minimum of 6 linear feet of ditch line in the direction and to the approximate grade of the future lateral as directed by the Owner, but do not excavate the material. Furnish the Owner with a record of the exact location of each tee installed.
- K. If the work consists of constructing a new sewer to replace an existing one, connect existing laterals to the new line. Laterals which have been disconnected, cut or abandoned shall be plugged and sealed with a backing block securing the plug.
- L. For new laterals to be installed on existing sewer lines larger than 6 inches in diameter, a sewer saddle as specified in Part 2 above may be used in lieu of a tee section. The saddle shall be installed on a clean-cut, properly sized hole on the existing sewer, such that a watertight connection results. The cut in the existing pipe shall be made with a hole saw which retains the coupon. Sewer saddles shall not be used on vitrified clay pipe, or any other pipe deemed unsuitable for this method by the Owner, unless approved by the Owner.
- M. For new laterals to be installed on existing sewer lines 6 inches in diameter, or as required by the Owner, the existing line shall be cut and a watertight tee section shall be installed, while pumping the existing wastewater flow around the work zone. The tee section shall consist of a new tee of the same diameter as the existing pipe, with short sections of pipe on either end. The tee section shall be installed with waterproof flexible couplings on each end as specified in Part 2 above to connect the pipe to the new tee section.
- N. Carefully protect from damage all existing sewers, water lines, gas lines, sidewalks, curbs, gutters, pavements, electrical lines, and other utilities or structures in the vicinity of the work at all times. If it is necessary to repair, remove, and/or replace any such utility or structure in order to complete the work properly, do so in

compliance with the provisions set forth in other sections of these Specifications. Any such work shall be considered incidental to the construction of sewer mains.

- O. Water service connections will be repaired or replaced in accordance with the Owner's standard specifications, by the Contractor at his expense as an incidental part of the work.
- P. Service or house connections to existing sewers that are damaged or removed shall be repaired or replaced by the Contractor at his own expense as an incidental part of the work.
- Q. Wastewater flow must be maintained in the existing sewers. Whenever pipe-laying progresses to the point where this flow must be interrupted, the Contractor shall plug the sewer upstream of the construction and provide by-pass pumping to the downstream manhole in accordance with Section 2542, Sewer Flow Control. All downstream pipes, manholes and appurtenances must be tested and acceptable to the Owner to receive wastewater flow. Discharging raw wastewater to natural waterways will not be permitted. The Contractor shall notify the Owner prior to proceeding with by-pass pumping. When working in areas where interruption of wastewater flow may occur, the Contractor shall have lines and all other equipment in readiness at the site to provide by-pass pumping. A back-up pump and hose is required. Contractor will be liable for clean-ups, fines, and any other problems that may occur. All equipment will be checked by Owner for proper working conditions.
- R. Sewer Flow Control shall be provided as deemed necessary by the Owner. Refer to Specification Section 02543 – Sewer Flow Control.

### 3.03 TESTING FOR ACCEPTANCE

- A. Visual Tests
  - 1. Prior to backfilling, the Owner shall make a visual inspection of the sewer. The visual tests shall include a check for proper grade and alignment, sufficient pipe bedding, pipe condition, and general cleanliness. The Contractor shall immediately repair all defects found by such inspection.
  - 2. Sewers shall be built so as to remain true to line and grade. The inclining grade of the bottom of the sewer after completion shall be such that, after flooding, the flood water drains off so that no remaining puddle of water is deeper than  $\frac{1}{2}$  inch on pipe 36 inches internal diameter or smaller and  $\frac{3}{4}$  inch on pipe larger than 36 inches internal diameter. Any section of pipe that does not comply with the specifications at any time previous to final acceptance of the work shall be replaced or re-laid at the Contractor's expense.



B. Air Testing for Sewers 24 inches in Diameter and Smaller

1. The Contractor is responsible for providing all labor and equipment for air testing.
2. This recommended practice defines the proper procedures for acceptance testing of installed gravity sewer pipe using low-pressure air, to provide assurance that the pipe, as installed, is free from significant leaks. Included are requirements for equipment accuracy, safety precautions, line preparation, test method, and minimum holding times.
3. Only lines tested after backfilling to final grade will be considered for acceptability. However, this test may also be used by the installer as a presumptive test to determine the condition of the line prior to backfilling. During sewer construction, all service laterals, stubs and fittings into the sewer test section shall be properly capped or plugged to prevent air loss that could cause an erroneous air test result. It may be necessary and is always advisable to restrain gasketed caps, plugs, or short pipe lengths with bracing stakes, clamps, and tie-rods or wire harnesses over the pipe bells.
4. Unless otherwise specified, the Contractor shall furnish all the necessary equipment and be responsible for conducting all low-pressure air tests. In addition, the Contractor is responsible for any necessary repair work on sections that do not pass the test. No sealant shall be used in any newly installed sewer without the prior approval of the Owner. Using sealant in a sewer is not the equivalent of a sound sewer pipe. Proper structural repair work is much preferred and may be required by the Owner.
5. The Owner shall witness all low-pressure air tests and verify the accuracy and acceptability of the equipment utilized. The Owner should inform the Contractor regarding acceptable methods of repair in the event one or more sections fail to pass the low-pressure air test.
6. It is extremely important and essential that all plugs be installed and braced in such a way that blowouts are prevented. As an example of the hazard, a force of 250 pounds is exerted on an 8-inch plug by an internal pipe pressure of 5 psig, and a force of 2,250 pounds is exerted on a 24-inch plug by an internal pressure of 5 psig. It must be realized that sudden expulsion of a poorly installed plug, or of a plug that is partially deflated before the pipe pressure is released, can be very dangerous. For this reason, it is recommended that every plug be positively braced against the manhole walls, and that no one be allowed in the manhole adjoining a line being tested so long as pressure is maintained in the line.

It is further recommended that no internal pressure of more than 9 psig be permitted except for leak location equipment where the plugs are firmly tied together.

Either mechanical or pneumatic plugs may be used. All plugs shall be designed to resist internal testing pressures without the aid of external bracing or blocking. However, the Contractor should internally restrain or brace the plugs to the manhole wall as an added safety precaution throughout the test.

7. All pressurizing equipment used for low-pressure air testing shall include a regulator or relief valve set no higher than 9 psig to avoid over-pressurizing and displacing temporary or permanent plugs. As an added safety precaution, the pressure in the test section should be continuously monitored to make certain that it does not at any time exceed 9 psig. (It may be necessary to apply higher pressure at the control panel to overcome friction in the air supply hose during pressurization.)
8. To facilitate test verification by the Owner, all air used shall pass through a single, above ground control panel. The above ground air control equipment shall include a shut-off valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psi. The continuous monitoring gauge shall be no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of +/- 0.04 psi. Two separate hoses shall be used to: (1) connect the control panel to the sealed line for introducing low-pressure air, and (2) a separate hose connection for constant monitoring of air pressure build-up in the line. This requirement greatly diminishes any chance for over-pressurizing the line.

If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the above ground control panel.

9. After a manhole-to-manhole reach of pipe has been backfilled to final grade and compacted, prepared for testing, and a 24-hour waiting period has elapsed, the plugs shall be placed in the line at each manhole and secured.

It is advisable to seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe should be pressurized to 9 psig. The plugs shall hold against this pressure without bracing and without any movement of the plugs out of the pipe. No persons shall be allowed in the alignment of the pipe during plug testing. It is advisable to plug the upstream end of the line first to prevent any upstream water from collecting in the test line. This is particularly important to high groundwater situations.

When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. A probable point of leakage is at the junction of the manhole and the pipe, and this fault may be covered by the pipe plug, and thus not revealed by the air test.

10. Low-pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig. If the groundwater table is above the sewer being tested, the air pressure shall be increased 0.43 psi for each foot that the water table is above the invert of the sewer, up to a maximum of 9.0 psig. After a constant pressure of 4.0 psig (greater than the average groundwater back pressure) is reached, the air supply shall be throttled to maintain that internal pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.

When temperatures have been equalized and the pressure stabilized at 4.0 psig (greater than the average groundwater backpressure), the air hose from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5 psig (greater than the average backpressure of any groundwater over the pipe). At a reading of 3.5 psig, timing shall commence with a stopwatch.

The time that must elapse prior to an air pressure drop of 0.5 is shown in the Air Test Time Table below. The test may be discontinued once the prescribed time has elapsed even though the 0.5 psig drop may not have occurred. If the pressure drops 0.5 psig or more before the time shown in the table, the air loss test will be considered failed and the pipe has not tested.

| Pipe Diameter<br>(inches) | Formula for Required Time to Elapse per Length<br>of Pipe in Seconds |
|---------------------------|--|
| 4                         | $T \text{ (seconds)} = 0.190L$                                       |
| 6                         | $0.427L$   |
| 8                         | $0.760L$   |
| 10                        | $1.187L$   |
| 12                        | $1.709L$   |
| 15                        | $2.671L$   |
| 18                        | $3.846L$   |

\* where L = Length in feet

If the section fails to meet these requirements, the Contractor shall determine at his own expense the source, or sources, of leakage, and he shall repair or replace all defective materials and/or workmanship to the satisfaction of the Owner. The extent and type of repair which may be allowed, as well as results, shall be subject to the approval of the Owner. The completed pipe installation shall then be retested and required to meet the requirements of this test.

### 3.04 PIPE DEFLECTION TESTING

- A. The CONTRACTOR is responsible for providing all labor and equipment for deflection testing.
- B. Test deflection of the pipe by manually pulling with twine a one-piece nine-arm go/no-go mandrel (sized in accordance with ASTM D3034) through the pipe. Within 24 hours after compaction of the backfill is complete, the line shall be tested using a 5 percent deflection mandrel. If the line is satisfactory, it shall be retested using a 7.5 percent deflection mandrel no less than 30 days following the completion of compaction.

### 3.05 CLEAN UP

- A. After the installation work has been completed and all testing acceptable, Contractor shall clean up the entire project area and return the ground cover to grade. Contractor shall properly dispose of all excess material and debris not incorporated into the permanent installation. Sidewalks, driveways, and street surfaces shall be restored as specified.

### 3.06 PRIVATE SERVICE LINE SHUTDOWN

- A. If it is necessary to shutdown a private service line while work is in progress and before the service lines are reconnected, the Owner shall be notified by Contractor at least one week prior to the shutdown. All resident notifications are to be handled by Contractor jointly with the Owner. Contractor shall not contact residences during the course of the work unless specifically instructed to do so by Owner. No service is to remain shutdown for more than a period of eight (8) hours unless Contractor provides substitute services for the residents. If the service is to be shutdown for more than eight (8) hours and Contractor cannot provide substitute services, then Contractor shall be required to provide temporary living quarters (i.e. hotel) for the resident at no additional cost to Owner or the resident. Temporary living quarters must be approved and coordinated by Owner.
- B. Commercial sewer services shall be maintained at all times while businesses are open. No sewage from the services or main line shall be allowed to be discharged on the ground or in waterways. Holding pits or tanks are not allowed unless permitted by TDEC.

End of Section

**SECTION 02542  
SEWER FLOW CONTROL**

**PART 1 GENERAL**

1.01 SECTION INCLUDES

- A. Sewer flow control shall be provided when necessary by the Owner to conduct connections to existing sewer collection lines, sewer line replacement, television inspection, sewer line testing, chemical root control application, and sewer line sealing operations.

1.02 PERFORMANCE REQUIREMENTS

- A. It is essential to the operation of the existing sewerage system that there is no interruption in the flow of sewage throughout the duration of the project. To this end, Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as necessary) to intercept the sewage flow before it reaches the point where it would interfere with his work, carry it past his work, and return it to the existing sewer downstream of his work.

1.03 FIELD QUALITY CONTROL AND MAINTENANCE

- A. Test: Contractor shall perform leakage and pressure tests of the pump around pumping discharge piping using clean water prior to actual operation. Owner shall be given 24 hours notice prior to testing.
- B. Inspection: Contractor shall inspect pump around pumping system every two hours to insure that the system is working correctly.
- C. Maintenance Service: Contractor shall insure that the temporary pumping system is properly maintained and a responsible operator shall be on hand at all times when pumps are operating.

**PART 2 PRODUCTS**

- A. Not Applicable

**PART 3 EXECUTION**

3.01 PLUGGING OR BLOCKING

- A. Insert a sewer line plug into the line at a manhole upstream from the line segment that is to be inspected, tested, and sealed. The plug shall be designed so that a portion of the sewage flow can be released. During the inspection portion of the operation, shut off or substantially reduce flows so that the pipe can be properly

inspected. During the sewer line testing and/or sealing, restore flows to normal, or no more than 1/3 of the pipe diameter.

- B. When flow in a sewer line is plugged, blocked, or pumped around, take precautions to protect the sewer lines from damage that might result from sewer surcharging. Take precautions to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

### 3.02 PUMP AROUND PUMPING

- A. When pump around pumping is required to ensure the completion of the replacement, inspection, testing, and sealing work, furnish pumping equipment, conduit, etc., conduct pumping operations from manhole to manhole, and discharge no flow on the surface or in natural waterways. Any and all sanitary sewer overflows shall be reported to Owner.
- B. Pumping Sewage around the Work Area: When required for acceptable completion of an insertion process, Contractor shall provide for continuous sewage flow around the section(s) of pipe designated for cleaning, televising, or the insertion of liners. For all lines, Contractor shall submit a pump around pumping plan to the Owner.
- C. The pump around pumping equipment shall include pump(s) with sufficient capacity to meet peak day flows. An identical back-up (or standby) pump shall be provided. Both the main and back-up pump(s) shall be equipped with engines and other means to minimize noise.
- D. The pump around pumping pipe shall be ductile iron, PVC, or HDPE, in sufficient quantity to meet the Contractor's pump around pumping requirements. Leaking pipe and/or joints in the pipe will not be allowed. Repair leaks immediately.
- E. The Contractor shall be responsible for furnishing all necessary labor and supervision to set up and operate the pump around pumping system. The pump around pumping system shall be capable of operating 24 hours with the Contractor providing supervision and operations, as necessary.

### 3.03 LIABILITY

- A. Contractor shall be responsible for damages to private or public property that may result from his sewer flow control operations. Contractor shall be responsible for any permit violations.
- B. Under no circumstances shall sewage be allowed to discharge on the ground or into the waters of the State.

**END OF SECTION**

**SECTION 02545  
BORING AND CASING FOR SEWER LINES**

1. GENERAL

- 1.1 The work to be performed hereunder shall consist of the installation of a casing pipe for the purpose of installing a sewer line as shown on the Drawings or as called for in these specifications. It shall include the excavation of a boring pit, auger boring between the points specified on the Drawings, furnishing and installing of the carrier pipe, and disposing of the excavated materials in the manner herein provided.
- 1.2 The Owner will provide the necessary control points required by the Contractor for this construction. The Contractor will provide the detailed layout required to keep the tunnel or bore on grade.

2. PRODUCTS

2.1 CASING PIPE

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

| <b>(For Highway H20 Loading)</b> |                         |                               | <b>( For Railroad E72 Loading)</b> |                               |
|----------------------------------|-------------------------|-------------------------------|------------------------------------|-------------------------------|
| Carrier Pipe<br>(inches)         | Casing Pipe<br>(inches) | Nominal<br>Thickness (inches) | Casing Pipe<br>(inches)            | Nominal<br>Thickness (inches) |
| 2                                | 6                       | 0.250                         | 8                                  | 0.250                         |
| 4                                | 8                       | 0.250                         | 10                                 | 0.250                         |
| 6                                | 12                      | 0.250                         | 14                                 | 0.250                         |
| 8                                | 16                      | 0.250                         | 18                                 | 0.281                         |
| 12                               | 20                      | 0.281                         | 24                                 | 0.375                         |
| 16                               | 24                      | 0.375                         | 30                                 | 0.500                         |
| 20                               | 30                      | 0.500                         | 30                                 | 0.500                         |
| 24                               | 36                      | 0.500                         | 36                                 | 0.625                         |
| 30                               | 42                      | 0.500                         | 42                                 | 0.625                         |
| 36                               | 48                      | 0.625                         | 48                                 | 0.750                         |
| 42                               | 54                      | 0.625                         | 54                                 | 0.875                         |
| 48                               | 60                      | 0.750                         | 60                                 | 0.875                         |

- 2.2 PIPE: The carrier pipe shall meet the standards specified in Section 02713.

3. EXECUTION

3.1 BORING



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

### 3.2 INSTALLATION OF CASING PIPE

- A. Jack the steel casing pipe into place as the boring proceeds. Weld sections of casing pipe together to provide watertight joints.
- B. Do not remove unacceptable casing without prior approval from the Owner. If the removal of casing pipe is permitted, make proper provisions to prevent caving in of the earth surrounding the casing.

### 3.3 INSTALLATION OF CARRIER PIPE

- A. The carrier pipe(s) shall be furnished by the Contractor. Upon acceptance of the casing, install the carrier pipe in the casing by jacking it through the casing. Spacers shall be used within the casing pipe. Casing Spacers shall be bolt style with a shell made in two sections of heavy T-304 Stainless Steel. Connecting flanges shall be ribbed for extra strength. The shell shall be lined with a PVC liner .090" minimum thickness with 85-90 durometer. All nuts and bolts are to be 18-8 stainless steel. Runners shall be made of ultra high molecular weight polymer with inherent high abrasion resistance and a low coefficient of friction. Runners shall be supported by risers made of heavy 304 Stainless Steel. The supports shall be mig welded to the shell and all welds shall be passivated. The height of the supports and runners combined shall be sufficient to keep the carrier pipe at least 0.75" from the casing pipe wall at all times. A minimum of three spacers shall be placed on each joint of pipe. Casing spacers shall be made by Cascade Waterworks Mfg. Co. or Pipeline Seal and Insulator, Inc., Model S 12G-2. Each end of the casing pipe shall be sealed with a wrap-around end seal.

### 3.4 TUNNELING ALTERNATIVE

- A. 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 TDOT. 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 samples 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 first class commercial quality free from injurious defects such as blister, flux, and uncoated spots.



2. The outside of the plates shall be given a bituminous coating meeting the AASHO 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 plate 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 of a minimum size as called for as a casing pipe in Paragraph 2.1A, 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 1 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. The carrier pipe shall be adequately blocked inside the tunnel so that no part of the carrier pipe touches the tunnel liner. The blocking shall be such that the carrier pipe cannot move horizontally or vertically. The blocking shall be installed within one foot on each side of the bell of the carrier pipe and at the center of each joint. The main portion of the support shall be stainless steel with a PVC liner between the support and the carrier pipe. Detailed plans and specifications shall be submitted showing the proposed bracing and support of the carrier pipe inside the tunnel. Each end of the tunnel liner shall be plugged with brick and mortar.
12. All tunnel liners shall have one 2 inch grout coupling in every ring. Grout back of the rings as required.

#### 4. GUARANTEE OF WORK

- 4.1 Guarantee a usable completed casing or tunnel 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.
- 4.2 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

**SECTION 02575  
PAVEMENT REPAIR**

1. GENERAL

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

1.2 Both these specifications and the drawings make reference to the current edition of the standard specifications of the Tennessee Department of Transportation (TDOT) and the Loudon or Monroe County Highway Department. 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. Refer to other sections for work related to that covered by this section.

2. PRODUCTS

- A. Mineral Aggregate Base: Type A Base, Grading D crushed stone (TDOT Specification Section 303);
- B. Bituminous Prime Coats: cutback asphalt, Grade RC-250, or material emulsified asphalt, Grade AE-P (TDOT Specification Section 402);
- C. Aggregate For Cover Material: Size 7, 8 or 78 (TDOT Specification Section 402) ;
- D. Tack Coat: Grade AE-3 (TDOT Specification Section 403);
- E. Bituminous Plant Mix Base (Hot Mix): Grading A, B, B (modified), or C, AS or CW, as directed by the Engineer (TDOT Specification Section 307);
- F. Asphaltic Concrete Surface: Grading B or C as specified (TDOT Specification Section 411);
- G. Pavement Marking Paint: White and Yellow (TDOT Specification Section 716);

3. EXECUTION

3.1 SUBGRADE

- A. Before any base material is installed, compact the subgrade of the area to be paved to 95 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 or as shown on the standard drawings. Take special care to ensure good compaction of the new base course at the joint. Apply and compact the surface to conform to the existing pavement so that it will have no surface irregularity.

### 3.2 BASE

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

### 3.3 SEAL COAT SURFACE

- A. Uniformly apply a bituminous prime coat of either emulsified asphalt, Grade AE-P, or cutback asphalt, Grade RC-250, over the entire width of the area to be surfaced at a rate of 0.3 gallons/square yard. Immediately after application, uniformly cover the entire area with Size 7 crushed stone chips at a rate of 12 pounds/square yard.

### 3.4 DOUBLE BITUMINOUS SURFACE

- A. Apply the first course at a rate of 0.38 to 0.42 gallons/square yard with either emulsified asphalt, Grade RS-2, or cutback asphalt, Grade RC-800 or RC-3000, and then immediately cover with Size 6 crushed stone chips at a rate of 33 to 37 pounds/square yard. After this is rolled, apply the second course at a rate of 0.30 to 0.35 gallons/square yard, and at once uniformly cover with Size 7 chips at a rate of 20 to 25 pounds/square yard. Then roll the entire area.
- B. After the application of the cover aggregate, lightly broom or otherwise maintain the surface for a period of 4 days, or as directed by the Owner. Maintenance of the surface shall include the distribution of cover aggregate over the surface to absorb any free bitumen and cover any areas deficient in aggregate. Sweep excess material from the entire surface with rotary brooms. Sweep the surface at the time determined by the Owner.

### 3.5 ASPHALTIC CONCRETE BINDER

- A. Apply a bituminous prime coat of emulsified asphalt, Grade AE-P, or cutback asphalt, Grade RC-250, at a rate of 0.38 to 0.42 gallons/square yard. Take care to prevent the bituminous material's splashing on exposed faces of curbs and gutters, walls, walks, trees, etc. If such splashing does occur, remove it immediately. After the prime coat has been properly cured, apply an asphaltic concrete binder to the thickness shown on the standard drawings or the plans.
- B. Carefully place the material to avoid segregation of the mix. Broadcasting of the material will not be permitted. Remove any lumps that do not readily break down.

### 3.6 ASPHALTIC CONCRETE SURFACE

- A. If the asphaltic concrete surface course is to be placed directly on the mineral aggregate base, place a bituminous prime coat as described above. If, however, the surface course is to be placed on a binder course, then apply a bituminous tack coat of the sort specified above under PRODUCTS at a rate of 0.05 to 0.10 gallons/square yard. Take care to prevent the bituminous material's splashing on exposed faces of curbs, gutters, walls, walks, trees, etc. If such splashing does occur, remove it immediately. After the prime or tack coat has been properly cured, apply the asphaltic concrete to the thickness shown on the drawings or standard drawings. Apply the surface course as described above for the binder course.

### 3.7 SMOOTHNESS

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

### 3.8 SAMPLING AND TESTING

- A. Submit to the Owner test reports made by an independent testing laboratory on the crushed stone aggregate, bituminous materials, and asphaltic concrete design mixes, and obtain his approval of these reports before starting paving operations.
- B. Tests shall be made 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 the deficiency shall be refused. Remove and reinstall all such sections. Patch all test holes in connection with thickness tests.
- C. When making surface tests, furnish one man to mark all surface defects for corrections.

End of Section

**SECTION 02600  
MANHOLES****PART 1 GENERAL**

- 1.01 Manholes shall be precast or monolithic concrete with eccentric cones unless otherwise approved by the Engineer.
- 1.02 Refer to other sections for items affecting manholes. Coordinate this work with that specified by other sections for timely execution.
- 1.03 Shop drawings are required for castings, plastic gaskets, precast manholes components, and appurtenances specified in this section, per Section 01302 requirements.

**PART 2 PRODUCTS**

## 2.02 CONCRETE MASONRY

- A. Reinforced or plain, 4,000-psi strength unless otherwise shown on the drawings.

## 2.03 CLAY BRICK (FOR CASTING ADJUSTMENT)

- A. Clay brick shall be medium hard or better quality Grade SM sewer brick conforming to the requirements of ASTM C32. Brick shall be solid and not cored.

## 2.04 MORTAR

- A. Composed of one-part Portland cement and two-parts sand (volumetric measure) thoroughly mixed in a tight box, with water added gradually, and mixed continually until mortar has attained the proper consistency for use in brick masonry. Prepare only in such quantities as needed for immediate use. Mortar mixed for more than 30 minutes or previously set will not be allowed.

## 2.05 GRAY IRON CASTINGS

- A. Cast iron conforming to the requirements of Class 30, ASTM A48; made accurately to the required dimensions; sound, smooth, clean, and free from blisters and other defects; not plugged or otherwise treated to remedy defects; machined so that covers rest securely in the frames with no rocking and are in contact with frame flanges for the entire perimeter of the contact surfaces; thoroughly cleaned subsequent to machining and, before rusting begins, painted with a bituminous coating so as to present a smooth finish; tough and tenacious when cold, but not tacky and with no tendency to scale; and with the actual weight in pounds stenciled or printed by the manufacturer on each casting in white paint. The clear opening in the frame casting shall not be less than 24 inches and the cover shall weigh not more than 180 pounds. Castings shall be heavy duty type, John Bouchard & Sons Company, No.1150; Neenah Foundry Company, No. R1642; Vulcan Foundry, No. VM1312; or equal. Watertight castings shall conform to the above specifications, but shall also be furnished with a neoprene O-ring gasket and

- B. Countersunk stainless-steel bolts to form a watertight seal between the cover sealing surface and the frame.

## 2.06 PLASTIC GASKET FOR PRECAST MANHOLES

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

| <u>COMPOSITION</u>                        | <u>TEST METHOD</u> | <u>MINIMUM</u> | <u>MAXIMUM</u> |
|---|--------------------|----------------|----------------|
| Bitumen (Petroleum Plastic Content)       | ASTM D4            | 50             | 70             |
| Ash Inert Mineral Matter                  | AASHTO T111        | 30             | 50             |
| Volatile Matter                           | ASTM D6            | —              | 2              |
| <u>PROPERTY</u>                           | <u>TEST METHOD</u> | <u>MINIMUM</u> | <u>MAXIMUM</u> |
| Specific Gravity at 77 degrees F          | ASTM D71           | 1.20           | 1.30           |
| Ductility at 77 degrees F (cm)            | ASTM D113          | 5              | —              |
| Softening Point                           | ASTM D36           | 320°F          | —              |
| Penetration 77 degrees F (150 gms) 5 sec. | ASTM D217          | 50             | 120            |

## 2.07 LADDER BARS

- A. An aluminum alloy weighing 2.2 pounds or 3/8 inch minimum steel reinforced rod encapsulated in polypropylene plastic.

## 2.08 PRECAST MANHOLE COMPONENTS



- A. Meeting the requirements of the standard drawings and ASTM C478. Manhole barrels shall conform to the requirements of ASTM C76, Class III, with wall thickness B. The manhole sidewall shall be of a length such that a minimum of one course and a maximum of four courses of brick shall be placed on top of the unit to bring the casting to grade.

## 2.09 MATERIAL TESTING

- A. All precast reinforced concrete manhole risers and tops specified herein shall be tested and inspected by a commercial testing laboratory approved by the Owner prior to delivery to the site. All materials that fail to conform to these specifications shall be rejected. After delivery to the site, any materials that have been damaged in transit or are otherwise unsuitable for use in the work shall be rejected and removed from the site. Supply certified copies in duplicate of the inspection and acceptance reports of the testing laboratory to the Owner before using the materials. The commercial testing laboratory shall be engaged and paid for by the Contractor. Submit a certificate from the manufacturer of the castings indicating that they meet all applicable requirements of these specifications.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Dewater sufficiently to maintain the ground water level at or below the bottom of the manhole foundation prior to and during placement of the foundation.
- B. Obtain an adequate foundation for all manhole structures by removing and replacing unsuitable material with well graded granular material, by tightening with coarse rock, or by such other means as provided for foundation preparation of the connected sewers or as directed by the Owner. Wherever water is encountered at the site, place all cast in place bases or monolithic structures on a one-piece, waterproof membrane to prevent any movement of water into the fresh concrete.
- C. When the foundation subgrade has been prepared and is approved by the Owner, carefully construct the concrete foundation for monolithic manholes to the line and grade required by the drawings. Construct the manholes after the concrete foundation has been allowed to set for a period of not less than 24 hours.
- D. For precast manholes, carefully block the base section above the prepared surface so that it is fully and uniformly supported in true alignment. Make sure that all entering pipe can be inserted at proper grade. Then place the concrete foundation and invert under and upon this base section as shown in the standard drawings. A base section with monolithic foundation (bottom) may be used when approved by the Owner.
- E. Thoroughly wet and then completely fill all lift holes and all joints between precast elements with mortar. Smooth and paint them both inside and outside to ensure



watertightness. Coat all joints and touch up all scarred areas on the bituminous seal coat.

- F. Construct monolithic concrete manholes and bases of 4,000-psi concrete unless shown otherwise on the drawings. The ladder bars shall be cast in place.
- G. Carefully set the cast-iron frame for the cover at the required elevation and properly bond it to the masonry with cement grout and/or anchor bolts. Wherever manholes are constructed in paved areas, tilt the top surface of the frame and cover so as to conform to the exact slope, crown, and grade of the existing adjacent pavement.
- H. Manhole inverts shall be constructed of concrete or Portland cement mortared masonry fill and may, at the Contractor's option, be covered with cement mortar to the approximate cross section of the sewers connected to them. Make any necessary changes in cross sections gradually from side to side of the manhole. Make changes in direction of flow of the sewers to a true curve of as large a radius as is permitted by the size of the manhole. Construct concrete inverts longitudinally with the invert channel. Provide minimum drop of 0.1 foot across invert or as shown on the drawings.
- I. All rigid unreinforced pipe entering or leaving the manhole shall be provided with flexible joints within 12 inches of the manhole structure, or encase the full joint in concrete. Place such pipe on firmly compacted bedding, particularly in the area of the manhole excavation, which is normally deeper than excavation for sewer trenches. Take special care to see that the openings through which pipes enter the structures are completely and firmly rammed full of shrinkproof mortar or otherwise constructed to ensure watertightness.
- J. Use gasketed PVC manholes sleeve on all PVC pipe at connections to manholes. Sleeve to be type as manufactured by Vassallo, Inc. or equal.
- L. Where the difference in the invert elevation of two or more sewers intersecting in one manhole is 24 inches or more, construct a drop manhole. Drop manholes shall be similar in construction to standard manholes except that a drop connection of pipe and fittings of the proper sizes and materials shall be constructed outside the manhole and supported by 4,000-psi concrete.
- M. Place backfill by hand around the manhole and to a distance of at least one pipe length into each trench and tamp with selected material up to an elevation of 12 inches above the crown of all entering pipes. Continue backfilling in accordance with the requirements for trench backfilling.

### 3.02 MANHOLE VACUUM TEST

- A. Manholes shall be tested by vacuum test, after assembly but prior to backfilling. Test shall comply with ASTM standard C1244 (93 revision). Manholes shall be tested by

vacuum, only if constructed of precast concrete. Testing shall include the joint between the concrete cone and spacer rings.

- B. Stubouts, manhole boots and pipe plugs shall be secured to prevent movement while the vacuum is drawn.
- C. Installation and operation of vacuum equipment and indicating devices shall be in accordance with equipment specification for which performance information has been provided by the manufacturer and approved by the Tennessee Department of Environment and Conservation.
- D. A measured vacuum of 10 inches of mercury shall be established in the manhole. The time for the vacuum to drop to 9 inches of mercury shall be recorded.
- E. Acceptance for leakage shall be established from the elapsed time for a negative pressure change from 10 inches to 9 inches of mercury. The maximum allowable leakage rate for a 4-foot-diameter manhole shall be in accordance with the following:

| <u>MANHOLE DEPTH</u> | <u>MINIMUM ELAPSED TIME FOR A PRESSURE CHANGE OF 1 INCH HG</u> |
|----------------------|--|
| 10 ft or less        | 60 seconds   |
| > 10 ft but < 15 ft  | 75 seconds   |
| > 15 ft but < 25 ft  | 90 seconds   |

For manholes 5 feet in diameter, add an additional 15 seconds and for manholes 6 feet in diameter, add an additional 30 seconds to the time requirements for 4-foot-diameter manholes.

- F. If the manhole fails the test, necessary repairs shall be made and the vacuum test repeated one time.
- G. If the manhole fails the second test or if the joint mastic is completely pulled out during the vacuum test, the manhole shall be disassembled and the mastic replaced.

#### END OF SECTION

**SECTION 02632  
SANITARY SEWER PIPING**

**PART 1      GENERAL**

1.01    REFERENCES

- A.    The following is a list of standards which may be referenced in this section:
1.    American Water Works Association (AWWA):
    - a.    C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fitting for Water.
    - b.    C105.A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
    - c.    C110/A21.10, Ductile-Iron and Gray-Iron Fittings, 3 inch Through 48 inch for Water and Other Liquids.
    - d.    C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
    - e.    C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water.
  2.    ASTM International (ASTM):
    - a.    A746, Standard Specification for Ductile Iron Gravity Sewer Pipe.
    - b.    D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
    - c.    D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
    - d.    D3034, Standard Specification for Type PSM Poly (Vinyl Chloride)(PVC) Sewer Pipe and Fittings.
    - e.    D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
    - f.    F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
    - g.    F679, Standard Specification for Poly (Vinyl Chloride) (PVC).
    - h.    F794, Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
    - i.    F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.

**PART 2      PRODUCTS**

2.01    DUCTILE IRON PIPE

- A.    Material: ANSI/AWWA C151/A21.51. Centrifugally Cast, Grade 60-42-10 iron.
- B.    Interior Lining: Cement Mortar: ANSI/AWWA C104/A21.4, except cement shall conform to ASTM C150, Type II, with seal coat
- C.    Exterior Encasement: Polyethylene Film:      ANSI/AWWA C105/A21.5 with minimum nominal thickness of 8 mil and minus tolerance of 10 percent. Provide

tubes for straight pipe and sheets for fittings or tees. Securing Tape: Thermoplastic material with minimum thickness of 8 mils, width 1 inch, and pressure sensitive adhesive face capable of bonding to metal, bituminous coating, and polyethylene.

- D. Fittings: ANSI/AWWA C110/A21.10
- E. Joints: Rubber Gasketed Push-On, ANSI/AWWA C111/A21.11 with lubricant as approved by manufacturer.
- F. Plugs: Removable. Removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

## 2.02 POLYVINYL CHLORIDE (PVC)

- A. Pipe 15-inch diameter and under: ASTM D3034. Standard Dimension Ratio less than 35, except that the cell classification shall be 12454-B or 12454-C as defined in ASTM D1784.
- B. Pipe 18-inch through 24-inch diameter: ASTM F679. Standard Dimension Ratio less than 35, except that the cell classification shall be 12454-C as defined in ASTM D1784.
- C. Joints: ASTM D3212 rubber gasketed.
- D. Fittings: PVC, gasketed. Provide plug when service piping is not required.
- E. Plugs: Removable. Removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.
- F. Source Quality Control: In accordance with specified ASTM.

## PART 3 EXECUTION

### 3.01 INSTALLATION OF PIPE, FITTINGS, AND APPURTENANCES

- A. General:
  - 1. Pipe laying shall proceed upgrade with spigot ends pointing in direction of flow.
  - 2. Excavate bell holes at each joint to permit correct assembly and inspection of entire joint.
  - 3. Pipe invert may deviate from line or grade up to ½ inch for line and ¼ inch for grade, provided that finished pipe line will present a uniform bore, and such variation does not result in a level or reverse sloping invert, or less than minimum slope shown.
  - 4. Pipe bedding shall form continuous and uniform bearing and support for pipe barrel between joints. Pipe shall not rest directly on bell or pipe joint.
  - 5. Prevent entry of foreign material into gasketed joints.
  - 6. Plug or close off pipes that are stubbed off for manhole, concrete structure, or for connection by others, with temporary watertight plugs.
- B. Ductile Iron Pipe Corrosion Protection:
  - 1. Remove foreign material from the exterior of the pipe.
  - 2. Wrap pipe with polyethylene encasement tube 2 feet longer than the pipe section prior to laying pipe section.

3. After assembling the pipe joint, overlap encasement tube with adjacent tube and seal joints with securing tape.
4. Provide additional securing tape at 3 foot intervals along the pipe.
5. Repair rips, punctures, or other damage to the polyethylene with securing tape.
6. Fitting may be wrapped with a flat sheet or split tube provided all seams are securely taped.

### 3.02 PRESSURE TESTING

- A. As specified in Section 02532.

### 3.03 REPAIR AND TESTING

- A. Sections of pipe not meeting the pressure test requirements shall be replaced or have individual joints tested and sealed.
- B. Following repairs, sections shall be retested as specified.

### 3.04 SEWER CLEANING

- A. Prior to final acceptance and final manhole-to-manhole inspection of the sewer system by Engineer and Owner, flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the sewer system at or near the closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.
- B. Upon Engineer's final manhole-to-manhole inspection of sewer system, if any foreign material is still present in the system, reflush and clean the sections and portions of the lines as required.

**END OF SECTION**

**SECTION 03303  
CONCRETE FOR UTILITIES**

1. GENERAL

- 1.1 This item shall include furnishing and installing concrete blocking, cradles, anchors, caps, pipe protection, and/or encasement at the locations shown on the drawings and/or as directed by the Owner.
- 1.2 Submit concrete mix design, including all add mixtures with past strength data for review per the requirements of Section 01302 – Submittals and Substitutions.

2. PRODUCTS

NOT USED

3. EXECUTION

- 3.1 Concrete work shall conform to ACI 301-72 (as revised), as modified by the supplemental requirements listed below.
- A. Strength: The strength of concrete shall be 4,000 psi unless otherwise shown on the drawings.
- B. Durability: All concrete exposed to weather shall be air entrained.
- C. Slump: Concrete shall be proportional and produced to have a slump of 3-inches with a 1-inch tolerance.
- D. Admixtures: Air entrainment, mandatory for concrete exposed to weather, may be used. A water reducing admixture [retarding (normal or accelerating) depending on placing temperature] may be used if approved by the Owner.
- E. Reinforcing Steel: Yield strength of reinforcing steel shall be 60,000 psi.

End of Section

**SECTION 11500****PREFABRICATED ABOVE GROUND PUMP STATION WITH  
SUCTION LIFT CENTRIFUGAL PUMPS**

## 1. GENERAL

1.1 Work under this Section includes but is not limited to furnishing and installing a factory built duplex pump station as indicated on the project drawings and specified herein.

## 1.2 REFERENCES

A. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

1. American National Std. Institute (ANSI)/American Water Works Association (AWWA)
  - a. ANSI B16.1 – Cast iron pipe flanges and flanged fittings
  - b. ANSI/AWWA C 115/A21.51 – Cast/ductile iron pipe with threaded flanges
  - c. ANSI 253.1 – Safety Color Code for Marking Physical Hazards
  - d. ANSI B40.1 – Gages, Pressure and Vacuum
  - e. AWWA C508 – Single Swing Check Valves
2. American Society for Testing and Materials (ASTM)
  - a. ASTM A 48 – Gray Iron Castings
  - b. ASTM A126 – Valves, Flanges, and Pipe Fittings
  - c. ASTM A307 – Carbon Steel Bolts and Studs
  - d. ASTM A36 – Structural Steel
3. Institute of Electrical and Electronics Engineers (IEEE)
  - a. ANSI/IEEE Std 100 – Standard Dictionary of Electrical Terms
  - b. ANSI/IEEE Std 112 – Test Procedure for Polyphase Induction
  - c. IEEE Std 242 – Protection of Industrial and Control Power Systems
4. National Electric Code (NEC)/National Electrical Manufacturers Association (NEMA)
  - a. NEC – National Electric Code
  - b. NEC 701 – National Electric Code Article 701
  - c. NEMA Std MG1 – Motors and Generators
5. Miscellaneous References
  - a. Ten State Standards – Recommended Standards for Sewage Works
  - b. Hydraulic Institute – Std for Centrifugal, Rotary, and Reciprocating Pumps
  - c. NMTBA and JIC Std – National Machine Tool Builders Association and Joint Industrial Council Standards
  - d. ISO 9001 – International Organization for Standardization

## 1.3 System Description

A. Contractor shall furnish and install one factory built above ground, automatic pump station. The station shall be complete with all equipment specified herein; factory assembled in a fiberglass reinforced polyester resin enclosure.

- B. In addition to the station enclosure, principle items of equipment shall include two horizontal, self priming, centrifugal sewage pumps, V-belt drives, motors, internal piping, valves, motor control panel, automatic liquid level control system, and internal wiring.
- C. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with the requirements under Part 2 – Products.

#### 1.4 Submittals

##### A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit 5 copies of submittal data for review and approval.
2. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: catalog cut sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and V-belt drive data, pump characteristic curves showing design duty point capacity (gpm), head (ft), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.
3. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for station. Pipe penetrations and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

##### B. Operation and Maintenance Manual

1. Operation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel and familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.
2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:
  - a. Functional description of each major component, complete with operating instructions.
  - b. Instructions for operating pumps and pump controls in all modes of operation.



- c. Calibration and adjustment of equipment for initial startup, replacement of level control components, or as required for routine maintenance.
  - d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
  - e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA 79. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.
  - f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.
3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

#### 1.6 Quality Assurance

- A. The pumps and pump station manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- B. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.
- C. Pump Performance Certifications
  1. All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.
  2. Reprime Performance

- a. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of the liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.
  - b. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.
  - c. Pump must be capable of repriming 20 vertical feet at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test setup:
    1. A check valve to be installed down stream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.
    2. A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to the atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.
    3. The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90 degree elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.
    4. Impeller clearances shall be set as recommended in the pump service manual.
    5. Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
    6. Liquid to be used for reprime test shall be water.
  3. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.
- C. Factory System Test

1. All internal components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational test shall simulate actual performance anticipated for the complete station.
2. Upon request from the engineer, the operational test may be witnessed by the engineer, and/or representatives of his choice, at the manufacturer's facility.
3. The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance.

#### 1.7 Manufacturer's Warranty

- A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
  1. Fiberglass components of the station enclosure shall be warranted for twenty (20) years to resist UV damage, corrosion from moisture or corrosive soils, or physical failures occurring in normal service, without the need for special protective coatings, when installed according to the manufacturer's recommendations.
  2. All other equipment, apparatus, and parts furnished shall be warranted for five (5) years, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, o-rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.
- B. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to the owner.
- C. The warranty shall become effective sixty (60) days after installation, or ninety (90) days after shipment, whichever occurs first.

## 2. PRODUCTS

2.1 In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these specifications that all system components are furnished by a single supplier. The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

### 2.2 Manufacturer

- A. The pump station system integrator must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

- B. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.
- C. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.
- D. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.
- E. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

### 2.3 Station Enclosure

- A. The station enclosure shall provide sufficient inside area for maintenance personnel to perform normal operation and maintenance inside, sheltered, and free from foul weather. The enclosure shall consist of a base to support the pumps and a cover that can be moved without lifting. Minimum dimensions of the enclosure shall be seven feet by ten feet and six feet in height.
- B. The station enclosure shall be manufactured of molded fiberglass reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Glass fibers shall have a minimum average length of 1 ¼ inches. Resin fillers or extenders shall not be used. Major design considerations shall be given to structural stability, corrosion resistance, and water-tight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long maintenance free life. They must be impervious to micro-organisms, mildew, mold, fungus, corrosive liquids, and gases which can reasonably be expected to be present in the environment surrounding the wet well. Wood core type enclosures shall not be considered acceptable and shall be basis for equipment rejection. See manufacturer's requirements for enclosure warranty in these specifications.
- C. All interior surfaces of the housing shall be gel coated with a polyester resin. It shall be of suitable thickness and formulated to provide:
  - 1. Maintenance-free service
  - 2. Abrasion resistance
  - 3. Protection from sewage, greases, oils, gasoline, and other common chemicals.
  - 4. Color fastness

## 5. Gloss retention

- D. Interior surfaces of the enclosure cover and end panels shall be white for maximum light reflectivity. The base shall be of a darker color to de-emphasize the presence of dirt, grease, etc. Colors used for both portions shall result in a pleasing looking structure.
- E. The outside of the enclosure shall be coated with a suitable pigmented resin compound to insure long, maintenance-free life. The fiberglass enclosure shall be a regular product of the pump station manufacturer.
- F. Station base shall be constructed with a completely encapsulated structural steel frame for corrosion protection. Frame shall provide adequate structural support for pumps, motors, and piping. The encapsulated frame shall extend to lift points provided and assure adequate strength to resist deformation of structure during shipping, lifting, or handling. The structural steel base shall be completely encapsulated within a molded fiberglass reinforced polyester base shell. Wall thickness shall be a minimum of 3/16 inch and base height a minimum of 5 inches to provide natural drainage of pump station floor to concrete pad. Interior of base shall be filled with a foamed in place rigid polyurethane structural foam. Foam shall be of closed cell type with a minimum density of 2.5 Pounds/cubic feet to give adequate floor support for maintenance personnel and for handling of equipment.
- G. Holes through the base shall be provided for suction and discharge lines, air release lines, and level control line. Holes for the suction and discharge lines shall be provided with a grout dam incorporated in a grout retention cavity which the contractor shall fill at installation with suitable grout to seal each pipe-to-base joint against the entrance of hazardous gases from the wet well.
- H. Station base shall incorporate a suitable flange designed for securing the pump station to the concrete pad in accordance with the station plans.
- I. The enclosure cover shall be movable without lifting to permit overhead access to either half of the station interior and shall be completely removable. A hasp and staple locking device shall be provided to secure the enclosure over the station base. Suitable gasketing shall be provided between the enclosure cover and end panels and base for protection from the elements.
- J. The enclosure cover shall be provided with a hinged fiberglass reinforced access door. Minimum dimensions of the door shall be 27 inches wide by 56 inches high for access by maintenance personnel to station interior. Door shall be a minimum 5/8 inch thick and shall be hinged with a full-length stainless steel piano hinge to a full perimeter aluminum door casing secured to the enclosure cover. Such door casing shall incorporate a suitable drip shield over the opening. Door shall be furnished with a locking handle connected to a three-point latching mechanism. Latch shall engage door casing at top, side and bottom for maximum security against vandalism. All mounting hardware for door casing and door must be concealed or of such type as to prevent vandalism with ordinary tools.
- K. A duplex ground fault indicating utility receptacle providing 115 volts, single phase, 60 hertz shall be mounted inside the pump station. Receptacle shall be NEMA 5-15r

configuration, heavy duty, specification grade and fitted with a weatherproof cover. The receptacle shall be protected by normal duty circuit breaker.

- L. A shuttered exhaust fan with a minimum capacity of 500 CFM to change the air in the enclosure once every minute, shall be mounted in one end wall. In the wall approximately opposite to this end panel shall be mounted an air intake. Both intake and exhaust opening shall be equipped with a screen and cowl suitably designed to prevent the entrance of rain, snow, rocks, and other foreign material. Fan circuit shall be protected by a normal duty circuit breaker.
- M. An enclosed and gasketed 200-watt light fixture shall be provided. The fixture shall be vapor-tight, universal type. The fixture shall be centrally located to provide adequate light to all parts of the station and shall not constitute a physical hazard to inspection or service personnel. Light circuit shall be protected by a normal duty circuit breaker and shall be provided with a disconnect switch.
- N. A 3 KW forced air heater shall be provided for protection of the pump station equipment. The heater shall maintain an inside/outside temperature differential of 60 degrees F while operating on the primary electrical power available to the station. The heater shall be controlled by a thermostat and contactor and protected by a heavy duty circuit breaker.

#### 2.4. Pump Design

- A. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section.
- B. The manufacturer of the pumps must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- C. Materials and Construction Features
  - 1. Pump casing: Casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:
    - a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
    - b. Fill port cover plate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.
    - c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.
    - d. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.
  - 2. Cover plate: Cover plate shall be cast iron Class 30. Design must incorporate



following maintenance features:

- a. Retained by hand nuts for complete access to pump interior. Cover plate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wear plate or check valve without removing suction or discharge piping.
  - b. A replaceable wear plate secured to the cover plate by weld studs and nuts shall be AISI 1015 HRS.
  - c. In consideration for safety, a pressure relief valve shall be supplied in the cover plate. Relief valve shall open at 75-200 PSI.
  - d. Two O-rings of Buna-N material shall seal cover plate to pump casing.
  - e. Pusher bolt capability to assist in removal of cover plate. Pusher bolt threaded holes shall be sized to accept same retaining cap screws as used in rotating assembly.
  - f. Easy-grip handle shall be mounted to face of cover plate.
3. Rotating Assembly: A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, seal plate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:
- a. Seal plate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, and shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.
    1. The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings. The seal cavity shall have an oil level sight gauge and fill/vent plug.
    2. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.
    3. Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.
  - b. Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lock screw and conical washer.
  - c. Shaft shall be AISI 4140 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel shall be supplied.
  - d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal

shall not be acceptable.

- e. Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the seal plate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton. Cage and spring to be AISI 316 stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.
  - f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same cap screws as used for retaining rotating assembly.
4. Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means.
- a. Clearances shall be maintained by external shimless cover plate adjustment, utilizing collar and adjusting screw design for incremental adjustment of clearances by hand. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Cover plate shall be capable of being removed without disturbing clearance settings.
  - b. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the cover plate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above
  - c. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.
5. Suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the cover plate opening, without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.
6. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.



## D. Serviceability

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs by incorporating the following features.

## E. Drain Kit:

1. Pumps to be supplied with a drain kit for ease of maintenance. The kit to contain 10' length of reinforced plastic hose with a female quick connect fitting at one end, and factory installed drain fittings in each pump. Fittings include a stainless steel pipe nipple, stainless steel bushing, stainless steel ball valve and aluminum male quick connect fitting.

## F. Spare Parts Kit:

1. The following minimum spare parts shall be furnished with the pump station:
  - a) One spare pump mechanical seal (complete with shaft sleeve)
  - b) One cover plate O-Ring
  - c) One rotating assembly O-Ring
  - d) One set of rotating assembly spacers
2. No special tools shall be required for replacement of any components within the pump.

## 2.5. Valves and Piping:

- A. Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O-ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean-out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings. Shaft nut shall have double O-rings which shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.
- B. Plug valves shall be of the non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connection drilled to ANSI 125 lb. Standard. Valves shall have ports designed to pass spherical solids equal to the pumps capability. Valves shall be furnished with a drip-tight shutoff plug mounted in stainless steel or teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface.

## C. Automatic air release valves:

1. An automatic air release valve shall be furnished for each pump designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.
2. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric-reinforced neoprene or similar inert material.
3. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.
4. Valves shall be field adjustable for varying discharge heads.
5. Connection of the air release valves to the station piping shall include stainless steel fittings.

## D. Gauge Kit

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

## E. Piping

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.
2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.
3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.
4. Bolt holes shall be in angular alignment within 1/20 between flanges. Flanges shall be faced with a gasket finish.
5. Contractor must insure all pipes connected to the pump station are supported to

prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

## 2.6. Drive Unit

### A. Motors

1. Pump motors shall be 3 phase, 60 hertz, 460 VAC, horizontal ODP, 1,800 RPM, NEMA design B with cast iron frame with copper windings, induction type, with Class F insulation and 1.15 service factor for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.
2. Motors shall be tested in accordance with provisions of ANSI/IEEE Std 112.

## 2.7. Drive Transmission

- A. Power to pumps transmitted V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions.
- B. Each drive assembly shall utilize at least two V-belts providing minimum a combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5 are not acceptable. Computation of safety factors shall be based on performance data published by the drive manufacturer.
- C. The pump manufacturer shall submit power transmission calculations which document the following:
  1. Ratio of pump/motor speed.
  2. Pitch diameter of driver and driven sheaves.
  3. Number of belts required per drive.
  4. Theoretical horsepower transmitted per belt, based on vendor's data.
  5. Center distance between pump and motor shafts.
  6. Arc-length correction factor applied to theoretical horsepower transmitted.
  7. Service factor applied to established design horsepower.
  8. Safety factor ratio of power transmitted/brake horsepower required.
- D. Pump drives to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed 1/2 inch.
  1. Guards must be completely removal without interference from any unit

component, and shall be securely fastened and braced to the unit base.

2. Metal to be free from burrs and sharp edges. Structural joints shall be continuously welded. Rivet spacing on panels shall not exceed five inches. Tack welds shall not exceed four inch spacing.
  3. The guard shall be finished in accordance with Section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.
- 2.8. Pumps, piping, and exposed steel framework shall be cleaned prior to painting. Exposed surfaces to be coated with one coat gray W.R. non-lift primer and one coat white acrylic alkyd W.R. enamel. Paint shall be low VOC, alkyd based, high solids, semi-gloss white enamel for optimum illumination enhancement, incorporating rust inhibitive additives. The finish coat shall be 1.0 to 1.2 MIL dry film thickness (minimum), resistant to oil mist exposure, solvent contact, and salt spray. The factory finish shall allow for over-coating and touch up after final installation.
- 2.9. Electrical Control Components
- A. The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.
  - B. Panel Enclosure
    1. Electrical control equipment shall be mounted within a common NEMA 1 stainless steel, dead front type control enclosures. Doors shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on removable steel back panels secured to enclosure with collar studs.
    2. All control devices and instruments shall be mounted using threaded fasteners, and shall be clearly labeled to indicate function.
  - C. UL Label Requirement:
    1. Pump station components and controls shall conform to third party safety certification. The station shall bear a UL label listed for "Packaged Pumping System". The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The pump station components, panel enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.
  - D. Branch Components
    1. Motor branch components to be of highest industrial quality, secured to the sub-plate with machine screws and lock washers. Mounting holes shall be drilled and tapped; Self-tapping screws shall not be used to mount any component.
    2. Circuit Breakers and Operating Mechanisms

- a. A properly sized heavy duty circuit breaker, with RMS interrupting rating of 14,000 amperes at 460 volts, shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.
  - b. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position.
3. Motor Starters
    - a. Allen and Bradley SMC Flex soft start with pump control option and up to speed by pass features.
  4. Transient Voltage Surge Suppressor:
    - a. A transient voltage surge suppressor shall be furnished to minimize damage to pump motors and control as result of transient voltage surges. The suppressor shall utilize metal-oxide varistors encapsulated in a non-conductive housing. The arrester shall be rated 480 volts RMS nominal with a discharge capability of 2000 amps.
  5. Phase Monitor:
    - a. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, high voltage, low voltage, and voltage unbalance. An adjustable time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart, following an adjustable time delay, when power conditions return to normal.
- E. Control Circuit
1. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
  2. Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be oil-tight design with contacts rated NEMA A300 minimum.
  3. Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.
  4. Six digit elapsed time meter (non-reset type) shall be connected to each motor starter to indicate total running time of each pump in "hours" and "tenths of hours". Separate pilot lights shall be provided to indicate which motor is energized and should be running.

5. A high pump temperature protection circuit shall override the level control and shut down the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing. If casing temperature rises to a level sufficient to cause pump damage, the high pump temperature protection circuit shall interrupt power to the pump motor. A visible indicator, mounted through the control panel door shall indicate motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.
6. A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.
7. The lift station shall be equipped with a 3 KVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer shall be protected by a thermal magnetic circuit breakers, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until primary circuit breaker is in "OFF" position.
8. The control panel shall be equipped with a panel heater to minimize the effects of humidity and condensation. The heater shall include a thermostat
9. Wiring
  - a. The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the main entrance terminal blocks and final connections to remote alarm devices.
  - b. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).
  - c. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:
    - 1) Line and Load Circuits, AC or DC power.....Black
    - 2) AC Control Circuit Less Than Line Voltage.....Red
    - 3) DC Control Circuit.....Blue
    - 4) Interlock Control Circuit, from External Source.....Yellow
    - 5) Equipment Grounding Conductor.....Green
    - 6) Current Carrying Ground.....White
    - 7) Hot With Circuit Breaker Open.....Orange
  - d. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.
  - e. Motor branch and other power conductors shall not be loaded above the temperature of the connected termination. Wires must be clearly numbered at

each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.

- f. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.
10. Factory installed conduit shall conform to following requirements:
- a. All conduit and fittings to be UL listed.
  - b. Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
  - c. Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
  - d. Conduit shall be sized according to the National Electric Code.
11. Grounding
- a. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.
  - b. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).
12. Equipment Marking
- a. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
    - 1) Equipment serial number
    - 2) Supply voltage, phase and frequency
    - 3) Current rating of the minimum main conductor
    - 4) Electrical wiring diagram number
    - 5) Motor horsepower and full load current
    - 6) Motor overload heater element
    - 7) Motor circuit breaker trip current rating
    - 8) Name and location of equipment manufacturer
  - b. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to



device being identified.

- c. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

## 2.10 Liquid Level Control

### A. Mercury Float Switches

1. The liquid level shall be sensed by direct acting float switches. Each switch shall be supplied with a minimum cable length of 30 feet. A float switch shall be provided for each of the following level switch points:
  - a. High Level Alarm
  - b. Lag Pump
  - c. Lead Pump
  - d. Pump Off
  - e. Low Water Alarm
2. Float switches shall be designed to insure long life and reliable operation. Float switch body shall be constructed of Teflon coated 20 gauge 316 stainless steel housing measuring not less than 5 ½" in diameter. A long life, high reliability, potted SPST magnetic reed switch rated for not less than 100 VA at up to 250 Volts shall be mounted inside the float and connected to a multi-stranded, 2 conductor plus ground, 16 gauge, CPE jacketed cable. The cord shall have fine strand conductors (not more than 34 gauge) made especially for heavy flexing service. The cable connection point shall be potted in epoxy providing a strong bond to the float and reed switch forming a water/moisture tight connection. A flexible Neoprene sleeve, not less than 1/8" thick, shall be provided over the CPE jacketed cable extending not less than 5" from the top of the mounting bracket extending down through the cable mounting bracket hinge point to the top of the float switch body, providing cable stress point relief and extended operational life.
3. A 316 stainless steel flanged cable mounting clamp assembly shall be supplied allowing pipe or cable mounting as specified herein. The float cable-mounting bracket shall be flared on both sides providing hinge point stress relief to both sides of the cable.
4. The float switch assembly shall provide a minimum of two pounds of buoyancy in solutions with a specific gravity of 1.0 (water) and shall have an operating temperature rating of -35 to +90 Deg. C.
5. The direct acting float switch liquid level sensors shall be mounted to a common stainless steel cable/weight suspension mounting kit. The stainless steel cable shall be multi-stranded and have a minimum diameter of 1/8" diameter. A plasticol-coated, 20 pound cast-iron weight with a cast-in -place stainless steel eyelet (for connection to the stainless steel cable with two stainless steel clamps) shall provide drift free mounting. The kit shall utilize stainless steel float switch cable clamp mounting hardware with two stainless steel screws per clamp to



provide easy field adjustment of float switch operating elevations. The stainless steel cable shall have a loop with two cable clamps at the upper end of the assembly for mounting to an eyelet installed by the Contractor in the top slab of the wet well. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second pump when the liquid reaches the "lag pump start level" so that both pumps are operating. These levels shall be adjustable as described below.

- B. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be oil tight design with contacts rated NEMA A300 minimum.
- C. Alarm Light (External):
  - 1. The pump control manufacturer will supply one 115 VAC alarm light fixture with vapor-tight red globe, guard, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the contractor.
- D. Alarm Horn (External):
  - 1. The pump control manufacturer will supply one 115 VAC weatherproof alarm horn with projector, conduit box, and mounting base. The design must prevent rain water from collecting in any part of the horn. The alarm horn will be shipped loose for installation by the contractor.

### 3. EXECUTION

#### 3.1 Examination

- A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Station manufacture shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

#### 3.2 Installation

- A. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacture at time of delivery.
- B. Suction pipe connections must be vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.
- C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.
- D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.
- E. After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

### 3.3. Field Quality Control

- A. Operational Test
  - 1. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.
  - 2. After construction debris and foreign material has been removed from the wet well, contractor shall supply water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gauge readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems.
- B. Co-ordinate station start-up with manufactures technical representative. The representative or factory service technician will inspect the completed installation. The technician will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.
- C. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.
- D. The pump station should be placed into service immediately. If operation is delayed,

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Standard Specifications

station is to be stored and maintained per manufactures written instructions.

END OF SECTION

**SECTION 11600****ABOVE GROUND SUBMERSIBLE PUMP VALVE PACKAGE**

## 1. GENERAL

1.1 Work under this Section includes but is not limited to furnishing and installing a factory built duplex pump station as indicated on the project drawings and specified herein.

## 1.2 REFERENCES

A. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

1. American National Std. Institute (ANSI)/American Water Works Association (AWWA)
  - a. ANSI B16.1 – Cast iron pipe flanges and flanged fittings
  - b. ANSI/AWWA C 115/A21.51 – Cast/ductile iron pipe with threaded flanges
  - c. ANSI 253.1 – Safety Color Code for Marking Physical Hazards
  - d. ANSI B40.1 – Gages, Pressure and Vacuum
  - e. AWWA C508 – Single Swing Check Valves
2. American Society for Testing and Materials (ASTM)
  - a. ASTM A 48 – Gray Iron Castings
  - b. ASTM A126 – Valves, Flanges, and Pipe Fittings
  - c. ASTM A307 – Carbon Steel Bolts and Studs
  - d. ASTM A36 – Structural Steel
3. Institute of Electrical and Electronics Engineers (IEEE)
  - a. ANSI/IEEE Std 100 – Standard Dictionary of Electrical Terms
  - b. ANSI/IEEE Std 112 – Test Procedure for Polyphase Induction
  - c. IEEE Std 242 – Protection of Industrial and Control Power Systems
4. National Electric Code (NEC)/National Electrical Manufacturers Association (NEMA)
  - a. NEC – National Electric Code
  - b. NEC 701 – National Electric Code Article 701
  - c. NEMA Std MG1 – Motors and Generators
5. Miscellaneous References
  - a. Ten State Standards – Recommended Standards for Sewage Works
  - b. Hydraulic Institute – Std for Centrifugal, Rotary, and Reciprocating Pumps
  - c. NMTBA and JIC Std – National Machine Tool Builders Association and Joint Industrial Council Standards
  - d. ISO 9001 – International Organization for Standardization

## 1.3 System Description

A. The contractor shall furnish and install one factory built automatically controlled above ground submersible pump valve package capable of handling raw unscreened sewage or similar liquids.

- B. The pumps and mechanical slide rail accessories shall be installed in the wet well as shown on the project plans. The pump control panel, liquid level control, valves and piping shall be installed within a factory built fiberglass enclosure.
- C. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with the requirements under Part 2 – Products.

#### 1.4 Submittals

##### A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit 5 copies of submittal data for review and approval.
2. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: catalog cut sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and V-belt drive data, pump characteristic curves showing design duty point capacity (gpm), head (ft), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.
3. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for station. Pipe penetrations and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

##### B. Operation and Maintenance Manual

1. Operation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel and familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.
2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:
  - a. Functional description of each major component, complete with operating instructions.
  - b. Instructions for operating pumps and pump controls in all modes of operation.

- c. Calibration and adjustment of equipment for initial startup, replacement of level control components, or as required for routine maintenance.
  - d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
  - e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA 79. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.
  - f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.
3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

#### 1.6 Quality Assurance

- A. The pumps and pump station manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- B. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.
- C. All pump openings and passages shall be of adequate size to pass 3.15" diameter spheres (minimum) and any trash or stringy material which can pass through an average house collection system.
- D. The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section

#### 1.7 Manufacturer's Warranty

- A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
  - 1. Fiberglass components of the station enclosure shall be warranted for twenty (20) years to resist UV damage, corrosion from moisture or corrosive soils, or physical failures occurring in normal service, without the need for special protective coatings, when installed according to the manufacturer's recommendations.
  - 2. All other equipment, apparatus, and parts furnished shall be warranted for five (5) years, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, o-rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.
- B. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to the owner.
- C. The warranty shall become effective sixty (60) days after installation, or ninety (90) days after shipment, whichever occurs first.

## 2. PRODUCTS

2.1 In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these specifications that all system components are furnished by a single supplier. The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

### 2.2 Manufacturer

- A. The pump station system integrator must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- B. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.
- C. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.
- D. In event the contractor obtains engineer's approval for equipment substitution, the

contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.

- E. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

### 2.3 Station Enclosure

- A. The station enclosure shall contain and enclose all valves, and associated controls and shall be constructed to enhance serviceability by incorporating the following design characteristics:
  - 1. Two access panels per side of station shall be provided. Panels shall be sized and placed to permit routine maintenance operations through the panel openings of the enclosure. For these purposes, routine maintenance shall include frequently performed adjustments and inspections of the electrical components, controls and valves.
  - 2. The access panels shall be provided with a hinge and latch. Hinge shall be the continuous type. Latch shall engage the enclosure at not less than three places, and shall be protected by a keyed lock.
  - 3. One enclosure side shall contain a screened vent to maximize air flow for enclosure ventilation.
  - 4. Station enclosure, less base, must be removable or able to be disassembled following the removal of reusable hardware.
  - 5. Removal or disassembly of the enclosure shall be accomplished by not more than two maintenance personnel without the use of lifting equipment.
- B. The station enclosure shall be manufactured of molded reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Resin fillers or extenders shall not be used.
- C. Glass fibers shall have a minimum average length of 1 1/4 inches. Major design considerations shall be given to structural stability, corrosion resistance, and watertight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long life. They must be impervious to micro-organisms, mildew, mold, fungus, corrosive liquids, and gases which can reasonably be expected to be present in the environment surrounding the wet well.
- D. All interior surfaces of the housing shall be coated with a polyester resin-rich finish. It shall provide:
  - 1. Maintenance-free service
  - 2. Abrasion resistance
  - 3. Protection from sewage, greases, oils, gasoline, and other common chemicals
  - 4. The outside of the enclosure shall be coated with a suitable pigmented resin, compounded to insure long maintenance-free life
- E. An exhaust blower shall be mounted in the roof of the enclosure. Blower capacity shall



be sufficient to change station air a minimum of once every two minutes. Blower motor shall be operated automatically and shall be turned on at approximately 70 degrees F and shall be turned off at 55 degrees F. Blower motor and control circuit shall be protected by a thermal-magnetic air circuit breaker to provide overcurrent and overload protection. Blower exhaust outlet shall be designed to prevent the entrance of rain, snow, rocks, and foreign material.

#### 2.4. Pump Design

- A. The pump(s) must be submersible slide rail type and be properly selected with the necessary characteristics to deliver the design flow at a design dynamic discharge head .
- B. The manufacturer of the pumps must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- C. Hydraulic Components and Solids
  - 1. The pump casing shall be of gray iron with a gray iron or ductile iron slide rail guide shoe attached to the discharge flange as an integral assembly. Casing shall be easily removable from the motor for full inspection of impeller.
  - 2. All pump openings and passages shall be of adequate size to pass 3" diameter spheres (minimum) and any trash or stringy material which can pass through an average house collection system. The impeller shall be recessed into the pump casing and shall not require flow of liquid through the impeller. The impeller and seal housing shall incorporate auxiliary vanes to hydraulically reduce pressure on the primary seal and force fibrous materials and solids away from the close axial clearance on the backside of the impeller. No impeller clearance adjustment or wear rings shall be required.
  - 3. The impeller shall be a multi-vane vortex type with integral winglets on each vane. The winglet shall form an L-shaped cross section at the face of the vane for improved hydrodynamic efficiency. Impeller shall be of ductile iron and precision balanced. Balancing shall not deform or weaken the impeller. The impeller shall have a tapered locking fit onto the shaft and further be secured by a key and locking bolt. Impeller fasteners shall be non-corroding.
  - 4. A hoisting bail shall provide for proper balance of pump and detente from the discharge connection while using a single lift cable.
  - 5. All other major pump components such as stator housing, seal housing, and bearing brackets must be of structural grade steel or gray iron - Class 30. All external surfaces coming into contact with sewage shall be protected by an epoxy coating of 8 mils minimum thickness. All exposed fasteners and lock washers shall be of 304 stainless steel.

#### 2.5. Pump Motor:

- A. The submersible pump motor shall operate in accordance with the electrical power indicated above. The motor and pump must be connected to form an integral unit.

Motor shall be a squirrel-cage, induction type in an air-filled water tight enclosure. The motor shall conform to NEMA design Class B, and incorporate Class F insulation materials to withstand a continuous operating temperature of 155 degrees C (311 degrees F). The pump and motor shall be capable of handling liquids with a maximum temperature of 40 degrees C (104 degrees F).

- B. Motor shall be capable of sustaining a minimum of 10 starts per hour. The motor shall operate while only partially submerged and not require a cooling jacket or any other means of auxiliary cooling during normal continuous operation.
- C. Motor housing shall be of cast iron. The stator shall consist of copper windings with copper connectors applied to high grade electrical steel laminations. The stator shall be held securely in place by a heat-shrink fit into the motor housing. Any other means of securing the stator which would require penetration of the motor housing shall not be considered acceptable.
- D. Rotor shall be solid cast and dynamically balanced for vibration-free operation. Rotor end bars and short circuit rings shall be of aluminum. The pump shaft shall be of AISI type 329 stainless steel (or hardened alloy steel with protective stainless steel shaft sleeve which prevents contact of the shaft with the liquid). The shaft shall be machined with shoulders or snap ring grooves for positive placement of bearings. The upper and lower bearing shall be of heavy duty design, capable of supporting the shaft and rotor while under maximum radial and thrust loads. The bearings shall be permanently grease lubricated and sealed at the time of installation.
- E. Watertight Integrity
  - 1. All static seals at water tight mating surfaces shall be of nitrile "O" ring type. Use of auxiliary sealing compounds shall not be required. The power and control cables shall enter the motor through a terminal housing. The entrance shall be sealed with a rubber grommet and clamp set which when compressed longitudinally causes a radial water tight seal. The clamp set shall prevent all slippage and rotation of cable while engaged, yet may be easily removed and reused during routine maintenance. Any other cable entrance design requiring use of epoxies, silicones, or similar caulking materials shall be considered unacceptable.
  - 2. The pump and electrical cables shall be capable of continuous submergence without loss of waterproof integrity to a depth of 65 feet.
  - 3. The water tight integrity of the motor housing and shaft seal shall be tested during manufacture by pressurizing the motor cavity and submerging in water with motor operating.
- F. Motor Protection
  - 1. The motor shall be protected from thermal and moisture damage. Thermal protection shall consist of three separate thermostatic switches embedded into the stator windings. Each switch shall open independently and terminate motor

operation if temperature of the protected winding reaches the high temperature set point. Any moisture in the motor housing shall be detected by a mechanically activated moisture sensing micro-switch. The switch shall be sensitive enough to detect airborne moisture and terminate operation of motor before liquid enters the cavity. Use of probes or floats that rely on the presence of liquid to initiate signal shall not be considered acceptable. The thermal and moisture sensing devices shall be connected to the pump control panel by the contractor.

## 2.6 Automatic Discharge Connection

- A. Each pump shall be furnished with a submersible discharge connection system to permit removal and installation of the pump without the necessity of an operator entering the wet well. The design must insure an automatic and firm connection of the pump to the discharge piping when lowered into place.
- B. A gray iron or fabricated steel base plate with integral guide rail pilots shall be provided along with all hardware and anchor bolts required for permanent installation to the wet well floor. The base plate shall be designed with an integral 90° elbow, or adapt to a commercially available elbow for connection to the vertical discharge piping utilizing standard ANSI 125 lbs. flanges. The base plate shall be coated with an epoxy coating for corrosion resistance. The manufacturer shall provide all necessary drawings to insure proper installation and alignment of baseplate within the sump.
- C. Each pump shall be provided with a replaceable ductile iron slide rail guide shoe attached to pump discharge flange. A replaceable neoprene seal shall be provided as an integral part of the guide shoe to form a seal with the base plate connection and eliminate the possibility of leakage and erosive wear during operation. The seal shall contact mating faces in a static position and shall have adequate flexibility to flex under pumping pressure to increase seal efficiency. Metal-to-metal contact at the discharge connection shall not be acceptable.
- D. The contractor shall provide two lengths of schedule 40 stainless steel guide rail pipe for each pump.
- E. Upper guide rail pilots, and a lifting cable shall be furnished for each pump. Bottom pilots shall be an integral part of the baseplate for ease of installation and proper alignment.
- F. The guide shoe shall direct the pump down two vertical guide rails and onto the discharge connection in a simple lineal movement. The buildup of sludge and grease on guide rails shall not present problems during the lifting operation. The guide shoe shall be designed with integral hooks at the top to transmit full weight of the pump to the base plate flange. No portion of the pump shall be supported directly on the bottom of the wet well, guide rails, or lifting cable.
- G. Lifting cable shall consist of a 316 stainless steel braided wire cable attached to the pump lifting bail. A crimped ball end shall be provided at the upper end of this cable for attaching to the wet well access frame.

- H. All bolts, machine screws, nuts, washers, and lockwashers for complete assembly of access cover, guide rails, and discharge elbow shall be stainless steel.

## 2.9. Wet Well Access

- A. The wet well access shall be fabricated from welded aluminum sections. A hinged aluminum door shall be provided for each pump. The hinged door shall be fabricated from 1/4" thick aluminum with non-skid diamond tread on upper surface. All hardware on access assembly shall be stainless steel with a flush upper surface without protrusions. For safety, the door shall have a 300 lbs/sq.ft. rating and be fitted with a recessed staple for padlock. Door shall be furnished with a flush aluminum drop handle and automatic hold open arm.

## 2/10 Valves and Piping

- A. Check Valve: Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O-ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean-out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings. Shaft nut shall have double O-rings which shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.
- B. Each discharge line shall be equipped with a 2-way plug valve to permit isolation of the pumps from the common discharge header. The plug valve shall be non-lubricated type. Valve body shall be semi-steel with flanged end connections drilled to 125 pound standard. Valve shall be furnished with a drip-tight shutoff plug mounted in stainless steel or teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface. Valves shall have ports designed to pass 3" spherical solids.
- C. Piping
  1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.
  2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.
  3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

4. Bolt holes shall be in angular alignment within  $1/2^{\circ}$  between flanges. Flanges shall be faced and a gasket finish applied.
5. All pipes connected to the pump station shall be supported according to good commercial practice.

## 2.9. Electrical Control Components

A. The pump station control panel will be tested as an integral unit by the pump station manufacturer.

### B. Panel Enclosure

1. The electrical control equipment shall be mounted within a 36"x30"x14" Nema 1 stainless steel, dead front type control enclosure. The enclosure door shall be hinged and sealed with a neoprene gasket. It shall include a removable plated steel back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. Operator controls shall be mounted on the enclosure door. The enclosure shall be mounted within the fiberglass valve enclosure. The control panel shall be equipped with vapor emission type corrosion inhibitors.
2. All components shall be of the highest industrial quality, securely fastened to a removable sub-plate with screws and lockwashers. The sub-plate shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component. All operating controls and instruments shall be securely mounted and shall be clearly labeled to indicate function.
3. A main terminal block and ground bar shall be furnished for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the pump station loads. The main terminal block shall be mounted to allow incoming wire bending space in accordance with Article 373 of the National Electrical Code (NEC).

### C. UL Label Requirement:

1. Pump station components and controls shall conform to third party safety certification. The station shall bear a UL label listed for "Packaged Pumping System". The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The pump station components, panel enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

### D. Branch Components

1. A properly sized heavy duty air circuit breaker shall be furnished for each pump motor. All circuit breakers shall be sealed by the manufacturer after calibration

to prevent tampering. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the door, with interlocks which permit the door to be opened only when circuit breakers are in the "OFF" position.

2. An open frame, across-the-line, NEMA rated magnetic motor starter shall be furnished for each pump motor. Starters of NEMA size 1 and above shall be designed for addition of at least two auxiliary contacts. Starters rated "O", "OO", or fractional size shall not be acceptable. Power contacts shall be double-break and made of cadmium oxide silver. Coils shall be epoxy molded for protection from moisture and corrosive atmospheres. The starter assembly shall be equipped with a metal mounting plate for durability. All motor starters shall be equipped to provide under-voltage release and overload protection on all three phases. Motor starter contacts and coils shall be easily replaceable without removing the motor starter from its mounted position.
3. Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection. A reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the door.

#### E. Other Control Components

1. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by The pump control panel shall be equipped to terminate pump operation due to high motor winding temperature or moisture in the motor housing, utilizing contacts in the pump motor housing. If either event should occur, the motor starter will drop out and a mechanical indicator visible on the door shall indicate that the pump motor has been shut down. The pump motor and the mechanical indicator shall require manual reset. Dry contacts, wired to terminal blocks, shall be furnished for each pump for thermal/moisture shutdown.
2. The control circuit shall be protected by a normal duty thermal- magnetic air circuit breaker which shall be connected in such a manner as to allow control power to be disconnected from all control circuits.
3. Pump mode selector switches shall be connected to permit manual start and manual stop for each pump individually, and to select automatic operation of each pump under control of the liquid level control system. Manual operation shall override the liquid level control system. Selector switches shall be heavy duty, oil-tight design, with contacts rated NEMA A300 minimum.
4. Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.



5. Control panel shall be equipped with one oil-tight pilot light for each pump motor. Light shall be wired in parallel with the related pump motor starter to indicate that the motor is on or should be running.
6. Six digit elapsed time indicators (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenth of hours".
7. A switch shall be provided to permit the station operator to select automatic alternation of the pumps, to select pump number one to be the lead pump for each pumping cycle or to select pump number two to be the lead pump for each pumping cycle. Selector switch shall be oil-tight design, with contacts rated NEMA A300 minimum.
8. A duplex ground fault indicating utility receptacle providing 115 VAC, 60 Hertz, single phase current, shall be mounted on the door panel of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.
9. The lift station shall be equipped with a 3 KVA stepdown transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door. and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position.
10. Wiring
  - a. The control panel, as furnished by the manufacturer, shall be completely wired. The contractor shall field connect the power feeder lines to the main terminal block, final connections to the remote alarm devices, and the connections between the pump and the pump motor control. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).
  - b. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:
    - 1) Line and Load Circuits, AC or DC power.....Black
    - 2) AC Control Circuit Less Than Line Voltage.....Red
    - 3) DC Control Circuit.....Blue
    - 4) Interlock Control Circuit, from External Source.....Yellow
    - 5) Equipment Grounding Conductor.....Green
    - 6) Current Carrying Ground.....White
    - 7) Hot With Circuit Breaker Open.....Orange
  - c. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be of 16 gauge minimum, type MTW or THW, 600 volts. Power wiring shall be 14 gauge minimum.

- d. Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires shall be clearly numbered at each end in accordance with the electrical diagrams. All wires on the sub-plate shall be bundled and tied.
  - e. Wires connected to components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be provided to allow the door to swing to its full open position without undue stress or abrasion on the wire or insulation. Bundles shall be held in place on each side of the hinge by mechanical fastening devices.
10. Conduit requirements are as follows:
- a. All conduit and fittings to be UL listed.
  - b. Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
  - c. Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
  - d. Conduit shall be sized according to the National Electric Code.
11. Grounding
- a. The pump control manufacturer shall provide a common ground bar mounted on the enclosure back plate. The mounting surface of the ground bar shall have any paint removed before making final connections.
  - b. The contractor shall make the field connections to the main ground lug and each pump motor in accordance with the National Electric Code.
12. Equipment Marking
- a. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
    - 1) Equipment serial number
    - 2) Control panel short circuit rating
    - 3) Supply voltage, phase and frequency
    - 4) Current rating of the minimum main conductor
    - 5) Electrical wiring diagram number
    - 6) Motor horsepower and full load current
    - 7) Motor overload heater element
    - 8) Motor circuit breaker trip current rating
    - 9) Name and location of equipment manufacturer



- b. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.
- c. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

## 2.10 Liquid Level Control

### A. Mercury Float Switches

- 1. The liquid level shall be sensed by direct acting float switches. Each switch shall be supplied with a minimum cable length of 30 feet. A float switch shall be provided for each of the following level switch points:
  - a. High Level Alarm
  - b. Lag Pump
  - c. Lead Pump
  - d. Pump Off
  - e. Low Water Alarm
- 2. Float switches shall be designed to insure long life and reliable operation. Float switch body shall be constructed of Teflon coated 20 gauge 316 stainless steel housing measuring not less than 5 ½" in diameter. A long life, high reliability, potted SPST magnetic reed switch rated for not less than 100 VA at up to 250 Volts shall be mounted inside the float and connected to a multi-stranded, 2 conductor plus ground, 16 gauge, CPE jacketed cable. The cord shall have fine strand conductors (not more than 34 gauge) made especially for heavy flexing service. The cable connection point shall be potted in epoxy providing a strong bond to the float and reed switch forming a water/moisture tight connection. A flexible Neoprene sleeve, not less than 1/8" thick, shall be provided over the CPE jacketed cable extending not less than 5" from the top of the mounting bracket extending down through the cable mounting bracket hinge point to the top of the float switch body, providing cable stress point relief and extended operational life.
- 3. A 316 stainless steel flanged cable mounting clamp assembly shall be supplied allowing pipe or cable mounting as specified herein. The float cable-mounting bracket shall be flared on both sides providing hinge point stress relief to both sides of the cable.
- 4. The float switch assembly shall provide a minimum of two pounds of buoyancy in solutions with a specific gravity of 1.0 (water) and shall have an operating temperature rating of -35 to +90 Deg. C.
- 5. The direct acting float switch liquid level sensors shall be mounted to a common stainless steel cable/weight suspension mounting kit. The stainless steel cable

shall be multi-stranded and have a minimum diameter of 1/8" diameter. A plasticol-coated, 20 pound cast-iron weight with a cast-in -place stainless steel eyelet (for connection to the stainless steel cable with two stainless steel clamps) shall provide drift free mounting. The kit shall utilize stainless steel float switch cable clamp mounting hardware with two stainless steel screws per clamp to provide easy field adjustment of float switch operating elevations. The stainless steel cable shall have a loop with two cable clamps at the upper end of the assembly for mounting to an eyelet installed by the Contractor in the top slab of the wet well. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second pump when the liquid reaches the "lag pump start level" so that both pumps are operating. These levels shall be adjustable as described below.

- B. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be oil tight design with contacts rated NEMA A300 minimum.
  
- C. Alarm Light (External):
  - 1. The pump control manufacturer will supply one 115 VAC alarm light fixture with vapor-tight red globe, guard, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the contractor.
  
- D. Alarm Horn (External):
  - 1. The pump control manufacturer will supply one 115 VAC weatherproof alarm horn with projector, conduit box, and mounting base. The design must prevent rain water from collecting in any part of the horn. The alarm horn will be shipped loose for installation by the contractor.

### 3. EXECUTION

#### 3.1 Examination

- A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Station manufacture shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect

complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

### 3.2. Installation

- A. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.
- B. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.
- C. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

### 3.3. Field Quality Control

- A. Operational Test
  - 1. Prior to acceptance by owner, an operational test of all pumps and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.
  - 2. After construction debris and foreign material has been removed from the wet well, contractor shall supply water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, discharge gauge readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems.
- B. Co-ordinate station start-up with manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. The technician will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.
- C. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

- D. The pump station should be placed into service immediately. If operation is delayed, station is to be stored and maintained per manufactures written instructions.

END OF SECTION

**SECTION 11700  
TELEMETRY**

## 1. GENERAL

## 1.1 DESCRIPTION OF WORK

- A. The Contractor shall furnish and install at each water booster pump station and/or water storage tank a MISSION Communication telemetry system. The system shall be a Model 100 RTU or Model 800 RTU. Selected Model will be determined by the Owner.

## 1.2 SUBMITTALS

- A. Shop drawings shall be submitted in accordance with Section 01302.
- B. Operation and maintenance manuals shall be submitted in accordance with Section 01302 of these specifications.

## 2. PRODUCTS

## 2.1 Field Hardware Requirements

- A. All field hardware shall come enclosed in a durable steel or similar enclosure capable of housing all electronics and backup batteries. An optional NEMA 4X enclosure shall be offered.
- B. The field hardware shall have at least 8 digital (dry contact) inputs.
- C. The field hardware trip inputs must have end of line resistor supervision, or similar supervision, that can detect normal alarm trip inputs and detect input wiring disconnection as a distinctly different signal and report.
- D. The field unit shall be capable of reporting for each input alarm, return to normal and fault condition.
- E. The field unit shall be made available with either a radio which transmits alarms only and daily status events or continuously transmits all digital, analog and pulse inputs on an as occurs basis or at least once every two minutes and the customer may choose to utilize either type of field unit at any proposed site. The submitting Company shall detail the cost difference between field units which transmit alarms only and daily status events and field hardware which continuously transmits all digital, analog or pulse counting input changes.
- F. The field unit shall have on board diagnostic enunciator lights for each digital input, which indicate real time the state of the dry contact inputs.
- G. The field unit shall have at least two analog inputs ( 0-5 Vdc or 4-20 ma ) of at least 10 bit resolution. Each analog input shall have at least 4 threshold alarm set points.

- H. The field unit shall be capable of reporting analog threshold alarms, daily high/low analog values and/or current analog values.
- I. The field hardware trip inputs must operate normally when either side of the trip inputs circuitry is shorted to ground and send a trouble signal upon detection of such short to ground.
- J. The field hardware trip inputs must have a programmable trip input detection delay between 0 and 90 seconds.
- K. The field unit shall have on board diagnostics that indicate received signal strength of the wireless carrier's signal, wiring faults and message transmission progress and status.
- L. The field unit hardware shall have some methodology that enables a single input to be temporarily disabled that does not conflict with the disabled inputs end of line resistor or wiring supervision method.
- M. At least three of the field hardware trip inputs must be capable of being programmed to record and report pump run times as indicated by a relay opening and closing for up to three pumps.
- N. If only two pumps are monitored then the unit shall also record and report simultaneous pump run times.
- O. The unit shall record and report individual pump starts on a one day or seven day basis. The unit shall also have the ability to report within one hour any individual pump starting in excess of a preprogrammed amount. These excess pump start messages shall be automatically forwarded to customer users via pager, email or fax.
- P. The field unit shall be optionally capable of counting voltage pulses or contact closures from two different sources and reporting those pulse counts daily or as they occur. This shall be in addition to the other inputs described above.
- Q. The field unit shall have a means of being put in local shut down without powering the unit down. This shall effectively stop any alarms from being either transmitted from the unit or sent from the central computer facility. The action of putting a field unit in local shut down mode must be authorized and documented via an electronic access control key or card reader. The act of the local shutdown shall be recorded, along with the name or identity of the person performing the local shut down at the central computer facility.
- R. The field hardware shall monitor its primary AC power supply input and shall be capable of sending an AC failure alarm. The unit shall delay the AC failure report for 300 seconds. The unit shall report AC restoration.
- S. The field hardware shall have a built in supervised battery back up power supply. This power supply shall be tested and operate the equipment for at least 15

seconds every day. The unit shall detect and report any backup battery power supply test failure.

- T. The field unit shall have a built in electronic key or card reader which will, when activated, cause the central monitoring/alarm notification facility to cancel any in-progress alarm notifications for that field unit. Additionally, the key use will prevent any subsequent alarms from being processed for a period of one hour, and record at a central facility the time and name of the electronic key used for the activation. Alarm notifications will resume when the electronic key is used again or automatically resume 1 hour after the last alarm message sent from the monitored site.
- U. The field unit shall have the capability of being shut down from transmitting any alarms by use of a push button switch. The push button switch shall be activated by use of an electronic key or card. The unit shut down switch will not allow unit shut down until said electronic key or card has been used within the preceding one minute. The electronic key or card use and the subsequent unit shut down shall be transmitted immediately and the event be logged at the central computer. The field unit shall be capable of re-enabling itself for alarm use by a subsequent electronic key or card use or subsequent push button activation or shall automatically re-enable at midnight. Such re-enabling shall be transmitted to the central computer for logging.
- V. The field hardware shall utilize a transmission scheme that detects and subsequently reports individual transmission failures.
- W. The field hardware shall utilize, in the case of a continuously transmitting field unit, a transmission scheme that encrypts the transmitted data utilizing an 128 bit encryption method that meets or exceeds the advanced encryption standard (AES). Additionally, the continually transmitting field units will have an effective, continuous, transfer rate of at least 19,200 baud.
- X. The field hardware shall utilize a transmission scheme that individually identifies each transmitted message by sequence number.
- Y. The field hardware shall optionally be capable of sending test transmissions at least every seven days and have the capability for daily and on demand test transmissions or transmitting a signal at least once a minute.
- Z. The field hardware test transmissions shall indicate current and historical radio signal reception quality and shall report any radio signal outages and the duration of the outage.
- AA. The field hardware must be capable of reporting, on demand or on schedule, operational status, accumulated pulse input values, pump run time duration's and current operational status of normal alarm trip inputs (trouble, alarm, normal states).

- BB. The field unit shall be capable of being put into a service mode at the remote site and such service mode operations shall be logged and accessible to the customer at a monitoring central facility
- CC. The field unit shall be capable of optionally providing a method to monitor the wet well float circuit directly while providing auxiliary wet well alarm relay contact closures with out the addition of a separate high wet well float. This optional circuitry shall detect high wet well conditions in the event of pump station AC failures.
- DD. The field unit shall not present any electric shock hazard.
- EE. The field unit shall be capable of being listed as complying with Underwriter's Laboratory requirements for remote signaling devices.
- FF. The system shall have a primary central monitoring and control center and a fully redundant, physically separate, backup-computer monitoring center. Either center shall have the capability of operating all the remote monitoring and control field RTU's.

## 2.2 MONITORING AND CONTROL CENTER SOFTWARE/HARDWARE REQUIREMENTS

- A. The monitoring center (if used) functionality and customer alarm and supervisory information must be made available to customer via secure Internet connection or other access manor acceptable to customer.
- B. The monitoring center or equivalent customer operated central monitoring software must be capable of interfacing and transferring, on a continuous basis, all RTU data to an OPC compliant database for access by other OPC compliant HMI software packages. Such transfer method will have 128 bit, or better encryption, and meet or exceed the advanced encryption standard (AES). Client side OPC software will run as an executable or NT service. Client side OPC software will, on a user definable interval, establish a socket connection to static IP address(s) at cellular RTU service provider's central computers. OPC software shall retrieve all changed OPC tag values and close the socket. OPC software shall be set up so as customers OPC computers firewalls may be programmed to only allow Internet traffic to/from the designated service providers IP addresses and port numbers. Customer's firewalls will not be programmed to accept socket connections. Cellular RTU service provider's central computers will offer a VPN option at customers request. Cellular RTU service providers OPC software will allow for multiple customer OPC software packages to establish, concurrently, OPC connections so as to provide for redundant HMI database operation at customers locations. Cellular RTU service providers OPC software shall provide HMI tags for the OPC link status, which shall include a toggling health pulse tag and the vendor's server's time to be used as a method to assure the link quality. Cellular RTU service providers OPC software shall provide HMI tags for:
  - All digital inputs (to include real time pump run status)
  - Any wiring faults at the RTU



- All analog inputs (with field RTU values updating every two minutes if desired)
  - Two pulse totalizing inputs
  - AC power status and voltages at corresponding RTU
  - Battery Status and voltages at corresponding RTU
  - 24 hour, since midnight and last hour totalized values from pulse totalizing inputs
  - 24 hour, since midnight and last hour pump runtime values
  - Electronic key reader data
  - RTU online status with last transmission time
  - Write to tags to operate all RTU relays with sub tags to indicate the success of the write to operation (relay command verification)
  - Hourly RF signal strength at the RTU
- C. The monitoring center or equivalent customer operated central monitoring software must be housed in a secured, access-controlled facility/enclosure.
- D. The monitoring center or equivalent customer operated central monitoring software critical equipment must be supplied power from an uninterruptable power source capable of stand-alone operation for at least 12 hours.
- E. The monitoring center customer Internet Web site or equivalent customer operated central monitoring software, shall provide the customer with on demand capability of shutting down/waking up individual units, remotely status testing individual units, remotely controlling individual units on-board relay, individually polling units for current trip inputs or accumulator input status and values, and be capable of remotely reprogramming other critical field unit operating parameters.
- F. The monitoring center or equivalent customer operated central monitoring software shall provide individual log on access and operational security levels as well as require logged, individual acceptance/acknowledgement off all presented alarms or supervisory messages.
- G. The monitoring center or equivalent customer operated central monitoring software shall provide an easy to use/understand general system overview graphic representation of the current state of all remote points being monitored by the system.
- H. The monitoring center or equivalent customer operated central monitoring software shall provide screens that can display the current status or value from field units that provide continuously transmitted digital, analog or pulse counting data. The graphic display tools shall display the associated data on an as occurred, 1-hour or one-day time interval basis.
- I. The monitoring center or equivalent customer operated central monitoring software shall provide screens that can display historical data trends in a graphic format from field units that provide continuously transmitted digital, analog or pulse counting data.

- J. The monitoring center or equivalent customer operated central monitoring software shall provide the ability to manually control field unit relays from field units that provide continuously transmitted digital, analog or pulse counting data. All such control functions shall be password protected and logged in a secure database.
- K. The monitoring center or equivalent customer operated central monitoring software shall provide for the remote command and control of the customers monitored field hardware in a manner consistent with the field unit's capabilities. The access to this remote command and control functionality shall be security level controlled and all events of use logged in a secure database.
- L. The monitoring center or equivalent customer operated central monitoring software shall provide functions for the customer to add/delete/change a field units alarm notification delivery methodologies and destinations.
- M. The monitoring center or equivalent customer operated central monitoring software shall provide easy to understand and use screens for the customer to securely access, globally or individually, alarms, testing and notification results for the customers field monitoring units.
- N. The monitoring center or equivalent customer operated central monitoring software shall provide a methodology to enable/disable a entire unit from reporting, or any of the units individual inputs from reporting with such enabling/disabling to be time scheduled by the customer.
- O. The monitoring center or equivalent customer operated central monitoring software must have a methodology to track the results of all alarm notifications as to successful or failed. If alarm notifications fail a log of said failures and there cause shall be provided.
- P. The monitoring center or equivalent customer operated central monitoring software must have the ability to analyze and display, graphically or tabular, all pump runtimes on a daily basis. The pump runtime analysis shall use regression analysis over the preceding thirty days. The analysis shall have preset variance limits, which when exceeded, automatically cause emails, pages or faxes to be generated to a customizable list of recipients.

### 2.3 NOTIFICATION CAPABILITY REQUIREMENTS

- A. The monitoring center or equivalent customer operated central monitoring software shall be equipped with adequate communications links to provide reasonable assurance that alarms will be delivered via any chosen delivery methodology to selected recipients within 30 seconds of the monitoring center receiving such alarms from field equipment.
- B. The monitoring center or equivalent customer operated central monitoring software shall be capable of automatically delivering alarm or other selected messages to numeric pagers, alphanumeric pagers, email addresses, facsimile machines or voice telephones (hardwired or wireless, local or long distance).

Such delivered messages will include a cancellation/acceptance code (or other such methodology) that is used by the recipient to indicate to the monitoring system that the recipient has received/accepted the sent message. All message notification attempts, failures and delivery/acceptance confirmations will be logged.

- C. The monitoring center or equivalent customer operated central monitoring software shall digitally record all phone based voice notifications (alarms) from off hook to on hook. The monitoring center or equivalent customer operated central monitoring software shall store these recordings for at least 60 days and shall provide a web based means to play back, or transfer these alarm recordings in a .wav or .mpeg file format.
- D. The monitoring center or equivalent customer operated central monitoring software shall be capable of scheduling alarm notifications to recipients by time of day, day of week, holiday and input type.
- E. The monitoring center or equivalent customer operated central monitoring software shall be capable of delivering to the alarm notification recipient the pump running status of all monitored pumps at the monitored site in the same alarm notification message as the initiating alarm message.
- F. The monitoring center or equivalent customer operated central monitoring software must have the ability to suppress erroneous digital alarms that occur in conjunction with AC power failures.
- G. The monitoring center or equivalent customer operated central monitoring software must have the ability to selectively suppress repeat or duplicate alarms from a particular field unit and a particular input.
- H. The monitoring center or equivalent customer operated central monitoring software shall be capable of buffering AC power failure messages for a customer defined amount of time and then issuing a single group alarm notification message that embodies a list of all of the monitored sites that have an AC power failure. The same group alarm notification function shall apply to monitored sites that have AC power restoring to normal.
- I. The monitoring center or equivalent customer operated central monitoring software shall store all system messaging transactions, operator commands, notification attempts and message delivery confirmations in a secure, nonalterable database.
- J. The monitoring center or equivalent customer operated central monitoring software shall automatically report and notify customer designated recipients of RTU telemetry link loss within five minute of link loss for continuous telemetry RTUs or twenty five hours of link loss for daily reporting RTUs.

#### 2.4 Administrative Reports Requirements

- A. The monitoring center or equivalent customer operated central monitoring software shall provide the customer with automatically generated, weekly reports of all alarms, notifications, delivery confirmations/acceptances and unit test failures. Such weekly reports shall be automatically faxed or e-mailed to up to 4 customer designated recipients.
- B. The monitoring center or equivalent customer operated central monitoring software shall be capable of generating historical reports of any/all field monitoring units alarms, notifications, delivery confirmations/acceptances and test failures.
- C. The monitoring center or equivalent customer operated central monitoring software shall automatically archive all logged system activity on a daily basis to a physically separate database and computer.
- D. The monitoring center or equivalent customer operated central monitoring software shall analyze (buy percent variance or regression analysis) all pump runtimes on a daily basis and automatically generate and send via email or fax out of bounds reports to up to 4 recipients.
- E. The monitoring center or equivalent customer operated central monitoring software must have the ability to display, by site or by electronic key-holder, all uses of the electronic key use for at least a months period of time. Such electronic key use records will be accessible in a report form for hard copy storage.
- F. The monitoring center or equivalent customer operated central monitoring software must have the ability to transfer alarm, electronic key use, analog values, pulse count values and pump run time values to other computers via a coma delineated text string file transfer so as the data can be imported into other generally accepted spread sheet computer programs.

### 3.0 EXECUTION

#### 3.1 GENERAL

- A. The telemetry system shall be manufactured and tested in accordance with the best applicable trade practices and in compliance with state, OSHA, and other governing code requirements.

#### 3.2 INSTALLATION

- A. Installation shall be in accordance with manufacturer's written instructions.

End of Section

**SECTION 11800****GRINDER PUMP SYSTEM**

## 1. GENERAL

## 1.1 General Description

- A. The Contractor shall furnish complete factory-built and tested Wetwell/Drywell Grinder Pump Station(s), each consisting of grinder pump(s) suitably mounted in a basin constructed of high density polyethylene (HDPE) for simplex stations and HDPE or Fiberglass Reinforced Polyester Resin for duplex stations with dimensions and capacities as show on the Contract Drawings, NEMA 6P electrical quick disconnect (EQD), pump removal system, stainless steel discharge assembly/shut-off valve, anti-siphon valve/check valve, each assembled in the basin, electrical alarm panel and all necessary internal wiring and controls. Component type grinder pump systems that require field assembly will not be acceptable due to the potential problems that can occur during field assembly. All components and materials shall be in accordance with section 2.0 of this Product Specification. For ease of serviceability, all pump, motor/grinder units shall be of like type and horsepower throughout the system.

## 1.2 Submittals

- A. After receipt of notice to proceed, the manufacturer shall furnish a minimum of six sets of shop drawings detailing the equipment to be furnished including dimensional data and materials of construction. The Owner shall promptly review this data, and return two copies as accepted, or with requested modifications. Upon receipt of accepted shop drawings, the manufacturer shall proceed immediately with fabrication of the equipment.

## 1.3 Manufacturer

- A. Grinder pump stations, complete with all appurtenances, form an integral system, and as such, shall be supplied by one grinder pump station manufacturer. The Contractor shall be responsible for the satisfactory operation of the entire system. The equipment specified shall be a product of a company experienced in the design and manufacture of grinder pumps for specific use in low pressure sewage systems. The company shall submit detailed installation and user instructions for its product, submit evidence of an established service program including complete parts and service manuals, and shall be responsible for maintaining a continuing inventory of grinder pump replacement parts. The manufacturer shall provide, upon request, a reference and contact list from ten of its largest contiguous grinder pump installations of the type of grinder pumps described within this specification.
- B. The manufacturer of the grinder pump station shall be Environment One Corporation.

- C. Attention is directed to the fact that the drawings and overall system design are based on a particular piece of equipment from a particular manufacturer. These specifications are intended to provide guidelines for standard equipment of a recognized manufacturer who already meets all the requirements of this specification.

#### 1.4 Operating Conditions

- A. The pumps shall be capable of delivering 15 GPM against a rated total dynamic head of 0 feet (0 PSIG), 11 GPM against a rated total dynamic head of 92 feet (40 PSIG), and 7.8 GPM against a rated total dynamic head of 185 feet (80 PSIG). The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valving be allowed to create a false apparent head.

#### 1.5 Warranty

- A. The grinder pump manufacturer shall provide a part(s) and labor warranty on the complete station (pumps, panel, valves, enclosures, etc.) and accessories for a period of 60 months after notice of Owner's acceptance. Any manufacturing defects found during the warranty period will be reported to the manufacturer by the Owner and will be corrected by the manufacturer at no cost to the Owner.
- B. The manufacturer shall provide a Warranty Certification Statement which certifies the 60 month warranty. Any exclusions from the warranty or additional cost items required to maintain the equipment in warrantable condition, including all associated labor and shipping fees, must be annotated. The warranty shall state that the manufacturer will bear all costs to correct any original equipment deficiency for the effective period of the warranty. All preventive maintenance type requirements shall be included in this form as exclusions. These requirements include, but are not limited to, unjamming of grinder mechanism, periodic motor maintenance, and periodic cleaning of liquid level controls.

## 2. PRODUCTS

### 2.1 Pump

- A. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. Double radial O-ring seals are required at all casting joints to minimize corrosion and create a protective barrier. All pump castings shall be cast iron, fully epoxy coated to 8-10 mil Nominal dry thickness, wet applied. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. This material shall be suitable for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, excellent aging properties, and outstanding wear resistance. Buna-N is not acceptable as a stator material because it does not exhibit the properties as outlined above and required for wastewater service.



## 2.2 Grinder

- A. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder impeller (cutter wheel) assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. Attachment by means of pins or keys will not be acceptable. The grinder impeller shall be a one-piece, 4140 cutter wheel of the rotating type with inductively hardened cutter teeth. The cutter teeth shall be inductively hardened to Rockwell 50 – 60c for abrasion resistance. The shredder ring shall be of the stationary type and the material shall be white cast iron. The teeth shall be ground into the material to achieve effective grinding. The shredder ring shall have a staggered tooth pattern with only one edge engaged at a time, maximizing the cutting torque. These materials have been chosen for their capacity to perform in the intended environment as they are materials with wear and corrosive resistant properties.
- B. This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to minimize clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump. These requirements shall be accomplished by the following, in conjunction with the pump:
1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.
  2. The maximum flow rate through the cutting mechanism must not exceed 4 feet per second. This is a critical design element to minimize jamming and as such must be adhered to.
  3. The inlet shroud shall have a diameter of no less than 5 inches. Inlet shrouds that are less than 5 inches in diameter will not be accepted due to their inability to maintain the specified 4 feet per second maximum inlet velocity which by design prevents unnecessary jamming of the cutter mechanism and minimizes blinding of the pump by large objects that block the inlet shroud.
  4. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.
- C. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, wipes, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter stainless steel discharge piping.

## 2.3 Electric Motor

- A. As a maximum, the motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with Class F installation, low

starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. The motor shall be press-fit into the casting for better heat transfer and longer winding life. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination shall have been specifically investigated and listed by Underwriters Laboratories, Inc., for the application. Non-capacitor start motors or permanent split capacitor motors will not be accepted because of their reduced starting torque and consequent diminished grinding capability. The wet portion of the motor armature must be 300 Series stainless. To reduce the potential of environmental concerns, the expense of handling and disposing of oil, and the associated maintenance costs, oil-filled motors will not be accepted.

#### 2.4 Mechanical Seal

- A. The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

#### 2.5 Tank and Integral Accessway (Model DH071) High Density Polyethylene Construction

- A. The tank shall be a Wetwell/Drywell design made of high density polyethylene, with a grade selected to provide the necessary environmental stress cracking resistance. Corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. The corrugations of the outside wall are to be a minimum amplitude of 1-1/2" to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be 0.250" thick (minimum). All seams created during tank construction are to be thermally welded and factory tested for leak tightness. The tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.
- B. The tank shall be furnished with one EPDM grommet fitting to accept a 4.50" OD DWV or Schedule 40 pipe. The tank capacities shall be as shown on the contract drawings.
- C. The Drywell accessway shall be an integral extension of the Wetwell assembly and shall include a lockable cover assembly providing low profile mounting and watertight capability. The accessway design and construction shall enable field adjustment of the station height in increments of 4" or less without the use of any adhesives or sealants requiring cure time before installation can be completed.
- D. The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation no field penetrations will be acceptable.
- E. All discharge piping shall be constructed of 304 stainless steel. The discharge shall terminate outside the accessway bulkhead with a stainless steel, 1-1/4" Female NPT



fitting. The discharge piping shall include a stainless steel ball valve rated for 235 psi WOG; PVC ball valves or brass ball/gate will not be accepted. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

- F. The accessway shall include a single NEMA 6P Electrical Quick Disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. The EQD will be supplied with 32', 25' of useable Electrical Supply Cable (ESC) outside the station, to connect to the alarm panel. The ESC shall be installed in the basin by the manufacturer. Field assembly of the ESC into the basin is not acceptable because of potential workmanship issues. The EQD shall require no tools for connecting, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. A junction box shall not be permitted in the accessway due to the large number of potential leak points. The EQD shall be so designed to be conducive to field wiring as required. The accessway shall also include an integral 2-inch vent to prevent sewage gases from accumulating in the tank.

2.6 TANK & INTEGRAL ACCESSWAY: (Models DH151 150 Gallon Simplex & DH152 150 Gallon Duplex) High Density Polyethylene Construction.

- A. The tank shall be a Wetwell/Drywell design made of high density polyethylene, with a grade selected to provide the necessary environmental stress cracking resistance. Corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. The corrugations of the outside wall are to be a minimum amplitude of 1-1/2" to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be 0.250" thick (minimum). All seams created during tank construction are to be thermally welded and factory tested for leak tightness. The tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.
- B. The tank shall be furnished with one EPDM grommet fitting to accept a 4.50" OD DWV or Schedule 40 pipe. The tank capacities shall be as shown on the contract drawings.
- C. The Drywell accessway shall be an integral extension of the Wetwell assembly and shall include a lockable cover assembly providing low profile mounting and watertight capability. The cover shall be high density polyethylene, green in color, with a load rating of 150 lbs per square foot. The accessway design and construction shall enable field adjustment of the station height in increments of 3" or less without the use of any adhesives or sealants requiring cure time before installation can be completed.
- D. The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation no field penetrations will be acceptable.

- E. All discharge piping shall be constructed of 304 stainless steel. The discharge shall terminate outside the accessway bulkhead with a stainless steel, 1-1/4" Female NPT fitting. The discharge piping shall include a stainless steel ball valve rated for 235 psi WOG; PVC ball valves or brass ball/gate will not be accepted. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.
  - F. The accessway shall include a single NEMA 6P Electrical Quick Disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. The EQD will be supplied with 32', 25' of useable Electrical Supply Cable (ESC) outside the station, to connect to the alarm panel. The ESC shall be installed in the basin by the manufacturer. Field assembly of the ESC into the basin is not acceptable because of potential workmanship issues. The EQD shall require no tools for connecting, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. A junction box shall not be permitted in the accessway due to the large number of potential leak points. The EQD shall be so designed to be conducive to field wiring as required. The accessway shall also include an integral 2-inch vent to prevent sewage gases from accumulating in the tank.
- 2.7 TANK & INTEGRAL ACCESSWAY: (DH272, 275-Gallon Duplex & DH502, 500-Gallon Duplex) Fiberglass reinforced polyester resin.
- A. The tank shall be a Wetwell/Drywell design custom molded of fiberglass reinforced polyester resin with a high density polyethylene accessway. Accessway corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. The corrugations of the outside wall are to be a minimum amplitude of 1-1/2" to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be 0.250" thick (minimum). All polyethylene seams created during tank construction are to be thermally welded and factory tested for leak tightness. The tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.
  - B. The tank shall be furnished with one EPDM grommet fitting to accept a 4.50" OD DWV or Schedule 40 pipe. The tank capacities shall be as shown on the contract drawings.
  - C. The Drywell accessway shall be an integral extension of the Wetwell assembly and shall include a lockable cover assembly providing low profile mounting and watertight capability. The cover shall be high density polyethylene, green in color, with a load rating of 150 lbs per square foot. The accessway design and construction shall enable field adjustment of the station height in increments of 4" or less without the use of any adhesives or sealants requiring cure time before installation can be completed.

- D. The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation no field penetrations will be acceptable.
- E. All discharge piping shall be constructed of 304 stainless steel. The discharge shall terminate outside the accessway bulkhead with a stainless steel, 1-1/4" Female NPT fitting. The discharge piping shall include a stainless steel ball valve rated for 235 psi WOG; PVC ball valves or brass ball/gate will not be accepted. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.
- F. The accessway shall include a single NEMA 6P Electrical Quick Disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight. The EQD will be supplied with 32', 25' of useable Electrical Supply Cable (ESC) outside the station, to connect to the alarm panel. The ESC shall be installed in the basin by the manufacturer. Field assembly of the ESC into the basin is not acceptable because of potential workmanship issues. The EQD shall require no tools for connecting, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque. Plug-type connections of the power cable onto the pump housing will not be acceptable due to the potential for leaks and electrical shorts. A junction box shall not be permitted in the accessway due to the large number of potential leak points. The EQD shall be so designed to be conducive to field wiring as required. The accessway shall also include an integral 2-inch vent to prevent sewage gases from accumulating in the tank.

## 2.8 Check Valve

- A. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 Series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of an engineered thermoplastic resin. The working pressure of the valve shall be at least 235 psi. Ball-type check valves are unacceptable due to their limited sealing capacity in slurry applications.

## 2.9 Anti Siphon Valve

- A. The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the discharge piping. Moving parts will be made of 300 Series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from an engineered

thermoplastic resin. Holes or ports in the discharge piping are not acceptable anti-siphon devices due to their tendency to clog from the solids in the slurry being pumped. The anti-siphon port diameter shall be no less than 60% of the inside diameter of the pump discharge piping.

## 2.10 Core Unit

- A. The grinder pump station shall have a cartridge type, easily removable core assembly consisting of pump, motor, grinder, all motor controls, check valve, anti-siphon valve, level controls, electrical quick disconnect and wiring. The core unit shall be installed in the basin by the manufacturer. Field assembly of the pump and controls into the basin is not acceptable because of potential workmanship issues and increased installation time. In some cases, stations taller than 96" may be shipped on their side without the cores assembled in the basin for freight purposes but this is the only exception. The core unit shall seal to the tank deck with a stainless steel latch assembly. The latch assembly must be actuated utilizing a single quick release mechanism requiring no more than a half turn of a wrench. The watertight integrity of each core unit shall be established by a 100 percent factory test at a minimum of 5 PSIG.

## 2.11 Controls

- A. All necessary motor starting controls shall be located in the cast iron enclosure of the core unit secured by stainless steel fasteners. Locating motor starting controls in a plastic enclosure is not acceptable. Wastewater level sensing controls shall be housed in a separate enclosure from motor starting controls. Level sensor housing must be sealed via a radial type seal; solvents or glues are not acceptable. Level sensing control housing must be integrally attached to pump assembly so that it may be removed from the station with the pump and in such a way as to minimize the potential for the accumulation of grease and debris accumulation, etc. Level sensing housing must be a high-impact thermoplastic copolymer over-molded with a thermoplastic elastomer. The use of PVC for the level sensing housing is not acceptable.
- B. Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The air column shall be integrally molded from a thermoplastic elastomer suitable for use in wastewater and with excellent impact resistance. The air column shall have only a single connection between the water level being monitored and the pressure switch. Any connections are to be sealed radially with redundant O-rings. The level detection device shall have no moving parts in direct contact with the wastewater and shall be integral to the pump core assembly in a single, readily-exchanged unit. Depressing the push to run button must operate the pump even with the level sensor housing removed from the pump.
- C. All fasteners throughout the assembly shall be 300 Series stainless steel. High-level sensing will be accomplished in the manner detailed above by a separate air column sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and high-level alarm functions shall

not be controlled by the same switch. Float switches of any kind, including float trees, will not be accepted due to the periodic need to maintain (rinsing, cleaning) such devices and their tendency to malfunction because of incorrect wiring, tangling, grease buildup, and mechanical cord fatigue. To assure reliable operation of the pressure switches, each core shall be equipped with a factory installed equalizer diaphragm that compensates for any atmospheric pressure or temperature changes. Tube or piping runs outside of the station tank or into tank-mounted junction boxes providing pressure switch equalization will not be permitted due to their susceptibility to condensation, kinking, pinching, and insect infestation. The grinder pump will be furnished with a 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a FACTORY INSTALLED NEMA 6P EQD half attached to it.

## 2.12 Alarm Panel

- A. Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic polyester to ensure corrosion resistance. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel. The enclosure shall not exceed 10.5" W x 14" H x 7" D, or 12.5" W x 16" H x 7.5" D if certain options are included.
- B. The alarm panel shall contain one 15-amp, double-pole circuit breaker for the pump core's power circuit and one 15-amp single-pole circuit breaker for the alarm circuit. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the alarm panel are to be protected with a conformal coating on both sides and the AC power circuit shall include an auto resetting fuse.
- C. The alarm panel shall include the following features: external audible and visual alarm; push-to-run switch; push-to-silence switch; redundant pump start; and high level alarm capability. The alarm sequence is to be as follows when the pump and alarm breakers are on:
  - 1. When liquid level in the sewage wet-well rises above the alarm level, audible and visual alarms are activated, the contacts on the alarm pressure switch activate, and the redundant pump starting system is energized.
  - 2. The audible alarm may be silenced by means of the externally mounted, push-to-silence button.
  - 3. Visual alarm remains illuminated until the sewage level in the wet-well drops below the "off" setting of the alarm pressure switch.
- D. The visual alarm lamp shall be inside a red, oblong lens at least 3.75" L x 2.38" W x 1.5" H. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain the NEMA 4X rating. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 93 dB @ 2 feet. The audible alarm shall



be capable of being deactivated by depressing a push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button).

- F. The entire alarm panel, as manufactured and including any of the following options shall be listed by Underwriters Laboratories, Inc.

#### 2.13 Duplex Stations (MOD T260 DUPLEX)

- A. Each grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic to ensure corrosion resistance. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel. The standard enclosure shall not exceed 12.5" W x 16" H x 7.5" D.
- B. The panel shall contain one 15-amp single pole circuit breaker for the alarm circuit and one 15-amp double pole circuit breaker per core for the power circuit. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the alarm panel are to be protected with a conformal coating on both sides and the AC power circuit shall include an auto resetting fuse.
- C. The visual alarm lamp shall be inside a red, oblong lens at least 3.75" L x 2.38" W x 1.5" H. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 93 dB @ 2 feet. The audible alarm shall be capable of being deactivated by depressing a push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button).
- D. The high-level alarm system shall operate as follows:
  - 1. The panel will go into alarm mode if either pump's alarm switch closes. During the initial alarm mode both pumps will run and the alarm light and buzzer will be delayed for a period of time based on user settings (default is 3-1/2 minutes). If the station is still in high-level alarm after the delay, the light and buzzer will be activated.
  - 2. The audible alarm may be silenced by means of the externally mounted push-to-silence button.
  - 3. The visual alarm remains illuminated until the sewage level in the wet well drops below the "off" setting of the alarm switch for both pumps.
- E. The entire alarm panel, as manufactured and including any of the following options shall be listed by Underwriters Laboratories, Inc.

#### 2.14 Serviceability

- A. The grinder pump core, including level sensor assembly, shall have two lifting hooks complete with lift-out harness connected to its top housing to facilitate easy core removal when necessary. The level sensor assembly must be easily removed from the pump assembly for service or replacement. All mechanical and electrical connections must provide easy disconnect capability for core unit removal and installation. Each EQD half must include a water-tight cover to protect the internal electrical pins while the EQD is unplugged. A pump push-to-run feature will be provided for field trouble shooting. The push-to-run feature must operate the pump even if the level sensor assembly has been removed from the pump assembly. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

#### 2.15 OSHA Confined Space:

- A. All maintenance tasks for the grinder pump station must be possible without entry into the grinder pump station (as per OSHA 1910.146 Permit-required confined spaces). *“Entry means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant’s body breaks the plane of an opening into the space.”*

#### 2.16 Safety

- A. The grinder pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump station shall be listed by Underwriters Laboratories, Inc., to be safe and appropriate for the intended use. UL listing of components of the station, or third-party testing to UL standard are not acceptable.
- B. The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the seal of NSF International. Third-party testing to NSF standard is not acceptable.

### 3. EXECUTION

#### 3.1 Factory Test

- A. **FACTORY TEST:** Each grinder pump shall be submerged and operated for 1.5 minutes (minimum). Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge assembly and each unit’s dedicated level controls and motor controls. All factory tests shall incorporate each of the above listed items. Actual appurtenances and controls which will be installed in the field shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps is not acceptable. Certified

test results shall be available upon request showing the operation of each grinder pump at two different points on its curve. Additional validation tests include: integral level control performance, continuity to ground and acoustic tests of the rotating components.

- B. The ENGINEER reserves the right to inspect such testing procedures with representatives of the OWNER, at the GRINDER PUMP MANUFACTURER'S facility.

### 3.2 Certified Service Program

- A. The grinder pump MANUFACTURER shall provide a program implemented by the MANUFACTURER'S personnel as described in this specification to certify the service company as an authorized serviced center. As evidence of this, the MANUFACTURER shall provide, when requested, sufficient evidence that they have maintained their own service department for a minimum of 30 years and currently employ a minimum of five employees specifically in the service department.
- B. As part of this program, the MANUFACTURER shall evaluate the service technicians as well as the service organization annually. The service company will be authorized by the MANUFACTURER to make independent warranty judgments. The areas covered by the program shall include, as a minimum:
  1. Pump Population Information — The service company will maintain a detailed database for the grinder pumps in the territory that tracks serial numbers by address.
  2. Inventory Management — The service company must maintain an appropriate level of inventory (pumps, tanks, panels, service parts, etc.) including regular inventory review and proper inventory labeling. Service technicians will also maintain appropriate parts inventory and spare core(s) on service vehicles.
  3. Service Personnel Certification — Service technicians will maintain their level-specific certification annually. The certifications are given in field troubleshooting, repair, and training.
  4. Service Documentation and Records — Start up sheets, service call records, and customer feedback will be recorded by the service company.
  5. Shop Organization — The service company will keep its service shop organized and pumps will be tagged with site information at all times. The shop will have all required equipment, a test tank, and cleaning tools necessary to service pumps properly.

### 3.3 Delivery

- A. All grinder pump units will be delivered to the job site 100 percent completely assembled, including testing, ready for installation. Field installation of the pump in



tanks under 96 inches is not allowed. Field installation of the level sensor into the tank is not allowed. Grinder pump stations will be individually mounted on wooden pallets.

### 3.4 Installation

- A. The CONTRACTOR shall be responsible for handling ground water to provide a firm, dry subgrade for the structure, and shall guard against flotation or other damage resulting from general water or flooding.
- C. The grinder pump stations shall not be set into the excavation until the installation procedures and excavation have been approved by the ENGINEER.
- D. Remove packing material. Users instructions MUST be given to the OWNER. Hardware supplied with the unit, if required, will be used at installation. The basin will be supplied with a standard 4" inlet grommet (4.50" OD) for connecting the incoming sewer line. Appropriate inlet piping must be used. The basin may not be dropped, rolled or laid on its side for any reason.
- D. Installation shall be accomplished so that 1" to 4" of accessway, below the bottom of the lid, extends above the finished grade line. The finished grade shall slope away from the unit. The diameter of the excavated hole must be large enough to allow for the concrete anchor.
- E. A 6" inch (minimum) layer of naturally rounded aggregate, clean and free flowing, with particle size of not less than 1/8" or more than 3/4" shall be used as bedding material under each unit.
- F. A concrete anti-flotation collar, as detailed on the drawings, and sized according to the Manufacturer's instructions, shall be required and shall be pre-cast to the grinder pump or poured in place. Each grinder pump station with its pre-cast anti-flotation collar shall have a minimum of three lifting eyes for loading and unloading purposes.
- G. If the concrete is poured in place, the unit shall be leveled, and filled with water, to the bottom of the inlet, to help prevent the unit from shifting while the concrete is being poured. The concrete must be manually vibrated to ensure there are no voids. If it is necessary to pour the concrete to a level higher than the inlet piping, an 8" sleeve is required over the inlet prior to the concrete being poured.
- H. The CONTRACTOR will provide and install a 4-foot piece of 4-inch SCH 40 PVC pipe with water tight cap, to stub-out the inlet for the property owners' installation contractor, as depicted on the contract drawings.
- I. The electrical enclosure shall be furnished, installed and wired to the grinder pump station by the CONTRACTOR. An alarm device is required on every installation, there shall be NO EXCEPTIONS. It will be the responsibility of the CONTRACTOR and the ENGINEER to coordinate with the individual property owner(s) to determine the optimum location for the alarm panel.

- J. The CONTRACTOR shall mount the alarm device in a conspicuous location, as per national and local codes. The alarm panel will be connected to the grinder pump station by a length of 6 conductor 12 gauge type TC cable as shown on the contract drawings. The power and alarm circuits must be on separate power circuits. The grinder pump stations will be provided with 32', 25' of useable, electrical supply cable to connect the station to the alarm panel. This cable shall be supplied with a FACTORY INSTALLED EQD half to connect to the mating EQD half on the core.

### 3.5 Backfill Requirements

- A. Proper backfill is essential to the long-term reliability of any underground structure. Several methods of backfill are available to produce favorable results with different native soil conditions. The most highly recommended method of backfilling is to surround the unit to grade using Class I or Class II backfill material as defined in ASTM 2321. Class 1A and Class 1B are recommended where frost heave is a concern; Class 1B is a better choice when the native soil is sand or if a high, fluctuating water table is expected. Class 1, angular crushed stone, offers an added benefit in that it doesn't need to be compacted.
- B. Class II, naturally rounded stone, may require more compactive effort, or tamping, to achieve the proper density. If the native soil condition consists of clean compactible soil, with less than 12% fines, free of ice, rocks, roots and organic material, it may be an acceptable backfill. Soil must be compacted in lifts not to exceed one foot to reach a final Proctor Density of between 85% and 90%. Heavy, non-compactible clays and silts are not suitable backfill for this or any underground structure such as inlet or discharge lines.
- C. If unsure of the consistency of the native soil, it is recommended that a geotechnical evaluation of the material is obtained before specifying backfill.
- D. Another option is the use of a flowable fill (i.e., low slump concrete). This is particularly attractive when installing grinder pump stations in augured holes where tight clearances make it difficult to assure proper backfilling and compaction with dry materials. Flowable fills should not be dropped more than four feet from the discharge to the bottom of the hole to avoid separation of the constituent materials.
- E. Backfill of clean, native earth, free of rocks, roots, and foreign objects, shall be thoroughly compacted in lifts not exceeding 12" to a final Proctor Density of not less than 85%. Improper backfilling may result in damaged accessways. The grinder pump station shall be installed at a minimum depth from grade to the top of the 1 1/4" discharge line, to assure maximum frost protection. The finish grade line shall be 1" to 4" below the bottom of the lid, and final grade shall slope away from the grinder pump station.
- F. All restoration will be the responsibility of the CONTRACTOR. Per unit costs for this item shall be included in the CONTRACTOR'S bid price for the individual grinder pump station. The properties shall be restored to their original condition in all respects, including, but not limited to, curb and sidewalk replacement, landscaping,

loaming and seeding, and restoration of the traveled ways, as directed by the ENGINEER.

### 3.6 Start-up and Field Testing

- A. The MANUFACTURER shall provide the services of qualified factory trained technician(s) who shall inspect the placement and wiring of each station, perform field tests as specified herein, and instruct the OWNER'S personnel in the operation and maintenance of the equipment before the stations are accepted by the OWNER.
- B. All equipment and materials necessary to perform testing shall be the responsibility of the INSTALLING CONTRACTOR. This includes, as a minimum, a portable generator and power cable (if temporary power is required), water in each basin (filled to a depth sufficient to verify the high level alarm is operating), and opening of all valves in the system. These steps shall be completed prior to the qualified factory trained technician(s) arrival on site.
- C. The services of a trained, factory-authorized technician shall be provided at a rate of 40 hours for every 100 grinder pump stations supplied.
- D. Upon completion of the installation, the authorized factory technician(s) will perform the following test on each station:
  - 1. Make certain the discharge shut-off valve in the station is fully open.
  - 2. Turn ON the alarm power circuit and verify the alarm is functioning properly.
  - 3. Turn ON the pump power circuit. Initiate the pump operation to verify automatic "on/off" controls are operative. The pump should immediately turn ON.
  - 4. Consult the Manufacturer's Service Manual for detailed start-up procedures.
- E. Upon completion of the start-up and testing, the MANUFACTURER shall submit to the ENGINEER the start-up authorization form describing the results of the tests performed for each grinder pump station. Final acceptance of the system will not occur until authorization forms have been received for each pump station installed and any installation deficiencies corrected.

## 4. OPERATION AND MAINTENANCE

### 4.1 Spare Core

- A. The MANUFACTURER will supply one spare grinder pump core for every 50 grinder pump stations installed or portion thereof, complete with all operational controls, level sensors, check valve, anti-siphon valve, pump/motor unit, and grinder.

- B. MANUALS: The MANUFACTURER shall supply four copies of Operation and Maintenance Manuals to the OWNER, and one copy of the same to the ENGINEER.

END OF SECTION

**SECTION 11810****STEP SYSTEM**

## 1. GENERAL

1.1 The contractor shall furnish, install, and place in satisfactory operation effluent pump system as specified herein.

## 1.2 Submittals

- A. After receipt of notice to proceed, the contractor shall furnish a minimum of six sets of shop drawings detailing the equipment to be furnished including dimensional data and materials of construction. The Owner shall promptly review this data, and return two copies as accepted, or with requested modifications. Upon receipt of accepted shop drawings, the manufacturer shall proceed immediately with fabrication of the equipment.

## 1.3 Manufacturer

- A. STEP effluent sewer systems, complete with all appurtenances, form an integral system, and as such, shall be supplied by one STEP system manufacturer. The Contractor shall be responsible for the satisfactory operation of the entire system. The equipment specified shall be a product of a company experienced in the design and manufacture of STEP systems for specific use in low pressure sewage systems. The company shall submit detailed installation and user instructions for its product, submit evidence of an established service program including complete parts and service manuals, and shall be responsible for maintaining a continuing inventory of pump replacement parts. The manufacturer shall provide, upon request, a reference and contact list from ten of its largest contiguous STEP installations of the type of STEP systems described within this specification.
- B. The manufacturer of the STEP effluent sewer systems shall be ORENCO Systems®, Inc.
- C. Attention is directed to the fact that the drawings and overall system design are based on a particular piece of equipment from a particular manufacturer. These specifications are intended to provide guidelines for standard equipment of a recognized manufacturer who already meets all the requirements of this specification.

## 1.4 Warranty

- A. The grinder pump manufacturer shall provide a part(s) and labor warranty on the complete station and accessories, including, but not limited to, the panel for a period of 60 months after notice of Owner's acceptance. Any manufacturing defects found during the warranty period will be reported to the manufacturer by the Owner and will be corrected by the manufacturer at no cost to the Owner.

1.5 The manufacturer shall provide the structural design and certification to the engineer for review. The design shall be in accordance with accepted engineering practice. Precast

concrete or fiberglass tanks shall have been designed by a registered engineer and approved by state or local regulatory agencies or authorities. To achieve effective performance and minimize pump-out occurrences, residential interceptor tanks shall have a nominal liquid capacity of 1000 gallons for up to 2 bedrooms, 1500 gallons for 3 bedrooms, 2000 gallons for 4 bedrooms, and, for more than 4 bedrooms, the sizing shall be determined based on an occupancy assessment and shall be in accord with Figure 1.

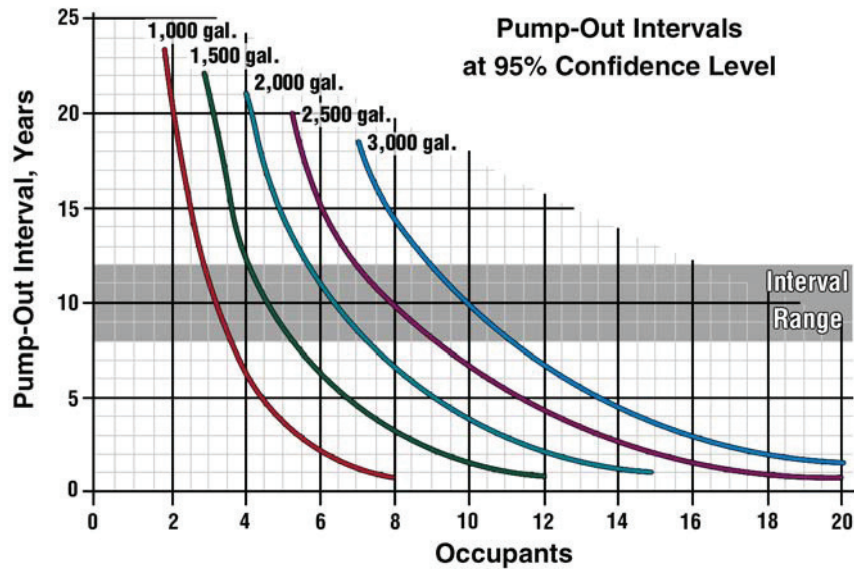


Figure 1. Interceptor Tank Pump-Out Intervals

Average flow ( $Q_a$ ) is based upon typical weekly discharges. Wastewater flows for single-family dwellings typically range from 40 to 60 gallons per capita per day (gpcd); 50 gpcd is a commonly used design parameter and is the value used in calculations herein. The number of individuals (capita) is assumed to average three per dwelling. Typical occupancies and flow relationships are shown in Table 1.

**Table 1: Relationship between Number of Bedrooms, Occupancies, and Flow**

| Bedrooms | $Q_p^a$<br>gpd/DU | Occupants <sup>b</sup><br>capita | $Q_c$<br>gpcd | $Q_a$<br>gpd/DU |
|----------|-------------------|----------------------------------|---------------|-----------------|
| 1        | 200               | 2                                | 55            | 110             |
| 2        | 300               | 3                                | 50            | 150             |
| 3        | 375               | 4                                | 50            | 200             |
| 4        | 450               | 5                                | 45            | 225             |

a. Peak day bedroom flows ( $Q_p$ ) are based on typical administrative rules.

b. Occupancy is based on typical usage of two occupants for the first bedroom and one occupant per additional bedroom.

## A. Loading Criteria:

- There shall be 140 lbs./cu.ft. for minimum weight of saturated backfill, or 127 lbs./cu.ft. for unsaturated backfill (500 lbs./sq.ft.minimum).
- Minimum lateral loading shall be 62.4 lbs./cu.ft. Lateral loading shall be determined from ground surface.
- The tank shall also support a concentrated wheel load of 2500 lbs.

There are four (4) typical loading conditions that should be analyzed:

1. 4 ft. Bury + Full Exterior Hydrostatic Load
2. 4 ft. Bury + Full Exterior Hydrostatic Load + 2500 lb. Wheel Load.
3. 1 ft. Bury + 2500 lb. Wheel Load.
4. Tank Full, Interior Hydrostatic Load and Unsupported by Soil.

*Load Case 4 represents the tank full of liquid at 62.4 lbs/cu.ft. This condition addresses seam and haunch stress-strain relationships that occur during watertightness testing, as well as poor soil bedding conditions that provide inadequate support.*

- B. Tanks requiring deep burial (>48") or subject to truck or heavy traffic loading require special consideration. (A minimum soil cover of 12" shall be used, unless specified otherwise by manufacturer.)
- C. *All tanks shall be structurally sound and watertight* and shall be guaranteed in writing by the tank manufacturer for a period of two years from the date of final acceptance. Manufacturer's signed guarantee shall accompany bids. The tank guarantee/warranty shall be furnished at the time of submittal. Tank warranty shall not be limited liability to replacement cost of the tanks. The septic tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.
- D. Tanks shall be manufactured and furnished with access openings 20" in diameter and of the configuration shown on the manufacturer's drawings. Modification of completed tanks will not be permitted.
- E. Inlet plumbing shall include an inlet tee that penetrates 18" into the liquid from the inlet flow line. (The depth may vary depending on the tank's height; in all cases, though, the inlet should extend to a level below the bottom of the maximum scum depth.) The inlet plumbing shall allow for natural ventilation back through the building sewer and vent stack.



- F. Tanks shall be capable of successfully withstanding an aboveground static hydraulic test and shall be individually tested.
- G. All tanks shall be installed in strict accordance with the manufacturer's recommended installation instructions.

#### 1.5 Concrete Tanks:

- A. Walls, bottom and top of reinforced concrete tanks shall be designed across the shortest dimension using one-way slab analysis. Stresses in each face of monolithically constructed tanks may be determined by analyzing the tank cross-section as a continuous fixed frame.
- B. The walls and bottom slab shall be poured monolithically; alternatively, water stops may be provided.
- C. Reinforcing steel shall be ASTM A-615 Grade 60,  $f_y = 60,000$  psi. Details and placement shall be in accordance with ACI 315 and ACI 318.
- D. Concrete shall be ready-mix with cement conforming to ASTM C150, Type II. It shall have a cement content of not less than six (6) sacks per cubic yard and maximum aggregate size of 3/4". Water/cement ratio shall be kept low ( $0.35 \pm$ ), and concrete shall achieve a minimum compressive strength of 4000 psi in 28 days. The Contractor shall submit a concrete mix design to the Engineer for review and approval. Three (3) concrete sample cylinders shall be taken and tested for each tank manufactured until the manufacturer and Engineer are satisfied that the minimum compression strength is being obtained. To ensure compliance, the manufacturer shall then make and set three (3) sample cylinders for a minimum of 20% of the remaining tanks at the discretion of the Engineer. If the minimum compressive strength is not being obtained, the manufacturer shall be required to make and test sample cylinders for each tank manufactured. Calcium chloride will not be allowed in the mix design. The cost of testing cylinders shall be the tank manufacturer's responsibility. The tank manufacturer may supply a Swiss hammer for compressive testing in the field in lieu of sample cylinders.
- E. Tanks may be protected by applying a heavy cement-base waterproof coating (Thoroseal<sup>®</sup> or approved equal), on both inside and outside surfaces, in compliance with Council of American Building Officials (CABO) report #NRB-168; 6181; however, the tank should be watertight without the addition of seal coatings.
- F. Form release used on tank molds shall be Nox Crete<sup>™</sup> or approved equal. Diesel or other petroleum products are not acceptable.
- G. Tanks shall not be moved from the manufacturing site to the job site until the tank has cured for seven (7) days or has reached two-thirds of the design strength.
- H. Tanks shall be manufactured and furnished with access openings of the size and configuration to accommodate individual packaged pump systems. For 24" diameter access risers, the tank manufacturer shall cast in place a flanged tank adapter to facilitate the bonding of a 24" diameter access riser. The flanged tank adapter shall



be made of 1/4" thick ABS and shall have an outside diameter of 27" and an inside diameter of 22-3/4". The flanged adapter shall be Orenco Systems®, Inc. Model PRTA24 or engineer-approved equal. The adapter must have an overall height of no less than 3" to allow 1-1/2" exposed for sufficient bonding area once the adapter is installed in the tank. For 21" and 30" diameter access risers, either a grooved tank adapter plate (Model RRFTA or RRFTA30) or a flanged tank adapter (Model PRTA30) may be installed in the tank. The adapter shall be manufactured of fiberglass or ABS and shall accommodate either a 21" or 30" diameter access riser.

- I. The septic tank and the top slab shall be sealed with a preformed flexible plastic gasket. The flexible plastic gasket shall be equal to the flexible butyl resin sealant congeal CS-102 or CS-202 as manufactured by Concrete Sealants, Inc. of New Carlisle, Ohio, and shall conform to federal specification SS-S-00210(2iOA) and AASHTO M-198. A mechanical fastening method shall be used if the seasonal groundwater level may reach the top slab seam of the tank.
- J. In order to demonstrate watertightness, tanks shall be tested at the factory and again on-site prior to acceptance. Inlets to the septic tank will be watertight pipe seal Cast-A-Seal™ (Manufactured by Press-Seal Gasket Corporation) or approved equal. Each tank shall be tested at the factory, prior to shipping, by filling with water to the soffit and letting stand. After 24 hours, the tank shall be refilled to the soffit and the exfiltration rate shall be determined by measuring the water loss during the next two (2) hours. Any leakage shall be cause for rejection. After installation is completed and before backfilling, each tank shall be filled with water to a point 2" above the top of the tank and the water loss measured after a twenty four-hour period. After it has been determined that there is no leakage, test the access riser seam. Backfill to a minimum depth of 2" above the riser seam to prevent damage from hydrostatic uplift. Fill the tank to a point 2" above the riser seam (the field test period may be reduced to not less than two (2) hours). No tank will be accepted if there is any leakage over the two (2) hour period.

## 1.6 Fiberglass Tanks:

### A. Method of Calculations:

1. Fiberglass tanks shall be analyzed using finite element analysis for buried structures.
2. Calculations shall address the following:
  - strength
  - buckling
  - deflection of 5% of the tank diameter, based on service load (including long-term deflection lag)
  - buoyancy

Performance testing

### Material Properties and Laminates

The laminates considered in this analysis shall be fiberglass reinforced polyester resin, using grades of resin and fiberglass considered acceptable for use with septic tank construction. The thicknesses for different regions of the tanks shall be described and shown in shop drawings for each individual tank.

Typical primary strength properties are listed below:

|                                     |           |
|-------------------------------------|-----------|
| Tensile Modulus (psi)               | 1,000,000 |
| Ultimate Tensile strength (psi)     | 10,000    |
| Ultimate Compressive strength (psi) | 21,000    |
| Ultimate Flexural strength (psi)    | 18,000    |
| Ultimate Shear In-Plane (psi)       | 7,000     |

- B. In lieu of calculations for fiberglass tanks, the supplier may elect in-situ performance testing.
- C. In-situ testing of each tank model shall include use of strain gauge and deflection gauge. The tank will be subjected to external forces equal to twice the actual load.
- D. Maximum initial deflection based on test loading shall not exceed 3% of the tank diameter.
- E. Performance testing will be evaluated by a Registered Professional Engineer (P.E.). The Engineer will have the sole responsibility to determine the maximum external loading on any of the tank models.
- F. The tank shall be constructed with a glass fiber and resin content specified by the manufacturer and with no exposed glass fibers. Any permanent metal part shall be 300 series stainless steel.
- G. Inspections may be made by the engineer in the supplier's yard, within the plant, upon delivery and again after installation. The minimum wall thickness shall be 3/16". If the wall thickness is suspected to be less than 3/16" or if delamination is suspected within any portion of the tank, the engineer may drill a 1/4" diameter hole through the tank wall for inspection purposes. If the required minimum 3/16" thickness is not found, repair if feasible shall be the responsibility of the contractor. If repair is judged not feasible, the tank shall be rejected. If twenty percent (20%) or more of the tanks are rejected for any of the aforementioned reasons, each tank under this bid will become suspect of substandard quality and subject to rejection by the engineer. If the required minimum 3/16" thickness is found and no delamination is present, the repair of the inspection holes shall be the responsibility of the engineer.
- H. The engineer shall specify the minimum weight of each tank model that will be allowed. The manufacturer will permanently mark the weight of each tank on the top near the access hole.

- I. The minimum tank weight shall be specified by the manufacturer's engineer (e.g., 330 lbs for 1000-gallon tanks, 450 lbs for 1500-gallon tanks; add 30 lbs for internal baffle).
  - J. Holes specified for the tank shall be provided by the manufacturer. Resin or other appropriate sealant shall be properly applied to all cut or ground edges so that no glass fibers are exposed and all voids are filled.
  - K. Orenco Systems<sup>®</sup>, Inc. EPDM gaskets, or approved equal, shall be used at the inlet to join the tank wall and the inlet piping. ABS or Schedule 40 PVC pipe and fittings shall be used at the inlets.
  - L. Inlet plumbing shall include an inlet tee that penetrates 18" into the liquid from the inlet flow line. (The depth may vary depending on the tank's height; in all cases, though, the inlet should extend to a level below the bottom of the maximum scum depth). The inlet plumbing shall allow for natural ventilation back through the building sewer and vent stack.
  - M. In order to demonstrate watertightness, tanks shall be tested at the factory and again on-site prior to acceptance. Each tank shall be tested at the factory, prior to shipping, by filling with water to the soffit and letting stand for a minimum of two (2) hours. Any leakage shall be cause for rejection. After installation is completed and before backfilling, completely fill the tank with water, to a level two (2) inches into the riser. Wait a minimum of two (2) hours (or as required by local rules) and inspect the tank for leaks. There should be no drop in liquid level and no visual leakage from seams, pinholes, or other imperfections. Once the tank is proven to be watertight, drop the water level in the tank below the invert – but not below the mid-seam.
  - N. Each tank shall be marked in the uppermost surface above or near the outlet and include a permit or identification number, weight of tank, type of tank, and date of manufacture.
  - O. Installation shall be in accordance with the manufacturer's recommendations, or as shown on the Contract Plans, whichever is more stringent—no variations.
2. RISERS & LIDS:
- 2.1 Risers:
- Risers shall be required for access to internal vaults and access into the septic tanks for septage pumping. All risers shall be constructed watertight. The risers shall be attached to the tanks such that a watertight seal is provided. Risers shall extend 3" above original grade to allow for settlement and to ensure positive drainage away from the access. Risers for inspection ports shall be a minimum of 18" in nominal diameter. Risers containing pumping assemblies or electrical splice boxes shall be a minimum of 24" in diameter and shall be of sufficient diameter to allow removal of internal vaults without removing splice boxes, etc. Risers shall be a minimum of 30" in nominal diameter when the depth of bury is 36" or greater or duplex pumping assemblies are used. All other risers shall be a minimum of 24" in nominal diameter and shall vary in height depending on the depth of bury on the various tanks. Adhesive required to adhere the PVC or fiberglass risers to either fiberglass or ABS tank adapter shall be a two-part adhesive, Model MA320, SS620, SS630 or approved equal,

or a single component adhesive Model ADH100 or approved equal. If backfilling the same day is desired, a combination of Model MA320 and Model ADH100 adhesives or approved equals should be used. To ensure product compatibility, a single manufacturer shall supply risers, lids, and attachment components.

## 2.2 Inlet Risers:

Inlet risers (required only on two-compartment tanks and tanks with greater than 1500-gallon capacity) shall be Orenco Systems<sup>®</sup>, Inc. Model Perma-Loc, Ultra-Rib, KOR FLO or engineer-approved equal. The material shall be PVC as per ASTM D-1784 and tested in accordance with AASHTO M304M-89. The risers shall be constructed of non-corrosive material and designed to be buried in soil. Risers shall have a minimum stiffness of 10 psi, when tested according to ASTM D2412. Risers shall be capable of withstanding a truck wheel load (54 square inches) of 2500 pounds for 60 minutes with a maximum vertical deflection of a 1/2 an inch. Risers shall extend to 3 inches above the ground surface to allow for settlement and shall have a minimum nominal diameter of 18 inches.

## 2.3 Outlet Risers:

Outlet risers shall be Orenco Systems<sup>®</sup>, Inc. Model Perma-Loc, Ultra-Rib, KOR FLO or engineer-approved equal. The material shall be PVC as per ASTM D-1784 and tested in accordance with AASHTO M304M-89. The risers shall be constructed of non-corrosive material and designed to be buried in soil. Risers shall have a minimum stiffness of 10 psi, when tested according to ASTM D2412. Risers shall be capable of withstanding a truck wheel load (54 square inches) of 2500 pounds for 60 minutes with a maximum vertical deflection of 1/2 an inch. Risers shall be at least 12 inches high, shall have a minimum nominal diameter of 24 inches for simplex pumping applications or 30 inches when used in a duplex pumping application and shall be factory-equipped with the following:

- A. Electrical and Discharge Grommets: when applicable, Orenco Systems<sup>®</sup>, Inc. EPDM grommets shall be installed by the manufacturer for discharge piping, vent piping, and/or the electrical conduit to assure a watertight seal. The manufacturer of the access risers shall install the grommets at the factory.
- B. Adhesive: When bonding to concrete or fiberglass grooves, a two-part adhesive, one pint required per 18" or 24" diameter riser and one quart required per 30" diameter riser, Model ADHP10 or ADHQ10, or approved equal shall be used. When bonding to a flanged riser tank adapter, either a two-part adhesive, Model MA320 or approved equal, or a single component adhesive Model ADH100 or approved equal shall be used.

## 2.4 Riser-To-Tank Attachment:

Risers shall be attached to tanks with one of the following attachment systems, or approved equal: (1) Orenco Systems<sup>®</sup>, Inc. Model RUBDKIT attachment kit; (2) Orenco Systems, Inc. Model PRTA24 tank adapter used with Model PRTA24BDKIT bolt down kit, and Model ADH100 and/or MA320 adhesives; (3) Orenco Systems, Inc. Model RRFTA tank adapter used with Model RRFTABDKIT bolt down kit and Model ADHP10 adhesive; (4) Orenco Systems, Inc. Model PRTA30 tank adapter used with Model PRTA30BDKIT bolt down kit and Model ADH100 and/or MA320 adhesives. All attachment components shall be constructed of waterproof, non-corrosive materials, such as PVC, ABS, fiberglass, or stainless steel. Adhesives and sealants shall be waterproof, corrosion resistant and approved for the intended application. The riser-to-tank connection shall be watertight and structurally sound.

The riser-to-tank connection shall be capable of withstanding a vertical uplift of 5000 pounds to prevent riser separation due to tank settlement, frost heave, or accidental vehicle traffic over the tank.

## 2.5 Lids:

One lid shall be furnished with each access riser. Lids shall be Orenco Systems<sup>®</sup>, Inc. Model FL18G-4BU, FL21G, FL24-4B, FL24G-4BU, or FL30G or engineer-approved equal, as appropriate, fiberglass with green non-skid finish, and provided with stainless steel bolts, and wrench. Manufacturer shall provide evidence that lids have been used successfully in continuous field service for a minimum of five years to demonstrate long-term integrity and suitability for the application. Lids shall be waterproof, corrosion resistant and UV resistant. Lids shall be flat, with no noticeable upward dome. A crown or dome of no more than 1/8" is allowable. Lids shall not allow water to pond on them. Lids shall have a green non-skid finish. Self-lubricating plastics, such as polyethylene, shall not be considered non-skid without addition of a non-skid coating. Lids shall form a watertight seal with the top of riser. Lids shall be capable of withstanding a truck wheel load (54 square inches) of 2500 pounds for 60 minutes with a maximum vertical deflection of 3/4 of an inch. Lids shall be provided with tamper-resistant stainless steel fasteners and a tool for fastener removal. Tamper-resistant fasteners include recessed drives, such as hex, Torx, and square. Fasteners that can be removed with common screwdrivers, such as slotted and Phillips, or fasteners that can be removed with standard tools, such as pliers or crescent wrenches, are not considered tamper-resistant. To prevent a tripping hazard, fasteners shall not extend above the surface of the lid.

### Optional Components

- A. Traffic bearing lid: The traffic bearing lid shall be a cast iron frame and cover, part number 6024, 3060, 4036, as manufactured by Sather Manufacturing Co., Inc., or approved equal, which will fit over a standard lid. The cover shall have the word SEWER cast into it.
- B. Rigid closed-cell foam insulation of 2-inch or 4-inch thickness shall be attached to the underside of the lid. Any fasteners shall be made of corrosion resistant stainless steel. The insulation shall have an R-value of no less than 10 per 2-inch increment.

## 2.6 Riser Installation:

Riser installation shall be accomplished according to the manufacturer's instructions.

## 3. SEPTIC TANK EFFLUENT GRAVITY ASSEMBLIES:

All filter systems shall be supplied by a reputable manufacturer with at least five years of experience in supplying equipment for effluent sewers. Effluent filters shall prevent particles larger than 1/8-inch in diameter from leaving the tank. Effluent filters shall have a solid bottom or deflecting device that prevents vertically rising solids from reaching the filtering surface area during ebullition (sludge bulking).

### 3.1 Single Family Residence Effluent Filters:

Gravity system tanks for single-family dwellings of less than four bedrooms shall be equipped with an Orenco Systems<sup>®</sup>, Inc. Biotube<sup>®</sup> Effluent Filter (FT04 Model Series) or engineer-approved equal, installed in conformance with the engineer's plans. Filter shall

consist of a 4" diameter PVC vault with eight (8) 1-1/8" diameter holes evenly spaced around the perimeter, located appropriately to allow for maximum sludge and scum accumulation before requiring pumping (approximately 70% of minimum liquid level). The Biotube cartridge shall be made with 1/8" mesh polypropylene and with a solid base (to prevent solids from entering through the bottom during ebullition). The Biotube cartridge shall be housed inside the PVC vault. The filter shall have an effective filter area of no less than 5.3 square feet. The lateral from the tank to the collection line shall be laid to a uniform grade with no high points. Optional flow-modulating orifice containing two (2) 1/2" diameter flow-modulating orifices and one (1) 1/2" diameter vent hole are available.

Alternate: 8" Effluent Filter

For single-family dwellings of four bedrooms or larger, the tanks shall be a minimum of 1,500 gallons and equipped with an Orenco Systems®, Inc. Biotube® Effluent Filter (FT08 Model Series) or engineer-approved equal, installed in conformance with the engineer's plans. Filter shall consist of an 8" diameter PVC vault with eight (8) 1-3/8" diameter holes evenly spaced around the perimeter, located appropriately to allow for maximum sludge and scum accumulation before requiring pumping (approximately 70% of minimum liquid level). The Biotube cartridge shall be made with 1/8" mesh polypropylene and with a solid base (to prevent solids from entering through the bottom during ebullition). The Biotube cartridge shall be housed inside the PVC vault. The filter shall have an effective filter area of no less than 14.6 square feet. The direct-coupled outlet for the 8" filter shall contain two (2) 1-1/8" diameter flow-modulating orifices and one (1) 3/4" diameter vent hole. The lateral from the tank to the collection line shall be laid to a uniform grade with no high points.

3.2 Commercial and Multiple-user Tanks:

Commercial and multiple-user tanks require larger Effluent Filters, the sizes of which must be individually determined and spelled out in the specifications. Commercial applications should be sized according to the Orenco Systems®, Inc. document titled "Biotube® Effluent Filter Sizing."

Alternate: 8" Effluent Filter

Orenco Systems®, Inc. Model FT08, series Biotube® effluent filter or engineered-approved equal. Filters shall consist of an 8" diameter PVC vault with eight 1-3/8-inch holes evenly spaced around the perimeter, located appropriately to allow for maximum sludge and scum accumulation before requiring pumping (approximately 70% of minimum liquid level). The Biotube cartridge shall be made with 1/8-inch mesh polypropylene and with a solid base (to prevent solids from entering through the bottom during ebullition). The Biotube cartridge shall be housed inside the PVC vault. The filter shall have an effective filter area of no less than 14.6 square feet.

Alternate: 12" Effluent Filter

Orenco Systems®, Inc. Model FT12 series Biotube® effluent filter or engineered-approved equal. Filters shall consist of a 12" diameter PVC vault with eight 1-3/8-inch holes evenly spaced around the perimeter, located appropriately to allow for maximum sludge and scum accumulation before requiring pumping (approximately 70% of minimum liquid level). The Biotube cartridge shall be made with 1/8-inch mesh polypropylene and with a solid base (to prevent solids from entering through the bottom during ebullition). The Biotube cartridge shall be housed inside the PVC vault. The filter shall have an effective filter area of no less



then 30.0 square feet. Optional 4" PVC slide rail for easy removal of vault housing is available.

Alternate: 15" Effluent Filter

Orenco Systems®, Inc. Model FT15 series Biotube® effluent filter or engineered-approved equal. Filter shall consist of a 15" diameter PVC vault with eight 1-3/8-inch holes evenly spaced around the perimeter, located appropriately to allow for maximum sludge and scum accumulation before requiring pumping (approximately 70% of minimum liquid level). The Biotube cartridge shall be made with 1/8-inch mesh polypropylene and with a solid base (to prevent solids from entering through the bottom during ebullition). The Biotube cartridge shall be housed inside the PVC vault. The filter shall have an effective filter area of no less than 50.5 square feet. Optional 4" PVC slide rail for easy removal of vault housing is available.

4. SEPTIC TANK EFFLUENT PUMPING ASSEMBLIES:

Single Family Residences

All pumping systems shall be supplied by a reputable manufacturer with at least five years of experience in supplying equipment for effluent sewers. References must be available on request from the engineer. Systems shall be Orenco Systems®, Inc. High-Head Pumping Assemblies or engineer-approved equal, composed of:

4.1 Risers & Lids:

Refer to section B, 1 through 6.

4.2 Pump Vault:

Orenco Systems®, Inc. Model PVU Series, Universal Biotube® Pump Vault or engineer-approved equal, installed in conformance with the engineer's plans. The filter shall have a minimum effective screen area of no less than 15.5 square feet. The Biotube pump vault shall consist of a 12-inch diameter polyethylene vault with eight (8) 2-inch diameter holes evenly spaced around the perimeter, located appropriately to allow for maximum sludge and scum accumulation before requiring pumping (approximately 70% of minimum liquid level). Housed inside the polyethylene vault shall be the Biotube assembly consisting of 1/8-inch mesh polypropylene tubes. Attached to the vault is a flow inducer to accept one or two high-head effluent pumps.

4.3 Discharge Hose and Valve Assembly:

For most single-family residences, Orenco Systems®, Inc. Model HV100BCFC or engineered-approved equal. Discharge assembly shall be 1-inch diameter and include 150 psi PVC ball valve, 150 psi PVC check valve, PVC flex hose with working pressure rating of 100 psi, and Schedule 40 PVC pipe.

Optional Components

- A. Anti-siphon valve: When pumping downhill discharge assembly shall include Orenco Systems®, Inc. Model HVAS100 series or engineer-approved equal, 1", 150 psi Schedule 40 PVC anti-siphon valve.

- B. Drain-back: For cold weather climates, drain-back style discharge assembly shall be used which includes an 1/8" drain back orifice above the check valve.
- C. Cold weather kit: For cold weather climates and deep bury tanks, Orenco Systems®, Inc. Model HVCW100-KIT series or engineer-approved equal. It shall include a Schedule 40 PVC elbow with a 1/8" drain back orifice, Schedule 80 nipple, and male adapter.
- D. Quick Disconnect: Shall include 1" cam coupler and adapter for quick disconnect.
- E. High-pressure flex hose: Orenco Systems®, Inc. Model HV100PR series or engineer-approved equal. Shall be constructed of a special elastomer compound with a working pressure of 250psi.

#### 4.4 Float Switch Assembly:

Orenco Systems®, Inc. Model MFABT with three switch floats mounted on a PVC stem attached to the filter cartridge. The floats must be adjustable and must be removable without removing the pump vault. The high- and low-level alarms and on/off function shall be preset as shown in the engineer's plans. Each float lead shall be secured with a nylon strain relief bushing at the splice box. The floats shall be UL or CSA listed and shall be rated for a minimum of 5.0A @ 120 VAC.

Alternate: VeriComm® Remote Telemetry Float Control System

Orenco Systems®, Inc. Model MF3A with three switch floats mounted on a PVC stem attached to the filter cartridge. The floats must be adjustable and must be removable without removing the pump vault. The high/pump on, pump off and low-level alarms shall be preset as shown in the engineer's plans. Each float lead shall be secured with a nylon strain relief bushing at the splice box. The floats shall be UL or CSA listed.

Alternate: VeriComm® Remote Telemetry Float Control System

Orenco Systems®, Inc. Model MF3V with three mechanical switch floats mounted on a PVC stem attached to the filter cartridge. The floats must be adjustable and must be removable without removing the pump vault. The high/pump on, pump off and low-level alarms shall be preset as shown in the engineer's plans. Each float lead shall be secured with a nylon strain relief bushing at the splice box. The floats shall be UL or CSA listed.

#### 4.5 High-Head Effluent Pump:

Must be approved for use in pump vault as described in D2. For most single family home applications, an Orenco Systems®, Inc. Model PF100511, 1/2 hp, 115 VAC, single phase, 60 Hz, two-wire motor, with 10 foot long extra heavy duty (SO) electrical cord with ground. Pump shall be capable of providing a flow rate of 5 gpm against a head of 200 feet, or 10 gpm against a head of 120 feet. When used in conjunction with a flow controller, the pump shall be capable of providing 5 gpm against a head of 190 feet. Pump shall be UL and CSA listed as an effluent pump. Pump shall be provided with a non-prorated five-year warranty. Larger horsepower units are available (3/4 to 1-1/2 hp, 230 VAC).

#### 4.6 Electrical Splice Box:



Orenco Systems®, Inc. Model SBEX series external splice box or engineer-approved equal, UL approved for wet locations, equipped with up to four (4) electrical cord grips and two 3/4-inch outlet fitting. Also included shall be UL listed waterproof butt splice connectors.

Alternate: Internal PVC Splice Box

Orenco Systems®, Inc., Model SB series internal splice box or engineer-approved equal, UL approved for wet locations, equipped with up to six (6) electrical cord grips and a 1-inch outlet fitting. Also included shall be UL listed waterproof wire nuts. The use of a UL-approved conduit seal kit shall be required to prevent the passage of gases, vapors, or flames through the conduit.

#### 4.7 Controls and Alarms:

Controls and alarms shall be listed per UL 508. Panels shall be repairable in the field without the use of soldering irons or substantial disassembly. For most single family home applications, an Orenco Systems®, Inc. Model S1 Series or engineered-approved equal control panel meeting the following:

Standard Components:

- A. Motor-Start Contactor: 120 VAC, 1hp, 16 FLA, 60 Hz; 2.5 million cycles at FLA (10 million at 50% of FLA).
- B. Toggle Switch: Single-pole, double-throw HOA switch. 20 amps, 1 hp.
- C. Controls Circuit Breaker: 10 amps, OFF/ON switch. Single-pole 120 VAC. DIN rail mounting with thermal magnetic tripping characteristics.
- D. Pump Circuit Breaker: 20 amps, OFF/ON switch. Single-pole 120 VAC. DIN rail mounting with thermal magnetic tripping characteristics.
- E. Audio Alarm: 95 dB at 24", warble-tone sound.
- F. Visual Alarm: 7/8" diameter red lens, "Push-to-silence." NEMA 4, 1-watt bulb, 120 VAC
- G. Panel Enclosure: Measures 11.5" high x 9.3" wide x 5.4" deep. NEMA 4X rated. Constructed of UV-resistant fiberglass; hinges and latch are stainless steel.
- H. S1 Panel Ratings: 120 VAC, 1 hp, 14 amps, single phase, 60 Hz.

Optional Components:

- I. Redundant Off Relay: 120 VAC, provides a secondary off. Sounds alarm on low-level condition. DIN rail mount.
- J. Pump Run Light: 7/8" green lens. NEMA 4, 1-watt bulb, 120 VAC.
- K. Heater: Anti-condensation heater. Self-adjusting: radiates additional wattage as temperature drops.

- L. Event Counter: 120 VAC, 6-digit, non-resettable.
- M. Elapsed Time Meter: 120 VAC, 7-digit, non-resettable. Limit of 99,999 hours; accurate to 0.01 hours.

Alternate: VeriComm<sup>®</sup> Remote Telemetry Control System

Orenco Systems<sup>®</sup>, Inc. Model VCOM-S1RO Series or engineered-approved equal control panel. The system will be monitored via remote telemetry, UL-recognized and FCC-approved for the application, and shall contain the following operating modes:

- A "Start-up Mode" during which the system will collect trend data for establishing future operating standards,
- A "Normal Mode" that manages day-to-day functions of the system,
- A "Test Mode" that suspends data collection and communications with the central server so that operators can install and service the system without affecting the panel's trend data and web-based communication.

In addition, the control system shall be capable of the following functions:

- Data Collection and Utilization: Logs data of system conditions and events, such as pump run time, pump cycles, alarm conditions, and alert conditions.
- Troubleshooting and Diagnostic Logic: Programmed to identify and report suspected failed components (Alarms) and negative trends in operating data (Alerts).
- Advanced Control Logic: Advanced control logic will activate in the event of component malfunction to diagnose the system using pre-established trend data and, if necessary, modify the operation of the system until the system can be serviced.
- Communications and Alarm Management: The control and monitoring system shall operate such that the telemetry control unit will communicate with a web-based monitoring application for reporting and alarm management. The system shall provide for a minimum of three levels of password-protected security access and control to ensure only qualified personnel can access and communicate with the panel. The communication protocol shall allow the operator to communicate with the telemetry unit using any modem (Mac or PC) and a web browser, or a simple communication program (e.g. HyperTerminal or Z-Term). Telemetry units requiring proprietary software shall not be considered.

The telemetry unit will provide automatic notification or call-in to the host in the event of:

- Alarms, which signal fault conditions that need to be addressed immediately (e.g. high or low liquid levels, pump failure, failed contactor, etc.);
- Alerts, which signal less critical conditions that require attention, but which will engage the panel's troubleshooting and diagnostic logic and alternative operating modes (e.g. stuck float switch, leaking tank, brownout, high flows, etc.);
- Updates, which include follow-up reminders or all-clear notifications following Alarms/Alerts, as well as scheduled panel reports;
- Manual forced communication, from panel to host to effect an update of queued programming changes.

In addition, the unit shall have the capability of real-time direct connection to the panel via laptop serial port, to allow the operator real-time access to detailed logged data and the ability to change point values.

Standard Components:

- A. Motor-Start Contactor: 120 VAC, 1hp, 16 FLA, 60 Hz; 2.5 million cycles at FLA (10 million at 50% of FLA).
- B. Remote Telemetry Unit: ATRTU-100; 36/18 VAC (center tap transformer), 8 digital inputs, 4 analog inputs, 4 digital outputs, 0 analog outputs, on-board modem (2400 baud), LED input and output indicators, 1-year battery backup of data and program settings.
- C. Phone line Surge Arrestor/DSL Filter: Surge protection for phone line. DSL filter for lines that also carry DSL service. Connection to panel via RJ11 jack or terminal block.
- D. Controls Circuit Breaker: 10 amps, OFF/ON switch. Single-pole 120 VAC. DIN rail mounting with thermal magnetic tripping characteristics.
- E. Pump Circuit Breaker: 20 amps, OFF/ON switch. Single-pole 120 VAC. DIN rail mounting with thermal magnetic tripping characteristics.
- F. Fuse: 120 VAC Primary, 36 VCT @ 0.85 A Secondary
- G. Transformer: 250VAC, 1A
- H. Audio Alarm: 95 dB at 24", warble-tone sound.
- I. Toggle Switch: Single-pole switch, automatic On, with spring-loaded, momentary, manual On. 20A, 1hp.
- J. Visual Alarm: 7/8" diameter red lens, "Push-to-silence." NEMA 4, 1-watt bulb, 120 VAC

- K. Panel Enclosure: Measures 13.51" high x 11.29" wide x 5.58" deep. NEMA 4X rated. Constructed of UV-resistant fiberglass; hinges and latch are stainless steel.
- L. VCOM-S1RO Panel Ratings: 120 VAC, 1 hp, 16 amps, single phase, 60 Hz.

Optional Components:

- M. Pump Run Light: 7/8" green lens. NEMA 4, LED, 120 VAC.
- N. Heater: Anti-condensation heater. Self-adjusting; radiates additional wattage as temperature drops.

4.8 Service Connection:

Orenco Systems<sup>®</sup>, Inc. Model SC100 or engineered-approved equal. Service connection will include 1" swing check valve factory connected to a 1" ball valve. All components will be PVC Schedule 40 and rated for 150psi.

- A. Service connection shall be enclosed in PVC access riser as manufactured by Orenco Systems<sup>®</sup>, Inc. or engineered-approved equal. Risers shall extend to two inches above the ground surface to allow for settlement and shall have a minimum nominal diameter of 8-inches.
- B. One lid shall be furnished with each access riser. Lids shall be Orenco Systems<sup>®</sup>, Inc. Model FL8G or engineered-approved equal, fiberglass with green non-skid finish.

4.9 Installation:

All pumping system components shall be installed in accordance with the manufacturer's recommendations, the engineer's plans, and all state and local regulations.

4.10 Location:

The pump control panel shall be mounted on a post or exterior wall nearest the tank and pump. If mounting to an exterior wall, try to select a garage or outbuilding where the sound of the motor contactor engaging will not be noticed. If a garage or outbuilding wall isn't available, installation should include use of sound-deadening insulation. (Post and panel mounting assemblies are acceptable.) The control panel shall be located within 50 feet and in sight of the pump motor or shall be provided with a lockable disconnect switch. The panel, when possible, should be mounted in the shade and protected from the weather. The panel should be located at a convenient height (usually about five feet above the ground) and where it will be accessible for maintenance.

5. SEPTIC TANK EFFLUENT PUMPING ASSEMBLIES

For Commercial or Multiple-User Tanks

All pumping systems shall be supplied by a reputable manufacturer with at least five years of experience in supplying equipment for effluent sewers. References must be available on request from the engineer. Systems shall be Orenco Systems<sup>®</sup>, Inc. High-Head Pumping Assemblies or engineer-approved equal, composed of:

5.1 Risers & Lids:

Same as section B, 1 through 6, above.

5.2 Pump Vault:

Orenco Systems<sup>®</sup>, Inc. Model PVU Series, Universal Biotube<sup>®</sup> Pump Vault or engineer-approved equal, installed in conformance with the engineer's plans. The filter shall have a minimum effective screen area of no less than 15.5 square feet. The Biotube pump vault shall consist of a 12-inch diameter polyethylene vault with eight (8) 2-inch diameter holes evenly spaced around the perimeter, located appropriately to allow for maximum sludge and scum accumulation before requiring pumping (approximately 70% of minimum liquid level). Housed inside the polyethylene vault shall be the Biotube assembly consisting of 1/8-inch mesh polypropylene tubes. Attached to the vault is a flow inducer to accept one or two high-head effluent pumps. (Note: Commercial and multiple-user tanks may require a larger or duplex Biotube Pump Vault, the sizes of which must be individually determined and spelled out in the specifications.)

5.3 Discharge Hose and Valve Assemblies:

Orenco Systems<sup>®</sup>, Inc. Model HV125BC or engineered-approved equal, 1 1/4-inch diameter, 150 psi PVC ball valve, 150 psi PVC check valve, PVC flex hose with working pressure rating of 80 psi, and Schedule 40 PVC pipe.

Optional Components

- A. Anti-siphon valve: When pumping downhill discharge assembly shall include Orenco Systems<sup>®</sup>, Inc. Model HVAS125 series or engineer-approved equal, 1-1/4", 150 psi Schedule 40 PVC anti-siphon valve.
- B. Drain-back: For cold weather climates, drain-back style discharge assembly shall be used which includes an 1/8" drain back orifice above the check valve.
- C. Cold weather kit: For cold weather climates and deep bury tanks, Orenco Systems<sup>®</sup>, Inc. Model HVCW125-KIT series or engineer-approved equal. It shall include a Schedule 40 PVC elbow with a 1/8" drain back orifice, Schedule 80 nipple, and male adapter.
- D. Quick Disconnect: Shall include 1-1/4" cam coupler and adapter for quick disconnect.
- E. High-pressure flex hose: Orenco Systems<sup>®</sup>, Inc. Model HV125PR series or engineer-approved equal. Shall be constructed of a special elastomer compound with a working pressure of 250psi.

Alternate:

Orenco Systems<sup>®</sup>, Inc. Model HV150BC, 1 1/2-inch diameter, 150 psi PVC ball-check valve, 150 psi PVC check valve, PVC flex hose with working pressure rating of 65 psi, and Schedule 40 PVC pipe.

### Optional Components

- A. Anti-siphon valve: When pumping downhill discharge assembly shall include Orenco Systems<sup>®</sup>, Inc. Model HVAS150 series or engineer-approved equal, 1-1/2", 150 psi Schedule 40 PVC anti-siphon valve.
- B. Drain-back: For cold weather climates, drain-back style discharge assembly shall be used which includes an 1/8" drain back orifice above the check valve.
- C. Cold weather kit: For cold weather climates and deep bury tanks, Orenco Systems<sup>®</sup>, Inc. Model HVCW150-KIT series or engineer-approved equal. It shall include a Schedule 40 PVC elbow with a 1/8" drain back orifice, Schedule 80 nipple, and male adapter.
- D. Quick Disconnect: Shall include 1-1/2" cam coupler and adapter for quick disconnect.
- E. High-pressure flex hose: Orenco Systems<sup>®</sup>, Inc. Model HV150PR series or engineer-approved equal. Shall be constructed of a special elastomer compound with a working pressure of 250psi.

### Alternate:

Orenco Systems<sup>®</sup>, Inc. Model HV200BC, quick disconnect, 1 1/2-inch diameter, 150 psi PVC ball-check valve, 150 psi PVC check valve, PVC flex hose with working pressure rating of 60 psi, and Schedule 40 PVC pipe.

### Optional Components

- A. Anti-siphon valve: When pumping downhill discharge assembly shall include Orenco Systems<sup>®</sup>, Inc. Model HVAS200 series or engineer-approved equal, 2", 150 psi Schedule 40 PVC anti-siphon valve.
- B. Drain-back: For cold weather climates, drain-back style discharge assembly shall be used which includes an 1/8" drain back orifice above the check valve.
- C. Cold weather kit: For cold weather climates and deep bury tanks, Orenco Systems<sup>®</sup>, Inc. Model HVCW200-KIT series or engineer-approved equal. It shall include a Schedule 40 PVC elbow with a 1/8" drain back orifice, Schedule 80 nipple, and male adapter.
- D. Quick Disconnect: Shall include 2" cam coupler and adapter for quick disconnect.
- E. High-pressure flex hose: Orenco Systems<sup>®</sup>, Inc. Model HV200PR series or engineer-approved equal. Shall be constructed of a special elastomer compound with a working pressure of 200psi.

#### 5.4 Float Switch Assembly:

Orenco Systems<sup>®</sup>, Inc. Model MF3AT with three switch floats mounted on a PVC stem attached to the filter cartridge. The floats must be adjustable and must be removable without removing the pump vault. The high- and low-level alarms and on/off function shall be preset as shown in the engineer's plans. Each float lead shall be secured with a nylon strain relief bushing at the splice box. The floats shall be UL or CSA listed.

Alternate: TCOM<sup>®</sup> Remote Telemetry Float Control System

Orenco Systems<sup>®</sup>, Inc. Model MF4A with three switch floats mounted on a PVC stem attached to the filter cartridge. The floats must be adjustable and must be removable without removing the pump vault. The high/pump on, pump off and low-level alarms shall be preset as shown in the engineer's plans. Each float lead shall be secured with a nylon strain relief bushing at the splice box. The floats shall be UL or CSA listed.

Alternate: TCOM<sup>®</sup> Remote Telemetry Float Control System

Orenco Systems<sup>®</sup>, Inc. Model MF4V with three mechanical switch floats mounted on a PVC stem attached to the filter cartridge. The floats must be adjustable and must be removable without removing the pump vault. The high/pump on, pump off and low-level alarms shall be preset as shown in the engineer's plans. Each float lead shall be secured with a nylon strain relief bushing at the splice box. The floats shall be UL or CSA listed.

#### 5.5 High-Head Effluent Pumps:

Must be approved for use in pump vault as described in E2. Orenco Systems<sup>®</sup>, Inc. Model PF Series or engineered-approved equal, 1/2 to 1.5 hp, 115/230 VAC, single phase, 60 Hz, two-wire motor, with 10 foot long extra heavy duty (SO) electrical cord with ground. Pump shall be UL and CSA listed as an effluent pump.

#### 5.6 Electrical Splice Boxes:

Orenco Systems<sup>®</sup>, Inc. Model SBEX series external splice box or engineer-approved equal, UL approved for wet locations, equipped with up to four (4) electrical cord grips and two 3/4-inch outlet fitting. Also included shall be UL listed waterproof butt splice connectors.

Alternate: Internal PVC Splice Box

Orenco Systems<sup>®</sup>, Inc., Model SB series internal splice box or engineer-approved equal, UL approved for wet locations, equipped with up to six (6) electrical cord grips and a 1-inch outlet fitting. Also included shall be UL listed waterproof wire nuts. The use of a UL-approved conduit seal kit shall be required to prevent the passage of gases, vapors, or flames through the conduit.

Alternate; Class 1, Division 1 Splice Box

Orenco Systems<sup>®</sup>, Inc. Model SBX series or engineer-approved equal, UL approved for Class I, Division 1 Type D gas applications, equipped with one quick disconnect, aluminum receptacle and malleable iron mounting box. Also included shall be explosion proof EY fitting for pump wire connection.

#### 5.7 Controls and Alarms:

Controls and alarms shall be listed per UL 508. Panels shall be repairable in the field without the use of soldering irons or substantial disassembly. Panel shall be Orenco Systems<sup>®</sup>, Inc. Model MVP Series control panel meeting the following:



## Standard Components:

- A. Programmable Logic Unit: 120/240 VAC programmable logic unit with built-in LCD screen and programming keys. Provides control functions and timing for panel operation.
- B. Motor-Start Contactor: 120 VAC 16 FLA, 1 hp, 60 Hz; 2.5 million cycles at FLA (10 million at 50% FLA). 240 VAC 16 FLA, 3 hp, 60 Hz; 2.5 million cycles at FLA (10 million at 50% FLA).
- C. Toggle Switch: Single-pole, double-throw HOA switch. 20 amps, 1 hp.
- D. Controls Circuit Breaker: 10 amps, OFF/ON switch. Single-pole 120 VAC. DIN rail mounting with thermal magnetic tripping characteristics.
- E. Pump Circuit Breaker: 20 amps, OFF/ON switch. Single-pole 120 VAC, double-pole 240 VAC. DIN rail mounting with thermal magnetic tripping characteristics.
- F. Audio Alarm: 95 dB at 24", warble-tone sound.
- G. Visual Alarm: 7/8" diameter red lens, "Push-to-silence." NEMA 4, 1-watt bulb, 120 VAC
- H. Panel Enclosure: NEMA 4X rated, constructed of UV-resistant fiberglass or NEMA 4 rated, constructed of steel; hinges and latch are stainless steel. Conduit couplings provided.
- I. MVP: Panel Ratings: 120 VAC, 1 hp, 16 amps, single phase, 60 Hz.; 240 VAC, 3 hp, 16amps, single phase, 60 Hz.

## Optional Components:

- J. Pump Run Light: 7/8" green lens. NEMA 4, 1-watt bulb, 120 VAC.
- K. Effluent Alarm: 95db at 24", warble-tone sound.
- L. Flashing Light: Flashing Light: Lexan lens, flanged based, Red, UL – recognized
- M. 3 way (main, auto, off) manual power transfer/disconnect switch
- N. 120 VAC Ground fault interrupter (GFI)
- O. Surge Arrestor: AG2401 120/230V, three 18" leads, rated for a maximum of 32,000amps, UL/CSA listed.
- P. Heater: Anti-condensation heater. Self-adjusting; radiates additional wattage as temperature drops.



- Q. Intrinsically Safe Controls Relays: 120 VAC. Listed per UL 913, for Class I, Div. I, Groups A, B, C, D hazardous locations. Larger enclosure required.
- R. Current Sensor: 120 VAC. Go/no-go operation. Pump fail indicator light on panel. Manual reset switch.
- S. Event Counter: 120 VAC, 6-digit, non-resettable.
- T. Elapsed Time Meter: 120 VAC, 7-digit, non-resettable. Limit of 99,999 hours; accurate to 0.01 hours.

Alternate: Remote Telemetry Control System

Controls and alarms shall be listed per UL 508. Panels shall be repairable in the field without the use of soldering irons or substantial disassembly. Panel shall be Orenco Systems®, Inc. TCOM™ control panel or engineer-approved equal, meeting the following:

The system will be monitored via remote telemetry with real time efficiency.

In addition, the control system shall be capable of the following functions:

- A. Data Collection and Utilization: Logs data for system conditions and events such as pump run time, pump cycles, and alarm conditions.
- B. Downloadable Logs: Download logs into a \*.dif or ASCII format for simple conversion to common spreadsheet or word processor programs.
- C. Multi-Level Password Security: Only qualified personnel can remotely access site.
- D. Program Logic Rules: Simple "If ... then" declarations. Rules can be written based on several operands, including the following:
  - Input/output status
  - Point status
  - Date: mm/dd/yy format
  - Time of day: 24 hour clock
  - Timers
  - Historical data (allows for control optimization or detection of trends)
- E. Schedule functions to control digital "Points" based on date or day of week/time.
- F. Automatic daylight savings time adjustment.

- G. Automatic call-out to pagers during alarm conditions when panel detects trends that could lead to system failure.

In addition, the unit shall have the capability of real-time direct connection to the panel via laptop serial port, to allow the operator real-time access to detailed logged data and the ability to change point values.

Standard Components:

- A. Motor-Start Contactor: 120V 16 FLA, 1 hp, 60 Hz; 2.5 million cycles at FLA (10 million at 50% of FLA). 240 VAC, 16 FLA, 3 hp, 60 Hz; 2.5 million cycles at FLA (10 million at 50% FLA).
- B. HOA 3- Way Toggle Switch: Single-pole switch, Hands (manual) Off, Auto ON. 20 amps, 1 hp.
- C. Controls Circuit Breaker: 10 amps, OFF/ON switch. Single-pole 120 VAC. DIN rail mounting with thermal magnetic tripping characteristics.
- D. Pump Circuit Breaker: 20 amps, OFF/ON switch. Single-pole for 120 VAC or double-pole for 230 VAC. DIN rail mounting with thermal magnetic tripping characteristics.
- E. Audio Alarm: 95 dB at 24", warble-tone sound.
- F. 120 VAC Ground Fault Interrupter (GFI)
- G. Current Sensor: 120 VAC with adjustable high & low alarm set points.
- H. Visual Alarm: 7/8" diameter red lens, "push-to-silence." NEMA 4, 1-watt bulb, 120 VAC.
- I. Panel Enclosure: NEMA 4X rated, constructed of UV-resistant fiberglass or NEMA 4, constructed of steel; hinges and latch are stainless steel. Conduit couplings provided.
- J. Remote Telemetry Unit: ATRTU-Net; self powered 24 VDC at 10 mA max, 8 digital inputs, 8 analog inputs expandable to 16 with expansion board. On-board modem (9600 baud), Ethernet port (10 base T, RJ45jack) and Modbus port (R5422/485 terminals).

Optional Components:

- K. Touch Screen Display: interface module with 5.7 color touch screen.
- L. Pump Run Light: 7/8" green lens. NEMA 4, 1-watt bulb, 120 VAC.
- M. Effluent Alarm: 95db at 24", warble-tone sound.
- N. Flashing Light: Lexan lens, flanged base, red, UL-recognized.

- O. Heater: Anti-condensation heater. Self-adjusting, radiates additional wattage as temperature drops.
- P. Intrinsically Safe Control Relays: 120 VAC. Listed per UL 698A, for Class 1 Div. 1, Groups A, B, C, D hazardous locations. Larger enclosure required.
- Q. 3- Way (main, auto, off) manual transfer/disconnect switch
- R. Event Counter: 120 VAC, 6-digit, non-resettable.
- S. Elapsed Time Meter: 120 VAC, 7-digit, non-resettable. Limit of 99,999 hours; accurate to 0.01 hours.

#### 5.8 Installation:

All pumping system components shall be installed in accordance with the manufacturer's recommendations, the engineer's plans, and all state and local regulations.

#### 5.9 Location:

The pump control panel shall be mounted on a post or exterior wall nearest the tank and pump. If mounting to an exterior wall, try to select a garage or outbuilding where the sound of the motor contactor engaging will not be noticed. If a garage or outbuilding wall isn't available, installation should include use of sound-deadening insulation. (Post and panel mounting assemblies are acceptable.) The control panel shall be located within 50 feet and in sight of the pump motor or shall be provided with a lockable disconnect switch. The panel, when possible, should be mounted in the shade and protected from the weather. The panel should be located at a convenient height (usually about five feet above the ground) and where it will be accessible for maintenance.

### 6. TOOLS FOR SEPTAGE MEASUREMENT

#### 6.1 Scum Measuring Utility Gauge (SMUG):

Contractor shall provide a minimum of one scum measuring utility gauge per 100 units. The gauge shall consist of a minimum 3/8" diameter stainless steel rod with an incremental scale for measuring scum levels. The rod shall be bent at a 90-degree angle at the base to aid in identifying the scum "by feeling." The gauge shall be Orenco Systems<sup>®</sup>, Inc. Model SMUG or engineer-approved equal.

#### 6.2 Sludge Measuring Device:

Contractor shall provide a minimum of one engineer-approved sludge-measuring device per 100 interceptor tanks.

### 7. FORCEMAIN COMPONENTS

#### 7.1 Automatic Air Release Valve:

Orenco Systems<sup>®</sup>, Inc. Model ARB05 or engineered-approved equal. Valve base shall be made of Zamak<sup>®</sup> zinc alloys and include a Buna N rubber base O-ring seal. Body shall be constructed of glass fiber reinforced nylon housing a glass fiber reinforced nylon kinetic

float. Valve will also include a polypropylene elbow to expel air horizontally. Valve shall be corrosion resistant and operable with a minimum line pressure of 2 psig.

- A. Piping shall be Orenco Systems<sup>®</sup>, Inc. Model ARA1 or engineered-approved equal. 1-inch diameter PVC and will include a 1/2-inch diameter ball valve, union, and in-line strainer mounted on a 3-1/2-inch diameter fiberglass base. All components shall be rated for 150psi working pressure.
- B. Air release assembly shall be enclosed in ribbed PVC access riser as manufactured by Orenco Systems<sup>®</sup>, Inc. or engineered-approved equal. The material shall be PVC as per ASTM D-1784 and tested in accordance with AASHTO M304M-89. Risers shall extend to two inches above the ground surface to allow for settlement and shall have a minimum nominal diameter of 24.
- C. One lid shall be furnished with each access riser. Lids shall be Orenco Systems<sup>®</sup>, Inc. Model FL24G-4BU or engineered-approved equal, fiberglass with green non-skid finish, and provided with stainless steel bolts, and wrench. The riser and lid combination shall be sealed for watertightness and able to support a 2500 lb. wheel load. (Note: This is not to imply that PVC risers are intended for traffic areas.)

#### 7.2 Combination Automatic Air/Vacuum Release Valve:

Orenco Systems<sup>®</sup>, Inc. Model ARB15 or engineered-approved equal. Valve base shall be made of Zamak<sup>®</sup> zinc alloys and include a Buna N rubber base O-ring seal. Body shall be constructed of glass fiber reinforced nylon housing a glass fiber reinforced nylon kinetic float. Valve will also include a polypropylene elbow to expel air horizontally. Valve shall be corrosion resistant and operable with a minimum line pressure of 2 psig.

- A. Piping shall be Orenco Systems<sup>®</sup>, Inc. Model ARA2 or engineered-approved equal. 1-inch diameter PVC and will include a 1/2-inch diameter ball valve, union, and in-line strainer mounted on a 3-1/2-inch diameter fiberglass base. All components shall be rated for 150psi working pressure.
- B. Air release assembly shall be enclosed in ribbed PVC access riser as manufactured by Orenco Systems<sup>®</sup>, Inc. or engineered-approved equal. The material shall be PVC as per ASTM D-1784 and tested in accordance with AASHTO M304M-89. Risers shall extend to two inches above the ground surface to allow for settlement and shall have a minimum nominal diameter of 24.
- C. One lid shall be furnished with each access riser. Lids shall be Orenco Systems<sup>®</sup>, Inc. Model FL24G-4BU or engineered-approved equal, fiberglass with green non-skid finish, and provided with stainless steel bolts, and wrench. The riser and lid combination shall be sealed for watertightness and able to support a 2500 lb. wheel load. (Note: This is not to imply that PVC risers are intended for traffic areas.)

#### 7.3 Manual Valves:

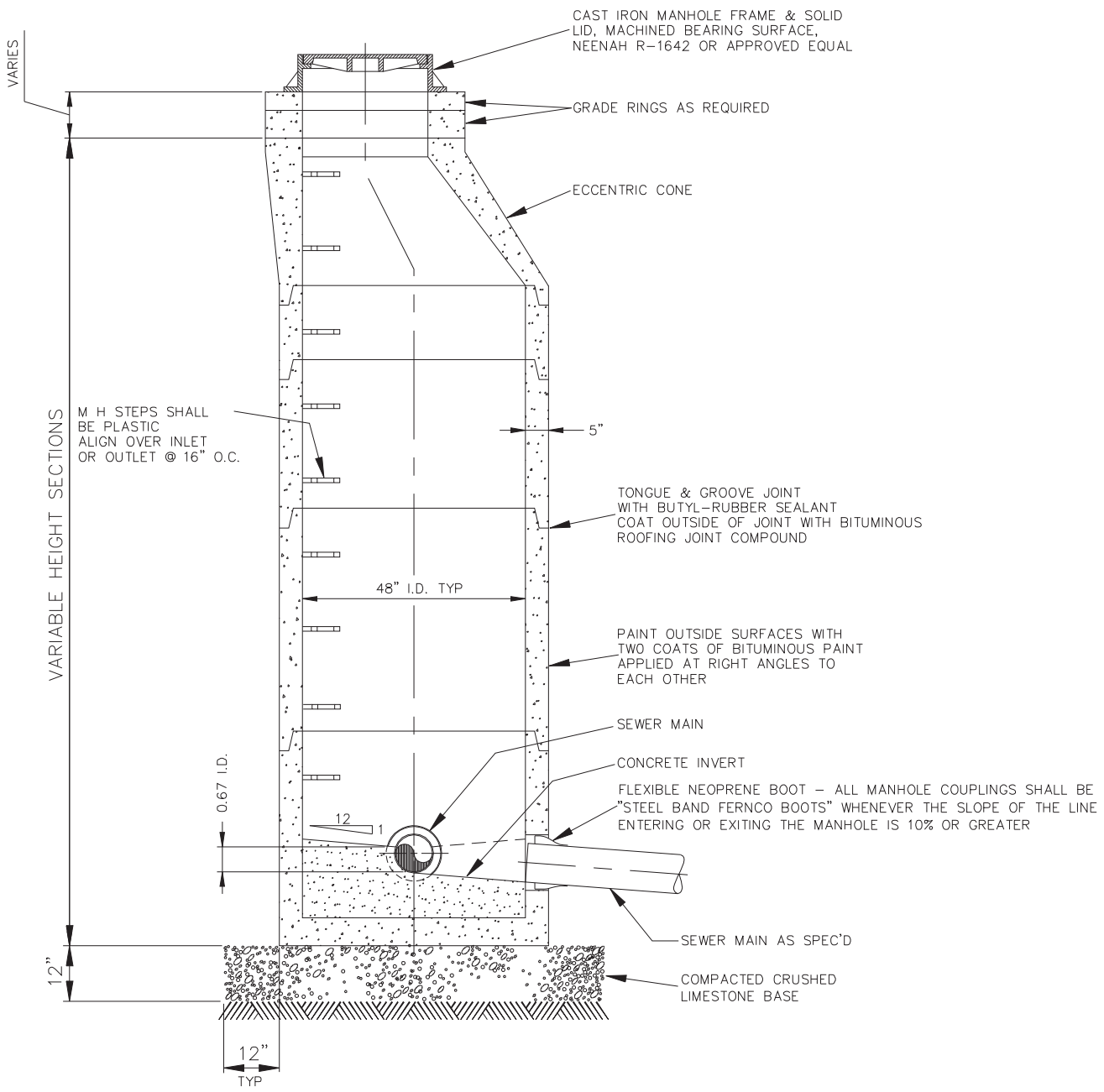
Orenco Systems<sup>®</sup>, Inc. Model ARB05 or ARB15 or engineered-approved equal as listed above. Valves will include the following piping:

- Orenco Systems<sup>®</sup>, Inc. Model ARAM or engineered-approved equal. 1-inch diameter PVC and will include a 1/2-inch diameter ball valve, union. All components shall be rated for 150psi working pressure.

END OF SECTION

**APPENDIX A**

**STANDARD DETAILS**



ALL MANHOLES SHALL BE VACUUM TESTED IN ACCORDANCE WITH STATE OF TENNESSEE REQUIREMENTS PRIOR TO ACCEPTANCE BY THE OWNER

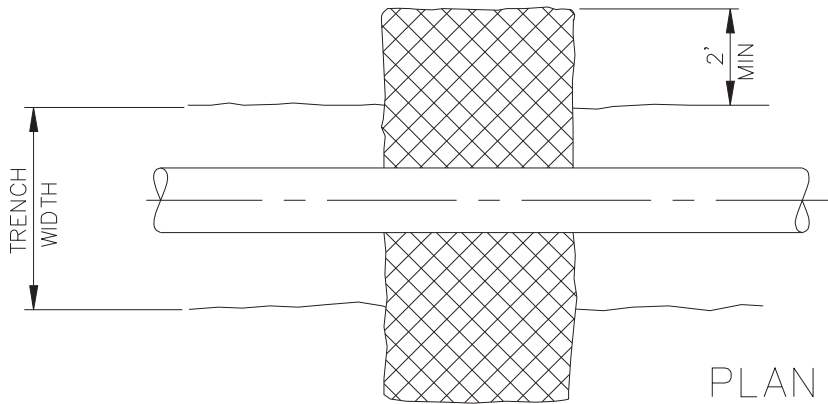
**B** SECTION ~ PRECAST CONCRETE MANHOLE

S4.0 SCALE NONE

**TELLICO AREA SERVICES SYSTEM (TASS)  
505 CLEARVIEW ROAD  
MARYVILLE, TN 37801**

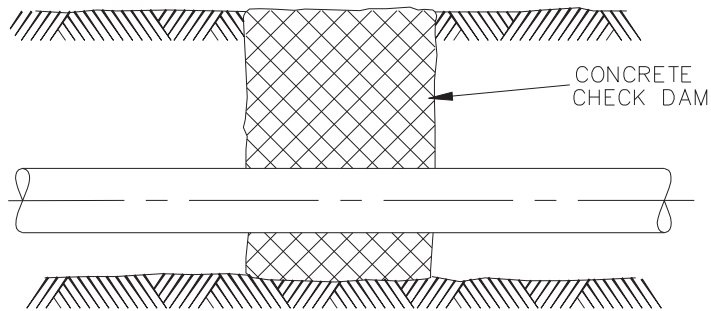
**SD-1**





PLAN

3'  
MINIMUM



CONCRETE  
CHECK DAM

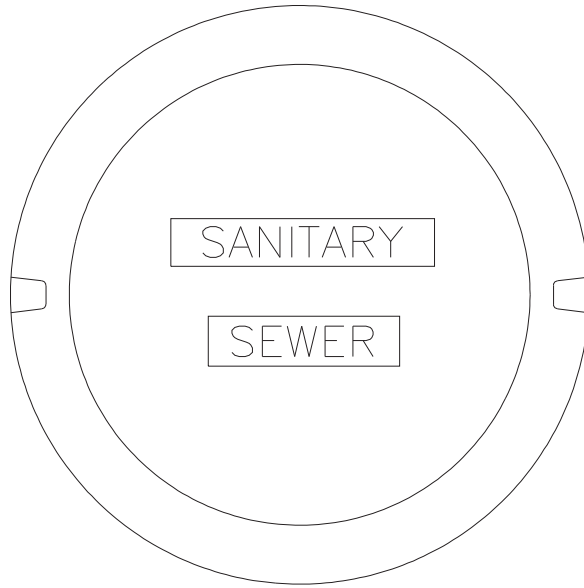
SECTION

A  
S4.0

# DETAIL ~ CHECK DAM

S C A L E N O N E

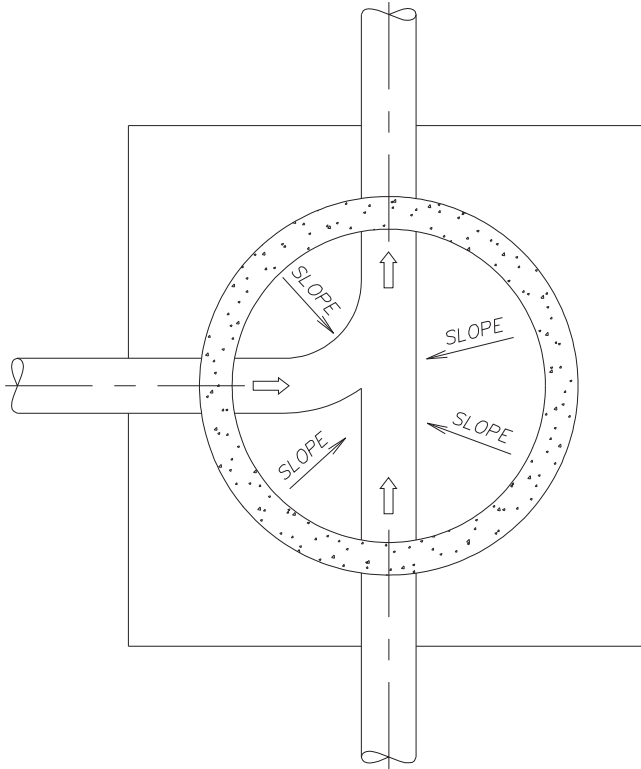
WATERTIGHT - 485 LBS MIN



E  
S4.0

COVER FACE

SCALE NONE



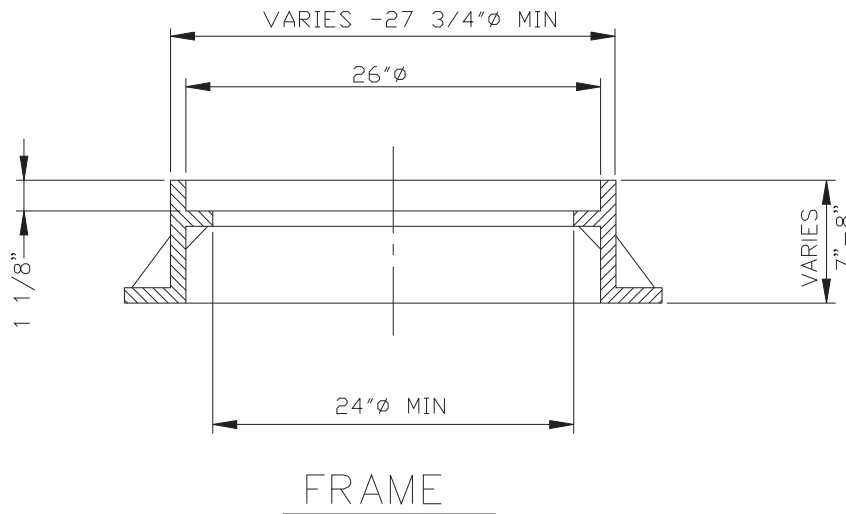
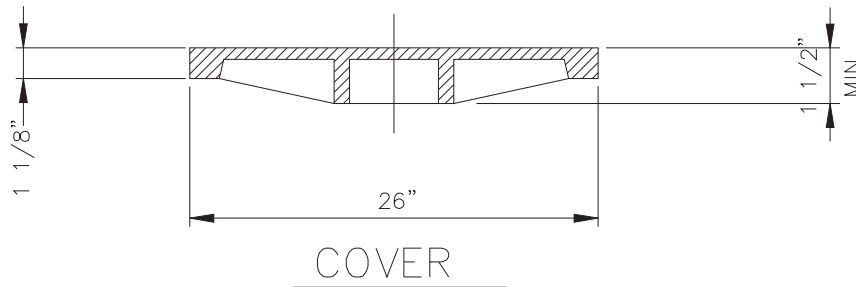
G  
S4.0

PLAN ~ INVERT

SCALE NONE

TELLICO AREA SERVICES SYSTEM (TASS)  
505 CLEARVIEW ROAD  
MARYVILLE, TN 37801

SD-3

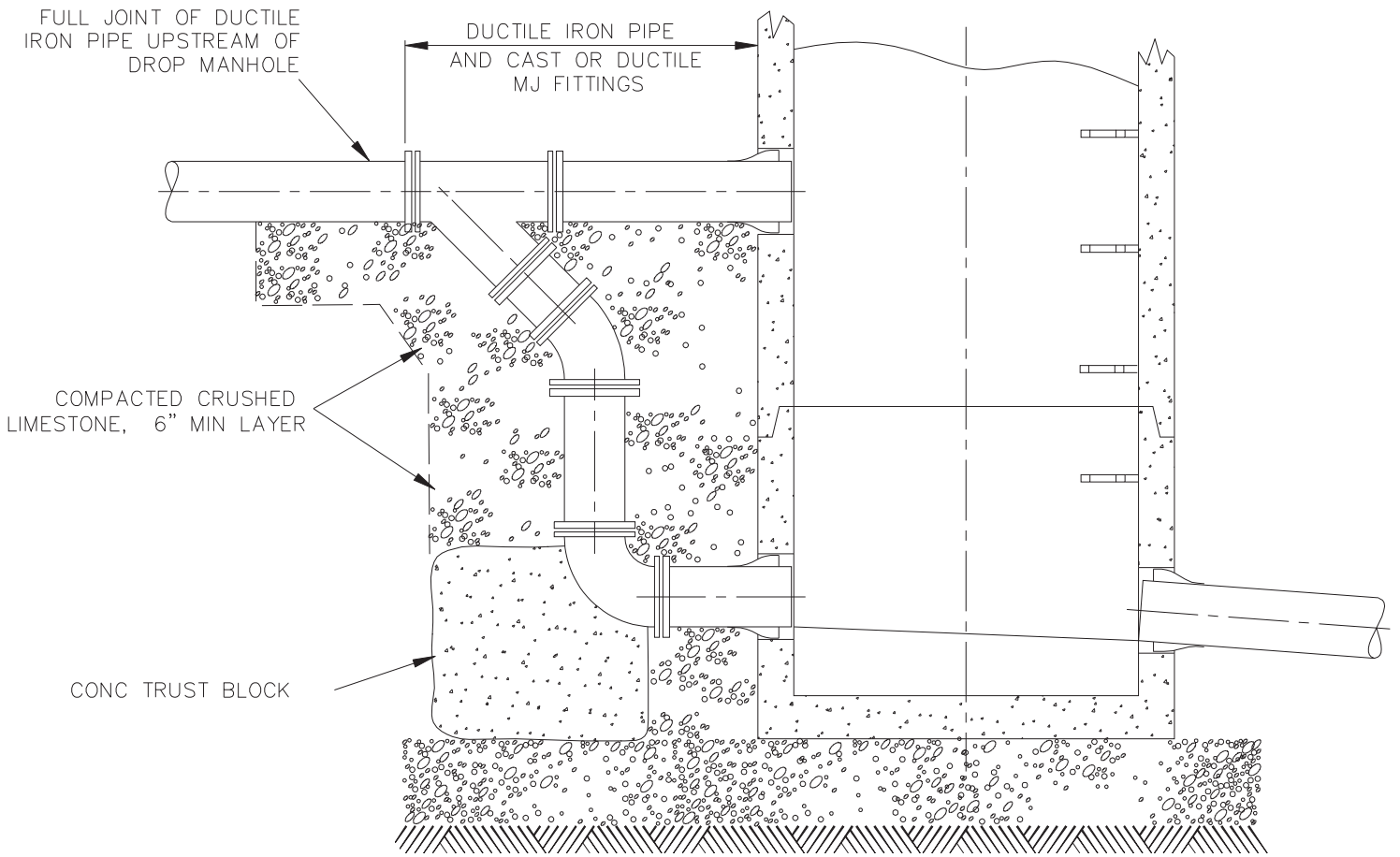


# MANHOLE FRAME

S C A L E N O N E

## MANHOLE FRAME SPECIFICATIONS

1. LOAD RATING: HEAVY DUTY
2. MATERIAL SPECIFICATION: ASTM A-48, CLASS 30
3. TOTAL WEIGHT OF FRAMES AND COVERS: STANDARD - 375 LBS MIN
4. COVER FACE SHALL BE EMBOSSED AS SHOWN
5. MANHOLE FRAME AND COVER DRAWINGS SHALL BE SUBMITTED TO ENGINEER FOR APPROVAL PRIOR TO ACCEPTANCE OF MANHOLE FRAMES AND COVERS



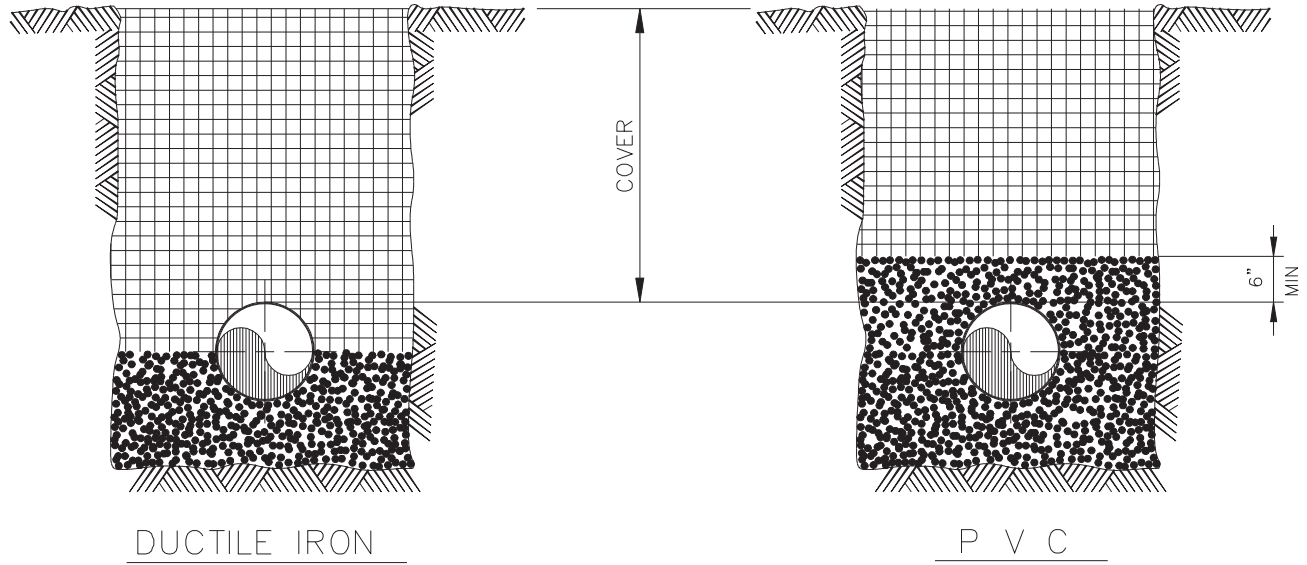
H  
S4.0

# SECTION ~ DROP MANHOLE

S C A L E N O N E

**TELLICO AREA SERVICES SYSTEM (TASS)  
505 CLEARVIEW ROAD  
MARYVILLE, TN 37801**

**SD-5**



ALL DUCTILE IRON PIPING SHALL BE BEDDED ON A 6" DEEP MINIMUM LAYER OF NO. 7 OR NO. 67 COMPACTED CRUSHED LIMESTONE TO CENTERLINE OF PIPE

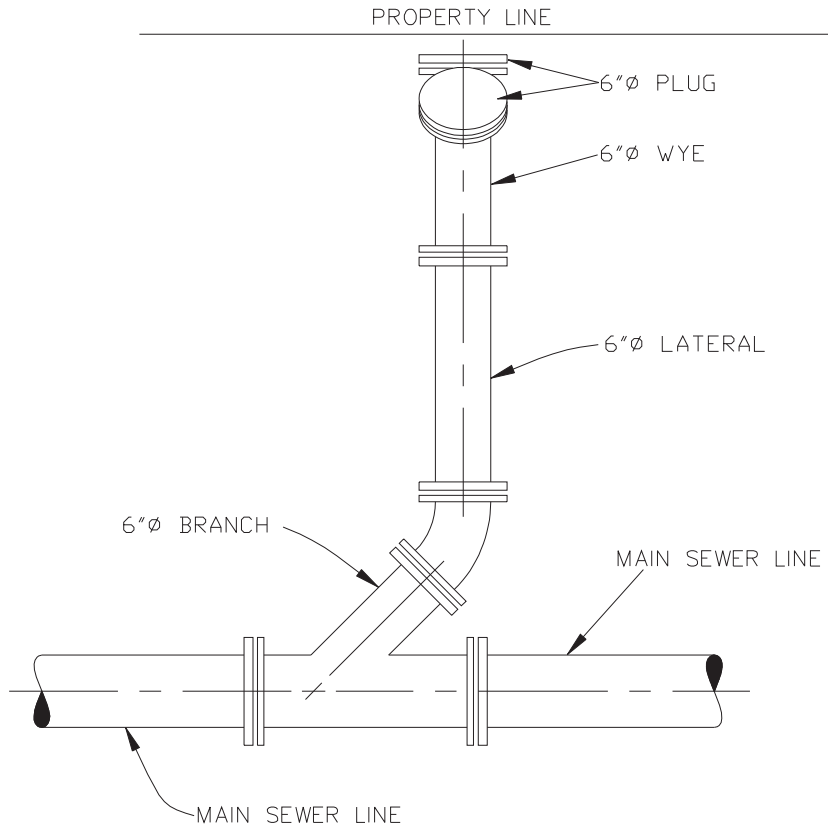
ALL PVC PIPING SHALL BE BEDDED AND COMPLETELY COVERED TO 6" ABOVE PIPE WITH NO. 7 OR NO. 67 COMPACTED CRUSHED LIMESTONE

BACKFILL MATERIAL SHALL NOT EXCEED 6 INCHES IN DIAMETER AT ITS GREATEST DIMENSION. DUCTILE IRON PIPE OR CONCRETE ENCASUREMENT SHALL BE USED WHENEVER COVER IS LESS THAN 48 INCHES UNDER ROADWAY PAVEMENT OR LESS THAN 30 INCHES OTHERWISE. USE OF DUCTILE IRON PIPE OR CONCRETE ENCASUREMENT FOR PVC PIPE OR RELOCATION WILL BE REQUIRED WHEN CULVERTS OR CONDUITS ARE PLACED SUCH THAT THE TOP OF THE SEWER LINE IS LESS THAN 18 INCHES BELOW THE BOTTOM OF CULVERT OR CONDUIT. SPECIAL CARE FOR COMPACTION IN THE HAUNCHING AREA OF THE SEWER LINE IS REQUIRED. ALL TRENCHES WITH STONE WHEN UNDER PAVEMENT OR IN SHOULDER. BACKFILL WITHIN 12" OF EDGE OF PAVEMENT.



## TRENCHING DETAILS

S C A L E N O N E



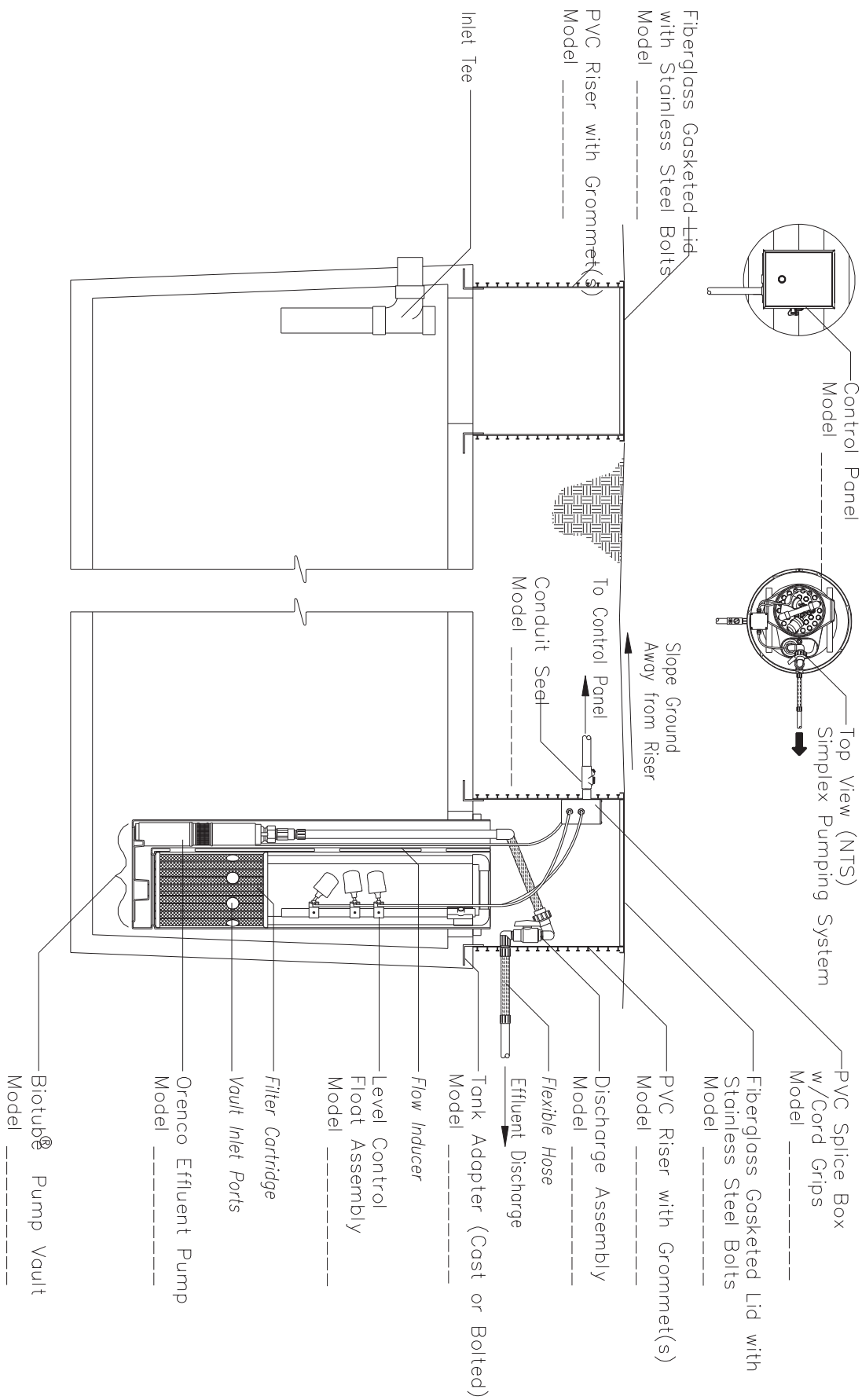
PLAN ~ TYP. SEWER STUB-OUT

1  
S4.0

SCALE NONE

# Effluent Pumping System – Simplex

Scale: 1" = 2'



Patents # 4,439,323 & 5,492,635  
 Foreign Patents May Apply  
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NDW-TD-EPS-01  
 Rev. 3.0 (03/06)

SD-8

**TELLICO AREA SERVICES SYSTEM (TASS)  
 505 CLEARVIEW ROAD  
 MARYVILLE, TN 37801**