

# ESCAMBIA COUNTY UTILITIES AUTHORITY ENGINEERING MANUAL

Adopted by the Board of the  
Escambia County Utilities Authority  
on May 26, 1988

*Update No.2 - August 1999*

Prepared by  
ECUA Engineering Department  
9300 Sturdevant Street  
P.O. Box 15311  
Pensacola, FL 32514-5311

## ECUA ENGINEERING MANUAL USERS' GUIDE

The Manual consists of 4 sections. A description of each section, its contents, and the use of each section is summarized below.

### Section

#### 1. ENGINEERING PROCEDURES

The procedures are for those areas or functions where developers, engineers, contractors and builders must interact with the ECUA Engineering Department. The procedures identify what information is required to be provided to the Engineering Department, how the Engineering Department will process the information, and the responses to be issued by the Engineering Department.

#### 2. DESIGN STANDARDS

This section is intended for consultant engineer or engineer-of-record when designing and preparing plans for submittal to and review by the ECUA Engineering Department.

#### 3. TECHNICAL SPECIFICATIONS

This section contains the acceptable specifications for construction of all water and wastewater improvements which will become the responsibility of the ECUA. The engineers design shall conform to these specifications and the contractor shall construct the improvements according to these standards.

#### 4. DETAIL DRAWINGS

This section contains standard plans for typical improvements and may be considered a supplement to the TECHNICAL SPECIFICATIONS. Where there is a conflict between the Technical Specifications and the Detail Drawings, the Detail Drawings will control.

## **TABLE OF CONTENTS**

---

<b>◆ DIVISION 1</b>	<b>ENGINEERING PROCEDURES</b>	<u>Pages</u>
Procedure 1	Engineering Review of a Development with a Water and/or Sewer Line Extension <ul style="list-style-type: none"> <li>• Request for Service Requirements</li> <li>• Utility Service Agreement</li> <li>• Notice of Intent</li> <li>• Contractor's Notification of Commencement of Construction</li> <li>• Certification of Completion – Water</li> <li>• Certification of Completion - Sewer</li> </ul>	1-12
Procedure 7	Easements for ECUA Utilities	1-16
Procedure 8	New Product Approval	1-2
Procedure 9	Change Orders	1-3
Procedure 10	Pay Request Submittals	1-3
<b>◆ DIVISION 2</b>	<b>DESIGN STANDARDS</b>	
Section 1	Forward	i
Section 101	Plan Preparation	1-4
Section 556	Potable Water System	1-15
Section 570	Sanitary Wastewater Collection System	1-7
Section 575	Wastewater Lift Stations and Force Mains	1-10
<b>◆ DIVISION 3</b>	<b>TECHNICAL SPECIFICATIONS</b>	
Section 1001	Abbreviations and Definitions	1-5
Section 1004	Testing Laboratory Services	1-3
Section 1013	Soils and Subsurface Investigations	1
Section 2102	Clearing and Grubbing	1-2
Section 2221	Trench Excavation, Backfill and Compaction	1-7
Section 2224	Pipe Boring, Drilling and Jacking	1-6
Section 2556	Water Distribution and Service Lines	1-32
Section 2570	Sanitary Sewers	1-14
Section 2575	Wastewater Lift Stations	1-16
Section 2576	Sanitary Sewer Force Mains ( <i>Interim</i> )	1-21
Section 3300	Cast-in-Place Concrete	1-5
<b>◆ DIVISION 4</b>	<b>STANDARD DETAIL DRAWINGS</b>	

## **Procedure for Engineering Review of a Development with a Water and/or Sewer Line Extension**

### **Purpose:**

**This procedure provides an outline of the steps to receive ECUA approval of a development that includes extensions to ECUA water and/or sewer mains, or the installation of private water and/or sewer mains. The ECUA will coordinate with the developer and his engineer to minimize the time required for review. The timely submittal of all the required information will be helpful in assuring a prompt review.**

### **I. Service Requirements (Optional)**

- A. At the conceptual stage of a project, the Owner/Developer may submit a written request to the ECUA Engineering Department for the availability of water and/or sewer service. Form E 1.1 may be used for this written request. This is an optional step in the review process.

The written request shall include the following information:

1. Type of development (i.e. commercial, residential, industrial, etc.)
2. Size of the development (i.e., number of units or homes, square footage of commercial building, etc.)
3. Location Map (to scale)
4. Type of service requested (water and/or sewer)
5. Service requirements (i.e. projected flows)
6. How water and/or sewer service will be provided if not by ECUA
7. Signature of the Owner, the Developer or the Engineer
8. Address and Telephone Number of the Owner or the Developer and of the submitter

- B. ECUA's Engineering Department will review the request and respond with either:

1. Unconditional Availability – Service is available adjacent to the site with capacity to serve the project. This does not guarantee capacity in the system.
2. Conditional Availability – If facilities are in need of upgrade, or if facilities are deficient, they will be identified.

### **II. Preliminary Submittals**

- A. Preliminary submittals may be submitted once the Civil Engineering plans for the Development are substantially complete. The following items are required (Items that must be signed & sealed by a Professional Engineer registered in the State of Florida):

1. **Three sets of preliminary plans** of the proposed project including the following information:
    - (a) Proposed improvements, with utility line sizes and types indicated, paving and stormwater improvements indicated and building footprints shown
    - (b) Existing improvements, with utility line sizes and types indicated
    - (c) Topographic contours at 2-foot intervals (minimum)
    - (d) Hydrographic data including groundwater information and the location of any open bodies of water and any jurisdictional wetlands
    - (e) Septic systems
    - (f) Other pertinent information
  2. **Two sets of specifications**, signed and sealed.  
  
If the project is to be constructed in accordance with the specifications contained within the ECUA Engineering Manual, in unmodified form, this item may be omitted from the review submittal/procedure.
  3. **Two sets of Lift Station Calculations** (if applicable), signed and sealed.
  4. **Two copies of the Executed Utility Service Agreement with Exhibits A and B attached** (see ECUA Engineering Manual for blank forms).
  5. **One executed copy of the Notice of Intent** to Construct an Extension to Escambia County Utilities Authority's Drinking Water Distribution System and/or Wastewater Collection/Transmission System (see ECUA Engineering Manual for blank forms).
  6. **The review fee**, in the form of a check in the amount of \$250, payable to the ECUA.
  7. **Draft easement forms**, if applicable (see ECUA Engineering Manual for blank forms).
  8. **Cost estimate information**, if applicable, for oversizing requests.
- B. The package will be processed as follows:
1. The Engineering Department Secretary will log it in, indicating items received, and in what quantity.
  2. A Project Engineer will be assigned to the project, and will review the package for completeness.
  3. One copy of the plans will be routed to the Regional Services Department and to the Water and Wastewater Department for comments.
  4. The plans, specifications and calculations will be reviewed for compliance with ECUA Requirements or FDEP Requirements, as appropriate.

5. The Notice of Intent and the Utility Service Agreements will be reviewed for completeness and routed to the appropriate individuals for execution.
- C. One of the following responses will be forwarded to the submitter:
1. A request for additional information will be issued when clarification is required or if all the required items were not included with the package.
  2. A single copy of the plans, specifications and/or lift station calculations, either "Approved," "Approved with Comments," or "Revise and Resubmit" may be returned to the submitter with comments to be used to prepare the Final Review Package. A letter may be issued in lieu of the marked plans, indicating changes required for the Final Review Package.

### III. Final Submittals

- A. Once comments from the Preliminary Review Package have been addressed by the submitter, the Final Review Package shall be submitted. Revised items shall be submitted in their original quantities (i.e. if specs have been revised, two sets are required). Six sets of plans, signed and sealed by a Professional Engineer registered in the State of Florida shall be submitted.

The Final Review Package will be processed as follows:

1. The Department Secretary will log it in, indicating items received, and in what quantity.
  2. The Project Engineer will review the package for completeness.
  3. One copy of the plans will be routed to the Regional Services Department and to the Water and Wastewater Department for comments.
  4. The plans, specifications and calculations will be reviewed for concurrence with ECUA comments indicated on the Preliminary Review Package.
- B. Packages marked "Revise and Resubmit" by the Project Engineer will be returned to the submitter for corrections. One copy of submitted information shall be retained by ECUA.
- C. Package marked "Approved" or "Approved with Comments" will be included in an Approval Package to the Owner/Developer. Inspection fees for the Development must be paid prior to the Owner/Developer picking up the package from the Engineering Department.

### IV. Construction

- A. Construction is authorized to proceed upon receipt of the Approval Package from ECUA's Director of Engineering. Other permits may be required from other agencies; the approval of ECUA's Engineering Department does not constitute approval from any other regulatory agency.
- B. The Owner/Developer's Contractor must provide 72 hours written notice to ECUA's Engineering Department prior to beginning water or wastewater utility construction activities. (See ECUA Engineering Manual for Notification Form).

- C. Any substantial changes to the construction plans shall be submitted to the Project Engineer and must be approved prior to construction of affected facilities.
- D. The Contractor shall have, on the job site, one set of the ECUA “Approved” or “Approved with Comments” plans. A current set of As-Built plans shall also be kept on the job site.
- E. All questions and comments regarding the construction plans shall be directed to the Engineer of Record (Owner/Developer’s Engineer).
- F. If facilities are not installed in accordance with the approved plans and/or the requirements of the ECUA, a re-inspection fee will be assessed for each required reinspection. Refer to the ECUA Code Book for specifics.

## V. Final Acceptance

- A. Upon completion of construction, including testing, the Engineer of Record shall submit a written statement to ECUA’s Engineering Department stating the project was completed according to the approved plans and requesting final inspection.

ECUA will schedule the final inspection. The following items shall be submitted to the ECUA Construction Inspector upon successful completion of the Final Inspection:

1. **One copy of the approved bacteriological test results** for installed water systems.
  2. **Two sets of As-Built drawings** completed by the Engineer of Record. A diskette containing the electronic as-builts in AutoCAD format, if applicable. As-builts in either format should clearly indicate the name, address and phone number of the Underground Utility Contractor of Record.
  3. **Certification of Developer Form (Form SD-3) with a Statement of Improvement values or cost** (if applicable)
  4. **Certification of Completion of Construction for an Extension to Escambia County Utilities Authority's Drinking Water Distribution System and/or Certificate of Completion of Construction for an Extension to Escambia County Utility Authority's Wastewater Collection/Transmission System** (see ECUA Engineering Manual for blank forms).
  5. **Recorded plat and/or any applicable easement forms** (executed and recorded by the Owner/Developer).
- B. After acceptance, the ECUA Engineering Department will issue a Certification of Final Acceptance Notice.

**UTILITY SERVICE AGREEMENT  
FOR CONSTRUCTION OF  
WATER AND WASTEWATER SYSTEM EXTENSIONS**

This AGREEMENT is made and entered into by and between the EMERALD COAST UTILITIES AUTHORITY, a governmental body, corporate and politic, (“ECUA”) and

(Name of Company or Individual): \_\_\_\_\_

(Business Address): \_\_\_\_\_

(Business Tax I.D. No.): \_\_\_\_\_

(the “Developer”). This Agreement shall be effective as of the date on which both the Developer and ECUA or their representatives, as indicated below have signed it.

WHEREAS, the Developer owns or otherwise controls a development interest in certain land (the “Property”) in Escambia County, Florida, more particularly described in Exhibit “A” to this Agreement and intends to construct on the Property a (Describe the type of project, i.e. subdivision, apartments, commercial, etc.):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

to be known as (Name of Project): \_\_\_\_\_ (the “Project”);

and

WHEREAS, the Developer desires ECUA to provide to the Project:

- A. Water service –  
Projected average daily demand of \_\_\_\_\_ gallons per day;
- B. Wastewater service –  
Projected average daily flow of \_\_\_\_\_ gallons per day; and

WHEREAS, ECUA is willing to provide such service upon the terms and conditions hereinafter set forth;

NOW, THEREFORE, in consideration of the premises and the mutual covenants herein contained the Developer and ECUA hereby agree as follows:

1. The Developer shall, at the sole cost and expense of the Developer:
  - A. Construct or cause to be constructed such mains, services, laterals, lift stations, force mains, fire hydrants and other facilities as may be necessary for ECUA to provide such service to the Project.

B. Construct or cause to be constructed such other facilities outside the Property as are generally described in Exhibit "B" to this Agreement.

2. The Developer shall pay all Project costs of any kind, including the cost of any necessary relocation of existing utilities, and shall secure such permits and easements as may be required. However, ECUA may elect to modify the intended design and participate financially in certain system extensions as necessary to meet other current or future needs of the system. Such participation by ECUA shall be described in Exhibit "D" to this Agreement.

3. All such design and construction shall be done in accordance with the requirements of the ECUA Engineering Manual, latest edition.

4. No such construction shall be commenced until plans and specifications therefor have been submitted to and approved in writing by ECUA and other agencies or permitting authorities having jurisdiction.

5. In accordance with the requirements and conditions of the Plan Approval process the Developer or his representative shall notify ECUA in writing before commencing construction. Failure of the Developer or his Contractor to provide timely notice before commencement of construction, as required, may be considered as a breach of this Agreement. The Developer will be responsible for payment of penalties and other costs associated with such failure to notify.

6. All work related to the construction of extensions to ECUA water or wastewater facilities shall be subject to inspection by ECUA. Employees and agents of ECUA may at any reasonable time during or after construction enter upon the Property for the purpose of inspecting such facilities. Any work done prior to proper notification or without appropriate inspection is subject to rejection. Work requiring repeated inspections, failure to properly prepare work for inspection, or other actions which result in excessive use of inspection services, shall be cause for assessment of additional inspection fees payable prior to final completion or acceptance of the project.

7. Upon completion of construction the engineer that prepared the approved plans and specifications shall at the Developer's expense certify such facilities as to conformity with the approved plans and specifications and provide copies of the project plan drawings indicating the final, as-built record of construction including location references. Also prior to the facilities being placed into service the Developer shall provide or cause to be provided additional documentation including but not limited to easements, warranties, dedications, etc.

8. Ownership and maintenance responsibility for the completed facilities shall be defined by ECUA and outlined in Exhibit "C" to this Agreement. Prior to completion of the project, the Developer shall provide appropriate easements or

property transfers for all facilities that are proposed for ECUA ownership but that are not located in public rights-of-way.

9. Upon determination by ECUA that the facilities have been constructed by the Developer in accordance with the approved plans and specifications and all applicable requirements of ECUA and other agencies having jurisdiction, ECUA shall accept ownership and maintenance responsibility or acknowledge satisfactory completion of construction of the facilities as appropriate. For facilities not being accepted by ECUA the Developer shall provide the name, address, phone number and other contact information for the person or agency responsible for the maintenance of the facilities.

10. No building or similar facility shall be connected to any new or existing water or wastewater facilities until such time as ECUA acknowledges satisfactory completion of construction, and until all applicable rates, fees and charges have been paid to ECUA. If for any reason service is established to the Project prior to the receipt of all documentation necessary to meet the requirements of the completion or acceptance process such service shall be considered temporary and limited to a period of ninety days. Failure of the Developer to provide the necessary documentation within this period may result in discontinuance of service until such documentation is provided.

11. Upon acceptance of any facility by ECUA, such facility, together with all permits, easements, warranties, engineering drawings, and other matters owned by the Developer in connection therewith shall be delivered to and owned by ECUA. The Developer shall execute such instruments of conveyance as ECUA may require, and shall provide ECUA with as-built records of construction in a format suitable to ECUA.

12. The Developer hereby warrants the new facilities to be free of defects in material, workmanship and design for two (2) years after the acceptance or acknowledgment of completion thereof. Any such defect appearing within one (2) years after acceptance shall be corrected by the Developer or, at the option of ECUA, shall be corrected by ECUA and the Developer shall reimburse ECUA for the cost of such correction within 30 days after receipt of a statement for the same.

13. The Developer shall not engage, directly or indirectly, in the ownership or operation of a water or wastewater system within or serving the Property or the Project. This provision does not preclude the submetering of water for purposes of allocating cost to individual dwelling units such as in apartment complexes in accordance with Florida laws.

14. The Developer agrees to operate and maintain any completed water or wastewater facilities in compliance with all federal, state, local and ECUA codes

and requirements, and agrees to allow ECUA access as required to inspect the facilities for compliance with those requirements.

15. The Developer hereby releases and agrees to hold harmless, indemnify, protect, and defend ECUA, its members, officers, employees and agents from any and all claims, damages, actions or causes of action relating to the planning, design, and construction of such facilities, or relating to any denial by the Florida Department of Environmental Protection or other authority of any permit to provide utility service to the Property, or any failure by the Developer to construct such facilities or develop the Property.

16. This Agreement may not be amended except by a writing executed by the Developer and by ECUA. All documents necessary for the implementation of this Agreement, including all permits, engineering design and construction contracts, plans and specifications for the facilities as and when approved and filed with the ECUA are a part of this Agreement and incorporated herein by reference.

17. The laws of the State of Florida shall govern this Agreement.

EXECUTED by the Developer or its representative this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

DEVELOPER

BY: \_\_\_\_\_

\_\_\_\_\_  
Witness

Printed Name & Title: \_\_\_\_\_

EXECUTED by the undersigned representative of ECUA this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_ .

EMERALD COAST UTILITIES  
AUTHORITY

BY: \_\_\_\_\_

\_\_\_\_\_  
Witness

Title: \_\_\_\_\_





EXHIBIT "C" – OWNERSHIP & MAINTENANCE RESPONSIBILITY

It is the intent of the Developer and of ECUA that the ownership and maintenance responsibility for the water or wastewater facilities to be constructed for this Project will be as follows after final completion or acceptance.

ECUA

Upon completion of construction and provision by the Developer of all appropriate completion documents the following described facilities will be accepted for ownership, maintenance and operation by ECUA:

\_\_\_\_\_ All facilities as shown on the approved Plans, or

Those facilities as shown on the approved Plans as described below:

---

---

---

---

---

---

---

---

Developer

Upon completion of construction and provision by the Developer of all appropriate completion documents the following described facilities will be retained for ownership, maintenance and operation by the Developer or his successor:

\_\_\_\_\_ All facilities as shown on the approved Plans, or

Those facilities as shown on the approved Plans as described below:

---

---

---

---

---

---

---

---

Ownership and contact information for these facilities will be as follows:

Owner's Name: \_\_\_\_\_

Owner's Address: \_\_\_\_\_

Contact Person: \_\_\_\_\_

Daytime Phone No. \_\_\_\_\_

Emergency Contact No: \_\_\_\_\_





**Notice of Intent to Construct  
an Extension to Emerald Coast Utilities Authority's**



- Drinking Water Distribution System and/or**  
 **Wastewater Collection/Transmission System**

P.O. Box 15311 9300 Sturdevant St. Pensacola, FL 32514-0311 Phone: (850) 476-5110 Fax: (850) 494-7335

**Instructions: This form is to be completed and submitted to the ECUA Engineering Department along with six (6) sets of engineering plans and specifications, and other supporting documentation, AT LEAST 30 DAYS PRIOR TO INITIATING CONSTRUCTION. All applicable blanks must be filled in. This form is for water and sewer lines 12 inches or less in diameter and pump stations appurtenant to such force mains.**

**I. Project Information:**

Project Name: \_\_\_\_\_

Location: \_\_\_\_\_

Section: \_\_\_\_\_ Township: \_\_\_\_\_ Range: \_\_\_\_\_

Escambia County Property Appraiser's I.D. No(s): \_\_\_\_\_

This project will serve: \_\_\_\_\_ Single Family Homes, \_\_\_\_\_ Multifamily Units, \_\_\_\_\_ Commercial Facilities, \_\_\_\_\_ Utility Relocation, Other (explain) \_\_\_\_\_

Estimated increase in flow/demand for water: \_\_\_\_\_ MGD and/or wastewater: \_\_\_\_\_ MGD

Owner/Developer: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

**II. Statement by Owner/Developer:**

I, the undersigned owner or authorized representative of \_\_\_\_\_\*  
 certify that the above information is true and complete to the best of my knowledge. I acknowledge that it is my responsibility to ensure that the facilities are constructed as designed and I have retained the services of a Professional Engineer registered in the state of Florida to observe that the construction of the project is in accordance with the engineering plans as submitted and approved. I am aware that the use of this permit is not transferable and will expire after 5 years. (\*Attach notarized letter of authorization.)

\_\_\_\_\_  
Signature of Owner or Owner's Representative\*

\_\_\_\_\_  
Printed Name and Title

\_\_\_\_\_  
Company Name (Print or Type)

\_\_\_\_\_  
Company Address (Print or Type)

\_\_\_\_\_  
Telephone Number Date

\_\_\_\_\_  
Facsimile Number Date

**III. Statement by Engineer:**

I certify that the engineering features of this system have been designed by me or those under my direct supervision in accordance with Chapters 62-604/62-555 FAC and the latest edition of the ECUA Engineering Manual, and any other regulatory requirements. A Certification of Completion Form, As-built Drawings, and appropriate clearances will be submitted to ECUA after completion of the facilities in order to obtain approval to place the facilities in service.

_____ Signature Sealed with Embossed Seal		_____ Date
_____ Printed Name	_____ Florida Registration Number	
_____ Company Name (Print or Type)		
_____ Company Address (Print or Type)		
_____ Telephone Number		_____ Date
_____ Facsimile Number		_____ Date

**IV. Approval by ECUA:**

The drinking water zone serving this system will be:

North Zone    South Zone    Pensacola Beach    Other (specify) \_\_\_\_\_

The Water Reclamation Facility serving this system will be:

CWRF    Bayou Marcus    Pensacola Beach    Other (specify) \_\_\_\_\_

The construction of these facilities is hereby approved in accordance with ECUA's Memorandum of Agreement with the Florida Department of Environmental Protection for the ECUA to independently regulate the construction of water distribution and sewage collection and transmission mains and pump stations appurtenant to such force mains.

_____ Signature	
_____ Printed Name	
_____ Title	_____ Date





**Certification of Completion of Construction  
for an Extension to Emerald Coast Utilities Authority's  
Drinking Water Distribution System**

**Instructions: This form is to be completed and submitted to the ECUA Engineering Department along with one (1) set of record drawings, and other supporting documentation required below, PRIOR TO PLACING THE SYSTEM INTO OPERATION. A distribution system extension should not be placed into service without prior written ECUA approval. All applicable blanks must be filled in.**

**I. Project Information**

ECUA Submittal No.: \_\_\_\_\_

Project Name: \_\_\_\_\_

Location: \_\_\_\_\_

Date of connection to ECUA system: \_\_\_\_\_

Owner/Developer: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

**Required Attachments for ECUA Acceptance of Ownership and O&M of System:**

- Bacteriological Test Results
- Letter from Engineer of Record for corrected punch list items
- Two (2) sets of as-built plans completed by Engineer of Record and one (1) set on diskette in AutoCAD format, if available
- Form SD-3 – Certification of Developer Form, with an itemized Statement of Improvement values or cost, if applicable
- Recorded plat and/or any applicable easement forms (executed and recorded by the Owner/Developer)

Substantial deviations from the approved plans and specifications:

---



---



---



---

**Certification of Completion of Construction for  
Drinking Water Distribution System Extension**

**II. Statement by Professional Engineer:**

I certify that the project has been completed substantially in accordance with the approved plans and specifications, or the deviations will not prevent the system from functioning in compliance with the requirements of Chapters 62-555 and 62-550, F.A.C., and/or the ECUA Engineering Manual. These determinations have been based upon on-site observation of construction, scheduled and conducted by me or by a project representative under my direct supervision, for the purpose of determining if the work proceeded in compliance with plans and specifications and application materials. I further certify that record drawings for the facilities have been reviewed by me, or by an individual(s) under my direct supervision, for completeness and adequacy, and have been proved to the permittee. I also certify that the new or altered water mains in this project have been disinfected and bacteriologically tested\* in accordance with Chapters 62-555, F.A.C. and applicable AWWA disinfection standards. I further certify that the record drawings identify those substantial deviations noted above.

_____ Signature Sealed with Embossed Seal	
_____ Printed Name	_____ Florida Registration Number
_____ Company Name (Print or Type)	
_____ Company Address (Print or Type)	
_____ Telephone Number	_____ Date
_____ Facsimile Number	_____ Date

*\*For all new and altered public drinking water facilities, bacteriological sampling shall be conducted by first reducing the total chlorine residual in the water within the facilities to no more than 4 mg/L and then collecting daily bacteriological samples (taken at least 24 hours apart) for two or more consecutive work-days until satisfactory test results are obtained. Bacteriological test results shall be considered satisfactory if two consecutive daily samples from each sample location show the absence of total coliform organisms. Bacteriological test results will be considered invalid if the results are for samples collected more than 30 days before the results are received ECUA, and if the pressure in the mains is not maintained at 20 psi or greater after the samples are collected.*

**III. Approval by ECUA:**

Drinking Water Zone: \_\_\_\_\_ North; \_\_\_\_\_ South; \_\_\_\_\_ Pensacola Beach; \_\_\_\_\_ Other

The release of these facilities for operation is hereby approved in accordance with ECUA's Memorandum of Agreement with the Florida Department of Environmental Protection for the ECUA to independently regulate the construction of water distribution and sewage collection and transmission mains and pump stations appurtenant to such force mains.

_____ Signature	
_____ Printed Name	
_____ Title	_____ Date



P.O. Box 15311 9255 Sturdevant St. Pensacola, FL 32514-0311 Phone: (850) 969-3310 Fax: (850) 969-6511

**Certification of Completion of Construction  
for an Extension to Emerald Coast Utilities Authority's  
Wastewater Collection/Transmission System**

**Instructions:** This form is to be completed and submitted to the ECUA Engineering Department along with one (1) set of record drawings, and other supporting documentation required below, **PRIOR TO PLACING THE SYSTEM INTO OPERATION.** A collection/transmission system should not be placed into service without prior written ECUA approval. All applicable blanks must be filled in.

**I. Project Information**

ECUA Submittal No.: \_\_\_\_\_

Project Name: \_\_\_\_\_

Location: \_\_\_\_\_

Date of connection to ECUA system: \_\_\_\_\_

Owner/Developer: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

**Required Attachments for ECUA Acceptance of Ownership and O&M of System:**

- Letter from Engineer of Record for corrected punch list items
- Two (2) sets of as-built plans completed by Engineer of Record and one (1) set on diskette in AutoCAD format, if available
- Form SD-3 – Certification of Developer Form, with an itemized Statement of Improvement values or cost, if applicable
- Recorded plat and/or any applicable easement forms (executed and recorded by the Owner/Developer)
- Test Results (if applicable)

Substantial deviations from the approved plans and specifications:

---



---



---



---

**Certification of Completion of Construction for  
Wastewater Collection/Transmission System**

**II. Statement by Professional Engineer:**

I certify that the project has been completed substantially in accordance with the approved plans and specifications, or the deviations will not prevent the system from functioning in compliance with the requirements of Chapter 62-604, F.A.C., and/or the ECUA Engineering Manual. These determinations have been based upon on-site observation of construction, scheduled and conducted by me or by a project representative under my direct supervision, for the purpose of determining if the work proceeded in compliance with plans and specifications and application materials. I further certify that record drawings for the facilities have been reviewed by me, or by an individual(s) under my direct supervision, for completeness and adequacy. I further certify that the record drawings identify those substantial deviations noted above.

_____ Signature Sealed with Embossed Seal	
_____ Printed Name	_____ Florida Registration Number
_____ Company Name (Print or Type)	
_____ Company Address (Print or Type)	
_____ Telephone Number	_____ Date
_____ Facsimile Number	_____ Date

**III. Approval by ECUA:**

The Water Reclamation Facility serving this system will be:

CWRP    Bayou Marcus    Pensacola Beach    Other (specify) \_\_\_\_\_

The release of these facilities for operation is hereby approved in accordance with ECUA's Memorandum of Agreement with the Florida Department of Environmental Protection for the ECUA to independently regulate the construction of water distribution and sewage collection and transmission mains and pump stations appurtenant to such force mains.

_____ Signature	
_____ Printed Name	
_____ Title	_____ Date

PROCEDURE 7  
EASEMENTS FOR ECUA UTILITIES

PURPOSE

This procedure establishes the process for acceptance of an easement by the ECUA.

I. GENERAL

- A. An easement is required for any water, sewer, or gas line which is not located in a public right-of-way, when said line is to be owned and maintained by the ECUA.
- B. Easements may be conveyed to the ECUA by either of the following methods.
  - 1. Recorded Plat
  - 2. Utility Easement Form
- C. ECUA may assist the developer in obtaining third-party easement(s) for secondary feed lines, by use of its governmental authority as provided by the Florida Statutes. Payment for acquisition of said easement(s) shall be the sole responsibility of the developer where the easement(s) is of primary benefit to the proposed development.

II. NEW CONSTRUCTION

- A. When reviewing the construction documents for new construction, the ECUA Engineering Department will notify the Engineer-of-Record which lines will require an easement granted to the ECUA.
- B. Upon completion of construction, no lines will be accepted by the ECUA until receipt of an easement approvable by ECUA's legal counsel or a copy of the recorded plat.
- C. Recorded Plat
  - 1. When a recorded plat is used to convey the easement, the Engineer-of-Record may request in writing the ECUA to accept the lines subject to the plat recording at the completion of all other City/County required improvements.
  - 2. ECUA will tentatively accept the lines subject to:
    - a. Recorded plat to be submitted within a specified

time, but not to exceed 3 months of date of acceptance.

- b. ECUA's approval of easement as shown on plat (a preliminary copy may be submitted to the ECUA Engineering Department prior to recording for approval).
  - c. Service connections to lines may be made but no service accounts will be accepted by the ECUA.
3. If recorded plat is not received within specified time, the ECUA will notify the Engineer-of-Record that the lines are not accepted by the ECUA for maintenance and that no further service connection will be allowed.
  4. The easement shall be clearly denoted on plat in relation to established benchmark or to the line itself.

#### D. Utility Easement Form

1. When a Utility Easement Form is used, it must be submitted to the ECUA Engineering Department for review.
2. The ECUA Engineering Department will forward copy to ECUA's legal counsel for review and approval.
3. The Utility Easement Form will be returned to the Engineer-of-Record for correction and/or revisions as determined by review and recording at County Courthouse.
4. Upon recording of easement, a copy will be returned to the ECUA before the line will be accepted.

### III. ABANDONMENT OF PUBLIC RIGHT-OF-WAY

- A. Utility Easement Form shall be used where a line is located in a public right-of-way which is to be abandoned.
- B. The form must be approved by the ECUA and its legal counsel prior to the ECUA approving the abandonment.
- C. The Utility Easement Form shall be recorded at the same time the abandonment is recorded at the Escambia County Courthouse.

## IV. PHYSICAL REQUIREMENTS

## A. Width

1. Where adjacent to a public right-of-way, a minimum width of 10 feet is required.
2. When not adjacent to a public right-of-way, a minimum width of 20 feet is required.

## B. Easements shall be continuously between:

1. Right-of-way to right-of-way,
2. Right-of-way to easement, or
3. Easement to easement.

## C. Easements should minimize corners, curves and other irregularities.

## D. The ECUA may require additional area where maintenance of line or structures dictate.

## V. STANDARD "UTILITY EASEMENT" FORM

## A. All easements shall be on standard form.

## B. The standard form consists of:

1. Information Sheet (1 page)
  - a. Address of Property
  - b. Type of Ownership
  - c. Name of Owner
  - d. Address of Owner
2. Easement (2 pages)
3. Signature and Seal (1 page)

## C. Signature Sheet - use appropriate page based on type of ownership.

## 1. Individuals

- a. If married, both husband and wife must execute.
- b. Signatures must be notarized.

## 2. Corporations

- a. Must be signed by the president or chief executive officer, or

- b. The easement must be accompanied by a resolution showing the authority of said officer to sign the easement on behalf of the corporation.
  - c. Include the corporate seal or signature of two witnesses.
  - d. Officer's signature must be notarized.
3. General Partnership
- a. Must be signed by a general partner.
  - b. Must be signed by two witnesses.
  - c. General partner's signature must be notarized.
4. Limited Partnership
- a. Must be signed by general partner.
  - b. Must be signed by two witnesses.
  - c. General partner's signature must be notarized.

EMERALD COAST UTILITIES AUTHORITY  
UTILITY EASEMENT

Date: \_\_\_\_\_

Type:    Individual       \_\_\_\_\_                    General Partnership \_\_\_\_\_  
          Corporation       X                      Limited Partnership \_\_\_\_\_

Name of Owner(s) \_\_\_\_\_

Address of Owner(s) \_\_\_\_\_

\_\_\_\_\_

Address of Property \_\_\_\_\_

\_\_\_\_\_

PREPARED BY: \_\_\_\_\_

Emerald Coast Utilities Authority  
P. O. Box 15311  
Pensacola, Florida 32514-5311

PROPERTY APPRAISER'S I.D. NO.: \_\_\_\_\_

UTILITY EASEMENT

STATE OF FLORIDA  
COUNTY OF ESCAMBIA

WHEREAS, \_\_\_\_\_, a  
corporation ("Grantor"), whose mailing address is \_\_\_\_\_  
\_\_\_\_\_, is the owner in fee  
simple of and has the right to convey an easement over, sell and  
convey certain real property hereinafter described; NOW,  
THEREFORE,

KNOW ALL MEN BY THESE PRESENTS that Grantor, for and in  
consideration of \$1.00 and other good and valuable  
consideration, in hand paid by the Emerald Coast Utilities  
Authority, a governmental body corporate and politic of the  
State of Florida ("Grantee"), whose mailing address is 9255  
Sturdevant Street, Pensacola, FL 32514, the receipt of which is  
hereby acknowledged, does hereby grant, bargain, sell and convey  
unto Grantee, its successors and assigns, forever, the perpetual  
right and easement to enter upon, occupy and use the following  
described real property for the purpose of utility lines and all  
facilities and equipment necessary or convenient in connection  
therewith, together with the right to lay, bury, construct,  
operate, maintain, dig up and repair such lines, facilities and  
equipment from time to time, together with all rights and  
privileges necessary or convenient for full enjoyment and use  
thereof for the aforesaid purposes, including the right of  
ingress and egress thereto and therefrom. If no legal  
description is entered below, then the legal description shall  
be that description contained in the attached Exhibit "A"  
consisting of one (1) page, which is incorporated herein and  
made a part hereof by reference.

The Grantor and the Grantee intend that the Grantor convey to the Grantee an easement and all the above-mentioned rights and privileges pertaining thereto with respect to a certain utility line or lines and related facilities which have been accepted or which it is anticipated will be accepted by the Grantee. In the event of any discrepancy between the actual location of such line or lines and facilities and the above-mentioned legal description, the actual location shall control to the extent of such discrepancy and said legal description shall be deemed to have been modified so that the centerline of the property subject to this easement shall coincide with the centerline of said utility line or lines, and the Grantor for itself, its successors and assigns, agrees to execute such corrective instruments as the Grantee may request.

In executing the above easement, the Grantor and the Grantee hereby covenant and agree that the above described property shall not be used for any purpose inconsistent with the location, construction, operation and maintenance of utility lines and facilities.

The Grantor for itself, its successors and assigns, hereby covenants and agrees that no building or other permanent structure shall be erected over or upon the easement area. Easily removable improvements such as paving, may be constructed with the prior consent of the Grantee, and the Grantor for itself, its successors and assigns, hereby covenants and agrees to pay the cost of any repair or replacement of such improvements which may be required as a result of Grantee's uncovering any of its utility lines or related facilities or exercising any of the other rights granted.

To HAVE AND TO HOLD the same rights and easements unto the Grantee, its successors and assigns, forever.

IN WITNESS WHEREOF, the said corporation, in pursuance of due and legal action of its stockholders and Board of Directors, has executed these presents, causing its name to be signed by its \_\_\_\_\_ President, and its corporate seal to be affixed hereto this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

\_\_\_\_\_  
A Corporation

[ CORPORATE SEAL ]

Signed, sealed and delivered  
in the presence of:

\_\_\_\_\_  
(signature)

By: \_\_\_\_\_  
(signature of grantor)

\_\_\_\_\_  
(name - printed or typed)

\_\_\_\_\_  
(name - printed or typed)

\_\_\_\_\_  
\_\_\_\_\_  
(signature)

(Title)

\_\_\_\_\_  
(name - printed or typed)

STATE OF FLORIDA  
COUNTY OF ESCAMBIA

The foregoing instrument was acknowledged before me this  
\_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by  
\_\_\_\_\_  
(name of officer)

as \_\_\_\_\_ of  
\_\_\_\_\_  
(office) (name of corporation)

a Florida corporation on behalf of the corporation. He/She is personally known to me or has produced \_\_\_\_\_ as identification and did not take an oath.

\_\_\_\_\_  
Notary Public

[ NOTARY SEAL ]

My commission expires: \_\_\_\_\_

\_\_\_\_\_  
(name - printed or typed)

**EMERALD COAST UTILITIES AUTHORITY  
UTILITY EASEMENT**

Date: \_\_\_\_\_

Type:	Individual	_____	General Partnership	<u>  X  </u>
	Corporation	_____	Limited Partnership	_____

Name of Owner(s) \_\_\_\_\_

Address of Owner(s) \_\_\_\_\_

\_\_\_\_\_

Address of Property \_\_\_\_\_

\_\_\_\_\_

PREPARED BY: \_\_\_\_\_

Emerald Coast Utilities Authority  
P.O. Box 15311  
Pensacola, Florida 32514-5311

PROPERTY APPRAISER'S I.D. NO.: \_\_\_\_\_

**UTILITY EASEMENT**

STATE OF FLORIDA  
COUNTY OF ESCAMBIA

WHEREAS, \_\_\_\_\_, a general partnership ("Grantor"), whose mailing address is \_\_\_\_\_, is the owner in fee simple of and has the right to convey an easement over, sell and convey certain real property hereinafter described; NOW, THEREFORE,

KNOW ALL MEN BY THESE PRESENTS that Grantor, for and in consideration of \$1.00 and other good and valuable consideration, in hand paid by the **Emerlad Coast Utilities Authority**, a governmental body corporate and politic of the State of Florida ("Grantee"), whose mailing address is 9255 Sturdevant Street, Pensacola, FL 32514, the receipt of which is hereby acknowledged, does hereby grant, bargain, sell and convey unto Grantee, its successors and assigns, forever, the perpetual right and easement to enter upon, occupy and use the following described real property for the purpose of utility lines and all facilities and equipment necessary or convenient in connection therewith, together with the right to lay, bury, construct, operate, maintain, dig up and repair such lines, facilities and equipment from time to time, together with all rights and privileges necessary or convenient for full enjoyment and use thereof for the aforesaid purposes, including the right of ingress and egress thereto and therefrom. If no legal description is entered below, then the legal description shall be that description contained in the attached Exhibit "A" consisting of \_\_\_ (\_\_) page(s), which is incorporated herein and made a part hereof by reference.

7.5g

The Grantor and the Grantee intend that the Grantor convey to the Grantee an easement and all the above-mentioned rights and privileges pertaining thereto with respect to a certain utility line or lines and related facilities which have been accepted or which it is anticipated will be accepted by the Grantee. In the event of any discrepancy between the actual location of such line or lines and facilities and the above-mentioned legal description, the actual location shall control to the extent of such discrepancy and said legal description shall be deemed to have been modified so that the centerline of the property subject to this easement shall coincide with the centerline of said utility line or lines, and the Grantor for itself, its successors and assigns, agrees to execute such corrective instruments as the Grantee may request.

In executing the above easement, the Grantor and the Grantee hereby covenant and agree that the above described property shall not be used for any purpose inconsistent with the location, construction, operation and maintenance of utility lines and facilities.

The Grantor for itself, its successors and assigns, hereby covenants and agrees that no building or other permanent structure shall be erected over or upon the easement area. Easily removable improvements such as paving, may be constructed with the prior consent of the Grantee, and the Grantor for itself, its successors and assigns, hereby covenants and agrees to pay the cost of any repair or replacement of such improvements which may be required as a result of Grantee's uncovering any of its utility lines or related facilities or exercising any of the other rights granted.

To HAVE AND TO HOLD the same rights and easements unto the Grantee, its successors and assigns, forever.

7.5h

IN WITNESS WHEREOF, the said general partnership has executed these presents, causing its name to be signed by its General Partner this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

Partnership

\_\_\_\_\_ A \_\_\_\_\_ General

Signed, sealed and delivered in the presence of:

\_\_\_\_\_  
(signature)  
Partner)

By: \_\_\_\_\_  
(signature of General

\_\_\_\_\_  
(name - printed or typed)

\_\_\_\_\_  
(name - printed or typed)

\_\_\_\_\_  
(signature)

\_\_\_\_\_  
(Title)

\_\_\_\_\_  
(name - printed or typed)

STATE OF FLORIDA  
COUNTY OF ESCAMBIA

The foregoing instrument was acknowledged before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_, by \_\_\_\_\_ (name of General Partner signing this easement), General Partner of \_\_\_\_\_ (name of partnership), a \_\_\_\_\_ (state) general partnership, on behalf of that partnership. He/She is personally known to me or has produced \_\_\_\_\_ as identification and did not take an oath.

[ NOTARY SEAL ]

\_\_\_\_\_  
Notary Public  
My commission expires: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_  
(name - printed or typed)

7.5i

**EMERALD COAST UTILITIES AUTHORITY  
UTILITY EASEMENT**

Date: \_\_\_\_\_

Type:    Individual      X      General Partnership    \_\_\_\_\_  
         Corporation    \_\_\_\_\_    Limited Partnership    \_\_\_\_\_

Name of Owner(s) \_\_\_\_\_

Address of Owner(s) \_\_\_\_\_

\_\_\_\_\_

Address of Property \_\_\_\_\_

\_\_\_\_\_

PREPARED BY: \_\_\_\_\_

\_\_\_\_\_  
Emerald Coast Utilities Authority  
P.O. Box 15311  
Pensacola, Florida 32514-5311

PROPERTY APPRAISER'S I.D. NO.: \_\_\_\_\_

**UTILITY EASEMENT**

STATE OF FLORIDA  
COUNTY OF ESCAMBIA

WHEREAS, \_\_\_\_\_, an individual ("Grantor"), whose mailing address is \_\_\_\_\_, is the owner in fee simple of and has the right to convey an easement over, sell and convey certain real property hereinafter described; NOW, THEREFORE,

KNOW ALL MEN BY THESE PRESENTS that Grantor, for and in consideration of \$1.00 and other good and valuable consideration, in hand paid by the **Emerald Coast Utilities Authority**, a governmental body corporate and politic of the State of Florida ("Grantee"), whose mailing address is 9255 Sturdevant Street, Pensacola, FL 32514, the receipt of which is hereby acknowledged, does hereby grant, bargain, sell and convey unto Grantee, its successors and assigns, forever, the perpetual right and easement to enter upon, occupy and use the following described real property for the purpose of utility lines and all facilities and equipment necessary or convenient in connection therewith, together with the right to lay, bury, construct, operate, maintain, dig up and repair such lines, facilities and equipment from time to time, together with all rights and privileges necessary or convenient for full enjoyment and use thereof for the aforesaid purposes, including the right of ingress and egress thereto and therefrom. If no legal description is entered below, then the legal description shall be that description contained in the attached Exhibit "A" consisting of one (1) page, which is incorporated herein and made a part hereof by reference.

The Grantor and the Grantee intend that the Grantor convey to the Grantee an easement and all the above-mentioned rights and privileges pertaining thereto with respect to a certain utility line or lines and related facilities which have been accepted or which it is anticipated will be accepted by the Grantee. In the event of any discrepancy between the actual location of such line or lines and facilities and the above-mentioned legal description, the actual location shall control to the extent of such discrepancy and said legal description shall be deemed to have been modified so that the centerline of the property subject to this easement shall coincide with the centerline of said utility line or lines, and the Grantor for itself, its successors and assigns, agrees to execute such corrective instruments as the Grantee may request.

In executing the above easement, the Grantor and the Grantee hereby covenant and agree that the above described property shall not be used for any purpose inconsistent with the location, construction, operation and maintenance of utility lines and facilities.

The Grantor for itself, its successors and assigns, hereby covenants and agrees that no building or other permanent structure shall be erected over or upon the easement area. Easily removable improvements such as paving, may be constructed with the prior consent of the Grantee, and the Grantor for itself, its successors and assigns, hereby covenants and agrees to pay the cost of any repair or replacement of such improvements which may be required as a result of Grantee's uncovering any of its utility lines or related facilities or exercising any of the other rights granted.

To HAVE AND TO HOLD the same rights and easements unto the Grantee, its successors and assigns, forever.

IN WITNESS WHEREOF, the Grantor has hereunto set (his, her their) hand(s) and seal this \_\_\_\_ day of \_\_\_\_\_ , 20\_\_.

Signed, sealed and delivered  
in the presence of:

\_\_\_\_\_  
(signature)

By: \_\_\_\_\_  
(signature of grantor)

\_\_\_\_\_  
(name - printed or typed  
typed)

\_\_\_\_\_  
(name - printed or

\_\_\_\_\_  
(signature)

\_\_\_\_\_  
(name - printed or typed)

STATE OF FLORIDA  
COUNTY OF ESCAMBIA

The foregoing instrument was acknowledged before me this \_\_\_\_ day of \_\_\_\_\_, 20\_\_, by \_\_\_\_\_. He/She is personally known to me or has produced \_\_\_\_\_ as identification and did not take an oath.

[ NOTARY SEAL ]

\_\_\_\_\_  
Notary Public  
My commission expires:\_\_\_\_\_

\_\_\_\_\_  
(name - printed or typed)

7.5c

**EMERALD COAST UTILITIES AUTHORITY  
UTILITY EASEMENT**

Date: \_\_\_\_\_

Type:    Individual        \_\_\_\_\_        General Partnership        \_\_\_\_\_  
         Corporation        \_\_\_\_\_        Limited Partnership          X  

Name of Owner(s) \_\_\_\_\_

Address of Owner(s) \_\_\_\_\_

\_\_\_\_\_

Address of Property \_\_\_\_\_

\_\_\_\_\_

PREPARED BY: \_\_\_\_\_

Emerald Coast Utilities Authority  
P.O. Box 15311  
Pensacola, Florida 32514-5311

PROPERTY APPRAISER'S I.D. NO.: \_\_\_\_\_

**UTILITY EASEMENT**

STATE OF FLORIDA  
COUNTY OF ESCAMBIA

WHEREAS, \_\_\_\_\_, a limited partnership ("Grantor"), whose mailing address is \_\_\_\_\_, is the owner in fee simple of and has the right to convey an easement over, sell and convey certain real property hereinafter described; NOW, THEREFORE,

KNOW ALL MEN BY THESE PRESENTS that Grantor, for and in consideration of \$1.00 and other good and valuable consideration, in hand paid by the **Emerald Coast Utilities Authority**, a governmental body corporate and politic of the State of Florida ("Grantee"), whose mailing address is 9255 Sturdevant Street, Pensacola, FL 32514, the receipt of which is hereby acknowledged, does hereby grant, bargain, sell and convey unto Grantee, its successors and assigns, forever, the perpetual right and easement to enter upon, occupy and use the following described real property for the purpose of utility lines and all facilities and equipment necessary or convenient in connection therewith, together with the right to lay, bury, construct, operate, maintain, dig up and repair such lines, facilities and equipment from time to time, together with all rights and privileges necessary or convenient for full enjoyment and use thereof for the aforesaid purposes, including the right of ingress and egress thereto and therefrom. If no legal description is entered below, then the legal description shall be that description contained in the attached Exhibit "A" consisting of \_\_\_ (\_\_) page(s), which is incorporated herein and made a part hereof by reference.

The Grantor and the Grantee intend that the Grantor convey to the Grantee an easement and all the above-mentioned rights and privileges pertaining thereto with respect to a certain utility line or lines and related facilities which have been accepted or which it is anticipated will be accepted by the Grantee. In the event of any discrepancy between the actual location of such line or lines and facilities and the above-mentioned legal description, the actual location shall control to the extent of such discrepancy and said legal description shall be deemed to have been modified so that the centerline of the property subject to this easement shall coincide with the centerline of said utility line or lines, and the Grantor for itself, its successors and assigns, agrees to execute such corrective instruments as the Grantee may request.

In executing the above easement, the Grantor and the Grantee hereby covenant and agree that the above described property shall not be used for any purpose inconsistent with the location, construction, operation and maintenance of utility lines and facilities.

The Grantor for itself, its successors and assigns, hereby covenants and agrees that no building or other permanent structure shall be erected over or upon the easement area. Easily removable improvements such as paving, may be constructed with the prior consent of the Grantee, and the Grantor for itself, its successors and assigns, hereby covenants and agrees to pay the cost of any repair or replacement of such improvements which may be required as a result of Grantee's uncovering any of its utility lines or related facilities or exercising any of the other rights granted.

To HAVE AND TO HOLD the same rights and easements unto the Grantee, its successors and assigns, forever.

IN WITNESS WHEREOF, the said limited partnership has executed these presents, causing its name to be signed by its General Partner this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
A \_\_\_\_\_ Limited

Partnership

Signed, sealed and delivered in the presence of:

\_\_\_\_\_  
(signature)  
Partner)

By: \_\_\_\_\_  
(signature of General

\_\_\_\_\_  
(name - printed or typed)  
typed)

\_\_\_\_\_  
(name - printed or

\_\_\_\_\_  
(signature)

\_\_\_\_\_  
(Title)

\_\_\_\_\_  
(name - printed or typed)

STATE OF FLORIDA  
COUNTY OF ESCAMBIA

The foregoing instrument was acknowledged before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_, by

\_\_\_\_\_  
(name of General Partner), General Partner of \_\_\_\_\_, (name of partnership), a \_\_\_\_\_ (state) limited partnership, on behalf of that partnership. He/She is personally known to me or has produced \_\_\_\_\_ as identification and did not take an oath.

[ NOTARY SEAL ]

\_\_\_\_\_  
Notary Public  
My commission expires:\_\_\_\_\_

\_\_\_\_\_  
(name - printed or typed)

PROCEDURE 8  
NEW PRODUCT APPROVAL

PURPOSE

This procedure establishes the process by which new products may be approved by ECUA for use within the system.

I. Definitions

- A. NEW PRODUCTS - New or changed material or equipment whose specifications differ from that which is contained in "Construction Specifications and Details", and if approved would require the specifications to be changed by addition, deletion, or modification.
- B. EQUAL - A new product that meets the existing specifications and desires approval on an "or equal" basis.
- C. The ECUA Engineering Department will promptly issue a letter of "acceptability" or a letter of "denial" with an explanation.

II. "EQUAL" APPROVAL

- A. The request for approval on an "equal" basis may be submitted by Developer, Engineer, Contractor, Distributor, or Manufacturer.
- B. The request shall include:
  - 1. Product specifications and data sheet.
  - 2. Local availability and service.
  - 3. References from other locations where used.
  - 4. Descriptive narrative explaining why product is equal to specified product.
- C. The ECUA Engineering Department will promptly issue a letter of acceptability or a letter of denial with an explanation.

III. CONDITIONAL APPROVAL

- A. The request for "conditional approval" shall be submitted by a Developer, Engineer, or Contractor for use on a specific project to the Engineer-of-Record who will assemble all pertinent information prior to submitting the request for "conditional approval" to the ECUA Engineering Department. The information, in duplicate, shall include, but not be limited to the following:

1. Product specifications and/or data sheet.
  2. Analysis of how it differs from ECUA specifications.
  3. Evaluation of its functional ability.
  4. Economic justification for use.
  5. Local availability and service.
  6. References from others who have or do use.
- B. The ECUA Engineering Department will promptly make an evaluation of submitted information, sending a copy to the responsible operating department. The response to the Engineer-of-Record will be a letter as follows:
1. A favorable response would authorize the new product to be used on the specific project as requested, and may contain some conditions, such as specific testing or inspections; and a time frame for full acceptance with inclusion in specifications.
  2. An unfavorable response could be a rejection or merely a request for added information and will contain an explanation.
- C. If a "conditional approval" is given in III.B.1., it will be for a specific project only and each time it is requested to be used a new approval must be obtained until the time or testing period previously established has been met. At that time a request for "final approval" may be submitted. Response to follow:
1. A letter of "final approval" will be issued if after review of available information which may include additional inspections or testing, it is determined that inclusion in ECUA specifications is warranted.
  2. A letter of rejection or continuation of conditional approval will be issued if the results of V., A. would so indicate.
- D. If "final approval" has been issued as in III.C.1., the appropriate sections of "Construction Specifications" will be revised and available for the next edition of the Manual.

PROCEDURE 9  
CHANGE ORDERS

PURPOSE

This procedure establishes steps for implementing and processing change orders of ECUA funded projects.

I. Initiation

- A. Change Orders will be required for any additions, deletions or revisions in the work as contracted and previously approved that affect function, costs or time. The Engineer-of-Record may authorize minor changes in the work which are consistent with the overall intent of the contract documents.
- B. Change orders may be initiated by the Contractor, Engineer-of-Record or the ECUA, but it will be the Engineer-of-Record's responsibility to complete the required form and obtain approvals as necessary.

II. Submittals

- A. Change orders will be submitted to the ECUA Engineering Department using ECUA Change Order Form E 2.1. The form shall be carefully completed, making sure to include justification of changes. The following attachments should be included when appropriate:
  - 1. Basis for costs (increases, decreases or balance)
  - 2. Revised plans
  - 3. Catalogue cuts or data sheets (equipment)
  - 4. Other support documentation
- B. Upon receipt, the ECUA Engineering Department will promptly review the requested changes with due regard toward functional compatibility with other systems and budgeting constraints.

III. ECUA Action

- A. Action to be taken by the ECUA Engineering Department:
  - 1. Approve as submitted. ECUA Executive Director or his

designee will sign at appropriate place and the copies will be returned to Engineer-of-Record for distribution.

2. Hold for additional information, by requesting in writing required clarification and/or supporting documents.
  3. Reject with explanation back to Engineer-of-Record.
- B. When change order is fully approved and signed, a copy will be distributed to all participating parties and become a part of the project documents. Subsequent progress pay requests and/or final pay request will so reflect the changes as will the "as-built" drawings.

NOTE: Change Orders in excess of \$4,999 require ECUA Board approval.



PROCEDURE 10  
PAY REQUEST SUBMITTALS

PURPOSE

This procedure establishes steps for processing pay requests or invoices for progress or final payment of an engineering service or construction contract with the ECUA.

I. Engineering Service Payment Request

Engineering Service Payment Requests will be submitted to the ECUA Engineering Department in duplicate on the Engineer's letterhead or normal invoice and shall show:

- A. Project Title and/or Description
- B. Project Number (ECUA and Engineer's)
- C. Chargeable Elements from Contract with Dollar Amounts
- D. Accumulative Charges for Each Element
- E. Accumulative Total Charges
- F. Retainage as Stipulated in Contract, Percentage and Dollar Amount
- G. Accumulative Amount Due This Request
- H. Accumulative Previous Payments
- I. Net Amount Due This Request
- J. If it is not clear from (C) and (D), a brief description and breakdown of the work and charges for current period will be included. (Separate Page).

II. Construction Contracts

- A. Construction contracts with Consulting Engineer acting in the capacity of "Engineer".
  1. The Contractor will submit to the "Engineer" in triplicate on the Contractor's letterhead or normal invoice, the request for payment and shall show:
    - a. Project title and/or description
    - b. Project number (ECUA and Engineer's)
    - c. Accumulative total charges
    - d. Retainage as stipulated in contract, percentage and dollar amount
    - e. Stored material for which payment is requested
    - f. Accumulative amount due this request
    - g. Accumulative previous payments
    - h. Net amount due this request
    - i. In addition, the Contractor will supply the

following additional information:

- (i) For a unit price contract or a lump sum contract with required itemization of project elements: Complete a detail "Periodic Estimate for Partial Payment" form such as form HUD-4207.
  - (ii) For a lump sum contract without itemization requirement, a brief description of work completed during the current period will be included on a separate page.
2. The Engineer upon receipt, and within the time allowed by Contract, will carefully review the Contractor's request as to accuracy and the reasonableness of the estimates.
  3. The payment request may be returned to Contractor if review indicates inaccurate and incorrect estimates.
    - a. The Engineer will then transmit the above to the ECUA Engineering Department with his recommendation.
    - b. Any minor corrections or changes will be worked out with Contractor before forwarding to ECUA.
    - c. Any significant corrections or changes will necessitate a rejection back to Contractor with copy to ECUA.
- B. Construction Contracts with the ECUA, Engineering Department acting as "Engineer".
1. The Contractor shall submit directly to ECUA Engineering Department the same information as noted in II., A., 1. above.
  2. The Engineer upon receipt and within the time allowed by Contract, will carefully review the Contractor's request as to accuracy and the reasonableness of the estimates.
  3. The payment request may be returned to Contractor if review indicates inaccurate and incorrect estimates.

### III. Review

The ECUA Engineering Department upon receipt of an approvable pay request:

- A. Will prepare an internal Voucher to be submitted to Finance through the Engineering Department Director. The Voucher in addition to stating the amount and to whom to be paid, will make reference to budget authorization, ECUA Board authorization and the time frame in which payment must be made in accordance with the Contract.
- B. Any minor corrections or changes will be worked out with the Engineer or Contractor prior to vouchering.

### IV. Final Pay Request

In addition to requirements previously stipulated, final payment requests must include: 1) Release of Lien and 2) Warranties; properly executed.

DESIGN STANDARDSFORWARD

The following standards are intended as a guide to the design engineer in the preparation of plans for water and wastewater improvements. While the design standards given are intended as minimum design criteria, it is recognized that there may be individual instances where a less stringent criteria may be approved without affecting the integrity of the system. An example would be the use of a water main less than 6-inch diameter to serve a cul-de-sac where adequate fire protection is available and a short dead end line is acceptable. The ECUA Engineering Department will consider deviations from these standards on a case-by-case basis.

SECTION 101PLAN PREPARATION STANDARDSPART 1: GENERAL

- 1.01 All plans submitted to ECUA for review shall comply with these standards for preparation.
- 1.02 The design shall be shown in sufficient detail to insure the intended construction. Anticipate problems and design a solution. All work shall be constructed in accordance with the latest edition of ECUA's Standard Specifications.
- 1.03 The plans shall be clean, legible, and free from smudges. Any plans which cannot readily be read will be rejected.

PART 2: PLAN MAKEUP2.01 General:

- A. All plans shall be submitted on standard engineering sheets of 24 inch by 36 inch.
- B. Lettering shall be of appropriate size.
- C. Plan sets shall consist of:
1. Cover sheet
  2. Location map
  3. Project map
  4. Design sheets
  5. Detail sheets
- D. All design and detail sheets shall have the following note in the upper right hand corner: "All work shall be constructed in accordance with the \_\_\_\_\_ edition of ECUA's Standard Specifications".
- E. Title block to be shown on all sheets except cover sheet, and shall include:
1. Project name
  2. Sheet title
  3. Engineer
  4. Date prepared
  5. Date revised
  6. Sheet number (sequential)

2.02 Cover Sheet to Include:

- A. Project Title.
- B. Identify ECUA and list Board members at time of bidding. (ECUA funded projects only).
- C. Developer and Engineer or Engineer.
- D. Project Number or Identification.
- E. Type of Project (if not clear in title).
- F. Date(s) of Design or Submittal and Subsequent Revisions.

2.03 Location Map Shall Include:

- A. Map of project area and area surrounding to easily identify location of project (minimum of 1/2 mile radius) at a scale of 1 inch = 1000 ft (min.), show graphically.
- B. North arrow (north to be between 0° and 90°).
- C. Title Block.

2.04 Project Map Shall Include:

- A. Map of project at 1 inch = 200 feet or other appropriate scale as approved by Director of Engineering. Show graphically.
- B. Index of Design Sheets in an appropriate manner.
- C. North arrow (north to be between 0° and 90°).
- D. General notes needed by field crew.
- E. Title block.
- F. Location map and Project map may be combined on single sheet if project size permits.

2.05 Design Sheets Shall Include:

- A. North arrow (north to be between 0° and 90°).
- B. Scale: show numerically and graphically, not less than 1 inch = 50 ft. horizontal 1 inch = 5 ft. vertical

- C. Title block.
- D. The following items will be shown on both Plan and Profile:
1. Pipe with size and material, to be installed.
  2. Show and locate all appurtenances (bends, T's, X's, valves, hydrants, manholes, services, etc.)
  3. At all road or paving crossing show if "opens cut" will be allowed; if not, show length, depth and size of pipe or casing to be bored or jacked.
  4. Special notes for construction that are specific to that sheet.
  5. Circle and reference items for which a detail is provided. Show on same sheet if possible; otherwise, see 2.06 below.
  6. Bench mark - minimum one per sheet.
  7. Match line with station for continued sheets.
  8. Boring location and results (if available).
- E. Plan view of project shall also include:
1. Stationing along centerline at 100 feet increments. May use survey baseline stationing if very close to pipeline. Restrict use of station equations.
  2. Location of other utilities within 20 feet of project or that may otherwise conflict with project.
  3. Poles, trees, structures, roads, etc. that may conflict with project.
  4. Property lines, ROW lines, easements (both temporary and permanent), which are existing and proposed.
  5. Topographical features, such as ditches, embankments, etc.
- F. Profile View of Project Shall Also Include:

1. Ground surface elevation as existing and as final if different.
2. Type and depth of underground utilities and other features that will be crossed or that might otherwise cause a problem.
3. Ground water elevations if known.
4. Stream or water crossings with stream bed elevations and the normal and extreme high and low water levels.

2.06 Detail Sheets: Shall be used when necessary for clarity of work and will include:

- A. Appropriate Scale
- B. Label
- C. Elevations
- D. Dimensions
- E. Other Information as Appropriate
- F. Title Block

PART 3: SPECIAL REQUIREMENTS

- 3.01 Water plans shall also clearly identify the intended depth of cover at least twice on each sheet.
- 3.02 Wastewater plans shall also clearly identify:
- A. The invert of each pipe in each manhole.
  - B. The calculated slope of each section.
  - C. The final rim elevation of each manhole and the type rim if other than standard (locking, waterproof, etc.).
  - D. The size (inside diameter) of each manhole and anything special, such as drop (inside or outside), shallow (flat top), etc., if different than standard size.

## **SECTION 556 - POTABLE WATER SYSTEM DESIGN STANDARDS**

---

### **PART 1: GENERAL**

#### **1.1 GENERAL**

All potable water distribution systems which are to be extensions to the ECUA system shall be designed and constructed in accordance with these Standards. Potable water distribution systems include transmission and distribution mains, service lines, valves, fire hydrants, meters and other appurtenances. Water system materials, installation, and construction methods and procedures shall be in accordance with current ECUA Specifications. Technical Specifications for Water Transmission, Distribution and Service Lines are included in Section 2556 of this Manual.

#### **1.2 MINIMUM REQUIREMENTS**

Proposed extensions to the water distribution system shall be considered minimum requirements, unless otherwise noted. The Design Standards outlined in this Manual are intended to provide an adequate supply of potable water to consumers, and fire protection at all times, at pressures and flows as required by Code.

All proposed system expansions shall be compatible with the Water Master Plan as maintained and amended by ECUA.

#### **1.3 DEVIATIONS**

Deviations from these Standards may be allowed by ECUA upon a finding by ECUA that, in accordance with sound engineering principles, the granting of the deviation will not result in an increase in the likelihood of a system failure. Proposed deviations shall be clearly noted on the Construction Plans and explained in an Engineering Report prepared by the Engineer-of-Record. Subsequent approval of proposed deviations from these Standards is at ECUA's sole discretion.

### **PART 2: OTHER STANDARDS**

#### **2.1 GENERAL**

ECUA's Potable Water System Design Standards may differ from the requirements of other local, state, and federal agencies. The more stringent requirement shall apply.

**2.2 FEDERAL AGENCIES**

The governing Standards of federal agencies such as the Environmental Protection Agency, and the U.S. Public Health Service shall be followed when applicable.

**2.3 STATE AGENCIES**

The potable water distribution system shall conform to the applicable Florida Departments of Environmental Protection and Health and Rehabilitative Services statutes, policies, standards, rules, and regulations for public water systems.

**2.4 PLUMBING CODES**

The provisions of the Plumbing Code of the City of Pensacola or Escambia County as they pertain to water supply and distribution, service locations and materials, and backflow prevention devices, except as provided for elsewhere in this Manual, shall apply.

**PART 3: WATER DISTRIBUTION SYSTEM DESIGN STANDARDS**

**3.1 FLOW REQUIREMENTS**

In sizing extensions to the water distribution system, the minimum required design flow shall be the sum of the required fire flow plus two-thirds (2/3) of the required domestic flow.

**A. Required Domestic Flow**

1. Required flow for domestic use in residential areas shall be in accordance with the following table:

<b>TABLE 556.1 - REQUIRED DOMESTIC WATER SUPPLY</b>						
MINIMUM SUPPLY, GPM PER DWELLING UNIT						
MAX. NO. DWELLING UNITS	SINGLE FAMILY DETACHED	MULTI-FAMILY		MOBILE HOMES		RETIREMENT SINGLE FAMILY
		2 BDR M	1 BDRM	2 BDRM	1 BDRM	2 BDRM (MAX)
50	4.0	3.6	3.4	3.2	3.0	2.6
100	3.0	2.7	2.6	2.4	2.3	2.0
200	2.0	1.8	1.7	1.6	1.5	1.3
200+	1.5	1.4	1.3	1.2	1.1	1.0

**NOTE: Multi-family, mobile home, or retirement units consisting of more than 2 bedrooms shall be considered as single-family detached.**

2. The required flow for commercial, industrial, or other nonresidential areas shall be as determined by the Engineer-of-Record and approved by the ECUA for each specific instance. **NOTE:** Fixture Values as contained in the Southern Standard Building Code Chapter XIII, Section 1304 may be used as a guide.

**B. Required Fire Flow**

1. The required design fire flow for residential areas shall be 600 gpm for each hydrant flowing individually with a minimum residual pressure of 20 psig.
2. The required fire flow for areas other than residential shall be as determined by the appropriate governing authority.
3. ECUA will, on request, provide the designer with available system data.

**3.2 GRID SYSTEM LAYOUT**

**A. Grid System**

All mains shall be interconnected to form a grid system. Six-inch mains shall be placed to form grids of 1,000 feet x 1,000 feet or less. In no case should 6-inch mains be installed such that there is more than 1,320 feet of line between grid interconnections unless authorized by the ECUA. Eight-inch mains shall form grids no greater than 4,000 feet x 8,000 feet. When larger grids are necessary, larger diameter pipes shall be used. Four-inch mains may also be used to form localized grid interconnections where appropriate.

**B. Dead-Ends**

If the installation of a "dead-end" main cannot reasonably be avoided, its dead-end length shall not exceed 1,000 feet unless authorized by the ECUA. All dead-end mains shall have a permanent flushing hydrant with provision for future ties into adjacent properties in accordance with Section 3.2E below, when appropriate.

C. **Single Connection**

A development to be supplied by the ECUA water system, and designed for no more than 25 single family dwellings, may have a single connection to the distribution system if connecting to a larger main. If connection is to an equal size or smaller main, then a multiple connection will be required in accordance with Section 3.2 D.

D. **Multiple Connection**

A development to be supplied by the ECUA water system and designed for more than twenty-five single family dwellings, shall have two (2) or more connections to the distribution system. A single connection may be made by using a pipe diameter sufficient to provide one and one-half (1-1/2) times the required flow with provisions for future connections, provided approval of the ECUA is obtained.

E. **Future Interconnections**

Provisions for future connecting mains shall be made by extending construction of all water mains to the exterior boundaries of the development wherever future connections to adjacent properties are anticipated or are required to form a grid system.

3.3

**WATER LINE SIZING**

Distribution mains shall be of sufficient size to furnish the required flow at pressures and velocities as herein provided. Mains shall be located to provide service to each metered unit within a development and to form a looped network as provided above.

A. **Required Pressure**

The system shall be designed such that the water pressure at all points in the distribution system shall not be less than 35 pounds per square inch with no fire hydrant in use. Water pressure in the main at ground level shall not be less than 20 pounds per square inch under all conditions, inclusive of fire flows.

**NOTE:** When the water pressure exceeds 80 pounds per square inch, there shall be installed and maintained by the customer, on the property side of the water meter, an approved pressure regulator in conformance with the Southern Building Code and other applicable codes.

**B. Standard Sizes**

Distribution mains used shall have nominal diameters of 2, 3, 4, 6, 8, 12 and 16 inches.

**C. Minimum Main Size**

Minimum distribution main diameter shall be 4 inches in single family residential areas where fire hydrants are not required, and 6 inches in all other areas. Exception: 3-inch mains may be used around cul-de-sacs serving no more than 10 residences, and 2-inch mains may be used for cul-de-sacs serving no more than 4 residences.

**D. Velocity**

Velocities of water for the non-fire flow conditions in the distribution mains shall not exceed 6 feet per second.

<b>TABLE 3.3 - APPROXIMATE CAPACITIES AND HEAD LOSS OF PIPES @ MAXIMUM DESIGN VELOCITY</b>			
<b>Size</b>	<b>Flow (gpm) at 6 fps</b>	<b>Head Loss C900 Pipe (c=130) ft/1000 ft</b>	<b>psi/1000 ft</b>
4"	235	39	17
6"	530	22	10
8"	950	15	6.5
12"	2100	10	4
16"	3700	7	3

**3.4 WATER LINE PLACEMENT**

**A. Location**

All mains to be accepted by ECUA shall be installed only in dedicated streets, alleys, public right-of-ways, utility easements, or on land owned by ECUA.

**B. Alignment**

Water mains shall be designed to be parallel to the adjoining pavement and/or right-of-way line to the extent practical. In order to keep the main within its desired alignment within the right-of-way or easement, the main may be deflected, or may require standard fittings. Standard fittings are available as 11¼-degree, 22½-degree or 45-degree bends. Joint deflection should be used in preference to fittings.

1. **Deflection**

Deflections of 1 to 5 degrees may be permitted with standard or special pipe joints in accordance with the manufacturer's specifications. Deflections should be made as small as possible at successive joints.

2. **Curving**

Curving of pipe may be permitted in lieu of standard fittings or joint deflection in small diameter pipes (3-inch and less). The radius of the pipe curve shall be not less than 40 feet for 2-inch pipe and 58 feet for 3-inch pipe.

- C. **Depth**

1. **General**

Water lines shall be designed to provide a minimum of 30 inches of cover below proposed finish grade. Valves shall be designed for installation at depths not greater than 48 inches below finish grade. Deviations from the required minimum cover may be allowed where conditions require, subject to prior approval of ECUA.

Water lines shall not be installed at depths greater than 36 inches below proposed finish grade, unless otherwise permitted by these Standards. Deviations from the required maximum cover may be allowed where conditions require, subject to prior approval of ECUA.

2. **Roadway Crossings**

- a. Water line installation in public rights-of-way shall conform to all applicable requirements of the governing agency responsible for the maintenance and operation of the roadway.
- b. In cases where open-trench construction of roadway crossings is allowed, water lines may be installed without casing, using an appropriate, approved pipe material in accordance with ECUA's Technical Specifications.

- c. In cases where open trench construction of roadway crossings is not allowed, water lines shall be installed in a steel casing in accordance with Section 2224 of ECUA's Technical Specifications. An appropriate, approved pipe material meeting the requirements of ECUA's Technical Specifications shall be installed in the casing. In cases where the length of casing required is excessive, or in other circumstances where conditions warrant, valves may be required on both sides of the casing.

### 3. **Water Crossings**

- a. Water line installation involving construction under or across water shall conform to all applicable requirements of the governing agency, or agencies, having jurisdiction for such activities.
- b. Creek, stream, river, or wetlands crossings not exceeding 100 feet in length as determined by the 100-year flood plain, and where open trenching is permitted, shall be constructed using ductile iron pipe (or other approved equal) at a depth not less than 36 inches below the bottom surface of the crossing. The ductile iron pipe shall extend at least 20 feet beyond either side of the maximum width of the crossing.
- c. Major streams and other crossings where the 100-year flood plain will create a width at the point of crossing of 100 feet or more, and where open trenching is permitted, shall be constructed using ductile iron river crossing pipe (or other approved equal) at a depth not less than 36 inches below the bottom surface of the crossing. The ductile iron pipe shall extend at least 20 feet beyond either side of the maximum width of the crossing, with valves on each side beyond the flood plain.
- d. Water lines installed under crossings where open trenching is not permitted shall be installed in a steel casing in accordance with Section 2224 of ECUA's Technical Specifications. Directional boring, where an appropriate pipe material is installed under the waterway without disturbance to the ground or water surface, may be considered in some circumstances. See Section 2234 of ECUA's Technical Specifications for further information.
- e. Where an existing or proposed bridge crosses the waterway at the same location as the proposed water line, provision should

be made to attach the water line to the bridge structure. Prior consent must be obtained from the agency responsible for the maintenance and operation of the bridge. Design of pipe restraints for the bridge attachment shall allow for limited movement of the pipe as a result of expansion and contraction.

#### 4. **Railroad Crossings**

- a. Water line installation involving construction under railroads shall conform to all applicable requirements of the governing agency, or agencies, having jurisdiction for such activities.
- b. Railroad crossings of any length shall be installed in a steel casing in accordance with Section 2224 of ECUA's Technical Specifications, or in accordance with any special requirements of the railroad company, whichever is more strict.

#### 5. **Other Crossings**

- a. Water lines which must be installed under existing obstructions, such as pipes or conduits, shall maintain a vertical separation of at least 6 inches. In cases where a minimum separation of at least 6 inches cannot be maintained, or in any case where there is a potential threat to the integrity of the water line as a result of an existing obstruction, the pipe shall be installed in a steel casing in accordance with Section 2224 of ECUA's Technical Specifications. Alternatively, Ductile Iron or C900 DR18 pipe shall be used. These special provisions shall extend at least 10 feet on either side of the pipe or obstruction being crossed.
- b. Water lines installed within easements for the purpose of extending or looping the system shall be constructed with Ductile Iron pipe through the entire length of the easement. Valves shall be installed at both ends of the line, unless otherwise approved by ECUA.

#### D. **Separation of Potable Water Lines From Sanitary Sewer Lines**

1. When a potable water line must cross over a gravity sewer line with less than 18-inch vertical clearance, one of the following methods may be used to protect the water line:
  - a. Fully encase the sewer line with a minimum of four inches of concrete ( $F_y = 2500$  psi min.) for a minimum distance of ten feet on either side of the point of crossing. The point of crossing must be at least five feet from a water line joint. If the crossing

is other than at right angles, increase the length of encasement so that the end of the encasement will be at least ten feet from the nearest water line joint.

- b. Use pressure pipe for the sewer line that is the same as or better than the water line being crossed; with joints no closer than 10 feet apart and at least 6 inches of vertical clearance.
  - c. Install sewer pipe in a 20-foot section of steel casing centered under the water line, so that each end of the casing will be at least 10 feet from the nearest water line joint. Seal the ends of the casing with non-shrink grout.
2. When a gravity sewer line must cross over a potable water line, regardless of the clearance (because the water line cannot be relocated above the sewer) use method 'b' or 'c' in subsection 1 above. Concrete encasement will not be allowed.
  3. When a sanitary force main must cross under a potable water line with less than an 18-inch vertical clearance, or over the water line, use method 'b' or 'c' in subsection 1 above.
  4. The above requirements do not apply when the water line being crossed is a house or building service 2 inches or smaller and the service is a continuous piece of PE DR9 tubing, located so that the distance to a sewer or force main joint is as great as possible.
  5. When a gravity sewer line must run parallel to and less than 18 inches below a potable water line and:
    - a. 6 to 10 feet apart for less than 40 feet, use method 'a', 'b' or 'c' in subsection 1 above.
    - b. 6 to 10 feet apart for over 40 feet, use method 'b' and stagger joints.
    - c. 3 to 6 feet apart for any distance, use a higher rated pressure pipe and staggered joints.
  6. When a sanitary force main must run parallel to and less than 18 inches below a potable water line and:
    - a. 6 to 10 feet apart for any distance, use a higher rated pressure pipe as in method 1 (b) above.

- b. 3 to 6 feet apart, use C-900 DR18 pipe for both water and force main.

E. **Pipe Restraints**

All water line fittings and appurtenances shall be restrained. See Section 2556-2.4.1.4 for further information.

3.5 **APPURTENANCES**

A. **Valves**

**General**

In-line valves shall be spaced such that no more than 1,000 feet of pipe would be out of service with valves shut, and shall be located on every branch line, with at least one valve on the main line at the junction. The valve may be located on the opposite side of the street from the fittings, except in cases where a tapping sleeve and valve is used. Butterfly valves may be used on lines of 16 inches and larger. Air release valves shall be located on distribution mains as required by ECUA. Valves shall be installed in accordance with ECUA Standard Detail D-34.

B. **Fire Hydrants**

Fire hydrant location shall be governed by the local Life Safety Officer or Fire Department, but in general shall be located on a 6-inch or larger main, and no more than 1,000 feet apart along rights-of-way. Fire hydrants shall be located at intersections when practical, otherwise as close as practical to common property lines.

Fire hydrants shall be located in single family residential areas so that no more than 600 feet of fire hose, as laid along a public right-of-way, will be required to reach any proposed house.

Fire hydrants shall be located in multi-family residential or commercial areas, so that no more than 500 feet of hose, as laid across unobstructed terrain, will be required to reach the most remote part of any proposed building.

Fire hydrants may be installed on private land supplied by a private dedicated fire line of at least 6 inches diameter, and protected with an appropriate detector-check assembly located at the property line.

C. **Flushing Hydrants**

Flushing hydrants shall be located within a right-of-way or easement near lot/property corners such that their location and use will not be hampered by improvements (driveways, fences, shrubbery).

All dead-end lines 4 inches and smaller shall have at least a 2-inch post hydrant assembly.

All dead-end lines 6 inches and larger shall have a standard fire hydrant with valve. See ECUA Standard Detail D-35.

D. **Backflow Preventers**

(see Section 3.7 below)

E. **Double Check Detector Assemblies**

An appropriate double check detector assembly may be required in any private fire line.

F. **Meters**

Residential meters and meter boxes are typically provided by ECUA. Commercial water meters less than 2 inches in size are also typically provided by ECUA. For commercial water meters 2 inches and larger, the developer is required to supply the meter vault in accordance with ECUA Standard Detail D-25 or D-26 as applicable.

3.6

**SERVICE LINES:**

**A. Potable Water Services**

**1. General**

Line size must be selected with due consideration for length, peak demand, elevation and pressure loss, including loss across backflow preventers, for the anticipated end use(s). A water meter of the size requested by the customer will be supplied and installed by the ECUA at each connection point. The meter size should be shown on the plans for all commercial developments. Refer to Table 3.6 for tubing size.

All meters shall be installed in boxes adjacent to the property line at the public right-of-way or easement and readily accessible to ECUA meter readers. Meter boxes shall not be located in driveways or where they might be obstructed by landscaping or other structures, or closer than five feet to the sanitary sewer service lateral.

<b>TABLE 3.6 RECOMMENDED TUBING SIZE FOR WATER SERVICES</b>					
<b>Size of Meter</b>	<b>Max. Flow (gpm)</b>	<b>Max. Pressure Loss (psi)</b>	<b>Max. Length of Tubing for Size Indicated</b>		
			<b>1"</b>	<b>1-1/2"</b>	<b>2"</b>
5/8"	20	10	92	661	2679
1"	50	10	17	121	492
1-1/2"	100	10	-	34	136
2"	160	10	-	14	57

**2. Residential**

Provision shall be made for individual service lines to each lot within all residential developments. Services should be located centrally on each lot. See ECUA Standard Detail D-21. Duplex water services will not be permitted except in the case of a zero-lot-line townhouse-type development where common lot lines are clearly established.

**3. Commercial**

Service connections to industrial or commercial lots may be omitted if the service size cannot be predetermined, provided approval is obtained and paving will not have to be cut when installation is required.

Master meters are required for shopping centers, malls and similar developments. Exceptions may be made when a beneficial part of the Distribution System runs through the development.

A master meter is required for a wholesale customer, where water is to be distributed to individual units through private lines and that development is not served by the ECUA wastewater system.

Master meters shall be used for apartment, condominium and other such complexes.

**B. Fire Service Lines**

1. ECUA will provide a fire line service at the customer's expense, provided that there is adequate existing capacity.
2. ECUA will accept for operation and maintenance only such portions of the fire line within a public right-of-way or in an easement.
3. An approved backflow preventer shall be installed by the customer at his expense adjacent to the property line. (See Section 3.7 below.)
4. All fire line services shall be pressure tested and chlorinated up to the backflow preventer in the same manner as other line extensions.

**C. Irrigation Service Lines**

Provision shall be made for separate irrigation services and meters to be installed at customer's expense, if required.

**3.7 CROSS CONNECTION CONTROL AND BACKFLOW PREVENTION**

**A. Protective Devices**

Backflow prevention devices shall be installed to protect the distribution system from potential contamination.

**B. Where Required**

1. **Single Family Residential** - Backflow prevention devices shall be installed by owner in accordance with the Standard Plumbing Code - latest edition.
2. **Commercial** - Backflow prevention devices shall be installed by owner for all services.

3. **Irrigation Services** - Backflow prevention devices shall be installed by owner in accordance with the Standard Plumbing Code - latest edition.

C. **Type of Protective Device**

1. The selection of an appropriate protective device will be based on the degree of hazard involved. However, the ECUA shall retain the final decision in individual cases. Refer to ECUA Code, Chapter 5, "Cross-Connection Control." All devices must be approved for use in potable water service by one or more of the following: NSF, ANSI, ASSE, UL.
  - a. **Air-Gap Separation Backflow Prevention Device:** will be used in any high-risk installation, but is acceptable in all situations described in this section.
  - b. **Reduced Pressure Principle Backflow Prevention Device:** will be used in any moderate to high-risk installation.
  - c. **Double Check Valve Assembly:** will be used in any moderate-risk installation, which will include most private fire lines, and private fire hydrants.
2. The type of backflow device shall be shown on the Construction Plans.
3. Bypasses around backflow devices are expressly prohibited.
4. A low flow detector meter may be required on any backflow device located on an unmetered water line.

D. **Location**

1. All backflow prevention devices are to be located immediately after the meter or immediately inside the property line at the right-of-way line, and be readily accessible for inspection and visible from the public right-of-way.
2. All backflow prevention devices are to be located above the 100-year flood elevation or a minimum of 18 inches above ground, whichever is higher, and should be protected from freeze and traffic.
3. Any deviation from No. 1 above must be individually approved by the ECUA.
4. The location of the backflow device is to be shown on the Construction Plans for all commercial developments.

E. **Installation**

Installation of the backflow device will be done by the Developer's Contractor. See ECUA Code, Chapter 5, "Cross Connection Control."

F. **Inspection and Testing**

Inspection and testing of the backflow device will be conducted by the ECUA as outlined in ECUA Code, Chapter 5, "Cross Connection Control."

## SECTION 570

### DESIGN STANDARDS SANITARY/GRAVITY WASTEWATER COLLECTION SYSTEM

#### PART 1: GENERAL

##### 1.1 General Description of Work

- A. The following minimum requirements are considered acceptable to the ECUA in the design of collection systems for wastewater from domestic and commercial customers.

Deviations from these standards may be allowed by ECUA only upon a finding by the ECUA that, in accordance with sound engineering standards, the granting of the deviation will not work to increase the likelihood of a system problem. No deviation will be allowed unless it is approved in writing by ECUA and is clearly noted on the approved construction plans.

- B. All expansion shall conform to the "Master Plan for Wastewater" as maintained and amended by the ECUA.
- C. When these standards differ from state and/or federal requirements, the more stringent requirement shall apply.
- D. The collection system for wastewater includes the gravity mains, manholes, customer service pipes, lift stations, force mains, and other appurtenances. The system should be designed to provide for the collection of wastewater from the customer and for its safe and economical transport TO ECUA's Wastewater Reclamation Facilities.

#### PART 2: STANDARDS

##### 2.1 U.S. Environmental Protection Agency and U.S. Public Health Service

The governing standards of these agencies will be followed when applicable.

##### 2.2 State of Florida Department of Environmental Protection

The wastewater collection system shall conform to the applicable Florida State Department of Environmental Protection laws, policies, standards, and rules and regulations for public wastewater collection systems.

##### 2.3 Plumbing Codes

The provisions of the Plumbing Code of the City of Pensacola or Escambia County as it pertains to sanitary wastewater collection, service line locations and materials, and on-site plumbing , except as provided for elsewhere in these criteria, shall apply.

## 2.4 Escambia County Utilities Authority

All wastewater collection systems that are to become a part of the ECUA system shall be designed and constructed in accordance with these standards. Materials, installation of materials, and construction methods and procedures shall be in accordance with the current ECUA material and installation specifications. Refer to Section 2570 of the Technical Specifications of the ECUA Engineering Manual. All discharges into the ECUA sewer system shall meet the requirements of the ECUA Code.

### **PART 3: DESIGN STANDARDS FOR SANITARY COLLECTION SYSTEMS**

#### 3.1 Flow Requirements

In sizing the collection system gravity mains, the required design flow shall be the sum of the required sanitary flow as contained below, plus an allowance for infiltration and inflow.

##### A. Required Sanitary Flow (Residential)

Required average daily flow for sanitary use in residential areas shall be based on 350 gallons per day per unit (100 gpcpd x 3.5 persons) or as approved by the ECUA.

##### B. Required Sanitary Flow (Nonresidential)

The required flow for commercial, industrial, or other nonresidential areas shall be as determined by the Engineer and approved by the ECUA for each specific instance.

##### C. Required Allowance for Inflow and Infiltration

The required allowance for infiltration and inflow for developed areas shall be in accordance with the following table: (based on 25 gal/inch dia./mile/day for new construction).

Pipe Diameter (Inches)	Min. Allowance I&I Flow (GPD/1000 Feet)
8	38
10	47
12	57
15	71

#### 3.2 Future Interconnections

Provisions for future connecting mains shall be made by providing appropriate easements and/or extending construction of all wastewater mains to the exterior boundaries of the subdivision or development wherever future connections to adjacent subdivisions or lots are anticipated.

## 3.3

Gravity Collection Mains

Gravity mains shall be of sufficient size to carry the required flow at velocities as herein provided. Mains shall be located to provide service to each lot within a development as herein provided. All mains shall be installed only in dedicated streets, alleys, public rights-of-way or utility easements, in favor of the ECUA for the use and benefit of the ECUA.. All main locations and sizes shall be in accordance with the ECUA's current "Master Plan for Works Improvements" and the approved subdivision master development plan and utility layout.

A. Minimum and Standard Main Size

Minimum gravity main diameter shall be 8 inches in all areas. Standard sizes of gravity mains used shall have nominal diameters of 8 inches, 10 inches, 12 inches, 15 inches, 18 inches, 21 inches, 24 inches, 30 inches, and 36 inches.

B. Slopes shall be designed with a hydraulic gradient sufficient to prevent deposition of solids, by developing a minimum velocity of 2.0 feet per second as computed using Manning's formula and a "n" value of not less than .013 while flowing full. The following table establishes the minimum allowable slopes for various size pipes:

1. Minimum slope allowable shall be:

Pipe Size Inches	Minimum Slope %
8	.4
10	.28
12	.22
15	.15
18	.12
21	.10
24	.08
30	.06
36	.05

Under special conditions, if full and justifiable reasons are given, slopes slightly less than those required for the 2 feet per second (0.61 m/s) velocity when flowing full may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for design average flow. Whenever such decreased slopes are selected the engineer must furnish with his report his computations of the depths of flow in such pipes at minimum, average, and peak rates of flow. It is recognized that such flatter grades may cause additional sewer maintenance expense and odor nuisance. The selection of the size of pipe shall be determined on the basis of the most desirable flow characteristics obtainable. The owner of the sewer system will give written assurance to the appropriate reviewing agency that any additional sewer maintenance required by reduced slopes will be provided.

2. In the case of sewers where the slope and volume are such that velocities will exceed 10 feet per second (3.0 m/s) at average flow, special provision

shall be made to protect against erosion. This protection may be secured utilizing C900 PVC, ductile iron, steel pipe or equivalent, when approved in writing by the ECUA.

- a. Where velocities greater than 15 feet per second (4.6 m/s) are anticipated, special provision shall be made to protect against displacement by erosion and shock.
  - b. Sewers on 20 percent slopes or greater shall be anchored securely with concrete anchors or equal, spaced as follows:
    - 1) Not over 36 feet (11 m) center to center on grades 20 percent and up to 35 percent;
    - 2) Not over 24 feet (7.3 m) center to center on grades 35 percent and up to 50 percent; and
    - 3) Not over 16 feet (4.9 m) center to center on grades 50 percent and over.
  3. Full advantage of suitable topography and paralleling of ground slopes shall be made. Minimum slopes should only be used when necessary, particularly with 8-inch pipe. When depth exceeds 10 feet, check pipe class for strength, and/or specify stricter bedding requirements.
  4. Sewers shall be designed and laid with a uniform slope between manholes.
- C. Change in pipe size shall not occur between manholes
1. Increasing Size. When a smaller sewer joins a larger one, the invert of the larger sewer shall be lowered sufficiently to maintain the same hydraulic gradient. The crowns of pipes shall be at the same elevation within the manhole.
  2. Decreasing Size. At times, due to increasing sewer slopes, a reduction in the size of the outgoing sewer from a manhole may be justified. Such a reduction shall not be permitted on sewers 24-inch in diameter or under, but may be permitted on sewers larger than 24-inch in diameter. Inverts of the pipes shall be matched in the manhole.
- D. When crossing other utilities, vertical separation shall be shown.
- E. There shall be a drop of .1 foot across each manhole with bends of 45° or more.
- F. When crossing under existing paved streets or roads, it must be determined if open cut will be permitted. If jack and boring will be required complete details must be shown.

Extra effort should be expended to locate any possible conflict with existing utilities. Allow extra slope through bore and specify minimum and maximum allowable deviations.

- G. The depth of the collector line shall be sufficient to receive flows by gravity from all buildings and lots to be served by service lines, installed in accordance with plumbing code specifications and slopes. A 30-inch minimum cover is required. Less cover may be considered with special provisions for protection of the pipe. It may be necessary to require buildings to pump into the line, by installing privately maintained lift station, the number of customers using stations should be kept at a minimum.
- H. Privately maintained pump stations for individual buildings and individual commercial developments will be considered when gravity service is not feasible.
- I. Alignment
1. Sewers shall be laid with straight alignment between manholes.
  2. Horizontal separation at approximately same elevations as other utilities shall be maintained.
  3. Sewers 48-inch and larger may be laid on a curve. Refer to pipe manufacturer for allowable curvature.
  4. Bends of greater than 90° to be avoided.
- J. Pipe Material: PVC pipe SDR35 will be utilized for gravity lines. C900 PVC or DI pipe will be specified where extra strength or joint integrity is required.
1. PVC pressure pipe (SDR26, 21, 18) may be considered in lieu of DI pipe for marginal demands, but care must be exercised as to availability of fittings that may be needed.
  2. Pipe material will not be changed between manholes (except where additional structural protection is required).
  3. Where ductile-iron pipe is to be installed, external pipe corrosion protection will be specified if soil resistivity is less than 1,000 ohms per square centimeter per centimeter. (Polyethylene sleeves or an anticorrosion embedment as directed by the ECUA.) Internal pipe corrosion protection shall be provided by proven Hydrogen Sulfide and abrasion resistant coatings. Fused Epoxy coating is recommended, others shall be approved by ECUA Engineering Department.
- K. Cover
1. A minimum cover of 30 inches must be provided where conditions permit.
  2. At road crossings, a minimum separation distance of 24 inches shall be maintained from the bottom of the roadway base to the top of the pipe or the top of the casing when provided.
  3. At buried stream crossings, a minimum cover of 36 inches is required.
- L. Crossings

1. Major road crossings shall be encased per Section 2224 of Standard Specifications or made using ductile iron pipe. Additional requirements of the regulatory agency responsible for the road shall be met.
  2. Buried stream crossing shall be encased in steel casing or made with ductile iron pipe. This protection shall extend 10 feet beyond the bank and the pipe or casing shall be anchored to prevent shifting.
  3. Aerial stream crossing shall be encased in steel casing or made with ductile iron pipe. This protection shall extend until 30 inches of cover is provided.
  4. When crossing under pipes, conduits, or other structures greater than 24 inches in diameter, and a 6-inch separation distance cannot be maintained, the pipe shall be encased in steel casing or made with ductile iron pipe for a minimum of 5 feet distance on either side of the crossed pipe.
- M. Manholes: Shall be installed at the end of each sewer line, at all junctions, at all changes in grade, size or alignment; with the following added considerations
1. Maximum spacing shall be 400 feet up to and including 36-inch pipe, controlled by available ECUA cleaning equipment. Spacing for pipes larger than 36-inch may be increased up to, but not to exceed 1,000 feet, controlled by cleaning requirement.
  2. Lamp hole may be substituted at ends of short lines, not to exceed 150 feet in length. Lamp holes shall not be used on any gravity sewer line larger than 8 inches in diameter.
  3. A drop manhole shall be provided when a sewer invert enters a manhole at an elevation of 2 feet or more above the manhole invert. Where the difference in elevation is less than 2 feet, the invert shall be formed to a half-round concrete channel of equivalent diameter of the outlet pipe to prevent solids deposition. Drop manholes shall use an outside drop connection, except inside drops may be approved for building services and laterals. Inside drops shall be securely fastened to the interior wall of the manhole with stainless steel clamps or pipe hangers. Inside drops shall be extended to the invert of the manhole on a 45° bend installed to direct flow correctly. The drop shall be installed so it does not block manhole access or inhibit maintenance.
  4. The inside diameter of manholes shall be a minimum of 48 inches up to and including 24-inch pipe. For pipe larger 24 inches, the inside diameter of the manhole shall be increased so as to provide at least a 12-inch shelf on each side of the pipe.
  5. Manholes shall be precast reinforced concrete unless special conditions would dictate a cast in place or other type.

6. The manhole flow channel should be constructed in the field to ensure a smooth flow line from all incoming lines to the outgoing. All channels must provide a smooth transition to the outgoing line with the maximum possible radius on all curves. Precast manhole channels or inverts may be approved, but only if they meet the above requirements. Channels shall have the equivalent diameter of the manhole effluent pipe.
7. Manholes shall be ventilated if the manhole is a receiving manhole for a force main, downstream of such a receiving manhole, is expected to experience conditions of turbulence, or has a drop main or lateral entering it. Ventilation may be required by the ECUA Engineering Department as conditions dictate. Ventilation methods shall be approved by the ECUA Engineering Department in writing before installed.

N. Inverted Siphons

Inverted siphons shall be avoided whenever possible. However, if used, inverted siphons shall have not less than 2 barrels, with a minimum pipe size of 6 inches and shall be provided with necessary appurtenances for convenient flushing and maintenance. The manholes shall have adequate clearance for rodding and in general, sufficient head shall be provided and pipe sizes selected to secure velocities of at least 3.0 feet per second for average flows. The inlet and outlet details shall be arranged so that the normal flow is diverted to one barrel, and so that either barrel may be cut out of service for cleaning.

3.4 Wastewater Services

A. Service Lines

Service lines shall be provided to all lots within a subdivision in accordance with the ECUA regulations. Customer service connections to industrial or commercial lots may be omitted provided approval of the ECUA is obtained prior to approval of plans and specifications.

B. Flow Measurement

The ECUA may require the flow measuring devices where flows in excess of 50,000 gpd can be expected. This includes apartment complexes, trailer parks, shopping centers, etc. The ECUA must approve method and location of flow measurements. Acceptable methods will include pre-approved open channel flow devices with meter/totalizer, pipe meters and hour meters on private lift stations.

C. Cleanouts

When a service line is excessively long, a cleanout shall be provided at the property line for all 4-inch and 6-inch laterals.

## **SECTION 575 - WASTEWATER LIFT STATIONS AND FORCE MAINS**

---

### **PART 1: GENERAL**

#### **1.1 DESCRIPTION AND CLASSIFICATION OF STATIONS**

Lift stations shall be provided at any point in a proposed sewage collection system where the upstream gravity collection system cannot be physically connected to the existing collection system in a manner to permit gravity flow. System extensions shall be designed to avoid lift stations as far as possible.

- A. In general, stations may lift flows to a higher elevation, transport flow horizontally or combine lifting and horizontal transport.
- B. Stations may be classified by rated flows as follows:
 

1. Very Small	10-100 gpm
2. Small	100-250 gpm
3. Medium	250-950 gpm
4. Large	950-2,000 gpm
5. Regional	2,000+ gpm
- C. In general, lift stations shall utilize submersible pumps placed in a below-ground wet well. Other configurations may be considered where appropriate.

1.2 Lift station location and design capacity shall be compatible with the ECUA Master Plan for Wastewater. Lift stations shall be designed to operate effectively at initial flows as well as at ultimate design flows. To that end, each lift station design must address several interrelated elements including, but not limited to:

- A. Wet well size (diameter and depth)
- B. Force main size and station piping
- C. Pump and control selection
- D. Flow quality and station appurtenances

1.3 Lift station design calculations submitted to ECUA for approval shall include all design considerations and assumptions. (See Lift Station Design Worksheet, pages 575.6 and 575.7)

### **PART 2: REFERENCE STANDARDS - See Section 570, Part 2**

**PART 3: DESIGN FLOWS****3.1 Flow Requirements**

Lift station design flow requirements shall be developed in accordance with Section 570, Part 3 of ECUA's Engineering Manual. In addition, flows shall be estimated for each of the following conditions:

- A. Peak flow for initial, intermediate, and ultimate periods
- B. Average flow for initial, intermediate, and ultimate periods
- C. Minimum flow for initial, intermediate, and ultimate periods

**PART 4: DESIGN PARAMETERS AND FUNCTIONAL CRITERIA****4.1 Lift Station Site**

Lift stations shall be located so as to permit gravity sewer connection(s) from the largest feasible drainage area, or to permit continuing downstream gravity sewer system development where possible.

- A. Station top elevation shall be above the 100 year flood level as designated by FEMA Flood Maps. In no case should the lift station be placed in an area subject to prolonged periods of flooding.
- B. Station shall be readily accessible by truck at all times.
  - 1. Not adjacent to right-of-way, access easement will be required.
    - a. 10-foot paved driveway preferred, but shell driveway on solid base with good drainage may be accepted.
    - b. Drainage ditches and streams must be crossed using properly sized culverts.
    - c. A truck turn-around shall be provided at all lift stations.
  - 2. Minimum size of parcel to be 20' X 20'; larger if appurtenances may be required.
    - a. Title to the lift station site shall be conveyed to ECUA in accordance with ECUA Policy.

- b. The lift station shall be fenced in accordance with ECUA requirements unless specifically exempted.
- C. Station shall be located with consideration for availability of:
- 1. Three-phase electrical service
  - 2. Potable water

## 4.2

**Functional Criteria**

- A. Lift stations shall contain a minimum of 2 pumps with each pump capable of pumping at peak hourly flow. Peak hours flow shall be determined using the curve or formula in Appendix E-2 (page 575.9).
- B. Wet well volume shall be calculated based on the projected ultimate peak flows with consideration for initial peak flows.
  - 1. Minimum liquid level in the wet well shall be 2 feet above the bottom of the wet well or in accordance with the manufacturer's requirements for the pump specified, whichever is greater.
  - 2. Cycle time, to pump down and refill, shall be not less than 10 minutes nor more than 15 minutes at 1/2 peak flow.
  - 3. The spacing between 'lead pump on' and 'lag pump on' shall be a minimum of 1 foot.
  - 4. The high level alarm shall be set not less than 1 foot above 'lag pump on', and at sufficient depth to provide a minimum of 30 minutes storage, calculated at average flow, below the lowest influent line.
- C.
  - 1. The force main velocity at the initial pumping rate shall be not less than 2.5 fps. The velocity in the force main at the design pumping rate shall be not more than 6 fps.
  - 2. Downstream capacities shall be checked.
  - 3. When the force main will manifold into an existing force main the impact on that line and all existing pump stations that utilize that line must be evaluated.
  - 4. When the force main could either discharge to an existing lift station or manifold into that station's force main, an analysis shall be made to determine which alternative is in the best long-term interest of ECUA.

- D. Calculate system head: static, friction and velocity. Select pumps. (See Worksheet, pages 575.6 and 575.7). Pump curves shall show range and efficiencies, and shall include the system curve(s).

## 4.3

**Wet Well Design**

The wet well shall be sized by determining the combination of diameter and depth most suitable to handle the intended maximum design capacity with adequate provision for emergency storage.

- A. Based on location constraints, functional criteria, and the approximate wet well size, the following design elements shall be established:
1. Ground elevation at wet well.
  2. Lowest influent elevation of gravity system.
  3. "High level alarm" elevation.
  4. "Lag pump on" elevation.
  5. "Lead pump on" elevation.
  6. "All pumps off" elevation.
  7. Wet well bottom elevation.
  8. Base thickness shall be calculated to assure that the wet well will not float when empty. See page 575.7 for method of calculation.
- B. When the wet well and force main are oversized for future requirements, the station piping, electrical service, and controls shall be sized accordingly. When it is anticipated that a third pump is to be installed in the future, the station shall be designed to accommodate through-wall piping in the wet well, a manifold into the discharge force main, and appropriate equipment in the control panel.

- C. Compute design elements for larger and/or smaller diameter wet wells, then select optimum size to meet initial and future demands. Wet well sizing, force main sizing and pump selection may require several iterations to arrive at optimum design for sound economic selection over the proposed design period.

**PART 5: DETAIL SPECIFICATIONS FOR WET WELL, PUMPS AND CONTROLS**

(See Section 2575)

**PART 6: APPURTENANCES**

- 6.1 The lift station site shall be fenced in accordance with ECUA specifications unless specifically waived by ECUA's Engineer.
  - A. The fence shall enclose an area sufficient to protect the lift station and all appurtenances.
  - B. The electric supply meter shall be outside the fence or located so as to be read without entering the fence.
  - C. See Section 2830 for specifications.
- 6.2 Emergency bypass piping with gate valve and quick-connect coupling shall be the same size (up to 8"  $\varnothing$ ) as the station piping, and shall be located within the valve box as shown on ECUA's Standard Lift Station Detail Sheet.
- 6.3 Standby emergency power will be required as follows:
  - A. Regional stations shall require an on-site emergency generator suitably located and wired for automatic transfer. Generator will be of sufficient size to run all of the station equipment.
  - B. All other lift stations, if not provided with on-site generating capabilities, shall be equipped with a manual transfer switch for connecting a portable generator.
  - C. Lift stations serving individual single-family homes are exempt from requirements for standby emergency power.
- 6.4 Chemical feed equipment may be required at lift stations or elsewhere in the collection system if detention times are such that septic conditions may develop causing generation of hydrogen sulfide and other gases.

# LIFT STATION DESIGN - WORKSHEET

Project Name: \_\_\_\_\_ Date: \_\_\_\_\_  
 Project Location: \_\_\_\_\_ By: \_\_\_\_\_

---

## REQUIRED CALCULATIONS FOR WET WELL DESIGN:

1. Estimate average daily flow (ADF):

Initial (first year)  $(\text{ERC} + \text{Acre} \times \frac{\text{ERC}}{\text{AC}}) \times \frac{300}{1440} = \text{gpm}$

Intermediate (this project)  $(\text{ERC} + \text{Acre} \times \frac{\text{ERC}}{\text{AC}}) \times \frac{300}{1440} = \text{gpm}$

Ultimate (build-out of lift station coverage area)  $(\text{ERC} + \text{Acre} \times \frac{\text{ERC}}{\text{AC}}) \times \frac{300}{1440} = \text{gpm}$

2. Select appropriate peaking factor (see Appendix E-1, page 575.8) and determine Design Peak Flow:

Initial	Avg. X _____	Peak = _____ gpm
Intermediate	Avg. X _____	Peak = _____ gpm
Ultimate	Avg. X _____	Peak = _____ gpm

3. Primary Operating Volume in gallons for a minimum cycle time of 12 minutes will be 3 X the pumping rate in gallons per minute.

Compute for Initial and Ultimate conditions.

4. Compute Primary Operating Range = Vol. required divided by Vol. per vertical foot. Compute for Initial and Ultimate conditions.

5. Calculate Emergency Storage Time (see paragraph 4.02, B.4, page 575.3).

6. Calculate Emergency Storage Volume = Emergency Storage Time X QAV X 1/2 Peaking Factor. Calculate for Initial and Ultimate Flow conditions.

7. Calculate Alarm Time Range = Alarm Volume divided by volume per vertical foot.

8. Identify the lowest discharge (or spill) point assuming all pumps off.

9. Establish critical pump control elevations.

10. Check Flotation: Total weight - buoyancy force must be positive.

Total Weight = Vol of (Walls thickness + top slab + bottom slab + taper fill) X 150 lbs./cu. ft.

Buoyancy Force = Exterior Vol (below max. high water) X 62.4 lbs./cu. ft.

If negative or close, increase bottom slab thickness and/or increase bottom diameter then calculate volume of earth (backfill) cone pressing on ring X 52.4 lbs./cu.ft.

**REQUIRED CALCULATION FOR FORCE MAIN DESIGN:**

Compute System Curve

TDH shall be evaluated separately for discharge elevation and elevation of high points of the force main, and for initial and aged "C" factors.

---



---

**Static Head**                      High Point \_\_\_\_ or Discharge \_\_\_\_ - Pump Off \_\_\_\_ = \_\_\_\_ ft.

---



---

**Pump Selection:**

PERIOD	PUMP			MOTOR				PERFORMANCE		
	MAKE	MODEL	IMPELLER	MODEL	HP	RPM	ELEC.	GPM	TDH	EFFIC.
Start										
Future										
Ultimate										

**APPENDIX E-1**  
**LIFT STATION DESIGN**  
**REFERENCE DATA**

***Peaking Factor Selection Guide***

STATION SIZE	TOP Q PUMP gpm	TOP Q PUMP MGD	AVG. PK FACTOR	AVG. Q MGD	AVG. ERC's	AVG. POP.	PEAKING FACTOR*
Very Small	100	.144	4.0	.036	144	432	4.01
Small	250	.360	4.0	.090	360	1080	3.78
Medium	950	1.368	3.5	.39	1560	4680	3.27
Large	2000	2.88	3.0	.96	3840	11520	2.89
Regional	5000+	7.20	2.5	2.86	11520	34560	2.42

*ERC = 300 gpd for Wastewater and 3 Persons Per Unit*  
*\*for Peaking Factor see Appendix E-2, page 575.9*

***Capacity of Force Mains at Given Velocity Q = AV gpm***

VELOCITY fps	FORCE MAINS - NOMINAL SIZE - INCHES DIAMETER										
	2"	3"	4"	6"	8"	10"	12"	14"	16"	20"	24"
2	20	45	80	180	310	490	700	950	1300	2000	2800
2.5	25	55	100	220	390	625	880	1200	1600	2500	3500
6	50	110	195	440	785	1340	1760	3000	3800	5900	8500
8	80	180	315	700	1250	1960	2820	4300	5000	7800	11200

*(for friction losses and full chart see Appendix E-3, page 575.10)*

PIPE VOLUME: GALS. PER 100 FT.	2"	3"	4"	6"	8"	10"	12"	14"	16"	20"	24"
		19	42	70	153	259	405	573	800	1044	1632

***Manhole or Wet Well Volume per Vertical Foot in Gallons***

DIAMETER (FT)	4	5	6	8	10	12	14
VOL. (GAL)	94.0	147.0	211.5	376.0	587.5	846.0	1151.5

*(adjust for reduced diameters for sidewall taper at bottom)*

**SECTION 1001**

**ABBREVIATION & DEFINITIONS**

**PART 1: ABBREVIATIONS**

1.1           Wherever the following abbreviations or symbols are used, they are to be construed the same as the respective expressions represented:

AASHTO .....	American Association of State Highway and Transportation Officials
ACI.....	American Concrete Institute
AGC.....	Associated General Contractors of America, Inc.
ANSI.....	American National Standards Institute
APWA.....	American Public Works Association
ASTM.....	American Society for Testing and Materials
AWWA.....	American Water Works Association
BM.....	Bench Mark
C.C. or C/C.....	Center to Center
Cem.....	Cement
CIP.....	Cast-iron Pipe
C.L. or CL.....	Center Line
CMP.....	Corrugated Metal Pipe
CO.....	Clean Out
Conc.....	Concrete
Const.....	Construct
DMH.....	Drop Manhole
D/W.....	Driveway
ECUA.....	Escambia County Utilities Authority
El. or Elev.....	Elevation
Ex. or Exist.....	Existing
F & C.....	Frame and Cover
FH.....	Fire Hydrant
FL.....	Flow Line
Fl. El.....	Floor Elevation
FS.....	Finished Surface
Galv.....	Galvanized
GL.....	Ground Line
Gr.....	Grade
H.....	Height or High
HC.....	House Connection Sewer
Hor.....	Horizontal
ID.....	Inside Diameter
Inv.....	Invert
Lin.....	Linear
Long.....	Longitudinal
Max.....	Maximum
MH.....	Manhole
m.....	Meter or Middle
Min.....	Minutes or Minimum
Mon.....	Monolithic or Monument
OC.....	On Center
OD.....	Outside Diameter
PCC.....	Portland Cement Concrete
PI.....	Plasticity Index

PL.....	Property Line or Plastic Limit
PP.....	Power Pole
ppm.....	Parts per Million
Prop.....	Proposed or Property
psf.....	Pounds per Square Foot
psi.....	Pounds per Square Inch
pvmt.....	Pavement
PVCP.....	Polyvinylchloride Pipe
Q.....	Rate of Flow
R.....	Radius
RC.....	Reinforced Concrete
RCP.....	Reinforced Concrete Pipe
Rdwy.....	Roadway
Ret. Wall.....	Retaining Wall
R/W.....	Right-of-Way
s.....	Slope
San.....	Sanitary
SCCP.....	Steel Cylinder Concrete Pipe
SD.....	Storm Drain
Sdl.....	Saddle
Sect.....	Section
Spec.....	Specifications
Sp. MH.....	Special Manhole
SS.....	Sanitary Sewer
St.....	Street
Sta.....	Station
Std.....	Standard
TH.....	Test Hole
UL.....	Underwriters' Laboratories, Inc.
V.....	Velocity
VC.....	Vertical Curve
VCP.....	Vitrified Clay Pipe
Vert.....	Vertical

**PART 2: DEFINITIONS**

- 2.1 Change Order: A written order to Contractor signed by ECUA authorizing an addition, deletion, or revision in the work or an adjustment in the contract price or contract time issued after execution of the agreement.
- 2.2 Contractor: The person, firm, or corporation that is performing work addressed these specifications.
- 2.3 Day: A calender day of twenty-four hours measured from midnight to the next midnight.
- 2.4 Drawings or Plans: The drawings which show the character and scope of the work to be performed and which have been prepared or approved by the Engineer and are referred to in the contract documents.
- 2.5 Engineer: The Project Engineer or his agent, who is responsible for the engineering design and construction inspection, acting directly or through duly authorized representatives.
- 2.6 ECUA: The public body or authority or the contracting agency for whom the work is to be performed. The Director of Engineering or his designee is the contact for the ECUA.

- 2.7 Field Order: A written order issued by Engineer which clarifies or interprets the contract documents.
- 2.8 Inspector: The authorized representative of Engineer for owner who is assigned to the project site or any part thereof.
- 2.9 Modification: (a) A written amendment to the contract documents signed by both parties, (b) a change order, (c) a written clarification or interpretation issued by Engineer, or (d) a written order for a minor change or alteration in the work issued by Engineer. A modification may only be issued after execution of the Agreement.
- 2.10 Owner: The same as the ECUA.
- 2.11 Project: The entire construction to be performed as provided in the contract documents.
- 2.12 Reference Specification, Test Methods, and Applicable Codes: All standard specifications and test methods of any society, association, or organization herein referred to are hereby made part of these contract documents the same as if written in full. (Any reference to a paragraph or subparagraph within a section shall include all general provisions of the section to which reference is made.) Reference to such standards refer to the latest published issued as of the date of Invitation to Bid. Reference to local or state codes and laws shall mean the latest adopted and published codes as of the date of the Invitation to Bid.
- 2.13 Service Connections: Service connections shall be construed to mean all or any portion of the pipe, conduit, cable, or duct which connects a utility main or distribution line to a building, home, residence, or property.
- 2.14 Shop Drawings: All drawing, diagrams, illustrations, brochures, schedules, and other data which are prepared by Contractor, a sub-contractor, manufacturer, supplier, or distributor and which illustrate the equipment, material, or some portion of the work.
- 2.15 Special Conditions: Conditions which are written for a specific project and which modify any section or paragraph of the general conditions.
- 2.16 Specifications, also Technical Specifications: Those portions of the contract documents consisting of written technical descriptions of materials, equipment, construction systems, standards, and workmanship as applied to the work.
- 2.17 Subcontractor: An individual, firm or corporation having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the work at the site.
- 2.18 Substantial Completion: The date as certified by Engineer when the construction of the project or a specified part thereof is sufficiently completed, in accordance with the contract documents, so that the project or specified part can be utilized for the purposes for which it was intended; or if there be no such certification, the date when final payment is due.
- 2.19 Supplementary Specifications: Specifications which are written to modify any section or paragraph of the technical specifications of this document.
- 2.20 Utility: Overhead or underground wires, pipe lines, conduits, ducts, or structures, operated and maintained in or across a public right-of-way or easement or private easement.

- A. Public Utility: Owned and operated by a municipality or another political subdivision of the State.
- B. Private Utility: Owned and operated by a private company or corporation.

2.21 Work: Any and all obligations, duties, and responsibilities necessary to the successful completion of the project assigned to or undertaken by Contractor under the contract documents, including all labor, materials, equipment, and other incidentals, and the furnishing thereof.

## SECTION 1004

### TESTING LABORATORY SERVICES

#### PART 1: GENERAL

- 1.1 The Contractor shall be responsible for providing materials which meet the requirements indicated. For manufactured materials such as reinforcing steel, expansion joint materials, concrete pipe, cement, miscellaneous steel, cast iron materials, etc., the Contractor will be required to furnish a manufacturer's certificate that the material meets the requirements specified for this project.
- 1.2 The Engineer shall monitor all materials incorporated into the project and their placement by testing at the Contractor's expense. The Engineer does not guarantee the accuracy or validity of the data nor does the Project Engineer or Owner assume any responsibility for the Contractor's interpretation of the data. Materials or work which do not meet the specifications shall be removed or modified.
- 1.3 All retesting for work rejected on the basis of the initial test results will be at the expense of the Contractor and the extent of the retesting shall be determined by the Engineer. The Engineer may require additional testing for failing tests and may required two passing retests. Acceptance will be made by the Engineer.
- 1.4 The testing laboratory will be approved by the Engineer and shall perform all work in a professional manner.

#### PART 2: LABORATORY DUTIES AND LIMITS OF AUTHORITY

- 2.1 Cooperate with Engineer and Contractor: provide qualified personnel as required promptly on notice.
- 2.2 Acquaint Engineer's personnel with testing procedures and with all special conditions encountered at the site.
- 2.3 Perform specified inspections, sampling and testing of materials and construction methods:
  - A. Comply with specified standards, ASTM and other recognized authorities.
  - B. Ascertain compliance with contract requirements.
- 2.4 Promptly notify the Engineer of irregularities or deficiencies of work which are observed during performance of services.
- 2.5 Promptly submit 3 copies of reports of observations and tests to the Engineer including but not limited to:
  - A. Date issued
  - B. Project title and number
  - C. Testing laboratory name and address
  - D. Name and signature of technician

- E. Date of sampling
  - F. Record of temperature and weather
  - G. Date of test
  - H. Identification of product and specification section
  - I. Location of product
  - J. Type of test
  - K. Observations regarding compliance with contract documents
- 2.6 Perform additional services ordered by the Engineer.
- 2.7 Laboratory is not authorized to:
- A. Release, revoke, alter or enlarge on contract requirements.
  - B. Approve or accept any portion of work.
  - C. Perform any duties of the Contractor.

**PART 3: CONTRACTOR'S RESPONSIBILITIES**

- 3.1 Furnish product concrete mix design together with the applicable design work sheets and data to meet or exceed contract requirements.
- 3.2 Cooperate with laboratory personnel, provide access to the work or to the manufacturer's operations.
- 3.3 Provide to laboratory preliminary representative samples of materials to be tested in specified quantities.
- 3.4 Furnish copies of mil test reports.
- 3.5 Furnish verification of compliance with contract requirements for materials and equipment.
- 3.6 Furnish casual labor and facilities:
- A. To provide access to work to be tested
  - B. To obtain and handle samples at site
  - C. To facilitate inspections and tests
  - D. For laboratory's exclusive use for storage and curing of test samples.
- 3.7 Notify Engineer 24 hours in advance of operations to allow for the assignment of personnel.

- 3.8 Notify laboratory 24 hours in advance of operations to allow for the assignment of personnel.
- 3.9 Correct work which is defective or which fails to conform to the contract documents. Corrective work shall not delay the project or the work of other Contractors.
- 3.10 Pay all costs of retesting when test results indicate non-compliance with contract requirements.
- 3.11 Patch all surfaces and areas disturbed by testing operations.

## **SECTION 1013**

### **SOILS AND SUBSURFACE INVESTIGATION**

#### **GENERAL**

- 1.1 Depending on the project requirements, the Engineer may have obtained geotechnical information, which may include subsurface data, logs of soil borings and recommendations from geotechnical consultants.
- 1.2 If soil borings have been prepared, they will be included in the specifications or on the plans.
- 1.3 Any geotechnical information included is for information only. The ECUA and the Engineer do not assume any responsibility for the Contractor's interpretation or conclusions drawn from the data.
- 1.4 The Contractor may, at his option, perform additional subsurface investigations at his own expense.

## **SECTION 2102**

### **CLEARING AND GRUBBING**

#### **PART 1: GENERAL**

##### 1.1 General Description of Work

- A. Clearing and grubbing on project site of trees, stumps, brush, roots, vegetation, logs, rubbish and other objectionable matter within limits described in specifications or as shown on plans.
- B. Clearing and grubbing shall be in advance of grading and trenching operations except that in cuts over 3 feet in depth, grubbing may be done simultaneously with excavation, provided objectionable matter is removed as specified.
- C. Disposal of all debris resulting from clearing and grubbing work.

##### 1.2 Protection of Adjacent Work: Protect existing improvements, adjacent property, utilities and other facilities, and trees and plants which are not to be removed from injury or damage.

##### 1.3 Protection from Erosion

- A. Contractor shall protect all disturbed areas from erosions.
- B. Repair any areas damaged by erosion.
- C. Clean erosion sediment from affected areas.

#### **PART 2: PRODUCTS**

##### 2.1 Materials: Provide materials required to perform work as specified.

#### **PART 3: EXECUTION**

##### 3.1 Clearing

- A. Clear all areas covered by dikes, roads, structures and embankments within project limits unless otherwise shown in plans.
- B. Remove all saplings, brush, down-timber and debris unless shown or directed otherwise.

##### 3.2 Grubbing

- A. Trees, stumps, root systems, rocks and other obstructions shall be removed to the depths shown when they fall within the construction boundary.
- B. Blasting not permitted.

##### 3.3 Removal of Debris and Cleanup

- A. Burn as permitted by regulating agencies or the Engineer as work progresses.
- B. Unguarded fires will not be permitted.
- C. Permits will be obtained, where required, for necessary burning or disposal sites.
- D. Dispose of all waste materials not burned by removal from site.
- E. Materials cleared and grubbed shall be the property of the Contractor and shall be his responsibility for disposal.

**PART 4: MEASUREMENT AND PAYMENT**

4.1 Clearing and Grubbing

- A. Clearing and grubbing shall be measured for payment either in acres or by lump sum only for areas indicated on the plans, or as provided in the proposal and contract.
- B. When not listed as a separate contract pay item, clearing and grubbing shall be considered as incidental work, and the cost thereof shall be included in such contract pay items as are provided in the proposal contract.
- C. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

## SECTION 2221

### TRENCH EXCAVATION, BACKFILL AND COMPACTION

#### PART 1: GENERAL

##### 1.1 General Description of Work

- A. Excavation, shoring, dewatering, pipe bedding, trench backfill, compaction, grading and cleanup of all pipeline trenching for the project.
- B. All work must be done in accordance with these specifications and the safety requirements of the State and OSHA standards.

##### 1.2 Job Conditions

- A. Accept site in condition existing during Contract time frame.
- B. Groundwater/surface water found during construction are conditions of the Contract and responsibility of Contractor.

#### PART 2: PRODUCTS

##### 2.1 Pipe Bedding and Backfill

- A. Determination of source of materials for bedding and backfill shall be responsibility of Contractor, but use of such materials shall be subject to approval of Engineer.
- B. Pipe bedding shall be angular material.

##### 2.2 Sand Backfill

(Where specified on plans.) Use sand or fine aggregate with source of material subject to approval of Engineering.

##### 2.3 Cradling Rock

Use crushed rock or stone with 70-100% passing 1" sieve and no more than 50% passing 3/4" sieve. Crushed oyster shells are acceptable.

##### 2.4 Controlled Density Fill

- A. Use high slump mixture of portland cement, fly ash and fine aggregate formulated, licensed and marketed as K-Krete or equal.
- B. Provide mixture with minimum 28-day compressive strength of 70 psi with no measurable shrinkage or surface settlement.

##### 2.5 Sheeting, Shoring and Bracing

- A. Use sound timber or structural steel.
- B. Use shapes and sizes as required.

## **PART 3: EXECUTION**

### 3.1 General

#### A. Dewatering

1. Prevent surface water from flowing into excavation.
2. Provide equipment for handling water encountered as required. Obtain approval of proposed method of dewatering.
3. No sanitary sewer shall be used for disposal of trench water.

#### B. Protection of Existing Utilities

1. Notify all utilities of location and schedule of work.
2. Locations and elevations of utilities shown on plans are to be considered approximate only. Notify utility and Engineer of conflicts between existing and proposed facilities.
3. Repair, relay or replace existing utilities damaged, destroyed or disrupted during work. Unless specified otherwise, replacement will be at the Contractor's expense.

#### C. Sheeting, Shoring and Bracing

1. Provide as necessary, to hold walls of excavation, prevent damage to adjacent structures, and to protect workmen and property.
2. Leave sheeting and shoring in place where removal might cause damage to work or as otherwise indicated on drawings.
3. When moveable trench shield is used below spring line of pipe, it shall be lifted prior to any forward movement to avoid pipe displacement.

#### D. Changes in Grade

1. Minor adjustments to grades may be made from plan grades to suit unforeseen construction conflicts or conditions with approval from Engineer.
2. No additional compensation will be made for such minor changes.

### 3.2 Excavation and Trenching

#### A. General

1. Method of excavation at Contractor's option.
2. The Contractor will use caution when excavating under tree roots and under and around structures and utilities. Excavate by hand when necessary.

3. Stockpile and replace topsoil equal to pre-existing depth for surface restoration in grassed or agricultural areas where specified or shown on plans.

B. Trench Characteristics

1. Depth: As indicated for pipe installation to lines and grades required with proper allowance for thickness of pipe and type of bedding specified or indicated.
2. Width
  - a. Keep width of trench as narrow as possible and yet provide adequate room for backfilling and jointing.
  - b. Maximum trench width of 30-inch or pipe O.D. plus 18 inches where soil conditions permit.
3. Provide bell holes for each pipe joint where pipe bears on undisturbed earth.
4. Trench bottom shall be free of large stones and other foreign material.

3.3 Organic or Unstable Materials

- A. Stop work and notify Engineer.
- B. Perform remedial work as directed.
- C. If material is judged unsuitable and removal is authorized, remove and replace with trench stabilizing material as directed by Engineer.

3.4 Rock Excavation

- A. Excavate any rock to maintain minimum 6-inch clearance around pipe.
- B. Dispose of rock material not suitable for backfill as directed by Engineer.
- C. Use of explosives not permitted without prior written authorization from Owner and Engineer.
- D. Provide Special Hazard Insurance covering liability for blasting operations.

3.5 Bedding

- A. Place after bottom of trench has been excavated to proper depth and grade.
- B. Place, compact and shape bedding material to conform to barrel of pipe to insure continuous firm bedding for full length of pipe.
- C. Provide bedding as described in following table unless indicated otherwise on Plans or in Special Conditions.

	Pipe Material	Minimum Bedding Class
1.	Ductile Iron Pipe	Class D*
2.	Flexible or Composite Pipe	Class 1**
* Refers to standard detail, "Pipe Envelope Requirements", Dwg. D-10.		
** Refers to standard detail, "Flexible Pipe Bedding Requirements", Dwg. D-11.		

3.6

Trench Backfill

- A. Use excavated material backfill unless otherwise specified or directed.
- B. Use suitable backfill for all trenches within 5 feet of buildings and beneath walks, parking areas, paved streets or existing exposed utilities.
- C. Initial Backfill
  - 1. Place after pipe has been bedded and checked for alignment, grade and internal obstructions.
  - 2. Carry out in an orderly fashion after authorization to cover pipe has been given.
  - 3. Allow no more than 300 feet of trench to be open at one time.
  - 4. Do not backfill until concrete or mortar has sufficiently cured.
  - 5. Record location of connections and appurtenances before backfilling.
  - 6. Place by hand and hand tamp to not less than 12 inches above top of pipe, in approximately 4-inch layers.
  - 7. Backfill simultaneously on both sides of pipe to prevent displacement.
  - 8. Place cushion of 4 feet above pipe envelope before using heavy compacting equipment.
- D. Subsequent Backfill
  - 1. Place backfill into trench at an angle so that impact on installed pipe is minimized.
  - 2. Compaction of all backfill material shall be performed in a manner that shall not crack, crush, and/or cause the installed pipe to be moved from the established grade and/or alignment.
  - 3. Area under pavement and walks or within buildings shall be mechanically compacted to the top of the subgrade in 6-inch lifts to a minimum of 95 percent Standard Proctor Density.
  - 4. Areas not subject to vehicular traffic shall be backfilled and compacted in layers not more than 12 inches in depth.
  - 5. Compaction method at discretion of Contractor with following exceptions:
    - a. If in Engineer's opinion compaction method presents potential damage to pipe, it will not be allowed.
    - b. Compaction of any backfill material by flooding or jetting will require prior written authorization of Engineer.
  - 6. Mound excavated materials no greater than 6 inches in open areas only.
  - 7. Fill upper portion of trench with topsoil as specified hereinbefore.

8. No trench shall be open overnight.

E. Controlled Density Fill

1. Use where shown on plans.
2. Provide suitable forms to limit volume of controlled density fill material.
3. Protect exposed utility lines during placement.
4. Place material in accordance with suppliers' written recommendations unless directed otherwise by Engineer.

3.7 Excess Material

Dispose of waste excess excavated material as directed by Engineer.

3.8 Testing

A. Payment of failed tests will be the responsibility of Contractor.

B. Standard Proctor Density

1. ASTM D698.
2. One (1) required for each type of material encountered.

C. In Place Density

1. ASTM D1556 (Sand Cone)
2. ASTM D2167 (Balloon)
3. ASTM D3017 (Nuclear)

**PART 4: MEASUREMENT AND PAYMENT**

4.1 Trench Excavation

- A. Trench excavation shall be considered incidental to pipeline installation.
- B. Payment shall be made at the contract unit price per cubic yard only if a bid item is established in the contract.

4.2 Backfill

- A. Payment for backfill shall be made at the contract unit price per cubic yard only if a separate bid item is established in the contract.
- B. No allowance for waste shall be made.
- C. If Engineer orders an initial backfill material other than that specified in contract, it shall be paid for as an extra in price per cubic yard as compacted in place, EXCEPT if a

- higher class embedment is ordered by Engineer because the Contractor has over-excavated the trench width.
- D. If the Contractor over-excavates the trench width and the Engineer orders the next higher class of embedment to be used, the embedment shall be paid for as if the original specified embedment was used.
  - E. If the Engineer orders the excavated material to be removed and disposed of and replaced with another material and a separate bid item is not established as a bid item, the material shall be paid as an extra.
  - F. If the Contractor fails to compact the backfill to the density requirements, the Engineer may order the material removed and replaced at no cost to the Owner.

## SECTION 2224

### PIPE BORING, DRILLING AND JACKING

#### PART 1: GENERAL

##### 1.1 General Description of Work

This work shall consist of boring, drilling or jacking operations related to the installation of water pipe and sanitary sewer pipe, in areas where trenching is not feasible or permitted, or as designated on the plans.

#### PART 2: PRODUCTS

##### 2.1 Steel Casing

- A. The steel casing shall be seamless or electric resistance-welded tubing for sizes under 24-inch O.D. and standard double-submerged arc-weld for sizes over 24".
- B. Steel pipe shall be A-139, Grade B with one bevelled end (to 37 degrees) and other end square cut.
- C. The following table shall be used for determining minimum casing size.

Steel Casing Diameter	MINIMUM WALL THICKNESS		Carrier Pipe I.D.	
	Highway	Railroad	Gravity	Pressure
10"	.188"	.188"	NA	4"
12"	.188"	.188"	4"	6"
14"	.250"	.250"	6"	8"
16"	.250"	.250"	8"	10"
18"	.250"	.250"	10"	10"
20"	.250"	.250"	12"	12"
24"	.250"	.281"	14"	14"
24"	.250"	.281"	16"	16"
30"	.250"	.312"	18"	18"
30"	.312"	.344"	20"	20"
36"	.312"	.406"	24"	24"
42"	.375"	.469"	30"	30"
48"	.500"	.532"	36"	36"
60"	.500"	.563"	42"	42"
72"	.625"	.625"	48"	48"

#### PART 3: EXECUTION

##### 3.1 Boring and Jacking

- A. Boring shall be performed to alignment and grade as shown on the construction drawings.
- B. The earth and/or rock augers shall not exceed the O.D. (outside diameter) of the steel casing by more than ¼ of an inch. The boring and insertion of the steel casing shall be performed with equipment capable of simultaneous operations.

- C. The feed rate of augers and hydraulic pushing of the casing shall be the same. Under no circumstances will boring be allowed unless operations are simultaneous.
- D. Every effort shall be made to avoid loss of earth.
- E. Excavated material shall be removed from the casing as excavation progresses and no accumulation of such material within the casing shall be permitted.
- F. Upon completion of the boring operations, all voids around the outside face of the casing shall be filled by grouting. Grouting equipment and material shall be on the job site before boring operations are started in order that grouting around the bored casing may be started immediately after the boring operations have finished.
- G. The allowable tolerance as to grade and alignment of the installed casing shall not exceed 1/10 of a foot per hundred feet of casing length.
- H. The Contractor shall be responsible for protecting any underground utilities and for any damage resulting to located utilities.
- I. The contractor shall be fully responsible for producing a sound, tight installation, true to line and grade. Gravity pipe shall be skidded through the casing on redwood or pressure treated, stainless-steel tied skids. Ductile iron pipe may be used instead of skids.

### 3.2 Installation Details

- A. Prior to the start of the boring operations, the Contractor shall submit the following details to the Engineer when requested.
  - 1. Boring pit bracing.
  - 2. Casing boring head.
- B. Only workmen experienced in boring operation shall perform the work.

### 3.3 Drilling and Jacking for Conduit

- A. Metallic conduit shall be installed under existing pavement by approved jacking or drilling methods.
- B. Nonmetallic conduit shall not be installed by jacking. Nonmetallic conduit may be installed by drilling if a hole larger than the conduit is pre-drilled and the conduit is hand-installed.
- C. Jacking or drilling pits shall be at least 2 feet from the edge of any type of any pavement, measured from the side of the pit nearest to the pavement.

### 3.4

#### Jacking

- A. If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. Such work shall be sheeted securely and braced in a manner to prevent earth cavings and to provide a safe, stable work area.
- B. Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used so that pressure will be applied to the pipe uniformly around the ring of the pipe.
- C. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides properly braced together, to support the section of the pipe and to direct it in the proper line and grade.
- D. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe and the pipe forced through the embankment with jacks, into the space thus provided.
- E. The excavation for the underside of the pipe, for at least 1/3 of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than 2 inches may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe.
- F. The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed 2 feet in any case. This distance shall be decreased if the character of the material being excavated makes it desirable to keep the advance closer to the end of the pipe.
- G. The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of 1 inch in 10 feet, provided that such variation shall be regular and only in one direction and that the final grade or flow line shall be in the direction indicated.
- H. If the Contractor desires, he may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping onto the pipe.
- I. When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practical, to prevent the pipe from becoming firmly set in the embankment.
- J. Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his entire expense.
- K. Immediately after jacking is complete and the carrier or encasement pipe is accurately positioned and approved for line and grade, the clearance space between the pipe and soil shall be completely filled by pressure grouting for the entire length of the installation.
- L. The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.

## **PART 4: MEASUREMENT AND PAYMENT**

### 4.1 Measurement

#### A. Boring

1. Measurement shall be per linear foot of bored casing, and shall include furnishing all labor, materials, equipment, and work involved in the boring operations.
2. The unit measurement shall also include skids, steel ties, grouting, and other items associated with the boring and casing.

#### B. Drilling and Jacking for Electrical Conduits

Measurement shall be per linear foot of installed electrical conduit and shall include all labor, materials, equipment, and work required for the operation.

#### C. Jacking

Jacking pipe will be measured by the linear foot of pipe complete in place. Such measurement will be made between the ends of the pipe along the central axis as installed.

### 4.2 Payment

#### A. Boring

1. The accepted quantities for boring will be paid at the unit bid price per diameter of casing per linear foot.
2. Payment for carrier pipe will be paid in accordance with Section 02556 and Section 2570.

#### B. Drilling and Jacking for Conduit

1. The accepted quantities for drilling and jacking for conduit will be paid at the unit bid price per diameter per linear foot.
2. The accepted quantities for jacking will be paid at the unit bid price per linear foot of the type, size, and class indicated.

C. When not listed as a separate contract pay item, boring, drilling and jacking conduit or jacking shall be considered as incidental work, and the cost there of shall be included in such contract pay item(s) as provided in the contract proposal.

D. Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

**SECTION 2556****WATER DISTRIBUTION AND SERVICE LINES****PART 1: GENERAL****1.1 GENERAL DESCRIPTION OF WORK COVERED**

The contractor shall furnish and install all pipes, fittings, structures and accessories required for water distribution and/or service lines in accordance with the requirements of the Construction Plans and related Contract Documents.

**1.2 QUALITY ASSURANCE****AWWA Standards**

Construction materials and methods shall comply with the requirements of the latest published edition of American Water Works Association (AWWA) Standards. Applicable standards include, but may not be limited to, the following:

1	AWWA C104	Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
2	AWWA C105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
3	AWWA C110, C110a	Gray Iron and Ductile Iron Fittings, 2-inch through 48-inch for Water and Other Liquids
4	AWWA C111	Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings
5	AWWA C151	Ductile Iron Pipe, Centrifugally Cast in Metal Mold or Sand Lined Molds, for Water or Other Liquids
6	AWWA C153	Ductile Iron Compact Fittings, 3-inch through 12-inch for Water and Other Liquids
7	AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
8	AWWA C301	Prestressed Concrete Cylinder Pipe (PCCP), 16-inch and Larger
9	AWWA C502	Fire Hydrants
10	AWWA C504	Butterfly Valves
11	AWWA C509	Resilient Seated Gate Valves
12	AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
13	AWWA C600	Installation of Ductile Iron Water Main and Appurtenances
14	AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
15	AWWA C651	Disinfection of Water Mains
16	AWWA C800	Underground Service Line Valves and Fittings
17	AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe 4-inch through 12-inch for Water
18	AWWA C901	Polyethylene Pressure Pipe and Tubing 1/2-inch through 3-inch
19	AWWA C905	Polyvinyl Chloride (PVC) Pressure Pipe, 14-inch and Larger
20	AWWA C906	Polyethylene (PE) Pressure Pipe, 4-inch through 63-inch
21	AWWA C907	Polyvinyl Chloride (PVC) Pressure Fittings, 4-inch through 8-inch

**ASTM Standards**

In addition, construction materials and methods shall also comply with the requirements of the latest published editions of the American Society for Testing and Materials (ASTM) Standards, and the National Sanitation Foundation (NSF) Standard 61.

## **PART 2: MATERIALS AND EQUIPMENT**

### **2.1 GENERAL**

All pipe, fittings and accessories shall be new, and shall be suitable and rated for potable water use.

### **2.2 DELIVERY, STORAGE, AND HANDLING**

Certificates of Compliance with the Specifications shall be required for all materials used on the Project. All materials shall be protected during transportation, storage, handling, and installation to avoid physical damage. All materials shall be stored to prevent physical deterioration due to sun and weather. The ECUA reserves the right to reject material which in any way does not meet the requirements of these Specifications.

### **2.3 WATER MAINS**

#### **2.3.1 Polyvinyl Chloride Pipe (PVC)**

PVC pipe shall meet AWWA Standard C900 or C905, or ASTM Standard D2241, with minimum designations per Table 2.3.1 below. PVC pipe shall be provided with push-on or insert-lock-type joints with the bell integrally cast into the pipe. PVC pipe shall be installed with elastomeric gaskets meeting ASTM Standard F477.

TABLE 2.3.1 - PVC PIPE STANDARDS					
Standard	Nominal Size	Dimension Ratio	OD	Pressure Class (psi)	Pressure Rating (psi)
AWWA C900	4-inch thru 12-inch	DR25	CI	100	(165)*
AWWA C905	14-inch thru 36-inch	DR25	CI	(100)*	165
ASTM D2241	2-inch thru 3-inch	SDR26	IP	(95)*	160

\*Pressure class and rating designations shown in parentheses are nominal designations.

#### **Markings**

PVC pipe shall be marked to indicate the following:

1. Nominal Pipe Size and OD Base
2. Material Code Designation
3. Dimension Ratio
4. Pressure Class or Pressure Rating
5. Manufacturer's Name or Trademark
6. National Sanitation Foundation Approved Marking
7. Appropriate AWWA or ASTM Standard Number

#### **Color-Coding**

PVC water pipe shall be color-coded blue in accordance with AWWA Standards. If blue pigmented pipe is not available, white pipe may be substituted subject to the approval of the Director of Engineering or his designee. White pipe used for potable water shall be marked with 3 blue stripes (1/2 inch wide) in permanent ink along the entire length and evenly spaced around the pipe circumference with the word WATER in 3/4-inch letters every 21 inches along each stripe.

### 2.3.2 Ductile Iron Pipe (DIP)

Ductile iron pipe shall meet AWWA Standard C151 and pressure class based on Table 2.3.2 below for design operating pressures of up to 150 psig, installed in Class 2 Trenching conditions. Increase pressure class or bedding class as required by AWWA C151 for surface loads greater than indicated above or operating pressures greater than 150 psi. DIP shall be constructed with push-on joints using rubber gaskets in accordance with AWWA Standard C111. Other methods of joint construction, such as mechanical, flanged, or ball-and-socket, may be required in special applications as appropriate. DIP shall be lined in accordance with AWWA Standard C104, unless otherwise specified and approved.

Diameter	Class	Max. Depth of Bury
3-inch & 4-inch	350	32 feet
6-inch & 8-inch	350	28 feet
10-inch & 12-inch	350	14 feet
14-inch thru 20-inch	250	10 feet
24-inch thru 64-inch	200	8 feet

#### Markings

Each ductile iron pipe section shall be marked to indicate the weight class or nominal thickness, and casting period. The manufacturer's mark, country where cast, year in which the pipe was produced, and the letters DI or DUCTILE shall be cast or stamped on the pipe. All required markings shall be clear and legible, and all cast marks shall be on or near the bell. All letters and numerals on pipe sizes 14-inch and larger shall be not less than 0.5-inch in height.

#### Soil Corrosion Protection Encasement

When required, DIP shall be encased in plastic sheet material in accordance with AWWA Standard C105 as stated on project plans/specifications if applicable.

### 2.3.3 Polyethylene Pipe (PE)

The pipe supplied under this specification shall be high performance, high molecular weight, high density polyethylene pipe and shall conform to ASTM D 1248 (Type III C, Class C, Category 5, p34). Minimum cell classification values shall be 345434C as referenced in ASTM D 3350 - latest edition. All pipe resin shall be manufactured by the same company that manufactures the pipe itself in accordance with these specifications to insure complete resin compatibility and total product accountability. The fittings shall be molded or manufactured from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe. To insure compatibility of polyethylene resins, all fittings supplied under this specification shall be of the same manufacturer as the pipe being supplied.

Property	Test Method	Unit	Value
Density	ASTM D1505	gms/cc	0.957
Melt Flow	ASTM D 1238 (190/21.60)	gms/ 10 min.	1.5
Environmental Stress Cracking Resistance Condition A, B & C, F <sub>0</sub> Compressed Ring, F <sub>0</sub>	ASTM D1693 Proposed ASTM	hrs. hrs.	>5000 >5000

Tensile Strength, Ultimate Type IV Specimen	ASTM D 638 (2"/min.)	psi	5000
Tensile Strength, Yield Type IV Specimen	ASTM D 638 (2"/min.)	psi	3500
Elongation at Break Type IV Specimen	ASTM D 638 (2"/min.)	%	>600
Impact Strength Specimen Thickness 0.125 inch	ASTM D 256 Method A	ft.lbs./inch notch	>12
Vicat Softening Temperature	ASTM D 1525	°F	257
Brittleness Temperature	ASTM D 746	°F	<-180
Flexural Modulus	ASTM D 3350	psi	125,000
Hardness	ASTM D 2240	Shore D	65
Coefficient of Linear Thermal Expansion Molded Specimen Extruded Pipe	ASTM D 696	in./in./ °F	8.3x10 <sup>-5</sup> 1.2x10 <sup>-4</sup>
Thermal Conductivity	Dynatech-Colora Thermoconductor	TRU, in./ ft. <sup>2</sup> /hrs./ °F	2.7
Long Term Strength 73°F 140°F	ASTM D 2837	psi psi	1600 800
Material Cell Classification	ASTM D 3350		355434C
Material Designation	PPI		PE 3408

### 2.3.3.1 Quality Control

The resin used for manufacture of the pipe shall be manufactured by the pipe manufacturer, thus maintaining complete control of the pipe quality. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification and from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects, and shall be identical in color, density, melt index, and other physical properties.

Approved manufacturers shall be Driscopipe, Plexco and CPS; others as approved by ECUA in writing.

The engineer may request, as part of the quality control records submittal, certification that the pipe produced is represented by the quality assurance testing. Additionally, test results from manufacturer's testing or random manufacturer's representation, may be cause for rejection of pipe represented by the testing. These tests may include density and flow rate measurements from samples taken at selected locations within the pipe wall and thermal stability determinations according to ASTM D 3350, 10.1.9.

#### 2.3.3.1.1 Verification

The owner or the specifying engineer may request certified lab data to verify the physical properties of the materials supplied under this specification or may take random samples and have them tested by an independent laboratory.

#### 2.3.3.1.2 Rejection

Polyethylene pipe and fittings may be rejected for failure to meet any of the requirements of this specification.

2.3.3.1.3 Pipe Dimensions

Pipe supplied under this specification shall have a nominal DIPS (Ductile Iron Pipe Size) O.D. unless otherwise specified. Pipe shall have a SDR (Standard Dimension Ratio) of 11 unless otherwise specified.

2.3.3.2 Color-Coding

HDPE water pipe shall be color-coded with blue striping or have an integral, extruded blue coating.

2.3.4 Alternate Pipe Materials

ECUA may consider other pipe materials as appropriate for the needs of the Project. Alternate pipe materials identified during design and approved for use on the Project shall be noted on the Construction Plans, and a detailed Technical Specification shall be prepared and included in the Contract Documents.

**2.4 WATER MAIN APPURTENANCES**

2.4.1 Water Main Fittings

Water main fittings shall include Tees, Wyes, Bends, Reducers, and other appurtenances commonly used in pipe construction. Fittings shall meet AWWA Standard C110 or C153 with pressure ratings of not less than that specified for adjacent pipe. Fittings shall be constructed with mechanical joints, unless otherwise specified, and shall be supplied complete with low alloy bolts and nuts, EPR gaskets and other necessary parts required for field assembly. Fittings shall be cement-mortar lined in accordance with AWWA Standard C104/A21.4.

2.4.1.1 Pipe Couplings

Pipe couplings shall be solid sleeve type with mechanical joints at each end containing a compression gasket. Couplings shall be ductile iron, 12 inches minimum in length, with low alloy bolts and nuts, and EPR gaskets. Rings and gaskets shall be sized to conform exactly to the requirements of the pipe manufacturer.

2.4.1.2 Pipe Cut-in Sleeves

Cut-in sleeves shall be solid ductile iron, one end plain for insertion to female fitting, the other end flanged mechanical joint, furnished with loose attaching flange and fastener, nominal length of 20-21 inches. Specify pipe main size and type of pipe fabrication.

Approved Manufacturers

Manufacturer	Model	Application
Clow	F-1220	for centrifugally cast or sand cast pipe (special)
Clow	F-3459	for all classes of centrifugally cast pipe
Union Foundry	21-4520 21-4610 24-4800	MJ X PE FLG X PE MJ X FLG
Clow	F-3459	for all classes of centrifugally cast pipe
Others as approved by ECUA in writing.		

### 2.4.1.3 Repair Clamps

Repair clamps shall not be used in the installation of new pipe except with the written permission of the Engineer. Repair clamps shall be full circle and selected based on Table 2.4.1.3 below.

TABLE 2.4.1.3 - REPAIR CLAMP SIZES	
Pipe Diameter	Maximum Sections
Up to 12-inch	Single Section
14-inch to 24-inch	Double Section
26-inch and above	Triple Section

Repair clamps shall be composed of stainless steel bands and bolts, DI lugs and full gridded virgin EPR compounded gasket.

Repair clamps shall be sized so that the OD of the existing pipe being repaired falls within the designated range for the clamp size. Repair clamps shall have ample length to give full gasketing at both ends.

#### Approved Manufacturers

Manufacturer	Model
Ford	F1, FS1 (all SS), Fordflex (SS-DI Lugs)
Smith Blair	2XX*
JCM	101,102,103,104,131,132,133,134
Mueller	520, 530
Others as approved by ECUA in writing.	

\*XX: See Mfr.'s catalog to complete model numbers by size.

### 2.4.1.4 Pipe Restraints

Joint restraints shall be used in conjunction with all water line pipe, fittings and appurtenances. Joint restraints shall be used on pipe and fittings in each direction in accordance with ECUA Standard Detail D-43 and D-44. Restraints shall have set or anchor screws used to secure body to pipe with torque limit break away head design. Stainless steel all-thread tie rods may be used at flanges with permission of the Engineer.

#### Approved Manufacturers

Manufacturer	Model
Ebaa Iron Works	MegaLug Series 1100, 1500, 2000, 2500, 3000, 3600, 6500
Ford	UNI-Flange UAI, UBI, UI, 1300, 1340, 1390, 1400
JCM Industries	Sur-Grip Restrainers No. 620, 621
Others as approved by ECUA in writing.	

### 2.4.1.5 Expansion Joints

Expansion joint fittings shall be used where specified on the Construction Plans. They shall be of the rigid or flexible type as specified, and manufactured of ductile iron in accordance with 2.4.1 above. They shall be capable of expanding or contracting to the extent shown on the plans, but in no case less than 4-inch axially, and designed to prevent separation beyond the maximum extension without the use of external tie rods.

Fittings shall be flanged or provided with restrained mechanical joints, individually pressure tested to a minimum of 350 psi against their own restraints, and internally coated on all exposed surfaces with a minimum of 15 mils. of fusion bonded epoxy conforming to AWWA C213. They shall be capable of deflecting not less than 15° by means of an integral ball at each joint in the case of flexible types.

#### Approved Manufacturers

Type	Manufacturer	Model
Rigid	EBAA Iron, Inc.	EX-TEND 200
Flexible	EBAA Iron, Inc.	Flex-Tend
Others as approved by ECUA in writing.		

#### 2.4.1.6 Tapping Sleeves

Tapping sleeves shall be designed for a working pressure of 200 psig without leakage. Tapping sleeves shall be stainless steel. The outlet branch connection shall have a recessed flanged face for connection of tapping valve with standard dimensions in accordance with MSS SP-60. A complete set of neoprene or other elastomer gaskets shall be furnished. Sleeves shall be furnished to fit cast iron, cement-asbestos, or Class 160 or C900/905 PVC pipe with side connection as shown on plans or specifications in standard pipe sizes of 4-inch X 4-inch through 16-inch X 12-inch. Sleeves shall be furnished with all necessary installation parts such as mechanical joint loose flange ends, bolts, fasteners, seals and gaskets. Refer to Section 2.4.1.6 for Tapping Valve requirements.

#### Approved Manufacturers

Manufacturer	Main Material	Model
Clow	CI & C900 PVC Class 50, 100, 150, 200 10-inch & 12-inch Class 50, 100	F-5205 F-5207 4 F-5205
American Darling	CI & C900 PVC CI & CA	2800C 2800A
Ford		FAST A
Mueller	CI, DI - 4-inch - 12-inch CA - 4-inch - 8-inch CI Class C & D - 10-inch - 14-inch CA - 4-inch-12-inch	H615 H615 H616 H619
JCM Industries		432
Smith-Blair		662
Others as approved by ECUA in writing		

Note: To specify exact fitting when ordering, state line diameter and line material.

#### 2.4.1.7 Pipe Hangers and Supports

Hangers and supports shall be in compliance with Federal Specification WW-H-171E, or Manufacturer's Standardization Society SP-69, or UL listed. Materials of construction shall be in accordance with the requirements outlined in Table 2.4.1.7 below.

TABLE 2.4.1.7 - PIPE HANGERS AND SUPPORTS MATERIALS OF CONSTRUCTION	
Part I.D.	Material
Clamps	Steel - Epoxy Coated or Galvanized Cast Iron – Galvanized Malleable Iron

Hanger Rods	Steel - Electro Galvanized Steel - Stainless 304
Roller Bases/Roller Stands	Cast Iron
Fasteners/Fittings	Galvanized Steel Stainless
Hanger Rod Inserts	Steel: Cadmium Plated Steel: Galvanized Universal Concrete Insert - Cast Iron - Galvanized
Rod Attachments	Clevis - Forged Steel Turnbuckle: 1) Forged Steel, 2) Malleable Iron Sockets, Eye Nuts, Extension - Malleable Iron
Roller Bases/Roller Stands	Cast Iron
Rollers	Steel or Iron Core, Insulated from Structure

### Approved Manufacturers

Manufacturer	Part I.D.	Model No.
Utility Pipe Products	Clevis Hanger	590
	Socket Clamp	224 246
	<u>Concrete Inserts:</u>	
	CB-Universal	282
	Screen Insert	152
	<u>Rod Attachments:</u>	
	Eye Nut	290
	Forged Clevis	299
	Forged Turnbuckle	230
	Carbon Steel	233
	Couplings	136
	Socket Eye	110R
	Extension	157
	<u>Pipe Rolls:</u>	
Adjustable Swivel	174	
Adjustable Steel Yoke	181	
Pipe Roll with Base	274	
Pipe Roll and Plate	277	
Others as approved by ECUA in writing.		

## 2.4.2 Valves

All valves shall be manufactured in accordance with the current appropriate AWWA Standard and shall be NSF approved for use in potable water.

### 2.4.2.1 Resilient Seated Gate Valves

Resilient seated gate valves shall be designed and fabricated in accordance with the current AWWA Standards. The basic design of the gate valves shall have an iron body, elastomer encapsulated iron disc, bronze stem and operating nuts with non-rising stem design. Valves 16-inches and larger shall be equipped with right angle gears (bevel gearing) for horizontal installation, and shall be equipped with rollers, tracks and scrapers.

The valve working pressure for all sizes shall be a minimum of 200 psig with a test pressure of 400 psig.

#### 2.4.2.1.1 General Materials and Construction

Valves shall open counterclockwise with a 2-inch square iron operating nut secured to the valve stem by a corrosion resistant nut to threads on the valve stem. The valve stem

shall be made of high tensile strength bronze and shall be of one piece construction sealed by O-Rings. The thrust collar shall be secured in place by a stuffing box or bonnet cover with a thrust washer located above the thrust collar. Valve construction shall be so that upper O-Rings can be replaced with the valve in service. The disc shall be cast iron encapsulated with an elastomer material bonded in accordance with ASTM D429 and shall be secured to the threaded stem by a bronze nut. The disc shall effect a seal that is bubble-tight at 200 psig.

#### 2.4.2.1.2 Body - Disc - Bonnet - Operating Nut Material

Cast iron construction in accordance with current AWWA Standard C-509; (or) Cast ductile iron construction in accordance with current AWWA Standard C-515 and AWWA Standard C-153.

#### 2.4.2.1.3 Corrosion Resistant Coatings

All interior and exterior cast iron surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550.

#### 2.4.2.1.4 Body Sizing

Valve body length shall be per ANSI Standard B16.2 for the type of end connections specified. In the full open position, the valve internal bore shall be smooth and obstruction-free without cavities or projections that could accumulate solids. The internal cross-sectional area of the valve shall be approximately equal to the nominal cross-sectional area for Schedule 40 PVC pipe of the same nominal internal diameter.

#### 2.4.2.1.5 End Connections

Valves shall be furnished with mechanical joint end connections, complete with flange kits, unless otherwise specified on the plans or purchase order.

When flanged ends are specified they shall be flat face nominal 125# ANSI B16.1 Standard with bolt holes straddling the vertical center line.

#### Approved Manufacturers

VALVE BODY CONNECTIONS				TAPPING VALVE
Manufacturer	MJ x MJ	MJ x FLG	FLG x FLG	MJ x SF
American Darling (Cast Iron)	4-inch - 12-inch CSR-80X	4-inch - 12-inch CSR-80X	CSR-80X Specify Ends	4-inch - 12-inch No. 862
(Ductile Iron)			4-inch - 24-inch Series 2500 (See Manufacturer's Catalog)	16-inch - 24-inch*
Clow (Cast Iron)	2-inch - 12-inch F6100	4-inch - 12-inch F-6106	4-inch - 12-inch F-6102	4-inch - 12-inch F-6114
				14-inch - 24-inch F-5093*
Kennedy (Cast Iron)	3-inch - 12-inch F-1571-XNRS	3-inch - 12-inch F-1572-XNRS	3-inch - 12-inch F-1561-XNRS	3-inch - 12-inch F-950X

M & H (Cast Iron)	4-inch - 12-inch S-4067-01		4-inch - 12-inch S-4067	2-inch - 12-inch H-667 200 PSI  14-inch - 24-inch H-667 150 PSI
Others as approved by ECUA in writing - Cast iron or ductile iron construction.				

\*Metal seated only, specify bypass if required  
14-inch and larger valves specify special appurtenances.

#### 2.4.2.2 Resilient Seated Tapping (Gate) Valves

Resilient seated gate valves shall be designed and fabricated in accordance with the current AWWA Standard C-509 or C515. The basic design of the gate valves shall have a cast iron body, elastomer encapsulated cast iron disc, bronze stem and operating nuts with non-rising stem design. The valve working pressure shall be a minimum of 200 psig with a test pressure of 400 psig.

##### 2.4.2.2.1 Materials and Construction

Valves shall open counterclockwise with a 2-inch square iron operating nut secured to the valve stem by a corrosion resistant nut to threads on the valve stem. The valve stem shall be made of high tensile strength bronze and shall be of one piece construction sealed by O-Rings. The thrust collar shall be secured in place by a stuffing box or bonnet cover with a thrust washer located above the thrust collar. Valve construction shall be so that upper O-Rings can be replaced with the valve in service. The disc shall be iron encapsulated with an elastomer material bonded in accordance with ASTM D429 and shall be secured to the threaded stem by a bronze nut. The disk shall effect a seal that is bubble-tight at 200 psig.

##### 2.4.2.2.2 Corrosion Resistant Coatings

All interior and exterior cast iron surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550

##### 2.4.2.2.3 Body Sizing

Valve body length shall be per ANSI Standard B16.1 for tapping valves. Tapping valves shall conform to Specification AWWA C509, latest revision, covering gate valves except as modified for passage and clearance of tapping machine cutters. The opening through the valve shall be at least 1/4-inch larger than nominal valve diameter. Tapping valves shall allow full size shell cutters to be used.

##### 2.4.2.2.4 End Connections

Valves shall be furnished with one end of the body with projecting face flange in accordance with specification MSS SP-60 for tapping valve/saddle connections to bolt to a standard tapping sleeve and the other end for mechanical joint.

Approved Manufacturers

See Section 2.4.2.1 above.

### 2.4.2.3 Butterfly Valves

All butterfly valves shall be of the rubber-seated, tight-closing type. They shall meet or exceed AWWA Standard C504. All valves must use full AWWA C504 Class 150B valve shaft diameter, and full Class 150B underground service operator torque rating throughout entire travel, to provide capability for operation in emergency service.

#### 2.4.2.3.1 Valve Construction

Valve body shall be high-strength cast iron ASTM A126 Class B with 18-8 Type 304 stainless steel body seat. Valve vane shall be high-strength cast iron ASTM A48 Class 40, having rubber seat mechanically secured with an integral 18-8 stainless steel clamp ring and 18-8 stainless steel self locked screws. Shaft shall be one piece ANSI 304 stainless steel. Bearings shall be sleeve-type, self lubricated with O-Ring seals.

#### 2.4.2.3.2 Operators

Operator shall be of the traveling-nut type, sealed, gasketed, and lubricated for underground service. It shall be capable of withstanding an overload input torque of 450 ft. lbs. at full-open or closed position without damage to the valve or valve operator. Operator shall have operating nut or post indicator as specified.

#### 2.4.2.3.3 End Connection

End connections shall be mechanical joint, wafer-type with flange meeting ANSI B16.1-125#, and furnished as specified.

Approved Manufacturers

Manufacturer	Model
Dresser	450
American Darling	Class 150
Clow	F-53XX*
M & H	450, 1450, 4500
Others as approved by ECUA in writing.	

\*XX: See Mfr.'s catalog to complete model numbers by size.

### 2.4.2.4 Valve Boxes

Valve boxes shall be provided for all direct buried valves. Use nominal 6-inch cast-iron sliding-type pipe shaft with cover and base casting. The box top shall be set at finished grade and encased with a concrete ring in unpaved areas. Each valve box shall be furnished with a drop-in cover marked "WATER". See ECUA Standard Detail D-34.

### 2.4.3 Line Stops

Line stops are to be used where specified to temporarily stop water line water flow without depressurizing the entire line. The line stop parts and installation equipment are to be rated at a minimum of 150 psig working pressure unless otherwise specified.

#### 2.4.3.1 Materials and Construction

Tapping saddles shall have 360° clamping on the main. Main sizes 4-inch - 8-inch to be fabricated of 304 Stainless Steel; 10-inch and greater to be fabricated Carbon Steel with

epoxy coating. All bolts and fasteners are to be 304 Stainless Steel, and the saddle shall be installed with Buna-N or neoprene rubber full facing gasket.

The stopping device attaching nozzle to be vendor's standard with connecting threads or flange face, and the nozzle I.D. to be machine with a shelf to provide a position stop for the closure plug.

The closure plug is to be fabricated carbon steel, ductile iron, or malleable iron with at least one Buna-N or neoprene O-Ring seal on the outside diameter.

2.4.3.2 Corrosion Resistant Coatings

Non-stainless steel permanently installed parts to have manufacturer's standard red or black water base epoxy coating.

2.4.3.3 Connection

Tapping saddle shall be fabricated with dimensions to fit on concrete, steel, CA, PVC, CI, DI main as specified.

2.4.3.4 Installation

Temporary line stops shall only be installed by vendor personnel or contractor personnel trained and certified for stop by the vendor.

Approved Manufacturers (Main Sizes 3/4-inch - 42-inch)

Manufacturer	Contact
Hydra-Stop, Inc.	Phone: 800-538-7867 FAX: 708-389-5125
International Piping Services Co. (IPSCO)	Phone: 708-343-1333 FAX: 708-343-1435
JCM 440	Phone: 800-527-8482 FAX: 800-874-9524
Others as approved by ECUA in writing.	

2.4.4 Location Aids

All new water main and service line installations shall include an approved method for locating lines from the ground surface after completion.

2.4.4.1 Tracer Wire

Tracer wire for water lines shall be minimum 12 gauge copper with blue PVC insulation. Tracer wire systems shall be electrically continuous covering all mains and services within the project. Wire-to-wire connectors shall be made with silicone-filled wire nuts. Wire-to-appurtenance attachments shall be made with lug-type terminals. Wire shall be secured to the top of each pipe joint with nylon ties or PVC tape placed on 10-foot intervals. Wire shall be secured to pipe with blue colored PVC Tape.

Approved Manufacturers (Tracer Wire Silicone-filled Wire Nut Connectors)

Manufacturer	Model
Ideal Industries	Twister® DB Plus
King Technology, Inc.	Failsafe™
Others as approved by ECUA in writing.	

#### 2.4.4.2 Pipeline Markers

Markers shall be of a passive electronic type that reflects a signal back to an electronic hand-held transmitter/detector. Electronic components shall be enclosed in a blue waterproof polyethylene housing. Markers shall have a different response frequency for each service line type.

Markers shall be ScotchMark® products manufactured by 3M Telecom Systems Group, Austin, Texas. Alternate manufacturers by ECUA in writing.

Application	Usable Depth	Dimension/ Configuration	Service	Model
Near Surface	2 feet	3½" L X 5/8" Ø Cylinder	Water	1434
Medium Depth	4 feet	4" Ø Ball	Water	1403
Deep	6 feet	8" Ø X 1" Thick Disc	Water	1257

## 2.5 HYDRANTS AND FLUSHING EQUIPMENT

### 2.5.1 Fire Hydrants

Fire Hydrants shall be current design in compliance with the AWWA Standard C-502, with rated working pressure of 200 psig. The basic design of the fire hydrant shall be of the dry barrel type of breakaway traffic design.

#### 2.5.1.1 Hydrant Construction

The hydrant inlet connection shall be 6-inch mechanical joint type complete with flange kit.

The hydrant shall be designed with a traffic breakaway feature incorporating a flanged design using breakable bolts and breakaway shaft coupling. Split ring retainer-type breakaway design with pinch bolts is not acceptable. The hydrant design shall allow the upper barrel to be rotated 360 degrees in order to assure proper nozzle orientation.

The drain valve shall assure quick and complete drainage of the hydrant and the drain hole shall be bushed with bronze if passing through cast iron. The drain valve sealing facing shall be made of Buna N, nylon or urethane. If the valve top plate comes in contact with the bronze seat ring to facilitate draining of the hydrant, the valve top plate shall be made of bronze.

#### 2.5.1.2 Main Hydrant Valve

The main hydrant valve shall be compression type, opening counterclockwise against system pressure and closing clockwise with system pressure. The main valve connection opening shall not be less than 5¼-inches. The main valve shall have a resilient seat.

The hydrant shall be designed such that the operating threads on the stem are prevented from coming in contact with potable water and shall be enclosed in an operating chamber and sealed by O-Rings at the top and bottom of the chamber. The

chamber shall be constructed for grease or oil lubrication with an installed grease fitting for maintenance.

The operating nut shall be 1½-inches in size and pentagon in shape and of one-piece construction.

The hydrant shall have one 4½-inch pumper nozzle, and two 2½-inch pumper nozzles having National Standard Hose coupling threads. The nozzles shall be field replaceable utilizing either a threaded or quarter-turn fitting with an O-Ring seal.

2.5.1.3 Operation and Maintenance Features

The hydrant shall not incorporate parts requiring field adjustment for proper operation.

The hydrant shall be designed to permit the removal of all working parts from the hydrant through the barrel without disturbing the earth around the hydrant.

Removal of the working parts of the hydrant shall be accomplished by use of a seat. Hydrants requiring other special tools to perform removal of interior parts will not be accepted.

2.5.1.4 Materials

All operating parts including operating nut, hold-down nut, drain ring and seat ring shall be bronze. The valve seat ring shall thread into a bronze insert or drain ring to provide bronze-to-bronze seating. Breakaway stem coupling is to have bronze or stainless steel bolts or pins.

2.5.1.5 Markings

The fire hydrant shall have permanent markings identifying the manufacturer by name, initials or insignia, the size of the main valve opening, and the year of manufacture.

Approved Manufacturers

Manufacturer	Model No
Kennedy	81-A
Mueller	A423
American Darling	B84B
Clow	Medallion
M & H	129T
Others as approved by ECUA in writing.	

2.5.2 Fire Hydrant Appurtenances

2.5.2.1 Extension Kits

When specified, hydrants shall be installed using original manufacturer hydrant extension kits as necessary to position the hydrant breakaway above finish grade per ECUA Standard Detail D-35.

Stand extension shall be in standard lengths of 12, 24, 36, 48, and 60 inches.

2.5.2.2 Hydrant Connectors

Hydrant connector spools shall be ductile iron per AWWA C151 used for connection between the hydrant and lead valve, and shall incorporate joint restraints. One end of the connector spool shall have swivel flange. See ECUA Standard Detail D-35.

Standard hydrant connector sizes shall be as follows:

1. 6-inch X 12-inch long
2. 6-inch X 24-inch long
3. 6-inch X 36-inch long
4. 6-inch X 48-inch long
5. 6-inch X 60-inch long

Hydrant Offset Connectors

When a connector between the hydrant and lead valve specified to adjust hydrant height or to offset the hydrant from the valve, an offset connector shall be used. Material to be ductile iron per AWWA C153/ANSIA2153. Sizes shall be as follows:

1. 6-inch X 18-inch long with 6-inch offset
2. 6-inch X 30-inch long with 12-inch offset
3. 6-inch X 41-inch long with 24-inch offset

Approved Manufacturers

Manufacturer	Straight Hydrant Connector	Offset Connector
Assured Flow Sales, Inc.	N/A	GRADELOK
Clow	✓	N/A
Others as approved by ECUA in writing.		

2.5.3 Flushing Hydrants

Flushing hydrants shall be current design and in general compliance with AWWA Standard C-502, with rated working pressure of 200 psig.

2.5.3.1 Hydrant Construction

Flushing hydrants shall meet the requirements of Section 2.5.1, except breakaway feature is not required.

2.5.3.2 Main Valve

Generally the same as Section 2.5.1, except main valve opening shall be not less than 2-1/8 inches and the flushing hydrant shall have one (1) 2½-inch nozzle having national standard hose coupling threads.

2.5.3.3 Operation and Maintenance Features

Unless otherwise specified, the hydrant bury length shall be 36 inches. The bury length is the distance measured to the nearest 1/2 foot, from the bottom of the connecting pipe to the ground line of the hydrant.

2.5.3.4 Materials

All operating parts including operating nut, hold-down nut, drain ring and seat ring shall be bronze. The valve seat ring shall thread into a bronze insert or drain ring to provide bronze-to-bronze seating.

2.5.3.5 Markings

Flushing hydrant markings shall meet the requirements of Section 2.5.1 for fire hydrants.

Approved Manufacturers

Manufacturer	Model
Clow	F-4764
M & H	Style 33
Mueller	A-411
Others as approved by ECUA in writing.	

**2.6 WATER SERVICE LINES**

2.6.1 Polyethylene (PE) - Tubing

Polyethylene service tubing for water supply shall conform to AWWA C901. PE tubing dimensions shall conform to ASTM D2737 with Copper Tubing OD base. Refer to Section 2.3.3 for service lines greater than 2 inches in diameter.

2.6.1.1 Materials

PE tubing material shall conform to ASTM D3350, Standard Code PE 3408.

2.6.1.2 Pressure Rating

PE tubing shall be Pressure Class 200 psi with a minimum working pressure of 150 psig, and comply with ASTM D1598, D1599, D1693, D3350 and AWWA 901.

Dimensions and acceptable standard sizes

NOM	OD	WALL	ID
1	1.125	.137	.851
1½	1.625	.200	1.225
2	2.125	.250	1.625

2.6.1.3 Markings

1. Nominal Size
2. Standard PE Code: 3408
3. Tubing: DR-9
4. Pressure Class: PC200
5. Manufacturer's Name or Trademark
6. Blue Markings and Stripes

Approved Manufacturers

Manufacturer	Model
Phillips	Driscopipe 5100 Ultra-line

Others as approved by ECUA in writing.
--

## 2.6.2 Copper Water Service Tubing

Copper water service tubing shall be Type K suitable for underground potable water services. Tracer wire is not required with copper tubing.

### 2.6.2.1 Material

Tubing is to be supplied in conformance with ASTM B88 for dimension and materials.

### 2.6.2.2 Pressure Rating

Test Pressure: 200 PSIG

Operating Pressure: 150 PSIG

TABLE 2.6.2 - COPPER WATER TUBING DIMENSIONS (ASTM B88)		
Size (inches)	Nominal OD	Wall Thickness
1	1.125	.065
1½	1.625	.072
2	2.125	.083

### 2.6.2.3 Pipe Markings

1. Nominal Size
2. Type K
3. ASTM B88
4. Manufacturer's name or logo
5. NSF seal

## 2.7 **SERVICE LINE APPURTENANCES**

### 2.7.1 Fittings and Valves

Fittings and valves shall be manufactured in accordance with AWWA C-800 and be listed and approved by NSF for underground use in potable water service.

#### 2.7.1.1 Material

Fitting and valve bodies, plugs, and compression nuts shall be bronze, copper alloy No. C83600 and meet chemical and mechanical requirements of ASTM B62 or ASTM B584.

Component parts such as fasteners, seals, and packings may be of other materials selected for adequate endurance, corrosion resistance and strength in accordance with AWWA C-800.

#### 2.7.1.2 Pressure

Fittings and valves shall be high pressure type for maximum allowable pressure of 150 PSIG, nominal operating pressure 100 PSIG.

#### 2.7.1.3 Thread Specifications

Fittings and valves shall be of materials and fabricated in accordance with appropriate specification:

TABLE 2.7.1 - THREAD SPECIFICATIONS	
Thread Type	Standard
Unified Inch	ANSI/ASME B1.1
General Purpose Pipe	ANSI/ASME B1.20.1
Dryseal	ANSI/ASME B1.20.3

Fittings and valves shall be marked as appropriate with the following information: manufacturer's name or logo; pressure rating; direction of flow; and size.

Pack Joint Couplings - Acceptable Manufacturers		
Type	Manufacturer	Model
Joint Couplings Copper or Plastic Tube X MPT	Ford Mueller	C84-XX H-15428-X
Copper or Plastic Tube X FPT	Ford Mueller	C14-XX H-15451-X
Copper or Plastic Tube to Tube	Ford Mueller	C44-XX H-15403-X
Female Copper Pipe (replaces flare nut) X Copper or Plastic Tubing	Ford Mueller	CO4-XX H-15071-X
Others as approved by ECUA in writing.		

[X, XX: See Mfr.'s catalog to complete model numbers by size]

#### 2.7.1.4 Tapping Saddles

Tapping saddles shall be either bronze or cast or ductile iron with shop coat. Saddles used to tap Class 160 PVC pipe shall be designed with mechanical features or stops to prevent over-tightening.

##### Saddle Sizes

1. Main Pipe: 2-inch - 16-inch
2. Tapping valve connections: 1-inch, 1½-inch, 2-inch

##### Acceptable Manufacturers

Manufacturer	Application	Model
Ford	1-inch tap on PVC/steel OD pipe 1-inch tap on DI and CI Pipe	S-70 and S-90 F-101 and F-202
Mueller		H-105
Smith Blair		313
Others as approved by ECUA in writing		

#### 2.7.1.5 Water Tubing Couplings

Water tubing couplings in sizes 1-inch, 1½-inch, and 2-inch only shall be bronze compression-type, inlet and outlet for PE or copper tubing. Crimp-type couplings are not acceptable.

##### Acceptable Manufacturers

Manufacturer	Model
--------------	-------

Ford	C44-XX*
Mueller	H-15403-XX*
Others as approved by ECUA in writing	

\*XX: See Mfr.'s catalog to complete model numbers by size.

2.7.1.6 Meter Couplings

Meter couplings shall be bronze and sized as appropriate to accommodate the relevant meter. Inlet shall have male pipe thread.

Acceptable Manufacturers

Manufacturer	Model
Ford	C84-XX*
Mueller	H-15428-XX*
Others as approved by ECUA in writing	

\*XX: See Mfr.'s catalog to complete model numbers by size.

2.7.2 Service Line Valves

2.7.2.1 Corporation Stops

Corporation stops shall be brass, high-pressure class, ball type, with inlet taper CC thread. Outlet shall be compression-type for PE or copper tubing. Corporation stops shall be sized for 1-inch, 1½-inch or 2-inch tubing as appropriate.

Acceptable Manufacturers

Manufacturer	Model
Ford	F-1000 and FB-1000
Mueller	300, Ball-type
Others as approved by ECUA in writing.	

2.7.2.2 Curb Stops

Curb stops shall be brass, high pressure, ball-type with locking wings. Inlet shall be compression-type for PE tubing. Outlet shall be female iron pipe threads. Curb stops shall be sized for 1-inch, 1½-inch or 2-inch tubing as appropriate.

Acceptable Manufacturers

Manufacturer	Size	Model
Ford	1-inch	B41 - 444W
	1½-inch	B41 - 666
	2-inch	B41 - 727
Others as approved by ECUA in writing.		

2.8 **BACKFLOW PREVENTION DEVICES**

Backflow prevention devices shall be manufactured in accordance with AWWA C-506, and shall also be approved by ASSE and/or approved by NSF for use in potable water systems with a maximum continuous operating pressure of 150 psig, and capable of sustaining a hydrostatic test pressure of 300 psig. Backflow prevention devices shall be located

Materials and Construction

The body shall be cast iron with hot dip galvanized coating or fusion bonded epoxy on the interior and exterior, or cast bronze with a maximum lead content 5%. Working parts and springs shall be bronze or stainless steel; valve discs shall be sili cone rubber; diaphragms shall be fabric reinforced neoprene, and O-rings shall be Buna-N, neoprene, or silicone rubber. Check valve enclosures shall be glass-filled nylon or Teflon, or bronze or stainless steel. Other working parts shall be bronze or stainless steel.

2.8.1 Double-check Device

Double-check backflow preventers shall have two independent check valve assemblies. The body may consist of one or more castings, and shall be equipped with ports and valves as necessary to allow testing in place.

2.8.2 Reduced Pressure Principle Device

Reduced pressure principle backflow preventers shall have two independent check valves with an intermediate relief valve incorporating a pressure diaphragm valve assembly that maintains a minimum 2 psig differential pressure across the assembly.

2.8.3 End Connections

Devices shall be manufactured with standard female pipe thread, size 3/4-inch, 1-inch, 1-1/2-inch, or standard ANSI B16.2 125# flanged, sizes 2-inch and greater.

2.8.4 Appurtenances

All back flow devices shall be provided and installed as a complete assembly with all necessary fittings to enable testing in place. Tapped test ports shall be fitted with test petcocks in each body cavity. Inlet and outlet gate or ball valve shall be of the same line size as that of the body.

Acceptable Manufacturers

Manufacturer	Type Device		
	Double Check	Double Check Detector	Reduced Pressure
Ames	2000 DCA OSY 2000 DCA NRS 2000 DCA OSY Epoxy 2000 DCA NRS Epoxy	3000 DCDA OSY 3000 DCDA NRS 3000 DCDA OSY Epoxy 3000 DCDA NRS Epoxy	4000 RP OSY 4000 RP NRS
Febco	850 NRS 850 OSY		860 NRS 860 OSY
Watts	709 OS&Y/BV	709 DDC	909 909 DDC (Detector)
Hersey	3/4" - 2" FDC 3" - 10" No. 2	3" - 10" DDC II	3/4" - 2" FRP II 2½" - 10" 6CM
Others as approved by ECUA in writing.			

2.9 **METER BOX ASSEMBLIES**

Meter box assemblies for 5/8-inch meters shall be cast iron open bottom per ASTM A-48 with cast iron lid with ECUA imprint. The box assembly shall include a ball valve with locking nuts, pack joint coupling for copper or PE tubing with expansion connection and gaskets as needed. Meter box and cover for meters 2-inch and larger shall be constructed in accordance with ECUA Standard Details D-25 and D-26.

## Acceptable Manufacturers

Manufacturer	Model	Meter Size
Ford	G148-133 (Modified) w/ 1" pack joint for copper or PE Tubing	5/8"
Others as approved by ECUA in writing.		

**PART 3: EXECUTION****3.1 GENERAL**

The contractor shall provide all labor, equipment and materials as required to install all pipes, valves, fittings, and other appurtenances as indicated on the construction plans or as specified in the contract documents.

**3.2 POTABLE WATER LINE SEPARATION FROM SANITARY SEWER LINES**

- A. When a gravity sewer line must cross under a water line with less than 18-inch vertical clearance, one of the following methods may be used.
1. Fully encase sewer line with a minimum of 4 inches of concrete (2500 psi) for a minimum distance of 10 feet either side of the point of crossing, which must be at least 5 feet from a water line joint. If the crossing is other than at right angles, increase the length of encasement so that the end of the encasement will be at least 12 feet from a water line joint.
  2. Use equally rated pressure pipe for the sewer lines with no joints closer than 12 feet apart and at least 6-inch vertical clearance.
  3. Install sewer pipe into at least a 20-foot section of steel casing (casing I.D. slightly larger than sewer pipe bell O.D.) and center over crossing so that end of casing will be at least 12 feet from water line joint. Seal the ends of the casing with non-shrink grout. Refer to Section 2224 – Pipe Boring, Drilling and Jacking, for casing and boring requirements.
- B. When a gravity sewer line must cross over a potable water line, regardless of clearance, because the water line cannot be relayed above sewer, use method 2 or 3 in subsection A. Concrete encasement will not be allowed.
- C. When a sanitary force main must cross under a potable water line with less than an 18-inch vertical clearance, or over the water line, use a higher rated pressure pipe as in method 2 or 3 in subsection A.
- D. When the water line being crossed in A, B or C is a house or building service lateral, 2-inch or smaller and the service lateral is a continuous piece of PE DR9 or copper tubing, then the above rules do not apply; but locate so that the distance to a sewer or force main joint is as great as possible.
- E. When a gravity sewer line must run parallel to and less than 18 inches below a potable water line and:
1. 6 to 10 feet apart for less than 40 feet, use method 1, 2 or 3 in subsection A.

2. 6 to 10 feet apart for over 40 feet, use method A2 and stagger joints.
  3. 3 to 6 feet apart for any distance, use a higher rated pressure pipe as in method A2.
- F. When a sanitary force main must run parallel to and less than 18 inches below a potable water line and:
1. 6 to 10 feet apart for any distance, use a higher rated pressure pipe as in method A2.
  2. 3 to 6 feet apart, use a higher rated pressure pipe for both water and force main. Example: If force main is PC160 PVC DR26, and water line is C-900 DR25; then force main should be PVC DR21 and water line should be DR21, using extreme care to have both properly color-coded.

### 3.3 PIPE INSTALLATION

The contractor shall utilize equipment and methods in accordance with pipe manufacturer's requirements and sound construction practices to insure pipe installation to line and grade as indicated.

#### 3.3.1 Trench Excavation

Refer to Section 2221: Trench Excavation Backfill and Compaction. Maintain minimum of 30 inches and maximum of 36 inches of cover below finished grade unless shown otherwise on the construction plans.

#### 3.3.2 Alignment

Pipe shall be installed along the alignment indicated by the construction plans. Accomplish horizontal and vertical changes in alignment of pipe with bends or other appropriate fittings. Limit joint deflection as recommended by the pipe manufacturer.

#### 3.3.3 Pipe Preparation

The contractor shall clean the interior of all pipes, fittings, and joints prior to installation. Pipes shall be inspected for defects prior to installation. Damaged pipe shall be rejected and removed from the project.

#### 3.3.4 Pipe Installation

Install pipe only when weather and trench conditions are suitable. Do not lay pipe in water. Join pipe in accordance with manufacturer's recommendations.

Provide initial backfill or anchoring as necessary to prevent displacement and preserve alignment after establishing final position.

Encase water pipe in steel casing or use ductile iron pipe when crossing under pipe, conduit, or structure when a 6-inch separation distance cannot be maintained. This protection shall extend a minimum of 5 feet beyond crossed structure. (See Section 2556.3.2.D for Sanitary Sewer Lines.)

#### 3.3.5 Protection

Prevent the introduction of foreign matter into the pipe at all times. Close open ends of pipe with water tight fitting closures or plugs. Do not let water fill trench, but include provisions to prevent flotation should water control measures prove inadequate. Remove water, sand, mud and other undesirable materials from trench before removal of pipe closure piece.

### 3.3.6 Cutting

PVC or PE pipe shall be cut in a neat workmanlike manner, and the spigot end shall be beveled per manufacturer's recommendation. Ductile iron pipe shall be cut in accordance with manufacturer's recommendation. Do not allow excessive heat to develop. Smooth and bevel cut end as per manufacturer's recommendation. Use of pipe with damaged lining is unacceptable.

### 3.3.7 Service Lines

Service lines shall be constructed where shown on plans and in accordance with ECUA Standard Detail Drawing D-21.

### 3.3.8 Closure Pieces

Closure pieces shall only be used where called for on plans, or with written permission of the ECUA. Closure may be accomplished with sleeve coupling as long as its length is such that gaskets are not less than 3 inches from pipe ends.

### 3.3.9 Restraints and Thrust Blocking

Mechanical joint restraints shall be furnished and installed for all water line fittings and appurtenances. Reference ECUA Standard Drawing D-44. Restraints and thrust blocks shall also be installed for 45° and 90° bends, tapping sleeves, tees and main dead ends. Reference ECUA Standard Drawings D-43 and D-44.

## 3.4 **APPURTENANCE INSTALLATION**

### 3.4.1 Valves

Valves shall be installed with operating stems vertical when installation is direct burial. Valves shall be installed on a suitable bearing surface so as to prevent vertical displacement.

### 3.4.2 Valve Boxes

Valve boxes shall be centered on the valve. The earth shall be compacted around each valve box to a distance of 4 feet on all sides of box, or to undisturbed trench face if less than 4 feet. An 18-inch diameter by 4-inch thick collar shall be constructed and sloped to direct water away from the valve box. In lieu of the constructed collar, a 24-inch by 4-inch thick pre-cast, sloped, concrete collar may be used.

### 3.4.3 Tracer Wire

Tracer wire shall be installed on all new water mains and on water service lines installed in conjunction with new water mains. The tracer wire shall be placed directly above the pipe and electrically continuous throughout the project. Tracer wire shall be secured to the pipe with PVC tape the same color as the wire insulation, at a maximum of 10-feet on center between tapings. The tracer wire shall be brought to the ground surface at

each valve location in accordance with ECUA Standard Detail D-34. Splices and/or connections in the tracer wire shall be installed with silicone-filled wire nuts designed for direct burial.

### **3.5 FIRE HYDRANT FLUSHING EQUIPMENT INSTALLATION**

#### **3.5.1 Hydrants**

Hydrants shall be installed in accordance with ECUA Standard Detail D-35.

#### **3.5.2 Flush Stands and Valves**

Flush stands shall be installed as shown on ECUA Standard Detail D-41, depending on line size.

### **3.6 SERVICE LINE INSTALLATION**

#### **3.6.1 General**

The contractor shall install individual services with tracer wire from the new main to a convenient point on the right-of-way or property line for each house, building or unit that is to be served through an ECUA meter. This section will deal with service line tubing 2-inches in diameter and smaller, to serve 5/8-inch, 1-inch, 1-1/2-inch, and 2-inch meters. The installation of service lines for 3-inch meters and larger shall be in accordance with the requirements for water main installation. (See Section 3.3)

#### **3.6.2 Service Line Connections**

Service lines shall be installed in accordance with ECUA Standard Detail D-21. Tubing shall be installed in one continuous length from corporation stop to curb stop with no intermediate fittings. Service lines damaged after initial installation but before acceptance may be repaired by means of a single splice, except that no repair fittings will be permitted under any paving. The tap location shall be not less than 10 feet from any sanitary sewer joint with less than 18 inches vertical clearance. Potable water taps shall be made with a tapping machine designed for the pipe material being tapped. Other makes of tapping machine may be used upon prior approval of the ECUA Inspector or Engineer.

### **3.7 TAPS ON PRESSURIZED LINES**

The contractor shall perform taps on pressurized lines for the installation of pipes other than service lines of 2-inch and smaller PE tubing in accordance with these requirements:

#### **Materials**

All materials used for taps on pressurized lines shall meet the requirements of these specifications. Tapping sleeves shall be properly sized for the pipe being tapped. (See Sec. 2.4.1.6) Resilient seated tapping valves shall be furnished with special end connections. (See Sec. 2.4.2.2) All other material used to accomplish the tap shall meet the standards set forth by the AWWA for potable water construction.

#### **Procedure**

The contractor shall notify the ECUA Inspector three working days in advance of work. The contractor shall in the presence of an ECUA inspector:

- A. Expose the existing pipe at the location shown on the plans, and clean the section of the pipe to receive the tapping sleeve.
- B. Check the tapping sleeve and valve for defects and make sure the gate fully retracts in the valve to allow the shell cutter free passage.
- C. Assemble the tapping sleeve on the pipe, then install the tapping valve.
- D. Hydrostatically pressure test the tapping sleeve and valve after it has been assembled on the water main using the test plug on the sleeve. The test shall be 150 psi minimum. The duration of the test shall be 15 minutes.
- E. Pour a thrust block behind the tapping sleeve sufficient to withstand the pressure of the new line. Also, provide a concrete pad sufficient to support the weight of the sleeve, valve, and tapping machine. Refer to Section 3.3.9 and ECUA Standard Detail D-43. Concrete shall be in place a minimum of 24 hours prior to testing the main installation.
- F. Assemble an approved tapping machine and proceed to make the necessary cut in accordance with the recommendation of the tapping machine manufacturer. Approved tapping machines shall be:
  1. In good working condition.
  2. Designed for and have a cutting bit for the pipe material to be cut.
  3. Equipped with a depth of cut gauge.
  4. Designed to capture the coupon.
  5. Equipped with the manufacture's recommended diameter shell cutter for the tap to be made.
  6. Tapping machine power head to be hydraulic or pneumatic drive; use of electric motor drives expressly prohibited.
  7. Tapping machining shall be disinfected prior to each use for potable water taps.

Nominal Main Size	Tapping Valve ID AWWA Standard	Tapping Machine Shell Cutter OD
2-inch	2 1/8-inch	1½ -inch
3-inch	3 1/8-inch	2½ -inch
4-inch	4 1/4-inch	3½ -inch
6-inch	6 1/4-inch	5½ -inch
8-inch	8 1/4-inch	7½ -inch
10-inch	10 1/4-inch	9½ -inch
12-inch	12 1/4-inch	11½ -inch
14-inch	14 1/4-inch	Per Manufacturer's Recommendation. Contractor shall submit shop drawings for valves and tapping machine for approval, prior to use. Per Manufacturer's Recommendation.
16-inch	16 1/4-inch	
18-inch	18 1/4-inch	
20-inch	20 1/4-inch	
24-inch	24 1/4-inch	

- G. Tap coupon shall be given to the ECUA Inspector. If the coupon is lost in the main, contractor shall, at his expense, dismantle main to retrieve the coupon. Main will be reassembled, pressure tested and bacteriological tests retaken as required at contractor's expense.

## **PART 4: ACCEPTANCE REQUIREMENTS**

### **4.1 INSPECTION**

Upon completion of the installation, the system shall be inspected to ascertain that valves, fittings, fire hydrants, flush hydrants, etc. are located in conformance with the plans, and confirm that all 'as-built' measurements have been accurately taken. The ECUA Inspector shall observe all appropriate activities related to properly placing the line in service including flushing, pressure and leakage testing, disinfection, and bacteriological sampling. Final connections and testing of fire hydrants shall be accomplished after final clearance of lines. Tracer wire shall be tested for continuity by the contractor with the ECUA Inspector present. The contractor, with the ECUA Inspector, shall make sure all main valves and hydrant valves are open.

### **4.2 FLUSHING**

All newly installed water lines shall be flushed with potable water to remove any sediment, solids and/or foreign matter prior to testing. ECUA will make water available to the contractor. Flushing shall be conducted at a sufficient velocity to clear the pipe. Discharge of flushing water must be through a 2-inch diameter pipe (or larger) and must be controlled so as not to cause any property damage. Flush water source connection shall incorporate backflow preventor when required by the ECUA Inspector or Engineer.

### **4.3 PRESSURE/LEAKAGE TEST**

#### **4.3.1 General**

All newly installed water lines and appurtenances shall be pressure/leak tested to assure the strength of materials and quality of workmanship of the installation. Testing shall be conducted in accordance with ECUA Standard Detail D-12 and the requirements of AWWA Manual 23 for PVC and other flexible pipe or AWWA C600 for Ductile Iron Pipe. Leakage testing may be conducted concurrently with the pressure test.

#### **4.3.2 Procedure**

Contractor shall notify the ECUA Inspector three ECUA working days prior to a scheduled test. Tests are to be conducted in segments not to exceed three thousand (3,000) feet of pipe. Water in the new line shall be pumped up to a pressure of 150 psi minimum. This pressure shall be maintained for a minimum of one (1) hour by pumping a quantifiable amount of water into the line and record the amount of water added during the test period. This represents the leakage.

Pressure/leakage tests shall be deemed acceptable when leakage does not exceed that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133200} \text{ (or 11.65 gpd/mi/inch/dia)}$$

$$\text{or } L = \frac{ND\sqrt{P}}{7400} \text{ for DI pipe 18' lengths}$$

$$\text{or } L = \frac{ND\sqrt{P}}{6600} \text{ for PVC pipe 20' lengths}$$

where: L = Maximum leakage, in gallons per hour.  
 S = Length of pipe under test, in feet.  
 N = Number of pipe joints in segment under test.  
 D = Nominal internal diameter of pipe, in inches.  
 P = Average actual leakage test pressure, psig.

Record all data for submission with as-built plans.

An ECUA Construction Inspector shall be present during test.

Refit and replace all pipe not meeting the leakage requirements. Repair clamps are not permitted.

Repair all visible leaks regardless of the amount of leakage.

When a satisfactory pressure/leakage test has been completed, reduce the pressure at or below normal line pressure, and continue on with line disinfection.

## 4.4 DISINFECTION

### 4.4.1 General

The contractor shall provide all equipment, materials and testing apparatus required to perform disinfection in accordance with AWWA 651, ECUA Standard Detail D-12, or as modified herein.

### 4.4.2 Procedure

- A. Prior to beginning disinfection, the contractor shall submit information to the engineer for approval of proposed materials and methods. ECUA will determine the number and location of all sampling points. Temporary sampling taps may be required consisting of a corporation cock with copper tube.
- B. Add chlorine to attain an initial concentration of 25 mg/l chlorine with 10 mg/l remaining after 24 hours.
  1. Initial concentration is to be obtained by mixing proper amount of HTH granules (65% Cl) into auxiliary tank, then pump/meter into regulated flow into or through the pipe section.
  2. Alternate methods of disinfection by use of granular or tablet forms of chlorine will not be allowed. The "SLUG" method as described in AWWA 651 will not be allowed.
  3. Check the chlorine concentration at all sampling points after the line has been filled and air expelled.
  4. Check residual chlorine concentration at the end of 24 hours to confirm that 10 ppm (minimum) is present.
- C. ECUA shall supply water for testing from the nearest available source. Flush main until chlorine concentration is 2 mg/l or less prior to taking bacteriological samples. Contractor shall provide a backflow preventor device as required by the ECUA Inspector or Engineer.

1. Check concentration at all sample point locations.
  2. Disposal of chlorinated water shall be the contractor's responsibility and shall be done without damage to public or private property. Chlorinated water disposal shall meet all State, Federal and local regulations.
- D. Contact ECUA for collection of samples. Two (2) satisfactory bacterial sample sets taken 24 hours apart must meet State requirements before placing the main into service.
- E. Repeat flushing and disinfection procedure should initial disinfection fail to yield acceptable bacteriological results at no additional cost to the Owner.

#### **4.5 OTHER CONNECTIONS**

After new system piping has been satisfactorily tested and cleared for use, make any approved additional connections to the pre-existing distribution system. Exercise care in making connection and disinfect as needed. When total system is approved for use, an ECUA Inspector shall verify that the contractor has opened all interior valves as required. Valves connecting new installations to ECUA's existing distribution system shall then be opened by an ECUA Inspector.

#### **4.6 TESTING FIRE HYDRANTS**

All newly-installed fire hydrants shall be flow tested by ECUA prior to final acceptance in accordance with established procedures. (Refer to AWWA-M17 and AWWA C502.) Static Leak Test of hydrant shall be done in conjunction with Section 4.3 with hydrant valve open.

Hydrant flow tests not meeting the minimum requirements of ECUA's Design Standards shall be immediately reported to the Engineer-of-Record. The system shall not be placed into service until the system meets the minimum requirements.

### **PART 5: MEASUREMENT AND PAYMENT**

#### **5.1 GENERAL**

Measurements shall be made to the nearest tenth of units and rounded to the nearest whole unit when totaled. Payments shall be for providing all labor, tools, equipment and materials as needed for: 1) furnishing, handling, and installing the required materials, fittings or fixtures; 2) excavation, backfill and compaction, including shoring, bracing and dewatering as required; 3) temporary removal and replacement of existing obstacles, including minor relocation and repair of other utilities; and 4) all required testing, disinfection and flushing. Payment for water main installations shall include the installation of tracer wire.

## 5.2 WATER MAINS

Water mains shall be measured in lineal feet by the specified pipe size along the pipe centerline with no deduction for fittings. Payment shall be based on the contract unit price per lineal foot.

## 5.3 APPURTENANCES

Water main appurtenances include fittings and valves as outlined in Section 2.4 of the specifications. Incidental appurtenances such as joint restraints, couplings, tracer wire, etc. are not considered separate pay items and their cost should be included in the unit price of the installed pipe.

### 5.3.1 Fittings

Water main fittings including bends, reducers, tees, wyes, tapping sleeves, expansion joints, pipe hangers/supports, and cut in sleeves shall be measured and paid for on a unit (per each) basis. Fittings shall be listed by size and type.

### 5.3.2 Valves

Water main valves inclusive of any required valve boxes or other appropriate appurtenances shall be measured and paid for on a unit (per each) basis. Valves shall be listed by size and type.

### 5.3.3 Line Stops

Line stops shall be measured and paid for on a unit (per each) basis.

## 5.4 HYDRANTS AND FLUSHING EQUIPMENT

Hydrants and flushing equipment shall be measured and paid for on a unit (per each) basis to include a complete installed assembly.

### 5.4.1 Fire Hydrants

Fire hydrant assemblies shall include the installed water main tee or tapping sleeve, lead valve and box, connectors (up to 10 feet of lateral distance), gravel pack, and hydrant.

### 5.4.2 Fire Hydrant Appurtenances

Fire hydrant appurtenances including extensions and off-site connectors shall be measured and paid for on a unit (per each) basis.

## 5.5 WATER SERVICE LINES

### 5.5.1 Service Lines (up to 2-inch diameter)

Water service lines shall be measured and paid for on a unit (per each) basis. Each service line installation shall include the main tap, corporation stop, service tubing, and curb stop. Service lines shall be listed by tubing size and nominal length. Nominal length shall typically be categorized as "short" (for services on the same side of the street as the water main), and "long" (for services on the opposite side of the street from the water main).

5.5.2 Large Service Lines (3-inch diameter and larger)

Large service lines, including fire lines, shall be measured and paid for in accordance with the requirements for water mains (see 5.2 and 5.3 above).

**5.6 TAPS ON PRESSURIZED LINES**

Taps on pressurized lines shall be measured and paid for on a unit price (per each) basis to include tapping sleeve, tapping valve, and valve box complete, in-place. Taps shall be listed by main and branch diameters.

**SECTION 2570****SANITARY SEWERS****PART 1: GENERAL**1.1 Related Requirements Specified Elsewhere

- A. Trenching, Backfilling and Compacting: Section 2221.
- B. Pipe Boring and Jacking: Section 2224.

1.2 Product Delivery, Storage and Handling

- A. Store materials to prevent physical damage.
- B. Protect materials during transportation and installation to avoid physical damage.

1.3 General Description of Work Covered

Furnish and install all sewer pipe, fittings and structures, and accessories required for sanitary sewer construction as indicated.

1.4 Quality Assurance

Comply with latest published editions of American Society of Testing and Materials (ASTM) Standards:

- A. ASTM C478 - Concrete Pipe Manholes.
- B. ASTM D1784 - Rigid Poly (vinyl chloride) (PVC) Compounds and Chlorinated Poly (vinyl chloride) (CPVC) Compounds.
- C. ASTM D2321 - Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
- D. ASTM D2564 - Solvent Cements for Poly Plastic Pipe and Fittings.
- E. ASTM D3212 - Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals.
- F. ASTM D3034 Type PSM - PVC Sewer Pipe and Fittings.

**PART 2: MATERIALS AND EQUIPMENT**2.1 General Requirements

- A. Pipe furnished shall be PVC for sanitary sewer construction unless shown otherwise on plans or bid forms.
- B. All pipe shall be marked in accordance with applicable standard specification under which pipe is manufactured unless otherwise specified.

2.2 Delivery, Storage and Handling

Certificates of Compliance with the Specifications shall be required for all materials used on the Project. All materials shall be protected during transportation, storage, handling, and installation to avoid physical deterioration due to sun and weather. The ECUA reserves the right to reject material which in any way does not meet the requirements of these Specifications.

### 2.3 Sewer Mains

#### 2.3.1 Polyvinyl Chloride Plastic Pipe (PVC)

- A. Comply with ASTM D3034 for pipe using material conforming to ASTM D1784 for pipe and fittings.
- B. Use single elastomeric gasket push-on joints complying with ASTM D3212.
- C. Provide pipe and fittings with minimum SDR-35 dimension ratio.
- D. SDR 35 shall be used for service laterals.
- E. Pipe shall be color coded by one of the following methods:
  - 1. 3 green stripes (½ inch high) with permanent ink along the entire length, evenly spaced around the pipe, with the word "Sewer" in ¾-inch letters every 21 inches along each stripe.
  - 2. Use pipe pigment to color code pipe green.

#### 2.2.1 Glass Fiber Reinforced Thermosetting Resin Pipe

- A. Acceptable for lines 18 inches diameter and larger.
- B. Use pipe to comply with AWWA C950 (Latest Edition).
- C. Use minimum pipe stiffness: 36 psi.
- D. Use joints per AWWA C950 (Latest Edition).
- E. Pipe shall be color coded by one of the following methods:
  - 1. 3 green stripes (½ inch high) with permanent ink along the entire length with ¾-inch letters every 21 inches along each stripe designating "Sewer".
  - 2. Use pipe pigment to color code pipe green.

### 2.4 Structures and Pipe Accessories

#### 2.4.1 Fittings

- A. Fittings shall be allowed only on service laterals and drop manholes.
- B. Fittings shall equal or exceed quality and strength of pipe.
- C. Wyes shall be long bell type.

## 2.4.2 Manholes & Sections

- A. Construction shall be precast reinforced concrete capable of sustaining an H-20 loading.
- B. Manholes shall be constructed in accordance with ASTM C-478, using Type II or Type III Portland Cement.
- C. Leakage shall not exceed 1 gallon per day per vertical foot of manhole.
- D. Manholes shall have a minimum I.D. of 48 inches, unless otherwise noted on plans.
- E. Base section shall be monolithic to a point 6" above the crown of the incoming pipe with minimum thick bottom section and 5" wall section and made in accordance with ASTM C-478.
- F. Pipe holes shall be properly located and either cast in place with appropriate boot or required shape, or core drilled after concrete has set. Minor field adjustments may be made with approval of ECUA. The invert of the lowest pipe shall be a minimum of 4" above the inside floor of the base section.
- G. Cone (top) sections shall be eccentric narrowing from 48" to 24" I.D., unless otherwise noted on plans.
- H. Flat top sections shall be used in place of cone sections for manholes less than 5 feet deep. The access hole shall be offset to allow easy access to steps (if used) and shall be reinforced to support an H-20 loading.
- I. Shallow manholes less than 3 feet deep shall be constructed according to ECUA detail drawing.
- J. The joints between sections shall be one of the following:
  - 1. Lap joint design with the upper lip inside and suitably shaped to accommodate a bitumastic joint sealer,
  - 2. Rubber "O" ring gasket.
- K. Pipe to manhole seals shall be made utilizing one of the following or approved equivalent.
  - 1. Kore-N-Seal or, Lock-Joint, with stainless steel bands and screws.
  - 2. A-LOK.
- L. Brick manholes shall only be used with consent of ECUA.

## 2.4.3 Manhole Accessories

- A. Manhole Lid and Cover
  - 1. Gray cast iron, with nominal opening of 24 inches.
  - 2. Cover shall be embossed with "SANITARY SEWER" as shown on detail drawings.

3. The lifting holes shall not extend through cover.
  4. Use Vulcan Model VM-37, USF 170E or approved equivalent for lids not requiring bolting features.
  5. Use Vulcan Model VM-360WT or approved equivalent for bolted covers.
  6. Use Vulcan Model VM-50 or approved equivalent for specified flood areas.
  7. Use Certain Teed RE 85 R3 FD with Anti-theft locking key (RE 80 K9 FD) for lids requiring locking features.
- B. Manhole Coating
1. Apply two coats of a foundation coating or approved equivalent to the interior and to the exterior.
  2. Manholes receiving discharges from force mains, and at a minimum the next two manholes downstream of the receiving manhole, shall be lined with an ECUA approved HDPE or polypropelene liner. Additional manholes shall be lined if required by ECUA. Other liners may be installed if approved by ECUA in writing.
  3. Manholes housing force main air release valves shall be lined with an ECUA approved HDPE liner. Other liners may be installed if approved by ECUA in writing.
- C. Steps
1. Shall be embedded in the concrete by the manhole manufacturer at 12" on center spacing from the top of the manhole cone to bench.
  2. Steps shall be grade 60 steel bar reinforced ABS plastic, with non-slip rungs, guaranteed for use in sewers.

### **PART 3: EXECUTION**

#### 3.1 General

Provide all labor, equipment and materials and install all pipe, fitting, specials and appurtenances as indicated or specified.

#### 3.2 Pipe Installation

##### A. Handling

1. Handle and store pipe in a manner to insure installation in sound and undamaged condition, and in accordance with pipe manufacturer's requirements.
  - a. Do not drop, bump, roll or drag.
  - b. Use slings, lifting lugs, hooks and other devices designed to protect pipe, joint elements, and coatings.

2. Ship, move and store with provisions to prevent movement or shock contact with adjacent units.
3. Handle with equipment capable of work with adequate factor of safety against overturning or other unsafe procedures.

B. Installation

1. Utilize equipment, methods, and materials insuring installation to lines and grades as indicated.
  - a. Do not lay on blocks unless pipe is to receive total concrete encasement.
  - b. Use calibrated laser or minimum of 3 batter boards for control of line and grade.
2. Install pipe of size, material, strength class, and joint type with embedment shown for plan location.
3. Insofar as possible, commence laying at downstream end of line and install pipe with bell ends in direction of laying (upstream). Sewer pipe shall have spigot ends in direction of flow. Obtain approval for deviations therefrom.
4. Clean interior of all pipe, fittings and joints prior to installation. Exclude entrance of foreign matter during discontinuance of installation.
  - a. Close open ends of pipe with watertight plugs at the end of each work day.
  - b. Do not let water enter trench. Pipe shall be laid in a dry trench. Include provisions to prevent pipe flotation and displacement should water control measures prove inadequate.
  - c. Remove water, sand, mud and other undesirable materials from trench before removal of end cap or plugs.
5. Inspect pipe prior to installation to determine if any pipe defects are present.
6. Brace or anchor as required to prevent displacement after establishing final position.
7. Perform only when weather and trench conditions are suitable.
8. Observe extra precaution when hazardous atmospheres might be encountered, especially when connecting to existing, active sanitary sewers.
9. Separation Of Sanitary Sewer Lines and Potable Water Lines.
  - a. When a gravity sewer line must cross under a water line with less than 18-inch vertical clearance, one of the following methods may be used:
    - 1) Fully encase sewer line with a minimum of 4 inches of concrete (2500 psi) for a minimum distance of 10 feet either side of the point of crossing, which must be at least 5 feet from a water line joint. If the crossing is other than at right angles, increase the

length of encasement so that the end of the encasement will be at least 12 feet from a water line joint.

- 2) Use equally rated pressure pipe for the sewer lines with no joints closer than 12 feet apart and at least 6-inch vertical clearance.
  - 3) Install sewer pipe into at least a 20-foot section of steel casing (casing I.D. slightly larger than sewer pipe bell OD) and center over crossing so that end of casing will be at least 12 feet from water line joint. Seal the ends of the casing with non-shrink grout.
- b. When a gravity sewer line must cross over a potable water line, regardless of clearance, because the water line cannot be relayed above sewer, use method 2) or 3) in subsection a. Concrete encasement will not be allowed.
  - c. When a sanitary force main must cross under a potable water line with less than an 18-inch vertical clearance, or over the water line, use a higher rated pressure pipe as in method 2) or 3) in subsection a.
  - d. When the water line being crossed in a, b or c is a house or building service lateral, 2-inch or smaller and the service lateral is a continuous piece of PE DR9 tubing, then the above rules do not apply; but locate so that the distance to a sewer or force main joint is as great as possible.
  - e. When a gravity sewer line must run parallel to and less than 18 inches below a potable water line and:
    - 1) 6 to 10 feet apart for less than 40 feet, use method 1), 2) or 3) in subsection a.
    - 2) 6 to 10 feet apart for over 40 feet, use method a. 2) and stagger joints.
    - 3) 3 to 6 feet apart for any distance, use a higher rated pressure pipe as in method a. 2).
  - f. When a sanitary force main must run parallel to and less than 18 inches below a potable water line and:
    - 1) 6 to 10 feet apart for any distance, use a higher rated pressure pipe as in method a. 2).
    - 2) 3 to 6 feet apart, use a higher rated pressure pipe for both water and force main. Example: If force main is PC160 PVC DR26, and water line is C-900 DR25; then force main should be PVC DR21 and water line should be DR21, using extreme care to have both properly color-coded.
10. Auger or jack casing in place where shown on plans.
  11. Maintain minimum of 30 inches of cover unless directed by Engineer.
  12. Encase sewer pipe in steel casing or use ductile iron pipe when crossing under pipe, conduit, or structure of 24 inches in diameter or greater when a 6-inch

separation distance cannot be maintained. This protection shall extend a minimum of 5 feet beyond crossed structure.

C. Jointing

General Requirements

1. Perform in accordance with manufacturer's recommendations.
2. Clean and lubricate all joint and gasket surfaces with lubricant recommended.
3. Utilize methods and equipment capable of fully homing or making up joints without damage.
4. Check joint opening and deflection for specification limits.

D. Closure Pieces

1. Connect two segments of pipelines or a pipeline segment and existing structure with short sections of pipe fabricated for the purpose.
2. Observe specifications regarding location of joints, type of joints and pipe materials and strength classifications.

E. Temporary Plugs

1. Furnish, install and secure water tight temporary plugs at each end of work for removal by others when completed ahead of adjacent contract or where indicated.
2. Remove from pipe laid under separate or prior contract in order to complete pipe connection when work by other contractor is finished prior to work at connection point under this contract.

3. Permanent Plugs

- a. Use test plugs as manufactured by pipe supplier, or
- b. Fabricate by Contractor of substantially same construction.
- c. Must be watertight against heads up to 20 feet of water.
- d. Secure in place in a manner to facilitate removal when required to connect pipe.

3.3 Manhole Installation

A. Precast Bases

1. Place on 12-inch layer of compacted sand, gravel or sandy material as approved by Engineer.
2. Base shall be leveled prior to installation of manhole sections.

B. Cast In Place Bases

1. Cast on 12-inch layer of compacted sand, gravel or sandy material as approved by Engineer.
2. Manhole bases and channel inverts may be constructed integrally.

C. Manhole Sections

1. Use precast sections unless cast-in-place manholes approved by Engineer.
2. Precast sections may be installed after base concrete has attained 75% of design strength.
3. Full circumference seals between manhole sections shall use one of the following or approved equivalent.
  - a. Bitumastic Seal (Kent No. 2, Ram Neck)
  - b. Rubber "O" ring gasket

D. Invert Channels

1. Form invert channel as indicated.
2. Alternate invert and shelf may be constructed of mortar over concrete fill with approval of Engineer.
3. Make changes in direction of flow with smooth curves of as large a radius as size of manhole permits.
4. Make changes in size and grade smoothly and uniformly.
5. Slope shelf of manhole adjacent to channels, toward the channels, and rough broom finish to provide a non-slip surface.
6. Finish channel bottom smoothly without roughness, irregularity, or pockets.
7. On straight through single pipe manholes, half sections of same pipe may be used with mortar and concrete with approval of Engineer.
8. Precast inverts in base sections are acceptable with approval from ECUA Engineering Department.

E. Pipe Connection Into Manholes

1. Make watertight.
2. Use specified pipe to manhole seals or other as approved by ECUA.

F. Field applied coatings shall be applied after Engineer's approval of structure.

### 3.4 Service Connections

- A. Service lines shall be located in accordance with requirements in the ECUA Code. Refer to the Code for clarification of availability of facilities and responsibilities of customer for the installation of service lines.
- B. Install service connections to each residential lot or individual business lot or property, or as directed by Engineer.
- C. Services wyes: install long bell type wyes, 4-inch branch diameter unless shown otherwise on plans. See ECUA standard detail, "Typical Service Connection".
- D. Risers: may be used with wyes for service connections where invert of sewer is 7 feet or more below ground surface or where shown on plans. Terminate each connection as shown on plans or as directed by Engineer. Glued 45 degree bends may be used on end of lateral, within grassy, or unpaved, areas.
- E. Glue cap on end of stub out.
- F. Backfill trench only after recording exact location and depth of service connection.
- G. Street crossings shall have a minimum of 2 feet of cover to subgrade unless approved by Engineer.
- H. Drive a ½-inch metal rebar adjacent to each service connection, with top of post 1 foot below ground surface.

### 3.5 Connection of Service Lines and Sewer System Facilities

#### A. Existing Service Lines and New Sewer Main:

Connect existing sanitary service lines which cross new sewer line through equal sized wye.

#### B. New Service Line Connections to Existing Manholes:

1. Insert new sewer pipe flush with inside of manhole.
2. Connect new lines to existing manholes. Seal new pipe in place to be watertight.
3. Reconstruct manhole channel and shelf to suit new connection.
4. All debris to be removed.

#### C. Connections to Existing Sewer

1. Build new manhole around existing sewer.
2. Break out existing sewer inside of manhole and construct channel and shelf to suit new connection.

**PART 4: ACCEPTANCE**4.1 Acceptance Tests for Sewer Pipelines and ManholesA. Infiltration Testing1. General

- a. Maximum infiltration for each section of sewer pipe shall not exceed 25 gal/mile/day/ inch of pipe diameter.
- b. Infiltration, exfiltration or air test may be used to prove compliance with infiltration requirement.
- c. Acceptance of air test or exfiltration results will not preclude rejection of work if infiltration is measured and exceeds limitation.
- d. Maximum infiltration for each manhole shall not exceed 1 gallon per vertical foot per 24 hours.
- e. All tests to be witnessed by ECUA.

2. Air Test

- a. Furnish all facilities required including:
  - 1) Necessary piping connections.
  - 2) Test pumping equipment.
  - 3) Pressure gauges or manometers.
  - 4) Bulkheads.
  - 5) All miscellaneous items required.
- b. Obtain approval from Engineer of equipment and methods proposed for use.
- c. Test pipe in sections determined by Contractor and approved by Engineer.
- d. Plug ends of line and cap or plug all connections to withstand internal test pressures.
- e. Introduce low pressure air until internal air pressure is 4.0 psi greater than the average back pressure of ground water above the pipe. (Add 0.43 psi for each vertical foot of ground water over the top of pipe.)
- f. Allow two minutes for air pressure to stabilize.
- g. Time required for pressure to decrease from 3.5 to 2.5 psi greater than average back pressure of any ground water above pipe shall not be less than time in following table for given diameters.

Pipe Diameter	
(Inches)	Minutes
6	3.0
8	4.0
10	5.0
12	5.5
15	7.0
18	8.5
21	10.0
24	11.5
27	12.75
30	14.0
36	17.0

h. Repeat test as necessary after all leaks and defects have been repaired.

**B. Exfiltration Test**

1. Furnish all facilities required to plug pipe sections and fill with water to attain a minimum elevation of water in upstream manhole two feet higher than top of pipe in line being tested, or two feet above existing ground water in trench, whichever is higher elevation.
2. Maintain water level in manhole at start of test period for one hour.
3. Water added to maintain level (water lost) shall not exceed the following amounts:
  - a. 8" pipe - 0.63 gallon per 100 feet.
  - b. 10" pipe - 0.79 gallon per 100 feet.
  - c. 12" pipe - 0.95 gallon per 100 feet.
  - d. 15" pipe - 1.19 gallon per 100 feet.
  - e. 18" pipe - 1.42 gallon per 100 feet.
  - f. 21" pipe - 1.66 gallon per 100 feet.
  - g. 24" pipe - 1.90 gallon per 100 feet.

Allowable leakage may be increased by 5% for each foot of head above water elevation indicated above.

**C. Infiltration Test**

1. May be used in lieu of air test or exfiltration test if contractor can prove that ground water conditions are such that crown of pipe is covered with not less than two feet of water at highest point in section being tested. The test head shall be maintained for not less than 24 hours before a weir measurement is made.
2. Infiltration shall be measured with weir at manhole and shall not exceed amounts stated in paragraph B. 3., Exfiltration Test.

3. Engineer will require exfiltration or air test if contractor cannot prove to satisfaction of Engineer that ground water conditions are satisfactory.

## **PART 5: MEASUREMENT AND PAYMENT**

### 5.1 Sewer Pipe

- A. Measure in lineal feet by specified pipe size along centerline of pipe with no deduction for manholes, wye connections or riser connections.
- B. Includes furnishing, handling, laying pipe materials and specified bedding materials; trench excavation, backfill and compaction; dewatering; sheeting, shoring and bracing; testing; utilities repair and relocation; providing all labor, tools, equipment and miscellaneous associated work necessary to complete item.
- C. Payment: unit price per lineal foot.

### 5.2 (Standard) (Drop) (Shallow) Manholes

- A. Includes furnishing and placing all precast and cast in place materials; excavation, backfill and compaction; frame and lid; stub pipes; providing all labor, equipment, tools and miscellaneous associated work needed to complete item.
- B. Payment: unit price for each manhole.

### 5.3 Wye Connections

- A. Measure each as installed by nominal pipe size.
- B. Includes additional cost of wye over straight pipe, joints, stoppers and one 1/8 bend sweep.
- C. Payment: unit price per each.

### 5.4 Riser Connections

- A. Measure each connection installed by nominal pipe size.
- B. Includes furnishing and installing wye or tee connection, elbows, concrete work, extra excavation, backfilling and compaction, stoppers and providing labor, equipment and miscellaneous associated work needed to complete item. Does not include straight pipe used for riser.
- C. Payment: unit price per each.

### 5.5 Riser Pipe

- A. Measure in lineal feet of straight pipe from fitting joints at upper and lower extreme of riser.
- B. Includes furnishing and installing pipe materials, bracing; supports; excavation, backfill and compaction; providing labor, equipment and miscellaneous associated work needed to complete item.

- C. Payment: unit price per lineal foot.

5.6 Service Connection Lateral Pipe

- A. Measure in lineal feet by nominal pipe size as installed.
- B. Includes furnishing, handling, laying pipe materials; trench excavation, backfill and compaction; dewatering; utilities repair; providing all labor, equipment and miscellaneous associated work needed to complete item.
- C. Payment: unit price per lineal foot.

5.7 Clean Outs/Lamp Holes

- A. Includes furnishing and placing all clean outs; excavation, backfill and compaction; stub pipe; frame and lid; providing all labor, equipment, tools and miscellaneous associated work needed to complete item.
- B. Payment: unit price for each clean out.

**SECTION 2575****WASTEWATER LIFT STATION CONSTRUCTION - INSTALLATION****PART 1: GENERAL**

- 1.1 The scope of work covered in this section of the specifications includes the construction and installation of a complete lift station, including: the wetwell, valve pit, pumps, valves and piping, electrical wiring, controls and control panel, and accessories.
- 1.2 Related Requirements Specified Elsewhere
- A. Excavation, Backfilling and Compaction: Section 2221
  - B. Gravity Sanitary Sewer: Section 2570
  - C. Sanitary Force Main: Section 2576
  - D. Fencing: Section 2830
  - E. Access Road/Driveway
- 1.3 Product Delivery, Storage and Handling
- A. Store material to prevent physical damage and theft.
  - B. Protect equipment during transportation and installation to avoid damage.
  - C. When large precast sections are to be used, verify weight and reach capability of equipment on site, as well as access roads.
- 1.4 Quality Assurances
- Comply with the latest published editions of AWWA and ASTM Standards
- A. AWWA C500 - Gate Valves for Water & Sewerage Systems
  - B. AWWA C509 - Swing Check Valves for Waterworks
  - C. AWWA C151 - Ductile Iron Pipe
  - D. ASTM A746 - Ductile Iron Pipe
  - E. ASTM C478 - Concrete Pipe Manholes
  - F. ASTM D2241 - Poly Plastic Pipe
  - G. ASTM F477 - Elastomeric Seals for Plastic Pipe

**PART 2: PRODUCTS**2.1 General Requirements

- A. All products shall be new and unused.
- B. Appropriate manufacturer's certifications, warranties and performance curves shall be supplied.
- C. The ECUA reserves the right to test or have tested any product to verify compliance with applicable specifications.

2.2 Wet WellA. General

- 1. Will consist of base section, wall sections, top slab, interior tapered bottom fill, hatches.
- 2. To be assembled or constructed on site in accordance with plans.
  - a. Very small stations will usually be 4-foot diameter as precast manhole sections.
  - b. Small stations will usually be 6-foot diameter as precast pipe or manhole sections.
  - c. Medium stations will usually be 8 or 10-foot diameter, either cast-in-place or precast sections.
  - d. Large Stations will usually be 12 or 14-foot diameter, either cast-in-place or precast sections.
  - e. Regional stations will usually be rectangular cast-in-place, and possibly a dry well section for pumps and equipment.
- B. Base Sections shall be monolithic and made of 3500 psi concrete, using reinforcing as shown on plans, commensurate with conditions; diameter larger than the vertical sections; and thickness 8" or more depending on total weight required. Provisions to be made for a watertight seal/joint with the walls.
- C. Wall sections, if precast, to be made of 3500 psi concrete with adequate reinforcing; at least 5" thick, increasing with size and depth; lap or tongue and groove joint to accept bitumastic joint sealer or neoprene O-ring so as to make a watertight seal with other sections. Grout interior and exterior joints.
- D. Top slab shall be precast reinforced concrete, made of at least 3500 psi concrete; at least 6" or more thick, increasing with larger diameters; with properly sized and located openings for hatchways. Top slab will fully cover the wet well, and may also extend to cover valve pit or dry pit.
- E. Interior tapered bottom fill will be cast-in-place, using at least 2000 psi concrete, around the periphery of the base section such that any solids that settle will be directed to the intake of the pumps. To be sloped at an angle of 60 degrees to the bottom (1 horiz. to 1.73 vert.) forming an oval pattern centered on the centerline of the pumps, with its ends

approximating the shadow line of the outboard pumps. See specific pump manufacturers recommendation.

- F. Painting of exterior and interior of wet well:
1. Exterior walls shall be waterproofed with two coats of bitumastic paint or heavy layer of emulsified asphalt, after grouting all joints for the entire surface from a point 2 feet above maximum high groundwater to 6" below the base section floor level.
  2. Interior surfaces shall be painted with two coats of epoxy coal tar paint after grouting joints and placing interior tapered fill. All surfaces, including underside of top slab to be painted.
- G. Hatches shall be positioned in the top slab to afford ready access to each pump as shown on plans, with single or double doors as indicated.
1. Size shown shall be the clear opening.
  2. Covers must have 300 lb. live load rating.
  3. Covers will be aluminum tread plate 1/4" minimum thickness, 6061T6.
  4. Frames shall be welded aluminum extrusions with continuous door stop.
  5. Hinges shall be 316 stainless steel attached with stainless bolts, nuts, washers.
  6. Cover/door lifting handles to be retractable.
  7. Padlocking provisions must be provided.
  8. Safety type open door latch to be provided.
- H. There shall be an inverted "J" air vent mounted in the top slab of sufficient size to allow maximum displacement of air to pass without causing back pressure or a negative pressure. Minimum 2", but may be 6". Exterior end to be screened.
- 2.3 Valve pit shall be constructed adjacent to the wet well to contain and allow access to the station valves on the discharge lines.
- A. To be constructed of 8" thick concrete masonry block on a cast-in-place concrete footing. May be all cast-in-place concrete, reinforced as needed, and structurally anchored to wet well.
- B. Top cover shall adequately cover entire pit with lockable hatch/doorways for access.
1. May be 6" precast reinforced concrete, or
  2. May be part of wet well top slab (see 2.02D), or
  3. May be aluminum hatch cover (see 2.02F).
- C. Floor of pit to be minimum 12" crushed stone to afford good draining.

- D. May only be constructed on good, thoroughly compacted wet well backfill. Backfill on that side of wet well should be selected with care.

## 2.4 Lift Station Pumps - Two or More as Required

### A. General

The pumps shall be centrifugal, non-clog submersible in design, capable of handling raw sewerage and designed for automatic connection to a permanently mounted discharge system, utilizing a guide rail system, powered by an integral squirrel cage, induction type electric motor.

### B. Pump Construction

1. Housing and major components shall be made of cast iron per ASTM A48 Class 40B with smooth surface, devoid of blow holes and other irregularities. All external surfaces shall be protected with a chloric rubber paint finish.
2. Shaft shall be of Series 400 stainless steel, with a Brinell hardness of 200, or ASTM A576 Gr 1045 carbon steel with an ASTM A276 type 420 stainless steel sleeve.
3. Impeller shall be of non-clog design, statically and dynamically balanced, capable of passing 3-7/8" solids, with easily replaceable stainless steel wear ring with a Brinnell hardness of 200-310.
4. The shaft shall rotate on two permanently greased and adequately sized bearings with a B-10 bearing life of 40,000 hour minimum.
5. The pump shall be provided with a balanced tandem mechanical seal cartridge of stainless steel. Each lower and upper faces shall be tungsten carbide silver-soldered to stainless retainers, operating in pressure compensating oil chamber. Seal faces shall be self-aligning, positively driven and each held by separate spring systems.
6. Discharge shall be flanged per ANSI 125 to accept slide-away coupling.

### C. Motors

1. The pump motor shall be integral to the pump for submersible or dry pit operation. The squirrel cage induction type motor shall be of Class F insulation, NEMA B design, Class H slot liners with a service factor of 1.25 and capable of resisting a heat rise to 155 degrees C, as defined in NEMA standard MG-1; and be capable of allowing 20 starts per hour.
2. Cooling shall be either air cooled through use of external fins, or oil cooled by a positive flow of contained oil to dissipate its heat to the pump fluid or external air.
3. Power cable entry to an isolated internal terminal board shall be such that moisture cannot enter external or internal through the cable; and shall be filled with an adequate strain relief and be of adequate length such that splices will not be required.
4. Mount large lifting eye or handle at top.

- D. Discharge coupling to the station discharge piping will be accomplished by using a universal slide-away coupling that bolts to the pump discharge flange and mates/seals against the fixed discharge piping elbow; and allows positioning or removal of the pump by simple downward/upward motion of the pump, being guided by one or two permanently mounted rails.
1. The seal will be replaceable rubber gasket that will seal the joint with just the weight of the pump exerting the closure pressure.
  2. Guide rails will either be 2" diameter rods, 2" X 2" tee bar, or dual X 2" channels. Preferred material will be stainless steel type.
  3. Guide rail brackets as required, top, intermediate and/or lower, shall be stainless steel with stainless steel hardware.
  4. Optional wire guide system may be approved.

#### 2.5 Approved Pumps:

The following submersible pumps are approved for installation in ECUA lift stations rated for 3, 5, 7 10, 12, or 15 HP:

- A. EMU
- B. Wemco
- C. ABS
- D. Ebara
- E. Hydro-matic

Approval is subject to review by ECUA for compatibility with other ECUA system components, and any special conditions associated with the specific installation.

#### 2.6 Lift station piping shall be matched to pumps so as to handle initial and future flows.

- A. Base discharge connection shall be cast iron flanged per ANSI-125 and suitable to accept slide-away coupling. Base section will be secured to wet well floor with stainless steel anchor bolts.
- B. Piping in wet well and valve box shall be flanged D.I. Class 53 poly-lined. As an alternate on smaller stations, PVC Schedule 80 pipe may be approved.
- C. Piping to exit wet well through properly sized cast iron sleeves and sealed.
- D. On the horizontal section of each discharge pipe there shall be installed, in order:
  1. 1" bronze gate valve, secured with proper saddle, and a 1" street elbow, directed down, inside wet well.
  2. Check valves: The check valves shall be horizontal swing checks, iron body, bronze mounted with flanged ends rated for operation at 125 psi. The cover shall be cast iron with cover bolts of rust-proofed steel. The gate, gate-ring, set ring, and hinge shall be all bronze. The check valve shall be of the adjustable external

spring-loaded type. The contractor shall adjust the tension in the spring as necessary to prevent slamming in the valve pit.

3. Gate Valves: All gate valves shall be iron-body bronze mounted of the double-disc, parallel-seat, non-rising stem type, area fitted with a square operating unit opening left. The net area of the valve opening shall not be less than the net area of the connection pipe. They shall be Class 125 valves with flanged connections in the valve pit.

E. On the horizontal section of one of the discharge lines, past the in-line gate valve, there shall be assembled an emergency pump out connection, readily accessible with the valve pit hatch opened, and of the same pipe size as follows: tee, spool piece, gate valve, spool piece with upper end threaded and capped.

F. Outside the valve pit the piping will change to the specified force main pipe material, and through the necessary bends, wyes and increasers will direct all flows into the force main as specified. Thrust restraints must be used as needed using precautions to insure adequate support.

2.7 Liquid Level Control will be mounted in the wet well with wires running in conduit to the control panel mounted above ground.

A. Four (4) stainless steel Bulletin B 100 Model 9G mercury float switches, as manufactured by Consolidated Electric Company, or equal, shall be mounted on a stainless steel 1" pipe or rod which will be secured to the wet well wall with stainless steel hardware.

B. Each float switch shall be set at the elevation as indicated on the plan to control the following signals.

1. Low water - all pumps off
2. Lead pump on
3. Lag pump on
4. High level alarm

C. Each float cable shall be sealed to switch inside float, long enough to reach terminal in control panel without splicing or junction box, and shall be PVC or neoprene jacket with 2 #18 (41 strand wire).

D. There shall be a stainless steel cable holder, mounted for easy access with the hatch door open, to support the four float cables and each pump motor cable prior to their exiting through conduits to the control panel.

2.8 Electrical Requirements

A. General

1. ECUA has several different types of lift stations in its collection system. The types of station vary depending on type and quantity of pump(s), wet well/dry well, variable/constant speed, emergency generator, size of SCADA RTU, etc.
2. Because of the UHF radio controlled SCADA system, a standard off-the-shelf pump control panel cannot be used. It must be modified/manufactured as per the following specification.

3. The electrical construction drawings accompanying this specification is for typical ECUA two pump lift stations, 19 horsepower and below, with 240V 3-phase and 480V 3-phase supply voltages, respectively. The various points should be wired and equipment supplied as specified. All wires and terminals shall be marked as per the above mentioned drawings. Any deviation in equipment and/or wiring method must be approved by ECUA.
4. In the event a panel is required for other than these typical stations (more or less pumps or greater than 19 horsepower) wiring diagrams and panel layout drawings may be obtained from the ECUA.

B. Electrical

1. Codes and Permits

All electrical equipment shall be manufactured and installed in accordance with NEMA requirements and any local laws and ordinances as last revised. All materials used shall be new, of the highest quality, and of proper type for the use intended. Where applicable, all materials shall carry the approval of the Underwriters Laboratory. Substitutes which tend to lower the quality of the work will not be permitted. IEC rated devices that are not built to NEMA Standards are specifically prohibited.

The project is to result in a complete and operable lift station that is compatible with the SCADA system and other ECUA lift stations. Any items not specified, but normally included in such installations, shall be furnished and installed, regardless of omissions from specifications. However, specified omissions are not affected by this requirements.

2. Tests and Warranty

Upon completion, make final operating test of the entire wiring installation and equipment furnished and/or installed and/or connected under these specifications, cleaning and testing same; electrically and mechanically demonstrating that the work fulfills all the requirements of these specifications and meets with all local and Underwriters requirements.

3. Temporary Power

The contractor shall supply, install and maintain all necessary temporary lights and power during construction for himself and he shall pay for all electrical energy consumed during the construction period.

4. Service Entrances

It shall be the responsibility of the contractor to coordinate his work with the power company. He shall provide a suitable service entrance to the electrical equipment at each lift station.

5. Main Circuit Breaker

All lift stations shall include a main circuit breaker. On 240V stations, this circuit breaker shall be a Square D Type FAL32xxx (100A service or less) or KAL362xx (200/225A service) as required, or approved equivalent. On 480V stations this circuit breaker shall be a Square D Type FAL34xxx (100A service or less) or KAL362xx (200/225A service) as required, or approved equivalent. This circuit breaker shall be mounted in a NEMA 3R enclosure with ground lug and grounded neutral bus and must be suitable for service disconnect.

6. Lightning protection

All lift stations shall have a lightning arrestor installed between each incoming power phase and ground. This lightning arrestor would be best located inside the main circuit breaker enclosure and connected to the line side of the main circuit breaker.

7. Transfer Switch

All lift stations shall include a 3-pole double throw switch for disconnecting the primary power source from the lift station, allowing an emergency generator to be tied in for temporary operation of the lift station. This switch shall be a Westinghouse RXUK3??N or approved equivalent. On 240 volt stations only, this transfer switch may be a GE Model TC10424R.

8. Generator Receptacle

All lift stations shall include an appropriate receptacle for connecting to a portable emergency generator if required. This receptacle shall be a Crouse Hinds AR1041 or Appleton ADR1044 or approved equivalent for 100 amp services. This plug shall be a Crouse Hinds AR20412 or Appleton AR20044 or approved equivalent for 200 amp service.

9. Transformer

On 480V lift stations a lighting transformer will be mounted on the back of the lift station backboard. This transformer will be a 10kva, wall hung, outdoor enclosure, Square D Class 7410 Type 10S1F or approved equivalent.

10. Junction Box

A corrosion resistant (NEMA 4X rated) isolation junction box with back panel shall be mounted on the lift station panel backboard. This box should be at least 16 inches high by 14 inches wide and should contain appropriately sized corrosion resistant terminal strips to connect all pump and float leads. The purpose of this box is to completely isolate the wet well wiring from the control panel and to facilitate easier removal of pump leads during preventive maintenance and repair. The conduits between this isolation junction box and the motor control panel should be sealed with mastic. This box should be a Hoffman A1614CHSCFG or approved equivalent. The back panel should be a Hoffman A16P14 or approved equivalent.

## 11. Final Power Turn-on

After satisfactory completion of the electrical inspection, the contractor will provide the electrical permit number, size and type of service, and address to ECUA in order for ECUA to arrange with Gulf Power Company for electrical power connection and turn-on.

### C. Materials

1. Conduit and conduit fittings shall be either rigid aluminum or schedule 80 PVC as per local code requirements. Electrical connectors and couplings shall be of the approved watertight type.
2. Wire and cable shall be properly sized to carry the anticipated load. Insulation, unless otherwise noted, shall be type THW, THWN, or THHN for all sizes. All wiring should be stranded copper.
3. All overload protection shall be provided by circuit breakers. An exception to this requirement can be made for those cases where special electronic equipment must be protected by quick acting fuses. These fuses will be installed as an addition to the required breaker.

### D. Controls

All pump controls mounted outdoors will be mounted in a 36 inch by 30 inch NEMA 3R or NEMA 4X enclosure with back panel and dead front style swing out panel. The enclosure should be manufactured of aluminum unless otherwise noted on the construction plans. This enclosure will be a Hoffman A-36H3008ALLP or an approved equivalent. The back panel will be a Hoffman A36P30 or approved equivalent and will be cut out, labeled and components mounted as per construction drawings. The swing out panel shall be an aluminum pane, sized appropriately, hinged, cut out, labeled and components mounted as per construction drawings. Panel must swing out from the same side as the enclosure door and must swing at least 180 degrees. An exception to the NEMA ratings can be made for enclosures that contain electronic components that require special cooling fans, etc. In these cases, the NEMA ratings should be maintained as much as possible.

Single-phase pump motors shall not be acceptable. Where three-phase power is not available, a Ronk Add-A-Phase unit or approved equivalent will be provided.

All pumps larger than 19 HP shall utilize auto transformer, electronic soft starters, or variable speed drives.

The pump control circuit shall be designed to use mercury floats to sense wet well levels unless otherwise noted on the construction plans. One low level float will be used to turn all pumps off. A separate start float is to be used for each pump. The pumps are to operate on a "lead-lag" sequence with the "lead" pump starting first and the "lag" pump to follow in sequence if the level continues to rise. The system is to include an alternator to alternate the "lead" pump each time the pumps cycle. The circuit must be such that, if either pump is disabled, turned off or trips its breaker, the other pump will continue to operate normally and control the level. The pump controller shall incorporate the following components:

1. A properly sized starter (with properly sized heaters installed) for each motor with two (2) normally open auxiliary contacts added to each starter. These starters will be Square D Class 8536 or approved equivalent.
2. A properly sized circuit breaker for each motor. On 240V stations these circuit breakers will be Square D Class 650 Type FAL32xxx or approved equivalent. On 480V stations these breakers will be Square D Class 650 Type FAL34xxx or approved equivalent.
3. A three position maintained-contact hand-off-auto switch for each pump. Each H-O-A switch must have two N.O./N.C. contact blocks. One N.O./N.C. combination will be used for pump motor control. The other will be used for status input to the SCADA system. These switches should be NEMA 4X rated such as Square D Class 9001 Type SKS43BH2 or approved equivalent. These switches should be labeled "PUMP 1" under and "HAND OFF AUTOMATIC" over for one switch and "PUMP 2" under and "HAND OFF AUTOMATIC" over for the other switch.
4. One 115 VAC, single-phase, 20 amp GFI duplex receptacle, with 20 amp single pole breaker. This breaker will be a Square D Type QOU120 or approved equivalent.
5. One 115 VAC, single pole, 15 amp breaker to be used for SCADA power. This breaker will be a Square D Type QOU115 or approved equivalent.
6. One 240 VAC, single-phase, 20A, simplex receptacle with 20A two pole breaker to be used for mechanics air compressor. This receptacle to be mounted external to the lift station control panel. This breaker will be a Square D Type QOU220 or approved equivalent.
7. One 115 VAC, single pole, 10A breaker to be used for lift station control power. This breaker will be a Square D Type QOU110 or approved equivalent.
8. On 480 VAC stations only, one 480 VAC, 2 pole 30A breaker to be used for transformer power. This breaker will be a Square D Class 650 Type FAL24030 or approved equivalent.
9. An octal base plug-in DIN rail mounted power monitor that senses loss of incoming power/loss of phase from the power company. This power monitor should be protected by input fusing. The output of this monitor will report to the SCADA system via a contact that opens when the monitor senses a power problem. On 240V stations, this power monitor will be a Timemark Model A-2578-240VAC or approved equivalent. On 480V stations, this power monitor will be a Timemark Model A-2578-480VAC or approved equivalent. Fuses will be Bussman KTK-1 or approved equivalent.
10. Each stop, lead and lag float must be isolated from the control circuits by a four pole double throw (4PDT) relay. One of the relay contacts is to be used for reporting float status to the SCADA system. Refer to the construction drawings for appropriate connection of the other relay contacts. These relays will be Potter and Brumfield KHAY-17A11-120 or approved equivalent. Relay sockets will be Potter and Brumfield 27E894 or approved equivalent.

11. One pump alternator that is "cross-wired" as per the construction drawings. This alternator should be Diversified Electronics Model ARA series, Timemark Model 261, or an approved equivalent.
12. Two indicating lights to indicate local/remote (SCADA) operation. The local lens should be green in color. The remote lens should be red in color. These indicating lights must be NEMA 4X rated with 120 VAC lamp module and MB120 bulb, such as Square D Class 9001 Type SKP38G31/SKP38R31 or approved equivalent. These lights should be labeled "CONTROL" under both and "LOCAL" over the green light and "REMOTE" over the red light. These lamps are to be operated by a relay of the same type used for float and pump control. The other contacts of this relay will be used by the SCADA system to switch the pump controls from local to remote operation.
13. One NEMA 4X rated two position sustained contact switch, such as Square D Class 9001 Type SKS11BH2 or equivalent, to be labeled "mechanic present" under and "YES NO" over. This switch to output to the SCADA system and disable/enable SCADA control.
14. All relays and other socket mounted devices shall be mounted on a DIN-rail.
15. All control and SCADA input/output points will be wired to a common terminal strip and appropriately identified as per the attached drawing to ensure standardization between panels. This terminal block will be a Square D Class 9080 Type BM6 or approved equivalent.
16. AC input power will be connected to the control panel via approved terminal blocks. The line power terminal block will be a Square D Class 9080 Type LBA362104 or approved equivalent. The neutral terminal block will be a Square D Class 9080 Type LBA162104 or approved equivalent. The ground lead will be connected to the back panel via an approved bonding lug.
17. The controller shall be completely assembled and bench tested prior to installation.

E. Liquid Level Control

The liquid level in each lift station wet well shall be controlled by normally open Bulletin B100 Model 9G stainless steel mercury float switches as manufactured by Consolidated Electric or Roto-float-SS, Type P by Anchor Scientific, Inc. or approved equivalent.

In lift stations where variable frequency drives are used, requiring analog representation of wet well level, or if analog representation of wet well level is required for any other reason, this float system will be replaced by an appropriate bubbler system and pump turn-on/turn-off will be accomplished by a PLC such as the Siemens Model 305 or equivalent or an electronic alarm module such as an AGM Model 4035 or equivalent, as needed.

F. High Level Alarm System

Each lift station will be equipped with a normally open float in the wet well which will be positioned to monitor high level conditions in the wet well. This float will be of the same type mentioned in paragraph E above, and will be utilized in the SCADA system for reporting wet well high level conditions to the lift station SCADA operator. Proper wiring of this float is shown in the construction drawings.

## G. SCADA

Each lift station will be provided with a SCADA RTU manufactured by DAQ Electronics, Inc. This RTU will be supplied and installed by ECUA after final inspection and acceptance of the lift station. The cost of this equipment and installation shall be prepaid by the developer as a part of the project cost.

## H. Installation Techniques

All conduit runs whether or not terminated in boxes shall be capped or plugged to prevent the entrance of foreign matter until wires are pulled.

Outlets, switches, boxes, etc., shall be rigidly secured and located properly with respect to easy accessibility.

All work shall be tested and subject to final approval of the Engineer.

No wiring shall be pulled until all conduit and boxes are permanently in place. Each branch circuit shall be separately controlled with a grounded neutral for each circuit. Circuiting shall be as indicated on the construction plans.

All feeders and branch circuits are to be color coded maintaining the same color code on the same phase.

All conduit runs under grade shall be rigid conduit from outlet to outlet, with 18 inches minimum cover. Waterproof construction techniques are to be used on all couplings to make the installation watertight.

All components of the lift station, including the main circuit breaker, the manual transfer switch, the lift station control panel, the transformer (when required) and the junction box will be mounted on an aluminum backboard as outlined in the construction drawings. Appropriate space will be provided on the backboard for later installation of the SCADA RTU by ECUA. The RTU currently being used by ECUA measures 24 inches high by 16 inches wide by 8 inches deep. Suitable allowance should be made for convenient entry of cabling from the antenna, conduit runs from the pump control panel and door opening.

Where space allows, the lift station control panel shall set back at least six feet from the wet well to minimize exposure to corrosive gasses.

## 2.9 Shop Drawings

The Contractor shall submit six copies of shop drawings for all major equipment and shall have the Engineer approve same in writing before ordering the equipment.

## 2.10 Supervision of Installation and the Guarantee

The Contractor shall see that all items of equipment are installed, piped, and wired in accordance with the manufacturer's recommendations and shall place all equipment in satisfactory operation. The plant equipment shall be checked by a manufacturer's representative to be sure that it has been installed in compliance with recommendations. The Contractor shall guarantee the satisfactory operation for all apparatus and machinery against defects in workmanship, material and installation for a period of one (1) year. The Contractor shall in turn protect himself with similar guarantees from all his suppliers and subcontractors.

## 2.11 Test Operation

- A. The Contractor shall turn over to the Engineer two copies of operation and maintenance manuals for each piece of equipment installed.
- B. He shall review and demonstrate the operation of the lift station with the Escambia County Utilities Authority's representative completely familiarizing the operator with all operation procedures.
- C. He shall fill out a "Lift Station Inventory" sheet as per the sample that follows.

2.12 Potable Water Service

- A. General: Each station is to be supplied at a convenient location an adequate potable water supply for station washdown and/or emergency operator washing.
- B. Minimum size to be 1" pipe terminated in a valve box with gate valve and backflow device. On larger stations there may be on-site lines to hose bibs and/or personnel showers.

**SECTION 2576****SANITARY SEWER FORCE MAINS (INTERIM)****PART 1: GENERAL****1.1 GENERAL DESCRIPTION OF WORK COVERED**

Furnish and install all pipe, fittings, structures and accessories required for sanitary sewer force mains.

**1.2 QUALITY ASSURANCE****1.2.1 AWWA Standards**

Construction materials and methods shall comply with the requirements of the latest published edition of American Water Works Association (AWWA) Standards. Applicable standards include, but may not be limited to, the following:

1	AWWA C110, C110a	Gray Iron and Ductile Iron Fittings, 2-inch through 48-inch for Water and Other Liquids
2	AWWA C111	Rubber Gasket Joints for Cast Iron Pressure Pipe and Fittings
3	AWWA C151	Ductile Iron Pipe, Centrifugally Cast in Metal Mold or Sand Lined Molds, for Water or Other Liquids
4	AWWA C153	Ductile Iron Compact Fittings, 3-inch through 12-inch for Water and Other Liquids
5	AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
6	AWWA C301	Prestressed Concrete Cylinder Pipe (PCCP), 16-inch and Larger
7	AWWA C509	Gate Valves
8	AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
9	AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe 4-inch through 12-inch for Water
10	AWWA C950	Glass Fiber Reinforced Thermosetting Resin Pressure Pipe

**1.2.2 ASTM Standards**

In addition, construction materials and methods shall also comply with the requirements of the latest published editions of the American Society for Testing and Materials (ASTM) Standards.

**PART 2: MATERIALS AND EQUIPMENT****2.1 GENERAL**

All items furnished shall be new and unused. Pipe to be furnished will be PVC Pressure Rating 160 SDR26 per ASTM D2241 with epoxy lined Ductile Iron fittings unless shown otherwise on the plans and bid documents. All pipe, fittings and accessories shall be suitable and rated for appropriate pressure use. SDR32-5 pipe may be approved for low pressure force mains.

**2.2 DELIVERY, STORAGE AND HANDLING**

Certificates of compliance with specifications shall be required for all materials used on the project. All materials shall be protected during transportation, storage, handling and

installation to avoid physical damage. All materials shall be stored to prevent physical deterioration due to sun and weather. The ECUA reserves the right to reject material which in any way does not meet the requirements of these Specifications.

## 2.3 FORCE MAINS

### 2.3.1 Polyvinyl Chloride Pipe (PVC)

PVC pipe shall meet ASTM D2241, AWWA C900 or C905 Standards, with minimum designations per table below. PVC pipe shall be provided with push-on joints with bell integrally cast into pipe, and shall be installed with elastomeric gaskets, as provided in ASTM F477.

TABLE 2.3 - PVC PIPE STANDARDS					
Standard	Nominal Size	Dimension Ratio	OD	Pressure Class (psi)	Pressure Rating (psi)
ASTM D2241	2"-18"	SDR26	IP	(128)	160
ASTM D2241	3"-18"	SDR32.5	IP	(100)	125
AWWA C900	4"-12"	DR25	CI	100	(165)
AWWA C905	14"-36"	DR25	CI	(100)	165

#### A. Markings

PVC pipe shall be marked to indicate the following:

1. Nominal Pipe Size and OD Base
2. Material Code Designation
3. Dimension Ratio
4. Pressure Class or Pressure Rating
5. Manufacturer's Name or Trademark
6. Appropriate AWWA or ASTM Designation Number

#### B. Color-Coding

One of the following methods of color-coding the pipe shall be used:

1. 3 brown stripes (1/2 inch high) with permanent ink along the entire length of white pipe with the word "FORCE MAIN" in 3/4 inch letters every 21 inches along each stripe.
2. Brown pigment to color entire pipe.

### 2.3.2 Ductile Iron Pipe (DIP)

Ductile iron pipe shall meet AWWA Standard C151 and pressure class based on Table 2.3.2 below for design operating pressures of up to 150 psig, installed in Class 2 Trenching conditions. Increase pressure class or bedding class as required by AWWA C151 for surface loads greater than indicated above or operating pressures greater than 150 psi. DIP shall be constructed with push-on joints using rubber gaskets in accordance with AWWA Standard C111. Other methods of joint construction, such as mechanical, flanged, or ball-and-socket, may be required in special applications as appropriate. DIP shall be epoxy lined to not less than 20 mil. and exterior coated with manufacturer's standard bituminous coating unless otherwise specified.

TABLE 2.3.2 - DI PRESSURE CLASSES		
Diameter	Class	Max. Depth of Bury
3-inch & 4-inch	350	32 feet
6-inch & 8-inch	350	28 feet
10-inch & 12-inch	350	14 feet
14-inch thru 20-inch	250	10 feet
24-inch thru 64-inch	200	8 feet

A. Markings

Each ductile iron pipe section shall be marked to indicate the weight class or nominal thickness, and casting period. The manufacturer's mark, country where cast, year in which the pipe was produced, and the letters DI or DUCTILE shall be cast or stamped on the pipe. All required markings shall be clear and legible, and all cast marks shall be on or near the bell. All letters and numerals on pipe sizes 14-inch and larger shall be not less than 0.5-inch in height.

B. Encasement

When required, DIP shall be encased in polyethylene material in accordance with AWWA Standard C105.

2.3.3 Glass Fiber Reinforced Thermosetting Resin Pipe (18-Inch And Larger)

Pipe manufactured by Price Brothers as HOBAS Pipe and complying with AWWA C950 may be used. Detail specifications will be developed for pipe and fittings when required or allowed as an alternate.

2.3.4 Prestressed Concrete Cylinder Pipe (Pccp) (16" And Larger)

This pipe shall comply with AWWA C301. When required, detail specifications will be developed for pipe and fittings.

**2.4 FORCE MAIN APPURTENANCES**

2.4.1 Force Main Fittings

Force main fittings shall include tees, wyes, bends, reducers, and other appurtenances commonly used in pipe construction. Fittings shall meet AWWA Standard C110 or C153 with pressure ratings of not less than that specified for adjacent pipe. Fittings shall be constructed with mechanical joints, unless otherwise specified, and shall be supplied complete with low alloy steel bolts and nuts, EPR gaskets and other necessary parts required for field assembly. Fittings shall be epoxy lined as specified for adjacent pipe.

A. Pipe Couplings

Pipe couplings shall be solid sleeve type with mechanical joints at each end containing and compressing a gasket. Couplings shall be ductile iron, 12 inches minimum in length, with low alloy steel bolts and nuts, and EPR gaskets. Rings and gaskets shall be sized to conform exactly to the requirements of the pipe manufacturer.

B. Pipe Cut-in Sleeves

Cut-in sleeves shall be solid ductile iron, one end plain for insertion to female fitting, the other end flanged mechanical joint, furnished with loose attaching flange and fastener, nominal length of 20-21 inches. Rings and gaskets shall be sized to conform with the requirements of the pipe manufacturer.

Approved Manufacturers

Manufacturer	Model	Application
Clow	F-1220	for centrifugally cast or sand cast pipe (special)
Clow	F-3459	for all classes of centrifugally cast pipe
Union Foundry	21-4520 21-4610 24-4800	MJ X PE FLG X PE MJ X FLG
Clow	F-3459	for all classes of centrifugally cast pipe
Others as approved by ECUA in writing.		

C. Repair Clamps

Repair clamps shall not be used in the installation of new pipe except with the written permission of the Engineer. Repair clamps shall be full circle and selected based on Table 2.4.1.3 below.

TABLE 2.4.1.3 - REPAIR CLAMP SIZES	
Pipe Diameter	Maximum Sections
Up to 12-inch	Single Section
14-inch to 24-inch	Double Section
26-inch and above	Triple Section

Repair clamps shall be composed of stainless steel bands and bolts, DI lugs and full gridded virgin EPR compounded gasket.

Repair clamps shall be sized so that the OD of the existing pipe being repaired falls within the designated range for the clamp size. Repair clamps shall have ample length to give full gasketing at both ends.

Approved Manufacturers

Manufacturer	Model
Ford	FS1 (all SS), Fordflex (SS-DI Lugs)
Rockwell	2XX*
JCM	101,102,103,104,131,132,133,134
Mueller	520, 530
Others as approved by ECUA in writing.	

\*XX: See Mfr.'s catalog to complete model numbers by size.

D. Pipe Restraints

Retainer glands shall be used on all force main fittings and appurtenances, unless otherwise approved. Stainless steel all-thread tie rods may otherwise be used, with the written permission of the Engineer. In cases of tees, tapping sleeves, and flushing hydrants, the fitting shall be restrained with retainer glands and thrust blocks. See ECUA Standard Details D-43 and D-44.

Approved Manufacturers

Manufacturer	Model
EBAA Iron Works	MegaLug
Others as approved by ECUA in writing.	

E. Expansion Joints

Expansion joint fittings shall be used where specified on the Construction Plans. They shall be of the rigid or flexible type as specified, and manufactured of ductile iron in accordance with 2.4.1 above. They shall be capable of expanding or contracting to the extent shown on the plans, but in no case less than 4-inch axially, and designed to prevent separation beyond the maximum extension without the use of external tie rods.

Fittings shall be provided with restrained mechanical joints, individually pressure tested to a minimum of 350 psi against their own restraints, and internally coated on all exposed surfaces with a minimum of 15 mils. of fusion bonded epoxy conforming to AWWA C213. They shall be capable of deflecting not less than 15° by means of an integral ball at each joint in the case of flexible types.

Approved Manufacturers

Type	Manufacturer	Model
Rigid	EBAA Iron, Inc.	EX-TEND 200
Flexible	EBAA Iron, Inc.	Flex-Tend
Others as approved by ECUA in writing.		

F. Tapping Sleeves

Tapping sleeves shall be mechanical joint or fabricated-type designed for a working pressure of 200 psig without leakage. The outlet branch connection shall have a recessed flanged face for connection of tapping valve with standard dimensions in accordance with MSS SP-60. A complete set of neoprene or other elastomer gaskets shall be furnished. Sleeves shall be furnished to fit cast iron, cement-asbestos, Class 160 or C900/905 PVC pipe with side connection as shown on plans or specifications in standard pipe sizes of 4-inch X 4-inch through 16-inch X 12-inch. Sleeves shall be furnished with all necessary installation parts such as mechanical joint loose flange ends, bolts, fasteners, seals and gaskets.

Approved Manufacturers

Manufacturer	Main Material	Model
Clow	CI & C900 PVC Class 50, 100, 150, 200 10-inch & 12-inch Class 50, 100	F-5205 F-5207 4 F-5205
American Darling	CI & C900 PVC CI & CA	2800C 2800A
Mueller	CI, DI - 4-inch - 12-inch CA - 4-inch - 8-inch CI Class C & D - 10-inch - 14-inch CA - 4-inch-12-inch	H615 H615 H616 H619
M & H	MJ Class A-B Pipe MJ Class C-D Pipe	1174 1274
Others as approved by ECUA in writing		

Note: To specify exact fitting when ordering, state line diameter and line material.

1. Mechanical Joint Tapping Sleeves

Mechanical joint tapping sleeves shall be cast iron with mechanical joint main ends and a standard special dimension tapping machine attaching flange on the branch connection. The sleeve shall be of split configuration and fabricated in accordance with AWWA Specification C-110 with joints to AWWA Specification C-111.

2. Fabricated Tapping Sleeves

Fabricated tapping sleeves shall be the high-strength type having a wide body, made of 285 Grade C steel, which conforms to and reinforces the pipe to be tapped. Body length must be at least twice that of the tap size. The sleeve shall have, as a minimum, a 7/8-inch wide recessed Buna-N gasket around the outlet, and 3/4-inch high-strength corrosion resistant alloy bolts. Sleeve to be furnished with manufacturer's standard corrosion resistant coating.

Approved Manufacturers

Manufacturer	Model
JCM Industries	Model 412
Smith & Blair	622
Ford	FTS
Others as approved by ECUA in writing.	

G. Pipe Hangers and Supports

Hangers and supports shall be in compliance with Federal Specification WW-H-171E, or Manufacturer's Standardization Society SP-69, or UL listed. Materials of construction shall be in accordance with the requirements outlined in Table 2.4.1.7 below.

TABLE 2.4.1.7 - PIPE HANGERS AND SUPPORTS MATERIALS OF CONSTRUCTION	
Part I.D.	Material
Clamps	Steel - Epoxy Coated or Galvanized Cast Iron - Galvanized Malleable Iron
Hanger Rods	Steel - Electro Galvanized Steel - Stainless 304
Rollers/Bases/Roller Stands	Cast Iron
Fasteners/Fittings	Galvanized Steel Stainless
Hanger Rod Inserts	Steel: Cadmium Plated Steel: Galvanized Universal Concrete Insert - Cast Iron - Galvanized
Rod Attachments	Clevis - Forged Steel Turnbuckle: 1) Forged Steel, 2) Malleable Iron Sockets, Eye Nuts, Extension - Malleable Iron
Rollers	Steel or Iron Core, Insulated from Structure

Approved Manufacturers

Manufacturer	Part I.D.	Model No.
ITT Grinnell	Clevis Hanger	590
	Socket Clamp	224
		246

	<u>Concrete Inserts:</u>	
	CB-Universal	282
	Screen Insert	152
	<u>Rod Attachments:</u>	
	Eye Nut	290
	Forged Clevis	299
	Forged Turnbuckle	230
	Carbon Steel	233
	Couplings	136
	Socket Eye	110R
	Extension	157
	<u>Pipe Rolls:</u>	
	Adjustable Swivel	174
	Adjustable Steel Yoke	181
Pipe Roll with Base	274	
Pipe Roll and Plate	277	
Others as approved by ECUA in writing.		

2.4.2 Valves

All valves shall be manufactured in accordance with the current appropriate AWWA Standard.

A. Resilient Seated Gate Valves

Resilient seated gate valves shall be designed and fabricated in accordance with the current AWWA Standard C-509. The basic design of the gate valves shall have a cast iron body, elastomer encapsulated cast iron disc, bronze stem and operating nuts with non-rising stem design. The valve working pressure shall be 200 psig with a test pressure of 400 psig.

1. Materials and Construction

Valves shall open counterclockwise with a 2-inch square cast iron operating nut secured to the valve stem by a corrosion resistant nut to threads on the valve stem. The valve stem shall be made of high tensile strength bronze and shall be of one piece construction sealed by O-Rings. The thrust collar shall be secured in place by a stuffing box or bonnet cover with a thrust washer located above the thrust collar. Valve construction shall be so that upper O-Rings can be replaced with the valve in service. The disc shall be cast iron encapsulated with an elastomer material bonded in accordance with ASTM D429 and shall be secured to the threaded stem by a bronze nut. The disc shall effect a seal that is bubble-tight at 200 psig.

2. Corrosion Resistant Coatings

All interior and exterior cast iron surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550.

3. Body Sizing

Valve body length shall be per ANSI Standard B16.2 for the type of end connections specified. In the full open position, the valve internal bore shall be smooth and obstruction-free without cavities or projections that could accumulate solids. The internal cross-sectional area of the valve shall be approximately equal to the nominal cross-sectional area for Schedule 40 PVC pipe of the same nominal internal diameter.

#### 4. End Connections

Valves shall be furnished with mechanical joint end connections, complete with flange kits, unless otherwise specified on the plans or purchase order.

When flanged ends are specified they shall be flat face nominal 125# ANSI B16.1 Standard with bolt holes straddling the vertical center line.

#### Approved Manufacturers

Manufacturer	VALVE BODY CONNECTIONS			TAPPING VALVES
	MJ x MJ	MJ x FLG	FLG x FLG	MJ x SF
American Darling	4-inch - 12-inch CSR-80X	4-inch - 12-inch CSR-80X	CSR-80X Specify Ends	4-inch - 12-inch No. 862  16-inch - 24-inch*
Clow	2-inch - 12-inch F6100	4-inch - 12-inch F-6106	4-inch - 12-inch F-6102	4-inch - 12-inch F-6114  14-inch - 24-inch F-5093*
Kennedy	3-inch - 12-inch F-1571-XNRS	3-inch - 12-inch F-1572-XNRS	3-inch - 12-inch F-1561-XNRS	3-inch - 12-inch F-950X
M & H	4-inch - 12-inch S-4067-01		4-inch - 12-inch S-4067	2-inch - 12-inch H-667 200 PSI  14-inch - 24-inch H-667 150 PSI
Others as approved by ECUA in writing.				

\*Metal seated only, specify bypass if required  
14-inch and larger valves specify special appurtenances.

#### B. Resilient Seated Tapping Valves

These resilient seated gate valves shall be designed and fabricated in accordance with the current AWWA Standard C-509. The basic design of the gate valves shall have a cast iron body, elastomer encapsulated cast iron disc, bronze stem and operating nuts with non-rising stem design. The valve working pressure shall be 200 psig with a test pressure of 400 psig.

##### 1. Materials and Construction

Valves shall open counterclockwise with a 2-inch square cast iron operating nut secured to the valve stem by a corrosion resistant nut to threads on the valve stem. The valve stem shall be made of high tensile strength bronze and shall be of one piece construction sealed by O-Rings. The thrust collar shall be secured in place by a stuffing box or bonnet cover with a thrust washer located above the thrust collar. Valve construction shall be so that upper O-Rings can be replaced with the valve in service. The disc shall be cast iron encapsulated with an elastomer material bonded in accordance with ASTM D429 and shall be secured to the threaded stem by a bronze nut. The disk shall effect a seal that is bubble-tight at 200 psig.

2. Corrosion Resistant Coatings

All interior and exterior cast iron surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550

3. Body Sizing

Valve body length shall be per ANSI Standard B16.1 for tapping valves. Tapping valves shall conform to Specification AWWA C509, latest revision, covering gate valves except as modified for passage and clearance of tapping machine cutters. The opening through the valve shall be at least 1/4-inch larger than nominal valve diameter. Tapping valves shall allow full size shell cutters to be used.

4. End Connections

Valves shall be furnished at one end of the body with projecting face flange in accordance with specification MSS SP-60 for tapping valve/saddle connections to bolt to a standard tapping sleeve and the other end for mechanical joint.

Approved Manufacturers

See Section 2.4.2.1 above.

C. Air Release Valves

Force mains shall be laid so as to minimize the number of high points. Air release valves shall be installed at all high points in force mains wherever the high point is more than one pipe diameter above the adjacent low points. Exact locations of air release valves shall be field determined. In all case, installation should be in the furthest downstream portion of each high point.

1. Manual Air Release Valves

Manual air release valves shall comprise a 2-inch diameter saddle and corporation stop, extended to grade, and terminated with a lockable curb stop housed in a meter box. These components are specified in Section 2556.2.7. See Standard Detail D-60.

2. Automatic Air Release Valves

Automatic air release valves shall be float operated to release accumulated air whenever the system is pressurized. The body and end covers shall be of cast iron conforming to ASTM A48, Class 35. All internal metal parts, including the float, shall be stainless steel. The air vent valve shall close drip tight, be rated for 200 psi operating pressure and 300 psi test pressure, and shall incorporate a renewable Viton seat. See Standard Detail D-61.

Approved Manufacturers

Manufacturer	Model
Empire Specialty Co., Inc., Mars, PA	Figure 905
Others as approved by ECUA in writing.	

D. Check Valves

Check valves are required on all force mains which manifold into an equal or larger sized force main. The check valve is to be installed in a vault adjacent to the gate valve at the point of connection into the larger line in order to prevent backflow from the larger line into the smaller line. Details shall be as shown in Section 2575.2.06.D.2 on page 2575.7, except that mechanical joint ends may be used.

E. Valve Vaults or Chambers

All valves which are not designed for direct burial shall be installed in vaults, which shall be constructed from standard precast concrete manhole sections. They shall be sized to allow sufficient room for maintenance and repair in situ. For shallow installations, flat tops should be used as shown in the ECUA Standard Shallow Manhole Detail D-2. Gravel bottoms shall be installed in areas where the water table is below the bottom. Where it is higher, a minimum 4-inch concrete bottom shall be provided with a 12-inch x 12-inch sump.

F. Valve Boxes

Valve boxes shall be provided for all direct buried valves. Nominal 6-inch cast-iron sliding-type pipe shaft with cover and base casting shall be used. The box top shall be set at finished grade and encased with a concrete ring in unpaved areas. Each valve box shall be furnished with a drop-in cover marked "SEWER". See ECUA Standard Detail D-34.

2.4.3 Location Aids

All new force main and service line installations shall include an approved method for locating lines from the ground surface after completion.

2.4.4. Tracer Wire

Tracer wire for force mains shall be minimum 12 gauge copper with brown PVC insulation. Tracer wire systems shall be electrically continuous covering all mains within the project. Wire-to-wire connectors shall be made with silicone-filled wire nuts. Wire-to-appurtenance attachments shall be made with lug-type terminals.

Approved Manufacturers (Tracer Wire Silicone-filled Wire Nut Connectors)

Manufacturer	Model
Ideal Industries	Twister® DB Plus
King Technology, Inc.	Failsafe™
Others as approved by ECUA in writing.	

2.4.5 Pipeline Markers

Markers shall be of a passive electronic type that reflects a signal back to an electronic hand-held transmitter/detector. Electronic components shall be enclosed in a waterproof polyethylene housing. Markers shall have a different response frequency for each service line type.

Markers shall be ScotchMark® products manufactured by 3M Telecom Systems Group, Austin, Texas. Alternate manufacturers are not acceptable.

Application	Usable Depth	Dimension/ Configuration	Service	Color Code	Model
Near Surface	2 feet	3½" L X 5/8" Ø Cylinder	Water	Blue	1434
			Wastewater	Green	1435
Medium Depth	4 feet	4" Ø Ball	Water	Blue	1403
			Wastewater	Green	1435
Deep	6 feet	8" Ø X 1" Thick Disc	Water	Blue	1257
			Wastewater	Green	1258

### **PART 3: EXECUTION**

#### **3.1 GENERAL**

The contractor shall provide all labor, equipment and materials as required to install all pipes, valves, fittings, and other appurtenances as indicated on the construction plans or as specified in the contract documents.

#### **3.2 POTABLE WATER LINE SEPARATION FROM SANITARY SEWER LINES**

- A. When a gravity sewer line must cross under a water line with less than 18-inch vertical clearance, one of the following methods may be used.
1. Fully encase sewer line with a minimum of 4 inches of concrete (2500 psi) for a minimum distance of 10 feet either side of the point of crossing, which must be at least 5 feet from a water line joint. If the crossing is other than at right angles, increase the length of encasement so that the end of the encasement will be at least 12 feet from a water line joint.
  2. Use equally rated pressure pipe for the sewer lines with no joints closer than 12 feet apart and at least 6-inch vertical clearance.
  3. Install sewer pipe into at least a 20-foot section of steel casing (casing I.D. slightly larger than sewer pipe bell O.D.) and center over crossing so that end of casing will be at least 12 feet from water line joint. Seal the ends of the casing with non-shrink grout.
- B. When a gravity sewer line must cross over a potable water line, regardless of clearance, because the water line cannot be relayed above sewer, use method 2 or 3 in subsection A. Concrete encasement will not be allowed.
- C. When a sanitary force main must cross under a potable water line with less than an 18-inch vertical clearance, or over the water line, use a higher rated pressure pipe as in method 2 or 3 in subsection A.
- D. When the water line being crossed in A, B or C is a house or building service lateral, 2-inch or smaller and the service lateral is a continuous piece of PE DR9 tubing, then the above rules do not apply; but locate so that the distance to a sewer or force main joint is as great as possible.
- E. When a gravity sewer line must run parallel to and less than 18 inches below a potable water line and:
1. 6 to 10 feet apart for less than 40 feet, use method 1, 2 or 3 in subsection A.
  2. 6 to 10 feet apart for over 40 feet, use method A2 and stagger joints.

3. 3 to 6 feet apart for any distance, use a higher rated pressure pipe as in method A2.
- F. When a sanitary force main must run parallel to and less than 18 inches below a potable water line and:
1. 6 to 10 feet apart for any distance, use a higher rated pressure pipe as in method A2.
  2. 3 to 6 feet apart, use a higher rated pressure pipe for both water and force main. Example: If force main is PC160 PVC DR26, and water line is C-900 DR25; then force main should be PVC DR21 and water line should be DR21, using extreme care to have both properly color-coded.

### 3.3 PIPE INSTALLATION

The contractor shall utilize equipment and methods in accordance with sound construction practices to insure pipe installation to line and grade as indicated.

#### 3.3.1 Trench Excavation

Refer to Section 2221: Trench Excavation Backfill and Compaction. Maintain minimum of 30 inches and maximum of 36 inches of cover below finished grade unless shown otherwise on the construction plans.

#### 3.3.2 Alignment

Pipe shall be installed along the alignment indicated by the construction plans. Accomplish horizontal and vertical changes in alignment of pipe with bends or other appropriate fittings. Limit joint deflection as recommended by the pipe manufacturer.

#### 3.3.3 Pipe Preparation

The contractor shall clean the interior of all pipes, fittings, and joints prior to installation. Pipes shall be inspected for defects prior to installation. Damaged pipe shall be rejected and removed from the project.

#### 3.3.4 Pipe Installation

Install pipe only when weather and trench conditions are suitable. Do not lay pipe in water. Join pipe in accordance with manufacturer's recommendations.

Provide initial backfill or anchoring as necessary to prevent displacement and preserve alignment after establishing final position.

Encase force main in steel casing or use ductile iron pipe when crossing under pipe, conduit, or structure when a 6-inch separation distance cannot be maintained. This protection shall extend a minimum of 5 feet beyond crossed structure.

#### 3.3.5 Protection

Prevent the introduction of foreign matter into the pipe at all times. Close open ends of pipe with water tight fitting closures or plugs. Do not let water fill trench, but include provisions to prevent flotation should water control measures prove inadequate.

Remove water, sand, mud and other undesirable materials from trench before removal of pipe closure piece.

### 3.3.6 Cutting

PVC pipe shall be cut in a neat workmanlike manner, and the spigot end shall be beveled per manufacturer's recommendation. Ductile iron pipe shall be cut in accordance with manufacturer's recommendation. Do not allow excessive heat to develop. Smooth and bevel cut end by power grinding. Use of pipe with damaged lining is unacceptable.

### 3.3.7 Closure Pieces

Closure pieces shall only be used where called for on plans, or with written permission of the ECUA. Closure may be accomplished with sleeve coupling as long as its length is such that gaskets are not less than 3 inches from pipe ends.

### 3.3.8 Joint Restraints and Thrust Blocking

Joint restraints and/or thrust blocking must be provided at all horizontal or vertical turns utilizing fittings, and at tees, 90's, and dead-ends.

## 3.4 **APPURTENANCE INSTALLATION**

### 3.4.1 Valves

Valves shall be installed with operating stems vertical when installation is direct burial. Valves shall be installed on a suitable bearing surface so as to prevent vertical displacement.

#### A. Air Release Valves

Air release valves shall be located and installed at the down-stream end of all high points as shown in Details D-60 or D-61 for manual or automatic types respectively as indicated on the approved construction plans.

#### B. Check Valves

Check valves complete with vaults shall be installed at locations shown in the approved construction plans in accordance with the manufacturer's instructions.

### 3.4.2 Valve Boxes

Valve boxes shall be centered on the valve. The earth shall be compacted around each valve box to a distance of 4 feet on all sides of box, or to undisturbed trench face if less than 4 feet. An 18-inch diameter by 4-inch thick collar shall be constructed and sloped to direct water away from the valve box.

### 3.4.3 Tracer Wire

Tracer wire shall be installed on all new force mains. The tracer wire shall be placed directly above the pipe and electrically continuous throughout the project. The tracer wire shall be brought to the ground surface at each valve location in accordance with ECUA Standard Detail D-34. Splices and/or connections in the tracer wire shall be installed with silicone-filled wire nuts designed for direct burial.

### 3.5 TAPS ON PRESSURIZED LINES

The contractor shall perform taps on pressurized lines in accordance with these requirements. An ECUA representative shall be on-site during testing and cutting.

#### 3.5.1 Materials

All materials used for taps on pressurized lines shall meet the requirements of these specifications. Tapping sleeves shall be properly sized for the pipe being tapped. (See Sec. 2.4.1.6) Resilient seated tapping valves shall be furnished with special end connections. (See Sec. 2.4.2.2) All other material used to accomplish the tap shall meet the relevant AWWA Standards.

#### 3.5.2 Procedure

The contractor shall:

- A. Expose the existing pipe at the location shown on the plans, and clean the section of the pipe to receive the tapping sleeve.
- B. Check the tapping sleeve and valve for defects and make sure the gate fully retracts in the valve to allow the shell cutter free passage.
- C. Assemble the tapping sleeve on the pipe, then install the tapping valve.
- D. Pressure test the tapping sleeve and valve after it has been assembled on the force main using the test plug on the sleeve. The test pressure shall be 150 psi.
- E. Pour a thrust block behind the tapping sleeve sufficient to withstand the pressure of the new line. Also, provide a suitable bearing surface sufficient to support the weight of the sleeve, valve, and tapping machine. Refer to Section 3.3.9 and ECUA Standard Detail D-43.
- F. Assemble an approved tapping machine and proceed to make the necessary cut in accordance with the recommendation of the tapping machine manufacturer.

Approved tapping machines shall be:

1. in good working condition.
2. designed for and have a cutting bit for the pipe material to be cut.
3. equipped with a depth of cut gauge.
4. designed to capture the coupon.

## **PART 4: ACCEPTANCE REQUIREMENTS**

### 4.1 INSPECTION

Upon completion of the installation, the system shall be inspected to ascertain that valves, fittings, air release valves, etc. are located in conformance with the plans, and confirm that all 'as-built' measurements have been taken. The ECUA Inspector shall

observe all appropriate activities related to properly placing the line in service including flushing, pressure and leakage testing. Final connections shall be accomplished after final clearance of lines. Tracer wire shall be tested for continuity.

## 4.2 FLUSHING

All newly installed force mains shall be flushed to remove any sediment, solids and/or foreign matter prior to testing. ECUA will make water available to the contractor. Flushing shall be conducted at a sufficient velocity to clear the pipe. Discharge of flushing water must be through a 2-inch diameter pipe or larger and must be controlled so as not to cause any property damage.

## 4.3 PRESSURE/LEAKAGE TEST

### 4.3.1 General

All newly installed force mains and appurtenances shall be pressure/leak tested to assure the strength of materials and quality of workmanship of the installation. Testing shall be conducted generally in accordance with ECUA Standard Detail D-12 and the requirements of AWWA Manual 23 for PVC and other flexible pipe or AWWA C600 for Ductile Iron Pipe. Leakage testing may be conducted concurrently with the pressure test.

### 4.3.2 Procedure

Tests are to be conducted in segments not to exceed three thousand (3,000) feet of pipe. Water in the new line shall be pumped up to a pressure of 100 psi. This pressure shall be maintained for a minimum of one (1) hour by pumping a quantifiable amount of water into the line and record the amount of water added during the test period. This represents the leakage.

Pressure/leakage tests shall be deemed acceptable when leakage does not exceed that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133200} \text{ (or 11.65 gpd/mi/inch/dia)}$$

$$\text{or } L = \frac{ND\sqrt{P}}{7400} \text{ for DI pipe 18' lengths}$$

$$\text{or } L = \frac{ND\sqrt{P}}{6600} \text{ for PVC pipe 20' lengths}$$

where:            L = Maximum leakage, in gallons per hour.  
                       S = Length of pipe under test, in feet.  
                       N = Number of pipe joints in segment under test.  
                       D = Nominal internal diameter of pipe, in inches.  
                       P = Average actual leakage test pressure, psig.

Record all data for submission with as-built plans.

An ECUA Construction Inspector shall be present during test.

Refit and replace all pipe not meeting the leakage requirements. Repair clamps are not permitted.

Repair all visible leaks regardless of the amount of leakage.

## **PART 5: MEASUREMENT AND PAYMENT**

### **5.1 GENERAL**

Measurements shall be made to the nearest tenth of units and rounded to the nearest whole unit when totaled. Payments shall be for providing all labor, tools, equipment and materials as needed for: 1) furnishing, handling, and installing the required materials, fittings or fixtures; 2) excavation, backfill and compaction, including shoring, bracing and dewatering as required; 3) temporary removal and replacement of existing obstacles, including minor relocation and repair of other utilities; and 4) all required testing, and flushing. Payment for force main installations shall include the installation of tracer wire.

### **5.2 FORCE MAINS**

Force mains shall be measured in lineal feet by the specified pipe size along the pipe centerline with no deduction for fittings. Payment shall be based on the contract unit price per lineal foot.

### **5.3 APPURTENANCES**

Force main appurtenances include fittings and valves as outlined in Section 2.4 of the specifications. Incidental appurtenances such as joint restraints, couplings, tracer wire, etc. are not considered separate pay items and their cost should be included in the unit price of the installed pipe.

#### **5.3.1 Fittings**

Force main fittings including bends, reducers, tees, wyes, tapping sleeves, expansion joints, pipe hangers/supports, and cut in sleeves shall be measured and paid for on a unit (per each) basis. Fittings shall be listed by size and type.

#### **5.3.2 Valves**

Force main valves inclusive of any required valve boxes or other appropriate appurtenances shall be measured and paid for on a unit (per each) basis. Valves shall be listed by size and type.

### **5.4 TAPS ON PRESSURIZED LINES**

Taps on pressurized lines shall be measured and paid for on a unit price (per each) basis to include tapping sleeve, tapping valve, and valve box complete, in-place. Taps shall be listed by main and branch diameters.

### **5.5 POLYETHYLENE WRAPPING**

Polyethylene wrapping shall be measured along the centerline of the pipe. Payment will be based on the contract unit price per lineal foot.

### **5.6 DEWATERING**

Well Point method shall be used when specified and bid item included. Measurement shall be in linear feet of pipe trench dewatered and payment by unit price per foot.

Screened and Packed Well Point method shall only be used when specifically indicated and bid item included. Measurement shall be in linear feet of pipe trench and vertical feet of screened and packed points and payment by unit price per foot.

Deep Well, Eductor Well Point, Bleeder Well or Vacuum methods will only be considered when specified.

Trench bottom sump pumps will not qualify for payment as dewatering.

## SECTION 3300

### CAST-IN-PLACE CONCRETE

#### PART 1: GENERAL

1.01 General Description of Work Covered: Mixing, placing, finishing and providing all related services necessary to construct all cast-in-place concrete work indicated on plans.

1.02 Quality Assurance

A. Comply with the latest published edition of the American Concrete Institute (ACI) and American Society of Testing and Materials (ASTM) standards and codes:

1. ACI 301 - Specification for Structural Concrete for Buildings
2. ACI 305 - Placing Concrete in Hot Weather
3. ACI 306 - Placing Concrete in Cold Weather
4. ACI 318 - Building Code Requirements for Reinforced Concrete

B. Manufacturer's Data: Submit manufacturer's product data with installation instructions for proprietary materials including reinforcement and forming accessories, admixtures, joint materials, hardeners, curing materials and others as requested by Engineer.

C. Laboratory Reports: Submit 2 copies of laboratory test or evaluation reports for concrete materials and mix designs as requested by Engineer.

D. Mix Proportions and Design: Proportion mixes complying with mix design procedures specified in ACI 301.

1. Submit written report to Engineer for each proposed concrete mix at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and are acceptable to Engineer.
2. Mix designs may be adjusted when material characteristics, job conditions, weather, test results or other circumstances warrant. Do not use revised concrete mixes until submitted to and accepted by Engineer.
3. Use air-entering admixture in all concrete, providing not less than 4 percent nor more than 6 percent entrained air for concrete exposed to freezing and thawing, and from 2 percent to 4 percent for other concrete.

E. Concrete Testing Service: Employ acceptable testing laboratory to perform materials evaluation, testing and design of concrete mixes. (When required by Owner).

1. Sampling: ASTM C 172
2. Slump: ASTM C 143, one test for each load at point of discharge.
3. Air Content: ASTM C 173, one for each set of compressive strength specimens.

4. Compressive Strength: ASTM C 39, one set for each cu. yds. or fraction thereof of each class of concrete; one specimen tested at 7 days, one specimen tested at 28 days, and one retained for later testing if required.
5. When the total quantity of a given class of concrete is less than 50 cu. yds., strength tests may be waived by Engineer if field experience indicates evidence of satisfactory strength.
6. Test results will be reported in writing to Engineer, Contractor, and concrete producer within hours after tests are made.

2.01 Products

- A. Portland Cement: ASTM C 150, type as required.
- B. Fly Ash: ASTM C 618, Type C or F.
- C. Limit use of fly ash in concrete mix design to not exceed 25 percent of cement content by weight.
- D. Aggregates: ASTM C 33, except local aggregates of proven durability may be used when acceptable to Engineer.

2.02 Water: Potable.

2.06 Admixtures

- A. Air-Entraining Admixture: ASTM C 260.
- B. Water-Reducing Admixture: ASTM C 494, type as required to suit project conditions. Only use admixtures which have been tested and accepted in mix designs, unless otherwise acceptable. Superplasticizers are not permitted without prior approval of Engineer.

2.07 Related Materials

- A. Waterstops: Flat dumbbell or centerbulb type, size to suit joints, of either rubber (CRD C 513) or PVC (CRD C).
- B. Moisture Barrier: Clear 8-mils thick polyethylene; polyethylene-coated barrier paper; or 1/8" thick asphalt core membrane sheet.
- C. Membrane-Forming Curing Compound: ASTM C 309, Type I.
- D. Joint Fillers
  1. Joint Sealer: Hot poured, non-extruding, elastic, ASTM D 1190.
  2. Performed Expansion Joint Filler: Non-extruding, bituminous fiber, ASTM D 1751.
- E. Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection.
- F. Exposed Concrete Surfaces: Material to suit project conditions.

2.08

Reinforcing Materials

- A. Deformed Reinforcing Bars: ASTM A 615, Grade 60, unless otherwise indicated.
- B. Welded Wire Fabric: ASTM A 185.

2.09

Forming and Placing Concrete

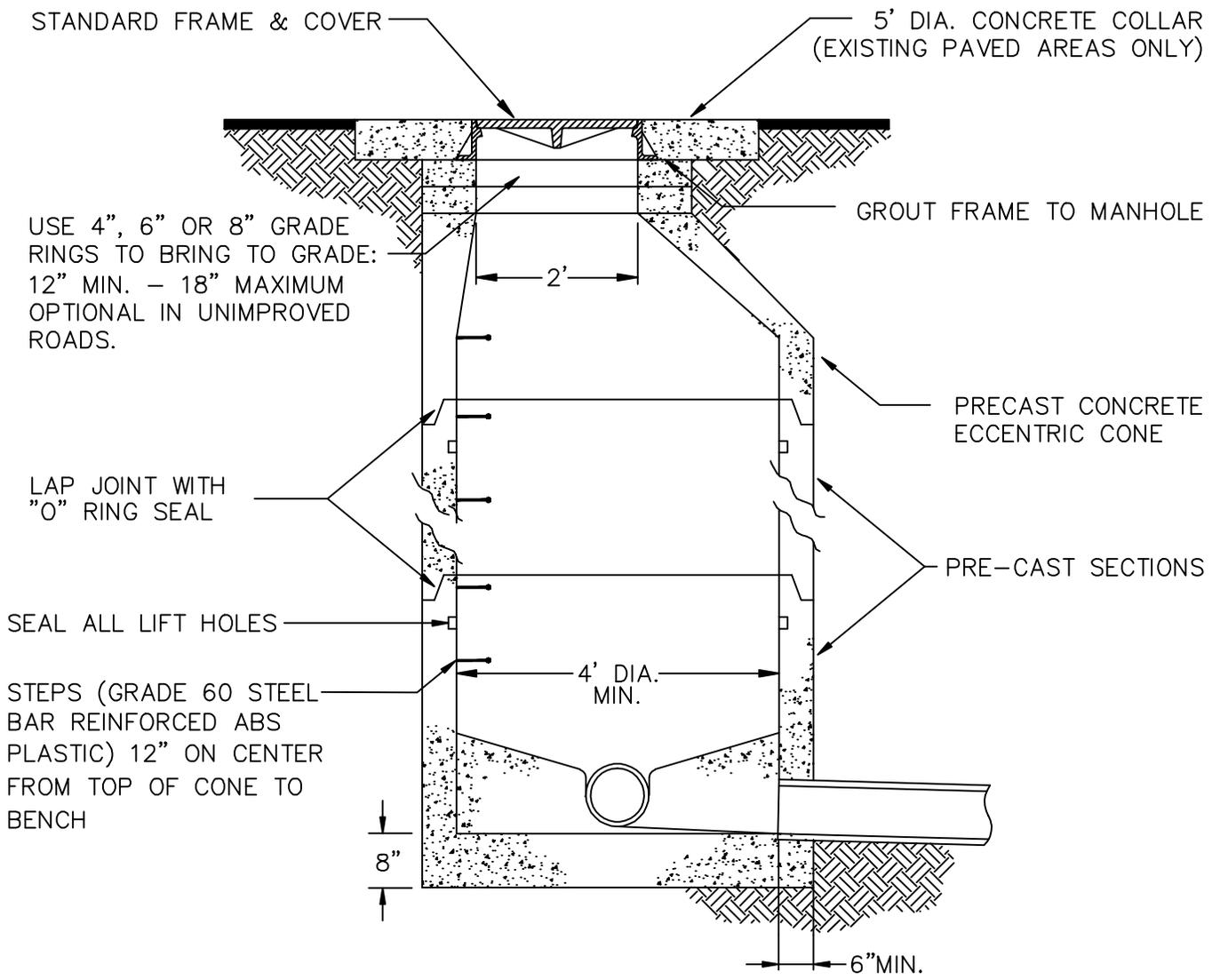
- A. Job-Site Mixing: Use drum type batch machine mixer, mixing not less than 1« minutes for one cu. yd. or smaller capacity. Increase mixing time at least 15 seconds for each additional cu. yd. or fraction thereof.
- B. Ready-Mix Concrete: ASTM C 94.
- C. Formwork: Construct so that concrete members and structures are of correct size, shape, alignment, elevation and position.
  - 1. Provide openings in formwork to accommodate work of other trades. Accurately place and securely support items built into forms.
  - 2. Clean and adjust forms prior to concrete placement. Apply form release agents or wet forms, as required. Retighten forms during concrete placement if required to eliminate mortar leaks.
- D. Reinforcement: Position, support and secure reinforcement against displacement. Locate and support with metal chairs, runners, bolsters spacers and hangers, as required. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in as long lengths as practicable, lapping at least one mesh at both ends and sides. Tie or interlace at laps.
- F. Joints: Provide construction, isolation, and control joints as indicated or required. Locate construction joints so as to not impair strength and appearance of structure. Locate isolation and control joints in slabs-on-ground to accommodate differential settlement and prevent random cracking.
- G. Installation of Embedded Items: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by cast-in-place concrete. Use setting diagrams templates and instructions provided by others for locating and setting.
- H. Concrete Placement: Comply with ACI, placing concrete in a continuous operation within planned joints or sections. Do not begin placement until work of other trades affecting concrete is completed.
- I. Consolidate concrete using mechanical vibrating equipment, hand rodding and tamping, so that concrete is well compacted around reinforcement and other embedded items and into forms.
- J. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placement and curing.
  - 1. In cold weather comply with ACI 306.

2. In hot weather comply with ACI 305.

2.10

Concrete Finishes

- A. Exposed-to-view Surfaces: Provide a smooth finish for exposed concrete surfaces and surfaces that are to be covered with a coating or covering material applied directly to concrete. Remove fins and projections, patch defective areas with cement grout, and rub smooth.
- B. Slab Trowel Finish: Apply trowel finish to monolithic slab surfaces that are exposed-to-view or are to be covered with resilient flooring, paint or other thin film coating. Consolidate concrete surfaces by floating then finish troweling, free of trowel marks and uniform in texture and appearance.
- C. Broom Finish: Apply broom finish to monolithic slab surfaces that are exposed to view and subject to vehicular or pedestrian traffic. Consolidate concrete surfaces by floating and troweling prior to applying broom finish.
- D. Curing: Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by use of moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until forms are removed. Provide protections as required to prevent damage to exposed concrete surfaces.



NOTE:

SEE SECTION 2570 FOR COMPLETE SPECIFICATIONS



# STANDARD MANHOLE DETAIL

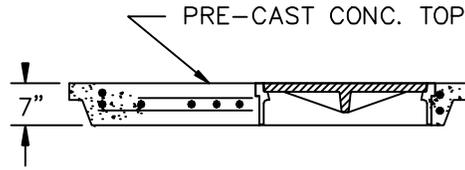
N.T.S.

D-1

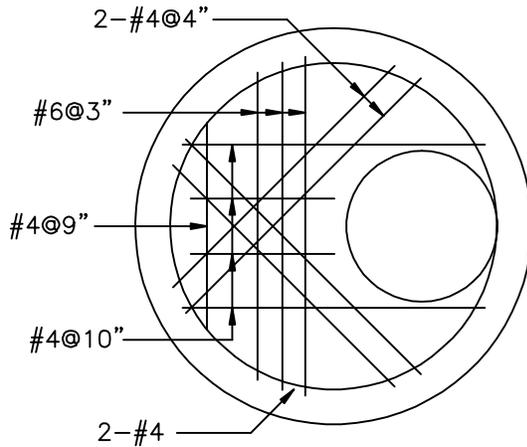
DATE: 10-2-97

REV: 6-1-99

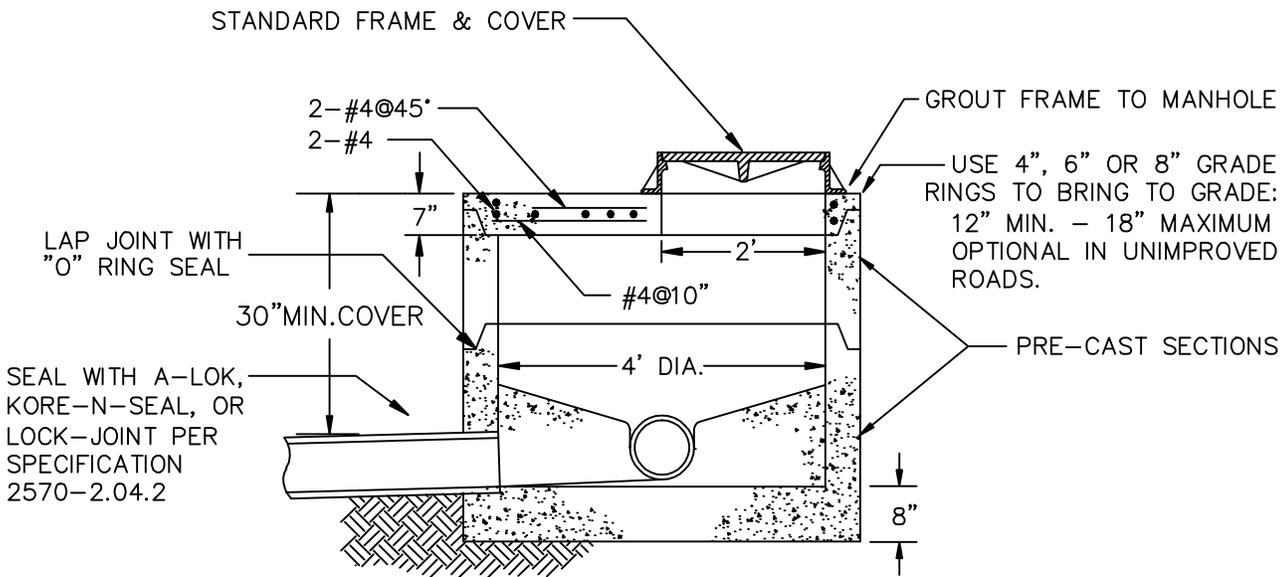
DETAIL



PRE-CAST CONC. TOP  
 7"  
 ALTERNATE TOP WITH  
 INVERTED RING



TOP REINFORCING



# SHALLOW MANHOLE DETAIL

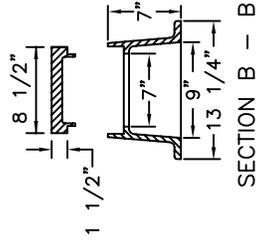
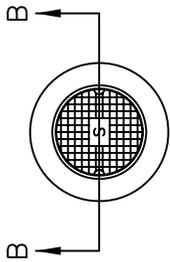
N.T.S.

D-2

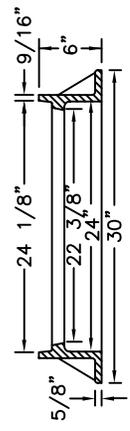
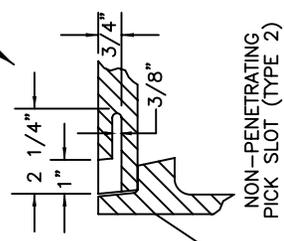
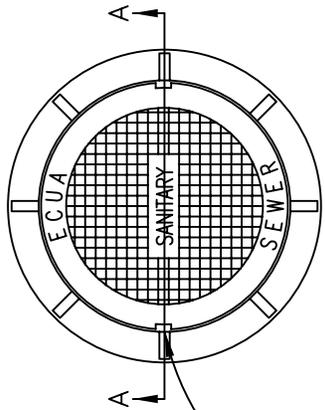
DATE: 9-8-95

REV: 6-1-99

DETAIL



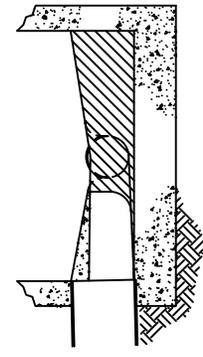
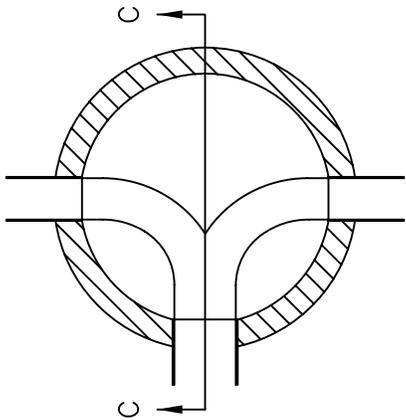
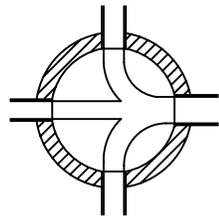
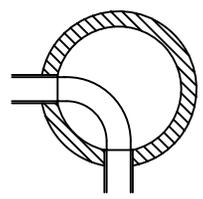
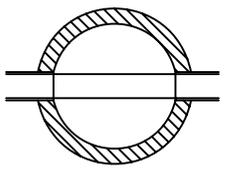
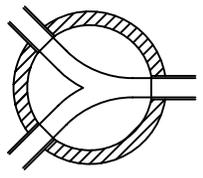
LAMPHOLE FRAME AND COVER



MANHOLE FRAME & COVER

NOTES:

1. FRAME AND COVER SHALL BE VULCAN MODEL VM 37, OR U.S. FOUNDRY USF170E, BOLTING FEATURES NOT REQUIRED. MODEL VM 360-WT, FOR BOLTED COVERS, MODEL VM 50 FOR FLOOD AREAS, OR APPROVED EQUIVALENTS, REFER TO SPECIFICATIONS.
2. FRAME AND COVER SHALL CONFORM TO ASTM SPEC. A-48, CLASS 30 CAST IRON.
3. MANHOLE COVER IS TO BE NON-VENTING, EXCEPT WHEN USED ON A RECEIVING MANHOLE FOR A FORCE MAIN, A MANHOLE THAT HAS A DROP MAIN OR LATERAL ENTERING IT, OR A MANHOLE THAT HOUSES AN ARV (SEE DETAIL D-61).



SECTION C - C

INVERT CHANNELS



TYPICAL MANHOLE DETAILS

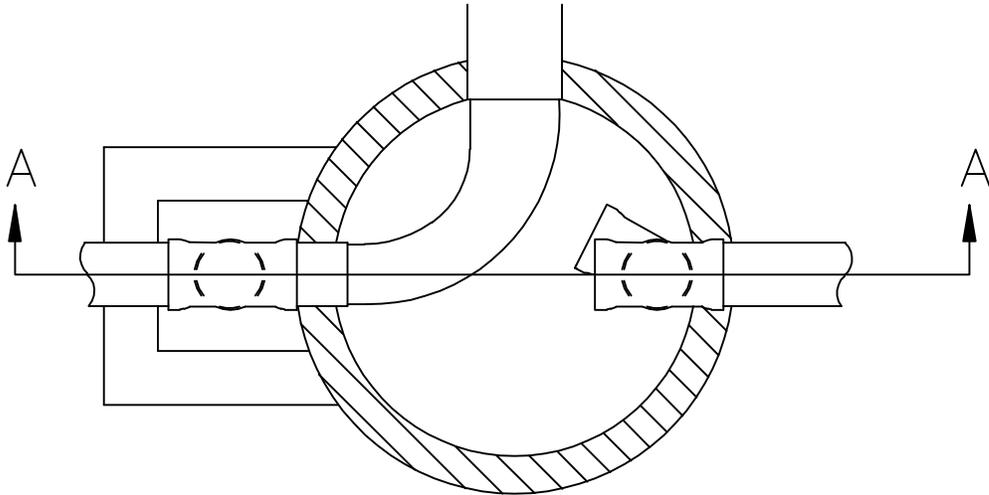
D-4

DATE: 11/87

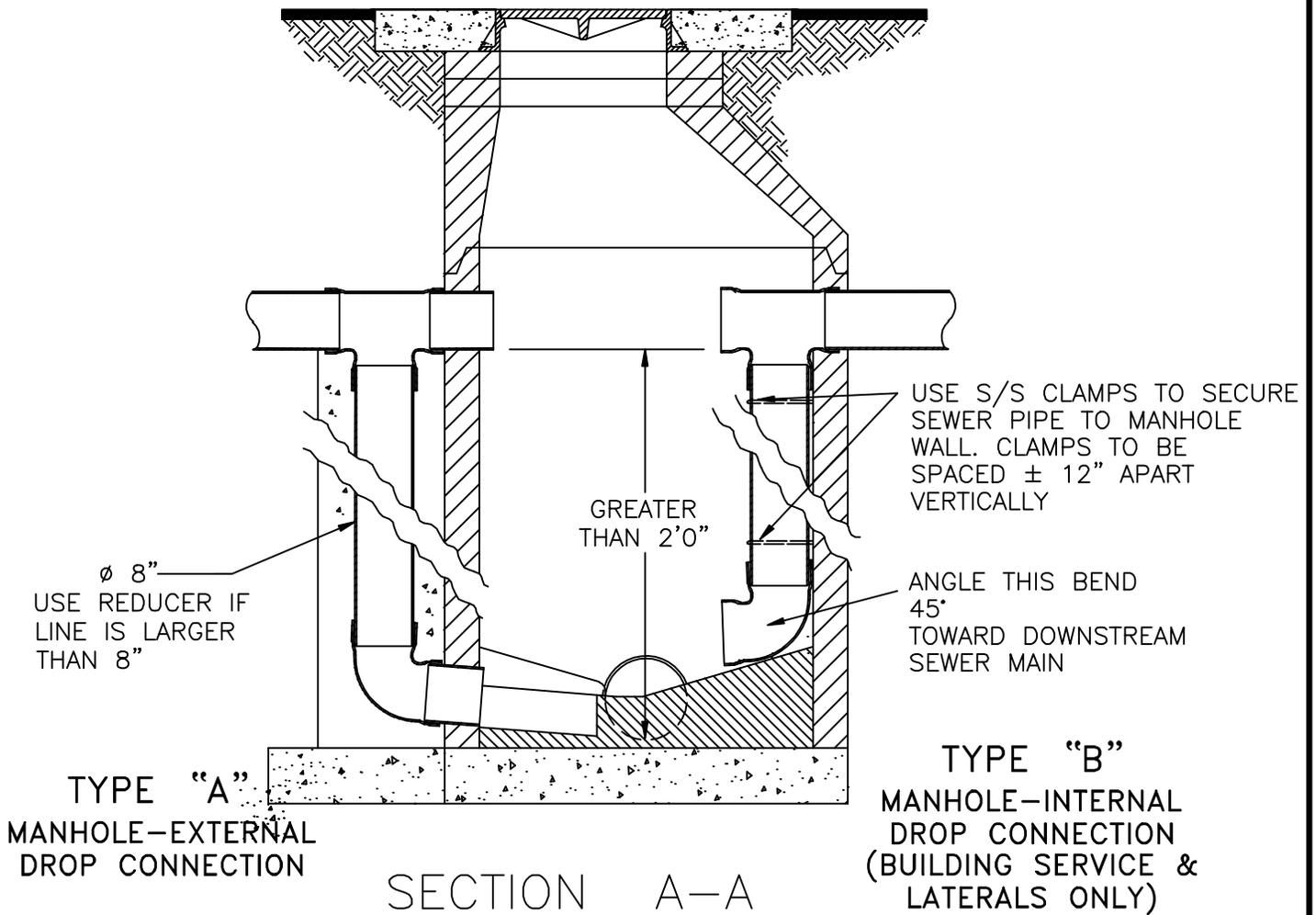
N.I.S.

REV: 6-1-99

DETAIL



NOTE:  
 REFER TO SPECIFICATIONS AND DETAILS D-1 &  
 D-4 FOR NOTES PERTAINING TO MANHOLE CONSTRUCTION.



TYPE "A"  
 MANHOLE-EXTERNAL  
 DROP CONNECTION

SECTION A-A

TYPE "B"  
 MANHOLE-INTERNAL  
 DROP CONNECTION  
 (BUILDING SERVICE &  
 LATERALS ONLY)



DROP MANHOLE CONNECTIONS

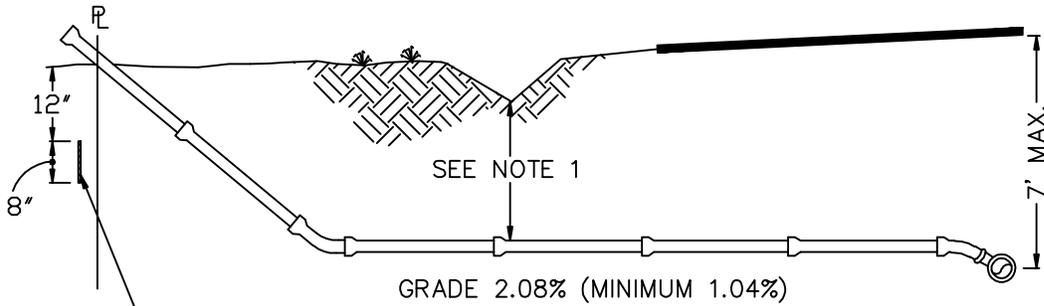
D-6

DATE: 10/12/95

N.T.S.

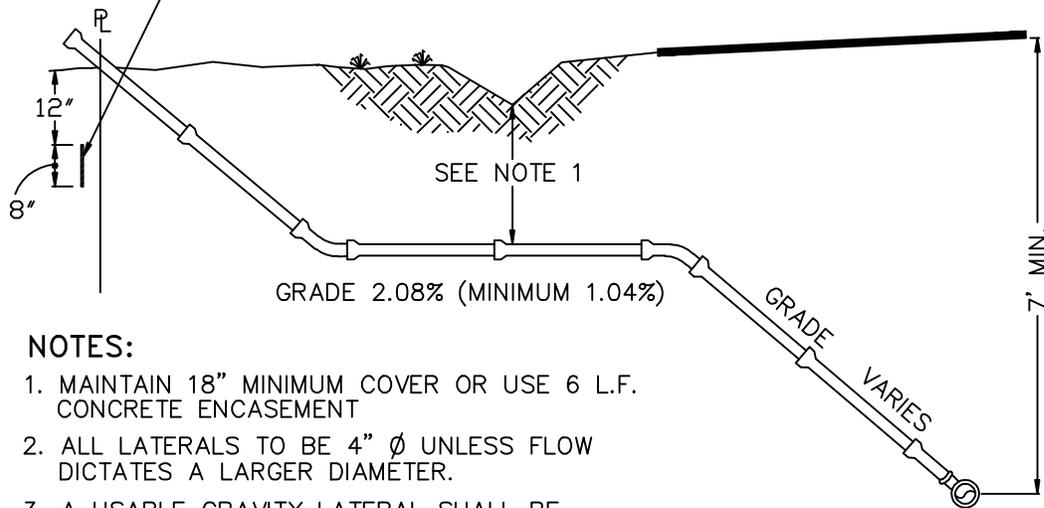
REV: 5/99

DETAIL



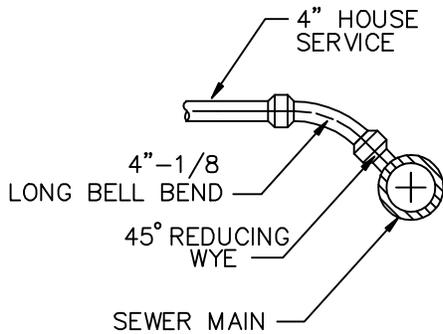
**WYE BRANCH (TYP.)**

1/2" THICK METAL REBAR  
ADJACENT TO EACH  
SERVICE CONNECTION

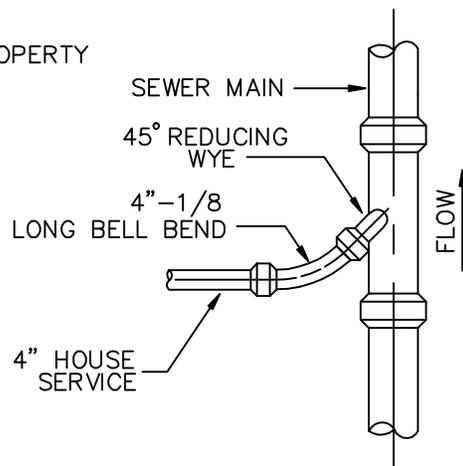


**NOTES:**

1. MAINTAIN 18" MINIMUM COVER OR USE 6 L.F. CONCRETE ENCASEMENT
2. ALL LATERALS TO BE 4" Ø UNLESS FLOW DICTATES A LARGER DIAMETER.
3. A USABLE GRAVITY LATERAL SHALL BE AVAILABLE TO EACH LOT UNLESS OTHERWISE INDICATED ON CONSTRUCTION PLANS.
4. A CLEAN OUT SHALL BE PROVIDED AT THE PROPERTY LINE FOR ALL 4-INCH AND 6-INCH LATERALS.



SECTION



PLAN



**TYPICAL LATERAL SEWER CONNECTION**

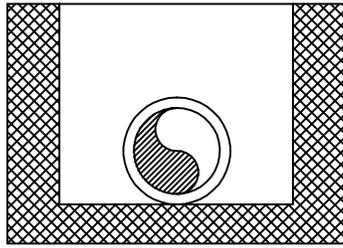
**D-7**

N.T.S.

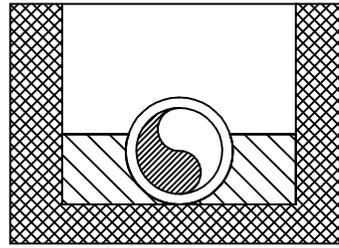
DATE: 9-26-95

REV: 5/99

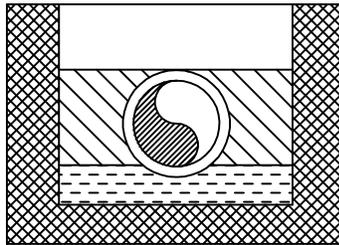
DETAIL



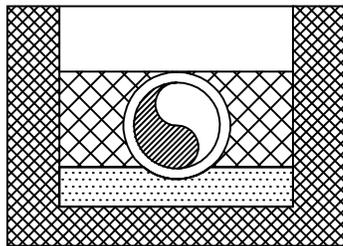
TYPE 1  
 FLAT-BOTTOM\* TRENCH, LOOSE EMBEDMENT  
 E = 50 psi (340 kPa). K = 0.110



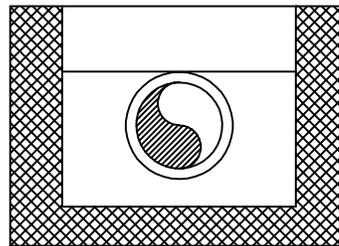
TYPE 2  
 FLAT-BOTTOM\* TRENCH, EMBEDMENT LIGHTLY  
 CONSOLIDATED TO CENTERLINE OF PIPE.  
 E = 200 psi (1,380 kPa). K = 0.110



TYPE 3  
 PIPE BEDDED ON 4" (100 mm) MINIMUM  
 OF LOOSE SOIL\*\* EMBEDMENT LIGHTLY  
 CONSOLIDATED TO TOP OF PIPE.  
 E = 400 psi (2,760 kPa). K = 0.102



TYPE 4  
 PIPE BEDDED ON SAND, GRAVEL OR CRUSHED  
 STONE TO DEPTH OF 1/8 PIPE DIAMETER, 4"  
 (100 mm) MINIMUM. EMBEDMENT COMPACTED  
 TO TOP OF PIPE. (APPROXIMATELY 80% STANDARD  
 PROCTOR. AASHTO T-99 OR ASTM D 698)  
 E = 1,000 psi (6,900 kPa). K = 0.096



TYPE 5  
 PIPE ENBEDDED IN COMPACTED GRANULAR  
 MATERIAL TO CENTERLINE OF PIPE. COMPACTED  
 GRANULAR OR SELECT MATERIAL TO TOP OF PIPE.  
 (APPROXIMATELY 90% STANDARD PROCTOR.  
 AASHTO T-99 OR ASTM D 698)  
 E = 2,000 psi (13,800 kPa). K = 0.083

NOTE: REQUIRED EMBEDMENT TYPE WILL DEPEND ON THE PIPE'S DIMENSION RATIO, INTERNAL OPERATING PRESSURE, AND EXTERNAL LOAD, AND SHALL BE SPECIFIED BY THE PURCHASER. (SEE SEC. 5.3)

\* "FLAT-BOTTOM" IS DEFINED AS UNDISTURBED EARTH.

\*\* "LOOSE SOIL" OR "SELECT MATERIAL" IS DEFINED AS NATIVE SOIL EXCAVATED FROM THE TRENCH, FREE OF ROCKS FOREIGN MATERIAL, AND FROZEN EARTH. A SOFT "LOOSE SOIL" BEDDING WILL CONTOUR TO THE PIPE BOTTOM. CAUTION MUST BE EXERCISED TO ENSURE PROPER PLACEMENT OF EMBEDMENT MATERIAL UNDER THE HAUNCHES OF THE PIPE.

From AWWA C.605  
 UNDERGROUND INSTALLATION OF PVC PIPE



# PIPE ENVELOPE REQUIREMENTS

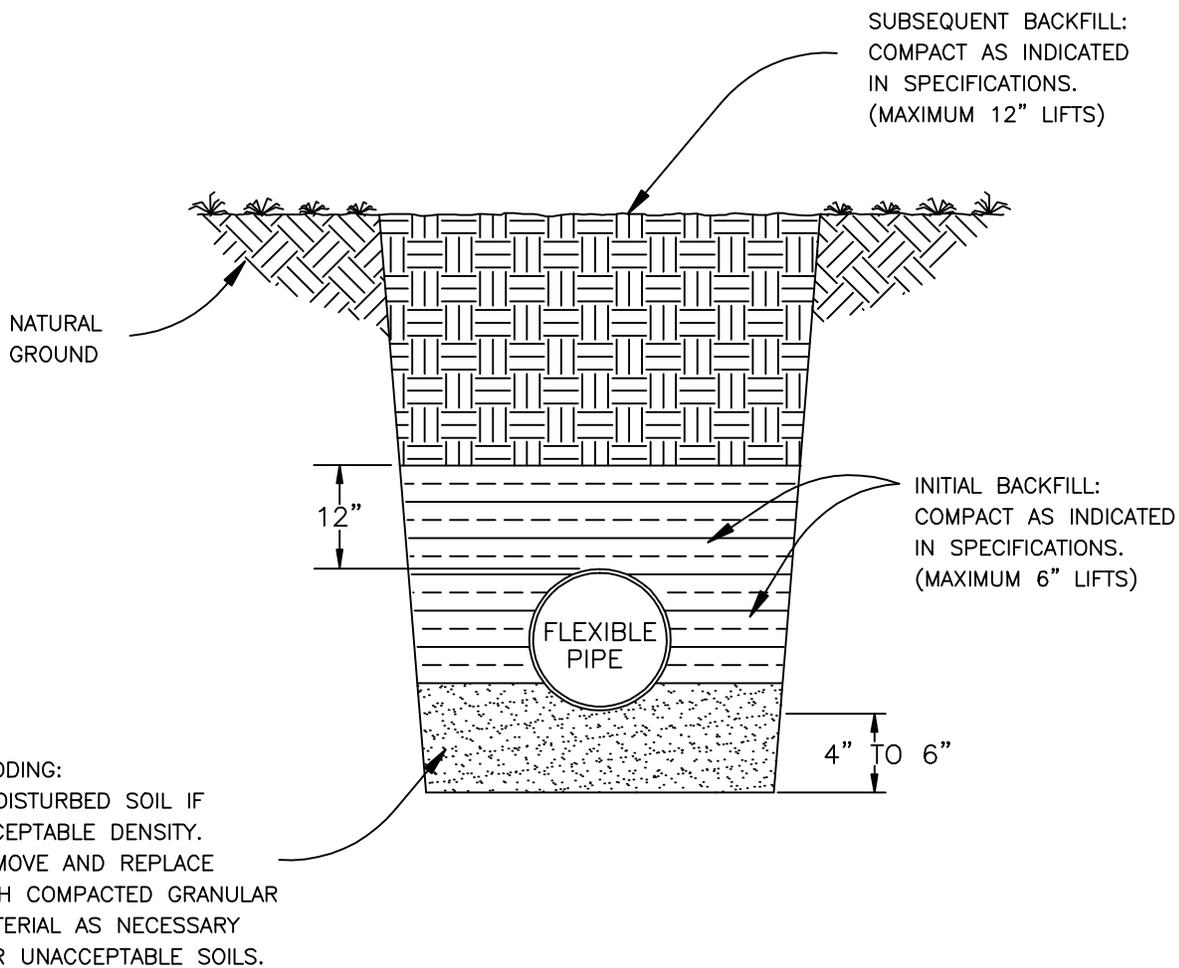
D-10

N.T.S.

DATE: 7-19-95

REV:

DETAIL



# FLEXIBLE PIPE BEDDING

D-11

DATE: 7-26-95

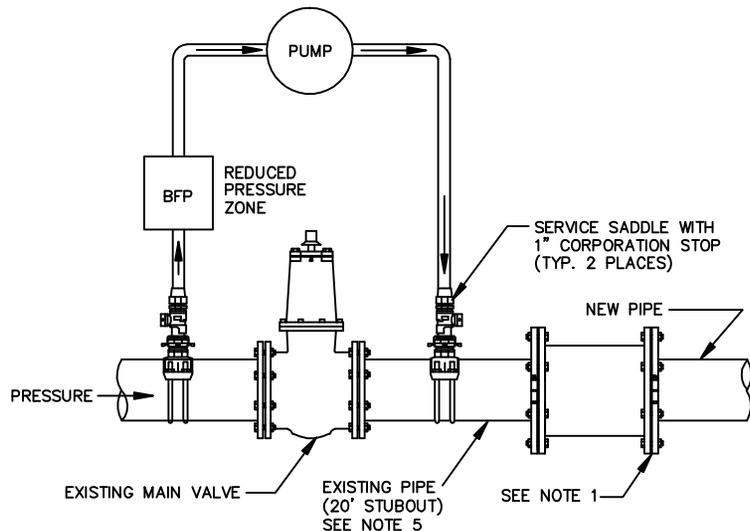
N.T.S.

REV:

DETAIL

NOTES:

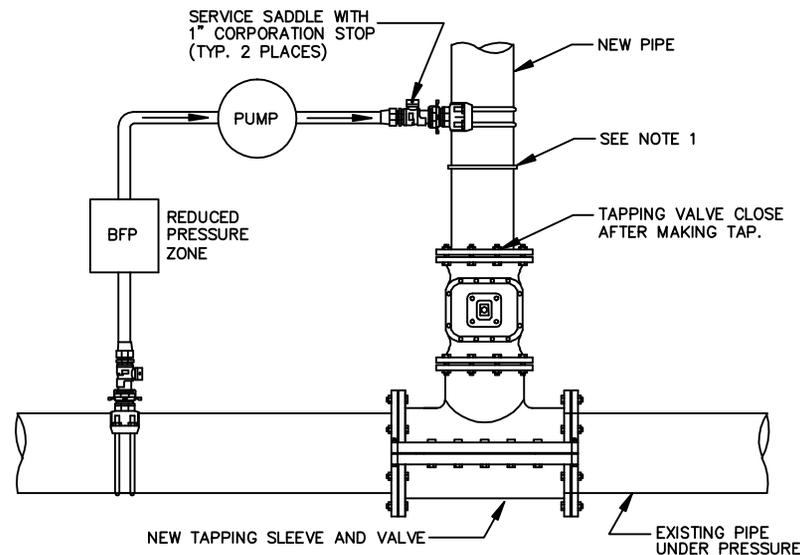
1. NEW PIPE SHALL BE CAPPED OR PLUGGED FOR PRESSURE TEST. ONCE TEST IS SATISFACTORILY COMPLETED NEW MAIN IS TO BE CONNECTED TO EXISTING MAIN IN A MANNER ACCEPTABLE TO E. C. U. A.
2. THE CONTRACTOR SHALL FLUSH LINE PRIOR TO STARTING THE CHLORINATION PROCEDURE. ALL FLUSHING SHALL BE DONE THROUGH THE EXISTING VALVE WITH ALL HYDRANTS AND SERVICE LINES OPEN. E.C.U.A. INSPECTOR SHALL BE THE ONLY PERSON ALLOWED TO OPERATE THE VALVE AND SHALL BE PRESENT DURING FLUSHING OPERATION. ONCE FLUSHING IS COMPLETE THE INSPECTOR SHALL CLOSE THE VALVE.
3. ONCE SATISFACTORY BACTERIOLOGICAL SAMPLES ARE OBTAINED THE CONTRACTOR SHALL CLOSE BOTH CORPORATION STOPS AND REMOVE SERVICE TUBING, PUMP AND BACK FLOW PREVENTER; CAP CORPORATION STOPS WITH BRASS CAPS.
4. CONTRACTOR SHALL FURNISH ALL MATERIALS, EQUIPMENT AND LABOR NECESSARY FOR FILLING, CHLORINATING AND TESTING PROCEDURES. CONTRACTOR SHALL PROVIDE SAMPLING TAPS AT THOSE LOCATIONS APPROVED BY THE E.C.U.A. INSPECTOR. E.C.U.A. SHALL COLLECT TEST SAMPLES.
5. IF 20' STUB OUT IS NOT PRESENT SPECIAL ARRANGEMENTS WILL HAVE TO BE MADE TO DEPRESSURIZE THE EXISTING MAIN TO MAKE CONNECTION TO THE EXISTING VALVE.



TYPICAL CONNECTION FOR NEW LINE FILLING, PRESSURE TESTING, FLUSHING AND CHLORINATION. (EXISTING STUBOUT)

NOTES:

1. NEW PIPE SHALL BE CAPPED OR PLUGGED FOR PRESSURE TEST. ONCE TEST IS SATISFACTORILY COMPLETED NEW MAIN IS TO BE CONNECTED TO TAPPING VALVE. TAPPING VALVE IS TO REMAIN CLOSED.
2. THE CONTRACTOR SHALL FLUSH LINE PRIOR TO STARTING THE CHLORINATION PROCEDURE. ALL FLUSHING SHALL BE DONE THROUGH THE TAPPING VALVE WITH ALL HYDRANTS AND SERVICE LINES OPEN. E.C.U.A. INSPECTOR SHALL BE THE ONLY PERSON ALLOWED TO OPERATE THE VALVE AND SHALL BE PRESENT DURING FLUSHING OPERATION. ONCE FLUSHING IS COMPLETE THE INSPECTOR SHALL CLOSE THE VALVE.
3. ONCE SATISFACTORY BACTERIOLOGICAL SAMPLES ARE OBTAINED THE CONTRACTOR SHALL CLOSE BOTH CORPORATION STOPS AND REMOVE SERVICE TUBING, PUMP AND BACK FLOW PREVENTER; CAP CORPORATION STOPS WITH BRASS CAPS.
4. CONTRACTOR SHALL FURNISH ALL MATERIALS, EQUIPMENT AND LABOR NECESSARY FOR FILLING, CHLORINATING AND TESTING PROCEDURES. CONTRACTOR SHALL PROVIDE SAMPLING TAPS AT THOSE LOCATIONS APPROVED BY THE E.C.U.A. INSPECTOR. E.C.U.A. SHALL COLLECT TEST SAMPLES.



TYPICAL CONNECTION FOR NEW LINE FILLING, PRESSURE TESTING, FLUSHING AND CHLORINATION. (TAPPING SLEEVE AND VALVE)



# TYPICAL DISINFECTION & CHLORINATION

N.T.S.

D-12

DATE: 7-19-95

REV:

DETAIL

## CHLORINE REQUIRED FOR STERILIZATION

PIPE SIZE	SPECIFICATION	I.D. INCHES	GALLS/100'	CHLORINE REQUIRED PER 100' FOR 25ppm	CHLORINE REQUIRED PER 100' FOR 50ppm
2'	D2241 DR26	2.193	20	0.10 oz.	0.20 oz.
3"	D2241 DR26	3.230	43	0.22 oz.	0.44 oz.
4"	C-900 DR18	4.230	73	0.37 oz.	0.75 oz.
	C-900 DR25	4.390	79	0.40 oz.	0.81 oz.
6"	C-900 DR18	6.090	151	0.78 oz.	1.55 oz.
	C-900 DR25	6.300	162	0.83 oz.	1.66 oz.
8"	C-900 DR18	7.980	260	1.33 oz.	2.67 oz.
	C-900 DR25	8.280	280	1.44 oz.	2.87 oz.
12"	C-900 DR18	11.650	554	2.84 oz.	5.69 oz.
	C-900 DR25	12.080	595	3.06 oz.	6.12 oz.
16"	C-905 DR18	15.470	977	5.01 oz.	10.03 oz.
	C-905 DR25	16.010	1,046	5.37 oz.	10.74 oz.
20"	C-905 DR18	19.200	1,504	7.72 oz.	15.45 oz.
	C-905 DR25	19.870	1,611	8.27 oz.	16.55 oz.
24"	C-905 DR18	N/A	N/A	N/A	N/A
	C-905 DR25	23.742	2,300	11.81 oz.	23.62 oz.

- NOTE :
- 16", 20" AND 24" PIPE SIZES ARE C.I.O.D.
  - FOR HTH WITH 65% AVAILABLE CHLORINE
  - 1 US GALLON WEIGHS 8.345 #
  - APPROX. 1 oz./100 gal FOR 50 ppm
  - APPROX. 0.5 oz./100 gal FOR 25 ppm



## CHLORINE REQUIRED FOR STERILIZATION

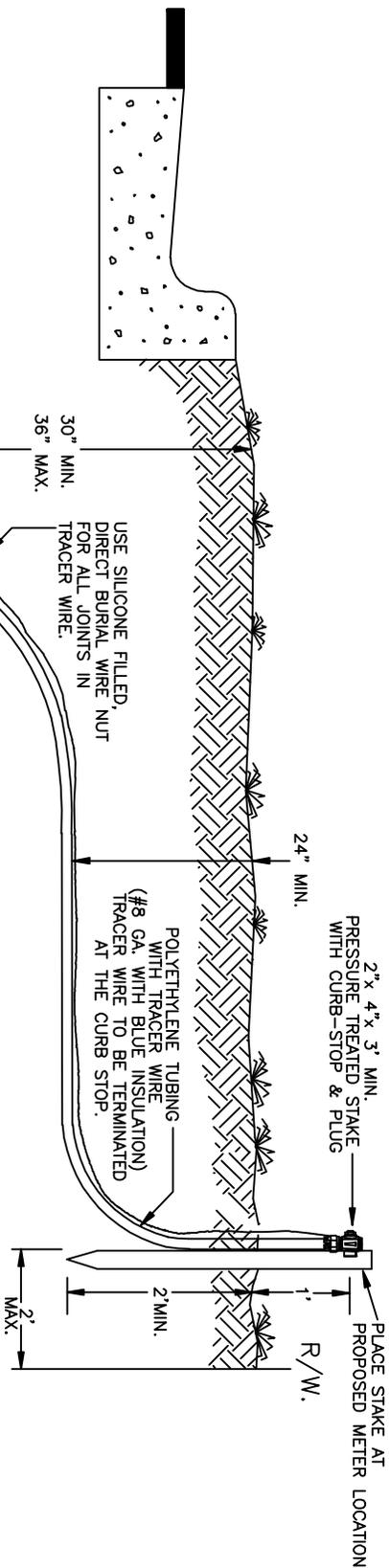
D-13

N.T.S.

DATE: 7-26-95

REV:

DETAIL



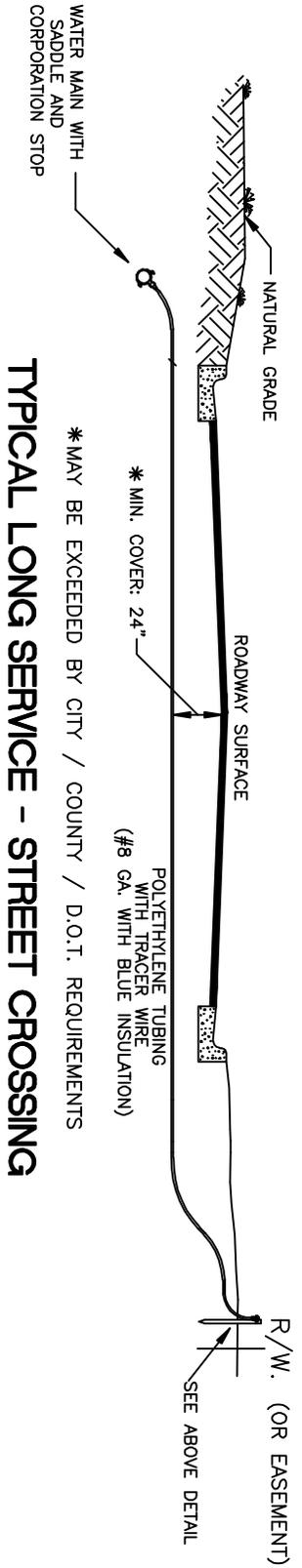
**RECOMMENDED TUBING SIZE FOR WATER SERVICES**

SIZE OF METER	DESIGN FLOW (GPM)	MAX. PRESSURE LOSS (PSI)	MAX. LENGTH OF TUBING FOR SIZE INDICATED		
			1"	1 1/2"	2"
5/8"	20	10	92	661	2679
1"	50	10	17	121	492
1 1/2"	100	10		34	136
2"	160	10			57

**TYPICAL SHORT SERVICE**

- SERVICES LINES TO BE TERMINATED WITHIN 2 FEET OF THE R/W LINE BUT NOT UNDER ANY SIDEWALK.  
 - EACH SERVICE TO BE LOCATED CENTRALLY ON THE LOT.

REFER TO SECTIONS 556 & 2556 OF ECUA'S ENGINEERING MANUAL FOR FURTHER INFO.



**TYPICAL LONG SERVICE - STREET CROSSING**

\* MAY BE EXCEEDED BY CITY / COUNTY / D.O.I. REQUIREMENTS



**TYPICAL WATER SERVICE INSTALLATION**

N.T.S.

DATE: 8-16-95

REV: 5/99

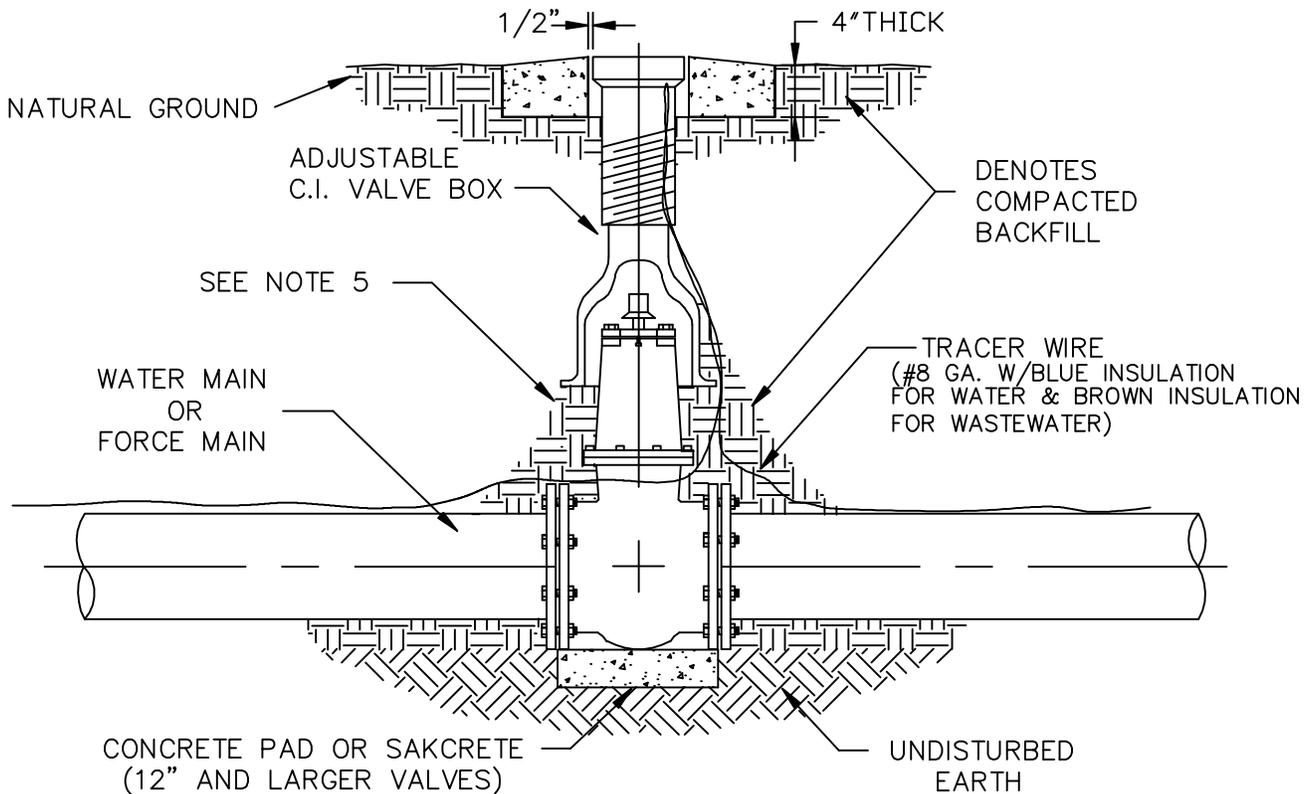
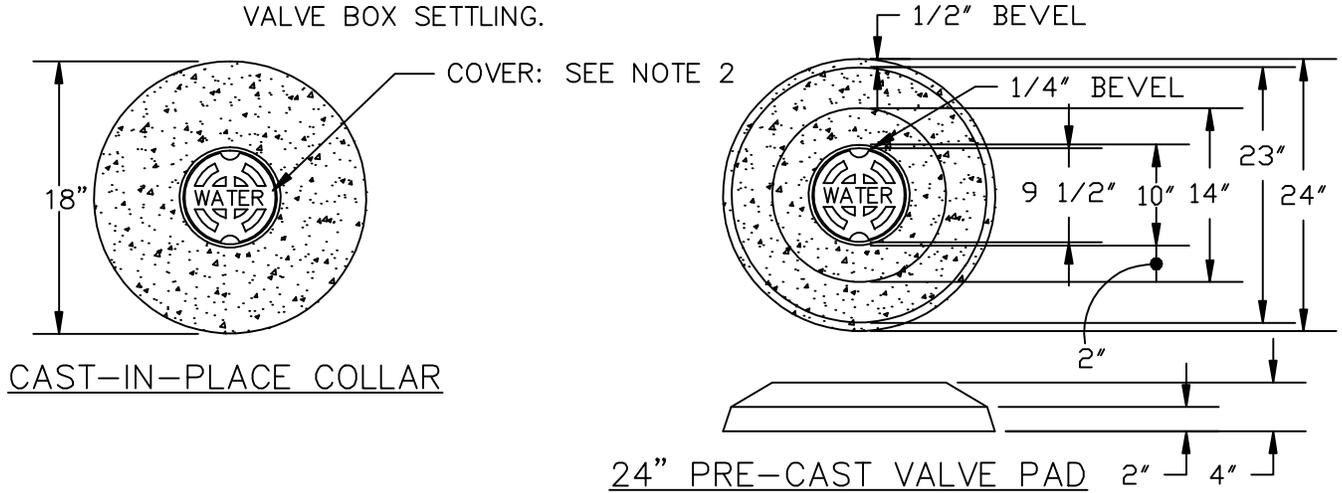
D-21

DETAIL



NOTES:

1. VALVE BOX AND BOOT SHALL BE CAST IRON.
2. VALVE COVER SHALL BE MARKED "WATER".  
OR "SEWER" AS APPLICABLE.
3. VALVE BOX TOP SHALL BE FLUSH WITH FINISHED GRADE OR 1/2" ABOVE NATURAL GROUND LEVEL.
4. GATE VALVE SHALL BE RESILIENT SEAT WITH MECHANICAL JOINT ENDS OR APPROVED EQUIVALENT.
5. EARTH UNDER FLANGE OF VALVE BOX & COLLAR TO BE FIRM AND WELL TAMPED TO ENSURE AGAINST VALVE BOX SETTLING.



TYPICAL VALVE & BOX INSTALLATION

D-34

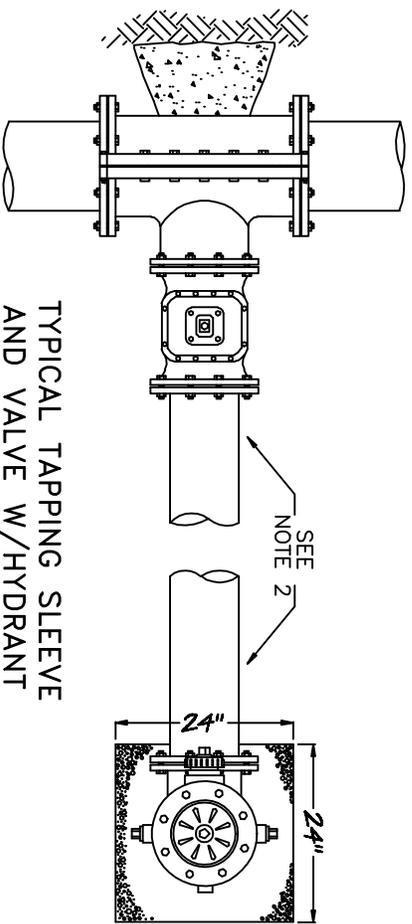


DATE: 7-26-95

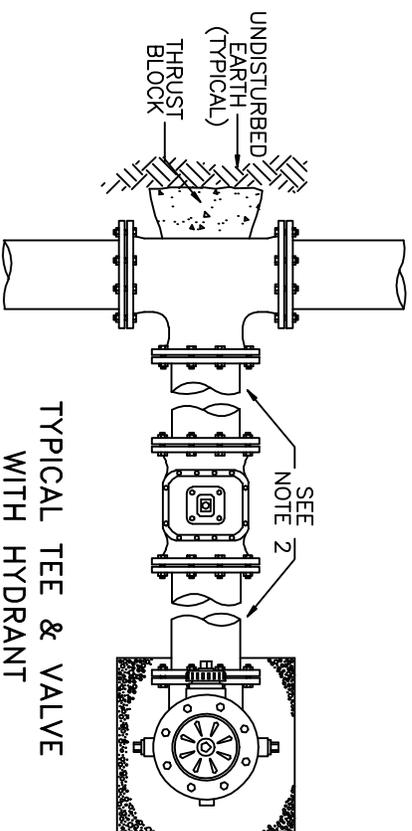
N.T.S.

REV: 5/99

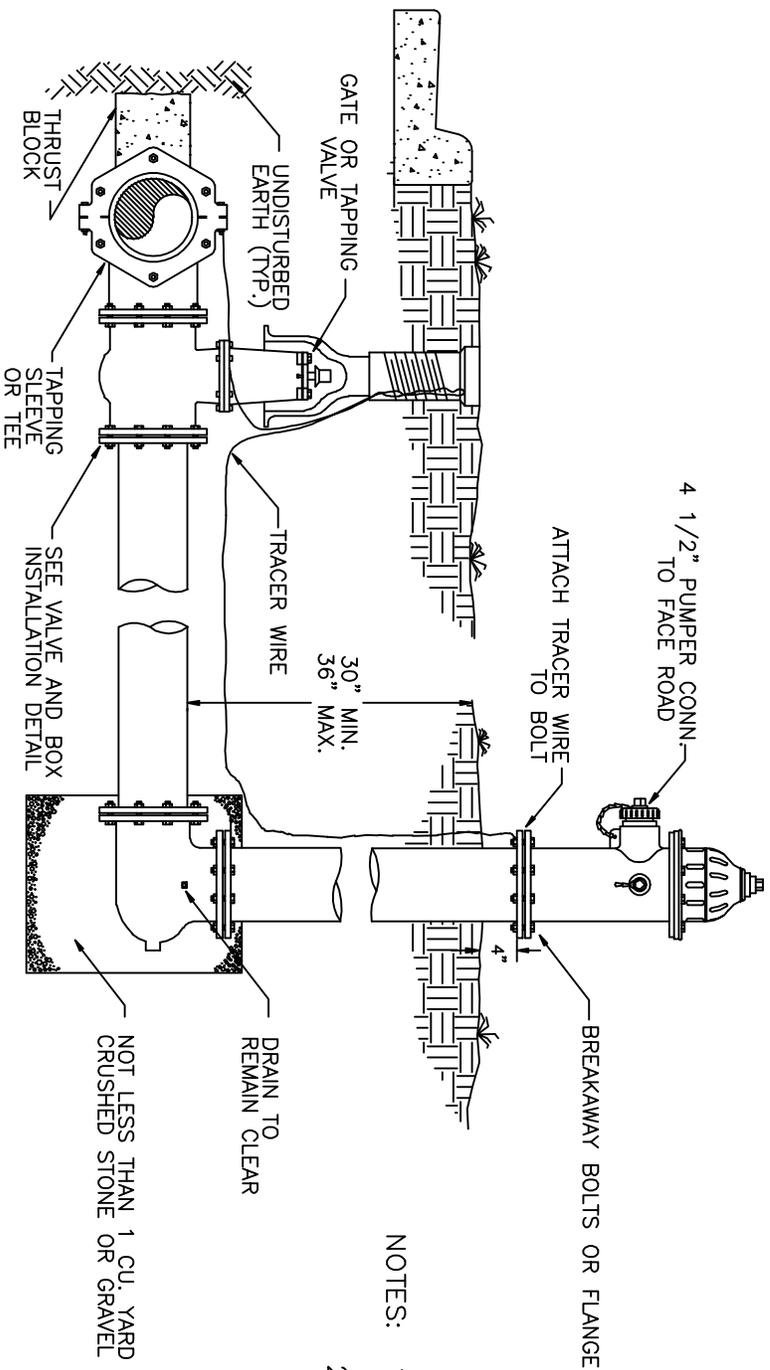
DETAIL



TYPICAL TAPPING SLEEVE AND VALVE W/HYDRANT



TYPICAL TEE & VALVE WITH HYDRANT



- NOTES:
1. CONTRACTOR TO ADJUST FIRE HYDRANT TO FINISHED GRADE.
  2. HYDRANT CONNECTORS OR D.I.P. SPOOLS WITH MEGALUG JOINT RESTRAINTS OR APPROVED EQUAL.

4" BREAKAWAY BOLTS OR FLANGE

4 1/2" PUMPER CONN. TO FACE ROAD

ATTACH TRACER WIRE TO BOLT

30" MIN. 36" MAX.

TRACER WIRE

DRAIN TO REMAIN CLEAR

NOT LESS THAN 1 CU. YARD OF CRUSHED STONE OR GRAVEL



# TYPICAL FIRE HYDRANT INSTALLATION:

## TAPPING SLEEVE & VALVE and TEE CONNECTION

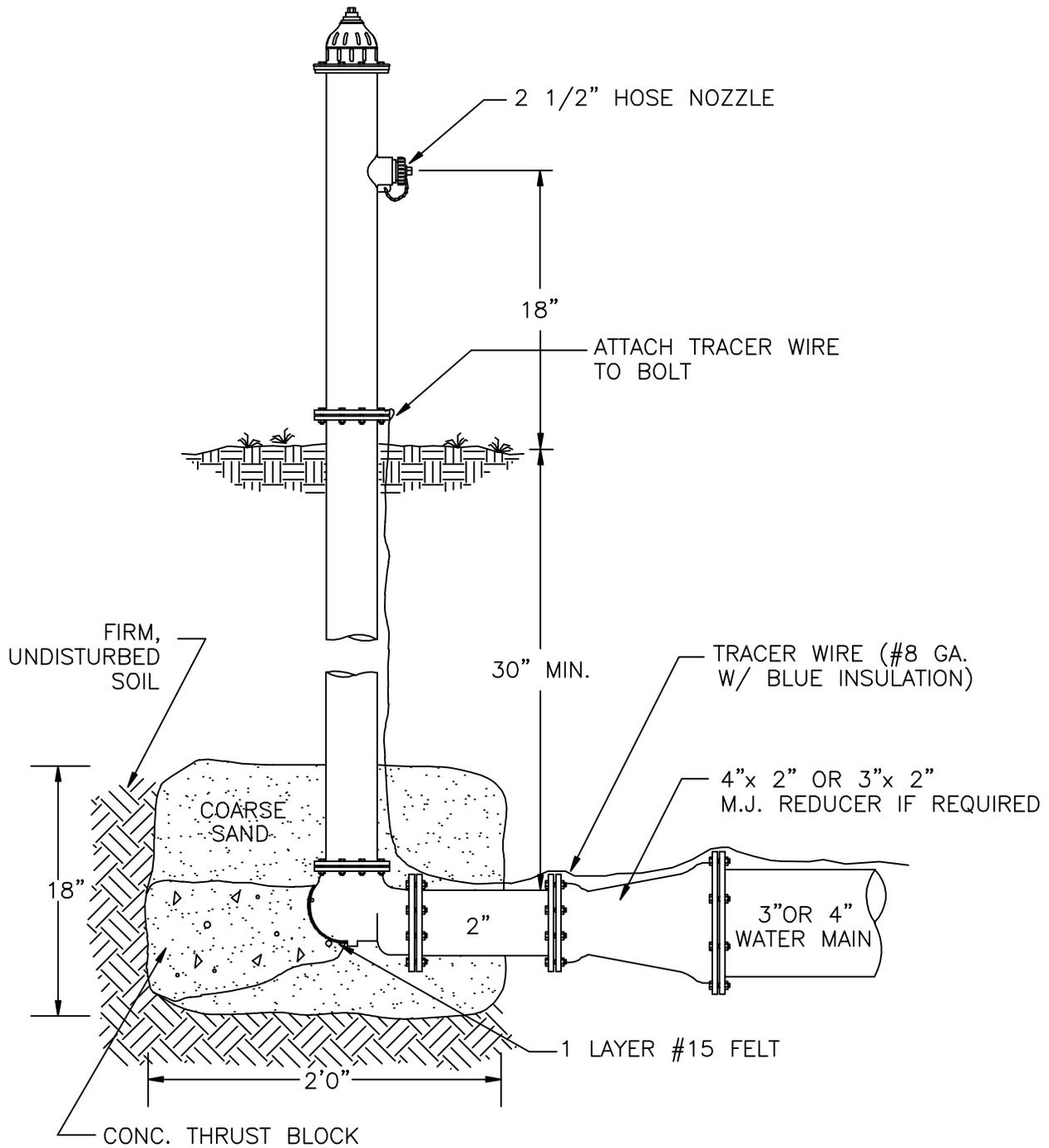
DATE: 8-16-95

N.T.S.

REV: 6/99

D-35

DETAIL



# TYPICAL 2" FLUSH HYDRANT

N.T.S.

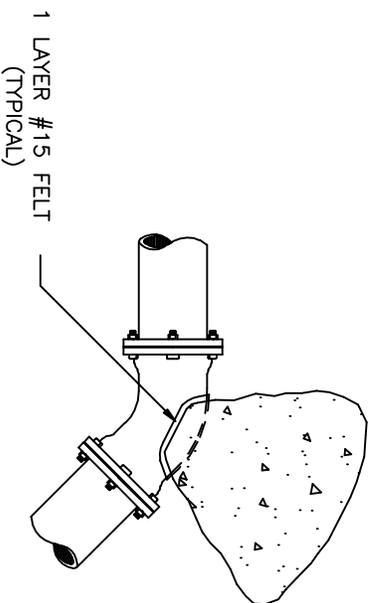
D-41



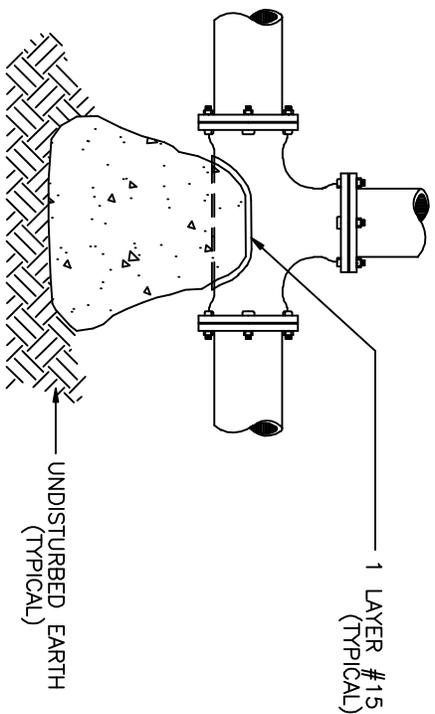
DATE: 8-09-95

REV:

DETAIL



45° BEND — M.J.



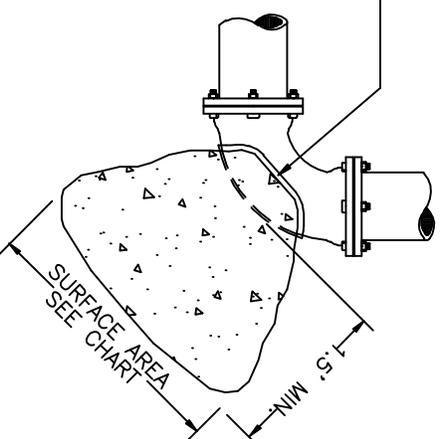
TEE — M.J.

FITTING PIPE SIZE	DEAD END OR TEE	90° BEND	45° BEND	22.5° BEND
4"	1' X 2'	1.5' X 1.5'	1' X 1.5'	1' X 1'
6"	2' X 2'	2.5' X 2.5'	2' X 1.5'	1' X 1.5'
8"	2.25' X 3'	3' X 3'	2' X 2.5'	1.5' X 1.5'
10"	3.5' X 3'	4' X 3.75'	2.75' X 3'	2' X 2'
12"	4' X 4'	4' X 5'	3' X 4'	2' X 3'
16"	5' X 5.5'	6' X 6.5'	4' X 5'	3' X 3.5'

MINIMUM THRUST BLOCK DIMENSIONS:  
SURFACE AREA AGAINST UNDISTURBED SOIL

NOTES:

1. ONE LAYER OF #15 FELT TO BE USED TO PREVENT ADHESION OF CONCRETE TO FITTING.
2. ALL THRUST BLOCKS TO BE BACKED BY UNDISTURBED SOIL
3. THRUST BLOCK DIMENSIONS BASED ON SM SOIL CLASSIFICATION
4. CONCRETE MIN. 2,500 PSI.
5. JOINT RESTRAINTS ARE TO BE USED ON ALL FITTINGS, TRUST BLOCKS REQUIRED ON 90° BENDS, 45° BENDS, TEES, TAPPING SLEEVES, AND DEAD ENDS.



90° BEND — M.J.



TYPICAL THRUST BLOCK INSTALLATIONS

DATE: 7-28-95

N.T.S.

REV: 6/99

DETAIL

D-43

## PIPE JOINT RESTRAINT TABULATION

SHOWING DISTANCES IN FEET FROM THE FITTING TO BE RESTRAINED TO THE LAST RESTRAINING GLAND REQUIRED

PIPE SIZE AND TYPE	HORIZONTAL BENDS				DEAD ENDS	EQUAL TEES See note 3
	90 Deg.	45 Deg.	22.5 Deg.	11.25 Deg.		
3" DI	18	8	4	2	33	1
4" DI	22	9	4	2	39	1
6" DI	31	13	6	3	55	1
8" DI	40	17	8	4	72	1
10" DI	48	20	9	5	86	1
12" DI	56	23	11	5	101	1
16" DI	70	29	14	7	129	1
20" DI	84	35	17	8	156	18
24" DI	96	40	19	9	181	41
4" PVC	28	12	6	3	62	1
6" PVC	39	16	8	4	87	1
8" PVC	50	21	10	5	114	1
10" PVC	60	25	12	6	136	1
12" PVC	70	29	14	7	160	1
16" PVC	88	36	17	9	205	1
20" PVC	105	43	21	10	247	29
24" PVC	120	50	24	12	287	64

- NOTES :
1. Test pressure = 150 psi, soil group = SM, trench type = 3, depth = 2.5', safety factor = 2
  2. Restrained lengths for vertical offsets, reducers & unequal size tees must be individually calculated.
  3. With equal tees, the distances shown are with a run length of 40' as an example only. For other lengths and for unequal tees, individual calculations must be made.



# PIPE JOINT RESTRAINT TABULATION

D-44

DATE: 7-28-95

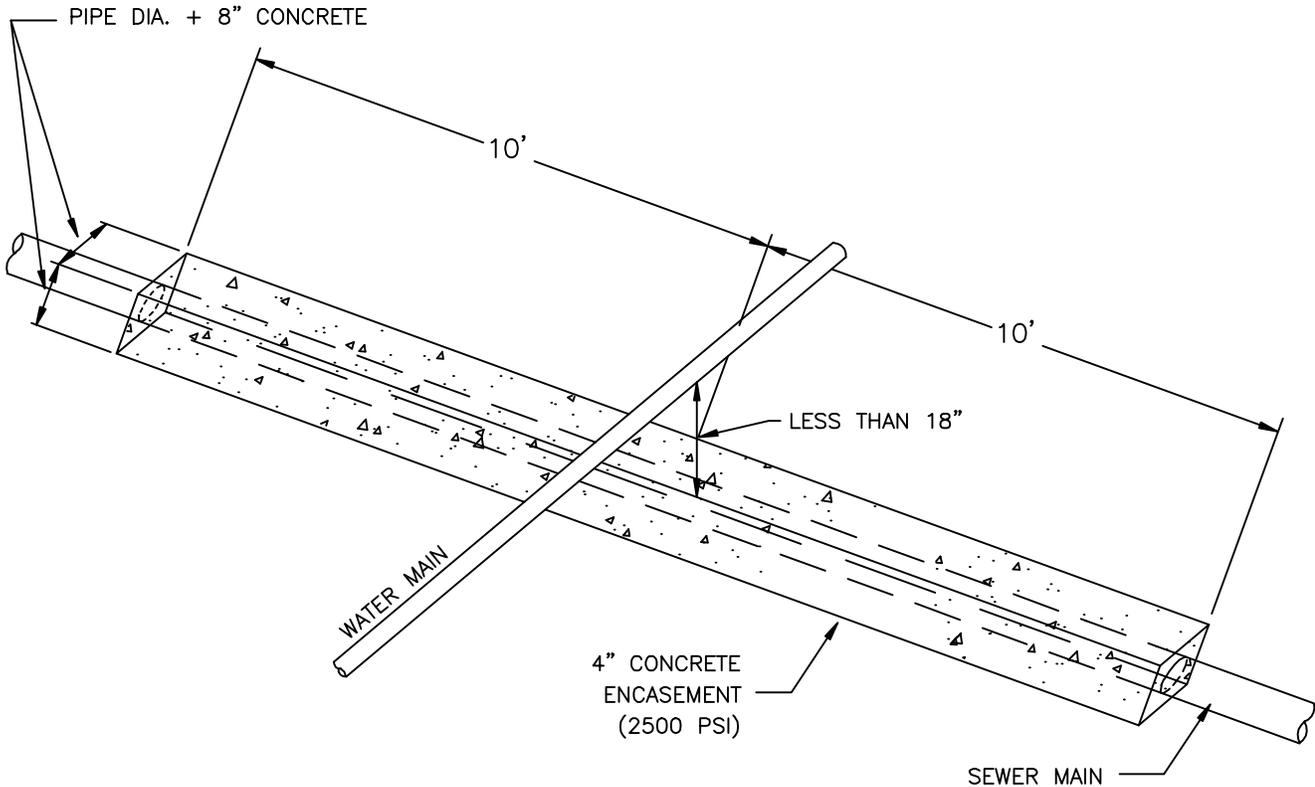
N.T.S.

REV:

DETAIL

SANITARY SEWER LINES (GRAVITY OR PRESSURE) SHALL HAVE 18" OR GREATER VERTICAL CLEARANCE BELOW ANY POTABLE WATER LINE WHEN CROSSING. A MINIMUM OF 6" VERTICAL CLEARANCE IS REQUIRED FOR OTHER UTILITIES. HORIZONTAL CLEARANCE BETWEEN SANITARY SEWER LINE THAT IS PARALLEL TO AND LESS THAN 18" BELOW A POTABLE WATER LINE SHALL BE 10' OR GREATER. A MINIMUM OF 30" IS REQUIRED FOR OTHER UTILITIES.

IF THIS IS NOT POSSIBLE OR PRACTICAL, SEE NOTES BELOW:



FOR CROSSING: ENCASE AS ABOVE SO THAT THE ENDS OF ENCASEMENT ARE AT LEAST 12' FROM ANY WATER LINE JOINT. WATER LINE JOINT MUST NOT BE CLOSER THAN 5' TO THE POINT OF CROSSING, OR IT MUST ALSO BE ENCASED.

ALTERNATE 1: USE EQUALLY (OR HIGHER) RATED PRESSURE PIPE FOR SEWER WITH NO JOINTS CLOSER THAN 12' APART AND 6" VERTICAL.

ALTERNATE 2: PLACE SEWER LINE INTO STEEL CASING AND CENTER 20' PIECE WITH 4' VERTICAL CLEARANCE AND SEAL ENDS.

FOR PARALLEL: AND 6' TO 10' APART USE ALTERNATE 2, BUT IF MORE THAN 40' IN LENGTH, ALTERNATE 1 MUST BE USED AND JOINTS ARE TO BE STAGGERED. IF LINES MUST BE 3' TO 6' APART, ALTERNATE 1 MUST BE USED WITH A HIGHER RATED PRESSURE PIPE FOR SEWER (i.e., WATER LINE IS DR25 THEN USE DR18 OR 21 FOR SEWER).



## SEWER / WATER SEPARATION & CLEARANCES

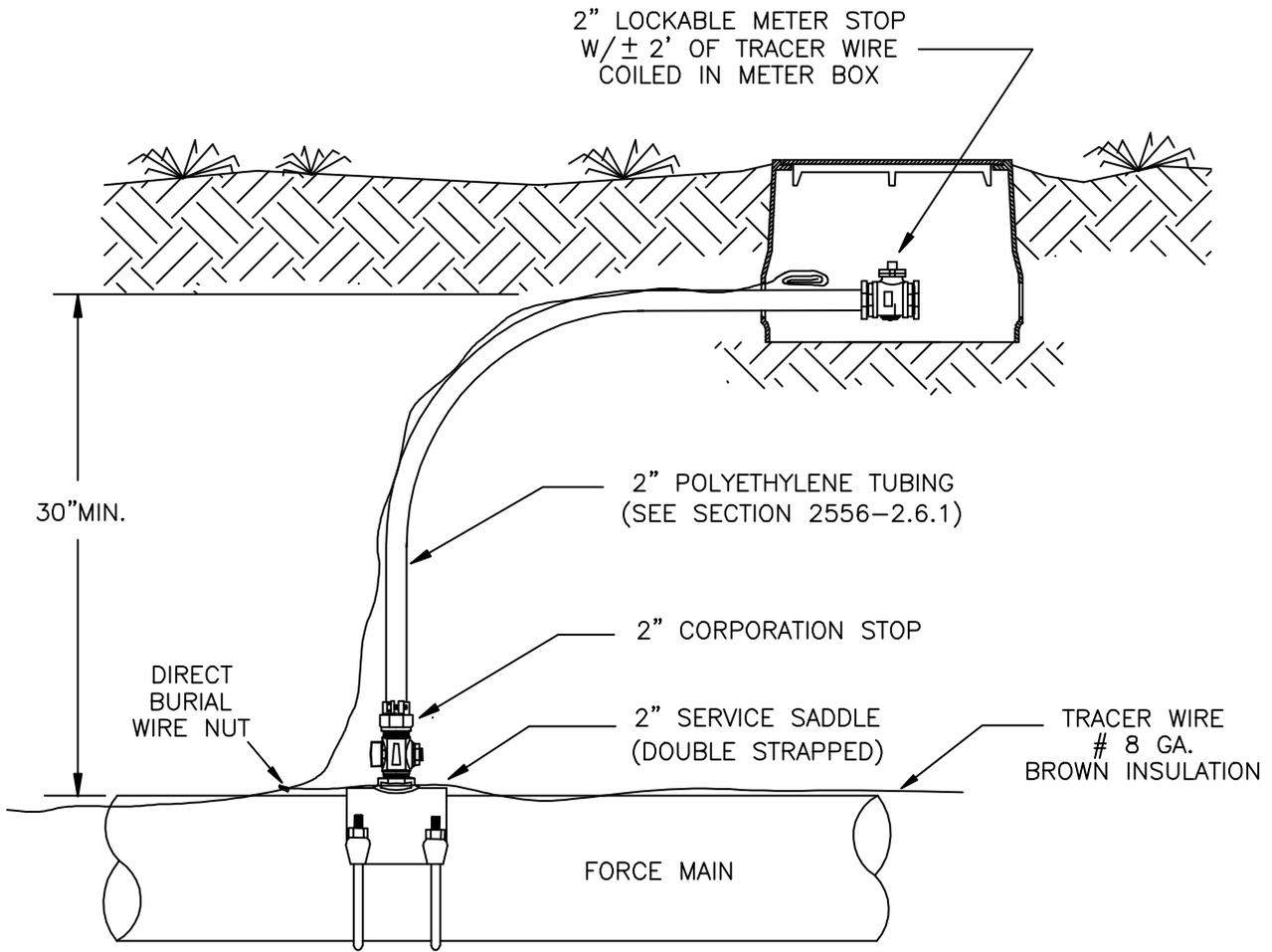
D-56

DATE: 7-19-95

N.T.S.

REV:

DETAIL



NOTE:  
 USE OF MANUAL ARV REQUIRES E.C.U.A. APPROVAL.

# AIR RELEASE VALVE

N.T.S.

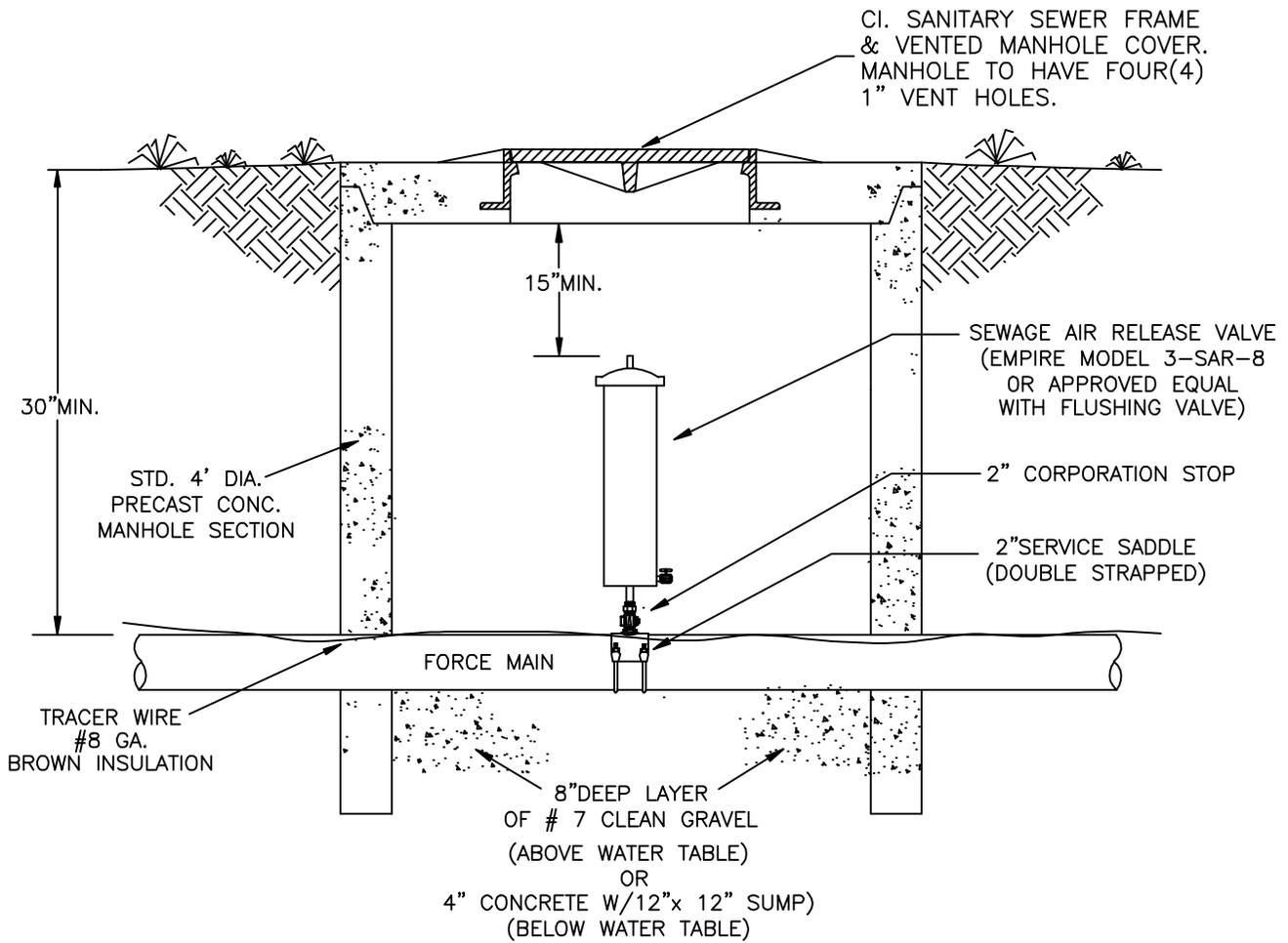
D-60



DATE: 9-8-95

REV: 6/99

DETAIL



# AUTOMATIC AIR RELEASE VALVE

D-61

N.T.S.

DATE: 9-8-95

REV: 6-1-99

DETAIL