

La Plata West Water Authority

RAW WATER PROJECT

CONTRACT 1: Raw Water Pumping Facilities and Pipeline

CONTRACT 2: Underwater Installation of Intake Screen(s)

CONTRACT 3: Lake Durango Treated Water Pipeline

ADDENDUM NO. 2

November 25, 2015

TO ALL BIDDERS:

Contractors submitting proposals for the above referenced project shall take note of the following changes, additions, deletions, clarifications, etc. to the Plans and Specifications which shall become a part of and have precedence over anything shown or described in the Contract Documents and shall be taken into consideration and be included with Contract Documents for the referenced project.

NOTE: Bidders must acknowledge receipt of Addenda on the first page of Document C-410 BID FORM and sign below and attach this sheet to the bid submittal.

Company

BARTLETT & WEST, INC.



Signature

Jeff Shamburg, P.E.

GENERAL CLARIFICATIONS

- A. The BID DATE is being postponed until December 17, 2015, same time and place.

DRAWINGS

- A. Replace sheets C144, C158, C159, D105, D106, D107, D108, and D109 with the attached sheets.

TECHNICAL SPECIFICATIONS

A. C-111

- 1. Delete this section in its entirety and replace it with Document C-111 with a date of 11/25/15 in the footer, attached to this addendum.

B. C-410 – Contract #1

- 1. Delete this section in its entirety and replace with Document C-410 with date of 11/25/15 in the footer, attached to this addendum.

C. Section 400513

- 1. Delete this section in its entirety and add Section 400513 attached to this addendum.

D. Section 432150

- 1. Delete this section in its entirety and add Section 432150 attached to this addendum.

**La Plata West Water Authority
Lake Durango Water Authority
La Plata County, Colorado
Raw Water Project**

ADVERTISEMENT FOR BIDS

Sealed Bids for the construction of the Raw Water Project will be received, by La Plata West Water Authority and Lake Durango Water Authority, at the office of Bartlett & West, Inc., 1199 Main Ave., Suite 209, Durango, Colorado 81301, until 2:00 PM local time on December 17, 2015, at which time the Bids received will be publicly opened and read. The Project consists of constructing an Intake Pumping Station, Booster Pump Station, Water Intake Screen(s), raw water pipeline and appurtenances, treated water pipeline and appurtenances, and other associated Work.

Bids will be received for a three Contracts:

Contract 1: Raw Water Pumping Facilities and Pipeline

Contract 2: Underwater Installation of Cylindrical Water Intake Screen(s)

Contract 3: Lake Durango Treated Water Pipeline

Bids shall be on a lump sum and unit price basis, with alternate bid items as indicated in the Bid Form.

The Issuing Office for the Bidding Documents is:

Bartlett & West, Inc.

1199 Main Ave., Suite 209

Durango, CO 81301

(970) 306-0924

Jeffrey Shamburg, PE

jeff.shamburg@bartwest.com

Prospective Bidders may examine the Bidding Documents at the Issuing Office on Mondays through Fridays between the hours of 9:00 AM – 4:00 PM, and may obtain copies of the Bidding Documents from the Issuing Office as described below.

Bidding Documents may be viewed and ordered online by registering with the Issuing Office at their website (<http://www.bartwest.com>, follow “Bid Documents” link). Following registration and payment of \$40 download fee, complete sets of Bidding Documents may be downloaded from the Issuing Office’s website as “zipped” portable document format (PDF) files. The cost of printed Bidding Documents, including shipping from the Issuing Office is \$400 for Contract 1 and Contract 3 documents and \$40 for Contract 2 documents. Cost of Bidding Documents and shipping is non-refundable. The date that the Bidding Documents are transmitted by the Issuing Office will be considered the Bidder’s date of receipt of the Bidding Documents. Partial sets of the Bidding Documents will not be available from the Issuing Office.

A pre-bid conference will be held at 10:00 AM local time on November 10, 2015 at La Plata Electric Association, 45 Stewart St., Durango, Colorado. Attendance at the pre-bid conference is highly encouraged but is not mandatory.

Bid security shall be furnished in accordance with the Instructions to Bidders.

Owner: La Plata West Water Authority (Contracts 1 & 2), Lake Durango Water Authority
(Contract 3)

By: Roy Horvath

Title: President, LPWWA

Date: ~~October 30, 2015~~ November 25, 2015

+ + END OF ADVERTISEMENT FOR BIDS + +

BID FORM FOR CONSTRUCTION CONTRACTS

Prepared by



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BID FORM

Contract 1: Raw Water Pumping Facilities and Pipeline

Raw Water Project

La Plata West Water Authority

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ARTICLE 1 – BID RECIPIENT

- 1.01 This Bid is submitted to:

Bartlett & West, Inc.

c/o La Plata West Water Authority

1199 Main Ave, Suite 209

Durango, CO 81301

- 1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

- 2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

- 3.01 In submitting this Bid, Bidder represents that:

- A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

<u>Addendum No.</u>	<u>Addendum, Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

- B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

- 5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Bid Package 1: Intake Pump Station

Base Bid Item 1: Intake Pump Station	\$
Bid Item 2: Sitework and Yard Piping	\$
Bid Item 3: Instrumentation and Control	\$
Alternate 1 Add: Air Burst System	\$
Alternate 2 Add: Bridge Crane	\$

Total of All Lump Sums \$ _____

Bid Package 2: Booster Pump Station

Base Bid Item 1: Booster Pump Station	\$
Bid Item 2: Sitework and Yard Piping	\$
Bid Item 3: Instrumentation and Control	\$
Alternate 1 Deduct: Alternate Pump Configuration 1	\$
Alternate 2 Deduct: Alternate Pump Configuration 2	\$
Alternate 3 Add: Extended Performance Test	\$

Total of All Lump Sums \$ _____

Bid Package 3: 210 Pipeline and Access Road**UNIT PRICE BID**

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
1	Unclassified Excavation	CF	7,800		
2	Rock Excavation	CY	2,000		
3	Roadway Sub-Base	CY	1,800		
4	Roadway Base	CY	870		
5	18" Storm Sewer Culvert Pipe	LF	201		
6	24" Storm Sewer Culvert Pipe	LF	29		
7	30" Ductile Iron Pipe	LF	4,000		
8	30" 11 1/4° Bend	EA	3		
9	30" 22 1/2° Bend	EA	8		
10	30" 45° Bend	EA	6		
11	Air/Vacuum Valve	EA	1		
12	Pig Retrieval Manhole	EA	1		
13	Electric Trenching and Backfill	LF	4,150		
Total of All Unit Price Bid Items					\$
A1	Alternate Add Minimum Bury Depth – 60"	LF	4,000		

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Bid Package 4: 125 Pipeline**UNIT PRICE BID**

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
1	8" CL 235 AWWA C-900 PVC Pipe	LF	8,975		
2	8" CL 165 AWWA C-900 PVC Pipe	LF	3,045		
3	8" CL 235 AWWA C-900 RJ PVC Pipe	LF	300		
4	Rock Excavation	CY	356		
5	NOT USED				
6	8" 11 1/4° Bend and Block	EA	4		
7	8" 11 1/4° Vertical Bend and Block	EA	6		
8	8" 22 1/2° Bend and Block	EA	5		
9	8" 22 1/2° Vertical Bend and Block	EA	1		
10	8" 45° Bend and Block	EA	2		
11	8" 90° Bend and Block	EA	2		
12	8" 90° Vertical Bend and Block	EA	1		
13	8" Gate Valve, Buried	EA	1		
14	8" Type 2 Road Crossing	EA	2		
15	8" Low Point Drain	EA	11		
16	Air/Vacuum Valve	EA	4		
17	Remove and Replace Gravel Surface	SY	270		
18	Remove and Replace Asphaltic Concrete Pavement	SY	73		
19	High Pressure Gas Main Crossing	LS	1		
Total of All Unit Price Bid Items					\$

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
A1.1	10" CL 235 AWWA C-900 PVC Pipe	LF	3,100		
A1.2	10" CL 165 AWWA C-900 PVC Pipe	LF	8,920		
A1.3	10" CL 235 AWWA C-900 RJ PVC Pipe	LF	300		
A1.4	Rock Excavation	CY	378		
A1.5	NOT USED				
A1.6	10" 11 1/4° Bend and Block	EA	4		
A1.7	10" 11 1/4° Bend and Block	EA	6		
A1.8	10" 22 1/2° Bend and Block	EA	5		
A1.9	10" 22 1/2° Vertical Bend and Block	EA	1		
A1.10	10" 45° Bend and Block	EA	2		
A1.11	10" 90° Bend and Block	EA	2		
A1.12	10" 90° Vertical Bend and Block	EA	1		
A1.13	10" Buried Gate Valve	EA	1		
A1.14	10" Type 2 Road Crossing	EA	2		
A1.15	10" Low Point Drain	EA	11		
A1.16	Air/Vacuum Valve	EA	4		
A1.17	Remove and Replace Gravel Surface	SY	270		
A1.18	Remove and Replace Asphaltic Concrete Pavement	SY	73		
A1.19	High Pressure Gas Main Crossing	LS	1		
Total of All Alternate 1 Unit Price Bid Items					\$

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
A2.1	16" CL 235 AWWA C-900 PVC Pipe	LF	12,020		
A2.2	16" CL 235 AWWA C-900 RJ PVC Pipe	LF	300		
A2.3	Rock Excavation	CY	444		
A2.4	NOT USED				
A2.5	16" 11 1/4° Bend and Block	EA	4		
A2.6	16" 11 1/4° Bend and Block	EA	6		
A2.7	16" 22 1/2° Bend and Block	EA	5		
A2.8	16" 22 1/2° Vertical Bend and Block	EA	1		
A2.9	16" 45° Bend and Block	EA	2		
A2.10	16" 90° Bend and Block	EA	2		
A2.11	16" 90° Vertical Bend and Block	EA	1		
A2.12	16" Buried Gate Valve	EA	1		
A2.13	16" Type 2 Road Crossing	EA	2		
A2.14	16" Low Point Drain	EA	11		
A2.15	Air/Vacuum Valve	EA	4		
A2.16	Remove and Replace Gravel Surface	SY	270		
A2.17	Remove and Replace Asphaltic Concrete Pavement	SY	73		
A2.18	16" Tee and Cap Assembly	EA	1		
A2.19	High Pressure Gas Main Crossing	LS	1		
Total of All Alternate 2 Unit Price Bid Items					\$

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
A2.21	Alternate Add Minimum Bury Depth – 60"	LF	12,320		

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Bid Package 5: Lake Durango Pipeline**UNIT PRICE BID**

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
1	8" CL 165 AWWA C-900 PVC Pipe	LF	7,220		
2	Rock Excavation	CY	215		
3	8" 11 1/4° Bend and Block	EA	8		
4	8" 22 1/2° Bend and Block	EA	11		
5	8" 45° Bend and Block	EA	4		
6	8" 90° Bend and Block	EA	2		
7	8" Gate Valve, Buried	EA	3		
8	8" Type 3 Road Crossing	EA	1		
10	8" Low Point Drain	EA	4		
11	Fire Hydrant Assembly	EA	1		
12	Air/Vacuum Valve	EA	5		
13	Remove and Replace Gravel Surface	SY	61		
14	Outlet Structure	LS	1		
Total of All Unit Price Bid Items					\$
A1	Alternate Add Minimum Bury Depth – 60"	LF	7,220		

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Time of Completion

- 5.02 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 5.03 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 6 – ATTACHMENTS TO THIS BID

- 6.01 The following documents are submitted with and made a condition of this Bid:
- A. Required Bid security;
 - B. List of Proposed Subcontractors;
 - C. List of Proposed Suppliers;
 - D. List of Project References;
 - E. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;
 - F. Contractor's License No.: (if applicable); and
 - G. Required Bidder Qualification Statement with supporting data

ARTICLE 7 – DEFINED TERMS

- 7.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 8 – BID SUBMITTAL

BIDDER: Indicate correct name of bidding entity

By:

Signature _____

Printed name _____

(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

Signature _____

Printed name _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail address: _____

Bidder's License No.: _____

(where applicable)

SECTION 400513
PIPING, GENERAL

PART 1 GENERAL

1.01 WORK INCLUDED

- A. All piping systems shall be furnished and installed as indicated on the Drawings and as specified. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, lining and coating, testing, disinfection, excavation, and backfill, to provide a functional installation.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards:

ANSI/AWS D1.1	Structural Welding Code
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class125
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
ASTM A307	Specification for Carbon Steel Externally Threaded Standard Fasteners.
ASTM A325	Specification for High Strength Bolts for Structural Steel Joints.
ASTM D792	Test Methods for Specific Gravity and Density of Plastics by Displacement
AWWA C900/C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings for Water Transmission and Distribution

1.03 CONTRACTOR SUBMITTALS

- A. Complete shop drawings and certificates, test reports, affidavits of compliance, of all piping systems shall be submitted in accordance with the requirements in the Submittals Section, and as specified in the individual piping sections.
- B. O&M Manuals: The Contractor shall furnish complete Operations and Maintenance Manuals for all equipment specified in the various sections and on the Drawings, together with all piping, valves, and controls for review by the Engineer and use by the Owner in accordance with Section entitled "Operation and Maintenance Data."
- C. Each shop drawing submittal shall be completed in all aspects incorporating all information and data listed herein and all additional information required to evaluate the proposed piping material's compliance with the Contract Documents. Partial or incomplete submissions will be returned to the Contractor without review.
- D. Data to be submitted shall include, but not be limited to:
1. Catalog Data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used for the various piping components and accessories. The illustrations shall be in sufficient detail to serve as a guide for assembly and disassembly.
 2. Complete layout and installation drawings with clearly marked dimensions and elevations. Piece numbers which are coordinated with the tabulated pipe layout schedule shall be clearly marked. Piping layout drawings shall indicate the following additional information; pipe supports, location, support type, hanger rod size, insert type and the load on the hanger in pounds.
 3. Weight of all component parts.

4. Design calculations above specified.
 5. Tabulated pipe layout schedule which shall include the following information for all pipe and fittings, service, pipe size, working pressure, wall thickness and piece number.
- E. Certifications: Prior to installation, the Contractor shall furnish an Affidavit of Compliance certified by the pipe manufacturer that the pipe, fittings and specials furnished under this Contract comply with all applicable provisions of AWWA and these specifications. No pipe or fittings will be accepted for use in the Work on this project until the affidavits have been submitted and accepted in accordance with the Section entitled "Shop Drawings, Project Data and Samples."
- F. All expenses incurred in making samples for certification of tests shall be borne by the Contractor.
- G. Coordination of Work: All work shall be fully coordinated with other work and shop drawings must be checked with each of the various trades. Conflicts in the sequence of the work shall be coordinated through consultation with the Engineer.

1.04 QUALITY ASSURANCE

- A. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards.
- B. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- C. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, acceptable testing agency not more than 12 months prior to commencing work. Machines and electrodes similar to those used in the Work shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders.

1.05 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Where the assistance of a manufacturer's service representative is advisable, in order to obtain correct pipe joints, supports, or special connections, the Contractor shall furnish such assistance at no additional cost to the Owner.

1.06 MATERIAL DELIVERY, STORAGE, AND PROTECTION

- A. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

1.07 CLEANUP

- A. After completion of the work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

PART 2 PRODUCTS

2.01 GENERAL

- A. All products shall be new and unused except as may be requested for testing and shall be the product of a reputable manufacturer regularly engaged in the manufacture of the product. Where two or more units of the same class are required, these units shall be products of a single manufacturer; however, the component parts of equipment need not be the products of the same manufacturer.
- B. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of the applicable Sections of Division 40 and furnished as specified herein.
- C. Pipe Supports: All pipes shall be adequately supported in accordance with the requirements of the "Pipe Supports" Section, and as shown.
- D. Lining: All requirements pertaining to thickness, application, and curing of pipe lining, shall be in accordance with the requirements of the applicable Sections of Division 40, unless otherwise specified.
- E. Coating: All requirements pertaining to thickness, application, and curing of pipe coatings, are in accordance with the requirements of the applicable Sections of Division 40, unless otherwise specified. Pipes above ground or in structures shall be field-painted in accordance with the Section entitled "Painting."

2.02 PIPE FLANGES

- A. Flanges: Where the design pressure is 125 psi or less, flanges shall conform to either ANSI/AWWA C115/A21.15 Class D or ANSI B16.1 125-lb class, unless otherwise specified in the applicable piping sections. Where the design pressure is greater than 150 psi, up to a maximum of 250 psi, flanges shall conform to either ANSI/AWWA C115/21.15 Class 125 or ANSI B.16.1 250-lb class, unless otherwise specified in the applicable piping sections. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C115/A21.15. Flanges for miscellaneous small pipes shall be in accordance with the standards specified for these pipes.
- B. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C 207, or with the standards for miscellaneous small pipes. All blind flanges for pipe sizes 12-inches and over shall be provided with lifting eyes in the form of welded or threaded eye bolts.
- C. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
- D. Flange Bolts: If studs are required, they shall be in accordance with ASTM A 307, Grade B, with heavy hex nuts. Machine bolts, nuts, washers used on all flanged connections exposed to wastewater shall be AISI Type 304 stainless steel and shall conform to the requirements of ASTM F593 and F594, respectively. All other flange bolts and nuts shall be plain carbon steel and shall conform to ASTM A307. Nuts shall be hexagonal, heavy semi finished pattern in accordance with ANSI/ASME B18.2.2. Flange bolts and studs shall extend through the nuts a minimum of 1/4-inch.
- E. Flange Gaskets: Gaskets for flanged joints shall be of materials as specified in applicable piping sections. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted.

2.03 GROOVED COUPLINGS

- A. Grooved couplings shall be provided where shown. Couplings shall be furnished with carbon steel bolts and nuts. Couplings shall be ductile iron or carbon steel with a fusion bonded epoxy coating, inside and out.

B. Suppliers for Steel Pipe Couplings, or equal:

1. Victualic Style 41 or 44 (banded).
2. Victualic Style 77 or 07 (grooved).
3. Gustin-Bacon (banded or grooved).
4. Depend-O-Lok (banded).
5. Note: Steel pipe couplings shall be furnished with Grade E rubber gaskets.

C. Suppliers for Ductile Iron Pipe Couplings, or equal:

1. Victualic Style 31.
2. Gustin-Bacon.
3. Depend-O-Lok Heavy Duty.
4. Note: Ductile iron pipe couplings shall be furnished with grade M flush seal gaskets.

D. Suppliers for PVC Pipe Couplings, or equal:

1. Victualic Style 775.
2. Gustin-Bacon
3. Note: PVC pipe couplings shall be furnished with grade E gaskets and radius cut or standard roll grooved pipe ends.

2.04 DISMANTLING JOINTS

- A. Dismantling joints shall be provided at the locations shown on the drawings. Dismantling joint flange shall conform to C207 with ANSI 150 bolt pattern and shall have a rated working pressure for pressures equal to or greater than that of the adjacent piping.
- B. Steel used in the manufacture of the dismantling joints for diameters greater than 12 inches shall conform to the requirements of ASTM A283 Grade C and ASTM A53. Ductile iron conforming to ASTM A56 Grade 65-45-12 shall be used for the flange adapter for pipe diameters 12 inches and smaller.
- C. The dismantling joint shall be restrained using 304 stainless steel tie rods extending from flange to flange. Use of point-load restraining bolts placed circumferentially around the flange adapter end of the joint shall not be permitted.
- D. The dismantling joint shall be shop coated with fusion bonded epoxy in accordance with AWWA C213-01 and NSF 61.
- E. Gaskets used with dismantling joints shall be nitrile (Buna-N) gaskets.
- F. Dismantling joints shall be manufactured by Romac Industries, Inc., or approved equal.

2.05 FLANGE ADAPTERS

- A. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10 (125#/Class 150 Bolt Pattern).
- B. Restraint for flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.
- C. The flange adapters shall be capable of deflection during assembly or permit lengths of pipe to be field

cut to allow a minimum 0.6 inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

- D. All internal surfaces of the gasket ring (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61. Exterior surfaces of the gasket ring shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
- E. For PVC pipe, the flange adapter will have a pressure rating equal to the pipe.
- F. For ductile iron pipe, the flange adapter shall have a safety factor of 2:1 minimum.
- G. The flange adapter shall be the Series 2100 MEGAFLANGE® Restrained Flange Adapter as produced by EBAA Iron, Inc. or approved equal.

2.06 SLEEVE-TYPE COUPLINGS

- A. Construction: Sleeve-type couplings shall be provided where shown, without a pipe stop, and shall be of sizes to fit the pipe, and fittings shown. The middle ring shall be not less than 1/4-inch in thickness and shall be either 5 or 7-inches long for standard steel couplings, and 16-inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to the requirements of Section entitled "Metal Fabrications".
- B. Pipe Preparation: The ends of the pipe, where specified or shown, shall be prepared for sleeve-type couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to an air test porosity by the manufacturer.
- C. Gaskets: Gaskets for sleeve-type couplings shall be Buna-N.
- D. The gaskets shall be immune to attack and degradation by the material which is being transported. All gaskets shall meet the requirements of ASTM D2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above.
- E. Insulating Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve or an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.
- F. Restrained Joints: Where harnesses are required for sleeve-type couplings, they shall be in accordance with the requirements of the appropriate reference standard, or as shown. Harnesses/Restrained Joints shall have a minimum pressure rating of the pipe/joint pressure rating.
- G. Supplier, or equal:
 - 1. Rockwell (Smith-Blair), Style 411.
 - 2. Dresser, Style 38.
 - 3. Ford Meter Box Co., Inc. Style FC1 or FC3.
 - 4. Depend-O-Lok, Type FXF.

2.07 INSULATING CONNECTIONS

- A. Insulating connections shall be made using clearflow dielectric pipe nipples unless otherwise specified or shown.
- B. General: Insulating bushings, unions, or couplings, as appropriate, may be used, if approved by the Engineer, for joining threaded pipes of dissimilar metals and for piping systems or connections where corrosion control and cathodic protection are involved.
- C. Materials: Insulating connections shall be of nylon, Teflon, poly-carbonate, polyethylene, or other nonconductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.08 REINFORCED FLEXIBLE PIPE COUPLING

- A. Reinforced flexible piping couplings shall be as manufactured by Mercer Rubber Company, General Rubber Co., Metraflex or equal.
- B. The coupling shall be rated for a minimum working pressure of 150 psig or higher as required for the individual piping system and shall be constructed of Kevlar reinforcing and natural rubber elastomer rates for a maximum temperature of 180 degrees F. A hypalon coating shall be applied to the exterior of the elastomer.
- C. All couplings shall have integrally molded flanges with split and beveled galvanized steel retaining rings. Galvanized steel washers shall be provided at the point where the rings are split. Bolt holes and bolt circle patterns shall conform to the mating flange patterns as specified in the piping paragraphs. Coupling lengths shall be as shown on the Drawings.
- D. Control units shall be 316 stainless steel and shall be provided and installed with all flexible pipe couplings. The control unit shall be supplied by the coupling manufacturer.

2.09 PIPE INSULATION

- A. Hot and cold liquid piping, flues and engine exhaust piping shall be insulated as shown on the Drawings. No unprotected hot piping shall be within reach of operating personnel or others.

2.10 UNIONS

- A. Ground joint type – materials and pressure class to match the respective piping system.
- B. Dielectric type – provide between piping systems of dissimilar metals or between piping and equipment of dissimilar metals. Where the use of dielectric unions are shown on the Drawings, the use of insulated bushings or couplings are not acceptable.

2.11 SERVICE SADDLES

- A. Service pipe saddle shall fit to the maximum O.D. of the saddle's range, and extend a minimum of 160 degrees around the pipe. When the saddle is used on pipe to the minimum pipe size of the range, the saddle shall extend 180 degrees around the pipe. Service saddles shall have a minimum pressure rating of 300 psi. Straps shall have ends chamfered and be provided with Class 2 fit, National Coarse Threads. Saddle casting shall be ductile iron, double strap and shall have epoxy or "Rilsan" coating. Straps shall be stainless steel. Valve gaskets shall be self-sealing neoprene or BUNA-N except for chlorine lines which shall be viton.
- B. Suppliers for Service Saddles less than 4", or equal:
 - 1. Smith-Blair #317.

2. Mueller series #DR2S.
 3. Romac Style 101NS.
- C. Suppliers for Service Saddles 4" or larger, or equal:
1. Smith-Blair #317.
 2. Mueller series #DR2S.
 3. Romac Style 202NS.

2.12 BELL X MALE THREAD ADAPTERS

- A. General: All adapters shall be manufactured of Ductile Iron conforming to ASTM A536-72, minimum grade 65-45-12. Fittings meet all requirement of AWWA C153. Fittings are of the all-bell rubber ring connecting type joints.
- B. Gaskets: Gaskets to meet requirements of AWWA C111 for Push-on Joint gaskets.
- C. Coating: Coated with Asphalt coating in accordance with AWWA C-153 standard.
- D. Suppliers for Adapters, or equal:
 1. Harco

2.13 MODULAR ANNULAR SEALING DEVICES

- A. Modular annular sealing devices shall be of the modular mechanical type, utilizing interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe sleeve and the passing pipe. Rubber links shall be EPDM rubber per ASTM D2000 M3 BA510. Assemble links with Type 316 stainless-steel bolts to form a continuous rubber belt around the pipe, with a glass reinforced nylon pressure plate under each bolthead and nut. Devices shall be Link-Seal or equal.
- B. The size of the wall sleeve needed to accommodate the passing pipe shall be as recommended by the modular annular seal manufacturer.
- C. Wall sleeves for modular annular sealing devices shall be galvanized in accordance with ASTM A 123 or molded high density polyethylene Model CS as manufactured by Link-Seal.

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall furnish all labor, tools, materials, and equipment necessary for installation and jointing of the pipe. All piping shall be installed in accordance with the Drawings in a neat workmanlike manner and shall be set for accurate line and elevation. All piping shall be thoroughly cleaned before installation, and care shall be taken to keep the piping clean throughout the installation.
- B. The Contractor shall investigate all conditions affecting his work, arrange the work accordingly, and have such fittings and accessories as required on hand to meet the condition and provide a complete installation. The pipelines shall be laid to the elevations shown on the plans and shall have a minimum depth of cover of 3'-0". The pipelines shall be installed by qualified and competent workmen in strict accordance with the manufacturer's instructions and recommendations. The pipe manufacturer shall provide the services of a field representative to instruct the Contractor on proper handling and installation of the pipelines.
- C. Before setting wall sleeves, pipes, castings and pipes to be cast in place, the Contractor shall check the Drawings and equipment manufacturer's drawings which may have a direct bearing on the pipe locations.

The Contractor shall be responsible for the proper location of the pipes and appurtenances during the construction of and renovation of all tanks and structures.

- D. Piping shall be attached to pumps, valves and equipment, in accordance with the respective manufacturers' recommendations.
- E. For piping assembled with threaded, solvent welded, welded or soldered joints, liberal use of unions shall be made. Unions shall be provided close to main pieces of equipment and in branch lines to permit ready dismantling of piping without disturbing main pipe lines or adjacent branch lines. A minimum of one union per straight run of pipe between fitting and/or valves with multiple lengths of pipe shall be used.
- F. All changes in directions or elevations shall be made with fittings.
- G. The Contractor shall plan his job to minimize the necessity for cutting. Cutting that absolutely must be done shall be by use of approved mechanical or roller chain cutters. The work shall be done by workmen experienced in pipe cutting and shall be accomplished in such a manner as not to damage the lining or coating of the pipe.
- H. All changes in direction or elevation shall be made with fittings except for Flexible Process Tubing or as noted in the piping paragraphs.

3.02 SHIPPING, HANDLING AND STORAGE

- A. Special care in handling shall be exercised during delivery, distribution and storage of pipe to avoid damage and setting up stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.
- B. No pipe shall be dropped from cars or trucks to the ground. All pipe shall be carefully lowered to the ground by mechanical means. In shipping, pipe and fittings shall be blocked in such manner as to prevent damage to castings or lining. Any broken or chipped lining shall be grounds for rejection of the pipe for installation. The Engineer will be the final judge as to the acceptability of any material on the project.
- C. All mechanical joint pipe shall be laid with 1/8-inch space between the spigot and shoulder of pocket.

3.03 LAYING PIPE

- A. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall, in general, agree with manufacturer's recommendation. At the time of laying, the pipe shall be examined carefully for defects, and should any pipe be discovered to be defective after being laid, it shall be removed and replaced with sound pipe by the Contractor at his expense.
- B. All piping shall be laid with the bells facing up slope for all slopes greater than 20%.
- C. All earthwork including excavation, backfill, bedding, compaction, sheeting, shoring and bracing, dewatering and grading shall be performed in accordance with the applicable Sections of Division 310000.
- D. Upon satisfactory excavation of the pipe trench and completion of the pipe bedding, a continuous trough for the pipe barrel and recesses for the pipe bells, or couplings, shall be excavated by hand digging. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure shall be exerted on the pipe joints from the trench bottom.
- E. All piping 3-inches and larger shall be provided with two 4-foot-lengths of pipe for the first two joints outside a building or tank wall unless a greater number of joints is shown on the Drawings.
- F. Pipe shall be installed by qualified and competent workmen in strict accordance with the manufacturer's

recommendation. Pipe shall not be laid in a wet or unstabilized trench. Before being lowered into the trench, the pipes and accessories shall be carefully examined and the interior of the pipes shall be thoroughly cleaned of all foreign matter and other acceptable methods. At the close of each work day and during suspension of work for any reason at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud, water or other foreign material from entering the pipe.

- G. Lines shall be laid straight and depth of cover shall be maintained uniform with respect to finish grade, whether grading is completed or proposed at time of pipe installation. Where a grade or slope is shown on the Drawings, the Contractor shall use laser based surveying instruments to maintain alignment and grade. At least one elevation shot shall be taken on each length of pipe and recorded. No abrupt changes in direction or grade will be allowed.
- H. Aligning Pipe: Pipe runs intended to be straight shall be laid straight. When horizontal or vertical deflections are required, the angular divergence of the axis of any two adjacent lengths of pipe shall not exceed three-fourths of the manufacturer's recommended allowable deflection.
- I. All underground piping shall be properly blocked at all fittings, where the pipeline changes direction, changes size, or ends, using cast in place concrete thrust blocks. All concrete blockings shall be at the locations shown and as indicated on the plans. In all cases, the concrete shall be placed directly against the wall of the trench opposing the thrust of the pipeline. The trench wall that is to act as a form for the concrete shall be vertical and shall be finished by hand to a smooth, firm surface. If necessary for stabilization, the trench wall shall be given a plaster coat of cement mortar. No concrete shall be placed until the Engineer has approved the excavation. Should over-excavation occur either below the base of anchor block or in the trench wall, the over-excavated areas shall be filled with concrete. All clamps, rods, bolts and other structural shapes used in anchors and blocks and not encased in concrete shall be Type 304/316 stainless steel, unless otherwise specified. Concrete for thrust blocks shall be Class B (3,000 psi) as specified in the Cast In Place Concrete Section. No concrete blocking shall be placed within 3-inches of the jointing area to allow for future maintenance work. All blocks shall have neat lines. All underground restrained joint piping and fittings shall be provided with concrete thrust blocks unless otherwise accepted by the Engineer.
- J. Conflicting Utilities: The trench shall be excavated a distance of 150 feet in advance of the completed pipe laying operation to allow the Engineer sufficient time to check the grades and the owner(s) of the utilities sufficient time to relocate them should it be necessary. The owner(s) shall be given ample notice in order to permit the required removal to be accomplished without delaying construction of the project. Any delay in construction resulting from the relocation of utility lines or their appurtenances will not be grounds for additional payment to the Contractor.

3.04 FLANGED JOINTS

- A. Flanged joints shall be made up with full face gaskets as specified in the piping paragraphs. Flange faces shall have a uniform bearing on the gaskets. Flanges shall be drawn together uniformly until the joint is tight. The length of the bolts shall be uniform and in accordance with the requirements specified herein. The bolt's maximum projection beyond the end of the nut shall be ½-inch maximum and ¼-inch minimum

3.05 WELDED JOINTS

- A. Welded joints shall be shop fabricated in accordance with the standards and specifications contained herein.
- B. Field welding will be permitted for black carbon steel pipe where it can be demonstrated that the interior of the pipe can be satisfactorily lined and inspected. Welding in the field shall be performed only when requested on the shop drawings and accepted by the Owner and Engineer in writing as specified herein.
- C. All welding shall be performed in accordance with ANSI B31.1 and AWWA C206 except as modified or supplemented herein. All welders shall be AWS certified in accordance with AWWA C206, and ANSI B31 requirements.

- D. Pipe and fittings with wall thicknesses of 3/16-inch and larger shall have ends beveled for welding. Bevels shall be 30 degrees with a maximum of 37½ degrees. The abutting pipe ends shall be separated before welding to permit complete fusion to the inside wall of the pipe without overlapping. Welding shall be continuous around the joint and shall be completed without interruption. Welds shall be of the single vee butt type, of sound weld metal thoroughly fused into the ends of the pipe and into the bottom of the vee. Welds shall be free from cold spots, pin holes, oxide inclusions, burrs, snags, rough projections or other defects.
- E. Filler metal for welding shall be of the same composition as the base metal. All welding of steel pipe flanges shall be in accordance with requirements of AWWA C207 and ANSI B31.1.
- F. Field repairs of cement mortar lining at welded joints shall be made in accordance with AWWA C205 Appendix A or AWWA C602.
- G. Field welds shall be "fixed position" type.
- H. All field welds shall be radiographically inspected by the Contractor if so ordered by the Engineer.

3.06 THREADED JOINTS

- A. All threads shall be clean, machine cut and all pipe shall be reamed before erection. Taps and dies shall be cleaned, sharpened and in good condition. All threaded joints shall be made tight with Teflon tape or Teflon thread sealer.
- B. After having been set thus, a joint shall not be backed off unless the joint is broken, the threads cleaned and new tape is applied.

3.07 SOLVENT WELDED JOINTS

- A. Joints shall be made up in accordance with ASTM D 2855 and the manufacturers' recommendations. The Contractor shall handle the solvent cements in accordance with ASTM F 402.

3.08 GROOVED COUPLINGS

- A. Grooved couplings shall be installed so that the coupling is firmly and completely seated against the seating faces of the grooves. Expansion of the grooved coupling when subjected to pressure shall not be permitted. The responsibility of repairing any damage caused by the expansion of the grooved coupling shall be born by the Contactor.

3.09 THRUST RESTRAINT

- A. Where the distance between adjacent flanges is in excess of ten feet or where a harness cannot be used, the pipe supports adjacent to the coupling shall restrain the piping preventing any linear or angular movement resulting in the pipe separating from the coupling or misalignment in the joint.
- B. All buried tie rods and associated hardware shall be AISI 316 stainless steel.
- C. In general, all valves and fittings shall be restrained in an acceptable manner such that the unbalanced force developed at them shall be supported independent of the piping system.
- D. On all piping, where sleeve-type couplings and flanged adaptors are located near fittings or valves, tie rods shall span across the coupling as specified herein to restrain movements of the pipe along its axial direction. Such restraints can be deleted if both ends of the pipe are anchored in a concrete structure with no fitting or valve occurring within the span length, in the suction piping to a pump where the coupling is between the pump and valve, or when the water pressure measured at the crown of the pipe is less than five feet.

- E. All sleeve-type couplings shall be harnessed except where noted specifically on the Drawings or as specified herein.
- F. Where expansion joints are used, control units shall be provided. All tie rods and control units shall be installed in accordance with the manufacturer's recommended procedures.
- G. Harnesses for ductile iron pipe shall be as shown on the Drawings.
- H. The following abbreviations are used in the project:

1. Material

304 SS	304 Stainless Steel (nonwelded joints) or 304L Stainless Steel - low carbon (welded joints)
316 SS	316 Stainless Steel (nonwelded joints) or 316L Stainless Steel - low carbon (welded joints)
AL	Aluminum
CPVC	Chlorinated Polyvinylchloride
DI	Ductile Iron
PVC	Polyvinyl Chloride

2. Wall Thickness

CL	Class
SCH	Schedule
SDR	Standard Dimension Ratio

3. Joint Type

CID	Cast Iron Drainage Fitting
FLG-	Flanged
MJ	Mechanical Joint
PO	Push on Joint
RJ	Restrained Joint

4. Fitting Type

304 SS	304 Stainless Steel (nonwelded joints) or 304L Stainless Steel – low carbon (welded joints)
316 SS	316 Stainless Steel (nonwelded joints) or 316L Stainless Steel - low carbon (welded joints)
AI	Aluminum
CPVC	Chlorinated polyvinylchloride
DI	Ductile Iron
PVC	Polyvinylchloride

5. Interior Surface Protection

CL	Cement Lined
EC	Epoxy Coated
PEL	Polyethylene Lined
PVC	PVC Liner

6. Exterior Surface Protective Coating

AC	Asphalt Coated
P	Painted

END OF SECTION

PIPING SCHEDULE

Service	Nominal Pipe Diameter (Inches)	Material	Schedule	Working Press PSIG	Type of Joints	Type of Fittings	Protective Coating	
							Interior	Exterior
All unless otherwise noted								
Above Ground	All	DI	--	--	FLG	DI	CL (PW) PEL/EC (FM)	P
*Below Ground	All	DI	--	--	MJ/RJ	DI	CL (PW) PEL/EC (FM)	AC
Potable Water (PW)	All	C-900	CL-165 CL-235	305	MJ/RJ	DI	CL	AC
Drain: Below Ground	ALL	PVC	SCH 80	--	SW	PVC	--	
*Refer to specifications for type of restrained joint.								

SECTION 432150
VERTICAL TURBINE PUMPS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes materials, testing, and installation of vertical turbine pumps for water service.

1.02 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions Section 013300.
- B. Submit dimensional drawings.
- C. Submit manufacturer's catalog data and detail drawings showing all pump parts and described by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show linings and coatings. Identify each pump by tag number to which the catalog data and detail sheets pertain.
- D. Submit pump manufacturer ISO-9001 certification per Part 2.A.1. As an alternative, provide a letter from the pump manufacturer accepting warranty responsibility for the entire pump, motor, and baseplate unit.
- E. Show shaft diameter and bearing spacing. Submit calculations showing shaft critical frequency and determination of bearing spacings. Show calculated bearing life.
- F. Submit pump curves on which the specified operating points are marked. Show efficiency and brake horsepower for the selected pump curve. Include moment of inertia of the complete pump unit including driver, impeller, and liquid pumped. Show required submergence and NPSH.
- G. As part of the field test procedure for the pumps, record measurements for impeller adjustment at the top of shaft and total radial shaft deflection (shaft runout) above the stuffing box or seal chamber.
- H. Submit manufacturer's sample form for reporting performance test results at least two weeks before the tests. The test form should contain the data presented in the sample form in Section 6 of the ASME PTC 8.2 or ANSI/HI 2.6.
- I. If pump is tested with job motor, do not correct test results for speed. If factory motor is used, correct speed to that indicated for the job motor.
- J. Submit manufacturer's certified performance curves for review at least two weeks prior to shipping the units from the factory. Show pump total head, torque, brake horsepower, pump efficiency, required submergence, and required NPSH. Provide copies of the data recorded during the test and methods of data reduction for determining certified test results.
- K. Submit motor data per Motors specification.
- L. Submit manufacturer's requirements for pump alignment limits.
- M. Submit detailed drawings and data showing the following information for each size and model of pump:
 - 1. Design, dimensions, configuration, and wall thicknesses of nozzles.
 - 2. Connection details of nozzles to discharge head.
 - 3. Wall thickness of pump discharge heads. Include designs and dimensions of supporting or reinforcing gussets, if used.

4. Design and dimensions of discharge baseplate, including plate thickness and method of attachment of baseplate to discharge head.
5. Wall thickness and diameter of pump column.
6. Dimensions and thicknesses of bowls.
7. Pump column lengths between flanges or couplings.
8. Shaft diameters and support spacings.
9. Size of motor and method of mounting to pump discharge head.
10. Weights of the above-mentioned components.

~~It is the intent that the Owner will review and analyze the pump designs for compatibility with the existing intake well. This review will include analyses of natural frequencies and potential resonance issues. The Owner may recommend modifications to the pump discharge heads and baseplates, which may consist of increasing the wall thicknesses, adding gussets, and other modifications. The pump manufacturer shall not begin fabricating the pumps until these reviews and analyses have been completed. It is estimated that the reviews and analyses will take 30 days after the receipt of the submittal data.~~

- N. The pumping unit shall be designed to safely operate free of resonant frequency. A natural frequency analysis of the head and electric motor shall be performed by a licensed Professional Engineer using FEA software. A report shall be provided with the submittal showing that the natural frequencies and mode shapes of the pump and motor have been considered in the design of the discharge head, and certify that the critical frequency is at least 20% above or below the operating range.**

1.03 DEFINITIONS

- A. Terms shall be as defined in ANSI/HI 2.1-2.5 for vertical pumps.
- B. Additional terms are defined below:

Submergence: Vertical distance in feet between the pumping water level and the bottom of the suction bell.

1.04 MANUFACTURER'S SERVICES

- A. Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:
- B. Two labor days for each service listed in the subsection on "Service Conditions" to check the installation and advise during start-up, testing, and adjustment of the equipment.
- C. One labor day to instruct the Owner's personnel in the operation and maintenance of the equipment.

PART 2 PRODUCTS

2.01 PUMP DESIGN

- A. Equipment for the pumps, including discharge heads, shafting, columns, motors, bases, and anchor bolts, shall be provided as a complete unit by the pump manufacturer in an ISO 9001 certified facility or by a pump manufacturer accepting warranty responsibility for the complete pump unit. Pump units assembled by entities other than the pump manufacturer will not be acceptable.
- B. Each pump shall be capable of at least a 10% head increase at normal operating conditions by installing a larger impeller or an impeller of different hydraulic design.

- C. Pump curve shall be continuously rising and shall be free of dips and valleys from the design point to the shutoff head. The shutoff head shall be at least 120% of the head that occurs at the design point.
- D. The NPSH required shall be at least five (5) feet less than the minimum NPSH available at all points on the pump curve up to 120% of the flow at the BEP.
- E. Design the pump and its components to operate continuously over a preferred operating range (POR, as defined in ANSI/HI 9.6.3-1997) of 70% to 120% of the flow at the BEP.

2.02 MOTORS

- A. Motors shall be vertical high thrust, ~~hollow~~ solid shaft. Motors shall be as further described in the subsection on "Service Conditions." ~~For pumps with mechanical seals and hollow shaft motors, provide steady bushings.~~
- B. The driver motor thrust bearing loading shall include the total pump lineshaft downthrust. Design the motor bearings to withstand any momentary total upthrust equivalent to at least 30% of the maximum downthrust developed.

2.03 COUPLINGS AND COUPLING GUARDS

- A. For hollow shaft motors, provide a threaded coupling. Provide coupling guards conforming to OSHA requirements.

2.04 DISCHARGE HEADS OR MOTOR STANDS

- A. Provide a fabricated steel ~~or cast iron~~ discharge head. The discharge head shall have bolted register or rabbet-fit connections for the motor. Discharge head shall have connections for the pump column and shall support the loadings which it imposes as well as contain the pump pressure.
- B. Design columns and discharge heads for 150% of the pump discharge pressure (suction pressure plus pump differential pressure) at shutoff.
- C. Access to the seal chamber or stuffing box shall be through windows placed 90 degrees from the discharge. Fit handholes and/or windows with Type 304 stainless steel expanded metal guards per OSHA requirements. Provide hinged or removable Type 304 stainless steel guards.
- D. Design fabricated steel discharge head to be aesthetically compatible with the mounted motor and with adjacent pumping units. Where the motor is smaller in horizontal dimension than the discharge pipe, shape a skirt to transition between the two masses. Where the motor is larger than the discharge head, a skirt of approximately motor diameter dimension shall enclose the discharge head so as to provide an adequate-appearing support.
- E. The discharge shall be flanged, having a pressure rating as shown in the subsection on "Service Conditions."
 - 1. Class 125 or 150 flanges shall comply with AWWA C207, Class E.
 - 2. Flanges shall be flat face.
 - 3. Groove welds shall be full penetration welds. Fabricated flanges shall be welded both inside and out.
 - 4. Fabricated steel discharge elbows shall have at least three pieces per AWWA C208, Table 2.
- F. Provide for lifting the heads by means of lifting eyes that are capable of sustaining the weight of the complete unit less the motor.
- G. Provide a 1-inch steel half coupling welded to the discharge column for an air release. Provide plug.

2.05 SEAL CHAMBERS OR STUFFING BOXES FOR OPEN LINESHAFT PUMPS

- A. The design of the seal chambers or stuffing boxes shall provide space and clearance for removal and service for any of the following types of packing or seals per Section 432102 without moving or disconnecting the motor: Type G.

2.06 LUBRICATION

- A. Pumps shall have self-lubricated open lineshafts.

2.07 COLUMN PIPE

- A. The column pipe joints shall be flanged and bolted to the discharge head and to the pump bowl assembly and shall have register fits at each end. Material shall be as listed in the subsection on "Pump Materials of Construction." Provide bearing retainer containing a neoprene bearing as an integral part of the top end of each section where a lineshaft bearing is used. As an alternative, provide a separate retainer that is registered in the pipe flanges and easily removable for maintenance.
- B. Top and bottom column pipe sections shall not exceed 5-foot length.
- C. Column pipe joints shall be flanged for columns 6 inches and larger and threaded or flanged for smaller sizes.

2.08 SHAFTS AND BEARINGS

- A. Support the shafting by bearings at intervals so that the first natural frequency of the rotating assembly is at least 30% above the maximum operating speed. Provide an additional bearing retainer just below the head for added support. Calculate and size the shaft diameter for the pump shutoff head and the maximum horsepower conditions.
- B. For metal or rigid bearings, support the shafting at intervals per API 610, paragraph 8.3.6, with a maximum spacing of 5 feet.
- C. For pumps having operating speeds 1,800 rpm and less with water-lubricated neoprene bearings, the bearing spacing for the intermediate columns shall not exceed 10-foot lengths. The bearing spacings for the top and bottom column sections shall not exceed 5 feet.
- D. Tolerance on the shaft diameter, with the shaft rotated on centers, shall not exceed 0.001-inch TIR. Shaft runout on the stuffing box or seal chamber face and at the impeller shall not exceed 0.002-inch full indication movement. The shaft stiffness shall limit the total deflection under the most severe dynamic conditions over the allowable operating range of the pump, with the maximum impeller diameter installed, to 0.002 inch at the primary seal faces or at the stuffing box faces.
- E. Pump shafts shall be machined or ground and finished throughout their entire length. The total indicated runout shall not exceed 0.0005 inch per foot of length. Total runout shall not exceed 0.003 inch over total shaft length. The pump shaft shall be in one piece unless otherwise approved by the Owner (because of total shaft length or shipping restrictions).
- F. Shaft couplings for shaft diameters 2 inches or larger shall be of the key and thrust-ring types or other nonthreaded design. Threaded couplings may be used for shaft diameters 1-15/16 inches or smaller. Thrust rings, cap screws, and keys where used shall be Type 410 stainless steel.
- G. Provide lineshafting with hardened sleeves under neoprene bearings per API 610 (tenth edition), paragraph 8.3.10.5 and Table H.1 in Annex H.

2.09 BOWL ASSEMBLY

- A. Each bowl assembly shall consist of the bowl, impeller and impeller shafting, and bearings. Bearings shall be located above and below the impeller. Bearings (other than sleeve type) shall have an AFBMA L-10 life of at least 20,000 hours at any specified flow condition excluding the shutoff head. Impellers shall be dynamically balanced.
- B. Pump bowls shall be of the material listed under the subsection on "Pump Materials of Construction." Bowls shall be sufficiently rigid to prevent adverse changes in bearing alignment. Bowls shall be flanged with male and female rabbets or registers for joining to the suction bell and the discharge column. Waterways and the diffusion vanes shall be smooth and free from nodules, bumps, and dips.

2.10 SUCTION BELL

- A. The suction bell shall have, as an integral part, vanes supporting a central hub in which the bottom bearing is carried below the impeller. The outer suction bell entrance shall be at least the size of the maximum pump bowl dimension and as much larger as is practical. Maximum entrance fluid velocity shall not exceed 6 fps at the specified maximum flow. The contour between the outer edge and the impeller suction eye shall be smooth, continuous, and bell shaped.

2.11 IMPELLERS

- A. Pump impellers shall be of the enclosed type made of the material listed in the subsection on "Pump Materials of Construction" and shall be cast in one piece. Machine impellers to fit the contour of the bowl and hand file in the waterways. Attach impellers to the shaft in such a manner that they cannot become loose under any operating condition or under reverse rotation. Provide for adjustment of the axial position of the impeller at the top of the pump or motor so that proper clearance between bowls and impellers may be maintained.

2.12 VIBRATION AND RESIDUAL UNBALANCE

- A. The maximum vibration levels shall not exceed those shown in Figures 9.6.4.13 and 9.6.4.14 in ANSI/HI 9.6.4-2000. Maximum residual unbalance in rotors shall not exceed that shown in Figure 9.6.4.15B in ANSI/HI 9.6.4.
- B. At any operating speed, the ratio of the pump's natural reed frequency to the pump's rotating speed (f/N) shall be less than 0.8 and greater than 1.3. A factory resonance test shall demonstrate the motor/discharge head structure's natural reed frequency. Obtain a modal shape signature with an FFT analyzer and submit to Owner's Representative for review.
- C. *The Contractor shall require that the pump manufacturer determine whether the infinite mass and rigidity described in ANSI/HI 9.6.4-2000, paragraph 9.6.4.5.2 is applicable to the service conditions in this project and to select the appropriate analytical method to determine the critical speed and resonant frequencies of the pump system. At a minimum, the pump system shall include the bowls, impellers, lineshaft diameters, lineshaft bearing spacing, column diameter and wall thickness, the design of the discharge stand or motor stand with discharge nozzle, and the baseplate and soleplate dimensions (length, width, and thickness).*

2.13 PUMP MATERIALS OF CONSTRUCTION

- A. Materials of construction shall conform to the requirements listed below. Materials of construction for components not listed below shall conform to API 610, Annex H, Material Class I-2.

Component	Material
Pump shafts and couplings	Stainless steel, ASTM A276, UNS Grade S31600 , S41000 or S41600

Component	Material
Bowl wear rings	Stainless steel, ASTM A743, Grade CF-8M or CA-15; or ASTM A276, Type 410; or bronze per paragraph 3 below.
Bearing retainers (fabricated integral)	Carbon steel, ASTM A283, Grade B
Bearing retainers (insert type)	Bronze; see paragraph 3 below.
Lineshaft bearings	Neoprene.
Impellers	Bronze per paragraph 3 below or stainless steel ASTM A743, Grade CF-8M.
Impeller wear rings	Stainless steel (if bowl wear rings are bronze) or bronze (if bowl wear rings are stainless steel). Stainless steel: ASTM A743, Grade CF-8M or CA-15 or ASTM A276, Type 410. Bronze: see paragraph 3 below.
Suction strainer	Stainless steel, AISI Type 316.
Pump bowls and suction bell	Cast iron, ASTM A48, Class 30 or ductile iron, ASTM A536.
Bowl bearings	Bronze; see paragraph 3 below.
All parts made of fabricated steel including discharge head	Carbon steel, ASTM A283, Grade B or C; ASTM A36; or ASTM A53, Grade B.
Column pipe	Carbon steel, ASTM A283, Grade B or C, or ASTM A53, Grade A or B.
Mounting plate	Carbon steel, ASTM A283, Grade A or B or ASTM A36.
Flanges	ASTM A105, A181, or A182.
Bolts and nuts for discharge heads, column pipe flanges, and bowl flanges. See paragraph 4 below	Bolts shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M. Nuts shall be Type 316 stainless steel conforming to ASTM A194, Grade 8M.
Any bronze components in contact with water	See paragraph 3 below.

- B. Do not construct the impeller wear ring and bowl wear ring of the same material. Impeller and bowl wear ring materials shall have a minimum Brinell hardness difference of 50, unless both the stationary and the rotating wear surfaces have Brinell hardness numbers of at least 400.
- C. Bronze shall have the following chemical characteristics:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

- D. Provide flange insulation kits for the stainless steel bolts and nuts on the column and bowl flanges. Do not provide flange insulation kits for the bowls if the bowl is of a design that uses a machined mating surface with no gasket and has a cast receiving nut for the bolts.

2.14 STRAINERS

- A. Provide suction strainers on the inlet to each pump as stated in the subsection on "Service Conditions."

2.15 SOLEPLATE AND ANCHOR BOLTS

- A. The Contractor shall assign the design and construction of the pump (including bowls, column, and discharge head), motor and supporting stand, and baseplate and soleplate system to the pump manufacturer. The pump manufacturer shall design and construct an integrated system to comply with the specified restraint, deflection, vibration, and critical speed criteria.
- B. If required by manufacturer to meet vibration requirements, provide a steel soleplate for deck-mounted pumps to be permanently grouted in place. The thickness and bolting to the discharge head base shall be sufficient to restrain the discharge head against the discharge pressure at shut off head or any other pump operating condition and provide sufficient rigidity such that the pump and baseplate system meets the specified lateral vibration and critical speed criteria. Machine the soleplate topside to mate with a fully machined base of the discharge head.
- C. Provide vertical leveling screws spaced for stability on the outside perimeter of the soleplate. Locate the leveling screws adjacent to anchor bolts to minimize distortion during the process of installation. These screws shall be numerous enough to carry the weight of the baseplate, pump, and drive train components without excessive deflection, but in no case shall fewer than six screws be provided. Sandblast the grout contact surfaces of the soleplate in accordance with SSPC SP-6, and coat those surfaces with a primer compatible with epoxy grout.
- D. Provide anchor bolts of sufficient quantity and size to restrain any pump operating condition. The anchor bolts shall conform to ASTM A193, Grade 8M with nuts conforming to ASTM A194, Grade 8M

2.16 SPARE PARTS

- A. Provide the following spare parts for each model of pump:

Quantity	Description
One	Impeller wear ring
One	Bowl wear ring
Two sets	Bowl bearings
Two sets	Shaft bearings
One	Shaft coupling
Two	Mechanical seals (for pumps specified to have mechanical seals)

- B. Pack spare parts in wooden boxes; label with manufacturer's name and local representative's name, address, and telephone number; and attach list of materials contained therein.

PART 3 EXECUTION

3.01 SHIPMENT AND STORAGE

- A. Prepare equipment for shipment including blocking of the rotor when necessary. Identify blocked rotors by means of corrosion-resistant tags attached with stainless steel wire. The preparation shall make the equipment suitable for six months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals.
- B. Identify the equipment with item and serial numbers and project equipment tag numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and

serial number and project equipment tag numbers of the equipment for which it is intended. In addition, ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

- C. Pack and ship one copy of the manufacturer's standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.
- D. Store and protect pumps per API 686 (first edition), Chapter 3, paragraphs 1.4 through 1.9, 1.15, 1.17, 1.20, and 1.21 and as described below.
- E. Coat exterior machined surfaces with a rust preventative.
- F. The interior of the equipment shall be clean and free from scale, welding spatter, and foreign objects.
- G. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Install closures at place of pump manufacture prior to shipping. For studed openings, use all the nuts needed for the intended service to secure closures.
- H. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Install plugs at place of pump manufacture prior to shipping.
- I. Clearly identify lifting points and lifting lugs on the equipment or equipment package. Identify the recommended lifting arrangement on boxed equipment.
- J. Wrap exposed shafts and shaft couplings with waterproof, moldable waxed cloth or volatile-corrosion-inhibitor paper. Seal the seams with oil-proof adhesive tape.
- K. If electric motors are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the manufacturer's recommended procedures for extended storage. Provide temporary covers over the motor electrical components. Provide temporary conduits, wiring, and electrical supply to space heaters. Inspect electrical contacts before start-up.

3.02 PUMP INSTALLATION

- A. Install equipment horizontal and vertical within 1 degree and according to the manufacturer's written instructions and the contract documents. Confirm that pumps are set to meet the vertical alignment requirements established by the manufacturer.
- B. Check to ensure that pump baseplates or soleplates have been provided with vertical leveling screws, as opposed to shims or wedges. Do not use shims and wedges.
- C. Provide the manufacturer's recommended lubricants and operating fluids and verify that each piece of equipment contains the amount recommended by the manufacturer.
- D. Provide threaded caps for protection of nuts and bolt threads per Section 400500 on the bolts and nuts of the column pipe flanges and bowl flanges.
- E. Connect piping. Verify that the installed pump is fully self-supporting before bolting pipe flanges, so that no strain is imparted on the flanges, pipes, or pipe supports from the pump assembly. Adjust the position of the pump assembly so that the pump discharge flanges are plumb and aligned with the adjacent pipe flanges. Do not use temporary shims or jacking nuts for leveling, aligning, or supporting equipment. Provide final grouting of the pump assembly base according to Section 033000.
- F. When the alignment is correct, tighten the foundation bolts evenly but not too firmly. Then grout the unit to the foundation. The leveling pieces may be grouted in place. Do not tighten foundation bolts until the grout is hardened a minimum of 48 hours after pouring.

- G. Provide continuous protection of the installed equipment from the elements, dust, debris, paint spatter, or other conditions that will adversely affect the unit's operation until such time as the equipment is scheduled for start-up testing.

3.03 MOUNTING AND ALIGNMENT OF VERTICAL HOLLOW SHAFT DRIVERS

- A. Remove the clutch or coupling from the top of the hollow shaft, and mount the driver on top of the discharge head/driver stand. For pump designs requiring the pump head shaft to be installed prior to mounting the driver, lower the hollow shaft driver with care over the head shaft to be sure the latter is not damaged. Check the driver for correct rotation, as given in the manufacturer's installation instructions. Install the head shaft, if not already done, and check it for centering in the hollow shaft. If off-center, check for runout in head shaft, misalignment from discharge head to driver, or out of plumbness of the suspended pump. Shims can be placed under the discharge head to center the head shaft, but shims shall not be placed between the motor and the discharge head unless recommended by the manufacturer.
- B. Install the driver coupling or clutch, and check the nonreverse ratchet for operability, if furnished. Install the coupling gib key and the adjusting nut, and raise the shaft assembly with the impeller(s) to the correct running position in accordance with the manufacturer's instructions. Secure the adjusting nut to the clutch, and double-check the driver hold-down bolts for tightness.

3.04 WELDING PROCEDURE AND WELDER QUALIFICATIONS FOR PUMP CONSTRUCTION

- A. Welding shall comply with the ASME Boiler and Pressure Vessel Code, Section IX. Provide full penetration welds. Open seam butt welds are not permitted.

3.05 FACTORY PERFORMANCE TESTS

- A. Each pumping unit shall be subjected to a nonwitnessed laboratory performance test. Conduct tests in accordance with the ASME PTC 8.2 or ANSI/HI 2.6, using the actual job driver. The performance test shall be equivalent to ANSI/HI 2.6.
- B. No motor overload above nameplate rating will be allowed at any flow up to 120% of the flow at the BEP.
- C. Hydrostatically test columns and discharge heads at design pressure.
- D. Deviations and fluctuations of test readings shall conform to ASME PTC 8.2, 1.11 (Type A) or ANSI/HI 2.6, paragraph 2.6.5.4.1.
- E. Measure flow by the "Capacity Measurement by Weight," the "Capacity Measurement by Volume," or the "Capacity Measurement by Venturi Meter, Nozzle, or Thin Plate Orifice" methods in ASME PTC 8.2 or ANSI/HI 2.6.
- F. For pumps in variable speed service, conduct a test at each operating speed necessary to attain the design points described in the subsection on "Service Conditions."
- G. Perform tests and record data, including head, flow rate, speed, and power at a minimum of seven points. These points shall include shutoff, minimum flow, midway between minimum flow and design flow, design flow, 120% of design flow, and maximum flow.
- H. Take vibration readings at design flow at each test speed.
- I. Performance tests shall be "full-scale." The complete pump, including column and discharge elbow, shall be used. Measuring devices shall have been calibrated within the previous year.
- J. Conduct tests preferably at the same minimum submergence that will be realized in the field.

- K. Locate the pressure tap for head measurement not less than 10 pipe diameters downstream from the discharge elbow of the test pump.
- L. Should results of the full-scale tests indicate, in the opinion of the Owner's Representative, that the pumps will fail to meet any of the specified requirements, the Owner's Representative will notify the Contractor of such failure. The manufacturer shall thereupon, at no expense to the Owner, make such modifications and perform additional tests as may be necessary to comply with these specifications.
- M. Perform a hydrostatic test on pump pressure-containing components per ANSI/HI 2.6, paragraph 2.6.4.

3.06 PAINTING AND COATING

- A. Coat exterior of discharge head and motor the same as the adjacent piping. If the adjacent piping is not coated, then coat per Section 099100, System No. 29. Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in field. Finish coat shall match the color of the adjacent piping.

3.07 SERVICE CONDITIONS

- A. Pump hydraulic performance characteristics shall be as shown below.
- B. Pump Tag Numbers: Intake Pump 1

Location:	Intake Pump Station
Type of discharge:	Surface
Service:	Indoors; environmental temperature range of 40°F to 90°F
Elevation:	Per Plans (greater than 6,800 feet above sea level)
Discharge Head Centerline Elevation	See Plans
Pump Room Finished Floor Elevation	See Plans
Sump Floor Elevation	6,780.00 ft.
Relative humidity:	0% to 90%
Fluid temperature range:	40°F to 80°F

Pump Data

Capacity (gpm)	Pump Total Head (feet) ⁽¹⁾	Minimum Pump Efficiency (%)
460	338	75%
460	419	75%
800 ⁽²⁾	419	80%
800	338	75%
⁽¹⁾ Pump manufacturer to add for pump internal friction losses, such as in columns and discharge heads. ⁽²⁾ Design point.		

Liquid pumped:	Raw Water
Maximum pump speed:	1,800 rpm
Minimum submergence available:	21 feet
Motor horsepower (minimum):	450 125 horsepower
Motor type:	ODP
Variable speed drive required:	Yes
Minimum shaft diameter:	1 11/16 inches

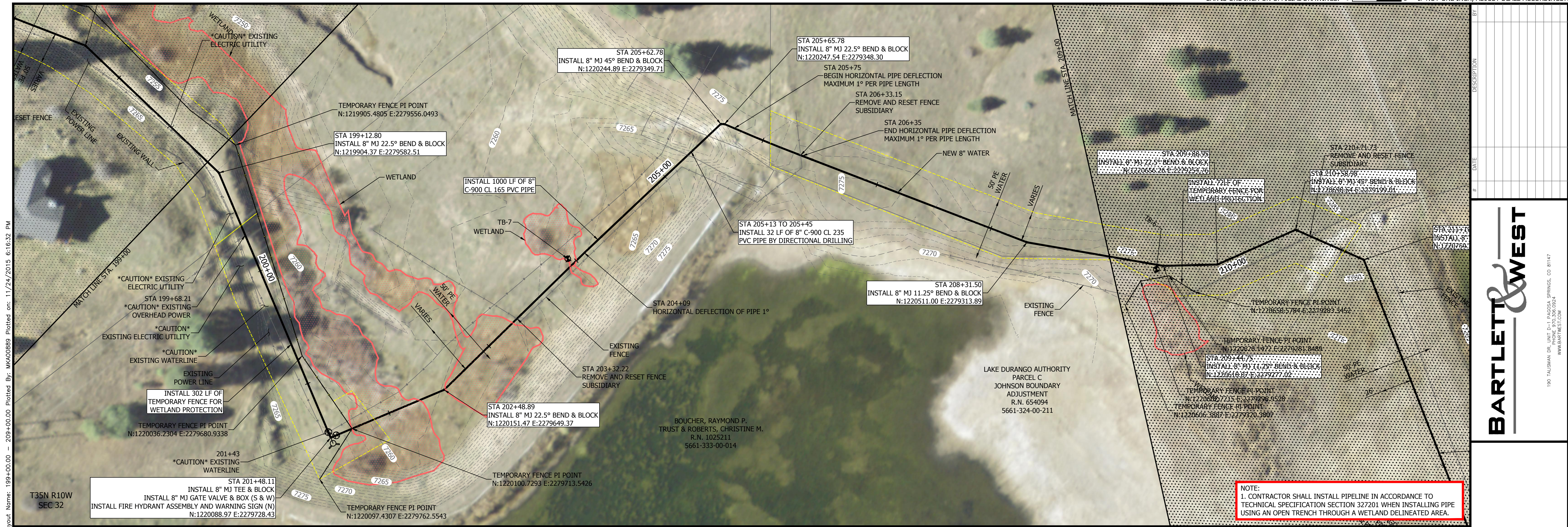
Pump lubrication:	Open lineshaft
Minimum discharge connection size:	6 8 inches
Minimum column size:	40 8 inches
Minimum column wall thickness:	0.375 inch
Discharge flange rating:	Class 150
Type of packing or seals per Section 432102:	Type G
Bearing lubrication:	Water
Suction strainer:	Yes
Pump manufacturers and models:	Pentair (Fairbanks Nijhuis) 11M-SS Weir Floway 11JKH/M Patterson

3.08 FIELD TESTING

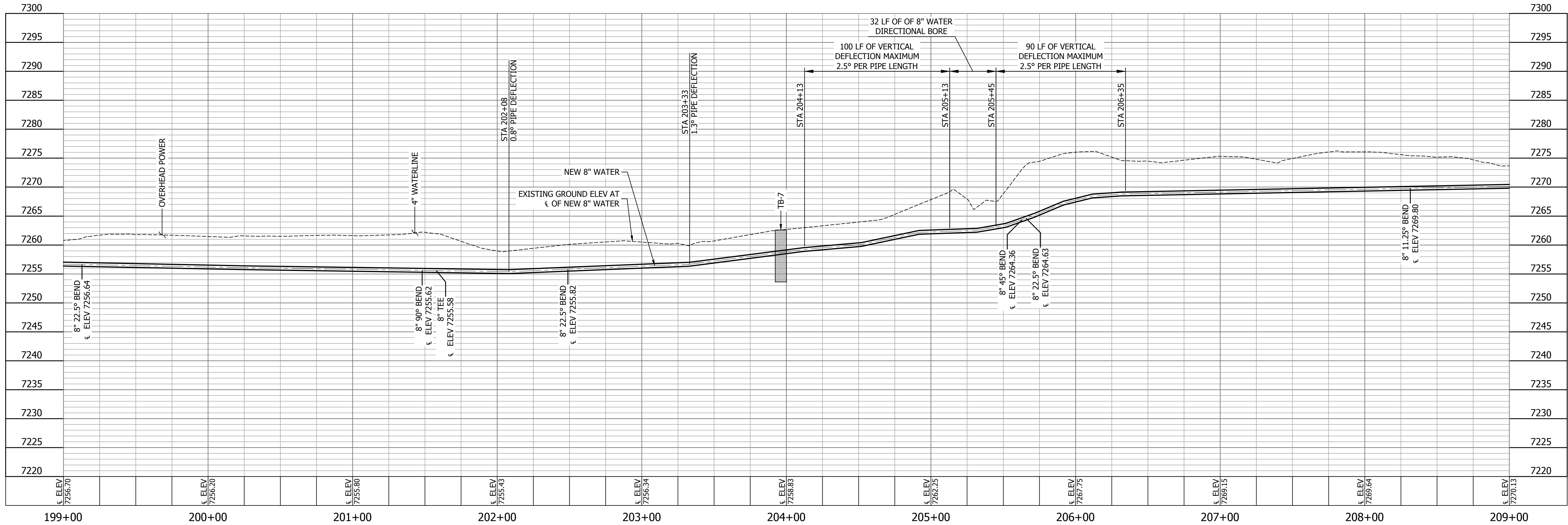
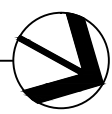
- A. Bump motor to ensure that motor has been connected for proper rotation prior to coupling pump.
- B. Perform field tests for seven (7) consecutive days on each pump. Measure flows at the following head points:
 1. Tag Numbers: Intake Pump 1
 2. Test Points (Feet): 338 feet, 419 feet
- C. If the measured flows at the above tabulated pump heads are more than 5% below the flows obtained from the laboratory or factory test, adjust the impellers or provide new impellers or otherwise repair or replace the pumps or calibrate meters or pressure gauges.
- D. Conduct vibration level tests with pumps operating at their rated capacity. Adjust or replace pumps that exceed the maximum vibration levels.
- E. Assure that in the automatic mode each pump responds to its pressure signal. Assure that each pump operates at a steady rate ($\pm 5\%$ of set point) at any given pressure for 30%, 40%, 50%, 60%, 80%, and 100% of the maximum capacity specified, but not below manufacturer rated minimum stable continuous flow.
- F. Demonstrate that the pumping units, drivers, and control system meet the following requirements:
 1. The pumping units operate as specified without excessive noise, cavitation, vibration, and without overheating of the bearings.
 2. Automatic and manual controls function in accordance with the specified requirements.
 3. Drive equipment operates without being overloaded.

END OF SECTION

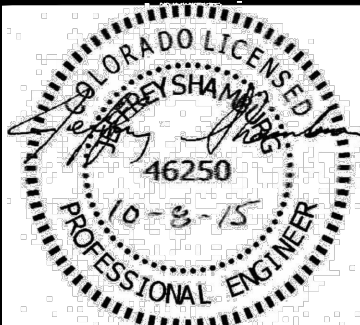
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Drawing Name: W:\Pro\17000\17865\17865.005\AutoCad\Raw Water Project\02 Civil\17865.005 Water Plan & Profile.dwg
Last edit on: 00/00/00



STA 199+00 - 209+00
SCALE: HORZ-1" = 40' VERT-1"=10'

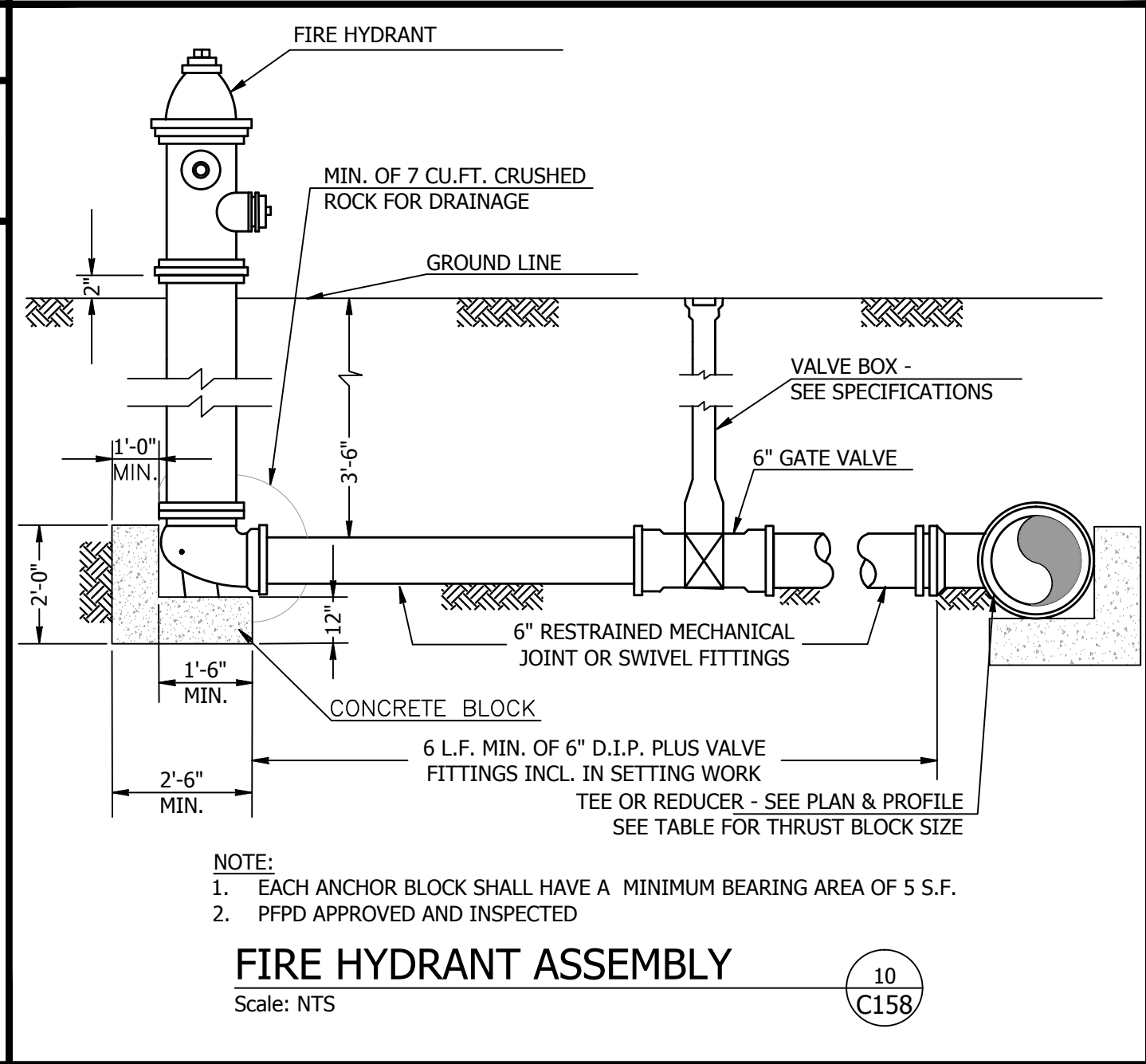
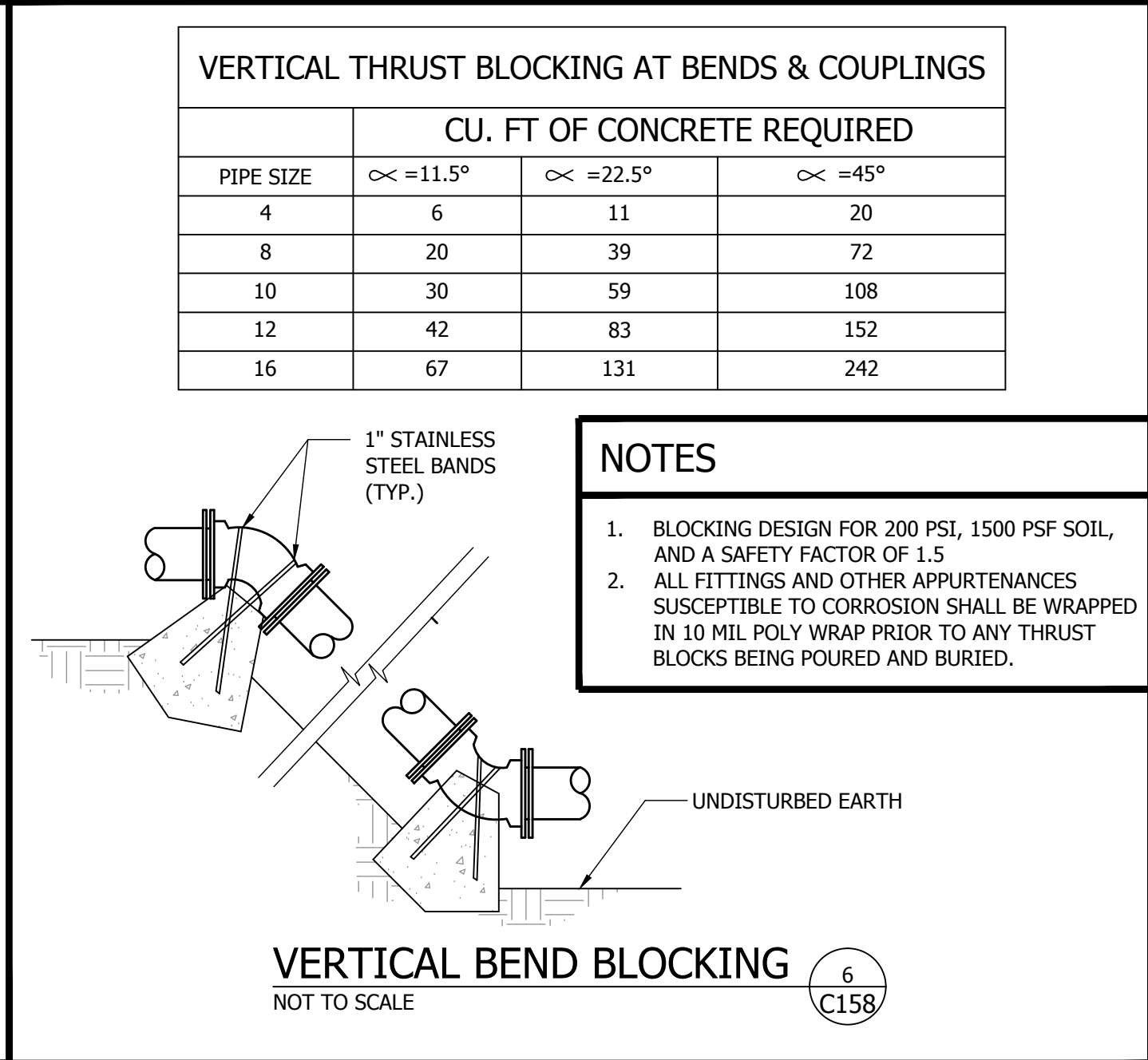
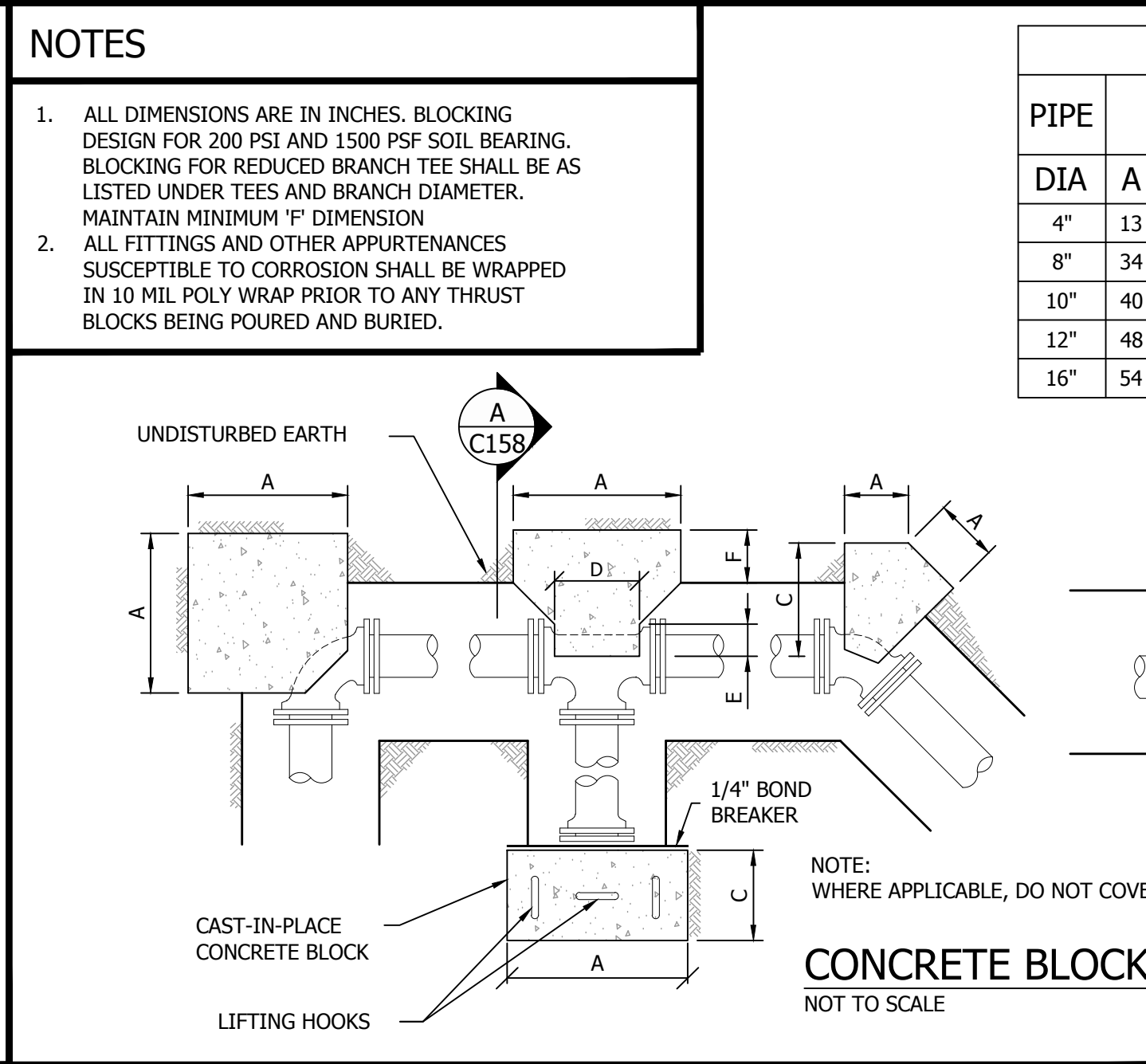
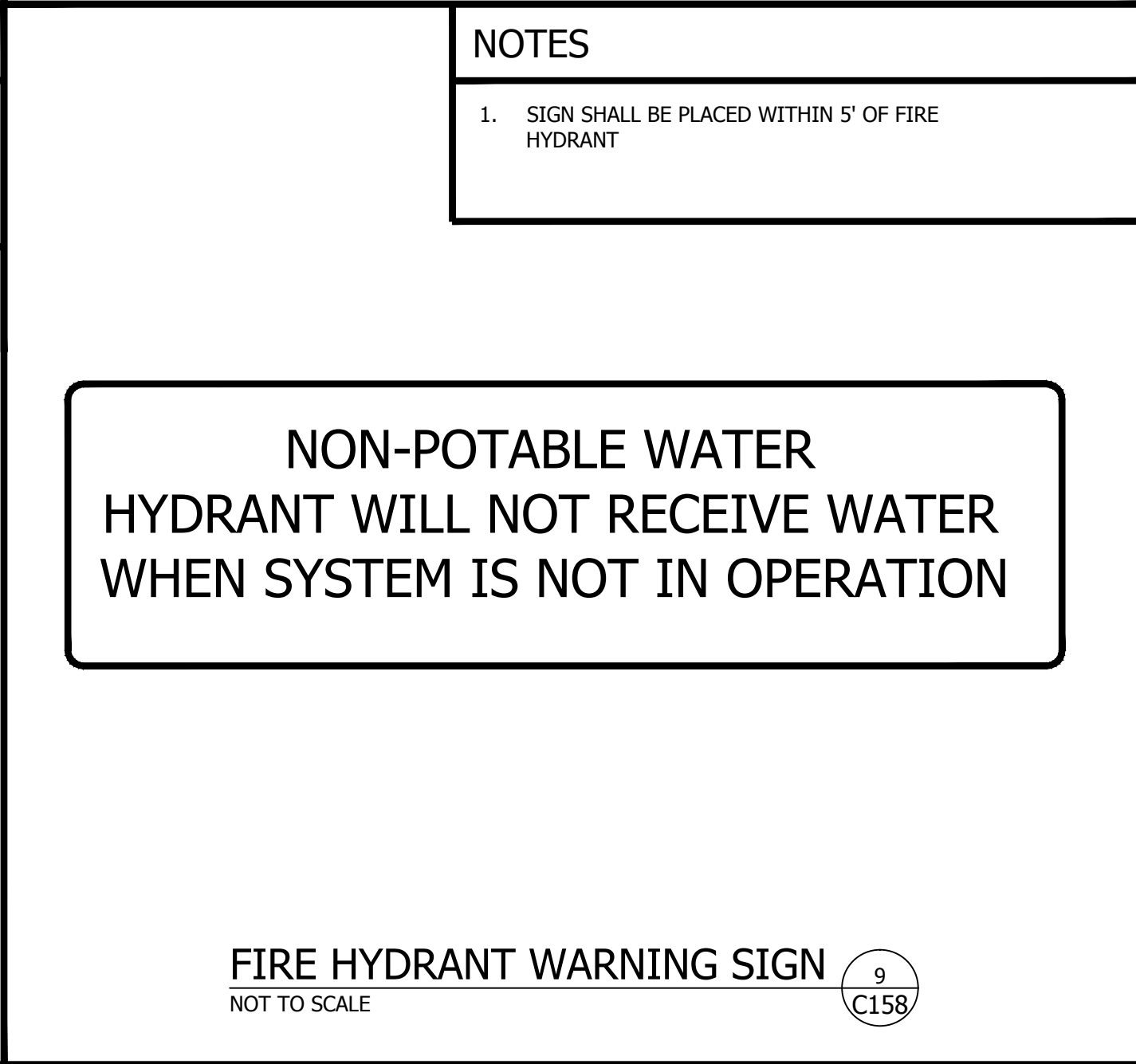
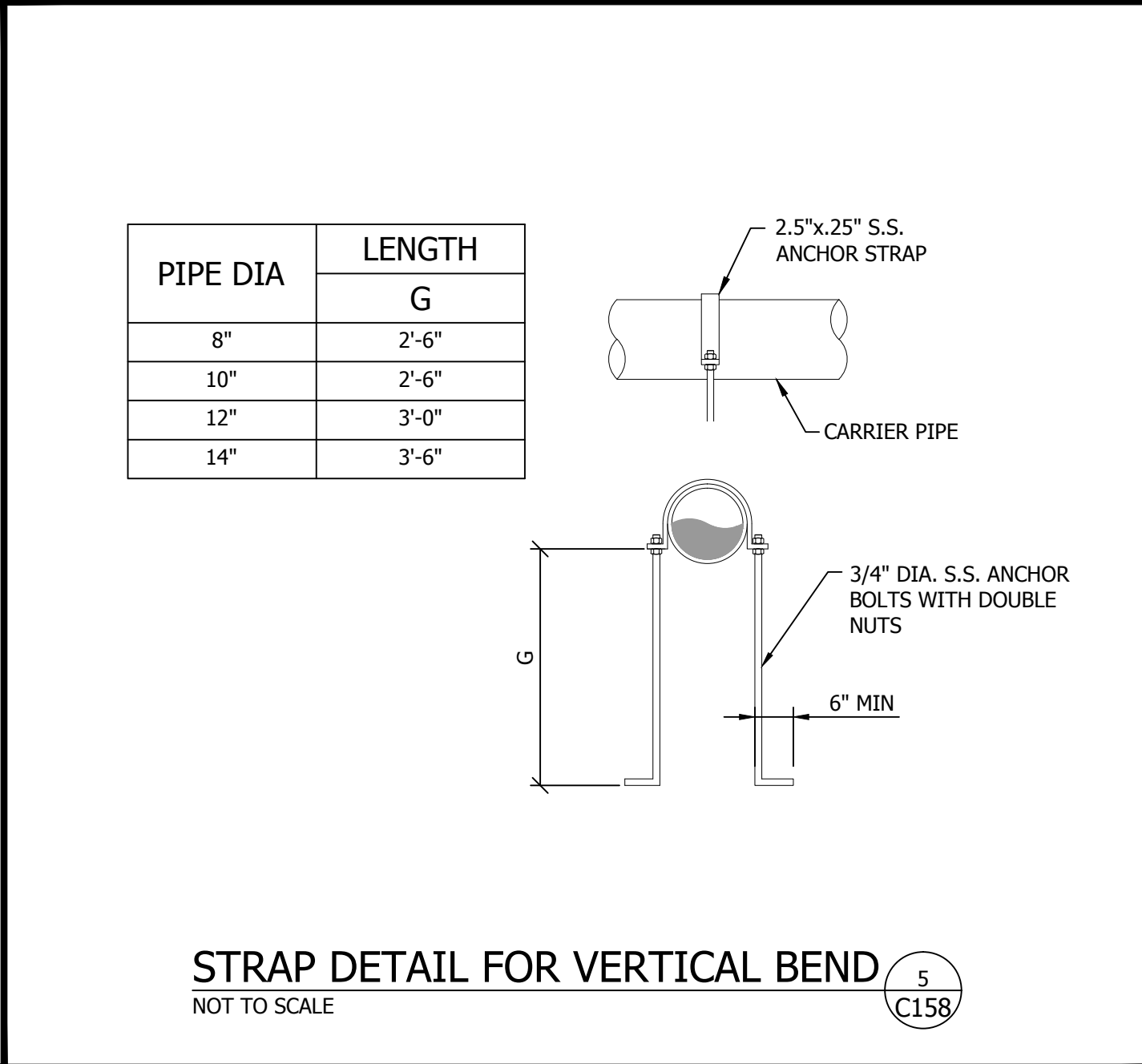
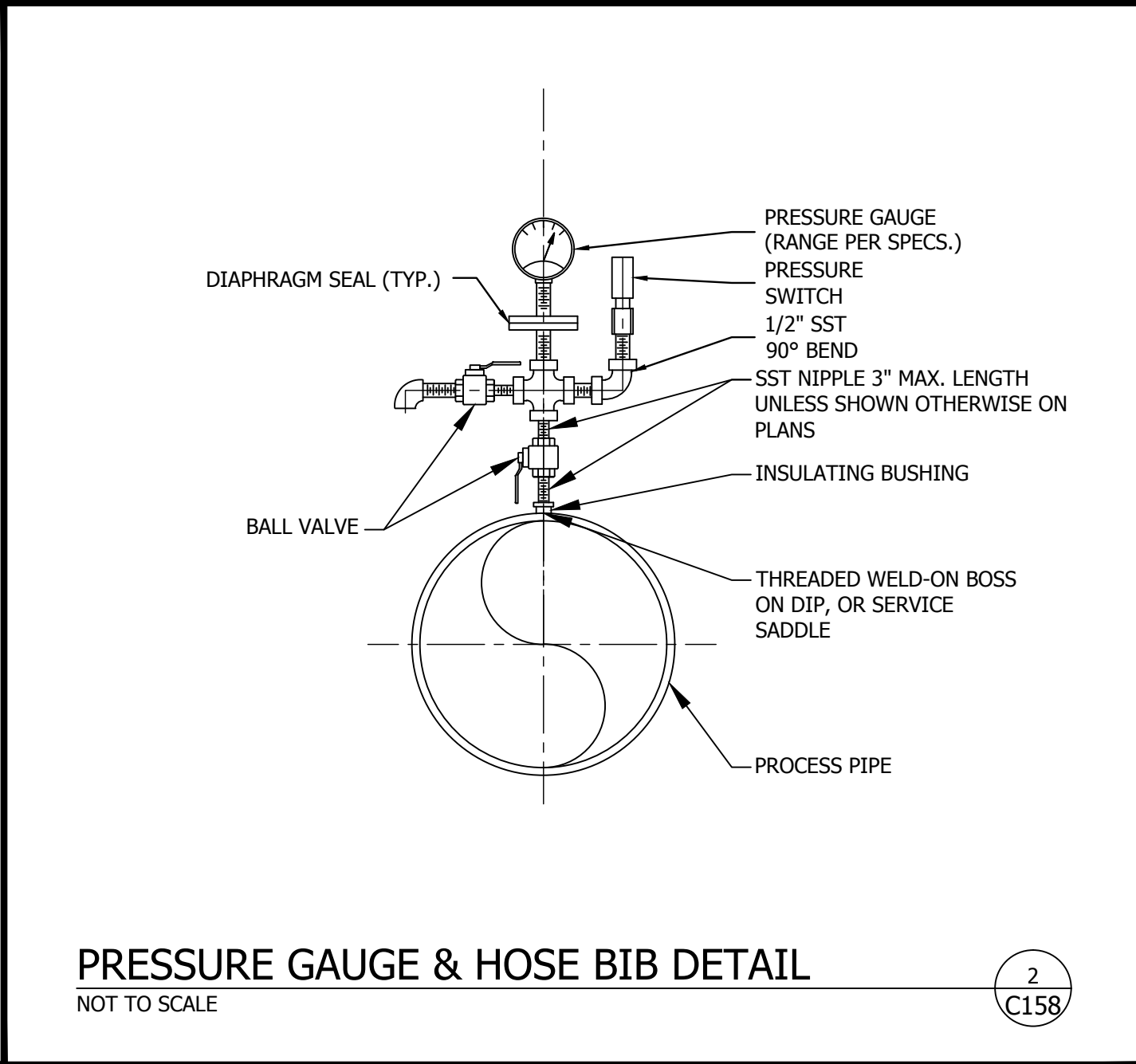
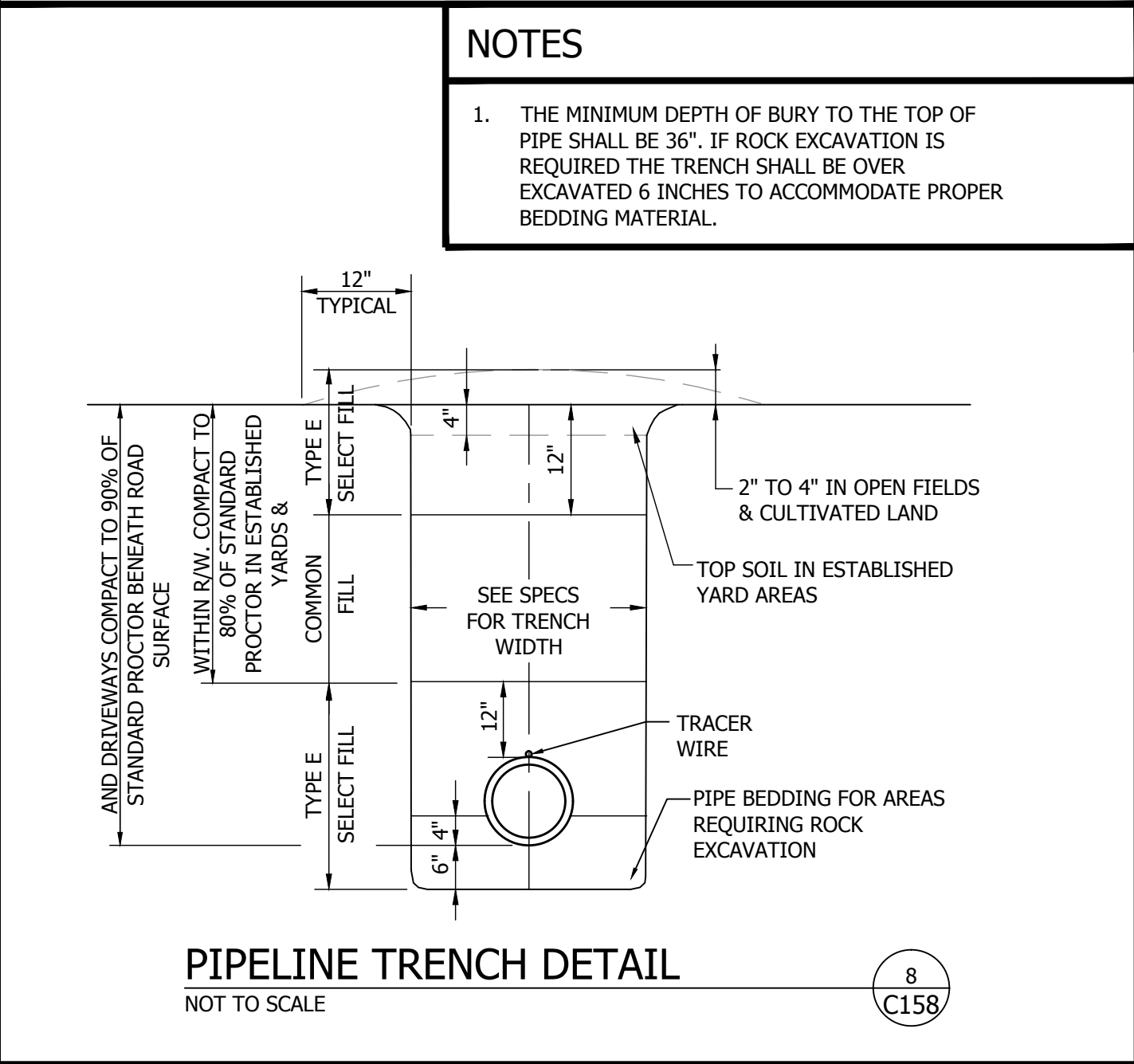
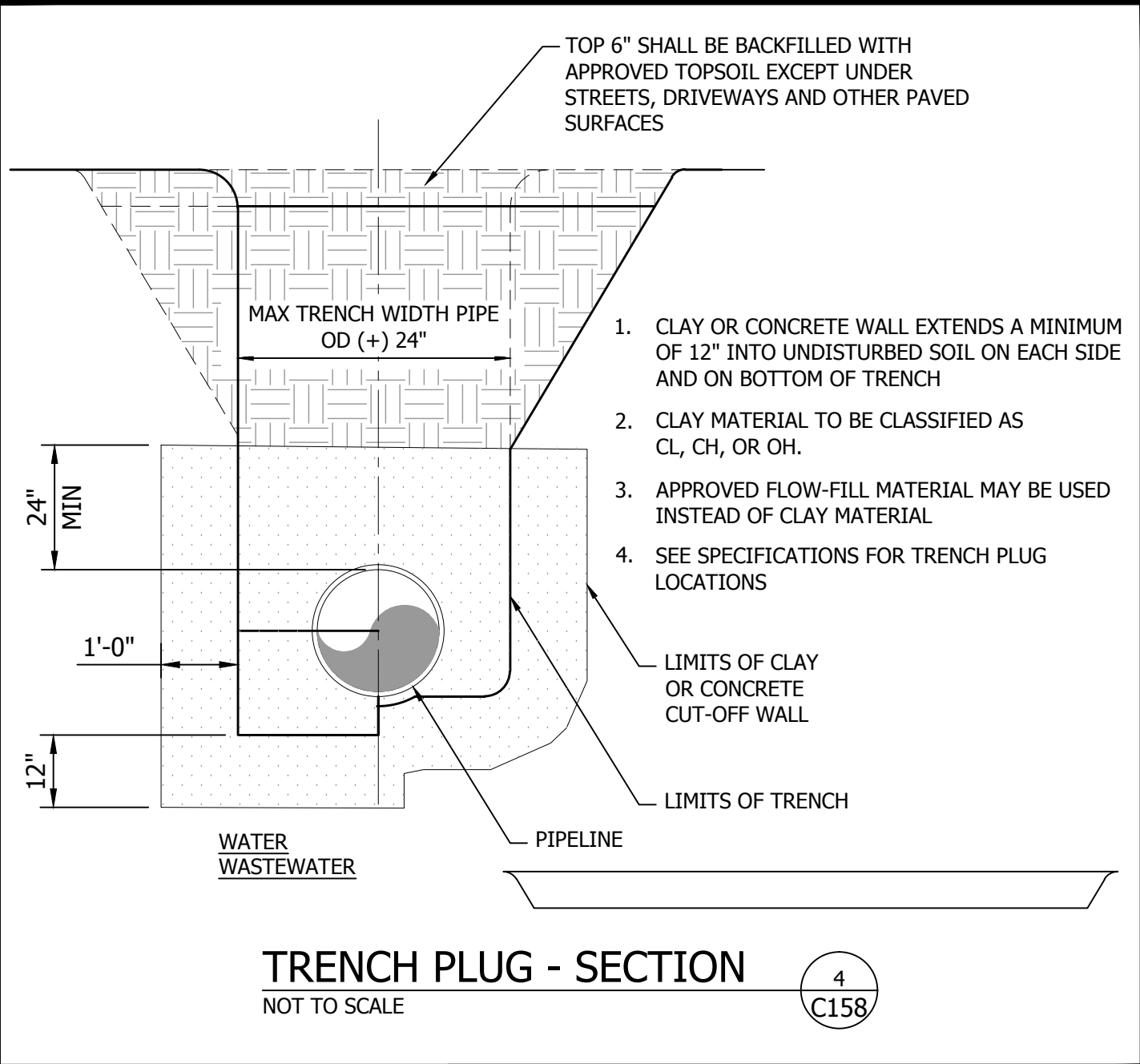
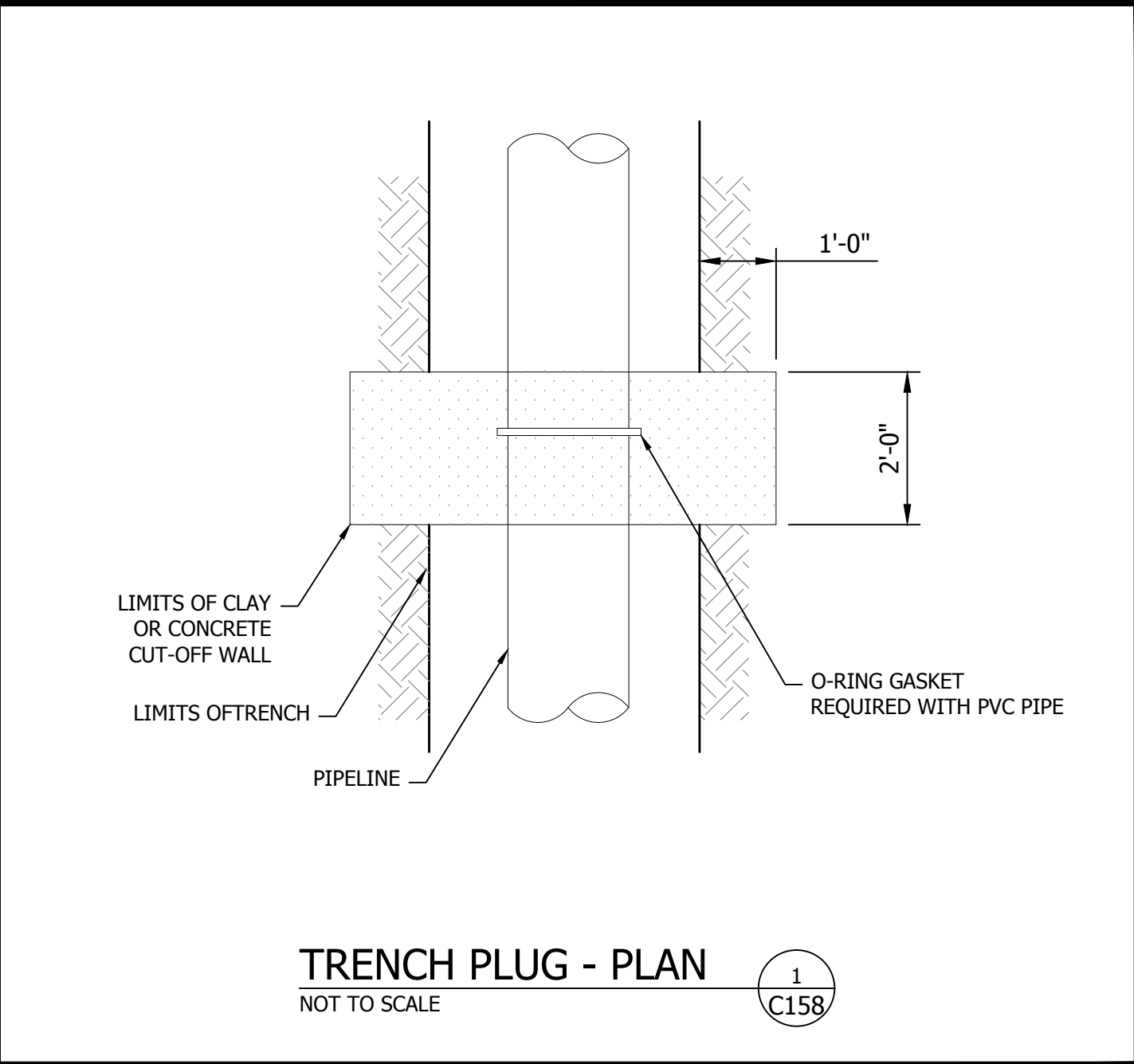


WATER PIPELINE
STA 199+00 - 209+00
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	RHT
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	C144
SHEET NO:	52 of 114

Drawing Name: W:\Proj\17000\17865\AutoCad_Raw Water Project\02 Civil\17865.005 Civil Details.dwg Layout Name: Details 3 Plotted By: MKAC0889 Plotted on: 11/25/2015 10:14:26 AM
Last edit on: 00/00/00



BLOCKING DIMENSIONS																							
TEES						PLUG			90° BEND			45° BEND			22.5° BEND			11.25° BEND					
B	C	D	E	F	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C				
22	9	13	-	-	13	22	9	13	22	9	9	12	12	6	12	12	6	12	12				
32	21	18	7	6	34	32	18	34	32	21	13	36	18	9	24	18	9	18	18				
42	23	22	8	6	40	42	24	40	42	23	18	38	27	12	30	27	12	24	27				
52	27	24	9	6	48	52	24	48	52	27	30	48	30	14	36	30	14	30	30				
60	30	27	12	6	54	60	30	54	60	33	42	60	36	14	36	30	18	36	36				

1/4" BOND BREAKER

LIFTING HOOKS

A

B

C

A/2

1/2 DIA.

ER PIPE JOINTS OR BOLTS WITH CONCRETE.

SECTION

NOT TO SCALE

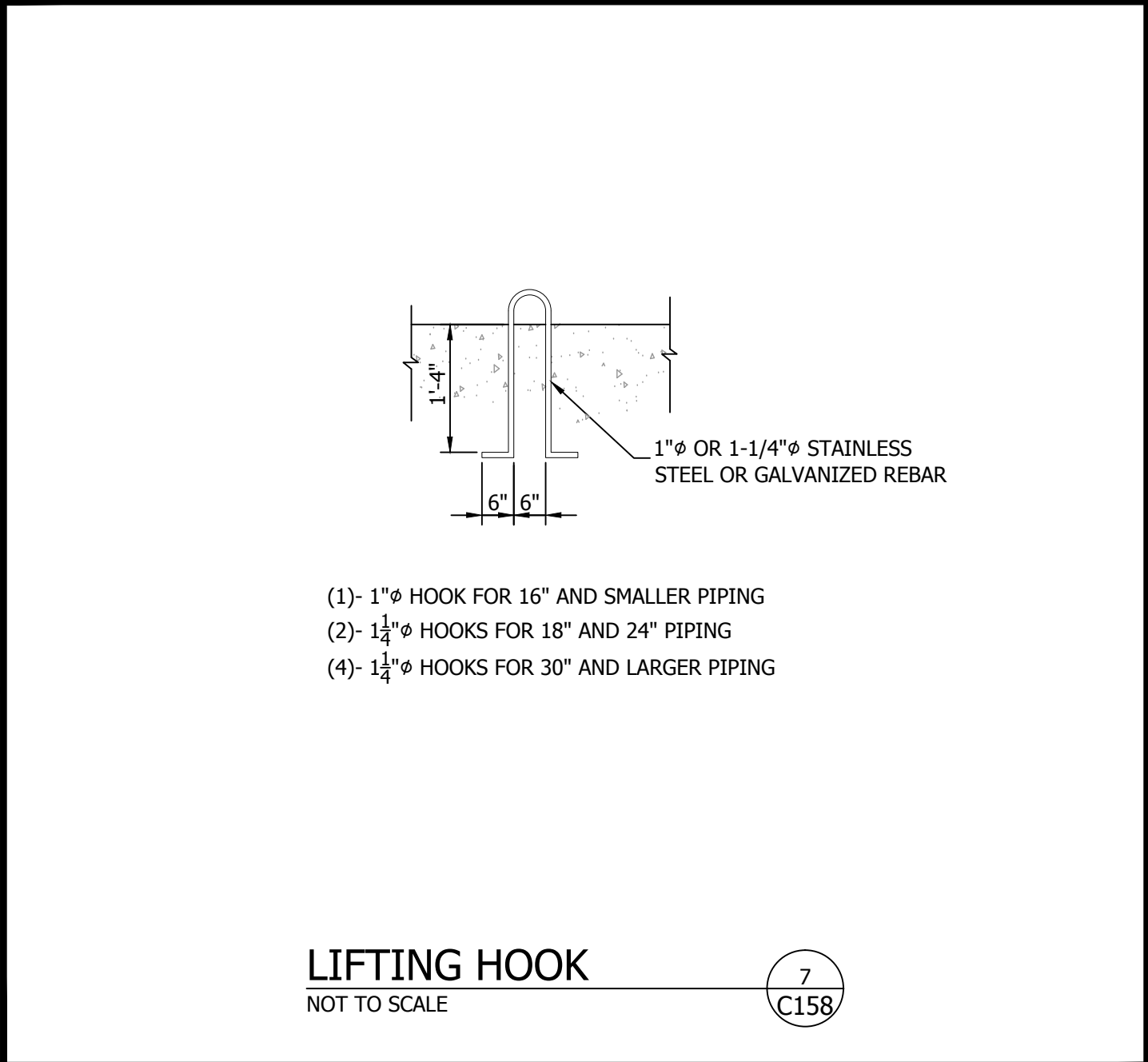
A

C158

ING DETAIL

3

C158



DESCRIPTION

DATE

#

BARTLETT & WEST

180 TALAMAN DR. UNIT D-1 PAGOSA SPRINGS, CO 81417
WWW.BARTLETTWEST.COM

CIVIL DETAILS

RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO

PROFESSIONAL ENGINEER
46250
10-8-15

DESIGNED BY: MKA
DRAWN BY: MKA
APPROVED BY: JAS
DESIGN PROJ: 17865.005
CONST PROJ: ----
SCALE: AS NOTED
DATE: OCT 2015
DRAWING NO: C158
SHEET NO: 66 of 114



1. CASING AND CARRIER PIPE SHALL BE PLACED SO AS NOT TO EXCEED THE BENDING LIMITS SET BY PIPE MANUFACTURER, IF NECESSARY STANDARD BENDS SHALL BE USED TO BRING CARRIER PIPE UP TO NORMAL BURY DEPTH. THE USE OF SHORT LENGTHS OF GASKET JOINT PIPE FOR JOINT DEFLECTION WILL NOT BE PERMITTED.

TYPICAL SPACER ARRANGEMENT

NOT TO SCALE

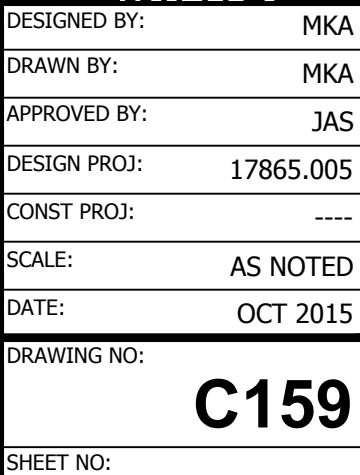


- # PIPELINE MARKER
-
- NOT TO SCALE

ALLOWABLE BEND FOR PVC PIPE

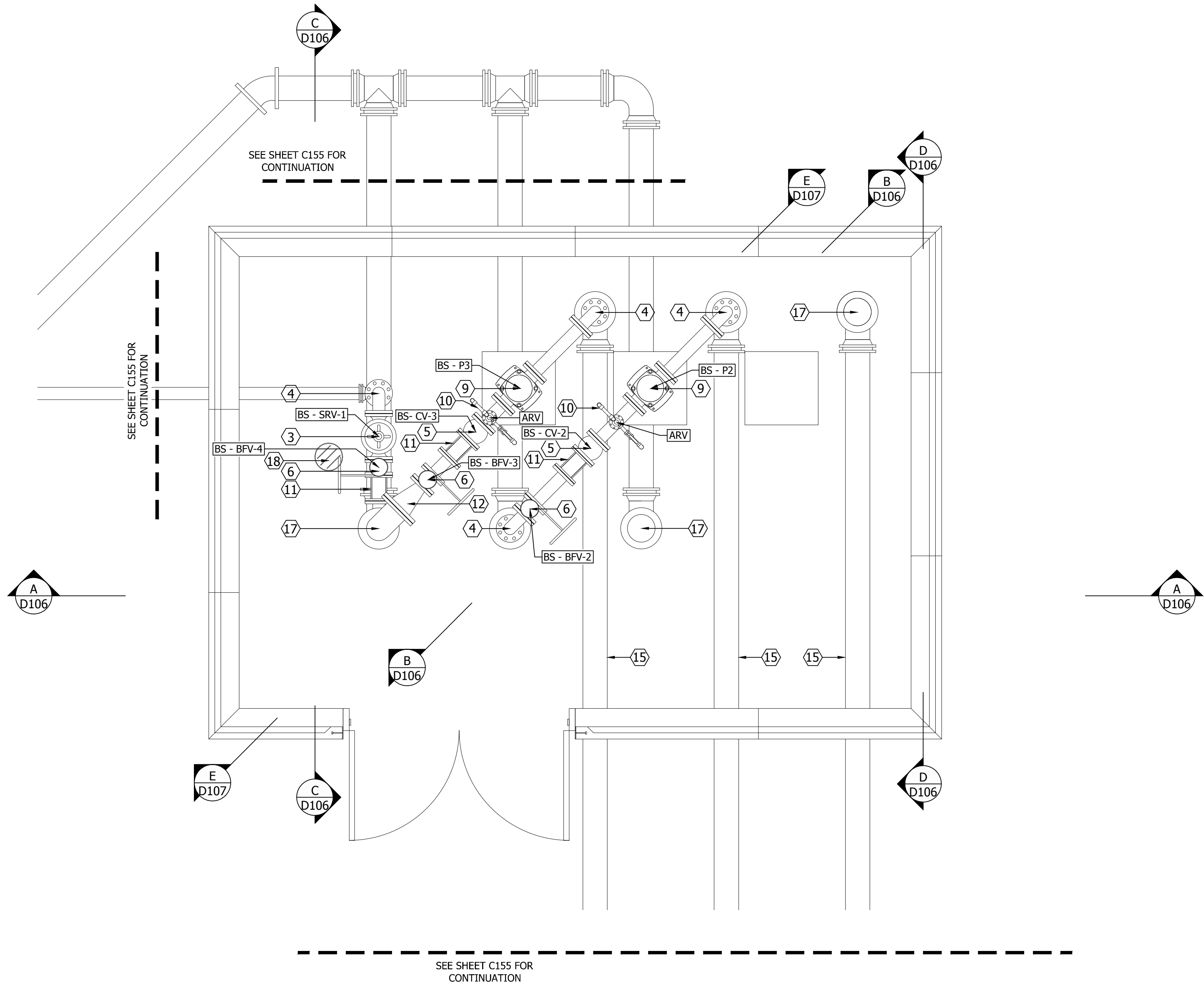


1. TOP OF ROOF HATCH SHALL BE 1'-6" ABOVE THE EXISTING GRADE OR AS REQUIRED TO ALLOW FINAL SITE TO BE GRADED FOR PROPER DRAINAGE AWAY FROM METER VAULT.



Drawing Name: W:\Proj\17000\17865\AutoCad\Raw Water Project\04 Process\17865.005 Booster Process Sheets.dwg Layout Name: Process Plotted on: 11/25/2015 10:09:56 AM Last edit on: 09/00/00

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1" IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.



BOOSTER STATION PROCESS PLAN
SCALE: 1/2" = 1'-0"

GENERAL NOTES:

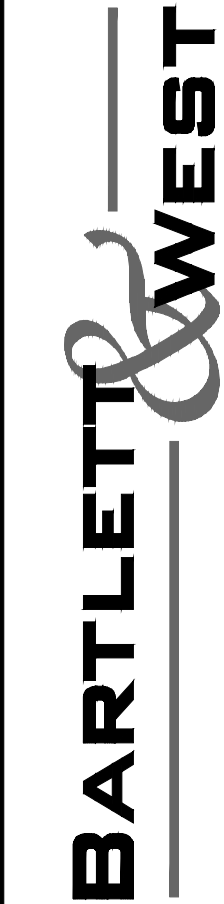
- SEE SHEET D104 FOR PROCESS GENERAL NOTES
- ENCASE ALL BURIED PIPE UNDER SLAB UNTIL 5'-0" BEYOND BUILDING PERIMETER.

EQUIPMENT LABELS:

BOOSTER PUMP 1	BS - P1
BOOSTER PUMP 2	BS - P2
BOOSTER PUMP 3	BS - P3
4" FL BUTTERFLY VALVE	BS - BFV-1
4" FL BUTTERFLY VALVE	BS - BFV-2
4" FL BUTTERFLY VALVE	BS - BFV-3
4" FL BUTTERFLY VALVE	BS - BFV-4
4" FL SURGE RELIEF VALVE	BS - SRV-1
4" FL CHECK VALVE	BS - CV-1
4" FL CHECK VALVE	BS - CV-2
4" FL CHECK VALVE	BS - CV-3

REFERENCE NOTES:

- 4"x4"x4" DI FL TEE
- 4" DI FL GATE VALVE
- 4" DI FL SURGE PROTECTOR
- 4" DI FL 90° BEND
- 4" DI FL CHECK VALVE
- 4" DI FL BUTTERFLY VALVE
- 8" DI RJ 90° BEND
- 8"x8"x8" DI RJ TEE
- 4" PUMP
- 4" DI FL AIR RELIEF
- 4" FI DL DISMANTLING JOINT
- 8"x4" DI FL REDUCER
- 8"x4" DI FL REDUCING TEE
- 4" DI RJ 90° BEND
- 8" DI FL x PE PIPE
- 4" DI FL x PE PIPE
- 8" DI FL 90° BEND
- ROUTE ALL ARVs TO FLOOR DRAIN, SEE SHEET M201
- 4" DI BLIND FLANGE



BOOSTER STATION
PROCESS PLAN
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



DESIGNED BY:	KJB
DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	D105
SHEET NO:	97 of 114

GENERAL NOTES:

- SEE SHEET D104 FOR PROCESS GENERAL NOTES
- ENCASE ALL BURIED PIPE UNDER SLAB UNTIL 5'-0" BEYOND BUILDING PERIMETER.

EQUIPMENT LABELS:

BOOSTER PUMP 1	BS - P1
BOOSTER PUMP 2	BS - P2
BOOSTER PUMP 3	BS - P3
4" FL BUTTERFLY VALVE	BS - BFV-1
4" FL BUTTERFLY VALVE	BS - BFV-2
4" FL BUTTERFLY VALVE	BS - BFV-3
4" FL BUTTERFLY VALVE	BS - BFV-4
4" FL SURGE RELIEF VALVE	BS - SRV-1
4" FL CHECK VALVE	BS - CV-1
4" FL CHECK VALVE	BS - CV-2
4" FL CHECK VALVE	BS - CV-3

REFERENCE NOTES:

- 4"x4"x4" DI FL TEE
- 4" DI FL GATE VALVE
- 4" DI FL SURGE PROTECTOR
- 4" DI FL 90° BEND
- 4" DI FL CHECK VALVE
- 4" DI FL BUTTERFLY VALVE
- 8" DI RJ 90° BEND
- 8"x8"x8" DI RJ TEE
- 4" PUMP
- 4" DI FL AIR RELIEF
- 4" FI DL DISMANTLING JOINT
- 8"x4" DI FL REDUCER
- 8"x4" DI FL REDUCING TEE
- 4" DI RJ 90° BEND
- 8" DI FL x PE PIPE
- 4" DI FL x PE PIPE
- 8" DI FL 90° BEND
- ROUTE ALL ARV's TO FLOOR DRAIN, SEE SHEET M201
- 4" DI BLIND FLANGE

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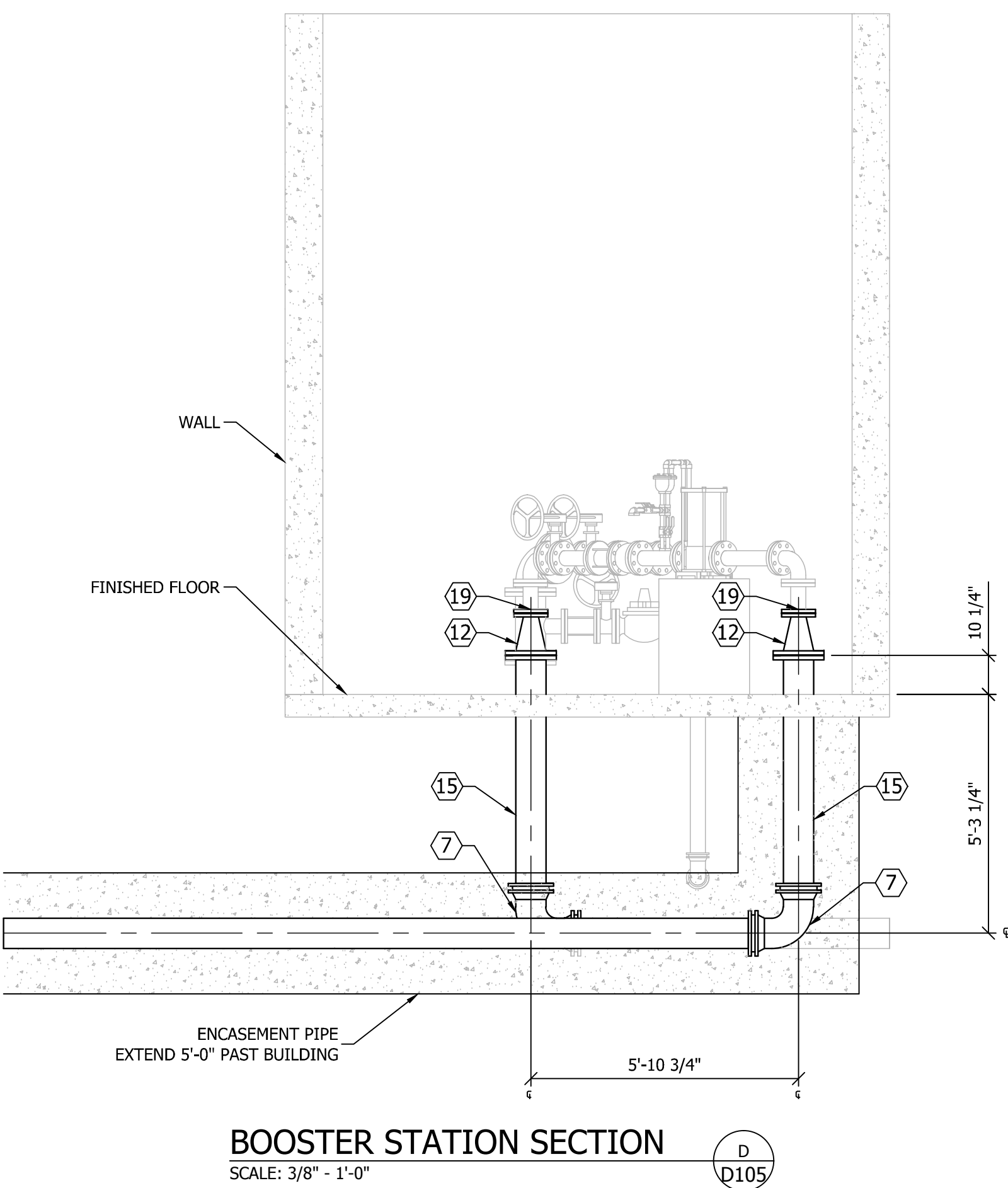
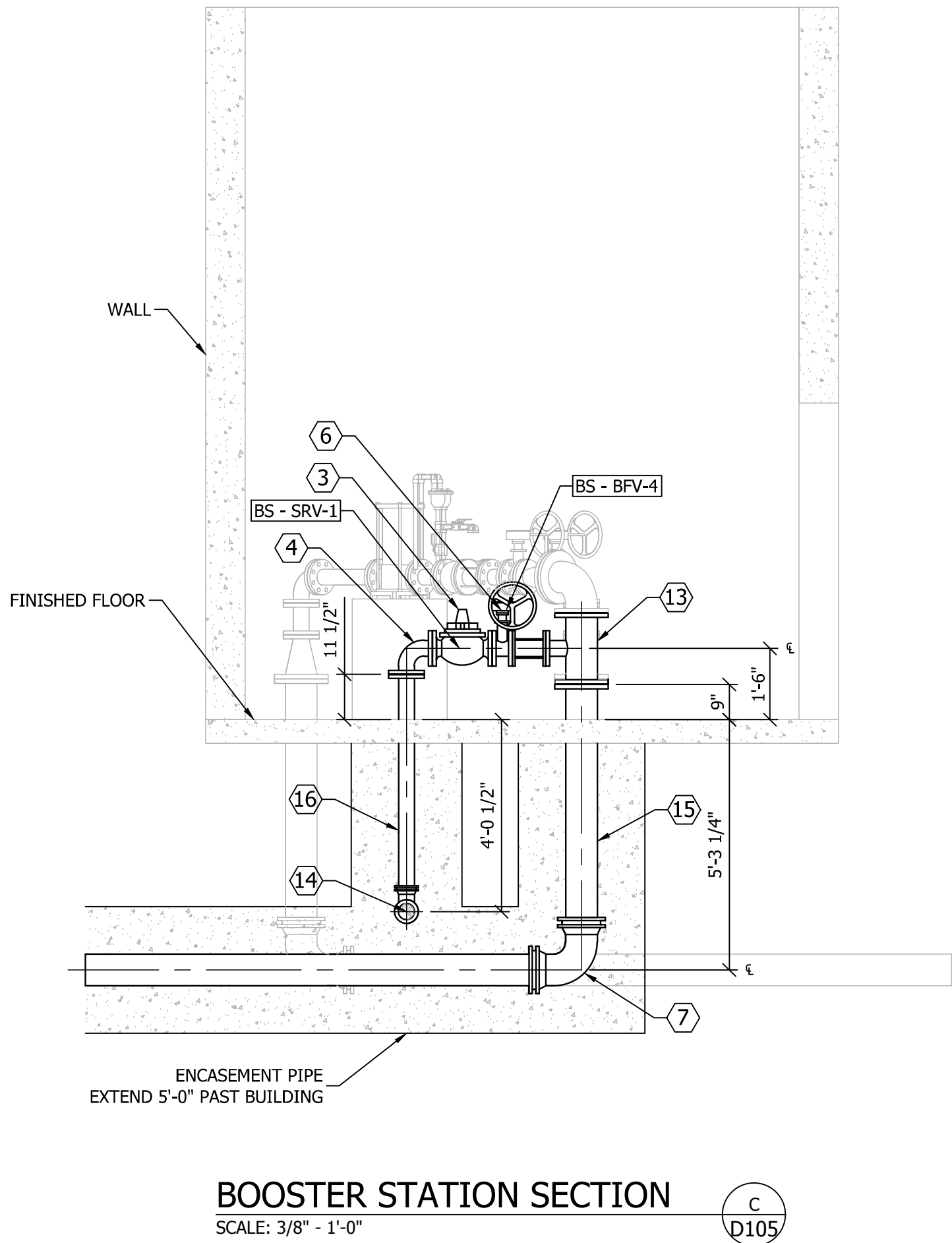
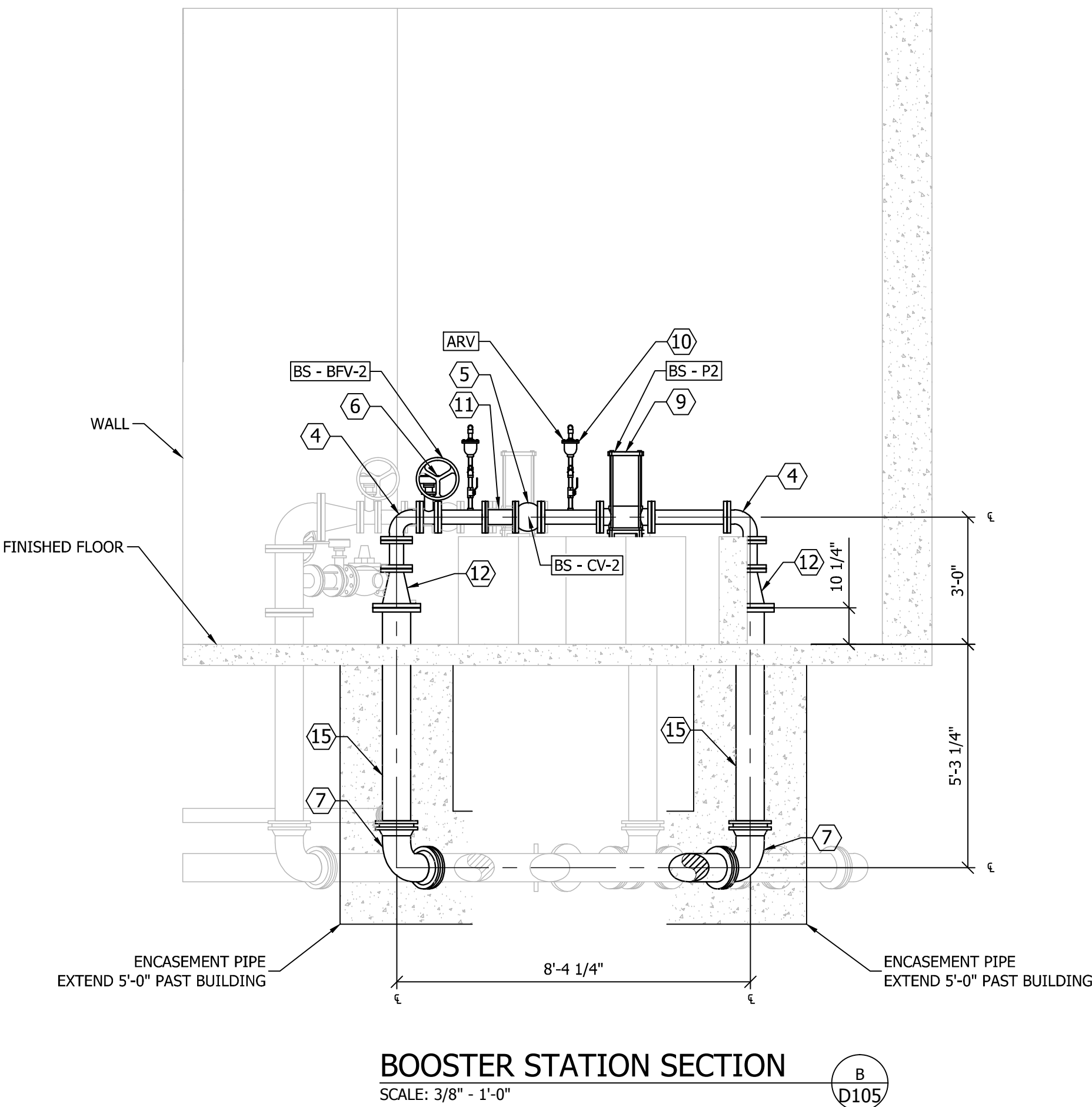
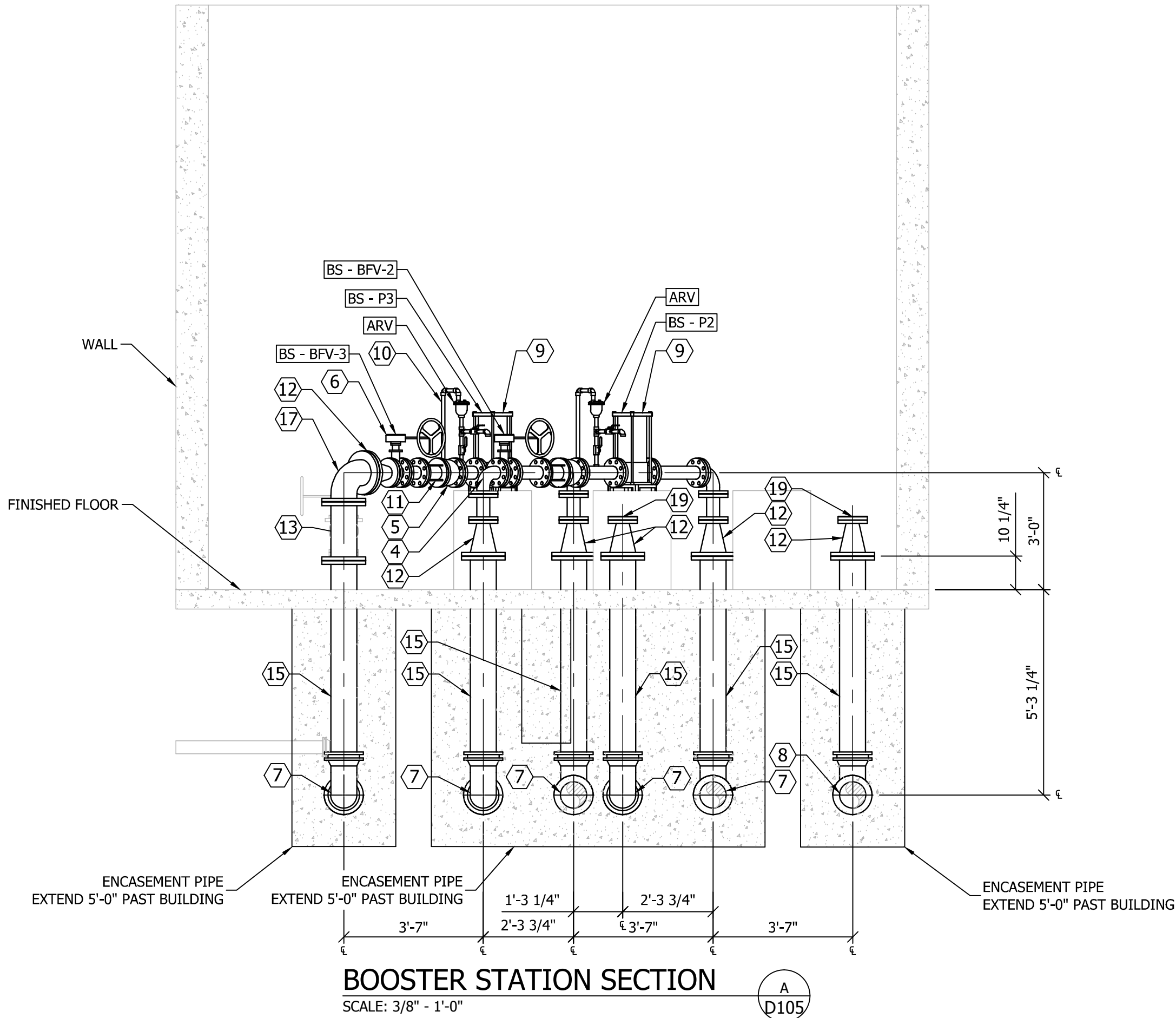
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**BOOSTER STATION
PROCESS SECTIONS**

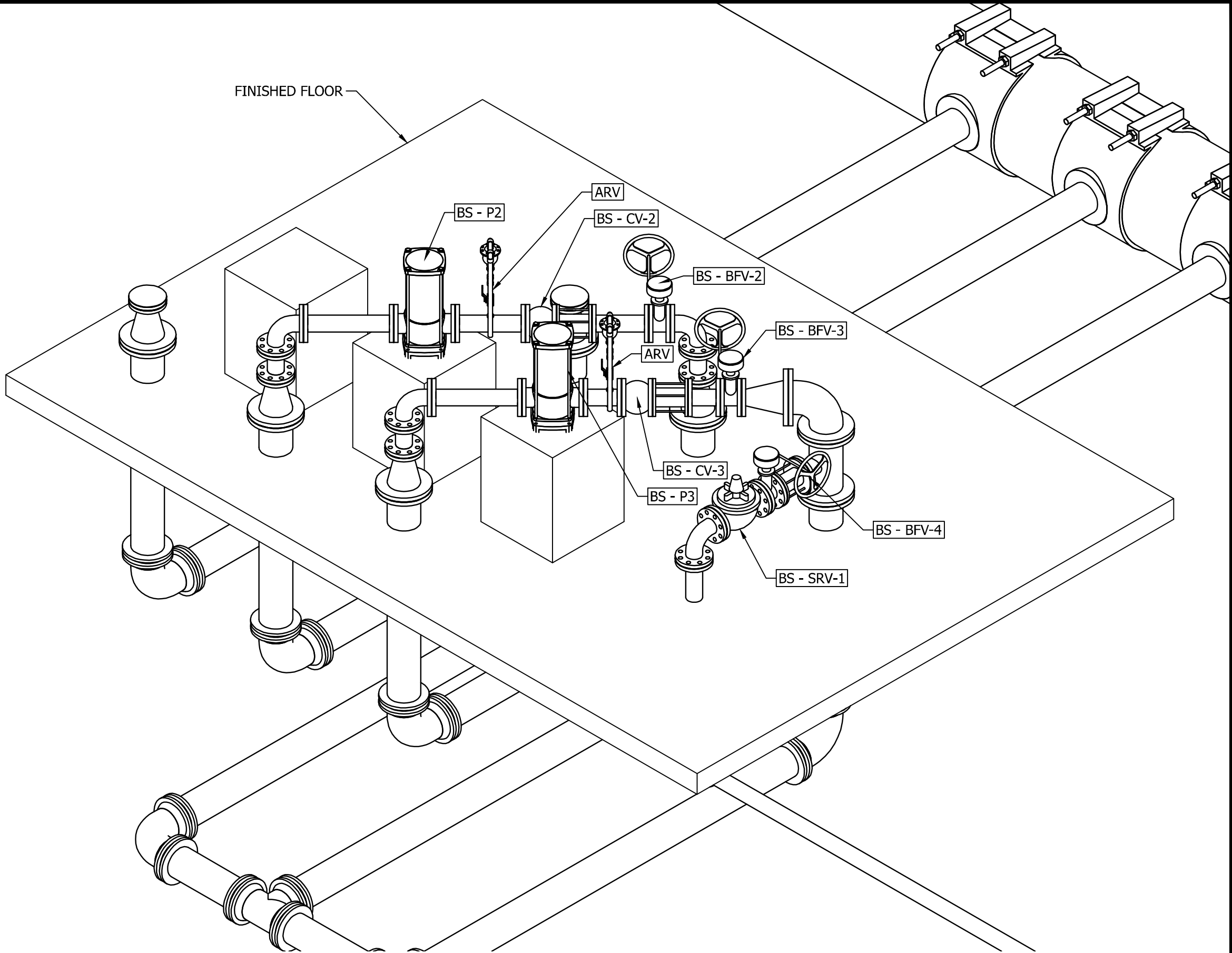
RAW WATER PROJECT
LA PLATA WEST WATER AUTHORITY
LA PLATA COUNTY, COLORADO



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DRAWN BY:	MKA
APPROVED BY:	JAS
DESIGN PROJ:	17865.005
CONST PROJ:	----
SCALE:	AS NOTED
DATE:	OCT 2015
DRAWING NO:	D106
SHEET NO:	98 of 114

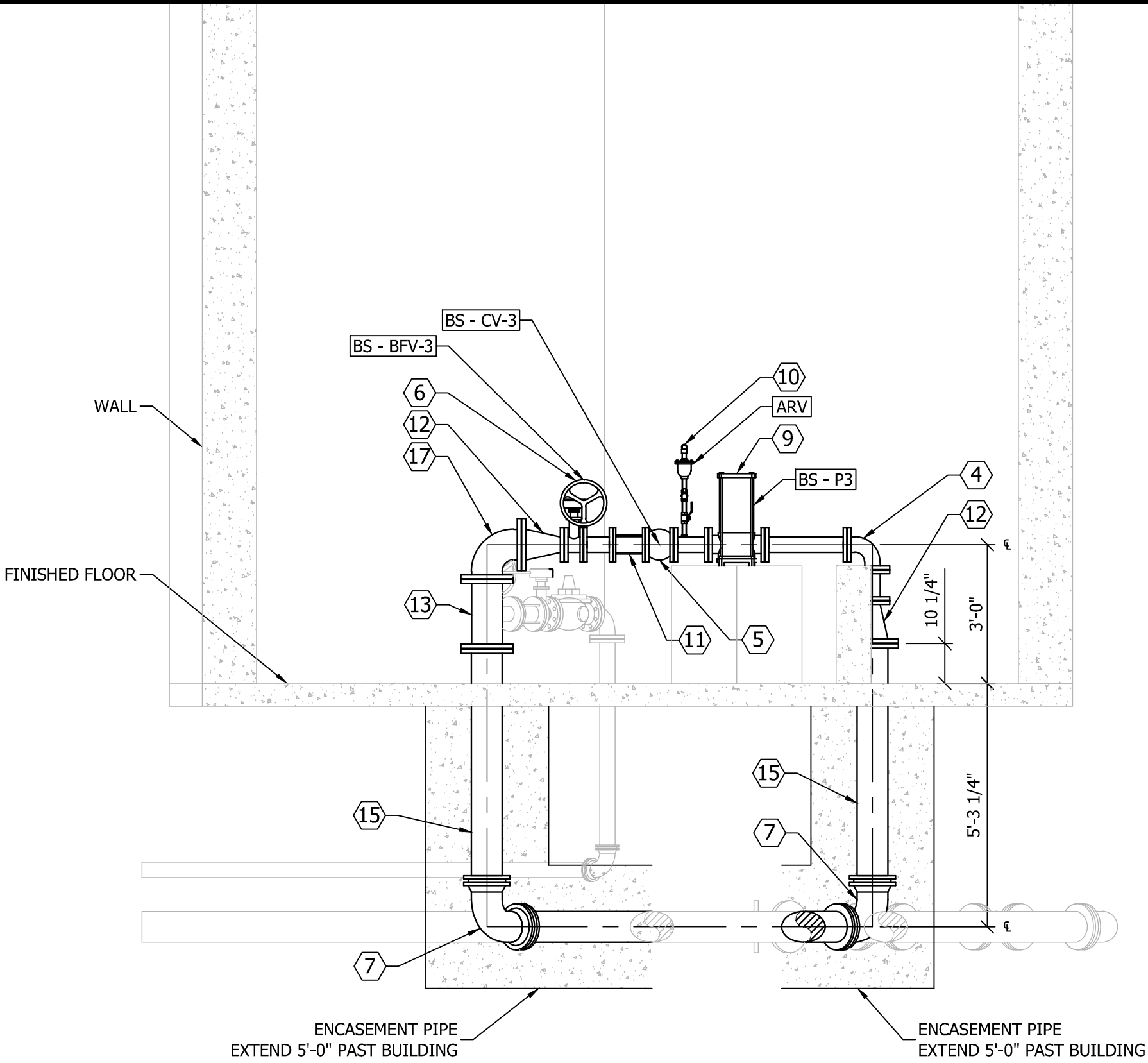


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 Layout Name: Sections 2
 Plotted By: MKA0889
 Plotted on: 11/25/2015 10:10:05 AM



NW ISOMETRIC VIEW
SCALE: 1/2" - 1'-0"

D107



BOOSTER STATION SECTION
SCALE: 3/8" - 1'-0"

E
D105

GENERAL NOTES:

- SEE SHEET D104 FOR PROCESS GENERAL NOTES
- ENCASE ALL BURIED PIPE UNDER SLAB UNTIL 5'-0" BEYOND BUILDING PERIMETER.

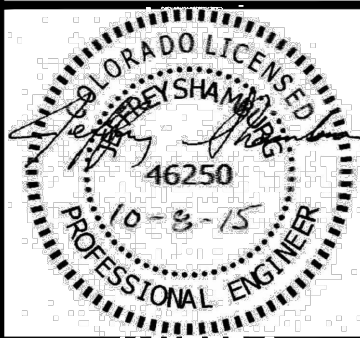
EQUIPMENT LABELS:

BOOSTER PUMP 1	BS - P1
BOOSTER PUMP 2	BS - P2
BOOSTER PUMP 3	BS - P3
4" FL BUTTERFLY VALVE	BS - BFV-1
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4" FL BUTTERFLY VALVE	BS - BFV-3
4" FL BUTTERFLY VALVE	BS - BFV-4
4" FL SURGE RELIEF VALVE	BS - SRV-1
4" FL CHECK VALVE	BS - CV-1
4" FL CHECK VALVE	BS - CV-2
4" FL CHECK VALVE	BS - CV-3

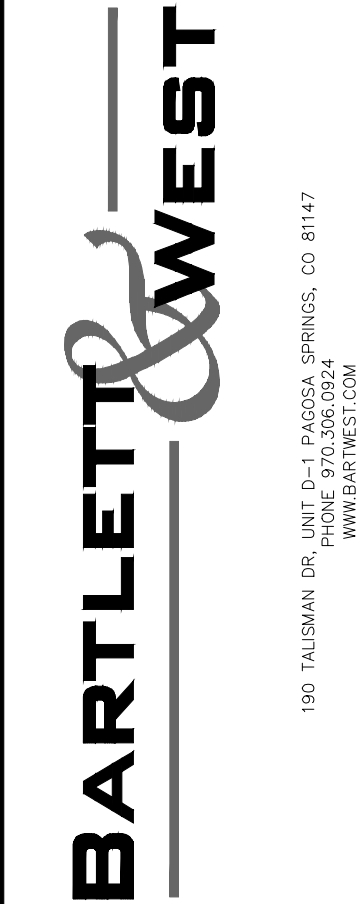
REFERENCE NOTES:

- 4"x4"x4" DI FL TEE
- 4" DI FL GATE VALVE
- 4" DI FL SURGE PROTECTOR
- 4" DI FL 90° BEND
- 4" DI FL CHECK VALVE
- 4" DI FL BUTTERFLY VALVE
- 8" DI RJ 90° BEND
- 8"x8"x8" DI RJ TEE
- 4" PUMP
- 4" DI FL AIR RELIEF
- 4" FI DL DISMANTLING JOINT
- 8"x4" DI FL REDUCER
- 8"x4" DI FL REDUCING TEE
- 4" DI RJ 90° BEND
- 8" DI FL x PE PIPE
- 4" DI FL x PE PIPE
- 8" DI FL 90° BEND
- ROUTE ALL ARVs TO FLOOR DRAIN, SEE SHEET M201
- 4" DI BLIND FLANGE

BOOSTER STATION
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