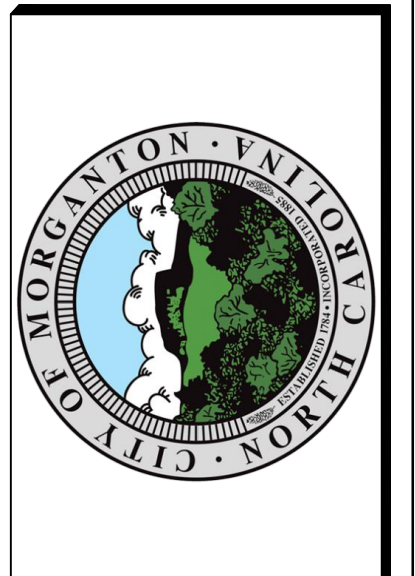
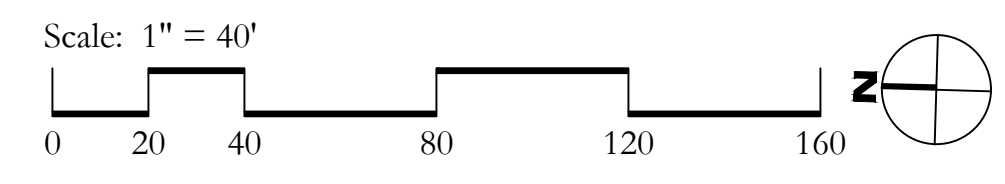


- NOTES:**
- FIELD VERIFY ELEVATION OF EXISTING UTILITIES BY POTHOLING PRIOR TO CONSTRUCTION. PROTECT IN PLACE. COORDINATE AND COMPLY WITH CROSSING AND INSPECTION REQUIREMENTS WITH UTILITY COMPANY
  - UTILITY CROSSINGS SHOWN AT ASSUMED ELEVATIONS
  - CAUTION: WORK AREA INCLUDES OVERHEAD ELECTRIC LINES
  - ROADWAY BORE NOTE: CONTRACTOR SHALL PROVIDE SHORING FOR ALL PITS ALONG ROADWAYS PER SPECIFICATIONS
  - ALL 8" PVC GRAVITY SEWER PIPE SHALL BE ASTM D3034 PER SPECIFICATION 33 05 05.03
  - CONTRACTOR SHALL PROVIDE APPROPRIATE TRANSITION FITTINGS FOR CHANGES IN PIPE MATERIAL



REVISIONS	DATE	BY	DESCRIPTION
1	06/06/22	DM	Adjusted MH 17 INV in
2	06/06/22	DM	
3	11/09/22	EC	
4	11/30/22	SK	

DESIGN BY:	DATE:
DM	06/06/22
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DM	06/06/22
CHECKED BY:	DATE:
EC	11/09/22
APPROVED BY:	DATE:
SK	11/30/22

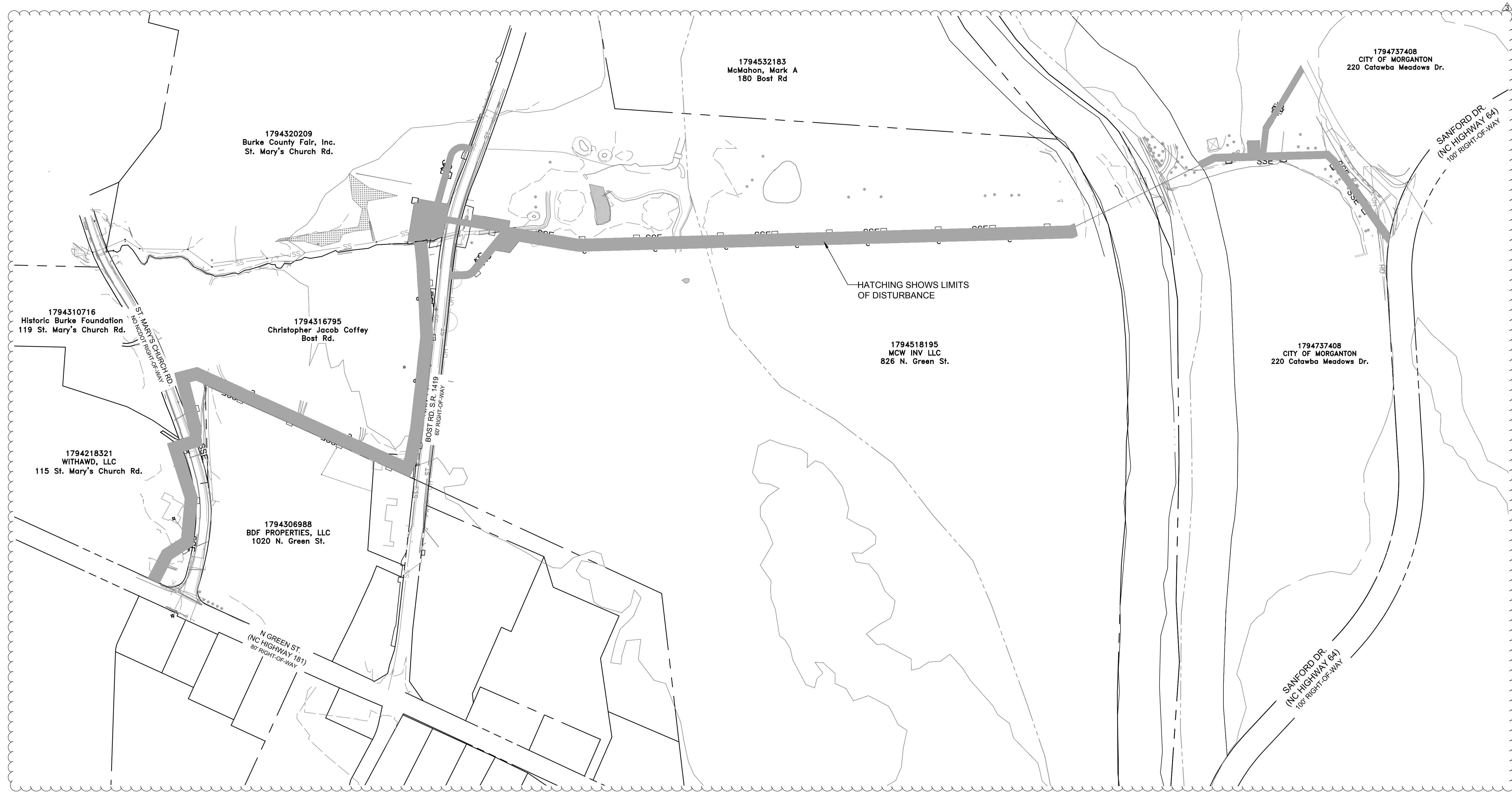
**Bost Rd Sewer Improvements**  
Morganton, NC

**Gravity Sewer Plan & Profile**  
STA 20+50 - END

**FINAL DESIGN - 100%**  
**RELEASED FOR**  
**CONSTRUCTION**

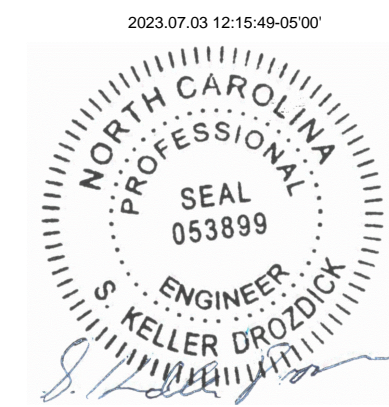
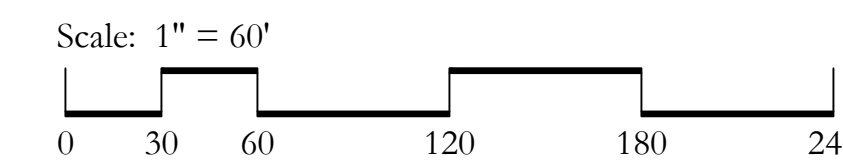
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DATE: 05/04/23  
SHEET: C2.3

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**NOTES:**

1. PROJECT IS LOCATED WITHIN THE CATAWBA RIVER BASIN, WS-IV CLASSIFICATION.
2. LIMITS OF DISTURBANCE ARE OUTLINED BY TEMPORARY, PERMANENT, AND ACCESS EASEMENT LINE TYPES.
3. THE GRAY HATCHED AREA IN THE PLAN REPRESENT THE FULL LIMITS OF DISTURBANCE FOR THIS PROJECT
4. IF ADDITIONAL AREAS OUTSIDE THE EXISTING LIMITS OF DISTURBANCE ARE REQUIRED BY THE CONTRACTOR, A PLAN SHOWING THE REVISED LIMITS OF DISTURBANCE MUST BE SUBMITTED TO NC DEQ REGIONAL OFFICE FOR REVIEW AND APPROVAL.
5. ADDITIONAL AREAS OUTSIDE THE EXISTING ACCESS ROADS MUST BE SUBMITTED TO NC DEQ REGIONAL OFFICE FOR REVIEW AND APPROVAL.
6. ALL LAYDOWN YARDS AND AREAS USED FOR STOCKPILE OR SPOIL STORAGE MUST BE ENCLOSED BY A TEMPORARY SILT FENCE.



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 OF SERVICE ARE NOT PROVIDING ANY GUARANTEE OR WARRANTY IN CONNECTION  
 WITH THIS PROJECT. THE PROJECT CONSTRUCTION SHALL BE THE RESPONSIBILITY  
 OF THE CLIENT. THE FIRM SHALL NOT BE RESPONSIBLE FOR ANY DAMAGE TO  
 PROPERTY OR LOSS OF LIFE OR LIMB DURING THE CONSTRUCTION OF THIS PROJECT.



REVISIONS:	DATE:	BY:	DESCRIPTION:
1	06/06/22	DM	Added limits of disturbance hatch

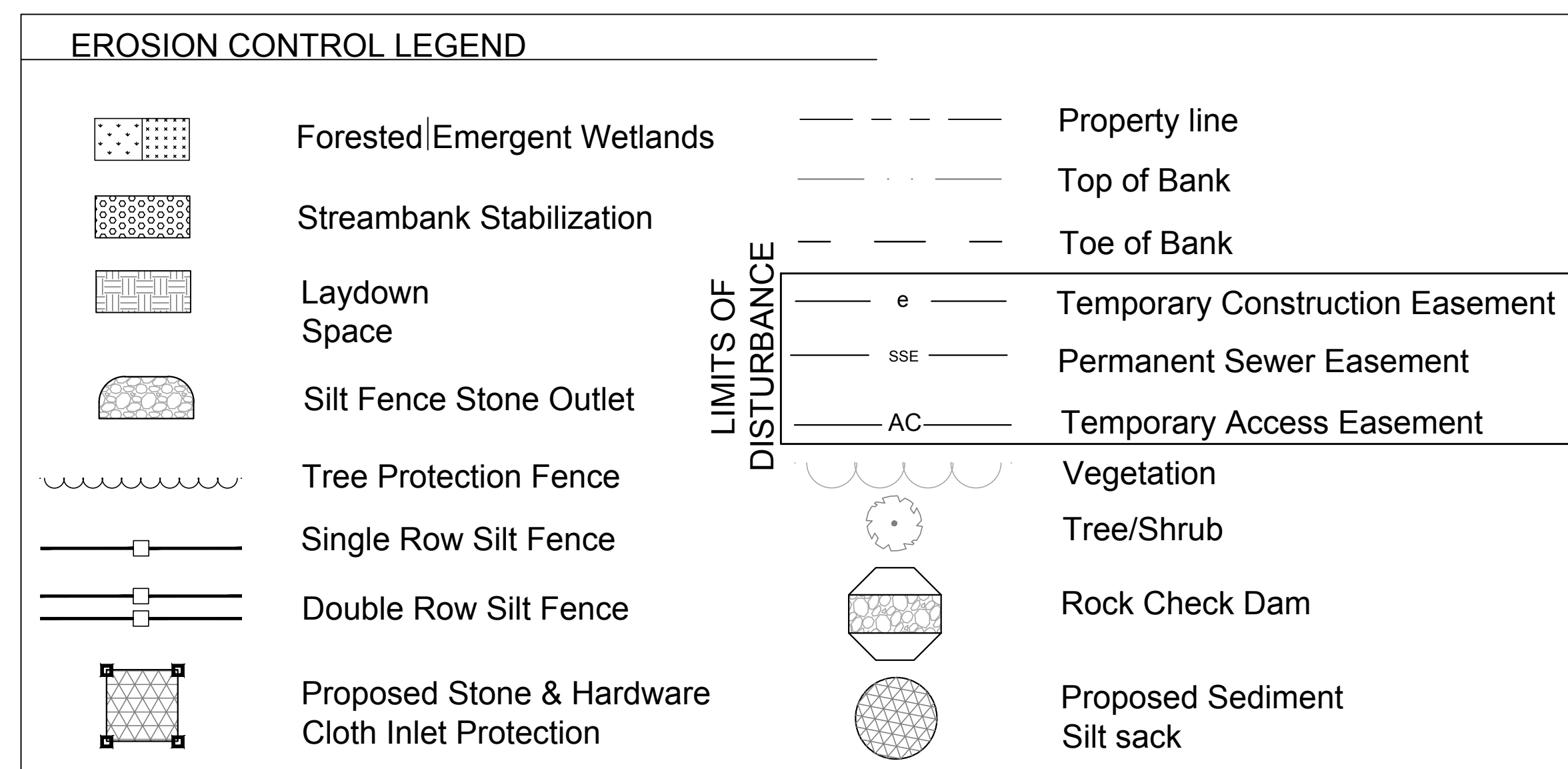
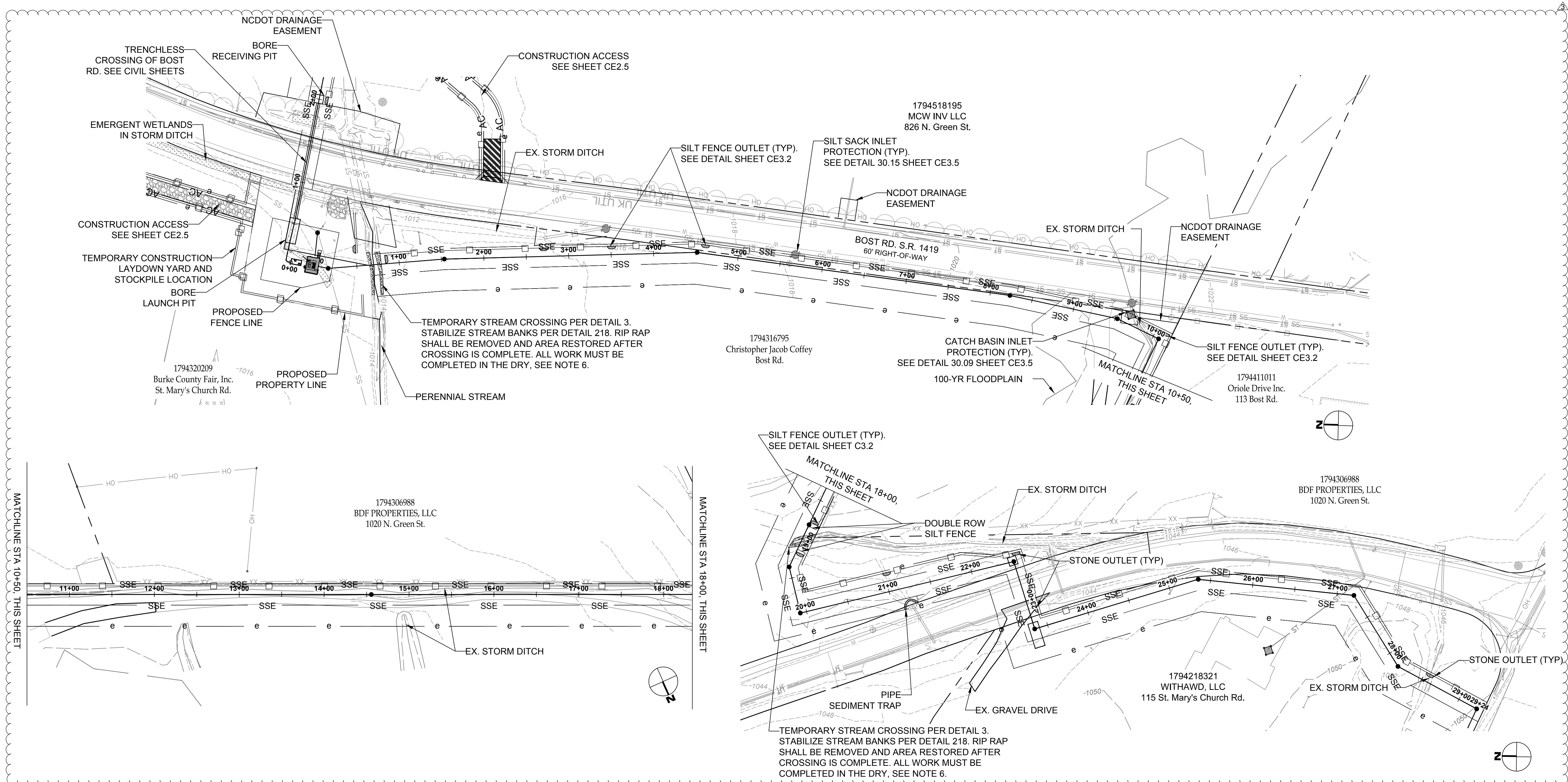
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BRH	06/06/22
DRWN BY:	DM
CHKD BY:	ECH
APPRD BY:	SK

**Bost Rd Sewer Improvements**  
 Morganton, NC  
**Site Plan**  
**Erosion Control**

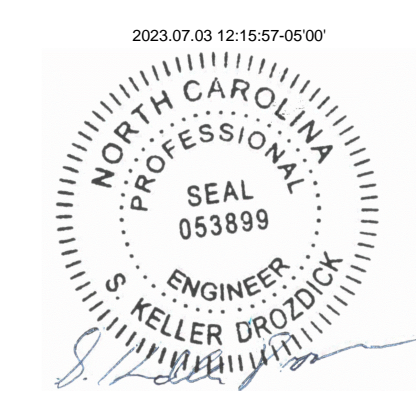
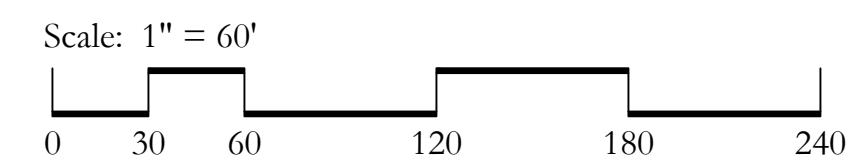
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**CONSTRUCTION**

JOB NO: 65421093  
 DATE: 05/04/23  
 SHEET: CE.1

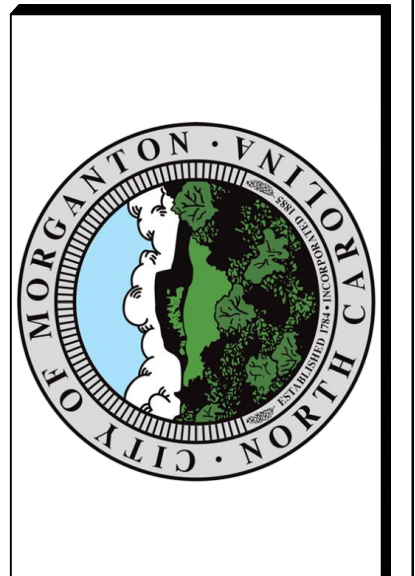
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- ### Notes
1. Polyacrylamides (PAM) shall be used to reduce turbidity and suspended solids whenever a sediment trap, basin, pit, hole or building foundation is being pumped out to remove sediment laden water. This activity must be inspected and approved by the regional erosion control inspector.
  2. Use Double Row Silt Fence along creeks and wetlands.
  3. Silt fence around bore pits, see detail 3 Sheet CE3.4
  4. A ground cover sufficient to restrain accelerated erosion must be provided within 7-14 calendar days of the date of last land-disturbing activity on any portion of the project. See seeding details on Sheet CE3.1.
  5. All diversion ditches and interior basin slopes must be matted. See detail 30.20 on Sheet CE3.2.
  6. Stockpile material for trenches will be placed upslope of the excavation to be promptly backfilled into trenches. Trenches to be stabilized same day for linear pipe work. All work in creeks and streams must be completed in the dry. Please see Detail 30.13 on Sheet CE3.2, Detail 4 on Sheet CE3.5, and Specification 31 23 19 for dewatering requirements.
  7. Any trees designated for protection and any other trees outside easements damaged by contractor shall be replaced as required by the City of Morganton.



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REVISIONS	DATE	BY	DESCRIPTION

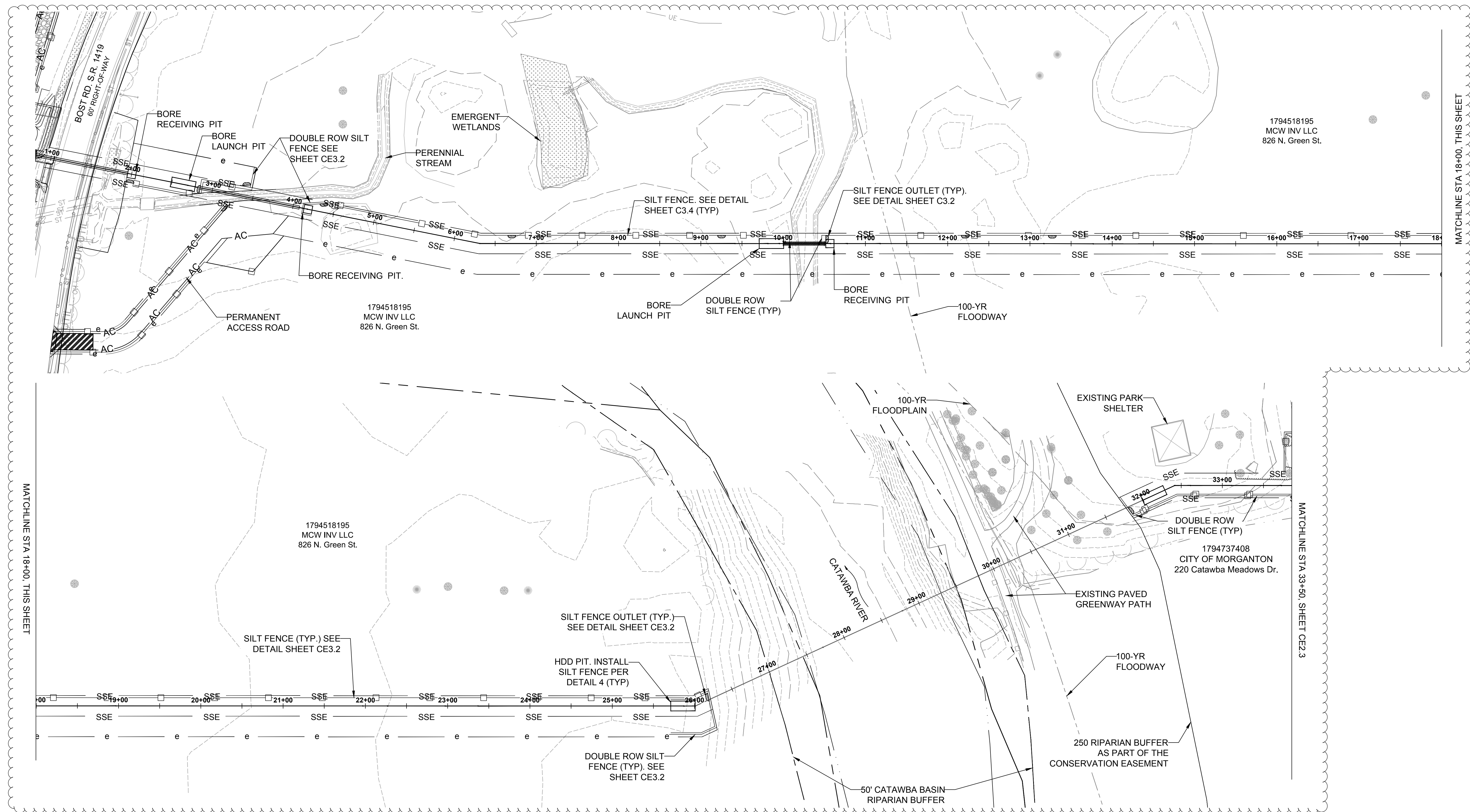
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CHKD BY:	
APP'D BY:	

**Bost Rd Sewer Improvements**  
 Morganton, NC  
**Gravity Sewer Erosion Control**

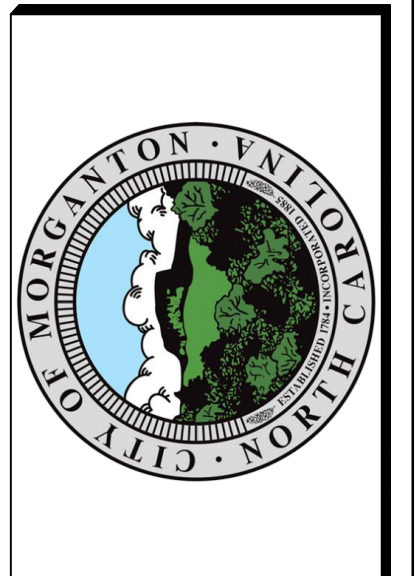
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 CONSTRUCTION**

JOB NO: 65421093  
 DATE: 05/04/23  
 SHEET: **CE.2.2**

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REVISIONS	DATE	BY	DESCRIPTION
1	06/06/22	DMW	Issue permanent and temp easement
2	11/09/22	ECH	Check
3	11/30/22	SKG	Check

DESIGN BY:	DATE:
BRH	06/06/22
DRAWN BY:	DATE:
DMW	06/06/22
CHECKED BY:	DATE:
ECH	11/09/22
APPROVED BY:	DATE:
SKG	11/30/22

**Bost Rd Sewer Improvements**  
 Morganton, NC  
**Force Main Erosion Control**

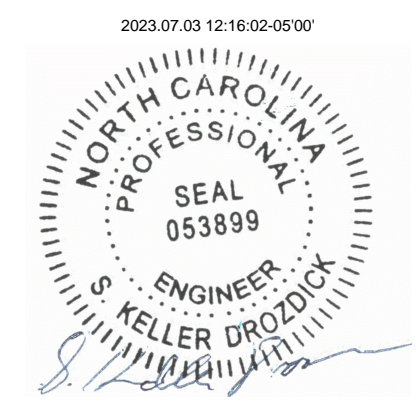
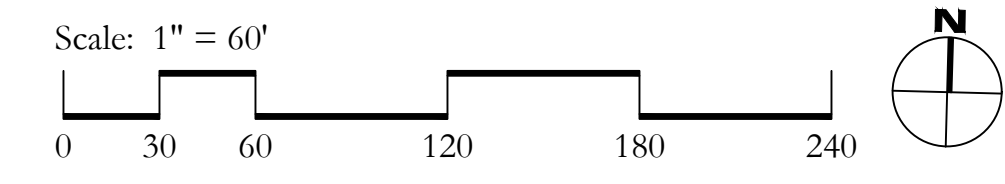
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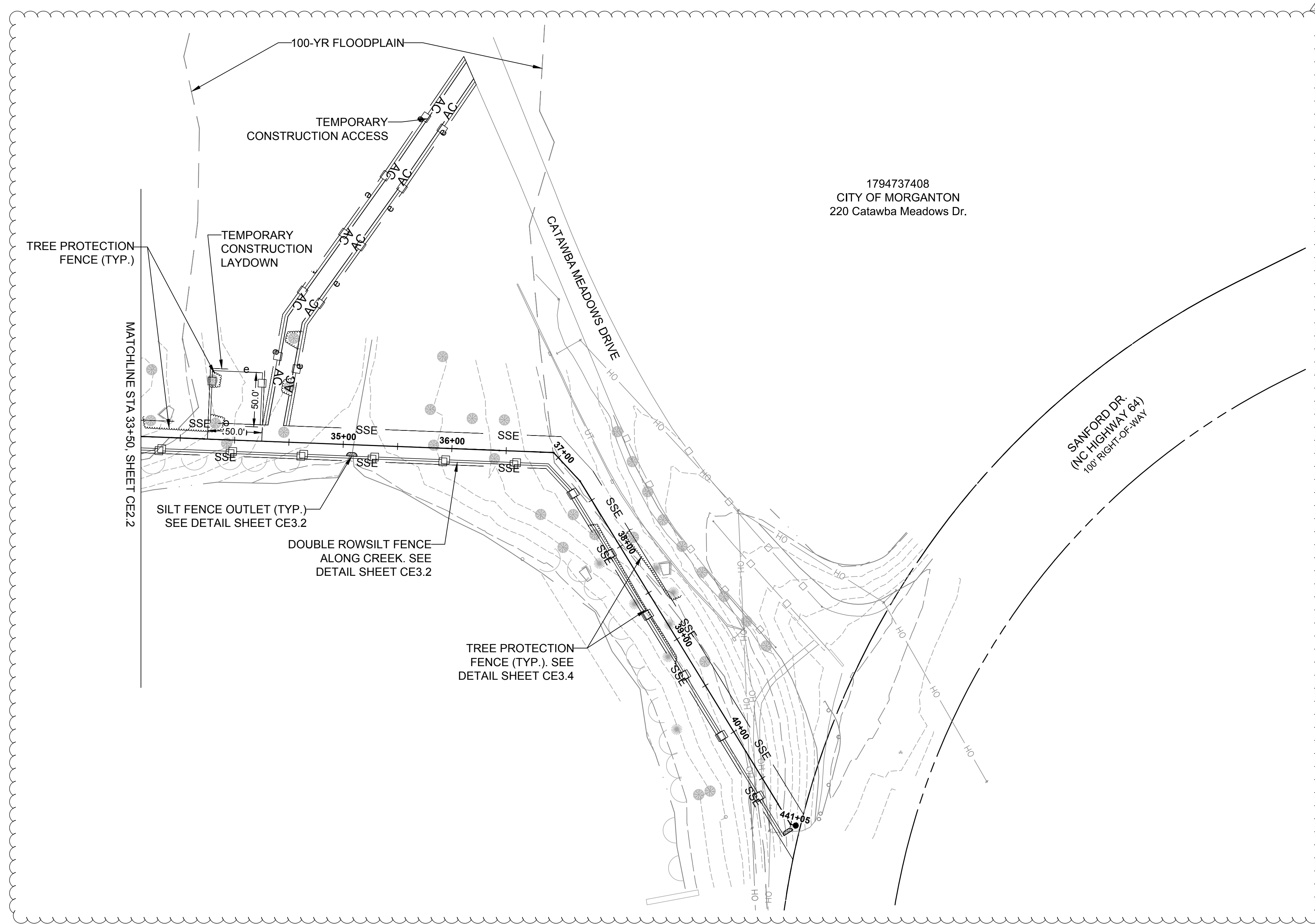
JOB NO: 65421093  
 DATE: 05/04/23  
 SHEET: CE2.3

**EROSION CONTROL LEGEND**

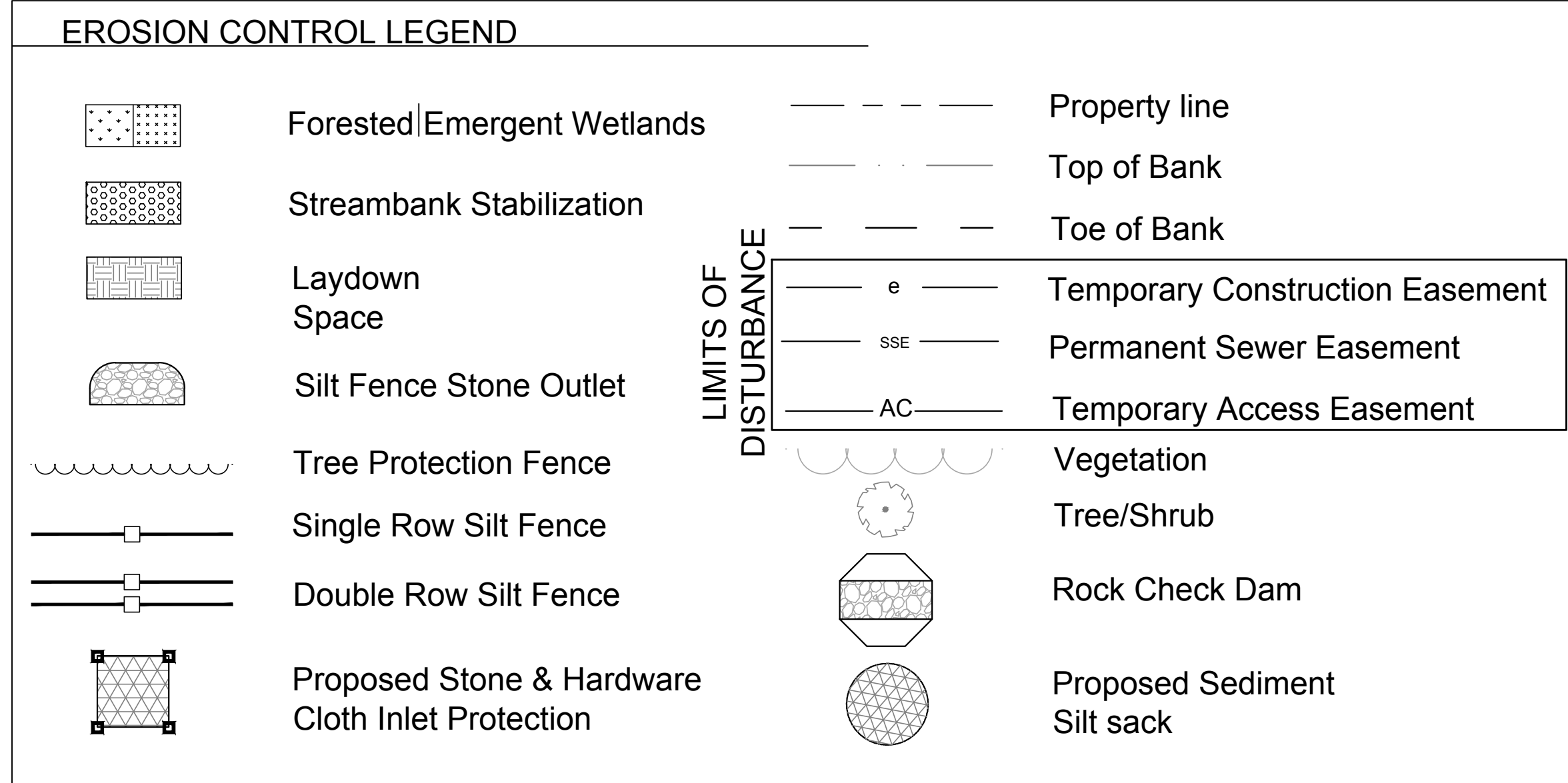
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	Streambank Stabilization		Top of Bank
	Laydown Space		Toe of Bank
	Silt Fence Stone Outlet		Temporary Construction Easement
	Tree Protection Fence		Permanent Sewer Easement
	Single Row Silt Fence		Temporary Access Easement
	Double Row Silt Fence		Vegetation
	Proposed Stone & Hardware Cloth Inlet Protection		Tree/Shrub
			Rock Check Dam
			Proposed Sediment Silt sack

1. Polyacrylamides (PAM) shall be used to reduce turbidity and suspended solids whenever a sediment trap, basin, pit, hole or building foundation is being pumped out to remove sediment laden water. This activity must be inspected and approved by the regional erosion control inspector.
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7. Any trees designated for protection and any other trees outside easements damaged by contractor shall be replaced as required by the City of Morganton. Contractor to coordinate with Owner if more than 6 trees are to be removed in the Catawba Meadows Park easement.

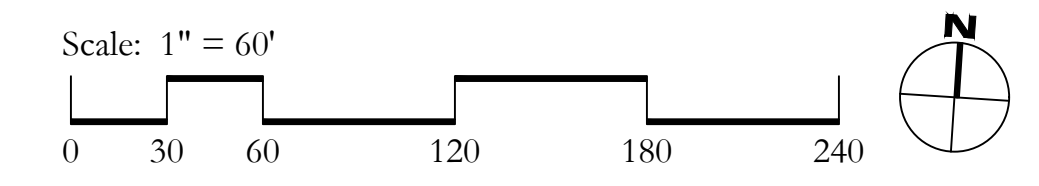




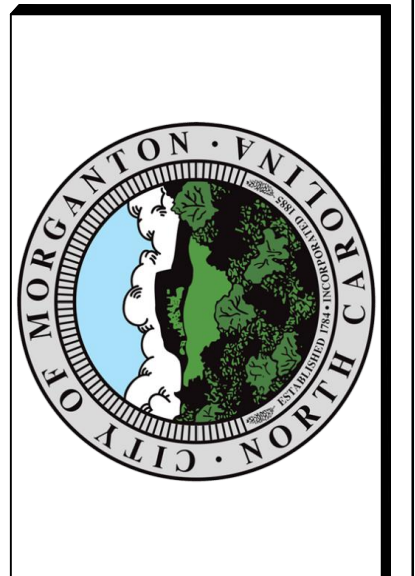
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CITY OF MORGANTON  
220 Catawba Meadows Dr.



- Notes**
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REV	REVISION DESCRIPTION	DATE	DESIGNED	CHECKED	APPROVED

DESIGN BY:	DATE:
BRI	06/06/22
DMM	06/06/22
ECH	11/06/22
SJC	11/30/22

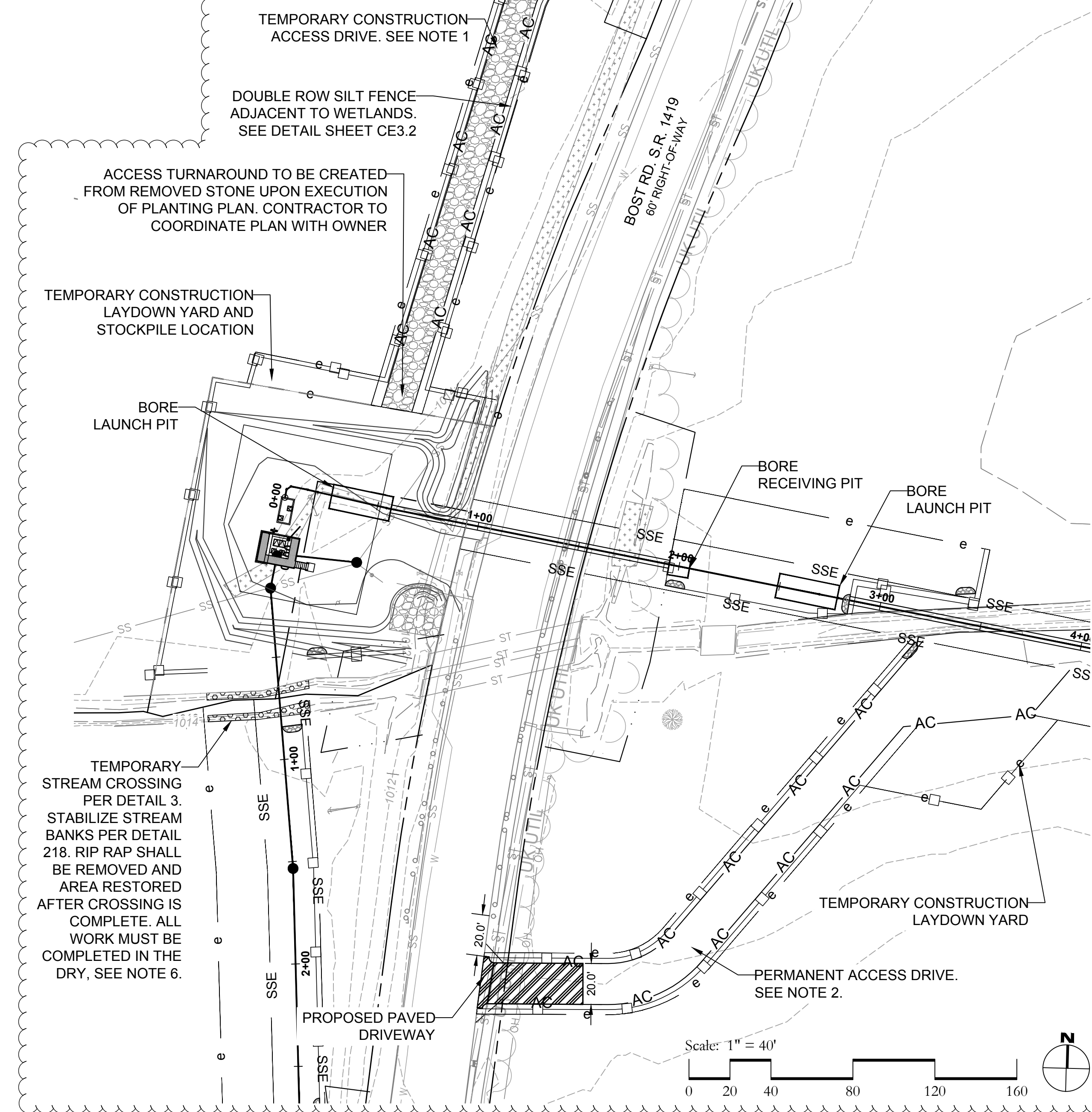
**Bost Rd Sewer Improvements**  
Morganton, NC  
**Force Main Erosion Control**

**FINAL DESIGN - 100%  
RELEASED FOR  
CONSTRUCTION**

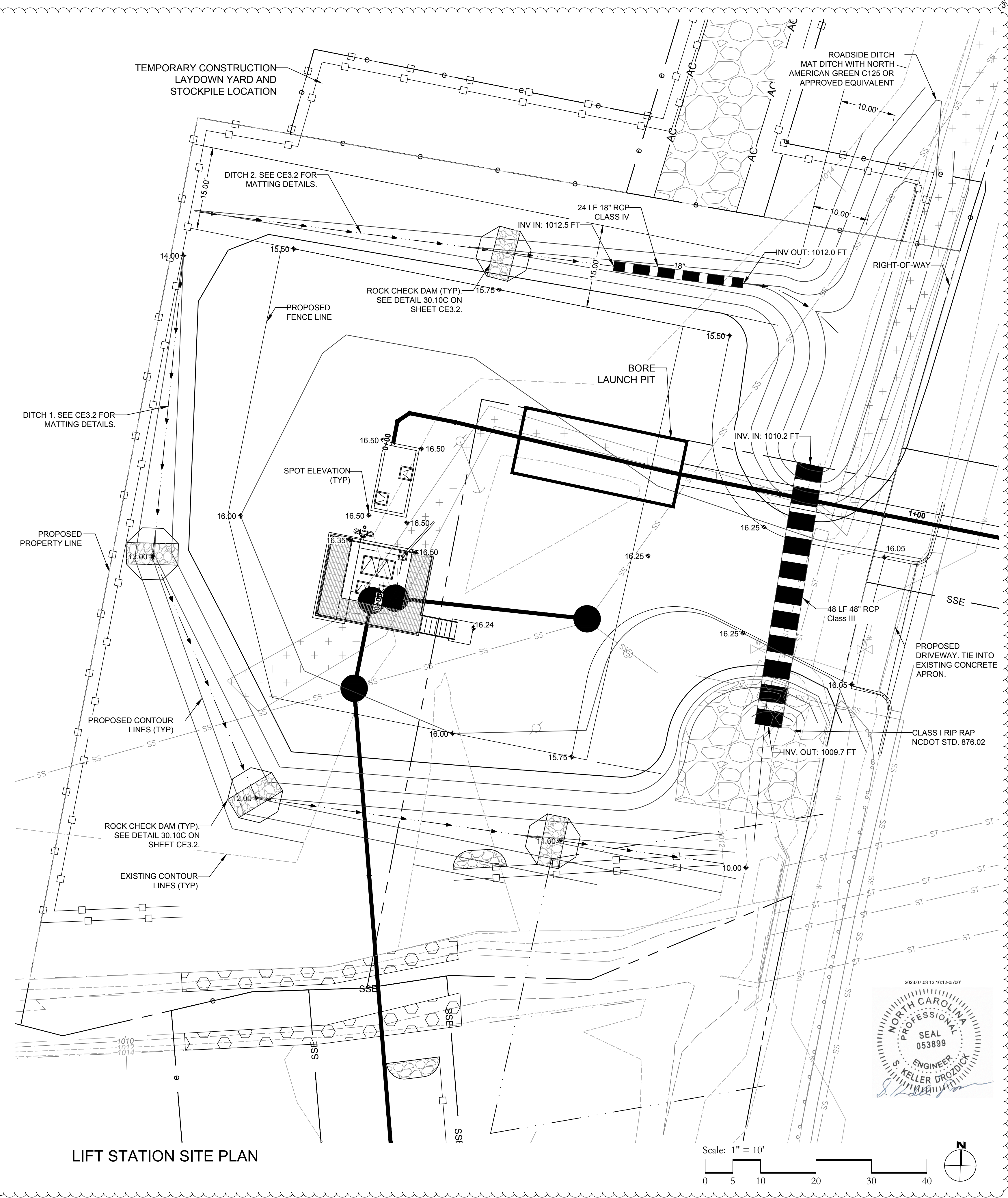
JOB NO: 65421093  
DATE: 05/04/23  
SHEET: **CE.2.4**

**ACCESS DRIVE NOTES:**

1. TEMPORARY CONSTRUCTION ACCESS DRIVE TO REMAIN AT END OF PROJECT AND TRANSFERRED TO PROPERTY OWNER.
2. PERMANENT ACCESS DRIVE TO BE INSTALLED AND MAINTAINED BY CITY OF MORGANTON. DRIVEWAY PERMIT TO BE ACQUIRED.
3. ACCESS LIMITED TO THE CONSTRUCTION ACCESS. IF CONTRACTOR WISHES TO USE THE EXISTING DRIVE THEY MUST SUBMIT DETAIL FOR SEDIMENT TRACK AND OBTAIN PRIOR APPROVAL FROM ENGINEER.
4. DO NOT IMPACT ANY WETLANDS OUTSIDE OF THE LIMIT OF DISTURBANCE



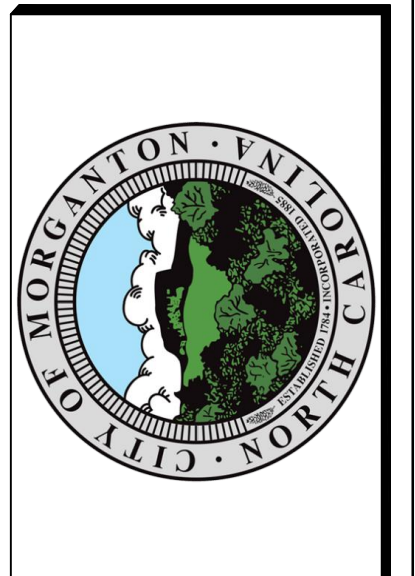
- Notes**
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  7. Any trees designated for protection and any other trees outside easements damaged by contractor shall be replaced as required by the City of Morganton.



**LIFT STATION SITE PLAN**

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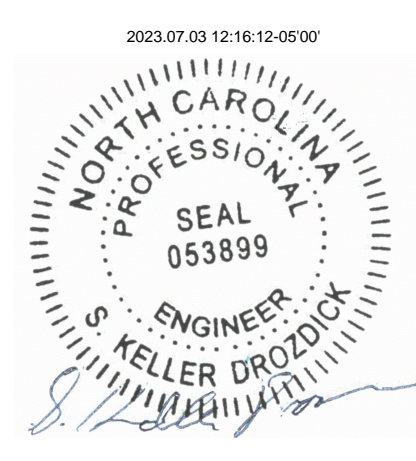
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2	11/09/22	ECH	Checked
3	11/30/22	SKD	Approved

DESIGN BY:	DATE:
BRH	06/06/22
DRAWN BY:	DATE:
DMW	06/06/22
CHECKED BY:	DATE:
ECH	11/09/22
APPROVED BY:	DATE:
SKD	11/30/22

**Bost Rd Sewer Improvements**  
 Morganton, NC  
**Pump Station and Access Dr**  
**Erosion Control**

**FINAL DESIGN - 100%**  
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**CONSTRUCTION**

JOB NO: 65421093  
 DATE: 05/04/23  
 SHEET: CE2.5





**MERRICK**  
 301 S. MCCOY STREET, SUITE 300  
 MORGANTON, NC 28650  
 PHONE: 704.520.6500  
 FAX: 704.520.6501  
 NC ENGINEERING FIRM # 2908



REV	DESCRIPTION	DATE	CHANGED BY	DESIGNED BY	APPROVED BY
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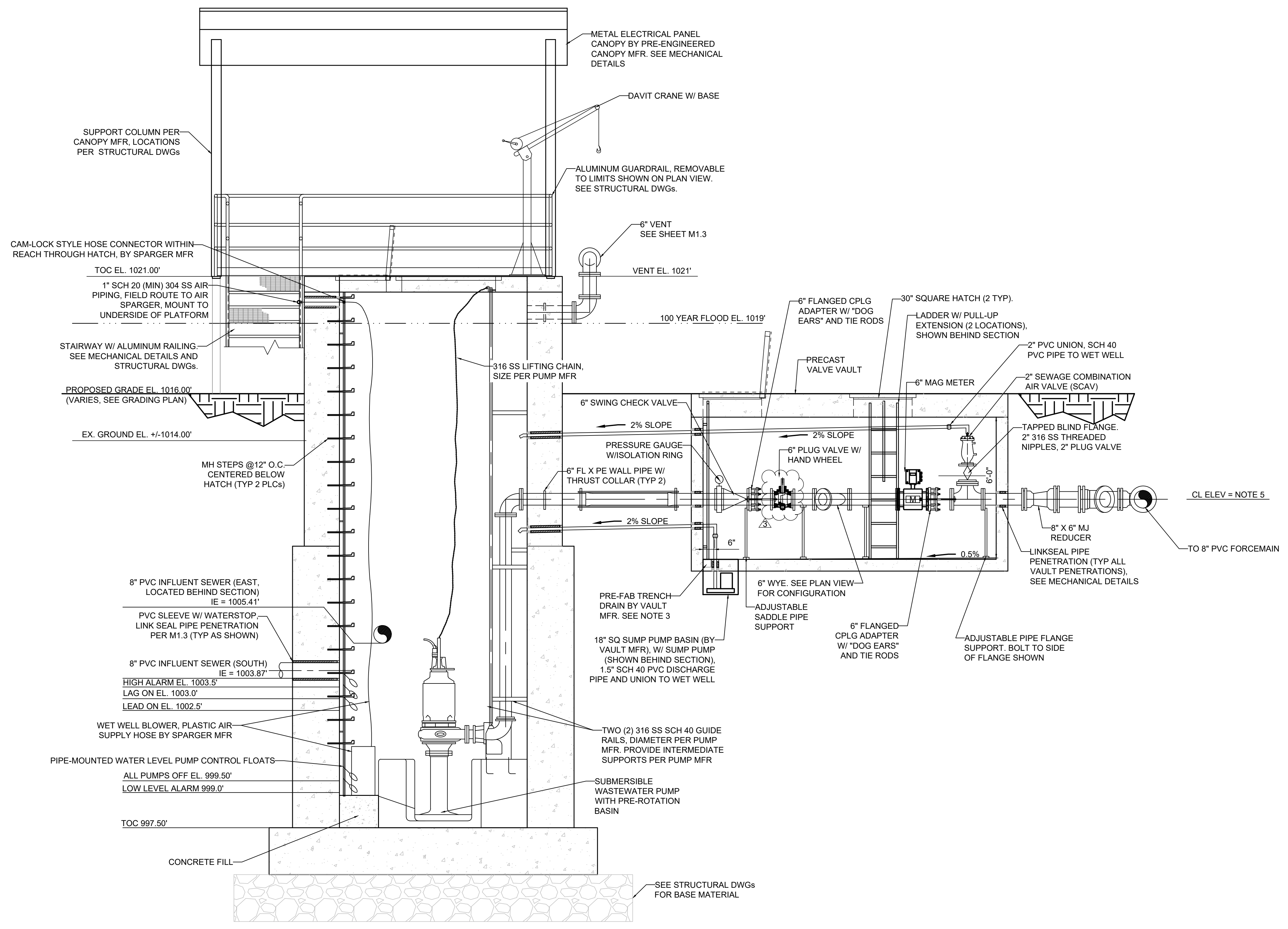
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ECH	11/06/22	ECH	11/06/22
SKD	11/30/22	SKD	11/30/22

**Bost Rd PS & Gravity Sewer Improvements**  
 Morganton, NC  
**PUMP STATION**  
**WET WELL SECTION A**

**FINAL DESIGN - 100%  
 RELEASED FOR  
 CONSTRUCTION**

JOB NO: 65421093	DATE: 05/04/23	SHEET: M1.2
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- NOTES**
- SEE STRUCTURAL DRAWINGS FOR METAL CANOPY STRUCTURE, DAVIT CRANE INSTALLATION, AND METAL GRATING DESIGN.
  - CONTRACTOR TO COORDINATE PUMP GUIDE RAIL AND PUMP LOCATIONS.
  - PRE-FABRICATED TRENCH DRAIN IS CONTINUOUS ALONG THE SOUTH WALL. ENTIRE VAULT FLOOR TO SLOPE 0.5% TOWARDS TRENCH.
  - SEE SPECIFICATIONS FOR SEQUENCE OF WORK AND PUMP STATION SHUTDOWNS. COORDINATE WITH ENGINEER AND OWNER BEFORE ANY SHUTDOWNS.
  - COORDINATE PUMP DISCHARGE PIPELINE ELEVATION THROUGH WET WELL WALL AND VAULT WITH VAULT MANUFACTURER BASED ON VAULT STRUCTURAL DESIGN. TOP OF VAULT LID ELEVATION SHALL BE PER CIVIL GRADING PLAN. VAULT INTERIOR CEILING HEIGHT SHALL BE 6'-0". PUMP DISCHARGE PIPELINE CENTERLINE ELEVATION SHALL BE 2'-6" ABOVE VAULT FLOOR.



**SECTION A**  
 SCALE 2/5" = 1'-0"

SECTION 33 05 05.01  
BURIED PIPING (PRESSURE SERVICE)



PART 1 GENERAL

1.1. SUMMARY

- A. The work to be performed in accordance with this Specification consists of furnishing all materials, equipment, supplies, and accessories and of performing all operations required in connection with the fabrication and installation of a buried piping for pressure service as shown on the Drawings and specified herein.
- B. Buried piping for pressure service includes:
1. Polyvinyl Chloride pipe (PVC)
  2. Ductile iron pipe (DIP)
  3. HDPE pipe
  4. Associated fittings
  5. Related appurtenances
- C. All materials shall be new and the best available. All material used shall be manufactured and supplied according to the latest revised standards of the American Water Works Association, the American National Standards Institute, and the American Society for Testing and Materials, or as mentioned hereinafter.
- D. Related Sections:
1. Exposed piping systems and appurtenances, located indoors, aboveground, and in vaults, are specified in Section 40 05 05.
  2. Valves associated with buried pipeline systems are specified in Section 40 05 50.
  3. Identification requirements for buried pipelines, including warning tape and tracer wire, are specified in Section 33 05 98.
  4. Trenchless methods for installation of buried piping are specified in Section 33 05 07.23 for Utility Boring and Jacking and Section 33 05 23.13 for Utility Horizontal Directional Drilling.

1.2. PRICE AND PAYMENT PROCEDURES

- A. Measurement and Payment
1. Pump Station Piping
    - a. Payment shall be subsidiary to the pump station item and is not a separate pay item.
  2. Force Main Piping
    - a. Payment shall be based on linear feet of installed buried pressure pipe of size as indicated in the Drawings.
    - b. Distance shall be measured from the transition to force main outside the pump station valve vault to the center of the terminal manhole.
    - c. Unit price for buried pressure pipe shall include excavation, pipe, bedding, backfill, compaction, surface restoration, and all other materials, labor, equipment, tools, and supplies necessary to complete the installation of buried pressure pipe.

1.3. REFERENCES



**A. Standards**

1. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
2. American Society for Testing and Materials (ASTM)
  - a. A307 (2021) - Standard Specification for Carbon Steel Bolts, Studs, And Threaded Rod 60,000 PSI Tensile Strength
  - b. A536 (2019) - Standard Specification for Ductile Iron Castings
  - c. D1784 (2020) – Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
  - d. D2239 (2021) - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
  - e. D2241 (2020) - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
  - f. D2657 (2015) - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
  - g. D2774 (2021) - Standard Practice for Underground Installation of Thermoplastic Pressure Piping
  - h. D3139 (2019) – Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals
  - i. D3261 (2016) - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
  - j. D3350 (2021) - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
  - k. F477 (2021) – Standard Specification for Elastometric Seals (Gaskets) for Joining Plastic Pipe
  - l. F1688 (2022) – Standard Guide for Construction Procedures for Buried Plastic Pipe
3. American National Standards Institute (ANSI)
  - a. B31.1 (2020) – Power Piping
4. American Water Works Association (AWWA)
  - a. C104 (2016) - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
  - b. C110 (2021) - Ductile-Iron and Gray-Iron Fittings
  - c. C111 (2017) - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
  - d. C115 (2020) - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
  - e. C151 (2017) - Ductile-Iron Pipe, Centrifugally Cast
  - f. C153 (2019) - Ductile-Iron Compact Fittings
  - g. C900 (2016) - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
  - h. C901 (2020) - Polyethylene (PE) Pressure Pipe and Tubing 3/4 In. (19 mm) Through 3 In. (76 mm) for Water Service
  - i. C906 (2021) - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm) for Waterworks
5. City of Morganton
  - a. Construction Specifications for Water Lines

**1.4. ADMINISTRATIVE REQUIREMENTS****A. Coordination**

1. The existing system must at all times remain under the control of the Owner. The Contractor shall

- operate no valves or hydrants on the system without permission of the Owner.
2. Service Interruptions, Shut Downs, and Continuity of Service
    - a. Take precautions as necessary to minimize interruption of all utility services and will be responsible for restoration of service.
    - b. Service shall not be disrupted for more than a four-hour period. If a longer shutdown period will be necessary, provide a temporary service to the customer, subject to the review and approval of the Engineer.
    - c. Coordinate service interruptions with the Owner and affected parties.
    - d. No interruption of service shall be permitted without prior approval.
    - e. Provide at least two (2) days' notice and make appropriate arrangements with the Owner and affected parties prior to shut down. Notice shall include when supply will be discontinued, when it will be resumed, and contact information.
    - f. Schedule shutdowns for periods of minimum use and at the Owner's and affected parties' convenience.
    - g. Have all material, equipment, and personnel on hand prior to beginning any work involving a potential shutdown.
    - h. Perform work in a manner that reduces the shutdown time to the minimum.
    - i. In some cases, an increased number of personnel or night or weekend work may be necessary.
  3. Submit a proposed plan for review and coordination.

B. Sequencing

1. Cut Ins and Connecting to Existing System
  - a. All points at which the existing piping systems are to be disconnected and connected to the new pipelines are shown on the Drawings.
  - b. Connections to the existing system shall be completed after new pipeline, valves, thrust blocks and other appurtenances are installed and tested.
  - c. Connections shall be done in accordance with the details given for each point of disconnection or reconnections.
  - d. At each point of connecting new pipes to existing pipes, expose the existing pipe and locate a good sound point at which to cut the existing pipe off square. Then provide and install the approved transition coupling or sleeve suitable for connecting the two types of pipe. If both pipes are DIPS compatible, a mechanical joint solid sleeve with mechanical restraints is preferred in lieu of a coupling, unless indicated otherwise.
  - e. Submit a proposed plan for review and coordination.

1.5. SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00:
1. Affidavit of compliance with AWWA and other referenced standards.
  2. Manufacturer's installation instructions and recommendations.
  3. Manufacturer's literature and product data sufficient to demonstrate compliance with the specified requirements. Highlight proposed products and features, cross out extraneous information.
  4. Pressure, Leakage, Disinfection, and other test results.
  5. Contractor's plan for connecting to service interruptions and connections to the existing system.

1.6. PRODUCT HANDLING

- A. Pipe, fittings, and all other accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage to them. Under no circumstances shall any materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. Skidding which damages protective coatings will not be permitted.
- B. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench to prevent moving more than once.
- C. All pipe and fittings shall be so handled that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be by the Contractor at their expense in a manner satisfactory to the Engineer. Any area damage beyond repair must be cut off and discarded.
- D. Do not store materials directly on the ground. Use opaque covers to protect PVC materials from direct sunlight (UV light).
- E. All pipe will be field inspected at the job site and checked for conformance to these specifications. Pipe and fittings will be checked for out-of-round or damaged joints, interior and exterior surface damage, gasket damage and the other requirements listed herein. Any pipeline or appurtenant material found defective will be rejected. Any material rejected at the job site shall be marked "Rejected," and the Contractor shall remove it immediately from the job site.

#### 1.7. SITE CONDITIONS

- A. Other Utilities and Potholing
  - 1. The type, size, location, and number of known underground facilities have been shown on the Drawings based on information available to the Engineer at the time of design; however, no guarantee is made as to the true type, size, location, or number of such facilities, or that all facilities are shown. It shall be the sole responsibility of the Contractor to verify the existence and location of all underground utilities along the route of the work. The omission from, or the inclusion of, utility locations on the Drawings is not to be considered as the nonexistence of, or a definite location of, existing underground utilities.
  - 2. If existing utilities were potholed during design, that information is shown or identified as such on the Drawings. If a certain utility is not identified as potholed, then its depth on the profile might be based on a reasonable assumption or on other available information such as nearby surveyed manhole invert elevations, valve nut measure-downs, record drawings, or other information as may or may not be indicated. If horizontal or vertical locations of existing utilities are found to be in conflict through the Contractor's own supplemental potholing efforts or during construction, then coordinate with the Engineer to adjust the elevation or location of the new pipeline to achieve adequate clearance from the existing utility or other agreed upon measure to resolve the conflict.
  - 3. The Engineer may not have independently verified any pothole information shown on the Drawings and is not responsible for the accuracy and completeness of utility locating and potholing work. Utility locates and potholing results are provided for the Contractor's convenience only. Reliance upon utility data depicted on the Drawings for risk management purposes during bidding does not relieve the Contractor from following all applicable utility damage prevention statutes, required use of 811, and/or other required or best practices during construction. It is important that the Contractor investigates and understands the scope of work between the Owner and Engineer regarding the scope and limits of the utility investigation leading

to the utility depictions shown on the Drawings. It may be necessary for the Contractor to provide for their own supplemental utility locating and/or potholing prior to excavating or ordering material to the extent they feel is necessary to complete the work safely and successfully.

B. Existing System, Continuity Of Service, Cut-Ins, And Shut-Downs

1. The existing system must at all times remain under the control of the Owner. The Contractor shall operate no valves or hydrants on the system without permission of the Owner.
2. The Contractor shall coordinate service interruptions with the Owner and affected parties. No interruption of service shall be permitted without prior approval. Give at least two (2) days' notice and make appropriate arrangements with the Owner and affected parties prior to shutdown. Schedule shutdowns for periods of minimum use and at the Owner's and affected parties convenience. Have all material, equipment, and personnel on hand prior to beginning any work involving a potential shutdown. Perform work in a manner that reduces the shutdown time to the minimum. In some cases, an increased number of personnel or night or weekend work may be necessary. The Contractor shall take precautions as necessary to minimize interruption of all utility services and will be responsible for restoration of service.
3. At any time that a customer on the existing system will be deprived of service, the Contractor shall advise such customer at least 2 days in advance when the service will be discontinued and when the service will again be available. Service shall not be disrupted for more than a four-hour period. If a longer shutdown period will be necessary, the Contractor shall provide a temporary service to the customer, subject to the review and approval of the Engineer.
4. All points at which the existing piping systems are to be disconnected and connected to the new pipelines are shown on the Drawings. Connections to the existing system shall be completed after new pipeline, manholes and other appurtenances are installed and tested. Connections shall be done in accordance with the details given for each point of disconnection or reconnections. At each point of connecting new pipes to existing pipes, the Contractor shall expose the existing pipe and locate a good sound point at which to cut the existing pipe off square. He shall then provide and install the approved transition coupling or sleeve suitable for connecting the two types of pipe.

## PART 2 PRODUCTS

### 2.1. GENERAL

- A. All pipe, fittings, couplings, and appurtenant items shall be new, free from defects or contamination, and wherever possible shall be the standard product of the manufacturer. They shall be furnished in pressure or thickness classes as specified or shown. All pipe shall have joints as called for in the specifications or indicated on the Drawings.
- B. All bell and spigot pipe and fittings shall allow a minimum of one degree of deflection and still meet all other specification requirements including pressure rating, leak prevention, and thrust restraint.

### 2.2. HARDWARE MATERIALS

- A. Hardware used for the assembly of piping systems, flanges, joints, and appurtenances (including coupling bolts, tie rods, mechanical restraint systems, and the like) shall comply with the following:
  1. Interior dry locations, or exterior above grade: Hot dip galvanized steel.

2. Moist locations (any interior or exterior space wholly or partially below grade level including vaults or pits, or having a wall or ceiling forming head space of part of a clean water channel or basin): Type 304 Stainless Steel with "Never Gall" (or equivalent) factory applied coating system.
3. Submerged locations and in corrosive areas (corrosive meaning spaces with NEC electrical classifications of Class 1 Divisions 1 and 2, in chemical storage and pumping areas, and in head space of channels or basins containing process liquids): Type 316 stainless steel with "Never Gall" (or equivalent) factory applied coating system.
4. Buried in earth: Type 304 stainless steel with "Never Gall" (or equivalent) factory applied coating system. Tie rods shall be Type 304 stainless steel in all cases.

### 2.3. DUCTILE IRON PIPE, FITTINGS, AND APPURTENANCES

- A. Pipe: Ductile-iron pipe, conforming to AWWA C151/ A21.51. Provide pressure class 350 for all pipe 12-inch and smaller.
- B. Joints: Ductile iron pipe shall be flanged, push-on, or mechanical joint as shown on the Drawings. In general, flanged pipe shall be used above ground or where exposed in vaults etc., while push-on or mechanical joint will be used where buried in earth.
  1. Mechanical and Push-On: In accordance with AWWA C111/ A21.11.
  2. Flanged joints: In accordance with Section 40 05 05.
  3. Gasket compound: EPDM compound shall be provided for sewage, sludge, and reclaimed water.
- C. Fittings:
  1. Ductile-iron conforming to the requirements set forth in AWWA C110/ A21.10 or AWWA C153/ 21.53. Provide Class 250 minimum. Joint type shall be as specified above, and as shown on the Drawings or appropriate for the installation location.
  2. All mechanical joint solid sleeves shall be long pattern.
- D. Spools and Wall Pipe:
  1. Spools may be cast as fittings in accordance with AWWA C110 or fabricated from Special Thickness Class 53 ductile iron pipe in accordance with AWWA C115. Wall pipe shall have collars integrally cast. Collars shall be located so as to be in the center of the concrete wall or floor into which they are to be placed.
- E. Interior Lining:
  1. Pipe, spools and fittings shall be cement mortar lined and seal coated in accordance with AWWA C104/ A21.4. Lining shall be recommended by manufacturer for sewer service. Linings in contact with potable water shall be NSF 61 approved.
- F. Exterior Coating:
  1. Pipe, spools, and fittings to be buried in earth or installed within below-grade vaults shall be furnished with standard thickness asphalt coating per AWWA C151.
  2. Pipe, spools, and fittings to be installed above ground shall be in accordance with Section 40 05 05.
  3. Pipe, spools, and fittings to be installed in submerged locations shall be supplied by the factory bare, for shop blasting and application of the specified submerged protective coating system. Asphalt coated or prime coated pipe shall not be used in exposed or submerged locations.

- G. Thrust Restraint:
1. All pressurized ductile iron piping systems shall be fully restrained against thrust. Thrust restraint shall be achieved by the use of both concrete thrust blocks and mechanical restraints.
  2. Thrust blocks shall be installed in accordance with the detail shown on the Drawings. Concrete shall be Class A, Type II, and have a minimum 28-day compressive strength of 3,000 psi. Concrete shall be placed against polywrapped fittings – never against bare fittings.
  3. Mechanical restraints shall be installed to the minimum restrained lengths shown on the detail on the Drawings, for horizontal and vertical bends, other fittings, valves, and dead-ends. Restraints shall conform to the following:
    - a. Push-On Joint Restraints:
      - 1) Restraint ring with serrated wedges on the spigot end of the pipe, with a split bell ring that engages behind the bell without serrations on the other. Ductile iron construction per ASTM A536 with epoxy protective coating, hardware material as specified elsewhere herein. EBBA Iron Megalug Series 1700, equivalent by Star with premium epoxy coating option, or approved equal.
      - 2) As an alternative, proprietary restrained pipe joints may be provided as approved for both pipe and fittings; TR FLEX as manufactured by U.S. Pipe, or equal, and meeting the requirements for ductile iron pipe and fittings specified elsewhere herein. Restrained push-on joint pipe and fittings shall be capable of being deflected after assembly. Any special assembly tools recommended by the manufacturer shall be supplied to the Owner.
    - b. Mechanical Joint Restraints: Restraint ring with serrated wedges and incorporating a follower gland, designed to bolt to a mechanical joint drilling pattern. Ductile iron construction per ASTM A536 with epoxy protective coating, hardware material as specified elsewhere herein. EBBA Iron Megalug Series 1100, equivalent by Star with premium epoxy coating option, or approved equal.

#### 2.4. POLYVINYL CHLORIDE (PVC) PIPE (4 THROUGH 12 INCHES IN DIAMETER)

- A. Pipe:
1. The pipe shall conform to AWWA C900 “Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 4 inch through 12 inch.” The pipe material shall be of new source, conform to ASTM D1784 Cell Classification 12454.
  2. Pipe shall be integrally colored in accordance with the service. Green-colored pipe shall be provided for pressure sanitary force main or sludge service. If a particular color pipe is not available or is a significant cost premium, the Engineer may approve installation of color-coded polywrapping around pipe of an available color which shall be provided at no additional cost. Seek clarification from the Engineer.
  3. Provide Pressure Class 235, DR18, unless specified otherwise on the Drawings.
  4. Joints will provide for contraction and expansion at each joint with a rubber ring, and integral thickened bell as part of each joint. Integral joints shall conform to ASTM D3139. Gaskets shall conform to ASTM F477. Pipe shall be supplied in nominal laying lengths of 20 feet. All pipe and fittings shall be assembled with a non-toxic lubricant. Each length of pipe shall have marked on the exterior the following:
    - a. Manufacturer’s Name or Trademark
    - b. Nominal Pipe Size/Dimension Ratio

- c. PVC Cell Classification (e.g. 12454-B)
  - d. Legend – Type AWWA C900 Pressure Pipe
- B. Fittings: Ductile iron with mechanical joints as specified elsewhere herein.
- C. Thrust Restraint: All pressurized PVC piping systems shall be fully restrained against thrust. Thrust restraint shall be achieved by the use of mechanical restraints.
- 1. Mechanical restraints shall be installed to the minimum restrained lengths shown on the details on the Drawings, for horizontal and vertical bends, other fittings, valves and dead-ends. Restraints shall conform to the following:
    - a. Straight Pipe: Split ring, with continuous serrations around the full circumference on the spigot end of the joint, and a non-serrated ring that rests against the back of the bell on the opposite end of the joint. Ductile iron construction per ASTM A536 with protective epoxy coating, hardware material as specified elsewhere herein. EBBA Iron Series 1600 for C900 pipe, equivalent by Star with premium epoxy coating option, or approved equal.
    - b. Mechanical Joint Fittings: Restraint ring with serrated wedges and incorporating a follower gland, designed to bolt to a mechanical joint drilling pattern. Ductile iron construction per ASTM A536 with protective epoxy coating, hardware material as specified elsewhere herein. EBBA Iron Series 2000PV for C900 pipe, equivalent by Star with premium epoxy coating option, or approved equal.

## 2.5. HIGH DENSITY POLYETHYLENE (HDPE) PIPE (4 THROUGH 63 INCHES IN DIAMETER)

- A. The pipe shall be solid wall high density polyethylene AWWA C906-~~PE3408~~-PE4710 pipe and fittings for pressure service.
- B. The pipe shall be supplied with a color-coded stripe in accordance with the service: a green stripe for sanitary or sludge service. If there is a question as to which color should be provided, seek clarification from the Engineer.
- C. Materials used to manufacture high density polyethylene pipe and fittings shall comply with all ASTM D3350 requirements and have a PPI recommended designation of ~~PE3408~~ PE4710. The molecular weight category shall be extra high (250,000 to 1,500,000) as per the Gel Permeation Chromatography determination procedure with a typical value of 330,000.
- D. HDPE pipe manufactured from materials meeting the specification of this section shall have an Environmental Stress Crack Resistance of zero failures when tested to greater than 10,000 hours (ESCR: $F_0 > 10,000$ ) when tested in accordance with ASTM F1248.
  - 1. Pipe supplied under this specification shall have a nominal DIPS (ductile iron pipe size) outside diameter. The dimension ratio (DR) shall be 11 (200 psi), unless specified on the Drawings.
  - 2. All pipe and fittings shall meet the testing requirements of the most current version of AWWA C906. Manufacturer's test data shall be furnished upon request by the Engineer.
  - 3. The pipe shall have product traceability. This shall be accomplished by the inclusion of a product code into the print line of all pipe products. This shall notate the manufacturer, the date of manufacture, the lot and supplier of raw material, the location of the manufacture, and the production shift on which the product was produced. The print line shall also include such other markings as are required by the current version of AWWA C901 or C906. Print line shall be made

permanent by using heat indentation. The use of industrial ink as the only method will be cause for rejection at the job site.

4. All fittings shall be pressure rated to match the system piping to which they are joined. At the point of fusion, the outside diameter and minimum wall thickness specifications of AWWA C906 for the same size of pipe. All fabricated fittings shall be properly rated according to manufacturer's written recommendations, and clearly labeled on the fitting as such. Manufacturer shall have a written specification for all standard fabricated fittings with established Quality Control criteria and tolerances. The manufacturer of the pipe shall be manufacturer of the fabricated fittings. Molded fittings shall be made from ~~PE 3408~~ PE4710 HDPE and have fusion compatibility with the pipe. Pipe manufacturer must certify that they produced the pipe, fabricated the fitting, and provide the warranty.
5. Pipe and fittings may be joined by thermal fusion, electrofusion, flange assemblies or mechanical methods as described in AWWA C906. All joints shall be fully restrained against thrust.
  - a. Fused HDPE joints and fittings are considered fully restrained.
  - b. Provide concrete thrust wall anchors on HDPE pipelines where HDPE connects to mechanical joint fittings, valves, or dissimilar pipeline materials where a mechanical (not fused) method of joining is required.
  - c. Connections to mechanical joints shall be restrained by use of a positively locking MJ adaptor fitting, such as that fabricated by Specified Fittings LLC of Bellingham WA, or equal. The plain end of the device is fused to the HDPE pipeline, and the opposite DIPS end inserts into the mechanical joint, with a fused or milled thrust collar that is "sandwiched" between the mechanical joint flange and follower gland. Provide a Type 304 stainless steel internal stiffener ring of sufficient length to encompass the full bearing length of the joint connection.
    - 1) Note: connections at MJ butterfly valves may obstruct full disc movement; Contractor to confirm, and if so provide short ductile iron spool pieces or flanged end connections in lieu of mechanical joint to reconcile the conflict, subject to approval of the Engineer.
  - d. HDPE flanged connections shall be provided with a Type 304 stainless steel backing ring behind the HDPE flange opposite the metallic flange to provide structural rigidity and strength. Drill to match the adjacent flange to which it is connecting. Flange joint assemblies and gaskets shall have a pressure rating of at least 1.5 times the specified test pressure of the pipeline.

#### 2.6. COPPER TUBE AND ACCESSORIES (2-INCHES AND SMALLER):

- A. All components shall be new, suitable for potable water use, and manufactured in accordance with AWWA C800 using lead-free copper alloy UNS No. C89520 or copper alloy UNS No. C89833, in accordance with ASTM B584, as applicable. Components shall be certified to comply with NSF 61, NSF 61 Annex G, NSF 372.
- B. Tube: Type K Copper. Seamless copper water tube. ASTM B88, UNS No. 12200. Furnished in coils and annealed.
- C. Tapping Saddles:
  1. For use with Ductile or Cast Iron Pipe: Double bronze straps. AWWA standard taper threads. Mueller BR2B series, Ford 202B-NL series, or equal.
  2. For use with PVC Pipe: Bronze saddles shall provide full support around the circumference of the



pipe, and have a bearing area of sufficient width along the axis of the pipe so that the pipe will not be distorted when the saddle is tightened. Saddles shall be double strap, bronze. Mueller H-13000 or H-134000 series, Ford S90-NL series, or equal.

D. Corporation Stops:

1. AWWA Standard taper thread by copper flare, unless other end connections are specified on the Drawings. Mueller B25000N, Ford FB-600-NL series, or equal.

E. Insulators:

1. Provide electrical insulators at all corporation stops for services on ductile or cast iron mains. Mueller, Ford or equal.

F. Curb Stops:

1. Flare by flare end connections, unless other end connections are specified on the Drawings. Mueller B25204N, Ford B22-NL series, or equal. Provide a cast iron box for each curb stop. Star Pipe Products SB90ES series, or RWB 145RHD series where located in roadways; or equal.

G. Couplings and fittings:

1. Flare by flare end connections, unless other end connections are specified on the Drawings or required for connection to equipment and devices. Ford C28-NL series, or equal.

## 2.7. FLEXIBLE COUPLINGS

A. Flexible couplings shall be the types below as shown on the Drawings or as otherwise permitted by the Engineer. Couplings shall provide the requisite pipe flexibility without jeopardizing pipe joint integrity due to hydraulic thrust, and shall have the same pressure-rating as the pipe. Couplings shall comply with AWWA C219. Hardware materials shall comply with the materials specified elsewhere herein. All materials in contact with potable water shall be NSF 61 approved.

1. Sleeve Type Couplings shall be properly gasketed and shall be of the diameter and type recommended by the manufacturer to fit the outer diameter and type of pipe to which it is connecting. Each coupling shall consist of a ductile iron or steel middle ring, 2 ductile iron or steel followers, 2 gaskets, and the necessary bolts and nuts to compress the gaskets. The couplings shall be Smith Blair 411, 413, or 441 (as appropriate for the pipe type and pressure rating), or approved equal. Couplings to be fusion epoxy lined and coated. Polyethylene encase in accordance with AWWA C105 when buried in earth.
2. Flanged Coupling Adapters shall have a ductile iron body and flange, gaskets, and bolts and nuts required to compress the gaskets. Flange shall be compatible with the flange to which it will mate. Fusion epoxy line and coat. Flanged coupling adapters shall be Smith Blair Model 912 or approved equal. Polyethylene encase in accordance with AWWA C105 when buried in earth.
3. Gasket compound: EPDM compound shall be provided for sewage, sludge, and reclaimed water. EPDM compound shall be provided for blower air service. EPDM, NBR or SBR compound may be provided for raw or potable water service.
4. Restraint: Flexible couplings shall be fully restrained against thrust unless the Engineer has given written approval to omit this feature for specific cases. Anchor studs or set screws shall not be used for restraint.
  - a. Exposed locations: Restraints shall be as specified in Section 40 05 05.

## 2.8. BURIED UTILITY WARNING TAPE

- A. As specified in Section 33 05 98.

## 2.9. TRACER WIRE:

- A. As specified in Section 33 05 98.

## PART 3 EXECUTION

### 3.1. GENERAL INSTALLATION REQUIREMENTS

- A. Do not lay pipe when trenches or weather conditions are unsuitable for such work.
- B. Each pipe length and fitting interior, interior surface of bells, and exterior surface of spigots shall be cleaned of all foreign material before placing it in the trench and shall be kept clean all times thereafter. Each item shall also be examined for cracks and other defects before installation.
- C. Field cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe, and to leave a smooth end at right angles to the axis of the pipe.
- D. Each pipe length shall be laid true to line and grade, without intermediate high or low points not shown on the Drawings. If field conditions are encountered that preclude installation per the Drawings, immediately notify the Engineer for resolution.
- E. Pipe shall be laid in a dry (dewatered) trench and shall not be used for draining water from the trench.
- F. Whenever the pipe is left unattended or pipe laying is not in progress, temporary plugs shall be installed at all openings. Temporary plugs shall be watertight and of such design as to prevent debris and animals from entering the pipe. All temporary plugs shall be subject to review by the Engineer.
- G. In some special circumstances it may be necessary to install the pipeline shallower than the minimum required depth of cover, such as to avoid other utilities or to achieve a specific slope or grade. All special circumstances are subject to the approval of the Engineer.
- H. The Contractor shall install the materials in accordance with the manufacturer's recommendations. If there is a conflict between the Contract Documents and the manufacturer's instructions, the Contractor shall obtain resolution from the Engineer before proceeding with the work.
- I. Where the Drawings call for deflection of pipe joints, Contractor shall deflect one or more joints, depending on constructed pipe configuration, to meet overall pipe alignment as indicated in the plans. Amount of deflection and manner of deflection shall comply with Manufacturer recommendations and requirements.

### 3.2. INSTALLATION OF DUCTILE-IRON PIPELINES

- A. Except as specified herein or unless specifically authorized by the Engineer, all installation of pipe shall conform to the recommendations contained in "A Guide for Installation of Ductile-Iron Pipe,"

published by the Ductile Iron Pipe Research Association. A copy shall be available at the job site.

- B. Pipe Laying: Pipe shall be laid with bell ends facing in the direction of laying, unless directed otherwise by the Engineer. Pipe shall be laid on the bedding with support over the full length of the pipe barrel.
- C. The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining to leave a smooth end at right angles to the axis of the pipe. Flame cutting of pipe by means of an oxyacetylene torch will not be allowed. The pipe end shall be beveled and free of sharp edges that could damage the gasket during installation.
- D. Jointing of Mechanical Joints:
  - 1. The last 8 inches of the pipe spigot and the inside of the bell of the mechanical joint shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating), and other foreign matter from the joint, and then painted with a manufacturer supplied lubricant or soap solution made by dissolving one-half cup of granulated soap in one gallon of water. The ductile-iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the spigot end. The gasket shall be painted with the lubricant or soap solution and placed on the spigot end of the pipe to be laid, with the thick edge toward the gland.
  - 2. The entire section of the pipe being laid shall be pushed forward to seat in the spigot end of the bell of the pipe in place. The gasket shall then be pressed into place within the bell, being careful to have the gasket evenly located around the entire joint. The cast-iron gland shall be moved along the pipe into position for bolting, all the bolts inserted, and the nuts screwed up tightly with fingers. All nuts shall then be tightened with a suitable (preferably torque-limiting) wrench. The torque for various sizes of bolts shall be as follows:

<u>Size (Inches)</u>	<u>Range of Torque ft. - lb.</u>
5/8	45 - 60
3/4	75 - 90
1	100 - 120
1-1/4	120 - 150

- 3. Nuts spaced 180 degrees apart shall be tightened alternately to produce an equal pressure on all parts of the gland.
- E. Jointing of Push-On Joints:
  - 1. In jointing the pipe, the exterior 4 inches of the pipe at the spigot end and the inside of the adjoining bell and particularly the groove for the gasket shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating), and other foreign matter. The proper gasket supplied with the pipe shall be placed in the bell as described by the pipe manufacturer so it will spring into its proper place inside the pipe bell. A thin film of the pipe manufacturer's joint lubricant shall be applied to the gasket over its entire exposed surface. The spigot end of the pipe shall then be wiped clean and inserted into the bell to contact the gasket. Then the pipe shall be forced all the way into the bell by crowbar, or by jack and choker slings. The location of the gasket shall be checked with a gauge or tool designed for that purpose to assure that the gasket is in the proper position.

F. Installation of Proprietary Restrained Joints:

1. Restrained-joint pipe and fittings shall be installed according to manufacturer's recommendations. Torque wrenches and any recommended special tools shall be used during installation. Any special tools shall be supplied to the Owner.

3.3. INSTALLATION OF PVC PLASTIC PIPE

A. Pipe Laying:

1. Pipe shall be laid with bell end facing in the direction of laying, unless directed otherwise by the Engineer.

B. The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe, and so as to leave a smooth end at right angles to the axis of the pipe. Bevel the end of the pipe with a beveling tool after the pipe is field cut. Place a clearly visible position mark at the correct distance from the end of the field cut pipe.

C. Jointing the Pipe:

1. The outside of the spigot and the inside of the bell shall be thoroughly wiped clean. Set the rubber ring in the bell with the marked edge facing toward the end of the bell. Lubricate the spigot end using a thin film of the manufacturer-supplied lubricant. Push the pipe spigot into the bell manually, with blocking and bar or with special jacks. Position the completed joint so that the mark on the pipe end is in line with the end of the bell. Pipe joint shall not be assembled using power or trenching equipment. DO NOT INSERT THE SPIGOT END OF THE PIPE BEYOND THE "HOME" MARK. THE MARK SHALL BE VISIBLE AND IN LINE WITH THE BELL END IN EVERY CASE. THE INSPECTOR MAY REQUIRE REMOVAL AND REINSERTION OF THE JOINT TO THE CORRECT POSITION AT ANY TIME THE MARK IS NOT VISIBLE AFTER INSERTION. no exceptions to this requirement are allowed under any circumstances.

3.4. INSTALLATION OF HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

A. Except as specified herein or unless specifically authorized by the Engineer, all installation of pipe shall conform to ASTM D2774, Underground Installation of Thermoplastic Pressure Pipe.

B. Joining:

1. Heat Fusion Joining: Joints between plain end pipes and fittings shall be made by butt fusion. Joints between the main and saddle branch fittings shall be made using saddle fusion. The butt fusion and saddle fusion procedures used shall be procedures that are recommended by the pipe and fitting Manufacturer. The Contractor shall ensure that persons making heat fusion joints have received training in the Manufacturer's recommended procedure. The Contractor shall maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction. External and internal beads shall not be removed.
2. Joining by Other means: Polyethylene pipe and fittings may be joined together or to other materials by means of (a) flanged connections (flange adapters and back-up rings), (b) mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material, (c) MJ Adapters or (d) electrofusion. When joining by other means, the installation instructions of the joining device manufacturer shall be observed.
3. Branch Connections: Branch connections to the main shall be made with saddle fittings or tees. Polyethylene saddle fittings shall be saddle fused to the main.

## C. Installation:

1. General: When delivered, a receiving inspection shall be performed and any shipping damage shall be reported to the manufacturer with 7 days. Installation shall be in accordance with ASTM D 2774, Manufacturer's recommendation and this specification. All necessary precautions shall be taken to ensure a safe working environment in accordance with all applicable safety codes and standards.
2. Mechanical Joint & Flange installation: Mechanical joint and flange connections shall be installed in accordance with the Manufacturer's recommended procedure. MJ Adapters and flanges shall be centered and aligned to the mating component before assembling and tightening bolts. In no case shall MJ gland or flange bolts be used to draw the connection into alignment. Bolt threads shall be lubricated, and flat washers should be used under the nuts. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the Manufacturer. At least 1 hour after initial assembly, flange connections shall be re-tightened following the tightening pattern and torque step recommendations of the Manufacturer. The final tightening torque shall be as recommended by the Manufacturer. The final tightening torque shall be as recommended by the Manufacturer.
3. Foundation and Bedding: Pipe shall be laid on grade on a stable foundation. Unstable trench bottom soils shall be removed, and a 6" foundation or bedding of compacted Class I material shall be installed to pipe bottom grade. Excess groundwater shall be removed from the trench before laying the foundation or bedding for the pipe. A trench cut in rock or stony soil shall be excavated to 6" below pipe bottom grade, and Brought back to grade with compacted Class I bedding. All ledge rock, boulders and large stones shall be removed.
4. Pipe Handling: When lifting with slings, only wide fabric choker slings capable of safely carrying the load shall be used to lift, move, or lower pipe and fittings. Wire rope and chain are prohibited. Slings shall be of sufficient capacity for the load, and shall be inspected before use. Worn or damaged equipment shall not be used.
5. Backing: Embedment material soil type and particle size shall be in accordance with ASTM D 2774. Embedment shall be placed and compacted to at least 90% Standard Proctor Density in 6" lifts to at least 6" above the pipe crown. During embedment placement and compaction, care shall be taken to ensure that the haunch areas below the pipe springline are completely filled and free of voids.
6. Protection against shear and bending loads: In accordance with ASTM D 2774, connections shall be protected where an underground polyethylene branch or service pipe is joined to a branch fitting such as a service saddle, branch saddle or tapping tee on a main pipe, and where pipes enter or exit casings or walls. The area surrounding the connection shall be embedded in properly placed, compacted backfill, preferably in combination with a protective sleeve or other mechanical structural support to protect the polyethylene pipe against shear and bending loads.
7. Final Backfilling: Final backfill shall be placed and compacted to finished grade. Native soils may be used provided the soil is free of debris, stones, boulders, clumps frozen clods or the like larger than 8" in their largest dimension.
8. Polyethylene Fittings & Custom Fabrications: Polyethylene fittings and custom fabrications shall be molded or fabricated by the Approved Pipe Manufacturer. All fittings and custom fabrications shall be pressure rated for the same internal pressure rating as the mating pipe. Reduced pressure-rated (de-rated) fabricated fittings are prohibited.
9. Molded Fittings: Molded fittings shall be manufactured in accordance with ASTM D 3261 and

shall be so marked.

10. Fabricated Fittings: Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service at least equal to the full service pressure rating of the mating pipe.
11. Polyethylene Flange Adapters: Flange adapters shall be made with sufficient throughbore length to be clamped in a butt fusion-joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves (serrations) to promote gasketless sealing, or restrain the gasket against blowout.
12. Back-up Rings: Flange adapters shall be fitted with Type 304 stainless steel back-up rings pressure rated equal to or greater than the mating pipe. The back-up ring bore shall be chamfered or radiused to provide clearance to the flange adapter radius.

D. Fusion Quality Control:

1. The Contractor shall ensure the field set-up and operation of the fusion equipment, and the fusion procedure used by the Contractor's fusion operator while on site. Upon request by the Owner, the Contractor shall verify field fusion quality by making and testing a trial fusion. The trial fusion shall be allowed to cool completely; then test straps shall be cut out and bent strap tested in accordance with ASTM D 2657. If the bent strap test of the trial fusion fails at the joint, the field fusions represented by the trial fusion shall be rejected. The Contractor at his expense shall make all necessary corrections to equipment, set-up, operation and fusion procedure, and shall re-make the rejected fusions.

3.5. INSTALLATION OF THRUST RESTRAINT

- A. The movement of fittings shall be restrained by use of mechanical restraints as specified above.
- B. Mechanical restraints shall be provided on all joints located within or exceeding the lengths adjacent to fittings and valves specified on the detail on the Drawings. Install in strict conformance with the manufacturer's written instructions and recommendations. Measure and mark said limits of restraints adjacent to the trench with spray paint while the laying operation is underway.

3.6. BURIED UTILITY WARNING TAPE

- A. Install in accordance with Section 33 05 98.

3.7. TRACER WIRE:

- A. As specified in Section 33 05 98.

3.8. EXTRA DEPTH EXCAVATION

- A. To facilitate crossing under existing pipelines and other utilities, or as shown on the Drawings, the Contractor may be required by the Engineer to increase the depth of burial of new pipelines beyond design depth. No separate payment for extra depth will be made.

3.9. FLUSHING

- A. The Contractor shall flush the pipelines as the work progresses in accordance with good practice to ensure that sand, rocks, or other foreign material are not left in any of the pipelines. If possible, the flushing shall be made through an open pipe end; otherwise, use of a fire hydrant may be acceptable, but only on approval of the Engineer.

### 3.10. TESTING

- A. Testing shall occur after the pipeline has been flushed clean of sediment and debris. In any case where a pressure test will be made against an existing closed valve of an existing potable water system, the pipeline shall be disinfected as specified prior to pressure testing.
- B. A pressure test shall be completed first for all pipelines. If a pipeline with rubber gasket joints does not pass the pressure test, then a leak test may be performed.
- C. Pressure Test: A Hydrostatic test shall be performed consistent with the requirements of the City of Morganton Construction Specifications for Water Lines.
- D. Leakage Test:
1. If the pipeline does not pass the pressure test, meaning there was a measured drop in pressure during the pressure test period, then a leakage test shall be conducted. Leakage tests shall be witnessed by the Engineer or their designated Inspector. The Contractor shall furnish the pump, pipe, gauges, connections, flow meters, and all other necessary apparatus, and shall furnish all necessary assistance to conduct the test. The duration of each leakage test shall be two hours, and, during the test, the main shall be subjected to a hydrostatic pressure of 150 psi.
  2. No pipeline installation will be acceptable until the leakage is less than the amount computed by the following formula:
    - a. DIP, PVC 
$$L = \frac{SD(P)^{0.5}}{133,200}$$

L = Allowable leakage in gallons (per hour)  
S = Tested length of pipe (feet)  
D = Nominal diameter of pipe (inches)  
P = Average test pressure during the test (psi)
  3. Should any test of pipe laid disclose leakage greater than that specified above, the Contractor shall, at their own expense, locate and repair the points of leakage until the leakage is within the specified allowance.
  4. The pipe may be subjected to hydrostatic pressure, inspected, and tested for leakage at any convenient time after the trench has been partially backfilled, except at the joints, or backfilled as permitted by the Engineer. Where any section is provided with concrete thrust blocks, the pressure test shall not be made until at least two days have elapsed after the concrete was installed.
  5. The Engineer shall be notified at least 48 hours before the pipe is to be tested so that they or their designated Inspector may be present during the entire duration of the test.

END OF SECTION