

RESOLUTION NUMBER 2024-01

**A RESOLUTION OF THE BOARD OF WORKS OF THE CITY OF
GREENSBURG, INDIANA ADOPTING THE CITY OF GREENSBURG,
INDIANA DESIGN STANDARDS MANUAL**

WHEREAS: The City of Greensburg has previously adopted the City of Greensburg Design Standards Manual; and

WHEREAS, Said Design Standards Manual has over time become out of date; and

WHEREAS, City of Greensburg staff and consultants have drafted a new City of Greensburg, Indiana Design Standards Manual for Wastewater, Stormwater and Roads and Streets; and


WHEREAS, The Board of Works of the City of Greensburg now desires to adopt such City of Greensburg, Indiana Design Standards Manual;

NOW, THEREFORE, BE IT RESOLVED

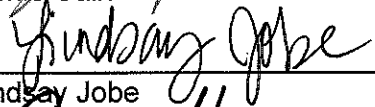
1. That the Board of Works of the City of Greensburg hereby adopts the City of Greensburg, Indiana CITY OF GREENSBURG, INDIANA DESIGN STANDARDS MANUAL attached hereto as Exhibit A.
2. That the implementation of the CITY OF GREENSBURG, INDIANA DESIGN STANDARDS MANUAL shall be effective immediately upon adoption.
3. That all previous versions of any City of Greensburg Design Manuals are hereby revoked.

ADOPTED and PASSED this 9th day of January, 2024 by the Board of Works for the City of Greensburg, Decatur County, Indiana.

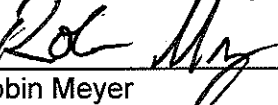
Aye



Jamie Cain



Lindsay Jobe



Robin Meyer



Glenn Tebbe

Nay

Jamie Cain

Lindsay Jobe

Robin Meyer

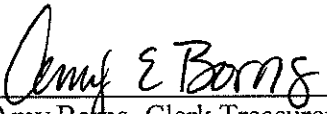
Glenn Tebbe

Attest: 

Amy Borns, City Clerk Treasurer

CERTIFICATE

The undersigned duly qualified and acting Clerk-Treasurer, of the City of Greensburg, Indiana certifies that the foregoing is a true and correct copy of a resolution adopted at a legally convened meeting of the Board of Works of the City of Greensburg, Indiana held on January 9, 2024.



Amy Borns, Clerk Treasurer
City of Greensburg, Indiana

EXHIBIT A

Professional

Engineering

Services

Design Standards Manual

Report

City of

Greensburg, Indiana

December 2023



Report for City of Greensburg, Indiana

Design Standards Manual

Prepared by:

STRAND ASSOCIATES, INC.®
629 Washington Street
Columbus, IN 47201
www.strand.com

December 2023



EXHIBIT A

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or Following

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EXECUTIVE SUMMARY

The Greensburg Design Standards Manual was developed as a tool to guide engineers, developers, contractors, and local officials for the design, construction, and maintenance of infrastructure for the City of Greensburg, Indiana (City). Goals of this manual include providing the user with clear expectations from the City, providing uniform equipment and products to make maintenance efforts more efficient, and ultimately providing the City of Greensburg with excellent public infrastructure.

Past manuals have been developed as stand-alone documents that tend to be very similar to industry-accepted design standards such as American Water Works Association (AWWA) standards or Indiana Department of Transportation (INDOT) standard specifications. A downfall of the stand-alone approach is that the locally developed design standard tends to diverge from the industry accepted standards over time because organizations like INDOT and AWWA regularly update their standards to keep up with the latest construction techniques and changes in construction materials and equipment. This manual was developed in a way to (whenever practical) point the user to those industry accepted standards with specific direction for use in the City. Users of this manual will be required to access the standards developed by other agencies to gain the clear direction that this manual is intended to provide. The goal of this approach is to provide design standards that are up to date, do not conflict with generally accepted industry standards, and stay up to date through the efforts of other agencies.

These design standards have been developed as typical minimum requirements. Depending on specific applications, local officials may establish more stringent requirements or accept alternate designs or materials to address atypical scenarios. In these cases, the user will be expected to follow best industry practice and communicate closely with local officials to establish expectations for addressing the unique situation.

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SECTION 1 DEFINITION OF TERMS

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1.01 DEFINITION OF TERMS

A. General

All references to outside sources shall refer to the current edition.

B. Abbreviations and Definitions

AASHTO	American Association of State Highway and Transportation Officials
AC	alternating current
AIC	amperes interrupting capacity
AISI	American Iron Steel Institute
ACI	American Concrete Institute
Aggregate	Natural or manufactured materials produced from, but not limited to limestone, dolomite, gravels, sandstones, steel furnace slag, or other geologic rock types approved by the City.
A	ampere
Amp	ampere
ANSI	American National Standards Institute
APWA	American Public Works Association
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWWA	American Water Works Association
Backfill/Fill	Earth or aggregate placed in trench from the top of bedding to finished grade, or to the subbase of pavement.
Base Course	The layer of specified or selected material of designed thickness placed on a subgrade treatment to support an intermediate or surface course.
Bedding	Earth or aggregate placed in trench to support pipe and conduit.
BEP	best efficiency point
BMP	Best Management Practice
Building Drain	The part of the lowest horizontal piping of a building drainage system which receives the discharge from sanitary pipes inside the walls of the building and conveys it to the building sewer, beginning two (2) feet outside the inner face of the building wall.
Building Sewer	The extension from the building drain to the Service Lateral or other place of disposal also called house connection.
°C	degrees Celsius
CCTV	closed circuit television
City	The City of Greensburg, Indiana, represented by the City Council, having the authority of approval of the drawings, specifications, and acceptance of the final construction.
Class II Bedding	No. 8 crushed limestone
Contractor	The person, firm, or corporation with whom the developer has entered into an agreement for construction of the project.
CRI	color rendering index
CSA	Canadian Standard Association

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CTS	copper tube size
DIN	Deutsche Institut fur Normung
DIPS	ductile iron pipe sizes
DPDT	double pole double throw
DR	dimension ratio
Drawings	Drawings for construction of the project as presented to the City.
Earth	Unconsolidated material in the crust of the Earth derived by weathering and erosion. Earth includes: <ul style="list-style-type: none">a. Materials of both inorganic and organic origin;b. Boulders less than 1/3 cubic yard in volume, gravel, sand, silt, and clay;c. Materials which can be excavated with a backhoe, trenching machine, drag line, clam shell, bulldozer, highlift, or similar excavating equipment without the use of explosives, rock rippers, rock hammer, or jack hammers.
Engineer	City Engineer or representative to act on behalf of the City.
EPDM	ethylene propylene diene terpolymer
Excavation	Removal of earth and rock to form a trench for the installation of a water main, gravity sanitary sewer, storm sewer, or force main.
°F	degrees Fahrenheit
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FM	Factory Mutual
GFI	ground fault interrupting
HDPE	high density polyethylene
HMA	hot mix asphalt
H-O-A	Hand-Off-Auto
House Connection	The pipe carrying the wastewater from a single-family dwelling to a common public sewer.
hp	horsepower
IAC	Indiana Administrative Code
ICS	Industrial Control Systems
IDEM	Indiana Department of Environmental Management
IEC	international Electrical Commission
IES	Illuminating Engineers Society
INDOT	Indiana Department of Transportation
Intermediate Course	The layer of specified or selected material of designed thickness placed on a base course to support a surface course.
I/O	input/output
ISS	INDOT's Standard Specifications
KVA	kilovolt amperes
kW	kilowatt
LED	light emitting diode
ma DC	low-level signal wiring
mil.	millimeter
mm	millimeter
MTW	machine tool wire

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MUTCD	Manual on Uniform Traffic Devices
Natural Subgrade	The prepared and compacted soil immediately below the pavement or walk system. Undisturbed bottom of a trench.
NBR	Acrylonitrile-butadiene
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NPT	National Pipe Thread Tapered
NPSHr	Net positive suction head required
NRMCA	National Ready Mix Concrete Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
OS&Y	outside stem and yoke
Owner	Person or firm having control of the development site, and management of the project.
PCCP	Portland Cement Concrete Pavement
PE	polyethylene
psig	pounds per square inch gauge
psi	pounds per square inch
PLC	programmable logic controller
Project	The total construction of which the work to be provided may be the whole or part
psf	pounds per square foot
PVC	polyvinyl chloride
QC	quality control
QC/QA	quality control/quality assurance
Record Drawings	Drawings prepared which reflect what was constructed on-site by the contractor
Rock	A natural aggregate of mineral particles connected by strong and permanent cohesive forces. Rock includes: <ul style="list-style-type: none">a. Boulders 1/3 cubic yard or more in volume;b. Materials which cannot be excavated by equipment which is used to remove earth overburden without the use of explosives, rock rippers, rock hammers, or jack hammers.c. Materials which cannot be excavated with a backhoe, trenching machine, drag line, clam shell, bulldozer, highlift, or similar excavating equipment without the use of explosives, rock rippers, rock hammer, or jack hammers.
Sanitary Sewer	Means a sewer that conveys liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, and to which storm surface, and ground water are not intentionally allowed to enter.
Sanitary Superintendent	The Superintendent of Greensburg Wastewater Treatment Plant or its representative.
SBR	styrene butadiene rubber
Service Lateral	The pipe that conveys wastewater from the property and/or easement line to the public sanitary sewer.
SPDT	single-pole double throw
SSPC	Society for Protective Coatings
Subgrade Treatment	The layer of specified or selected material of designed thickness placed on a prepared subgrade.

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Surface Course	The layer of specified or selected material of designed thickness placed on a base or intermediate course to support the traffic load.
Storm Sewer	Means a sewer that conveys surface water from rainfall events and ground water.
Ten State Standards	Recommended Standard for Wastewater Facilities written by the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers.
Topsoil	Earth containing sufficient organic materials to support the growth of grass.
Undercutting	Excavation of rock and unsuitable earth below the bottom of the pipe or conduit to be installed in the trench.
UL	Underwriters Laboratory
VAC	volts alternating current
VDC	volts of direct current
VFD	variable frequency drives
Wastewater	Liquid and water carried industrial waste and sewage from residential dwellings, commercial buildings, industrial and manufacturing facilities, and institutions, whether treated or untreated, which are contributed to the publicly owned treatment works.
Work	The entire completed construction or the various separately identified parts thereof required to be furnished.
3PDT	3 pole double throw

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**SECTION 2
WATER**

EXHIBIT A

2.01 DESIGN STANDARDS

A. General

1. Scope: Furnish and install pipe, fittings, valves, hydrants, and appurtenances necessary to complete the Work shown or specified.
2. Meters (1.5 inches and larger) must be installed in a vault or inside the building for access and must be approved by the City of Greensburg, Indiana (City).
3. Requirements for backflow preventers are stated in Ordinance 51.29 in the City's, Code of Ordinances.
4. All applicable permits shall be obtained from the Indiana Department of Environmental Management (IDEM) for the construction of a water main.
5. All required permits or exemptions from other federal, state, and local units must be obtained before the commencement of construction of any water main.
6. The contractor shall be responsible for the preparation and submittal of record drawings.

B. Water Main Placement

1. Separation Distances from Contamination Sources

Separation from all sources of contamination for parallel installation and crossings shall conform to what is written in the Ten State Standards for Water Works.

2. Cover

Water mains shall have a minimum cover as stated in the most recent version of 327 IAC 8 for Decatur County. The minimum cover is 48 inches as of 2023, but if there is a difference between these, 327 IAC 8 will apply.

3. Thrust Blocking

Thrust blocks shall be used in addition to joint restraints on all water mains 12 inches in diameter and larger. A recommendation is required from a geotechnical engineer relative to allowable soil pressure. The design of thrust blocks should be custom to the project.

C. Contractor's Organization

1. The contractor shall have a competent supervisor on the site during the progress of the Work, acting for the contractor in all matters concerning the Work. The supervisor shall have the authority to receive directions and act upon them for the City of Greensburg through the City's representative.

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2. The contractor shall keep a set of drawings and specifications available on-site and in good condition.

2.02 CONSTRUCTION AND MATERIAL SPECIFICATIONS

A. Materials

1. All materials in contact with potable water supplies shall be National Sanitation Foundation (NSF)-approved. These standards include (but are not limited to) NSF 61 and 372, if applicable.
2. All pipe and materials shall be clearly marked as to strength, class, or grade.
3. Water Main
 - a. Ductile Iron Pipe and Fittings
 - (1) Ductile iron piping shall conform to American Water Works Association (AWWA) C151/A21.51 with mechanical joints or push-on joints. Pipe wall thickness shall be furnished as required by AWWA C150 for buried piping with the depth of cover as shown on the Drawings.
 - (2) The contractor shall furnish certification data representing each class of pipe or fitting furnished. The certification report shall clearly state that all furnished pipe and fittings meet the appropriate AWWA specification. Ductile iron pipe shall consist of pipe centrifugally cast in metal or sand-lined molds. Pipe walls shall be homogeneous from inside to outside and shall be completely free of laminations, blisters, or other imperfections. Defects may be removed at the factory only.
 - (3) Except as otherwise specified, underground pipe shall have mechanical joints or push-on joints conforming to AWWA C110 and C111, as well as AWWA C153 (compact), with vulcanized styrene butadiene rubber gaskets, conforming to AWWA C111. Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe and provide joint restraint are not acceptable. Bolts on mechanical joints shall be high-strength low-alloy steel (Corten, or equal), conforming to AWWA C111.
 - (4) Restrained joints shall be provided in accordance with Part 2–Execution. Mechanical joints shall be restrained with MEGALUG® Series 1100 or 1100 SD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1400 by Ford Meter Box Co., Inc., or equal, restraint. Push-on joints for ductile iron piping shall be restrained with MEGALUG® Series 1700 or 1100 HD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1450 by Ford Meter Box Co., Inc., Flex-Ring or Lok-Ring by American Cast Iron Pipe Company, TR Flex by U.S. Pipe Company, TR Flex by McWane, or equal.

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- (a) Pipe restraint fittings shall be provided as follows:
 - 1) For ductile iron pipe with ductile iron mechanical joints MEGALUG® Series 1100 or 1100SD by EBAA Iron Sales, Inc., Series D SLDE or SSLD by Sigma, Series 3000 or 3000S by Star Pipe Products, or equal.
 - 2) For ductile iron pipe with ductile iron push-on joints MEGALUG® Series 1100HD or 1700 by EBAA Iron Sales, Inc, Series SLDEH or SSLDH by Sigma, Series 3100P or 3100S by Star Pipe Products, Flex Ring or Lok Ring by American Cast Iron Pipe Company, TR Flex by U.S. Pipe Company, or equal.
 - 3) For PVC pipe with ductile iron mechanical joint fittings–MEGALUG® Series 2000 PV, 1100SV, or 2000SV by EBBA Iron Sales, Inc., Series D SLCE or PVM by Sigma, Series 1000C or 4000 by Star Pipe Products; or equal.
 - 4) For polyvinyl (PVC) pipe with PVC push-on joints (not solvent welded)–MEGALUG® Series 1100HV, 1900, or 2800 by EBAA Iron Sales, Inc., Series SLCEH, PWP (greater than 12-inch only), or D PWP (12 inches or less) by Sigma, Series 4100P by Star Pipe Products, or equal.
- (b) Gland body, wedges, and wedge actuating components shall be ductile iron conforming to American Society for Testing and Materials (ASTM) A536 Grade 65 45 12. Bolts and tie rods shall be high strength low alloy steel conforming to AWWA C111.
- (c) Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe to provide joint restraint are not acceptable.
- (5) Joint restraint shall be provided for any pipe requiring pressure testing.
- (6) Underground pipe shall have mechanical joint or push-on joint ductile iron fittings conforming to AWWA C110 and C111 or AWWA C153 compact fittings with a minimum rated working pressure of 150 pounds per square inch (psi). Gaskets for fittings shall conform to AWWA C111.
- (7) Unless otherwise specified, all exterior ductile iron piping and fittings shall be cement-mortar lined and asphaltic-coated inside. Cement-mortar lining shall be in accordance with AWWA C104. Unless otherwise specified, underground piping and fittings shall be shop-primed or asphaltic-coated outside. Asphaltic coating shall conform to American National Standards Institute (ANSI)/AWWA C151-A21-51 Section 4.4 Coatings and Linings.
- (8) The outside pipe coating shall comply with AWWA C151. Lining and coatings shall be suitable with potable water systems. The asphaltic coating shall be applied over the cement lining on the inside of the pipe and

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directly on the outside of the pipe. The coatings shall be smooth and impervious to water without any tendency to scale off.

- (9) In cases where curb stops are to be tapped into mains, pipe wall thickness shall be furnished (as specified in AWWA C151) to provide four threads or pipe saddles shall be furnished as approved by manufacturer.
- (10) Cutting in and repair tees and sleeves and tapping tees shall be Type 304 stainless steel and shall conform to AWWA C223. Sleeves shall be Smith-Blair Style, or equal.
- (11) Exterior joints, fittings, and gaskets: Joints, fittings, and gaskets shall have the same rated working pressure of the pipe in which they are installed but no less than a minimum rated working pressure of 150 psi.

b. PVC Pipe (AWWA) and PVC Pressure Pipe Fittings (4 inches and larger)

- (1) PVC water main may be allowed with written approval by the City.
- (2) PVC water main shall be PVC pressure-rated pipe and shall conform to the requirements of AWWA C900 for pipe from 4 to 60 inches. Pipe shall be furnished with integral elastomeric bell and spigot joints.
- (3) PVC pipe diameter shall conform to ductile iron pipe sizes (DIPS). The type of PVC material, nominal pipe size, standard dimension ratio (SDR), and pressure class shall be not less than pressure class 235 and not greater than pipe dimension ratio (DR) 18.
- (4) All fittings for PVC pressure pipe shall be ductile iron pipe fittings as specified herein.
- (5) Tracer Wire
 - (a) Provide tracer wire for underground PVC piping.
 - (b) Provide minimum 10-gauge solid insulated copper tracer wire with buried thermoplastic pressurized pipe. Wire shall be continuous, terminate, and be accessible at valve boxes, fire hydrants, or at test stations as specified in the following paragraph. Tracer wire shall be located 12 inches above the top of the pipe. Any splices in copper wire shall be made with a 3MTM DBR/Y-6 splice kit, or equal.
 - (c) Tracer wire test stations shall be SnakePit magnetized tracer boxes by Copperhead Industries, or equal. Tracer box shall be corrosion-resistant with brass wire lugs and wax pad to cover the wire

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connection. Cover shall be color-coded according to American Public Works Association (APWA) standards for fluid conveyed. Provide a SnakePit Lite Duty Box in unpaved areas and a Roadway Box in paved areas. Provide Rhino Triview Marker Posts, or equal, at all test stations. Provide custom decals to identify the fluid in the piping. The tracer wire shall be accessible at a minimum of every 500 feet along the pipeline and at horizontal bends in the piping.

(d) Contractor shall perform continuity testing of all tracer wire.

4. Water Service Lines (2 inches in diameter or smaller)

a. High Density Polyethylene (HDPE) Water Piping

- (1) HDPE piping shall be copper tube size (CTS).
- (2) HDPE services shall meet the requirements of AWWA C901 with a pressure class not less than 160 psi and shall not have a DR greater than 9. HDPE pipe shall be manufactured according to ASTM 3035 and with material conforming to polyethylene (PE) code PE3408. HDPE shall be installed using one continuous coil of pipe. No unions or joint of any type will be acceptable during the installation of the pipe.
- (3) Piping shall be permanently indented every 2 feet along the pipe barrel, identifying the pipe with manufacturer's name or logo, pressure rating, nominal size, NSF logo, and quality control (QC) control codes.
- (4) HDPE pipe fittings shall be compatible with and from the same manufacturer as HDPE piping, shall be equal in material and construction to that of HDPE piping, and shall be fusion butt-welded to piping.
- (5) Fusion welding of HDPE piping shall be in accordance with ASTM F2620. Welders shall be trained and certified for this practice.
- (6) Shut-off valves shall be placed on each branch of the underground piping.
- (7) Brass quick joint couplings (Ford Meter Box Company or equal) made specifically for HDPE piping may be used on a limited basis and subject to approval by the City Water Superintendent. Couplings shall conform to AWWA Standard C800. No couplings shall be installed under floor slabs.
- (8) Provide tracer wire as specified with the buried PVC piping. The ends of the tracer wire shall be brought to the ground surface and stored in an access terminal box, Drain, Waste, Sewer (DWS)–Tracer Wire Access Box, or equal, at a location selected by the City. At the location of the terminal box 18 inches of additional wire length shall be coiled.

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5. Fire Hydrants

Fire hydrants provided under these standard specifications shall conform to AWWA C502 for Dry Barrel Fire Hydrants. Hydrants shall have the following features:

Bury Length	Approximately 4 feet to traffic flange.
Nozzle Size	One 4 1/2-inch and two 2 1/2-inch-diameter openings.
Nozzle Threads	National standard fire hose coupling screw threads.
Drain Port:	Drain port at the base of the hydrant barrel. Plug drain port when the hydrant is installed in an area where the groundwater level may rise above the drain port.
Size of Main Valve Opening	5 1/4-inch-diameter minimum. The hydrant lead connection shall be minimum 6-inch-diameter mechanical joint.
Torque Requirements	Hydrant shall comply with AWWA C502 even if greater than a 5-foot bury.
Lubrication	Nontoxic and providing proper lubrication for a temperature range of -30 to +120°F.

°F=degrees Fahrenheit

Table 2.02-1 Fire Hydrant Feature Requirements

- b. Contractor shall furnish all necessary fittings in the fire hydrant lead to install the fire hydrant in a plumb condition at locations shown on the drawings and at the specified depth of bury. The pumper nozzle of all fire hydrants shall be installed with the nozzle pointing toward the street.
- c. Fire Hydrant
 - (1) Fire hydrants shall be Model No. A423 as manufactured by Mueller Company.
 - (2) Hydrants shall be painted a color selected by the City Water Superintendent.
 - (3) A restrained joint system will be provided from the auxiliary valve in the road box back to the tee.
 - (4) Connect the hydrant to the auxiliary valve with a 2-foot length of pipe.
 - (5) Provide a drain port at the base of the hydrant barrel. Plug the drain port when the hydrant is installed in an area where the groundwater level may rise above drain port.

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6. Valves

a. Gate Valves

- (1) Shut-off valves in potable water lines 4-inch diameter and larger shall conform to AWWA C515 or C509, be resilient seat, nonrising stem, 150 psi working pressure with O-ring packing box, Mueller Company, or equal. Valves shall open counterclockwise (left).
- (2) Underground valves shall have an extended stem, cast iron telescopic valve box, and key. Right angle operators shall be provided, if required, because of the valve position.
- (3) Tapping valves shall conform to AWWA C509.
- (4) Tapping sleeves shall be type 304 stainless steel and shall conform to AWWA C223. Sleeves shall be Smith-Blair Style, or equal.

b. Butterfly Valves

General–Butterfly valves shall be AWWA C504, short body, Class 150B. Provide certified drawings by manufacturer and Affidavit of Compliance.

c. Corporation Stop and Curb Stop Valves

- (1) Corporation Stop Valves: (2 inches and smaller) shall be a bronze body ground key valve, bronze plug, AWWA taper thread inlet and copper flare outlet nut connections or compression type, AWWA C800.
- (2) Curb Stop Valves: (Boxes 2 inches and smaller) shall be a bronze body plug valve, bronze plug, quarter turn check, O-ring seals, copper flare nut connections or compression type, AWWA C800. Provide Minneapolis-type curb box complete with lid and stationary rod.

d. Air Release Valves

- (1) Air valves shall conform to AWWA 512 and shall be as follows:

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Size	Specification
1/2 inch	Apco Body Style 50A, Val-Matic No. 15A, or equal
1 inch	Apco Body Style 200A, Val-Matic No. 38, or equal
2 inches	Apco Body Style 200, Val-Matic No. 45, or equal
3 inches	Apco Body Style 200, Val-Matic No. 45.2, or equal

Table 2.02-2 Air Release Valves

7. Valve Boxes

- a. A valve box shall be provided for the fire hydrant auxiliary valves and for valves in the main. The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of the valve boxes so that the bottom of the base is approximately 2 inches away from contact with the valve bonnet. A gate valve adaptor by Adaptor Inc., or equal, shall be provided.
- b. Valve boxes shall be made of cast iron conforming to ASTM A48. The castings shall be thoroughly coated with a 1 millimeter (mil) minimum thickness bituminous coating. Valve boxes shall be 5 1/4 inches in diameter. Extensions shall be provided for deeper mains.
- c. Valve boxes shall be Tyler/Union 6850 Series, 4 through 12 inches, or equal. Extension heights shall be provided as required. Lids shall be marked "WATER." Contractor shall verify that all valve boxes are large enough to accommodate all operating nuts and wrenches.

8. Service Saddles

Service saddles shall conform to AWWA C800. Saddles shall be Smith-Blair, Style 313, or equal.

9. Bedding and Backfill

- a. All pipe bedding shall conform to the standard details in this manual. The materials used for bedding and backfilling shall conform to:
 - (1) Section 213 of the Indiana Department of Transportation (INDOT) Standard Specifications (ISS) for Flowable Fill.
 - (2) Section 904 of the ISS for Aggregate.
- b. Bedding shall be in accordance with the standard construction details in this section.

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- c. Backfill pipe cover material shall be in accordance with the Standard Construction Details in this section.
 - d. Flowable backfill shall be used in scenarios where a trench is cut in a pavement section. Flowable backfill shall conform to the requirements of Section 213 in the ISS (see the standard construction details in this section).
10. Pavement for patching shall follow:
- a. Section 401 of the ISS for quality control/quality assurance (QC/QA) Hot Mix Asphalt (HMA) Pavement.
 - b. Section 506 of the ISS for Portland Cement Concrete Pavement (PCCP) Patching.
11. Water meters shall be furnished by the City. The meter pit assembly for a 3/4 service shall be as follows:

Items Supplied and Installed by Contractor	Part Numbers (For 3/4-inch Service)	
	Ford Meter Box Co.	Mueller Co.
Yoke	Y502	H-5020, 5/8 inches
Shut-off valve	AV 94-323	H-1426-3
Check valve	HA 94-323	H-1424-5
Frame and cover	NO. C-3T	Tyler Mode; 6150

Table 2.02-3 Water Meter Pit Assembly Parts

2.03 EXECUTION AND INSTALLATION

A. Installation

1. Earthwork

All excavation shall conform to section 203 in the ISS.

2. Inspection

Contractor shall inspect the pipe, fittings, and appurtenances for defects when delivered to the jobsite and before lowering into the trench. Defective material shall be removed from the jobsite. All material shall be clean and free of deleterious substances before use in the Work.

3. Water Mains

Water main shall be installed in accordance with AWWA C600 for iron pipe and AWWA C605 for PVC pipe. Water mains 12 inches in diameter or greater shall be provided with thrust blocking and joint restraints at the pipe bends.

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4. Water Service Lateral Installation

- a. Water service laterals requiring reconstruction and new service laterals shall be installed in accordance with AWWA C600. Contractor shall perform all excavation, backfill, and other Work necessary for a complete installation. The service tubing shall be continuous and shall be placed at a minimum depth of 4 feet. Each service shall include a corporation stop at the main, HDPE tubing, curb stop, curb box, couplings, and all other appurtenances necessary for a complete installation. Where existing services in the street are being reconstructed, the new service shall be connected to the existing service at the property line (unless otherwise shown or specified). Taps in the main shall be at an angle of 45 degrees above the horizontal.
- b. The City reserves the right to make taps and connections to the new mains before backfilling by contractor. Contractor shall delay backfilling until the City has completed its Work.
- c. All curb boxes on new services shall be marked by placing a 4-foot long 2 by 4 adjacent to it. The 2 by 4 shall project 1 foot above existing ground and shall be painted blue. All services shall be extended to the street property line, unless otherwise shown or specified.

5. Valves, valve boxes, and fire hydrants shall be installed according to AWWA C600 and the standard details in this section.

6. Jointing

Joints shall be installed according to AWWA C600 for ductile iron pipe and AWWA C605 for PVC pipe.

7. Joint Restraints

- a. Except where noted or specified, all underground piping shall be laid in accordance with AWWA C600 for ductile iron and AWWA C605 for PVC with the conditions that (1.) blocking shall not be used to support pipe and (2.) all bends and fittings shall be restrained as specified in Table 2.02-4, and pipe joints shall be restrained in all directions from all bends and fittings to the length as specified in Table 2.02-4.
- b. Pipe Length
 - (1) The minimum length of pipe to be restrained shall be as shown in Table 2.03-1
 - (2) Table 2.03-1 assumes horizontal orientation of fittings, 150 psi test pressure plus a 100-psi water hammer allowance, ductile iron pipe, and a

EXHIBIT A

4-foot bury depth. Lengths shall be adjusted for other conditions and fittings.

Fitting	Minimum Length (feet)
90 Degree Bend (≤ 6 inches)	36
90 Degree Bend (8 inches to 10 inches)	54
90 Degree Bend (12 inches to 14 inches)	72
90 Degree Bend (16 inches)	84
45 Degree Bend (≤ 8 inches)	18
45 Degree Bend (10 inches to 16 inches)	36
22 1/2 Degree Bend ≤ 16 inches	18
11 1/4 Degree Bend ≤ 16 inches	9
Fire Hydrant Leads	All Joints
End of Line Tees (≤ 4 inches)*	18 (Along Branch)
End of Line Tees (6 inches to 8 inches)*	36 (Along Branch)
End of Line Tees (10 inches to 12 inches)*	54 (Along Branch)
End of Line Tees (14 inches to 16 inches)*	72 (Along Branch)

*Restrained run length on tees assumed 18 feet on each side of the fitting.

Table 2.03-1 Required Length of Restrained Pipe Beyond Fitting in Feet

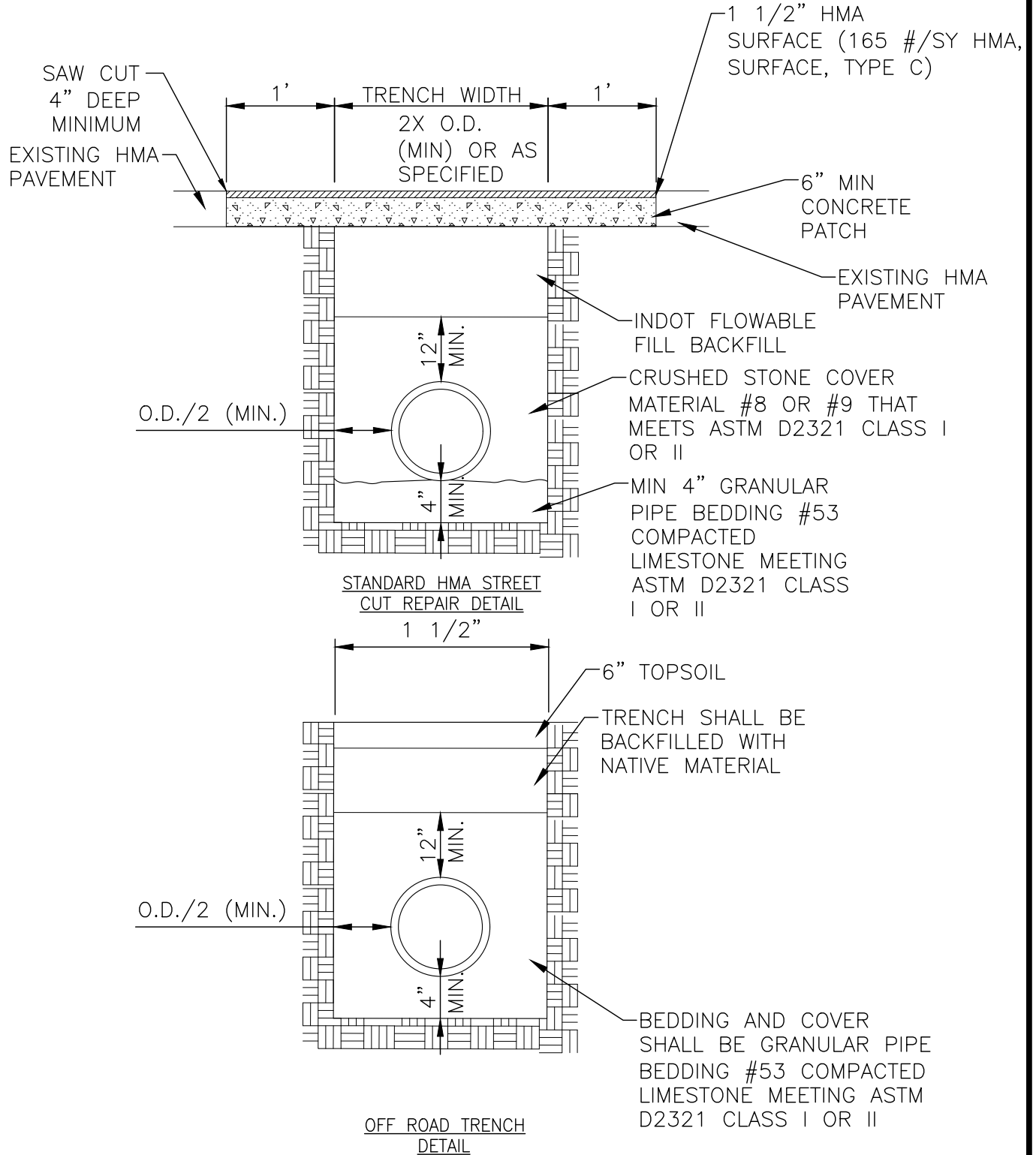
8. Testing

a. Hydrostatic Pressure and Leakage Testing

Pressure tests shall be performed as required by AWWA C600 and C605, unless otherwise noted herein.

2.04 STANDARD DRAWINGS

EXHIBIT A



TRENCH DETAILS

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

W-1

EXHIBIT A

#5 DOWELS 12" OC

EXISTING
CONCRETE

TRENCH WIDTH

2X O.D.
(MIN) OR AS
SPECIFIED

6" FIBER
REINFORCED
CONCRETE

O.D./2 (MIN.)

12"
MIN.

INDOT FLOWABLE
FILL BACKFILL

CRUSHED STONE COVER
MATERIAL #8 OR #9 THAT
MEETS ASTM D2321 CLASS I
OR II

MIN 4" GRANULAR
PIPE BEDDING #53
COMPACTED
LIMESTONE MEETING
ASTM D2321 CLASS
I OR II

CONCRETE STREET CUT
DETAIL

TRENCH WIDTH

2X O.D.
(MIN) OR AS
SPECIFIED

8"-#53'S

FILTER FABRIC

12"
MIN.

CRUSHED STONE COVER
MATERIAL #8 OR #9 THAT
MEETS ASTM D2321 CLASS I
OR II

MIN 4" GRANULAR
PIPE BEDDING #53
COMPACTED
LIMESTONE MEETING
ASTM D2321 CLASS
I OR II

O.D./2 (MIN.)

GRAVEL ROAD TRENCH
DETAIL

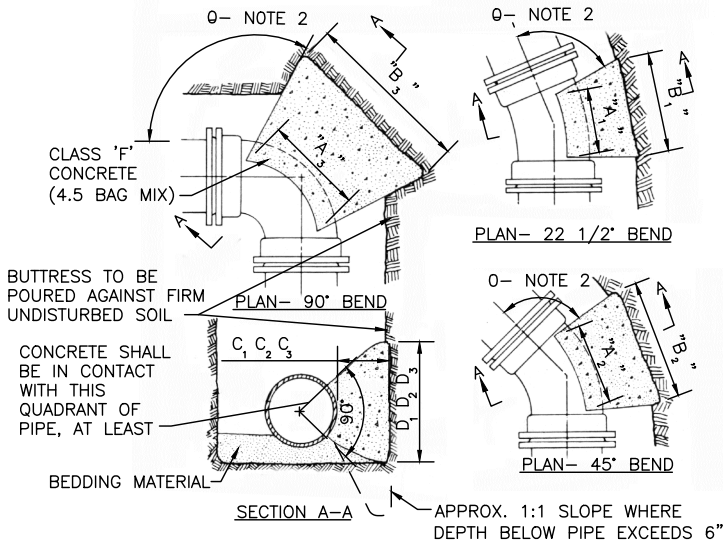
TRENCH DETAILS

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

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EXHIBIT A

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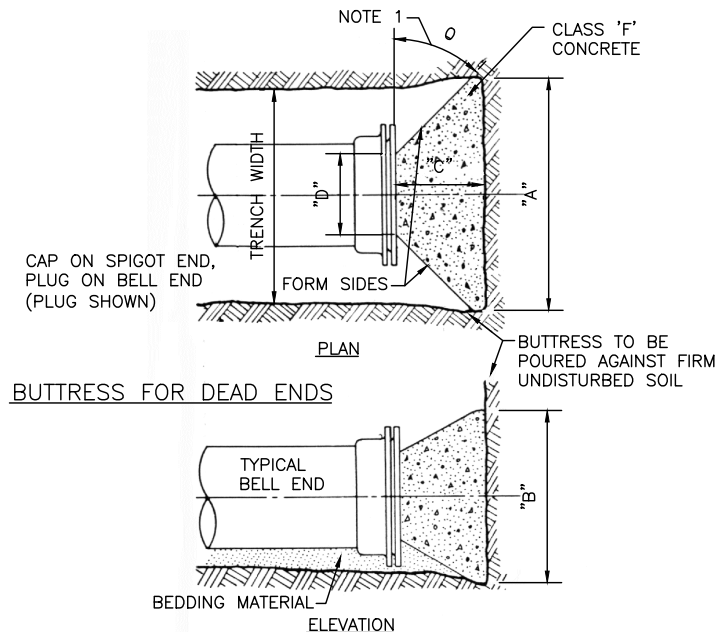


BUTTRESS FOR BENDS

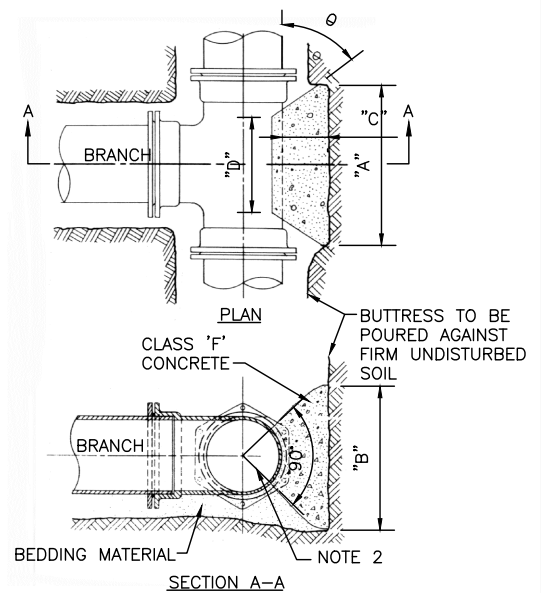
NOTES:

1. DIMENSIONS IN TABLE ARE BASED ON A WATER PRESSURE OF 150 PSI AND ON EARTH RESISTANCE OF 2 TONS PER SF.
2. DIMENSION C₁, C₂, C₃, SHOULD BE LARGE ENOUGH TO MAKE ANGLE θ EQUAL TO OR LARGER THAN 45°.
3. DIMENSION A₁, A₂, A₃, SHOULD BE AS LARGE AS POSSIBLE WITHOUT INTERFERING WITH MJ BOLTS.
4. SHAPE OF BACK OF BUTTRESS MAY VARY AS LONG AS POUR IS AGAINST FIRM UNDISTURBED EARTH.
5. ALL IRON PIPE AND FITTINGS SHALL BE WRAPPED IN POLYETHYLENE.

BUTTRESS DIMENSIONS						
PIPE SIZE	22 1/2° BENDS	45° BENDS		90° BENDS		
	B ₁	D ₁	B ₂	D ₂	B ₃	D ₃
6"	1'-0"	1'-0"	1'-0"	1'-0"	1'-4"	1'-2"
8"	1'-0"	1'-0"	1'-4"	1'-2"	1'-10"	1'-6"
12"	1'-4"	1'-4"	1'-10"	1'-10"	2'-8"	2'-3"
16"	1'-10"	1'-8"	2'-6"	2'-4"	3'-10"	2'-10"
20"	2'-4"	2'-0"	3'-3"	2'-10"	5'-0"	3'-4"
24"	2'-10"	2'-4"	4'-0"	3'-3"	6'-4"	3'-10"
30"	3'-6"	3'-0"	5'-4"	3'-10"	8'-0"	4'-8"



BUTTRESS FOR DEAD ENDS



BUTTRESS FOR TEES

NOTES:

1. DIMENSION "C" SHOULD BE LARGE ENOUGH TO MAKE ANGLE θ EQUAL TO OR LARGER THAN 45°.
2. CONCRETE SHOULD BEAR ON THIS QUADRANT OF PIPE AS MINIMUM.
3. DIMENSION "D" SHOULD BE AS LARGE AS POSSIBLE BUT CONCRETE SHOULD NOT INTERFERE WITH MECHANICAL JOINTS.
4. BUTTRESS DIMENSIONS ARE BASED ON A SOIL RESISTANCE OF TWO TONS PER SF AND A WATER PRESSURE OF 150 PSI.
5. ALL IRON PIPE AND FITTINGS SHALL BE WRAPPED IN POLYETHYLENE.

BUTTRESS DIMENSIONS				
BD	A	B	C	D
6"	1'-3"	1'-0"	SEE NOTE 1	SEE NOTE 3
8"	1'-6"	1'-4"		
12"	2'-3"	2'-0"	SEE NOTE 1	SEE NOTE 2
16"	3'-2"	2'-6"		
20"	4'-0"	3'-0"	SEE NOTE 1	SEE NOTE 2
24"	5'-3"	3'-4"		
30"	6'-3"	4'-3"	SEE NOTE 1	SEE NOTE 2

NOTES:

1. DIMENSION "C" SHOULD BE LARGE ENOUGH TO MAKE ANGLE θ EQUAL TO OR LARGER THAN 45°.
2. DIMENSION "D" EQUALS APPROX. I.D. OF PIPE LESS 2". AN EFFORT SHOULD BE MADE TO PREVENT THE CONCRETE FROM COVERING THE MJ BOLTS.
3. WHERE BUTTRESSES ARE NOT POSSIBLE BECAUSE OF POOR SOIL CONDITIONS OR LACK OF ROOM, STRAPPING SHALL BE PERMITTED.
4. BUTTRESS DIMENSIONS ARE BASED ON A SOIL RESISTANCE OF TWO TONS PER SF AND A WATER PRESSURE OF 150 PSI.

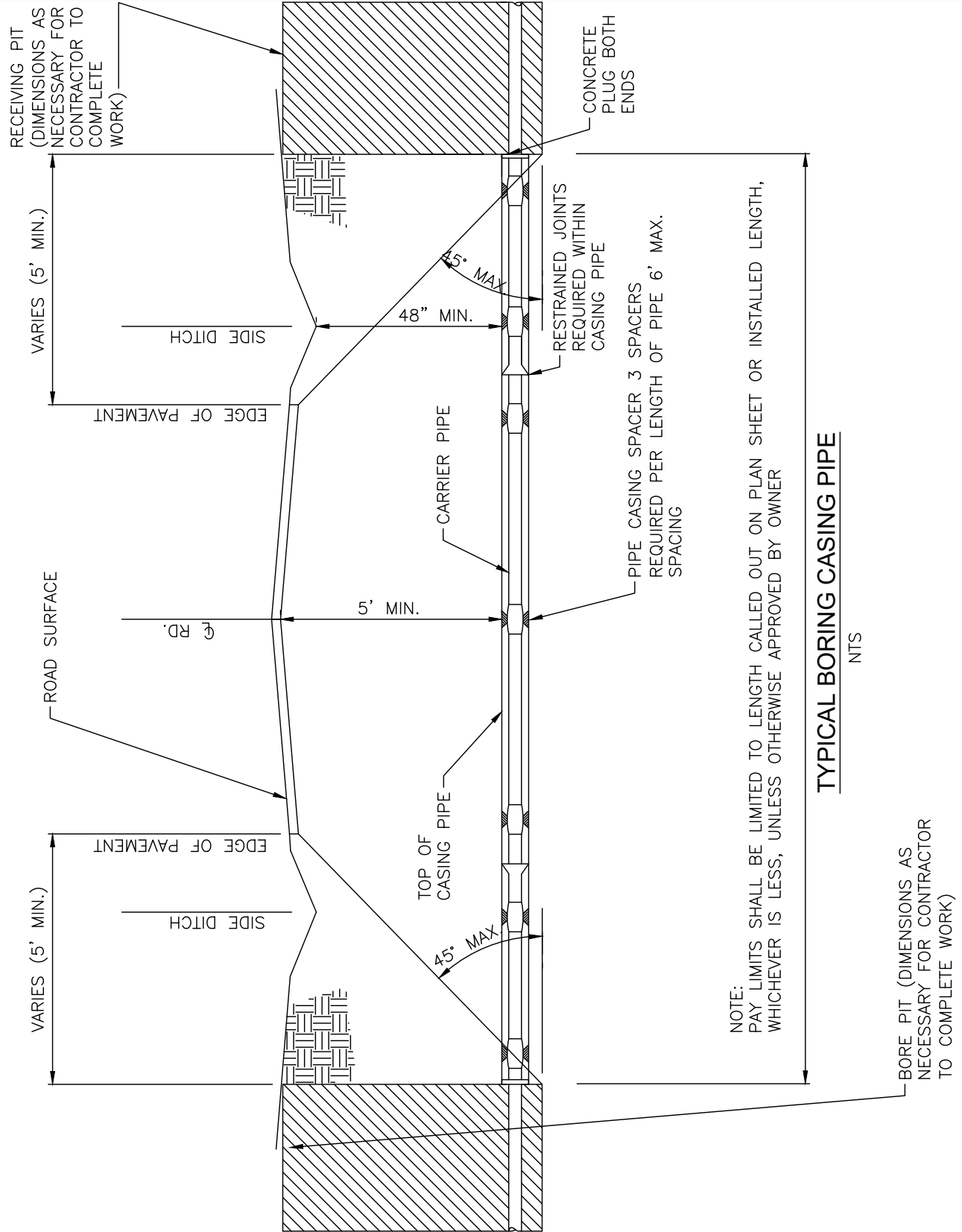
BUTTRESS DIMENSIONS				
BD	A	B	C	D
6"	1'-6"	1'-2"	SEE NOTE 1	SEE NOTE 2
8"	2'-0"	1'-4"		
12"	2'-5"	1'-10"	SEE NOTE 1	SEE NOTE 2
16"	3'-4"	2'-4"		
20"	4'-3"	2'-10"	SEE NOTE 1	SEE NOTE 2
24"	5'-2"	3'-4"		
30"	6'-9"	4'-0"	SEE NOTE 1	SEE NOTE 2

THRUST BLOCK DETAIL

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

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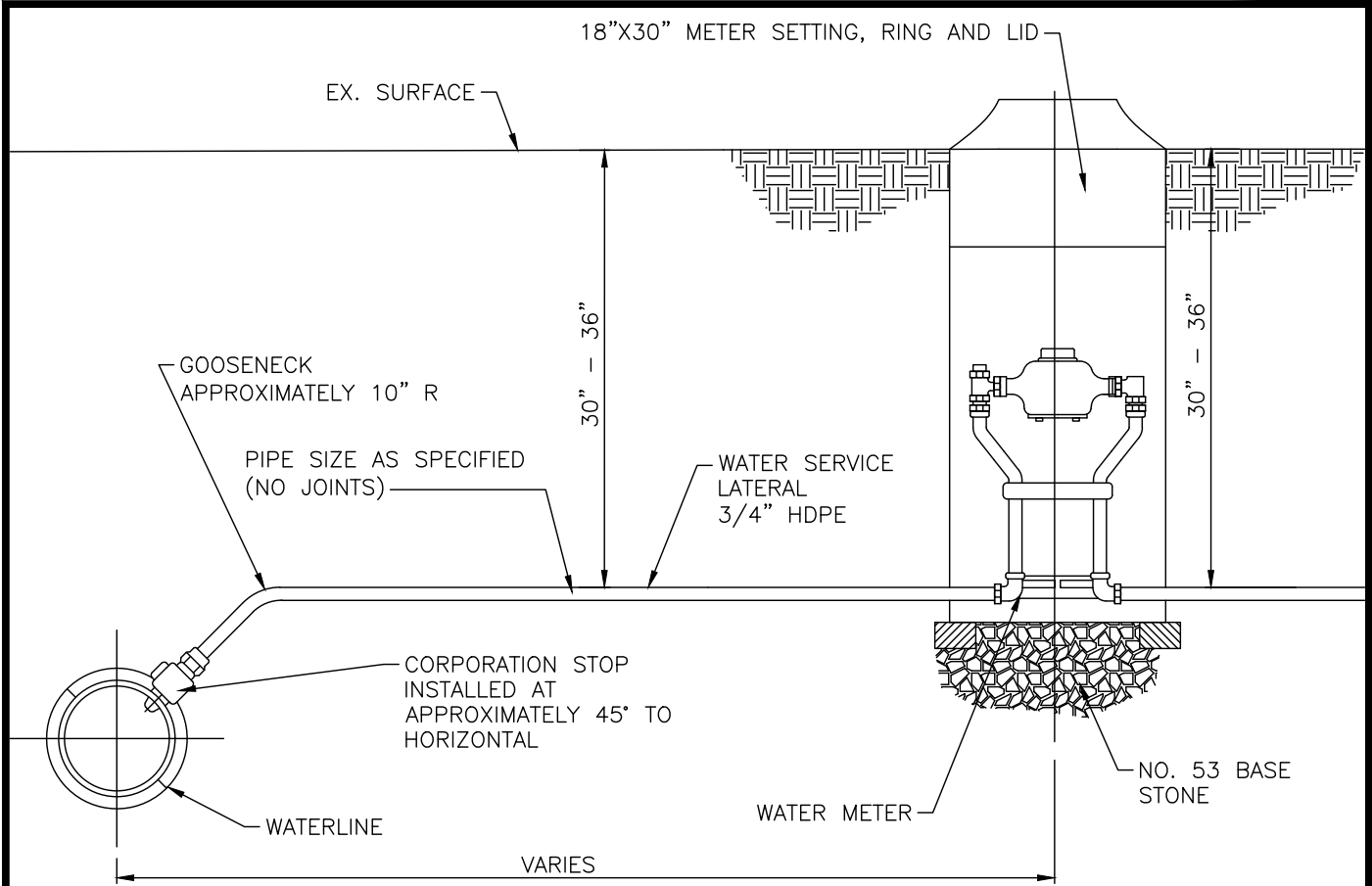
EXHIBIT A



TYPICAL BORING DETAIL

**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

EXHIBIT A



- NOTES
- 1. ALL FITTINGS SHALL BE COMPRESSION JOINT TYPE, AND CONFORM TO AWWA REQUIREMENTS
 - 2. CORPORATION STOP TO BE ATTACHED TO DUCTILE IRON AND PVC WATERLINES WITH A SADDLE, UNLESS OTHERWISE SPECIFIED.
 - 3. ALL TAPS TO BE MADE UNDER PRESSURE WHEN APPLICABLE
 - 4. NO TAPS TO BE CLOSER THAN 18" APART ALONG MAIN
 - 5. ALL TUBE BENDS TO BE SMOOTH RADIUS, 10" MIN.
 - 6. WATER SERVICE LATERAL TO BE TESTED ALONG WITH WATERLINE, UNLESS IT IS AN EXISTING SERVICE BEING RECONNECTED
 - 7. TRACER WIRE SHALL BE INSTALLED ON ALL PROP. WATER SERVICE LATERALS

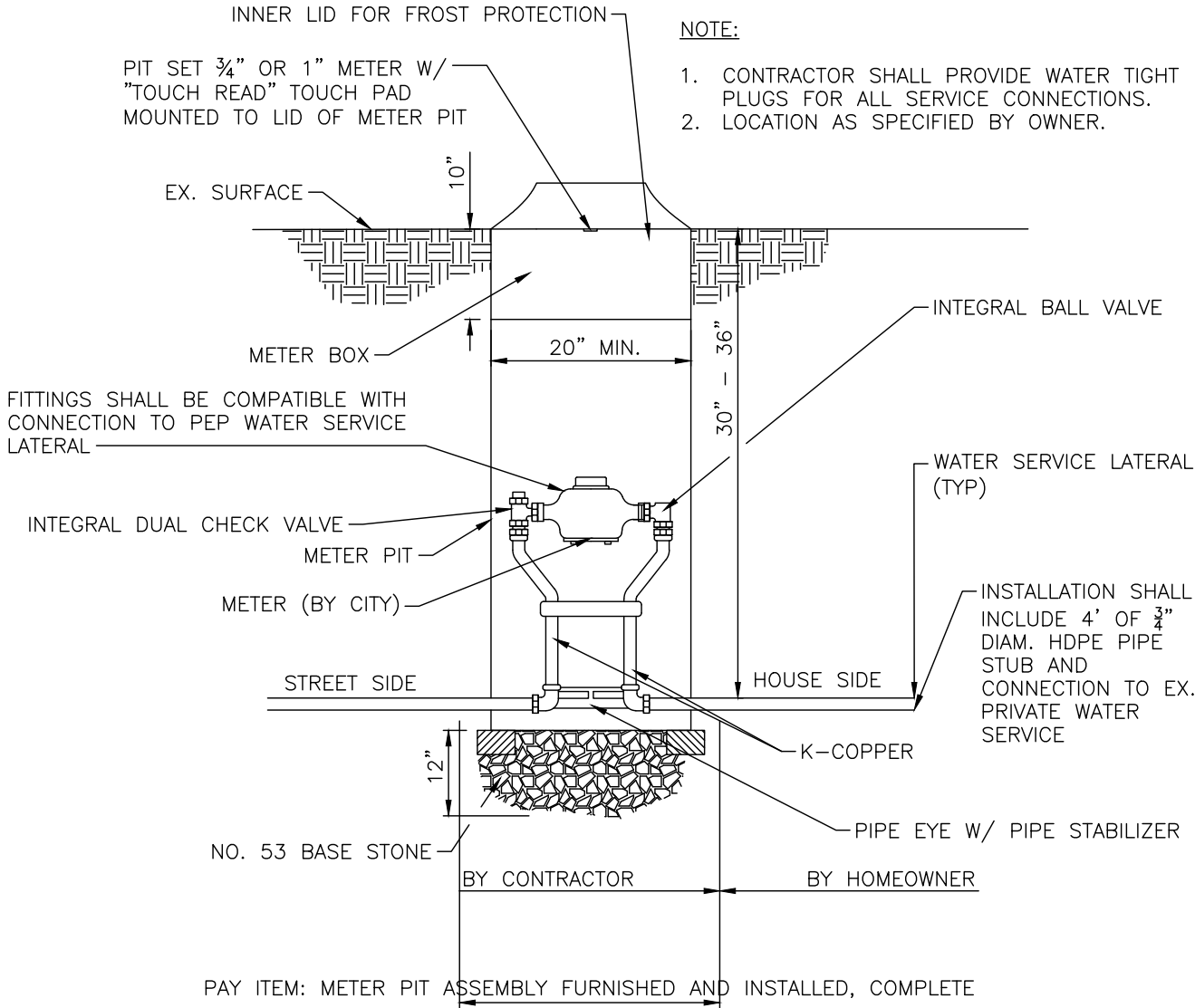
WATER SERVICES - WATER METER

NTS

SERVICE TO WATER METER DETAIL
(SINGLE RESIDENTIAL SERVICE)

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

EXHIBIT A



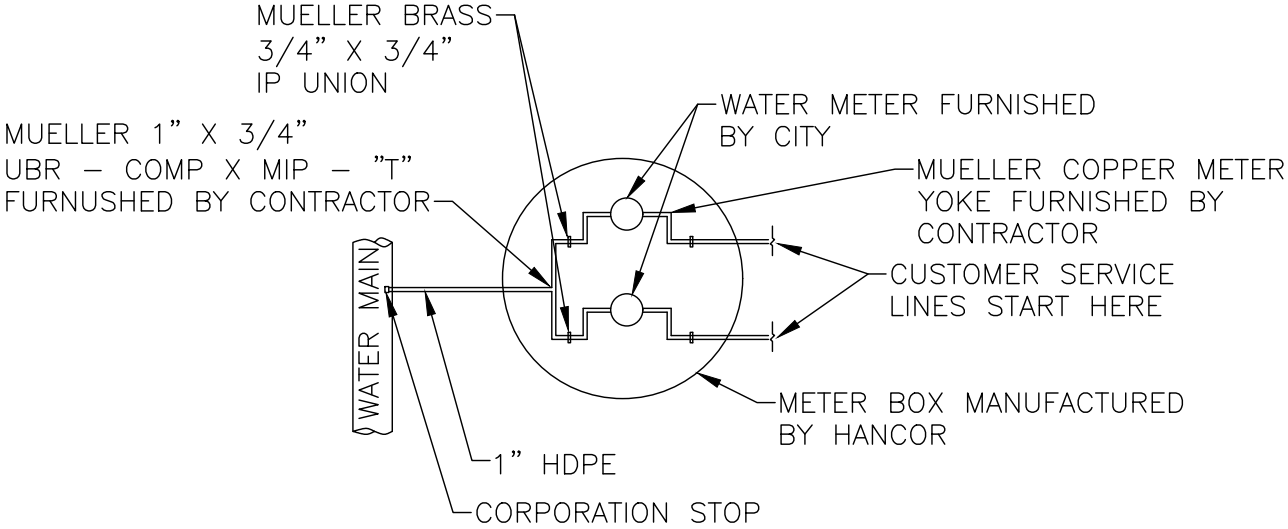
ITEMS SUPPLIED AND INSTALLED BY CONTRACTOR	PART NUMBERS (FOR 3/4" SERVICE)	
	FORD METER BOX CO.	MUELLER CO.
YOKE	Y502	H-5020, 5/8"
SHUT-OFF VALVE	AV 94-323	H-1426-3
CHECK VALVE	HA 94-323	H-1424-5
FRAME AND COVER	NO. C-3T	TYLER MODEL 6150

METER PIT ASSEMBLY
NTS

WATER METER PIT DETAIL
3/4" RESIDENTIAL SERVICE

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

EXHIBIT A

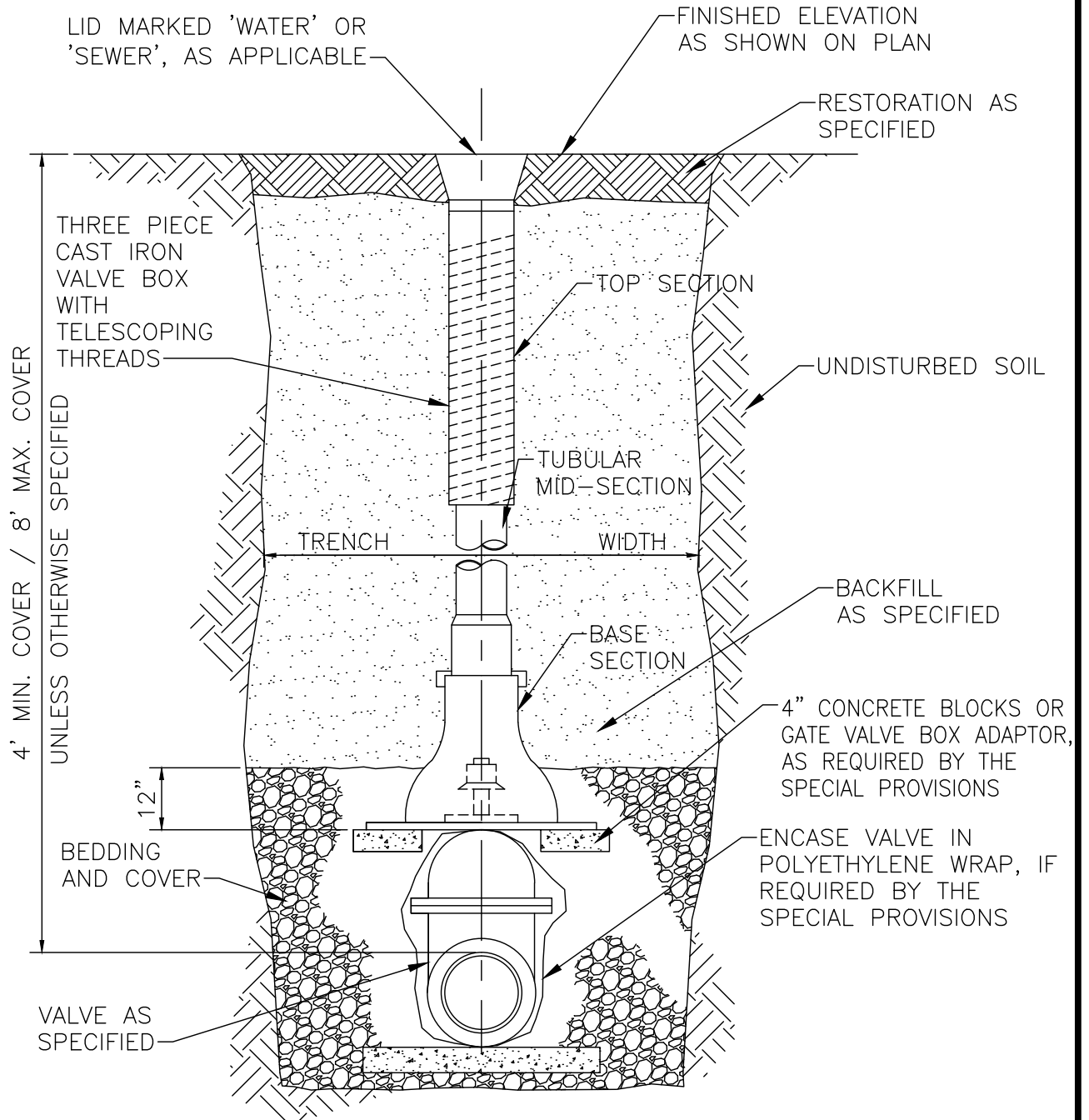


TYPICAL DOUBLE METERED SERVICE INSTALLTION PLAN
NTS

DOUBLE SERVICE WATER METER PIT DETAIL

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

EXHIBIT A



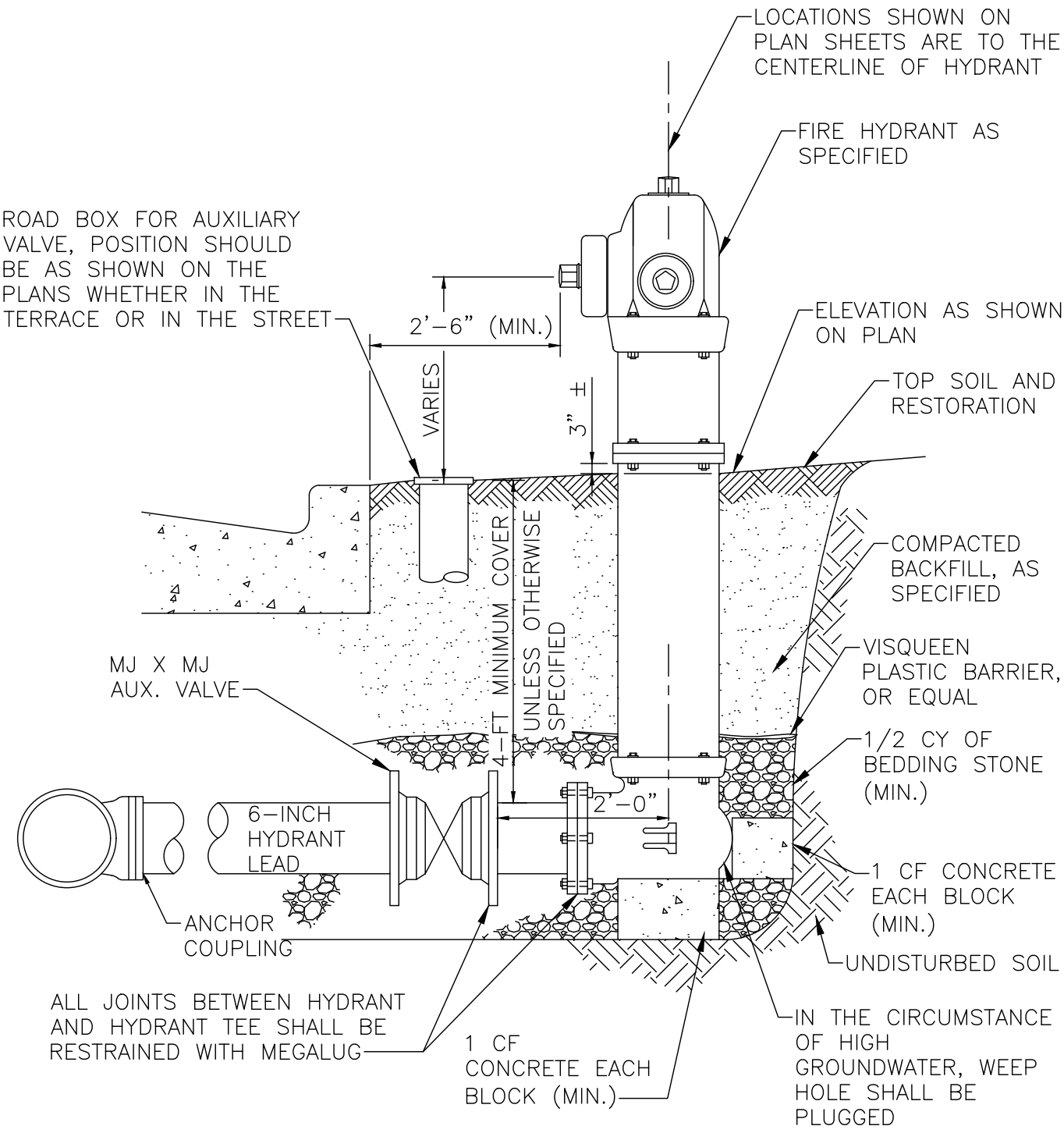
STANDARD BURIED GATE VALVE BOX SETTING

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

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EXHIBIT A

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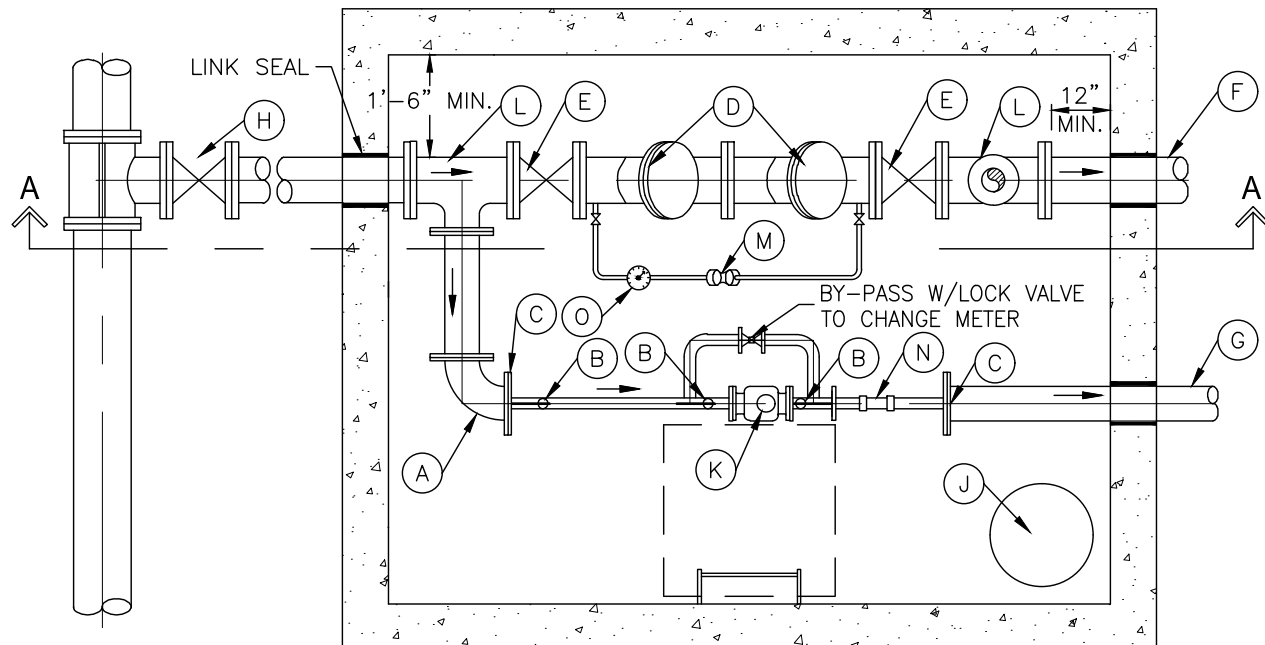


FIRE HYDRANT INSTALLATION

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

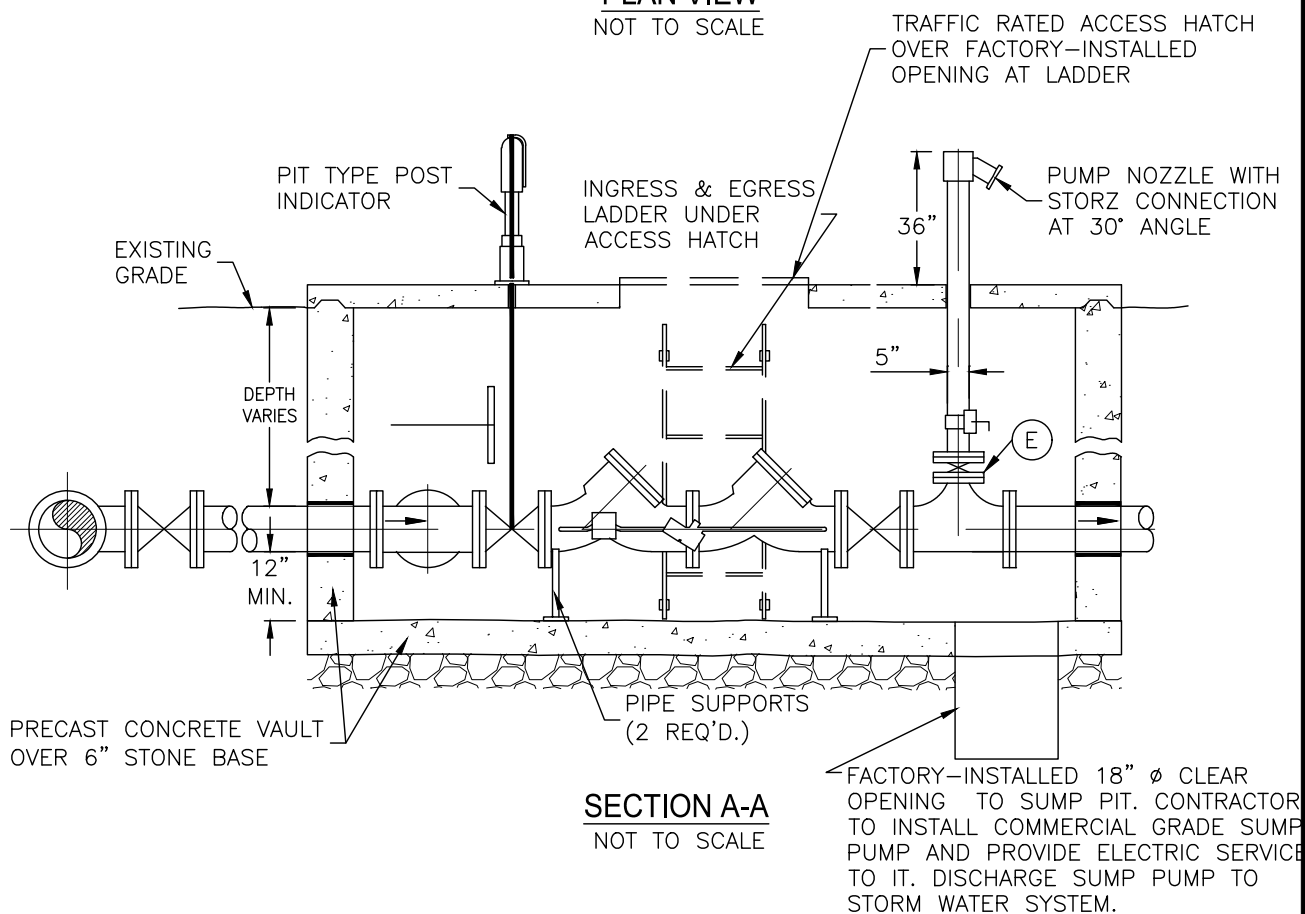
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EXHIBIT A



PLAN VIEW

NOT TO SCALE



SECTION A-A

NOT TO SCALE

COMBINED FIRE SERVICE & METER VAULT (SHEET 1 OF 2)

**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

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EXHIBIT A

KEY NOTES:

- (A) 90° FLANGED BEND W/PIPE SUPPORT
- (B) BALL VALVE
- (C) REDUCING FLANGE
- (D) DOUBLE DETECTOR CHECK VALVE ASS'Y.
- (E) FLANGED OS & Y VALVE
- (F) FIRE LINE
- (G) DOMESTIC SERVICE
- (H) MECHANICAL JOINT GATE VALVE & BOX
- (I) TAPPING SLEEVE W/TAPPING VALVE & BOX
- (J) SUMP
- (K) METER – (BY UTILITY)
- (L) FLANGED TEE
- (M) DOUBLE CHECK VALVE
- (N) LOK-PAK
- (O) PRIVATE METER

NOTES:

1. CONTRACTOR SHALL CONSTRUCT METER VAULT.
2. CONSTRUCTION MATERIALS: PRECAST CONCRETE.
3. INSIDE DIMENSIONS PER DRAWING NOTES. VAULT TO BE SET LENGTHWISE WITH SERVICE.
4. TOP OF VAULT TO BE PRE-CAST CONCRETE, AT LEAST 4" THICK WITH REINFORCING TO SUPPORT ASHTO HS20 TRAFFIC LOAD. TOP OF VAULT SHALL CORRESPOND WITH FINISHED GRADE LEVEL OF SURROUNDING AREA, LEVEL WITH PAVEMENT IF CONSTRUCTED IN PAVED AREA.
5. BOTTOM OF VAULT TO BE PRE-CAST 6" CONCRETE, WITH MINIMUM CLEARANCE OF 12" BELOW BOTTOM OF FIRE/SERVICE LINE.
6. CUSTOMER SHALL FURNISH 2" BALL VALVES ON OUTLET SIDE OF THE 2" METER SETTING.
7. CUSTOMER SHALL FURNISH DOUBLE DETECTOR CHECK VALVE. METER IS FURNISHED BY UTILITY.
8. CUSTOMER SHALL FURNISH VAULT FRAME AND LID TO BE INSTALLED IN TOP OF VAULT BY CUSTOMER (BILCO J-2AL OR 30"X30" ALUMINUM PCM).
9. UTILITY WILL INSTALL A LADDER IN PIT FOR INGRESS AND EGRESS.
10. CUSTOMER SHALL INSTALL A LADDER IN PIT FOR INGRESS AND EGRESS.
11. A 2" TEST PLUG SHALL BE INSTALLED AT LEAST 2 PIPE DIAMETERS DOWNSTREAM OF 2" OR LARGER METERS.
12. USED FOR LEAK DETECTION METER IS FOR FIRE LINE ONLY.

COMBINED FIRE SERVICE & METER VAULT (SHEET 2 OF 2)

**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

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EXHIBIT A

EXHIBIT A

3.01 DESIGN STANDARDS

A. General Requirements

1. This section covers all Work necessary for installing gravity sanitary sewers, force mains, submersible lift stations, and related items including manholes, junction chambers, diversion chambers, house services, miscellaneous concrete structures, fittings, valves, and appurtenances. This section also describes the definitions, policies, and procedures for the construction of sanitary sewers, force mains, and submersible lift stations in the City.
2. All sanitary sewers, force mains, and submersible lift stations are to meet the following specifications, state and federal regulations, and the Ten State Standards.
3. All easements for collection system sewers must prohibit the construction of permanent structures over the sanitary sewer and must also provide enough access for maintenance with mechanical equipment. Unless otherwise approved by the City, sewer conveyance systems are not to be constructed along the backside of properties without alleyways present. The width of the sanitary sewer, force main, and lift station easements shall be at least three times the depth of the sewer and shall be centered on the applicable infrastructure. The City may require additional width to ensure proper access for the maintenance equipment.
4. All applicable permits shall be obtained from the IDEM for the construction of sanitary sewers, lift stations, and force mains.
5. All required permits or exemptions from other federal, state, and local units must be obtained before the commencement of construction of any sanitary sewer.
6. The Superintendent of the Greensburg Wastewater Treatment Plant is to be notified 24 hours before installing of any sanitary sewer.
7. All Work shall be inspected, tested, and approved, in accordance with federal, state, and local rules and regulations. All Work shall also be tested as specified in this section. Test results shall be recorded, and three copies of the reports or appropriate certificates shall be submitted to the City.
8. The contractor shall be responsible for the preparation and submittal of record drawings.

EXHIBIT A

B. Gravity Sanitary Sewers

1. The positioning of the sanitary sewers in relation to water mains shall conform to the latest edition of the Ten State Standards.
 - a. When it is impossible to obtain proper horizontal and vertical separation as stipulated by the Ten State Standards, the sewer shall be designed and constructed equal to pressure rated PVC AWWA C900 or C905 pipe (as detailed in the Section 2–Water) and shall be pressure tested to assure watertightness before backfilling. Maximum distance between sewer pipe joints and the water pipe shall be provided where vertical separation is not achievable.
2. Positioning of sanitary sewers in relation to stream crossings or water bodies shall conform to 312 IAC 10-5-4, for minimum depth of cover.
3. Positioning of sanitary manholes shall conform to the latest edition of the Ten State Standards, with a maximum manhole spacing of 400 feet.
4. No contractor shall open more than 100 feet of trench at one time unless it has the permission of the City. The contractor may open no more than 30 feet of trench in advance of the completed pipe laying operation, and the trench may only obstruct one street crossing at a time.
5. When joining two dissimilar types of pipe, standard fittings shall be used when available.
6. Piping appurtenances shall be made of the materials specified.
7. All pipe, fittings, infrastructure, and appurtenances shall be new, unused or as required by the manufacturer and ANSI, AWWA, or ASTM standard specification.

C. Force Mains

1. Separation distances from water sources and water mains are the same as gravity sanitary sewer.
2. All pipe, fittings, valves, and appurtenances shall be as specified in this section. All pipe, fittings, valves, and appurtenances shall be new and unused.

D. Submersible Lift Stations

1. Codes and regulations
 - a. Shall conform to the latest edition of the Ten State Standards.
 - b. Shall conform to the latest edition of 327 IAC 3-6.

EXHIBIT A

- c. All projects must have a wastewater facility construction permit approved and issued by the IDEM before construction.
- 2. Performance requirements
 - a. Contractor shall supply pumps to meet the following requirements using constant speed operation:
 - (1) Pumping units shall meet the requirements of Hydraulics Institute (HI) standards.
 - (2) Pumps shall operate at the normal condition within +10 percent of given capacity at given head, or within +5 percent of given a head at a given capacity.
 - (3) While operating under suction head at the normal operating conditions, the pump design shall be so that the pump will operate satisfactorily without cavitation, excessive noise, or vibration when installed and operating at the given head.
 - (4) The motor horsepower shall be sufficient not to be overloaded at any point on the design curve for the pump chosen to meet the operating conditions. In addition, the motor shall be large enough to be nonoverloading along the curve from 60 to 140 percent of Best Efficiency Point (BEP).
 - (5) Pumps shall be designed to operate in submerged condition in the space allotted.
 - (6) Pumps shall be vertical, nonclog centrifugal wastewater pumps with integral motors designed and assembled by the same manufacturer.
 - (7) Pumps shall be capable of handling 3-inch solids and long stringy materials found in raw unscreened wastewater.
 - (8) Pumps shall be capable of operation with continuous submergence without loss of watertight integrity to a depth of 65 feet with its appurtenances and cable.
 - (9) Pumps shall be capable of running continuously at a full nameplate-rated load while the pump is submerged, partially submerged, or unsubmerged. The use of shower systems, secondary pumps, or cooling systems to cool the motor shall not be acceptable.
- 3. Other requirements
 - a. The design shall be so the pumping unit will be automatically and firmly connected to the discharge piping when lowered into place on its mating discharge connection, which shall be permanently installed in the wet well.

EXHIBIT A

- b. The pump shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be disconnected. For this purpose, there shall be no need for personnel to enter the wet well.

E. Contractor's Organization

1. The contractor shall have a competent supervisor on-site during the progress of the Work, acting for the contractor in all matters concerning the Work. The supervisor shall have the authority to receive directions and act upon them for the City through the City's representative.
2. The contractor shall keep a set of drawings and specifications available on-site and in good condition.

3.02 CONSTRUCTION AND MATERIAL SPECIFICATIONS

A. Gravity Sanitary Sewers

1. Gravity Sanitary Sewer Pipe Materials
 - a. Solid Wall PVC Pipe
 - (1) PVC pipe shall meet the requirements of ASTM D3034 for pipe sizes 4 through 15 inches and ASTM F679 for pipe sizes 18 through 60 inches.
 - (2) PVC material for ASTM D3034 pipe shall have cell classification as defined in the latest edition of ASTM D1784, with minimum modulus of elasticity of 400,000 psi. Pipe stiffness shall be minimum 46 psi when tested in accordance with ASTM D2412. Pipe shall have a maximum SDR of 35.
 - (3) PVC material for ASTM F679 pipe shall have cell classification as defined in the latest edition of ASTM D1784, with a minimum modulus of elasticity of 500,000 psi. Pipe stiffness shall be a minimum 115 psi when tested, in accordance with ASTM D2412.
 - (4) Pipe and fittings shall be the product of one manufacturer, and the manufacturer shall have experience records substantiating acceptable performance of the pipe and fittings to be furnished. The minimum wall thickness of fittings shall be the same as the pipe to which it connects.
 - (5) Acceptance of piping and fittings shall be subject to tests conducted in accordance with ASTM D3034 and/or ASTM F679.
 - (6) Fittings (such as saddles, elbows, tees, wyes, and others) shall be of material and construction corresponding to and have a joint design

EXHIBIT A

compatible with the adjacent pipe. Approved adapters shall be provided for transitions to other types of pipe.

- (7) Joints shall be of the elastomeric type for pipes 4 inches or larger and elastomeric or solvent cement for pipes less than 4 inches.
 - (8) Elastomeric joints shall be a bell and spigot joint (conforming to ASTM D3212) sealed by a rubber gasket conforming to ASTM F477 so that the assembly will remain watertight under all conditions of service, including the movements resulting from the expansion, contraction, settlement, and deformation of the pipe. Bells shall be formed integrally with the pipe and shall contain a factory-installed positively restrained gasket.
 - (9) Solvent cement joints shall be assembled using solvent cement obtained from the pipe manufacturer, which conforms to the requirements of ASTM D2564.
 - (10) The assembled joint shall pass the performance tests as required in ASTM D3212.
- b. Open Profile Wall PVC (18 inches and larger pipe only)
- (1) Open profile PVC pipe and fittings shall meet the requirements of ASTM F794. Fittings shall also conform to ASTM D3034 SDR 35. Pipes shall have a smooth interior with a ribbed exterior. Exterior ribs shall be perpendicular to the axis of the pipe to allow placement of gaskets without additional cutting or matching. Pipe shall have solid wall cross section; no voids between inner and outer surfaces of pipe wall.
 - (2) PVC materials shall have cell classification as defined in the latest edition of ASTM D1784, with minimum modulus of elasticity of 400,000 psi. Pipe stiffness shall be minimum 46 psi when tested in accordance with ASTM D2412. Impact strength shall equal or exceed values given in ASTM D3034 or F679.
 - (3) Pipe and fittings shall be the product of one manufacturer, and the manufacturer shall have an experience record substantiating acceptable performance of the pipe to be furnished. Fittings shall be injection molded.
 - (4) All joints shall be of the flexible elastomeric type with bells and spigots conforming to ASTM D3212. Gaskets shall conform to ASTM F477. All bells shall be formed integrally with the pipe. The elastomeric gasket shall be positively restrained in the ribs on the spigot of the pipe.

EXHIBIT A

- (5) Acceptance of piping shall be subject to tests conducted by a City approved testing agency in accordance with ASTM F794.
 - (6) Fittings (such as saddles, elbows, tees, wyes, and others) shall be of material and construction corresponding to, and have a joint design compatible with, the adjacent pipe. Approved adapters shall be provided for transitions to other types of pipe. Fittings shall be molded.
 - (7) Joints shall be sealed with elastomeric gaskets meeting the requirements of ASTM F477. Solvent cement shall not be used to join pipe lengths or fittings to pipe lengths. The assembled joint shall pass the performance tests, as required in ASTM D3212.
 - (8) The pipe wall will be homogeneous and contain no seams. Minimum pipe stiffness (in accordance with ASTM D2412) shall be 60 psi for 18 inches and 46 psi for 21 inches and larger pipe sizes. Pipes shall withstand an impact of 220-foot pounds. Standard lengths shall be 13 or 20-foot lengths. Pipe shall withstand flattening up to 60 percent without cracking, splitting, or breaking and pass acetone immersion, in accordance with ASTM D2152.
- c. Gravity Sanitary Sewer Service Branches and Laterals
- (1) Branches (tees and wyes) shall be of the same material as the main.
 - (2) Fittings for laterals shall be of the same material as the lateral pipe unless special fittings are needed for transition between material types or sizes or standard fittings are not manufactured.
 - (3) Where the wye or tee branches and laterals are of dissimilar materials, the contractor shall provide a transition coupling for the connection.
 - (4) All fittings used (including type of jointing) are subject to review and approval by the City.
- d. Gravity Sanitary Sewer Manholes
- (1) Unless otherwise specified by the City, all manhole sections (including risers, flat slab tops, conical tops, base sections, and adjusting rings) shall be precast reinforced concrete. Reinforced concrete manhole sections shall conform to ASTM C478.
 - (2) Precast reinforced concrete manhole bases, riser sections, flat slabs, and other components shall be manufactured by wet cast methods only, using forms that will provide smooth surfaces free from irregularities, honeycombing, or other imperfections.

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- (3) Lengths of manhole riser (barrel) shall be furnished in such combinations as to conveniently make up the depth of the manhole. A maximum of two handling holes per length of riser will be permitted.
- (4) Standard sewer manholes shall be constructed with eccentric cone top section for 48-inch-diameter barrel sections. A minimum of two and a maximum of five concrete adjusting rings shall be furnished per manhole, in order to set the manhole casting to established grade.
- (5) Drop entrances to the sanitary sewer manholes shall be installed where required. Drop entrances shall be of the same diameter as the sewer main, from sizes 8 through 18 inch. For larger diameters, the drop shall be 18 inches unless otherwise specified by the City.
- (6) The interior bottom of sanitary sewer manholes shall be constructed of concrete benches, which shall be precast or poured-in-place in the field. Benches shall extend to the top of each pipe to a maximum height of 42 inches. Flow lines shall be made smooth with uniform curves to promote flow through the manhole.
- (7) All joints between manhole pipe sections and top shall be tongue and groove, conforming to ASTM C443. Manhole joints shall be sealed with circular O-ring conforming to ASTM C443 or bituminous jointing material equal to EZ-Stick, Kent Seal, Ram-Nek, or Mas-Stik butyl rubber gasket, or butyl rubber rope.
- (8) Manhole connections for sanitary sewer mains shall be made using flexible, watertight connections, PSX Press Seal, Kor-N-Seal, or equal, for sewers up through 18-inch-diameter. Other sanitary sewer manhole connections shall be made with A-Lok, PSX Press Seal, Kor-N-Seal, or equal.
- (9) Manhole bottoms for sanitary sewers shall be monolithically precast with the bottom section for manholes up through 6-foot diameter. Bottoms for larger diameter manholes shall be precast concrete but need not be monolithically cast with the bottom section. Other manhole bottoms shall be either cast-in-place or precast concrete.
- (10) Manholes shall be furnished large enough to provide a minimum distance, between adjacent pipe, measured tangentially along the inside face of the manhole, equal to one-half the outside diameter of the intersecting sewer pipe. In any event, manholes shall be furnished in the diameter necessary to accommodate intersecting sewer pipe and the pipe to manhole connection as proposed for use.
- (11) Precast reinforced concrete manhole risers and tops shall be tested, in accordance with ASTM C497. Precast reinforced concrete manhole risers

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and tops meeting the strength requirements will be considered acceptable and shall be stamped with an appropriate monogram. When requested, copies of test reports shall be submitted to the City before the manhole sections are installed in the Project. Final acceptance will be made after field inspection upon delivery to the job site.

- (12) Precast reinforced concrete manhole sections shall be subject to rejection for failure to conform to specification requirements. In addition, individual sections of manhole risers and tops may be rejected because of the following reasons:
 - (a) Fracture or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.
 - (b) Defects that indicate imperfect proportioning, mixing, and molding.
 - (c) Surface defects indicating honey-combed or open texture.
 - (d) Damaged ends, where such damage would prevent making a satisfactory joint.
 - (e) Noticeable infiltration into the manhole.
 - (f) Variation in diameter of the manhole section of more than 1 percent from the nominal diameter.
 - (g) Any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more, regardless of position in the section wall.
- (13) Each precast reinforced concrete manhole riser and top section shall be clearly marked with the name or trademark of the manufacturer and the date of manufacture. This marking shall be indented into the manhole section or shall be painted thereon with waterproof paint.
- (14) Precast concrete adjusting rings for standard manholes shall have an inside diameter of 26 inches, be not less than 2 inches nor more than 6 inches high, and shall have a wall thickness of 6 inches, unless otherwise specified. The rings shall contain a minimum of one No. 2 reinforcing rod centered within the ring.
- (15) Frames and Covers—For standard sanitary manholes, frames shall be East Jordan Iron Works 1037Z, 1050Z1, or equal.
- (16) Manhole Chimney Seals

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- (a) External manhole chimney seals shall be provided for new manholes. Chimney seal shall be Cretex, or equal.
 - (b) Existing manholes exposed during the construction period shall have the adjustment rings replaced and a new chimney seal installed. Existing castings shall be reused.
- e. Gravity Sanitary Sewer Bedding and Backfill
 - (1) All pipe bedding shall conform to the standard details in this manual. The materials used for bedding and backfilling shall conform to the ISS.
 - (2) Bedding shall be No. 8 or 9 compacted aggregate.
 - (3) Backfill pipe cover material shall be No. 8 or 9 crushed aggregate.
 - (4) Flowable backfill shall be used in scenarios where a trench is cut in a pavement section. Flowable backfill shall conform to the requirements of the ISS (see the standard details in this section).

B. Force Mains

1. Materials

a. PVC Pipe

- (1) PVC piping for force main shall be pressure class 235 psi, DR 18, meeting the requirements of AWWA C900 or AWWA C905.
- (2) Fittings on PVC pipe shall be ductile iron mechanical joint conforming to AWWA C110
- (3) Push-on joints for PVC piping shall be restrained with MEGALUG® Series 1500 (AWWA C900) by EBAA Iron Sales, Inc., Uni-Flange® Series 1350 by Ford Meter Box Co., Inc., or equal. PVC piping with ductile iron mechanical joint fittings shall be restrained with MEGALUG® Series 2000 PV by EBBA Iron Sales Inc., Uni-Flange® Series 1500 by Ford Meter Box Co., Inc., or equal.
- (4) Provide tracer wire and location/testing markers.

b. Ductile Iron Pipe and Fittings

- (1) Unless otherwise shown or specified, all underground piping 3 inches in diameter or larger shall be ductile iron conforming to AWWA C151/A21.51 with mechanical joints or push-on joints. Pipe wall thickness shall be

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furnished as required by AWWA C150 for buried piping with the depth of cover as shown on the drawings for laying condition 4, minimum Special Thickness Class or Pressure Class as listed in Table 3.02-1, unless otherwise shown or specified.

Pipe Size (Inches)	Special Thickness (Class)	Pressure Class
3	53	—
4	53	—
6	53	—
8	53	—
10	53	—
12	53	—
14	52	—
16	52	—
18	52	—
20	—	250
24	—	250
30	—	250
36	—	250
42	—	250
48	—	250
54	—	250
60	—	250
64	—	250

Table 3.02-1 Pipe Special Thickness Classes and Pressure Classes

- (2) The contractor shall furnish certification data representing each class of pipe or fitting furnished. The certification report shall clearly state that all pipe and fittings furnished meet the appropriate AWWA specification. Ductile iron pipe shall consist of pipe centrifugally cast in metal or sand-lined molds. Pipe walls shall be homogeneous from inside to outside and shall be completely free of laminations, blisters, or other imperfections. Defects may be removed at the factory only.
- (3) Except as otherwise specified, underground pipe shall have mechanical joints or push-on joints conforming to AWWA C110 and C111, as well as AWWA C153 (compact), with vulcanized styrene butadiene rubber gaskets conforming to AWWA C111. Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe and provide joint restraint are not acceptable. Bolts on mechanical joints shall be high-strength low-alloy steel (Corten or equal), conforming to AWWA C111. A certificate to that effect shall be provided.
- (4) Restrained joints shall be provided in accordance with 4.03—Execution and Installation. Mechanical joints shall be restrained with MEGALUG® Series 1100 or 1100 SD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1400 by

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Ford Meter Box Co., Inc., or equal, restraint. Push-on joints for ductile iron piping shall be restrained with MEGALUG® Series 1700 or 1100 HD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1450 by Ford Meter Box Co., Inc., Flex-Ring or Lok-Ring by American Cast Iron Pipe Company, TR Flex by U.S. Pipe Company, TR Flex by McWane, or equal.

- (a) Pipe restraint fittings shall be provided as follows:
 - 1) For ductile iron pipe with ductile iron mechanical joints: MEGALUG® Series 1100 or 1100SD by EBAA Iron Sales, Inc.; Series D SLDE or SSLD by Sigma; Series 3000 or 3000S by Star Pipe Products; or equal.
 - 2) For ductile iron pipe with ductile iron push on joints: MEGALUG® Series 1100HD or 1700 by EBAA Iron Sales, Inc.; Series SLDEH or SSLDH by Sigma; Series 3100P or 3100S by Star Pipe Products; Flex Ring or Lok Ring by American Cast Iron Pipe Company; TR Flex by U.S. Pipe Company; or equal.
 - 3) For PVC pipe with ductile iron mechanical joint fittings: MEGALUG® Series 2000 PV, 1100SV, or 2000SV by EBAA Iron Sales, Inc.; Series D SLCE or PVM by Sigma; Series 1000C or 4000 by Star Pipe Products; or equal.
 - 4) For PVC pipe with PVC push on joints (not solvent welded): MEGALUG® Series 1100HV, 1900, or 2800 by EBAA Iron Sales, Inc.; Series SLCEH, PWP (greater than 12-inch only), or D PWP (12 inches or less) by Sigma; Series 4100P by Star Pipe Products; or equal.
- (b) Gland body, wedges, and wedge actuating components shall be ductile iron conforming to ASTM A536 Grade 65 45 12. Bolts and tie rods shall be high-strength low-alloy steel conforming to AWWA C111.
- (c) Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe to provide joint restraint are not acceptable.
- (5) Joint restraint is not required for gravity sewers and drains. Joint restraint shall be provided for any pipe requiring pressure testing.
- (6) Underground pipes shall have mechanical joint or push-on joint ductile iron fittings conforming to AWWA C110 and C111 or AWWA C153 compact fittings with a minimum rated working pressure of 150 psi. Gaskets for fittings shall be as specified for underground piping.
- (7) Unless otherwise specified, all exterior ductile iron piping and fittings shall be cement-mortar lined and asphaltic-coated inside. Cement-mortar lining shall be in accordance with AWWA C104. Unless otherwise specified,

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underground piping and fittings shall be shop-primed or asphaltic-coated outside. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.

- (8) Cutting in and Repair Tees and Sleeves and Tapping Tees: Cutting-in and repair tees and sleeves and tapping tees shall be of ductile or cast iron with the same rated working pressure of the pipe in which they are installed but no less than 150 psi.
- (9) Exterior Joints, Fittings, and Gaskets: Joints, fittings, and gaskets shall have the same rated working pressure of the pipe in which they are installed but no less than a minimum rated working pressure of 150 psi.

c. HDPE Pipe and Fittings

- (1) HDPE pressure-rated pipes shall conform to the requirements of AWWA C906 for pipe from 4 through 65 inches. HDPE pipes shall be manufactured from materials conforming to PE Code PE4710.
- (2) HDPE pipes outside diameter shall conform to DIPS. The type of HDPE material, nominal pipe size, SDR, and pressure rating shall be not less than pressure class 250 and not greater than a DR 9.
- (3) Markings on the pipe shall include the following: Nominal pipe size, type of plastic pipe material, DR number, pressure class rating, manufacturer's name, and the seal or mark of the laboratory making the evaluation of the suitability of the pipe for the transport of potable water.
- (4) Fittings for HDPE pipes shall conform to AWWA C906 and shall have the same pressure rating as the pipe in which they are installed.

d. Gate Valves

- (1) Shut-off valves in cast or ductile iron lines (containing wastewater) 4 inches in diameter and larger shall be AWWA C515, ductile iron AWWA C509, cast iron, resilient seat, outside stem and yoke (OS&Y) (rising stem) for wastewater applications, 150 psi working pressure with O-ring packing box, Kennedy, American, American AVK, or equal.
- (2) Where shown or specified, gate valves in lines 4 inches in diameter or larger shall be AWWA C500 iron body, bronze-mounted, nonrising stem, double-disc, parallel seat, Class 150, O-ring stem seals.
- (3) Shut-off valves in nonpotable water lines, grit flush water lines, pump vent, and drain lines 1- through 3-inch diameter shall be gate valves, Class 150, bronze or iron body bronze-mounted, solid wedge disc, threaded, rising

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stem, Nibco T-131, Milwaukee Valve 1150, or equal. Provide unions for ease of valve removal.

- (4) Underground valves shall have an extended stem, cast iron telescopic valve box, and key.
- (5) Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated (prime and finish coats). Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade Society for Protective Coatings (SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valve once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; the contractor shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by the contractor with a minimal amount of surface preparation.

e. Plug Valves

- (1) Shut-off valves in cast or ductile iron lines containing wastewater shall be DeZURIK Series PEC or PEF 100 percent port Eccentric, or equal. Shutoff valves in sample lines and 2 1/2 inches or smaller air piping shall be DeZURIK PEC Eccentric, Val-Matic Cam-Centric Series, or equal.
- (2) Eccentric-type valves shall be nonlubricated rectangular-ported with resilient faced plugs and end connections. The plug profile shall be of a cylindrical eccentric shape so that the vertical face of the plug is straight and the horizontal face is eccentrically curved in relation to the plug shafts. Segmented ball valves with spherical plugs shall not be acceptable. Port areas shall be at least 100 percent PEF or 80 percent PEC through 20 inches and 70 percent PEC for 24 inches and higher than the full pipe area. Valve bodies shall be of ASTM A126, Class B cast iron. Valve bonnets shall be of the same material as the body. Resilient plug facings shall be chloroprene or Buna-N, suitable for use with wastewater. The valve shall be oriented with the shaft horizontal, seat upstream, and plug above flow stream when open.
- (3) Valves shall be furnished with corrosion-resistant seats, replaceable oil-impregnated permanently lubricated 316 stainless steel sleeve-type bearings and grit shaft seals on upper and lower bearing journals that

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comply with the latest edition of AWWA C507 and C504. All valves shall include grease fittings on upper and lower journals. Bodies of 3-inch and larger valves shall be furnished with a minimum a 1/8-inch-thick machined smooth-welded overlay seat of not less than 90 percent nickel. Seat area shall be a raised surface, completely covered with weld so that the plug face contacts only nickel. Sprayed or screwed-in seats are not acceptable. Valve shaft seals for valves 4 inches and larger shall be of the type using a stuffing box and pull-down packing gland. Shaft seals shall be designed for replacement with the line pressurized at design pressure with the plug in the open and closed position. For submerged service, or in valve manholes, valve vaults, or underground utility structures, valves shall have stainless steel bolts.

- (4) The design of the valve and stuffing box assembly shall be so that the packing can be adjusted or completely replaced without disturbing any part of the valve or operator assembly, except the packing gland follower. Stuffing boxes shall have a depth sufficient to accept at least four rings of Buna-N vee-type packing. Valve seating adjustment shall be accomplished without removing the valve from the pipe line and with pressure in the line. For lever-operated valves, the plug position retention friction device shall consist of an adjustable phenolic cone that clamps on the plug shaft or a moly sheath. Metal-to-metal friction devices shall not be acceptable.
- (5) Valve working pressure ratings shall be 175 psi for valves through 12 inches and 150 psi for valves 14 through 24 inches. Valves shall provide drip-tight shutoff up to the full pressure rating.
- (6) All plug valves for buried service, all plug valves 8 inches in diameter or larger, all plug valves with direct pressure greater than 75 psi or reverse differential pressure greater than 25 psi shall have worm gear actuators. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent the entry of dirt and water into the actuator. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall indicate valve position. Buried or submerged valves and valves in manholes shall be supplied with actuators suitable for direct burial or submergence, shall be mounted on a gasketed and totally enclosed actuator mounting bracket, and shall have a totally enclosed and gasketed cover. Other valves shall be furnished with lever actuators. Supply one lever for every four valves of like size furnished. All valves 3 inches and smaller shall have individual levers. All underground valves shall be equipped with cast iron telescopic adjustable valve boxes and covers. Buried or submerged service valves shall be supplied with 316 stainless-steel bolts and hardware for both valve and actuator.

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- (7) Extension stems and other accessories shall be provided. Extension stems for quarter-turn plug valves shall be fabricated from 2-inch pipe, and extensions stems for gear-operated valves shall be fabricated from steel or stainless-steel rod. Extension stems, stem guides, and related hardware and accessories for submerged valves shall be stainless steel. Stems shall be provided with a 2-inch operating nut or other mechanism. Stem guides shall be provided as recommended by the manufacturer. Maximum unsupported length of the stem shall be limited to an l/r ratio of 200.
 - (8) Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated. Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10, removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valves once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235, or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; the contractor shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by the contractor with a minimal amount of surface preparation. Except as subsequently noted, valve interior shall be shop-primed, and finish painted with epoxy painting system or fusion-bonded epoxy system.
- f. Air and vacuum valves shall be as follows:
- (1) Combination air valves shall be APCO model ASU manufactured by DeZurik, Model D-020 SS manufactured by A.R.I., or equal. Combination air valves in sizes 1- to 8-inches shall be a single body design and shall provide both air release and air/vacuum valve functions.
 - (2) Air release shall be designed to automatically provide varied and predictable air flow over a wide range of conditions. The air release orifice must be capable of releasing the maximum anticipated air volume.
 - (3) The valves shall close tightly at any pressure between 2 and 300 psi without leaking or spilling. The air/vacuum inlet and outlet areas shall meet the flow area requirements set forth in AWWA M51 and be manufactured as set forth in AWWA C512.

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- (4) The valve shall have an upper body compression chamber to limit fluid level and solids interference. It shall also have a funnel-shaped lower body to reduce solids buildup and allow for self-cleaning and maximum outflow.
- (5) A hydraulics-based float design shall be used to reduce the ballistic effect and instability of high-speed fluid flow. The guided float shaft shall provide smooth automatic air release and air/vacuum operation that will not foul and reduce performance on dirty service applications. To avoid loss of performance, the air release and air/vacuum seating action shall be direct driven by the shaft-mounted float. No linkages shall be used. Flow deflector/splash reduction ring shall be used to restrict solids entry and minimize flow effect and splash that can cause float instability.
- (6) A 90-degree threaded side outlet shall be included with the valve with an extension pipe. Valves shall be capable of converting to optional vertical threaded outlet or mushroom cap without removing the valve from service and valve disassembly.
- (7) Materials of Construction
 - (a) Body, float shaft, and hardware shall be 316 stainless-steel.
 - (b) Floats shall be 316 stainless steel or polypropylene.
 - (c) Elastomer seals shall be acrylonitrile-butadiene (NBR) or ethylene propylene diene terpolymer (EPDM).
- (8) End connections shall be National Pipe Thread Tapered (NPT) or ANSI 125/150 flanged. Valves 4 inches and larger shall have two lifting lugs for ease of valve installation.
- (9) A 2-year warranty shall be provided for all valves.

g. Valve Boxes

- (1) Valve boxes shall be provided for all buried valves.
- (2) Valve boxes shall be made of cast iron conforming to ASTM A48, Class 20. Valve boxes shall consist of a base section, tubular mid and top sections, both with cast threads by which one can be telescoped on the other, extension sections if required, and a circular drop cover. The castings shall be free from blowholes, porosity, hard spots, shrinkage defects or cracks, or other injurious defects, and shall have a normal smooth casting finish. The castings shall be thoroughly coated with a 1 mil minimum thickness bituminous coating. Valve boxes shall be 5 1/4 inches in diameter. Valve boxes shall have a maximum length of

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7 feet when extended without extension sections. Extensions shall be provided for deeper mains.

- (3) The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of the valve boxes so that the bottom of the base is approximately 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.
- (4) All valve box alignment devices shall be supplied with a gate valve adaptor, as manufactured by Adaptor, Inc., or equal. All adaptors shall have a metal frame and be supplied with a 3/4-inch rubber gasket. All adaptors shall be sized to fit the brand of valve being supplied.

h. Bedding and Backfill

- (1) All pipe bedding shall conform to the standard details in this manual. The materials used for bedding and backfilling shall conform to the ISS.
- (2) Bedding shall be No. 8 or 9 compacted aggregate.
- (3) Backfill pipe cover material shall be No. 8 or 9 crushed aggregate.
- (4) Flowable backfill shall be used in scenarios where a trench is cut in a pavement section. Flowable backfill shall conform to the requirements of the ISS (see the standard details).

C. Submersible Lift Stations

1. Scope

- a. Furnish, install, and place into successful operation a submersible lift station and all appurtenances necessary to complete the same as shown or specified. The lift station shall be complete with submersible, nonclog sewage pumps, motors, discharge elbows, access hatch, guide system, piping, valves, electrical controls, concrete wet well, and appurtenances. The pumps and appurtenances shall be furnished by the same supplier.
- b. Submersible pumps shall be manufactured by Xylem-Flygt or Hydromatic.

2. Material requirements

- a. The contractor shall supply pumps to meet the following minimum requirements:
 - (1) Pump materials shall meet the requirements of the latest editions of the following specifications:

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- (a) Material ASTM or ANSI Designation
 - (b) Cast Iron A-48 Class 30
 - (c) Stainless Steel ANSI Type 316L, 304, and 431
 - (d) Bronze B-144 Class 3B
 - (e) Hot Rolled Steel A 107-50-T Grade (Gr.) 1015 .20 Copper Minimum (Cu. Min.)
 - (f) Cold Rolled Steel A 108-50-T Gr. 1141 Turned, Ground and Polished
 - (g) Pipe ANSI A21.51
- (2) Where applicable specifications are not designed herein, supply high class commercial grades of materials that meet the requirements specified and which are satisfactory to the City.
 - (3) Materials of construction for the pumps and related equipment shall be suitable for the environment in which they are to be located.
 - (4) Be Underwriters Laboratory (UL), Canadian Standard Association (CSA), or Factory Mutual (FM) approved for Class I, Division 1, Groups C and D hazardous locations.

3. Pump Construction

- a. All major parts, such as stator casing, lubricant casing, sliding bracket, discharge connection, volute, and impeller, shall be gray iron, ASTM A48, Class 30, with smooth surfaces devoid of blow holes and other irregularities. All metal surfaces coming in contact with the pumped liquid, other than steel or brass, shall be protected by an approved coating resistant to sewage. All exposed bolts, screws, and nuts shall be 304 stainless-steel.
- b. A wear ring system shall be installed to provide efficient sealing between the volute and suction inlet. The wear ring shall consist of a brass or nitrile rubber-coated, steel-ring insert, which is drive-fitted to the volute inlet.
- c. The impeller shall be gray cast iron of a double-shrouded, nonclogging design capable of handling solids, fibrous materials, heavy sludge, and other matter found in normal sewage applications. The impeller shall be constructed with a long throughlet without acute turns. The impeller shall be statically and dynamically balanced. Static and dynamic balancing operations shall not deform or weaken it. The impeller shall be bolted or keyed to the shaft. Noncorroding fasteners shall be used. The impeller shall be coated with a manufacturer-selected primer.

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- d. The volute shall be of single piece, cast iron, nonconcentric design and shall have smooth fluid passages large enough at all points to pass any size solid, that can pass through the impeller.
- e. The pump shall be provided with a tandem mechanical rotating shaft seal system consisting of two independent seal assemblies running in a lubricant reservoir having separate, constantly hydro-dynamically lubricated lapped seal faces. The lower seal unit between the pump and the lubricant chamber shall contain one stationary and one positively driven rotating tungsten-carbide ring.
- f. The upper seal unit between the lubricant chamber and motor housing shall contain one stationary tungsten-carbide ring and one positively driven rotating tungsten carbide ring. Each interface shall be held in contact by its own spring system and not require being supplemented by external liquid pressures. Both seals shall be mounted on the shaft. The lower seal shall not be mounted on the impeller hub. The seals shall require neither maintenance nor adjustment but shall be easily inspected and replaceable. nor depend on direction of rotation for sealing. Shaft seals without positively driven rotating members or conventional double mechanical seals with a common single or double spring acting between the upper and lower units, requiring a pressure differential to offset external pressure and effect sealing shall not be considered acceptable, nor equal to, the dual independent seal system specified. The pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug (with positive antileak seal) shall be easily accessible from the outside. No seal damage shall result from operating the pump in an unsubmerged condition. The seal system shall not rely on the pumped media for lubrication.
- g. The pump and motor shaft shall be one unit. Couplings are not acceptable. The shaft shall be made of American Iron and Steel Institute (AISI) 420 martensitic stainless steel. The shaft shall rotate on two permanently lubricated bearings with a L-10 bearing life of 50,000 hours when the pump is operating at or near best efficiency point. Bearings shall compensate for axial thrust and radial forces.
- h. A cable entry seal shall be provided where the pump cable enters the pump. The cable entry seal design shall preclude specific torque requirements to provide a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomeric grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain-relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary, using the same entry seal. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or a terminal board that shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be required or used.

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- i. All mating surfaces of major parts shall be machined and fitted with nitrile O-rings where watertight sealing is required. Machining and fitting shall be so that sealing is accomplished by automatic compression in two planes and O-ring contact made on four surfaces without the requirement of specific torque limits to affect this. Rectangular cross-sectioned gaskets requiring specific torque limits to achieve compression shall not be considered adequate or equal. Tolerances of all parts shall be so that this allows replacement of parts without additional machining required to provide sealing. No secondary sealing compounds, greases, or other devices shall be used.
- j. Each unit shall be provided with an adequately designed cooling system. The pump shall be capable of operating in a dry condition without damage to the motor or pump. As required for air-filled motors, the pump shall be provided with an integral motor cooling system. The system shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. Impeller back vanes or an impeller integral to the cooling system and driven by the pump shaft shall provide the necessary circulation of the cooling liquid through the jacket. The cooling media channels and ports shall be nonclogging. Provisions for external flushing shall be provided. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F (40 degrees Celsius [°C]). Operational restrictions at temperatures less than 104°F are not acceptable. Fans, blowers, or auxiliary cooling systems that are externally mounted to the pump motor are not acceptable.
- k. Internal thermal sensors shall be required on each pump motor. The motor stator shall incorporate three thermal switches (in series) to monitor the temperature of each phase winding. These shall be used in conjunction with and supplemental to external motor overcurrent protection, and they shall be located in the control panel. At a temperature preset to protect the motor, the internal thermal sensors shall show and/or sound an alarm and automatically shut down the pump before motor damage occurs.
- l. Moisture sensing probes shall be installed in the mechanical seal cavity of each pump unit. These probes shall sense the intrusion of the pumped liquid into the seal cavity, send a signal to the panel-mounted alarm device, and shut the pump down immediately. The alarm device shall be activated until the pump is removed from service or is repaired.
- m. Each pump shall be fitted with a stainless-steel lifting cable or chain of adequate strength and length to permit raising and lowering the pump for inspection and removal. The lifting system must permit the pump to be removed in one continuous motion, without intermediate hooking. The hoist end of the pump retrieval cable or chain shall be fitted with a swaged ball to allow for connection to pump lifting equipment. All components shall be of adequate size, length, and strength for the pump being lifted and shall be provided to allow a cable to automatically be wound on the cable drum.

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4. Guide System

- a. A sliding guide bracket shall be an integral part of the pump unit. The volute casing shall have a machined discharge flange to automatically and firmly connect with the cast iron discharge connection that, when bolted to the floor of the wet well and discharge line, will receive the pump discharge connecting flange without the need of adjustment, fasteners, clamps, or similar devices.
- b. Alignment of the pump to the discharge connection shall be the result of a simple linear downward motion of the pump unit guided by two guide rails, a T-bar, or other suitable guide system.
- c. Guide rail pipes shall be constructed using 304 stainless-steel.
- d. Guide bars shall be of a diameter and wall thickness as recommended by the pump manufacturer. Provide stainless-steel top guide bar brackets and intermediate guide-bar brackets, as required. Guide bars shall extend from the access door to the discharge connection.
- e. No other motion of the pumping unit, such as tilting or rotating, shall be required. Sealing the pump to the discharge flange connection shall be by a machined metal-to-metal contact. As an alternative, provide a machined groove to hold a molded urethane sealing ring in place to provide a redundant leak-proof seal.
- f. No portion of the pump unit shall bear directly on the floor or wet well. The entire weight of the pump shall be borne by the pump discharge elbow. There shall be no more than one 90-degree bend allowed between the volute discharge flange and station piping. The discharge connection to discharge pipe shall be an ANSI B16.1 Class 125 flange.

5. Motor

- a. The pump motor shall be housed in an air-filled, watertight casing and shall have moisture resistant Class F 155°C insulation. If variable frequency drives (VFDs) are used, then the insulation shall be Class H.
- b. The motor shall be National Electrical Manufacturers Association (NEMA) design B and designed for continuous duty, capable of sustaining a minimum of 15 evenly spaced starts per hour. No motor winding damage shall result from operating the pumping unit out of its liquid environment for extended periods of time.
- c. The combined service factor (combined effect of voltage, frequency, and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of $\pm 10\%$. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. If VFDs are used, the motor shall meet the requirements of NEMA MG-1 part 31 and be suitable for VFD operation.

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- d. Upon request, a performance chart shall be provided showing curves for torque, current, power factor, input/output kilowatt (kW) and efficiency. This chart shall also include data on starting and no-load characteristics.
6. Controls
- a. The pumping station shall be provided with a NEMA 4X stainless steel starter panel, which shall be sized to accommodate starters and controls for specified pumps. The starter panel shall consist of, but not be limited to, the following:
 - (1) NEMA 4X stainless-steel enclosure, with padlocking hasp and staple, and provided with matching stainless steel drip shield.
 - (a) The enclosure shall be front access only, minimum No. 14 gauge steel with continuously hinged doors. Enclosures equal to or smaller than 24 inches wide by 24 inches high shall be equipped with at least two quarter-turn latches. Enclosures larger than 24 inches (in any dimension) shall be equipped with a 3-point latch with top and bottom bolts actuated by one rotating, lockable handle on each door. Provide a door stop kit for each door and data pockets for wiring diagrams.
 - (b) Panels shall include a nonfused main disconnect with interlock to prevent opening the panel with switch in the "On" position. A defeater shall be provided to bypass this interlock, with the handle lockable in "Off" position.
 - (c) Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust-inhibiting enamel, white interior, and an exterior color selected by the City Wastewater Superintendent. All doors and panels shall be gasketed, and panels shall be insulated.
 - (d) Enclosures shall be as manufactured by Hoffman or Saginaw.
 - (e) The bottom of the enclosure shall be provided with two 1/2-inch drains located at opposite sides of the enclosure, similar to Crouse-Hinds No. ECD 17.
 - (f) The top of the enclosure shall be provided with two 1/2-inch breathers located at opposite sides of the enclosure, similar to Crouse-Hinds No. ECD 16.
 - (g) The enclosure shall be provided with an internal mounting panel and a swing-out panel.

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- (h) The interior of the enclosure shall be provided with properly sized industrial grade corrosion inhibitors.
 - (i) The enclosure shall be provided with a thermostatically controlled, properly sized, anti-condensation heater. The heater shall be mounted on the lower portion of the enclosure internal mounting panel. The anti-condensation heater shall be as manufactured by Hoffman, Model D-AH, X000 Series, sized as required.
 - (j) The enclosure shall be provided with a door limit switch actuated, minimum 12-inch, bolt-on, light emitting diode (LED) light.
 - (k) All wiring within the control panels shall be insulation-type machine tool wire (MTW), minimum size 16 American Wire Gauge (AWG). Wiring within the enclosure shall be routed through plastic wiring troughs with removable covers. Maximum fill for wiring troughs shall be 60 percent. Low level signal wiring shall not be mixed with high voltage (110 Volts alternating current [AC] or greater) wiring within the same trough. Plastic wiring duct shall be Panduit Panduct, or equal.
 - (l) Terminal blocks located adjacent to wiring troughs shall have a minimum of 1 1/2 inches between terminal block and trough. All wiring in the control panels that are not in wiring troughs shall be bound with continuous-type spiral windings.
 - (m) All wiring within the enclosure shall be terminated at Deutsche Institut fur Normung (DIN) rail-mounted terminal blocks; splices shall not be permitted within the enclosure.
 - (n) Field wiring shall be insulation type XHHW-2, minimum size 14 AWG. Field wiring terminals shall be clearly identified as to which input/output (I/O) terminals they are wired. Wire markers shall be permanently attached heat-shrink-type. Wire numbering preprinted on the conductor or insulation, flag-type labels, and individual wraparound numbers are not acceptable.
 - (o) All conduit entry into the enclosure (originating from the wet well) shall be sealed to prevent moisture and gas vapors from entering the enclosure.
 - (p) All low-level signal wiring milliamp direct current (mA DC) shall be twisted shielded cable types.
- (2) The enclosure shall be sized to house all electrical equipment described herein, including, but not limited to the telemetry panel as specified herein.

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- (3) The incoming power wiring shall be terminated at the distribution lugs and shall be provided with voltage surge arresters to protect all equipment mounted within the enclosure from switching surges and lightning induced surges.
- (4) Power supplies shall be protected against short circuits and contain their own overcurrent and overvoltage protection. Twelve and 24 volts of direct current (VDC) power supplies shall be provided and installed in the enclosures for powering all analog input signals where required.
- (5) All motor control power shall be 120 volts with suitable circuit protection, fuses or breakers. Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- (6) Devices powered at 120 volts from control panels shall be fused.
- (7) Provide lightning protection, isolation transformers, and fused disconnects at each end of each power circuit, supervisory circuit, and local supervisory circuit with transformers and relays, if necessary, to obtain supervisory power. Lightning protection shall be completely solid-state and self-healing and not require the use of fuses. Lightning protection shall be as manufactured by Citel, Model DS240, or equal. Surge protection shall be provided for all phases and neutral.
- (8) The contractor shall furnish one complete extra set of fuses and similar parts which may need replacement in normal service and an identification list of all component parts and where they may be obtained for operating the system for 3 years from start-up.
- (9) All internal wiring shall be color-coded and numbered, and each wire shall be terminated on terminal blocks. Schematic and wiring layout drawings that show all connections to the external devices, a complete bill of materials, interior and exterior panel layouts, and a detailed description of operation, shall be submitted for each control panel.
- (10) Each analog signal entering or leaving a control panel shall be provided with a surge protection device as manufactured by Citel, Model DLA-24D3, or equal. Each transmitter shall be provided with a surge protection device as manufactured by Citel, Model TSP15M on the output and Citel, Model No. DS240 on the power supply, or equal.
- (11) Power within the panel shall be distributed further through thermal magnetic circuit breakers and motor circuit protectors, which shall be accessible from the front of the swing-out panel without opening the swing-out panel. Provide the following:

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- (a) A motor circuit protector for each pump starter.
 - (b) A circuit breaker for a 480/120-volt AC transformer (only if the incoming power is 480 volts AC). The circuit breaker shall have a minimum interrupting rating of 25,000 amperes (amps).
- (12) If the incoming power is greater than 120/240 volts AC, provide a transformer that shall step down the incoming power to 120 Volts AC. The transformer shall be high efficiency type, with 105° Celsius temperature class, extra regulation and low losses. The minimum size of the transformer shall be 1.0 kilo-volt-amperes (KVA). The primary feeder of the transformer shall be protected by the circuit breaker previously mentioned. The transformer shall be sized to provide power to all 120 Volt AC loads subsequently listed.
- (13) The 120-volt AC power within the enclosure shall be further distributed through single pole, 15-amp circuit breakers, with 10,000 ampere interrupting capacity (AIC). A dedicated circuit breaker shall be required for each of the following items:
 - (a) Motor control circuit.
 - (b) Panel light and thermostatically controlled enclosure heater previously mentioned.
 - (c) Convenience receptacle.
 - (d) An alarm beacon light fixture.
 - (e) Telemetry panel.
- (14) Provide a duplex convenience receptacle, which shall be mounted within the starter enclosure, accessible from the front of the swing-out panel. The receptacle shall be 120-volt, 15-amp, ground fault interrupting (GFI) type.
- (15) Each starter power feed shall be provided with a magnetic-only motor circuit protector. The motor circuit protectors shall be as follows:
 - (a) They shall be provided with adjustable instantaneous trips.
 - (b) As a minimum, they shall be rated 25,000 AIC. The size, voltage, and configuration shall be as required.
 - (c) The motor circuit protectors shall be accessible from the front of the swing-out panel without opening the swing-out panel.

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- (16) Motor starters shall be NEMA-rated, full-voltage, nonreversing type. International Electrical Commission (IEC) rated motor starters shall not be acceptable. The starters and thermal overloads shall be sized according to the motor nameplate data.
- (17) Provide a duplex pump alternator, which shall automatically sequence the operation of the pumps.
- (18) Control devices shall be industrial-grade oiltight and watertight types. Each pump shall be provided with the following controls, which shall be visible from the front of the swing-out panel, with the enclosure door opened:
 - (a) An hand-off-auto (H-O-A) selector switch.
 - (b) An amber "FAIL" pilot light.
 - (c) An amber "SEAL FAILURE" pilot light.
 - (d) A red motor "RUN" pilot light.
 - (e) A green motor "OFF" pilot light.
 - (f) A "RESET" push button.
 - (g) A nonresettable elapsed time meter.
- (19) Push buttons, indicating lights, and selector switches shall be NEMA Industrial Control and Systems (ICS) 2; heavy-duty, oiltight (30 millimeter [mm]), NEMA 4X. Indicating lights shall be LED, push-to-test type. Elapsed time meters shall be Redington/Engler 722 series, 3 inches round, flush door-mounted, capable of reading up to 99,999.9 hours, nonreset type.
- (20) All door-mounted indicating and control devices shall be located at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of device. All door-mounted devices shall be furnished flush-mounted, and an exterior engraved phenolic nameplate with black background and white characters worded by the manufacturer and reviewed by the City (upon receipt of shop drawings), shall be provided for each component, device, and light. All components within the enclosures shall be identified with sticky-back adhesive, self-laminating, machine-printed labels with white background and black text; minimum 12-point font. Labels shall be installed on the enclosure back panel and not on the device or wireway. Devices shall be grouped for each device or unit being controlled.
- (21) Each starter shall be provided with the following:

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- (a) A minimum of two sets of normally open starter auxiliary contacts.
 - (b) A minimum of two sets of normally closed starter auxiliary contacts
 - (c) One set of normally open auxiliary overload alarm contacts.
- (22) Control circuits shall be designed so that the pumping station will operate as follows:
 - (a) When the H-O-A selector switch is in the "H" position, the pump motor shall run.
 - (b) When the switch is in the "O" position, the pump motor shall be off.
 - (c) When the switch is in the "A" position, the pump shall operate automatically as described subsequently.
 - (d) The amber "FAIL" light shall be energized when the starter thermal overload relay trips, or when the motor winding temperature detector trips.
 - (e) The amber "SEAL FAILURE" light shall be energized when the seal failure contacts trip.
- (23) Pump motors shall be provided with motor high winding temperature and seal failure detector.
 - (a) The detector circuit shall shut down the motor and energize the pump FAIL pilot light when the motor winding temperature detector trips. The motor shall remain shut down until its associated "RESET" push button is depressed.
 - (b) The detector circuit shall energize the SEAL FAILURE pilot light when the seal failure detector trips. The seal failure detector shall automatically reset when moisture is no longer detected in the motor housing.
- (24) The following single-pole double-throw (SPDT) dry contacts shall be provided for remote monitoring purposes:
 - (a) Pump failure status of each pump motor, which shall include the following conditions:
 - 1) Starter thermal overload.
 - 2) Motor winding temperature high.
 - 3) Seal failure.

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- (b) Wet well high-level condition, which shall include contacts from the high-level float switch and from the electronic pump controller high level alarm.
 - (c) Level sensor failure from the electronic pump controller.
- (25) The wiring shall be terminated at the terminal blocks, grouped and dedicated to remote monitoring.
- (26) Industrial control and power relays shall be installed in control panels where required. Relays used to interface with programmable logic controller (PLC) I/O, motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, alarm lights, alarm horns, field wiring, or loads up to 15 amps shall be industrial, general purpose square base relays. The contactors for themotor power control shall be industrial, electrically held power contactors. Relays shall meet the following requirements:
 - (a) Interposing/isolation relays:
 - 1) Configuration: SPDT or double pole double throw (DPDT), as required.
 - 2) Mounting: DIN rail with screw terminal base socket.
 - 3) Voltage: 120 VAC, or as required.
 - 4) Contact rating: 8 A (DPDT), 16 A (SPDT).
 - 5) Operating life: 10 million cycles.
 - 6) Status: On-Off flag-type or LED indicator.
 - 7) UL listed.
 - 8) Manufacturer: Allen-Bradley, 700-HK, or equal.
 - (b) General purpose relays:
 - 1) Configuration: DPDT or three poles, double throw (3PDT), as required.
 - 2) Mounting: DIN rail with screw terminal base socket.
 - 3) Voltage: 120 VAC.
 - 4) Contact rating: 15 A, minimum; 3/4 horsepower (hp).
 - 5) Operating life: 10 million cycles.
 - 6) Status: On-Off flag-type or LED indicator.
 - 7) UL listed.
 - 8) Manufacturer: Allen-Bradley, 700-HB, or equal.
 - (c) Power contactors:
 - 1) Configuration: Electrically-held, three poles.
 - 2) Mounting: DIN rail.
 - 3) Voltage: 120 VAC.
 - 4) Minimum contact rating: 20 ampere (A) continuous, 1 hp.
 - 5) Operating life: 1.3 million cycles.

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- 6) UL listed.
 - 7) NEMA rated.
 - 8) Manufacturer: Allen-Bradley, Bulletin 300, or equal.
- (27) Hard-wired Motor Controls:
 - (a) Equipment and wiring specified to be hardwired shall be physically wired independent of controllers, programmable relays, and communication systems to allow manual operation in the event of an emergency.
 - (b) Motor control wiring and logic shall be set up so that in the event of a power failure, equipment shall automatically restart if previously running, or remain off if previously off. A manual reset shall not be required to restart the equipment following a power failure.
- b. The pumping station shall be provided with the following types of level control systems:
 - (1) Five float switches, to control the pump operation:
 - (a) Common pumps off float switch.
 - (b) Start lead pump float switch.
 - (c) Start lag pump float switch.
 - (d) High-water level alarm float switch.
 - (e) Low-water level alarm float switch.
 - (2) Submersible hydrostatic pressure type level sensor.
 - (3) Electronic pump controller.
- c. Float switches shall be constructed as follows:
 - (1) The float switches shall be watertight, encapsulated mercury switch type, encased in a chemical-resistant polypropylene casing.
 - (2) Each float switch shall be suspended on its own cable, which shall be long enough to reach the bottom of the wet well. The switch shall be weighted with an enamel-coated cast iron weight to permit the float to pivot for proper operation.
 - (3) All installation hardware shall be 316 stainless-steel.

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- (4) The float switch elevations shall be adjustable over the entire wet well depth.
 - (5) The pumping station shall be provided with a high-level alarm float switch and a low-level emergency shutdown float switch.
- d. Submersible hydrostatic pressure type level sensor and electronic pump controller shall be constructed as follows:
 - (1) The hydrostatic pressure-type level sensor shall be a submersible-type, suspended on its cable, which upper end shall be secured as shown on the drawings.
 - (2) The level sensor shall be mounted on pipe assemblies, as shown on the drawings.
 - (3) The level sensor tip shall be suspended not lower than 12 inches above the wet well floor.
 - (4) The level sensor shall be as follows:
 - (a) The sensor range shall be selected based on the wet well depth.
 - (b) The sensor output shall be 4 to 20 mA DC proportional to water level, two-wire type, with loop power supply of 12 to 40 volts DC.
 - (c) All exposed parts shall be constructed of 316 stainless-steel.
 - (d) The sensor shall be filled with silicon oil.
 - (5) The electronic pump controller shall be mounted in the starter panel enclosure and shall be visible from the front of the swing-out panel, with the enclosure door opened. The electronic pump controller shall be as follows:
 - (a) The electronic pump controller shall accept a 4 to 20 mA DC, two-wire level signal, and shall indicate the wet well level digitally in direct engineering units (feet).
 - (b) The unit shall provide a minimum of four pump control outputs, with independent adjustment for each starting and stopping set point. Each level set point shall be indicated digitally in direct engineering units.
 - (c) In addition to the pump control outputs, the unit shall provide outputs for the following points:

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- 1) High water alarm
 - 2) Low water alarm
 - 3) Level sensor failure or signal loss
 - (d) A built-in adjustable time delay for each actuation point shall be provided to permit level signal to stabilize before control actions are initiated.
 - (e) Power to the unit shall be 120 volts AC.
 - (f) Interposing relays shall be provided for each control output, to provide signal isolation.
- e. Pump Automatic Operation
- (1) When the pumps are in the automatic mode, (their mode selector switches are in the "A" position), the pumps shall alternate through the following sequence: lead and lag. The level setpoints at which each pump starts and stops in sequence shall be field adjustable through the front panel of the electronic pump controller.
 - (2) The pumping station shall be provided with a back-up high-level alarm float switch. When level in the wet well rises to the float elevation, both pumps shall be forced to run.
 - (3) The pumping station shall be provided with back-up low-level shut down float switch. When level in the wet well falls to the float elevation, the switch shall open, and both pumps shall be forced to shut down.
- f. Provide an alarm beacon light, which shall be energized on high water alarm condition only. The alarm beacon light shall be as follows:
- (1) The beacon light shall be watertight, suitable for outdoor installation and provided with a red lens.
 - (2) The light source shall be high intensity strobe type, with light intensity of 1,000,000 (1 million) peak candle power.
 - (3) The beacon light shall be mounted on top of the starter panel enclosure using a watertight conduit hub, similar to Myers ST-1, T&B 401, or OZ-Gedney CHM-50T.
- g. Acceptable Manufacturers:
- (1) Motor starters and control components: Allen Bradley.

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- (2) Circuit breakers and motor circuit protectors: Square D.
- (3) Electronic pump controller: ESSEX Engineering Corporation, Model 2410.
- (4) Level sensor: Ametek, model 575, or Delta Controls Corporation.
- (5) Beacon light: Federal Signal "Fireball 2."
- (6) Alternator: Furnas.

7. Omnisite Telemetry

- a. Provide new OmniSite Model XR50 remote monitoring and autodialer system in a NEMA 4X, 316 stainless steel enclosure with GuardDog web interface software. Cellular service contract and OmniSite contract by the City. Equipment shall be installed and configured by the contractor.
- b. Signals to be monitored shall include:
 - (1) Pump No. 1 Status (query only)
 - (2) Pump No. 1 Fail Status
 - (3) Pump No. 2 Status (query only)
 - (4) Pump No. 2 Fail Status
 - (5) High water level alarm
 - (6) Controller/level sensor failure
 - (7) Station power loss

8. Power Distribution

- a. The contractor shall coordinate with the City and electric utility regarding electric service entrance sizing, location, metering, and other requirements.
- b. Secondary grounding
 - (1) Ground Rods: Copper bonded, 5/8-inch diameter, minimum length 10 feet.
 - (2) Ground Connections Below Grade: Exothermic type, Cadweld, compression type by Thomas & Betts, or equal. Compression connectors shall be prefilled with an oxide inhibitor.

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- (3) Ground Fittings: O-Z/Gedney, Type ABG, CG, TG, KG, GBL, or equal.
- (4) Compression-type connectors shall be installed with the manufacturer recommended tools. Compression dies shall emboss an index on the connector, when installed correctly. An indenter crimp shall be made on ground rods before connection of grounding conductor.
- (5) Provide a separate insulated equipment grounding conductor for each feeder and branch circuit. Terminate each end on a grounding lug, bus, or bushing.
- (6) Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, and receptacle ground connectors.
- (7) Ground system, transformer neutrals, and equipment as required by code and local ordinances.
- (8) All feeder neutrals shall be connected to neutral at only one point in the control panel.
- (9) All bare copper conductors installed outdoors shall be buried a minimum of 2 feet below grade.
- (10) Water system grounds and a minimum of three ground rods at 15-foot separations near service entrance shall be provided, and ground wires must attach to a point ahead of a meter or service shut-off valve. These shall be connected to ground bus by conductors sized to code requirements.
- (11) All service entrance ground conductors shall be installed in PVC conduit. All conduit bends shall be made using sweep elbows. Conduit bodies and 90 degree bends are not allowed.
- (12) Flexible connections do not qualify for ground. All flexible connections must have separate green ground wire from the motor base or equipment frame to conduit system.
- (13) Separately derived systems (as defined by the National Electric Code [NEC]) shall be grounded as such. This shall include, but not be limited to, four-wire transformers and four-wire standby generators.
- (14) Inspect grounding and bonding system conductors and connections for tightness and proper installation.

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- (15) Provide ground system resistance test report for each ground grid. Test reports shall document ground system resistance following the three-point “Fall-of-Potential” test. The test results shall include a graph of the results plus a diagram of the testing layout. The remote current probe (C2) shall be placed a minimum of 100 feet from the ground system potential/current probe (P1/C1) or as required to provide sufficient spacing to demonstrate a resistance plateau on the graph. The ground resistance shall be tested with the potential probe (P2) between the P1/C1 probe and the C2 probe at 10 percent intervals starting at 0 and ending at 100 percent of the distance between P1/C1 and C2, 11 points total. A single point of measurement is not acceptable, and the two-point method of ground system testing shall only be used where there is no or insufficient “open earth” area to use the three-point Fall-of-Potential method. Resistance at any point in the grounding system shall not exceed 5 ohms. All ground system tests shall be witnessed by City.
 - (16) The test meter shall be Associated Research Vibroground test set with null balance, James A. Biddle Megger Earth-Tester-Null Balance, or equal. All ground system tests shall be performed in accordance with the procedures outlined in the instruction manuals of the ground system test report.
 - (17) Ground resistance testing shall be performed with all rods connected and shall be isolated from all metallic connections, such as from the ground rods to other grounded structures and electrical system neutrals.
- c. Provide a manual transfer switch appropriately sized for the electric service and lift station loads. Manual transfer switch shall be Eaton Type DT, or equal, double-throw nonfusible switch. Switch shall be NEMA KS 1; heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in “On” position. A defeater shall be provided to bypass this interlock. Handle shall be lockable in “Off” position. Provide auxiliary contacts to remove control power associated with field devices or instruments interlocked with equipment served. Auxiliary contacts shall be by the transfer switch manufacturer.
 - d. Provide a portable generator plug to match the City’s existing installations.
 - e. Some projects may include a permanent standby generator and automatic transfer switch instead of a manual transfer switch and portable generator plug. The requirements and design parameters for this equipment shall be reviewed with the City on a case-by-case basis.
 - f. Provide pole-mounted site lighting with LED fixture. Coordinate lumen level and light distribution with the City.

9. Piping Materials

- a. All gravity sewer pipe entering the wet well shall conform to the requirements of the gravity sanitary sewer sections of this manual. All force mains leaving the lift station site beyond a transition point shown on the drawings shall conform to the requirements of the force main sections of this manual. Piping in and between the wet well and valve vault and from the valve vault to the force main transition point shall conform to the requirements of this section.
- b. Ductile iron pipe
 - (1) Ductile iron pipe shall meet the requirements of ANSI Specification A21.51 (AWWA Standard C151). Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge and a safety factor of 2 and a depth of cover indicated on the drawings and specified in this Section. Minimum thickness class shall be 350.
 - (2) Except where shown, pipe joints shall be flanged. Flanged joints shall conform to applicable flanged joint sections of AWWA C110, C111, and C115 and shall be compatible with ANSI B16.1 Class 125. Flanges shall be ductile iron.
 - (3) Gaps between flanges and all locations where a gap exists at flange hub/pipe intersection shall be caulked before finish painting with Sonneborn NP-1 by Sonneborn-Chem Rex, Inc., Sika FLEX 1-A, or equal. The contractor shall verify compatibility of caulk with finish painting system. Caulking shall be completed following installation and testing. Trim back the excess edge of the rubber gasket between the flanges as necessary to achieve a uniform and flush caulk joint, but no more than 1/8-inch from outside edge of flange. Caulking shall be done and fully cured as required before painting the piping.
 - (4) Flanged gaskets shall be minimum 1/8-inch-thick, styrene butadiene rubber (SBR), full-face, Toruseal, Flange-Tyte, Maloney, or equal, gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerance.
 - (5) Flanged bolts and nuts installed in valve vaults shall be standard zinc plated steel with hex head and hex nuts for the rated working pressure and installation conditions specified or shown. Flanged bolts and nuts installed in wet wells and other submerged locations shall be 316 stainless-steel.
 - (6) Flanged fittings shall be of ductile iron with ductile iron flanges. Flanged fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with

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a minimum rated working pressure of 150 psi. Thrust blocking or restrained joints may be as required or necessary.

- (7) All flanged sections of pipe shall be made up in accordance with AWWA C115 specifications. No field makeup flanges will be allowed unless strictly conforming to AWWA C115, with facing done after turning pipe through flange.
- (8) Unless otherwise specified, all ductile iron piping and fittings shall be cement mortar-lined and asphaltic-coated inside. Cement mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings. Exterior exposed, submerged, and interior piping shall be furnished with outside surfaces prepared by abrasive blasting, in accordance with NAPF 500C-03. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140, or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; the contractor shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all piping, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by the contractor with a minimal amount of surface preparation.
- (9) Unless otherwise specified, piping and fittings in wet wells shall be asphaltic-coated outside. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.

c. Gate valves

- (1) Shut-off valves in ductile iron lines containing wastewater shall be AWWA C515, ductile iron, resilient seat, outside stem and yoke (OS&Y) (rising stem), 150 psi working pressure with O-ring packing box. Provide malleable iron handwheel. Valve opening direction shall be counterclockwise. Flange joints and accessories shall meet the requirements of ANSI/AWWA C110. Nuts and bolts shall be stainless steel. Gaskets shall be full face and be red rubber, or equal. Coatings shall conform to ductile iron pipe requirements previously mentioned.
- (2) Gate valves shall be as manufactured by Waterous, U.S. Valve, or equal.
- (3) Small gate valves: Shut-off valves in nonpotable water lines, pump vent, and drain lines 1- through 3-inch diameter shall be gate valves, Class 150, bronze or iron body bronze-mounted, solid wedge disc, threaded, rising stem, Nibco T-131, Milwaukee Valve 1150, or equal. Provide unions for ease of valve removal.

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d. Check Valves

- (1) Single disc, swing check valves, 4-inch and larger, shall be used in sewage pump stations and shall be ductile iron or iron body, bronze or stainless steel trimmed, swing check, bolted cover, flanged ends, 150 pounds per square inch gauge (psig) working pressure, AWWA Standard C508, suitable for use in a horizontal position. Flanges shall conform in dimensions and drilling to ANSI B16.1. Coatings shall conform to ductile iron pipe requirements previously mentioned.
- (2) Swing check valves shall have outside weight and lever. Two levers and/or additional weights shall be used, if necessary, to stop slamming.
- (3) Swing check valves shall be GA Industries Figure 220-DS, Apco Model 250 LW by DeZURIK, or equal.
- (4) Small Check Valves: Check valves in other than cast iron lines shall be Milwaukee Valve UP509, Nibco T-413-Y-LF, or equal, screwed-end bronze swing-check for water and air. Provide unions to allow for ease of removal.

e. Pressure Gauge Connections

Provide a pressure gauge tap connection on each new pump discharge piping in the valve vault. Provide isolation valve and union at connection to pipe to allow the gauges to be removed while the line is under pressure.

10. Concrete Wet Well and Valve Vault

- a. The contractor shall furnish and install a monolithic concrete or precast manhole-type wet well as indicated on the drawings. Pump and related equipment shall be installed and/or mounted as shown.
- b. The contractor shall furnish and install a monolithic concrete or precast manhole-type valve vault as indicated on the drawings to house the valves and appurtenances.
- c. Precast, reinforced concrete manhole sections, including risers, tops, and bases shall conform to requirements of ASTM Specification C478. Precast, reinforced concrete wastewater structures shall conform to requirements of ASTM Specification C913.
- c. Contractor may offer wet well sections conforming to ASTM C-76, Class IV, Wall B pipe sections if shown on the drawings and approved by the City.

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- e. Precast, reinforced concrete materials and manufacturing, joint and gaskets, marking, testing, and inspection shall conform to the requirements for gravity sewer manholes previously mentioned.
 - f. Openings in the wet well and valve vault shall be provided by a supplier at the factory. Gravity sewer pipe openings into wet well shall be sealed using flexible, watertight connections such as A-Lok, PSX Press Seal, Kor-N-Seal, or equal. All force main and other openings into wet well and valve vault shall be grouted watertight with hydraulic cement or may be sealed with A-Lok, PSX Press Seal, Kor-N-Seal, or equal connectors. Provide rubber waterstop on all pipes through the wet well and valve vault walls sealed with hydraulic cement.
 - g. Wet well and valve vault base slabs shall be monolithically precast with the bottom section for structures up through 6-foot diameter. Base slabs for larger diameter structures shall be precast but need not be monolithically cast with the bottom section. All other structure base slabs shall be either poured-in-place or precast concrete. The base slab shall be designed for buoyant force assuming groundwater level at grade and the structure empty unless other subsurface investigation documentation is provided and approved by the City. The contractor may provide cast-in-place slabs instead of precast. If cast-in-place slabs are used, the contractor shall submit design calculations. Use of cast-in-place slab shall not relieve the contractor of requirement to provide watertight joints.
 - h. Coat exterior surface of wet well and valve vault with coal tar epoxy. Coat interior of the force main discharge manhole with chemical resistant coating.
 - i. All anchors, bolts, and fabricated metal within wet well shall be stainless-steel.
 - j. All electrical Work and equipment in wet well shall be rated for a Class I, Division 1, Groups C and D location. All electrical Work and equipment within a 3-foot radius of the wet well vent shall be rated for a Class I, Division 1, Groups C and D location. All electrical Work and equipment between a 3 and 5-foot radius of the wet well vent and 3 feet from the access door (all sides) to 1.5 feet abovegrade shall be rated for a Class I, Division 2, Groups C and D location.
11. Access Doors and Accessories
- a. Provide aluminum access doors on the wet well and valve vault, as manufactured by Bilco, Durred, or equal. Aluminum access doors shall be Bilco Type J or JD, or equal.
 - b. The frame shall be 1/4-inch extruded aluminum with built-in neoprene cushion and with strap anchors bolted to exterior. Cover leaf/leaves shall be 1/4-inch aluminum reinforced with aluminum stiffeners, as required. Stainless steel hinges shall be bolted to the underside and pivot on stainless-steel bolts and hardware. The doors shall include a positive hold-open arm with a release handle and a tubular

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stainless-steel compression-spring operator. Provide doors with a flush slam-lock with an inside handle and removable key wrench. The cover shall open to 90 degrees and lock automatically in that position. A vinyl grip handle shall be provided to release and close the cover with one hand. Covers shall be equipped with a snap lock and removable handle. Aluminum doors shall be mill finish. All aluminum surfaces in contact with concrete shall be painted with bitumastic coating, as prescribed by manufacturer. Covers shall be diamond pattern plate.

- c. Covers shall be built to withstand a live load of 300 pounds per square foot (psf) or American Association of State Highway and Transportation Officials (AASHTO) HS-20 loading where appropriate.
- d. Access cover shall be provided with fall-through protection consisting of aluminum grating designed to withstand live load of 300 psf. Grating shall allow for visual inspection, limited maintenance, and float adjustment while the grate is in place. A grate shall be provided with a permanent hinging system which will lock grate in 90-degree position once opened. A locking device to prevent unauthorized entry to the confined space below shall be provided. Aluminum grating shall be powder-coated safety orange.
- e. Doors shall be cast into the top slab. The contractor shall coordinate the location of the door to provide proper clearance between door and pumps and to allow for proper placement of pumps. When closed, covers shall not protrude above the operating surface in which they are installed. Provide two wrenches for opening covers.
- f. The valve vault cover shall be watertight with a drain system.
- g. Provide stainless steel or fiberglass Unistrut, as necessary, attached to doors to mount accessories. Accessories (upper guide holder, cable holder, power and float cable holder) shall be stainless steel.
- h. The contractor shall provide padlocks for the new wet well and valve vault covers. The locks shall be keyed alike with a lock provided by the City.

12. Finishes

- a. It is the intent of these specifications that the submersible pumps be furnished shop-primed and factory-finished painted. Priming and finish painting shall be as recommended by manufacturer and shall be suitable for the uses described in these specifications. Touch-up paint shall be provided by manufacturer.
- b. The impeller shall be coated with manufacturer selected primer.

13. Anchor Bolts

Contractor shall provide anchor bolts necessary for the equipment furnished. Anchor bolts shall be stainless steel and be of ample strength for the intended service.

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14. Fencing

- a. Provide a vinyl coated 6-foot chain link fence with a #9 tension wire at the bottom of the fence.
- b. Provide three strands of barbed wire at the top of the fence.
- c. Provide a 3-foot pedestrian gate.
- d. Provide a 16-foot double gate for maintenance access.
- e. Coordinate the layout of the fencing and gates with the City.

15. Additional Equipment

- a. Some projects may include additional equipment, such as:
 - (1) Flow metering
 - (2) Bypass pump piping
 - (3) Triplex pumping
 - (4) Pressure sensor
 - (5) Portable hoist
 - (6) Yard hydrant
 - (7) Permanent standby power generator
 - (8) Control buildings
 - (9) Odor control
- b. The requirements and design parameters for such equipment shall be reviewed with the City on a case-by-case basis.

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3.03 EXECUTION AND INSTALLATION

A. Gravity Sanitary Sewers

1. Underground Piping

- a. Utility lines shall be laid and installed to the lines and grades specified with valves, fittings, manholes, and other appurtenances at the specified locations; spigots centered in bells; and all manholes and riser pipes plumb. Force main shall be installed at the depth indicated. Gravity sewer mains and laterals shall maintain a minimum 3 feet of cover but shall be deep enough to provide service to buildings. Force main shall be installed to within (plus or minus) 0.1 feet of designed grades. Sanitary sewer and laterals shall be installed to within (plus or minus) 0.03 feet of designed grades.
- b. Deviations Occasioned by Underground Facilities: Wherever significant obstructions are encountered during the progress of the Work, the contractor shall proceed in accordance with the General Conditions to notify the City and protect the facilities. Existing items unnecessarily damaged during the performance of the Work shall be repaired and replaced at the expense of the contractor.
- c. Before commencing the pipe laying, the contractor shall notify the City of the intended date for starting the Work. The City may request at the contractor's expense the removal and relaying of pipe that was installed before notification of the City.
 - (1) Proper implements, tools, and facilities shall be provided and used by the contractor for the safe and convenient prosecution of the Work. All pipe, fittings, and appurtenances shall be carefully lowered into the trench piece by piece with a crane, rope, or other suitable tools or equipment, in such manner as to prevent damage to materials. Under no circumstance shall pipe be dropped or rolled into the trench.
 - (2) Materials shall be as specified herein.
- d. Material inspection: The contractor shall inspect the pipe, fittings, and appurtenances for defects when delivered to the jobsite and before lowering into the trench. Defective material shall be removed from the job site. All material shall be clean and free of deleterious substances before use in the Work.
- e. PVC sewer piping shall be installed in accordance with ASTM D2321. Except where noted or specified, PVC or other thermoplastic pressure piping shall be installed in accordance with ASTM D2774.
- f. Except where noted or specified, reinforced concrete pipe shall be installed in accordance with ASTM C12.

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- g. A plumbing system shall be installed and tested in accordance with local and state plumbing code requirements and applicable portions of Ordinance 50.021 of the City Code of Ordinances. If requirements conflict, the stricter standard shall apply.
- h. The contractor shall lay all gravity pipe to the line and grade with bell ends uphill wherever possible. If not possible, the contractor shall lay pipe to the line and grade with bell ends in the direction of laying. Unless shown otherwise, drainage piping shall clear the floor slabs or footings by a minimum of 6 inches.
- i. Any pipe or fittings cracked in cutting or handling or otherwise not free from defects shall not be used. Pipes must be kept clean of mortar, cement, clay, sand, or other material. When PVC piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to the ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided where needed.
- j. At times when pipe laying is not in progress, the open ends of pipe shall be closed with plugs to prevent the entry of foreign material. Acceptable plugs include Foreman Nite Caps by APS, mechanical joint cap or plug, bladder plug, or test plug. All foreign material shall be removed from the pipe before acceptance.
- k. The locations and elevations of existing piping and manholes are approximate. Where necessary, existing piping shall be exposed by the contractor to confirm location and elevation before installing new piping. Any changes in pipe location or elevation shall be approved by the City.

l. General Excavation

(1) Pipe Laying

- (a) All pipe shall be laid accurately to the line and grade as designated. Preparatory to making pipe joints, all surfaces of the portions of the pipe to be joined or of the factory-made jointing material shall be clean and dry. Lubricants, primers, adhesives, and other joint material shall be used and installed as recommended by the pipe or joint manufacturer's specifications. The jointing materials or factory fabricated joints shall then be placed, fitted, joined, and adjusted in such a workmanlike manner as to obtain the degree of watertightness specified. Pertinent specifications from the joint and pipe manufacturer that outline procedures to be followed in making the joint shall be furnished to City.
- (b) Wyes, tees, and special fittings shall be installed as called for on the drawings, or as requested by the City. Wyes, tees, and special fittings, shall, in general, be jointed with the same type of joint as used in the pipe.

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- (c) In joining two dissimilar types of pipe, manufactured adapters and fittings shall be used. Adapters and fittings shall be configured to maintain invert elevations at same level.
 - (d) Joint deflections shall not exceed the limits established by the pipe manufacturer for the pipe and joint being used.
 - (e) After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with specified backfill material tamped around it except at the bells.
 - (f) Pipe shall be brought home by using a cross member and levers or jacks. It will not be permissible to push pipe home with motor powered excavation equipment.
- (2) Sewer Service Branch and Lateral Installation
- (a) The contractor shall furnish and install sanitary sewer branches, laterals, and leads as shown on the Drawings or requested by the City. Under normal circumstances, service laterals will be installed within the right-of-way or easement to serve all existing buildings and all platted lots. In certain cases, only wye or tee branches will be installed to vacant lots. Service laterals shall consist of a branch fitting at the main and extension of the specified lateral pipe to the end of lateral as called for and requested. All necessary fittings shall be furnished and installed to complete the installation as shown in the standard drawings.
 - (b) Wye or tee branches: Wherever shown on the Drawings or requested by the City, wye or tee branches shall be provided for use in making sanitary sewer service connections. Unless specified otherwise on the drawings, wye or tee branches for sanitary sewer service lateral connections to single family residences shall be 4-inch diameter. All other sanitary sewer service lateral connections shall be 6 inches.
 - (c) Sanitary sewer service branches shall be turned so that the branch is at an angle of 30 or 45 degrees from the horizontal.
 - (d) Sanitary sewer service laterals: Under normal conditions and unless otherwise shown on the drawings or requested by the City, all service laterals shall be standard laterals, Type 1. Service laterals of Types 2 through 6 may be requested by City to meet field conditions.

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- (e) It is the general intent to install modified laterals, Type 2, 4, or 5 for service to homes that presently have shallow or no basements or where the depth to groundwater at the end of lateral is shallow. Types 3 and 6 risers are only to be provided where shown on the drawings.
- (f) Installation and Testing Requirements: Except for those branches that are to be used for extending sanitary sewer service laterals, wye and tee branches shall be closed with airtight stoppers blocked to withstand air test pressures.
- (g) The ends of all laterals shall be plugged and blocked to resist air test pressures. All plugs shall be manufactured to fit the pipe used and shall be watertight. The ends of all laterals shall be marked using flagging tape and 2 by 4 markers.
- (h) Unless otherwise provided for in the drawings, each service lateral shall have a tracer wire installed from the main to the property line or the location of the connection to the existing service, whichever is greater or applicable. The tracer wire shall be 10-gauge solid copper with no splices. The wire shall be secured to the pipe with duct tape at a minimum of 3-foot intervals. The ends of the tracer wire shall be brought to the ground surface and stored in an access terminal box, DWS–Tracer Wire Access Box, or equal, at a location selected by the City. An additional 18 inches of wire length shall be coiled at the location of the terminal box. The contractor shall confirm the method of installation is compatible with the City's means of detecting the location of the service lateral. Each tracer wire shall be tested by the contractor to confirm it accurately provides the location and depth of the sewer lateral.
- (i) A complete and accurate tabulation of length, depth, and location of all branches, risers, and laterals shall be kept by the contractor on cards available from the City. Measurements shall be made from the nearest downstream manhole. Lateral installation to meet these standards and field conditions are the responsibility of the contractor. Problems occurring because of failure to provide proper installation or proper records shall be corrected by the contractor at its expense.
- (j) No installed lateral shall be backfilled until the City has been notified that the lateral is complete and reasonable time is allowed for observation of the Work.
- (k) Lateral tap-ins shall be performed by a licensed plumber.

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- (l) In new subdivisions, where new curbs are being installed, the contractor is to mark an “S” in the curb where the lateral crosses under the curb.
- (3) Manholes
 - (a) Manholes shall be installed in accordance with the standard details for sanitary sewer. Manholes shall be plumb with any steps aligned and openings located over steps. For sanitary sewers, openings shall be located over the bench and not the sewer flow line itself.
 - (b) All manholes shall be made watertight and shall show no visible signs of leakage at the time of final review and within the correction period. Any leakage shall be sealed from the exterior of the manhole.
- (4) Masonry
 - (a) No masonry shall be laid when the temperature of the outside air is below 40°F unless all masonry materials are heated and protected against freezing.
 - (b) Only enough mortar shall be mixed that can be conveniently use before it reaches initial set. Retempering of mortar will not be permitted.
- (5) Abandoning Utilities

Utilities to be abandoned shall, unless otherwise noted on the Drawings, be abandoned in place. Open ends of pipes shall be plugged with 12 inches of concrete. Manhole barrels, valve boxes and other such structures shall be removed to a point 3 feet below the existing or final ground surface, whichever is lower, and shall then be filled with backfill material compacted to that of the trench backfill. An approximate 9-inch-diameter opening shall be made in the bottom of the structure to allow for groundwater movement.

- (6) Connections to and Modifications of Structures and Mains
 - (a) Unless otherwise noted on the drawings, openings in existing structures to allow for connection of mains shall be core drilled, and the mains themselves shall be connected by use of watertight connections. Flow channels in the bottoms of existing structures shall be modified as necessary to provide smooth transition for incoming flow and/or orientation of the mains. These modifications may include breaking out and reforming flow channels.

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- (b) Where new and existing mains are to intersect, doghouse manholes shall be provided to facilitate connection and to gain access to the intersecting mains. Manholes shall be provided at the manufacturing plant with arched openings in lower barrel section to span each intersecting main. Reinforcing shall be cut and bent back. In the field, manhole shall be set on concrete blocks. Concrete shall be poured under and around the manhole to seal all openings, cover and adhere to the slab and bent reinforcement, and provide for benches or fillets in the manhole. Sanitary sewer mains shall be kept intact until the bench or fillet is poured. Then the top of pipe to springline shall be removed to provide access.
- (7) Stubs, Connections, Bulkheads, And Miscellaneous Items of Work
 - (a) Where special junction chambers are to be constructed or where existing sewers carrying sanitary sewage are encountered, the Contractor shall provide and maintain temporary connections to prevent a nuisance. All such temporary connections, pumping, and diversion shall be included in the price bid for this Work.
 - (b) Where called for, shop connections and stubs for future sewer connections shall be provided.
 - (c) New sewer connections to existing manholes shall be neatly made by cutting a hole in the existing structure, concreting the sewer in place, and providing a watertight connection.
 - (d) The contractor shall not connect any existing sewers or house/building services before the completion of the exfiltration/infiltration tests, air tests, and acceptance of the sewer without the written permission of the City.

2. Testing

- a. All tests shall be conducted in the presence of and in the manner accepted by the City. The contractor shall furnish and install all equipment necessary for the sewer tests.
- b. Deflection testing requirements and procedure shall follow Chapter 30 of the Ten State Standards.
- c. Infiltration/Exfiltration Tests
 - (1) Infiltration/exfiltration tests for all gravity sewers (except laterals) will be as follows: If the groundwater is above the pipe, measurements shall be taken to determine the rate of infiltration into the pipe. If groundwater is below the

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pipe, the stretch of pipe shall be plugged at its downstream end and water shall be placed inside the pipe to fill the pipe. Measurements shall then be taken to determine the rate of leakage out of the pipe by filling the pipe. Concrete pipe shall be filled with water at least 8 hours before measurements are taken. The rate of infiltration or leakage shall not exceed 100 gallons per inch-diameter per mile per day for any stretch of pipe measured. Contractor shall immediately make all necessary repairs to bring infiltration or leakage within the previously mentioned acceptable limits.

- (2) Air test procedure shall follow ASTM F1417 for plastic pipe.

e. Manhole Testing

If required on the drawings, sanitary sewer and process piping manholes shall be vacuum tested in accordance with ASTM C1244. Pipes entering the manhole shall be plugged and the seal inflated in accordance with manufacturer's recommendations. The contractor shall provide all required test apparatus, including vacuum pump and gauges.

3. Sewer Televising

a. Televising of Existing or New Sewer Sections Not Previously Televised

- (1) Televising shall be by closed-circuit color television (CCTV).
- (2) The contractor shall clean and CCTV these lines before other Work for the Project.
- (3) The CCTV camera shall view and tape tap cuttings.
- (4) The section of sewer being televised shall be suitably isolated from the remainder of the sewer system, as required.
- (5) Operator shall be NASSCO Pipeline Assessment Condition Procedure (PACP®) certified.
- (6) All observations, videos, equipment, reports, and software shall be in accordance with NASSCO PACP® standards.

b. Sewer isolation shall be completed during sewer televising and, unless otherwise approved in writing by the City, shall be by plugging off the flow of all upstream pipes through the use of sewer line plugs.

c. The following procedures shall be employed, as required, to adequately complete the televising:

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- (1) Televising at night.
 - (2) Televising short sections of sewer and releasing the plug several times during the televising, as required.
 - (3) Bypass pumping, where required, shall be performed by the contractor
- d. The contractor shall notify the City a minimum of 48 hours before performing any televising.
- e. The contractor shall allow the City a 1-week period to review and comment on the sewer televising report once received. All Work found to be defective shall be repaired before concrete or asphalt paving.
- f. Equipment
 - (1) The color television camera used for inspection shall be specifically designed and constructed for such inspection.
 - (2) The camera shall be operative in 100 percent relative humidity conditions.
 - (3) The camera shall have a minimum of 460 horizontal resolutions.
 - (4) Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe.
 - (5) The camera shall have a maximum 2-Lux image pick-up device.
 - (6) The camera shall have a variable focus from the viewing operator's station.
 - (7) The camera shall have a pan and tilt head for observing into the service connections and the complete circumference and height of manholes.
 - (8) The camera shall have zoom capabilities.
- g. Procedures
 - (1) The camera shall be moved from manhole to manhole through the line in either direction at a uniformly slow rate by means of self-propelled equipment.
 - (2) The speed shall not exceed 30 feet per minute, stopping to document sewer condition.

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- (3) Direction of travel and viewing shall be downstream except where access prevents it.
- (4) A reverse television setup shall be attempted, if necessary or where access prevents.
- (5) Measurement of defects shall be at the ground level by means of a metering device.
 - (a) Marking on cable, or the like, which would require interpolation for the depth of the manhole, will not be allowed.
 - (b) Measurements shall be accurate to 0.2 of a foot.
 - (c) A measuring target in front of the television shall be used as an exact measurement reference point, and the meter reading shall show this exact location of the measurement reference point.
 - (d) The measurement aboveground between manholes shall be performed a minimum of twice, near the beginning of the Work and near the end of the Work, to verify the televising equipment counter accuracy.
- (6) Telephones or other suitable means of communication shall be set up between winches, any pumping unit, and the monitor control center.
- (7) All procedures shall conform to NASSCO PACP® standards.
- h. Record Keeping—The following information shall be noted as required for the Work:
 - (1) Printed records shall include the following:
 - (a) Street or easement location.
 - (b) Upstream and downstream manhole numbers.
 - (c) Approximate depth of sewer to the nearest 0.1 foot.
 - (d) Overall length of the sewer.
 - (e) Nominal inside diameter of the sewer.
 - (f) Type of sewer pipe material (include color of pipe).
 - (g) Pipe joint spacing within one-half-foot accuracy.

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- (h) Unusual observations in the manholes.
- (2) Printed location records shall be kept by the contractor that will clearly show the exact location, in relation to adjacent manholes, of each point of infiltration, inflow, or pipe defect discovered.
 - (a) Defects shall be referenced according to a clockwise orientation.
 - (b) Where offset or sheared joints are encountered, the amount of vertical or horizontal displacements shall be noted.
 - (c) Service connections shall be noted.
 - 1) Wye, tee, or break-in type connection shall be noted.
 - 2) Clockwise orientation shall be noted.
 - 3) Size of pipe shall be noted.
 - 4) Presence of a plug or an active lateral pipe shall be noted.
 - (d) Where cracks are observed, they shall be noted and include:
 - 1) Type of crack shall be noted.
 - a) Longitudinal
 - b) Spiral
 - c) Circular
 - d) Multiple
 - e) Collapsed pipe
 - 2) Displacement of any pipe or opening of crack shall be noted.
 - (e) Where roots are observed, the percentage of root growth in relation to the pipe opening shall be noted.
 - (f) Scale, corrosion, soap, and grease shall be noted and include:
 - 1) Heavy
 - 2) Medium
 - 3) Light
 - 4) Clockwise orientation or amount of pipe wall covered
 - (g) Infiltration or inflow observed shall include:
 - 1) Clockwise orientation
 - 2) Estimate of amount of flow in gallons per minute
 - (h) Manhole televising shall include:
 - 1) Manhole corbels
 - 2) Manhole barrels
 - 3) Manhole cone section
 - (i) Any other unusual conditions observed shall be reported.

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- (3) Three copies of all reports shall be provided to the City. For sewer televising of sewer sections not previously televised, reports shall be provided within one week of completion of the televising.
- (4) Two copies of external thumb drives of all sewers televised shall be provided to the City. Video shall be provided within 1-week of completion of the televising. Video shall include the following information:
 - (a) Visual (on screen):
 - 1) Date of televising
 - 2) Sewer reach between manholes
 - 3) Direction of flow and direction of televising
 - 4) Continuous distance along reach
 - (b) Audio:
 - 1) Date of television inspection, operator name, name of overlying or adjacent street, and manhole numbers.
 - 2) Confirmation of sewer reach and televising direction in relation to direction of flow.
 - 3) Description of pipe size, type, and pipe joint length.
 - 4) Description and location of each service connection and pipe defect.
 - 5) Type of weather during televising.
- (5) An external thumb drive record of all observations shall be provided of the televised sewers. The database contained on the thumb drive shall be PACP[®]-certified and compatible with Microsoft Access XP. Two copies of the thumb drives shall be provided to the City.
- (6) The following deliverables shall be submitted:
 - (a) Videos saved in MPEG format or Windows Media video format.
 - (b) Electronic version (.pdf) of the pipe televising reports.
 - (c) Map depicting areas televised.
- i. The lateral service connections shall be televised and videoed: During initial televising to assist in determining if the service is active.
- j. Rehabilitation Televising
 - (1) Televising of sewer reaches or sections of sewer to be rehabilitated shall be performed as required by the contractor for performance of the

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Work. Televising and record keeping shall be as required by the contractor for performance of the Work.

- (2) Televising of protruding tap cutting shall be performed wherever possible during tap cutting. Televising of the entire cutting operation will not be required. Following cutting, the tap periphery and the inside of the service lateral shall be televised and recorded.
- (3) Televising shall be performed during chemical sealing–seal specific, chemical sealing–seal service connection, sewer lining–spot liner, and sewer lining –lateral reinstatement. Televising of the entire rehabilitation operation will not be required. Televising of lateral reinstatement to observe the cutter shall be conducted.
- (4) Following completion of rehabilitation, the contractor shall televise each sewer reach where rehabilitation was completed. Record keeping shall be as specified in subpart Record Keeping.

k. The City makes no guarantee that all sewers to be entered are clear for the passage of a camera. The methods used for securing passage of the camera are to be at the option of the contractor.

l. The contractor shall video all sewers before acceptance by the City.

4. Sewer Cleaning

- a. The contractor shall provide all supervision, equipment, labor, and material necessary for the proper cleaning. Methods shall include, but not be limited to:
 - (1) Rodding
 - (2) Bucketing
 - (3) Brushing
 - (4) Flushing
 - (5) Root cutting
- b. The City makes no guarantee that all sanitary sewers to be entered are clear for the passage of cleaning equipment. The methods used for securing passage of the cleaning equipment are to be at the option of the contractor
- c. Satisfactory precautions shall be taken to protect the sewer lines from damage that might be inflicted by the improper use of cleaning equipment. The

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contractor shall be responsible for and shall immediately repair any and all damage caused by its operations.

- d. Selection of the cleaning equipment shall be based on the condition of the sewers at the time the Work commences.
- e. All cleaning before any type of sewer rehabilitation shall be performed using methods in accordance with manufacturer's recommendations for rehabilitation equipment being used.
- f. Requirements and Procedures
 - (1) The equipment shall be capable of removing root growth, dirt, grease, rocks, sand, and other materials and obstructions from the sewers and manholes. If cleaning of an entire sewer reach cannot be successfully performed from one manhole, the equipment shall be set up at the other manhole and cleaning again attempted. If, again, successful cleaning cannot be performed or the equipment fails to traverse the entire sewer reach, the contractor shall remove the blockage.
 - (2) Cleanliness:
 - (a) All material shall be removed that would impede sewage flow and any subsequent televising and/or rehabilitation efforts.
 - (b) Cleaning shall be completed by using as many passes as required to remove growth and debris to allow any such televising camera and/or rehabilitation to proceed. Cleaning shall be completed to a minimum of 95 percent of the original carrying capacity and as required for any future televising or rehabilitation procedures.
 - (c) All loose material shall be removed from the sewers. No material shall be passed downstream of the areas cleaned.
- g. Debris Removal and Disposal
 - (1) All water, sludge, dirt, sand, rock, roots, grease, and any other material resulting from the cleaning operation shall be removed by the contractor at the downstream manhole of the section being cleaned and properly disposed of by the contractor. Passing material from manhole section to manhole section, which could cause blockage, accumulations of sand in wet wells, or damage to pumping equipment, shall not be permitted.

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- (2) Under no circumstances shall sewage or solids removed from manholes and lines be dumped onto streets or into ditches, catch basins, storm drains, or sanitary sewer manholes.
- (3) Chemical cleaning will not be allowed.

B. Force Mains

1. Installation

- a. All excavation shall conform to Section 203 in the ISS.
- b. Cutting and laying pipe shall follow the same procedure as gravity sewer.
- c. Utility lines shall be laid and installed to the lines and grades specified with valves, fittings, manholes, and other appurtenances at the specified locations; spigots centered in bells; and all manholes and riser pipes plumb. Force main shall be installed at the depth indicated. Force main shall be installed to within (plus or minus) 0.1 feet of designed grades.
- d. All piping shall be adequately supported and braced to resist thrust at bends and joints. Use base elbows, poured concrete, or rod ties. The weight of the piping shall be supported independently of connected equipment.
- f. For restrained pipe joints, all underground force main pipe joints (except for the branch of tees and dead ends) shall be restrained to the length listed in Table 3.03-2 in all directions from all bends and fittings. The branch of tees shall be restrained to two times the length listed in Table 3.03-2. Dead ends shall be restrained to 2.5 times the length listed in Table 3.03-2. Where wall penetrations occur at less than the length indicated in Table 3.03-2, the wall fittings shall also be restrained. Additional restraint shall be provided inside of structures as required.

	Test Pressure (psi)				
	10	25	50	100	150
Pipe Size, Inches					
3 to 12	5	18	18	36	36
14 to 18	5	18	18	36	54
20 to 24	5	18	36	54	72
30	10	18	36	72	90
36	10	18	36	72	
42	10	36	54	90	
48	10	36	54	90	

Table 3.03-2 Minimum Length (in Feet) Restrained Pipe from Bends or Fittings (Minimum 4 Feet Bury Depth)

EXHIBIT A

f. Valves

On clear liquids and lines carrying solids where neither side of the pipeline drains, the valve shall be positioned so that the seat end of the valve is downstream of the shut-off pressure. The highest pressure should always be on the back side of the plug, except for a valve installed in a vertical pipe. Where possible in horizontal pipelines, the valve shall be installed with the axis of the plug horizontal and the plug in the top of the valve when in the open position. Valve installation shall be in accordance with manufacturer's requirements.

g. Valve Boxes

The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is approximately 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.

2. Testing

- a. The contractor shall conduct hydrostatic pressure tests and leakage tests of all joints in accordance with the requirements of AWWA C600 for iron pipe and AWWA C605 for PVC pipe. During performance of the hydrostatic pressure test, force main shall be tested to 200 percent of normal operating pressure in the main, but to no more than the pressure rating of the pipe. All air shall be removed from the main during testing. This shall be done by flushing, installing corporations at high points, or releasing air at valves at high points. Test pumping equipment used shall be centrifugal pumps or other pumping equipment that will not place shock pressures on the main. Power plunger pumps will not be permitted for use on closed pipe systems. Pumps shall be disconnected during test periods.
- b. Before conducting the pressure and leakage test, Contractor shall backfill the trench for its full depth. All bends and special connections to the main shall be adequately blocked and tied before the test. Any damage caused to the main or its appurtenances during performance of these tests shall be corrected by Contractor at its expense.
- c. The contractor shall keep a record of all tests performed. These records shall show the individual lengths of main tested and test results.
- d. Where connections are made to existing mains, it shall be the responsibility of the contractor to provide the necessary hydrostatic tests on all new mains installed. This may necessitate, but is not limited to, the installation of temporary valves to isolate the new system from the existing system. All materials, Work, and equipment necessary for this Work shall be furnished by the contractor at its expense.

EXHIBIT A

- e. All testing of pipelines shall proceed concurrently with installation. The contractor is advised that it may be advantageous to conduct daily preliminary testing of its Work.

C. Submersible Lift Stations

1. Inspection

Inspect all pumps, motors, and appurtenances before installation in the Work. Promptly remove damaged or unsuitable products from the job site. Replace damaged or unsuitable products with new, undamaged, and suitable products.

2. Installation

- a. Install the submersible pumps in accordance with the drawings and manufacturer's written instructions, as supplemented herein.
- b. The discharge elbow of each pump shall be securely anchored to the wet well base and properly aligned with the guide system and upper guide bracket.
- c. The discharge piping shall be properly anchored and supported inside the wet well.
- d. The contractor shall coordinate the proper location of wet well cover casting in the wet well top slab and all associated pump accessories to facilitate installation and removal of pumps. Locations shall be suitable to meet current design and future design conditions without interference.
- e. All equipment supplied and installed shall meet the requirements of the Occupational Safety & Health Act (OSHA) of 1970.
- f. All electrical Work shall be done by a qualified electrician and shall conform to the NEC.

3. Testing

- a. Factory Test: Each pumping unit to be furnished shall be fully performance tested with water in the manufacturer's facility in accordance with the Standards of the Hydraulic Institute to determine compliance with the rated conditions. The pump tests shall be witnessed by the City at the City's option. Notify the City at least 3 weeks in advance regarding the proposed test dates and location. Certified test curves, test data, and computations shall be submitted for approval before shipment and shall include pump performance curves for each speed needed to meet the specified operating conditions. Each pump performance curve shall include at least four operating points and shall show:

- (1) Head versus discharge

EXHIBIT A

- (2) Pump efficiency
 - (3) Test voltage and amperage
 - (4) Brake horsepower
 - (5) Net positive suction head required (NPSHr) for maximum flow conditions
 - (6) Hydrostatic pressure test for casing at 75 psi.
- b. Installed Test: The manufacturer shall provide the services of a factory-trained representative for a period of 1 day at each lift station to perform the initial startup of the pumping station, instruct operating personnel in the operation and maintenance of the equipment, and to demonstrate satisfactorily the performance of each piece of equipment. Before startup at the City's facility, manufacturer's representative shall certify that the equipment has been properly aligned and installed.
- c. Start-Up Tests: During equipment startup, the manufacturer's representative shall confirm each pump is operating properly as specified. The pump manufacturer shall perform the following inspections and tests on each pump at start-up:
1. Impeller, motor rating, and electrical connections shall first be checked for compliance to the specifications.
 2. A motor and cable insulation test for moisture content or insulation defects.
 3. Verify correct rotation.
 4. Verify proper voltage.
 5. Verify proper current draw on each phase.
 6. Verify thermal sensor trip will shut down motor in Hand and Auto mode.
 7. A written certified test report giving the previously mentioned information shall be supplied after start-up. Pump shall be modified if specified conditions are not met.
- d. Force main piping between the wet well and valve vault and between the valve vault and the transition point shall be tested per the force main testing requirements previously mentioned.

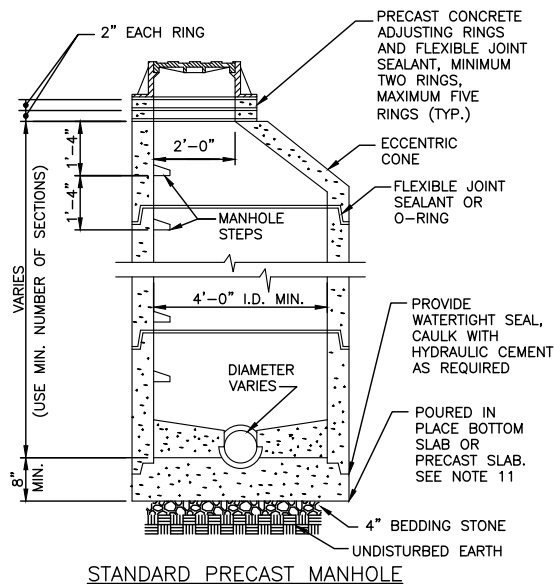
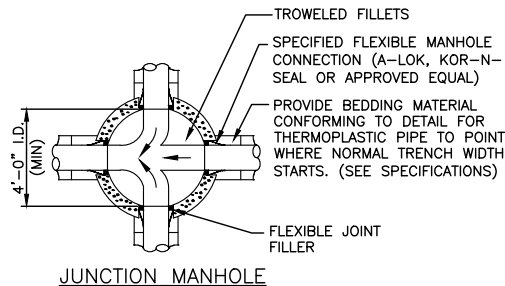
EXHIBIT A

4. Warranty

The pump manufacturer shall warrant the pumps being supplied to the City against defects in workmanship and materials for a period of 5 years or 10,000 hours under normal use, operation, and service. In addition, the manufacturer shall replace certain parts that become defective through normal use and wear or a progressive schedule of cost for a period of five years; parts included are the mechanical seal, impeller, pump housing, wear ring, and ball bearings. The warranty shall be in printed form and apply to all units. The warranty shall not start until the equipment has been placed in operation for beneficial use as determined by the City.

3.04 STANDARD DRAWINGS

EXHIBIT A



NOTES:

1. DETAILS RELATIVE TO ITEMS SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.
2. VARIATIONS IN DIMENSIONS AND DESIGN MAY BE PERMISSIBLE, PROVIDING EQUIVALENT CAPACITY AND STRENGTH ARE ATTAINED.
3. ALL CONCRETE FILLETS SHALL BE HAND TROWELED WITH A 1/4"/FT. SLOPE.
4. INSIDE DIMENSIONS FOR MANHOLES: USE MINIMUM 4' DIAMETER FOR SEWER LESS THAN 18" IN DIAMETER; USE MINIMUM 5' DIAMETER FOR SEWER 18" THRU 24" IN DIAMETER; USE MINIMUM 6' DIAMETER OR MINIMUM 6' SQUARE FOR SEWER OVER 24" IN DIAMETER. USE 7 FT. DIAMETER WHERE SHOWN ON THE DRAWINGS.
5. BEDDING CLASSES "B" AND "C" SHALL MEET OR EXCEED ASTM C12 REQUIREMENTS.
6. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF REGULATORY BODIES OF THE STATE AND APPLICABLE MUNICIPAL ORDINANCES.
7. ALL NEW CONSTRUCTION SHALL BE PLACED ON UNDISTURBED EARTH OR STONE BEDDING.
8. FLAT SLAB TOPS SHALL BE DESIGNED FOR H-20 TRUCK LOADING AND SHALL MEET REQUIREMENTS OF ASTM C-478.
9. BASE SLABS SHALL BE REINFORCED AS FOLLOWS: REINFORCING SHALL BE PLACED IN EACH DIRECTION AT 2" CLEAR FROM TOP SURFACE OF SLAB, REINFORCING SHALL BE GRADE 60. USE OF CAST-IN-PLACE SLAB SHALL NOT RELIEVE CONTRACTOR OF REQUIREMENTS TO PROVIDE WATERTIGHT JOINTS.
10. FLAT SLABS SHALL BE PROVIDED IN SHALLOW DEPTH SITUATIONS IN LIEU OF ECCENTRIC CONES.

INSIDE DIA.	DEPTH	REINF.
4'	≤ 30'	#3@8"
5'	≤ 20'	#3@8"
5'	20'-30'	#4@10"
6'	≤ 20'	#4@10"
6'	20'-25'	#4@8"
6'	25'-30'	#4@6"
7'	≤ 20'	#4@6"

SANITARY MANHOLE DETAIL

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

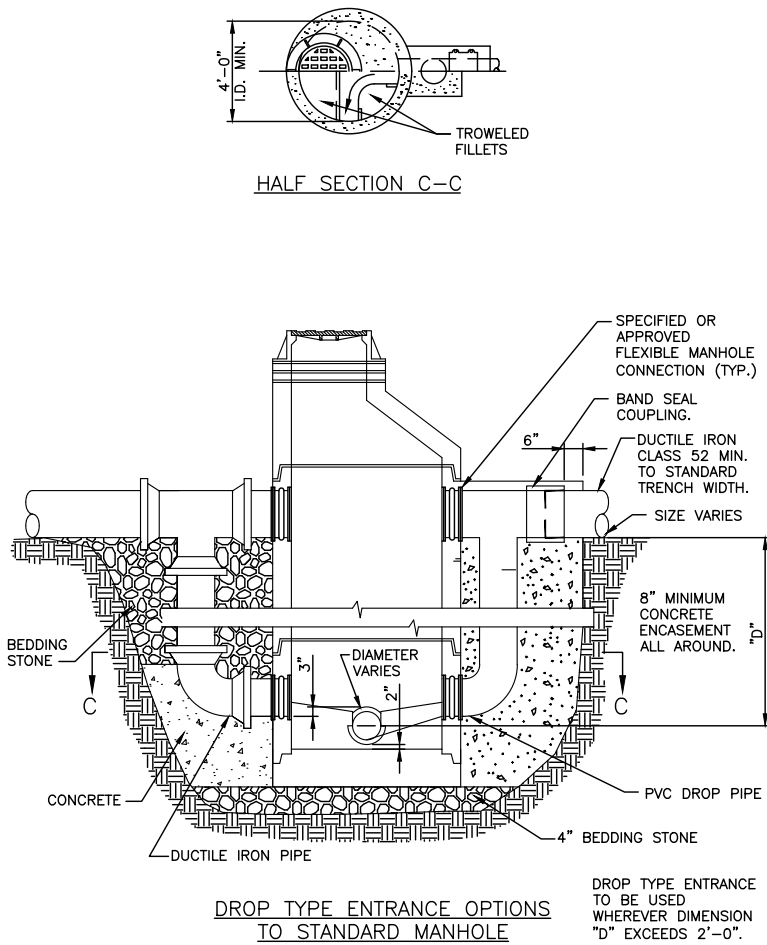
WW-1

EXHIBIT A

NOTES:

1. DETAILS RELATIVE TO ITEMS SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.
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5. BEDDING CLASSES "B" AND "C" SHALL MEET OR EXCEED ASTM C12 REQUIREMENTS.
6. DROP TYPE ENTRANCE TO STANDARD MANHOLE WILL BE PAID FOR SEPARATELY IF SO LISTED IN THE BID.
7. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF REGULATORY BODIES OF THE STATE AND APPLICABLE MUNICIPAL ORDINANCES.
8. ALL NEW CONSTRUCTION SHALL BE PLACED ON UNDISTURBED EARTH OR STONE BEDDING.
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INSIDE DIA.	DEPTH	REINF.
4'	≤ 30'	#3@8"
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5'	20'-30'	#4@10"
6'	≤ 20'	#4@10"
6'	20'-25'	#4@8"
6'	25'-30'	#4@6"
7'	≤ 20'	#4@6"



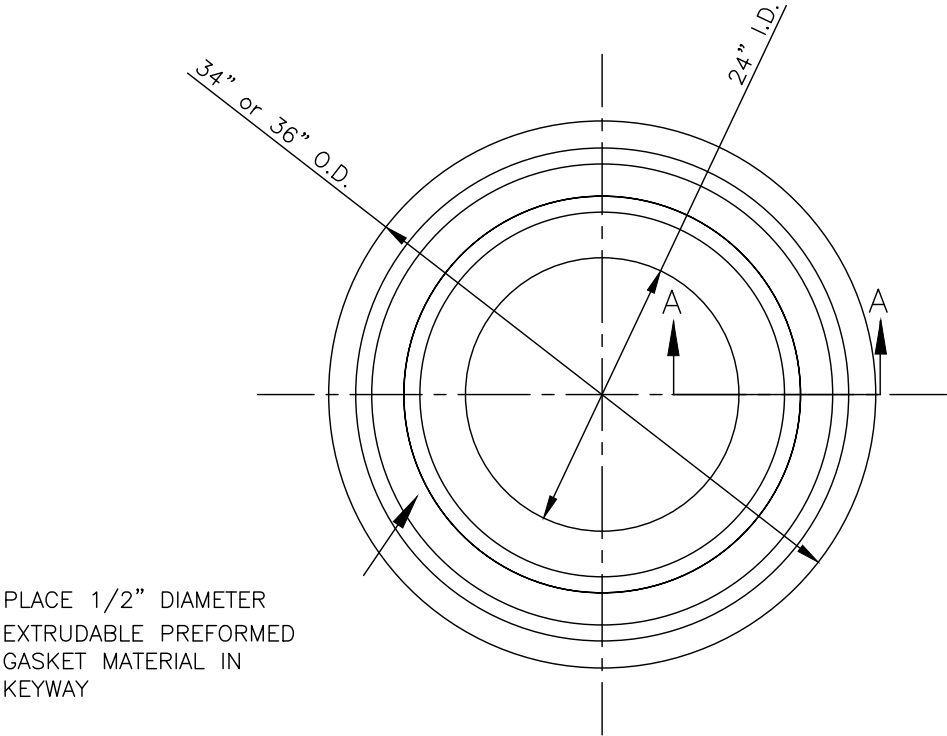
DROP TYPE MANHOLE DETAIL

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

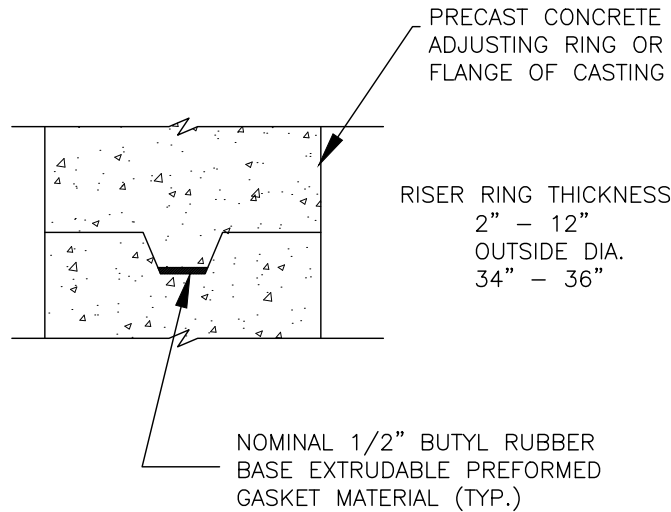
WW-2

EXHIBIT A

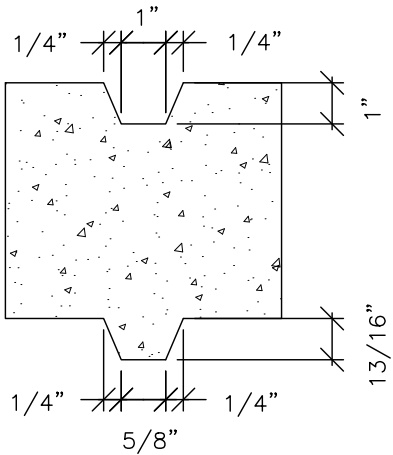
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PLACE 1/2" DIAMETER
EXTRUDABLE PREFORMED
GASKET MATERIAL IN
KEYWAY



GASKET DETAIL



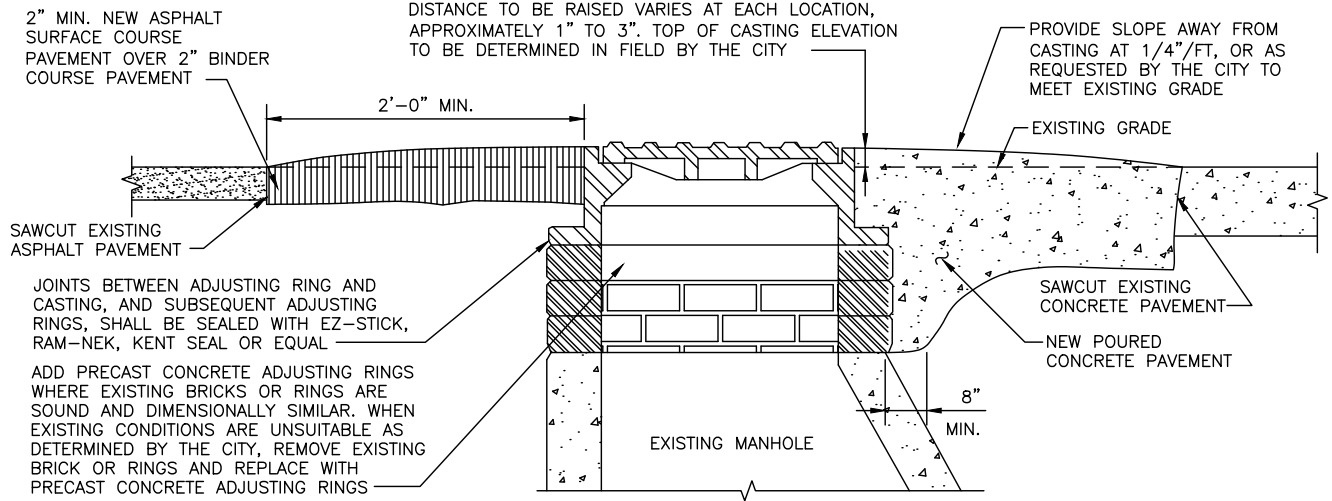
SECTION "A-A"

ADJUSTING RING DETAIL
NO SCALE

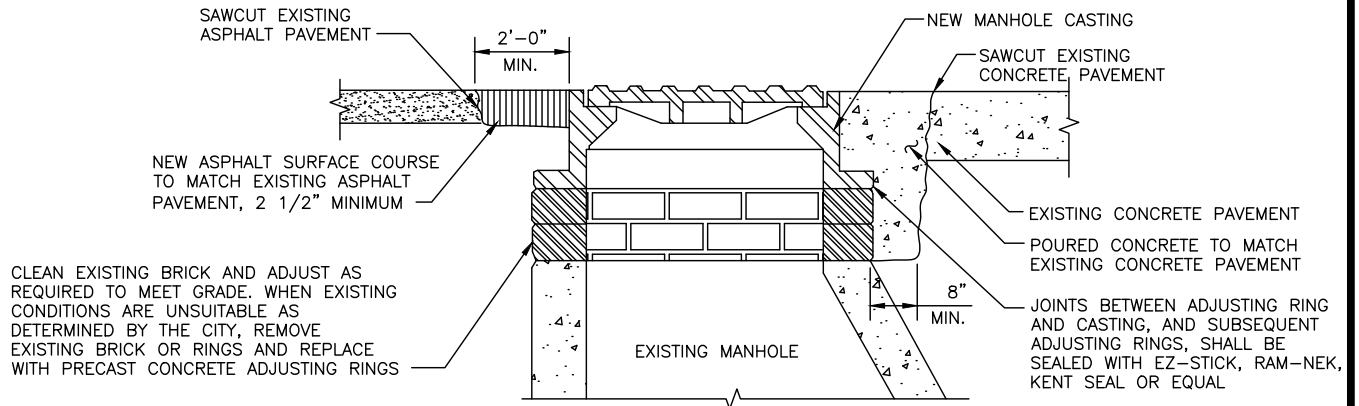
ADJUSTING RING DETAIL

**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

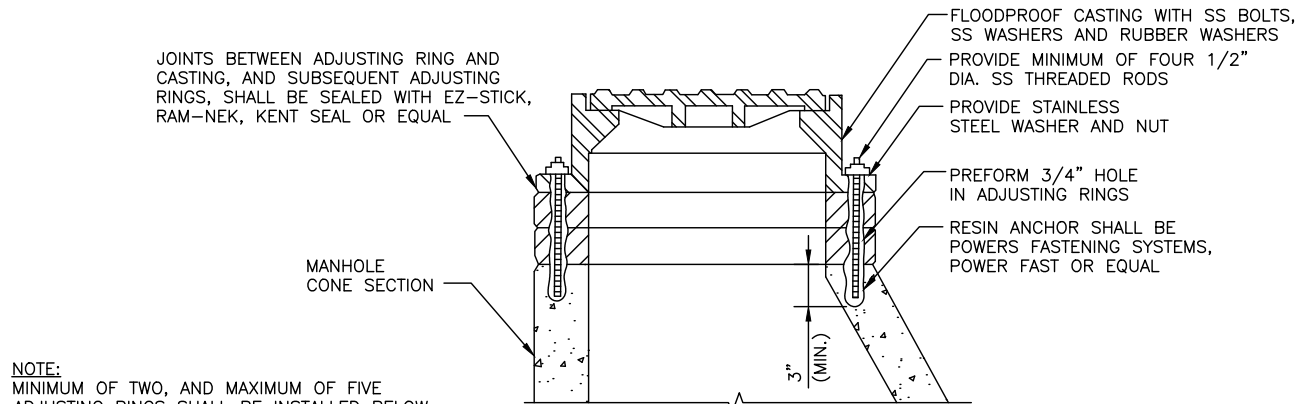
EXHIBIT A



RAISE MANHOLE CASTING



REPLACE MANHOLE CASTING



NEW WATERTIGHT MANHOLE CASTING AND ANCHORS

NOTE:
MINIMUM OF TWO, AND MAXIMUM OF FIVE ADJUSTING RINGS SHALL BE INSTALLED BELOW CASTING. MANHOLE SECTION SHALL BE MODIFIED AS REQUESTED BY THE CITY TO REDUCE CHIMNEY HEIGHTS BELOW MAXIMUM.

MANHOLE CASTINGS ADJUSTMENT DETAILS

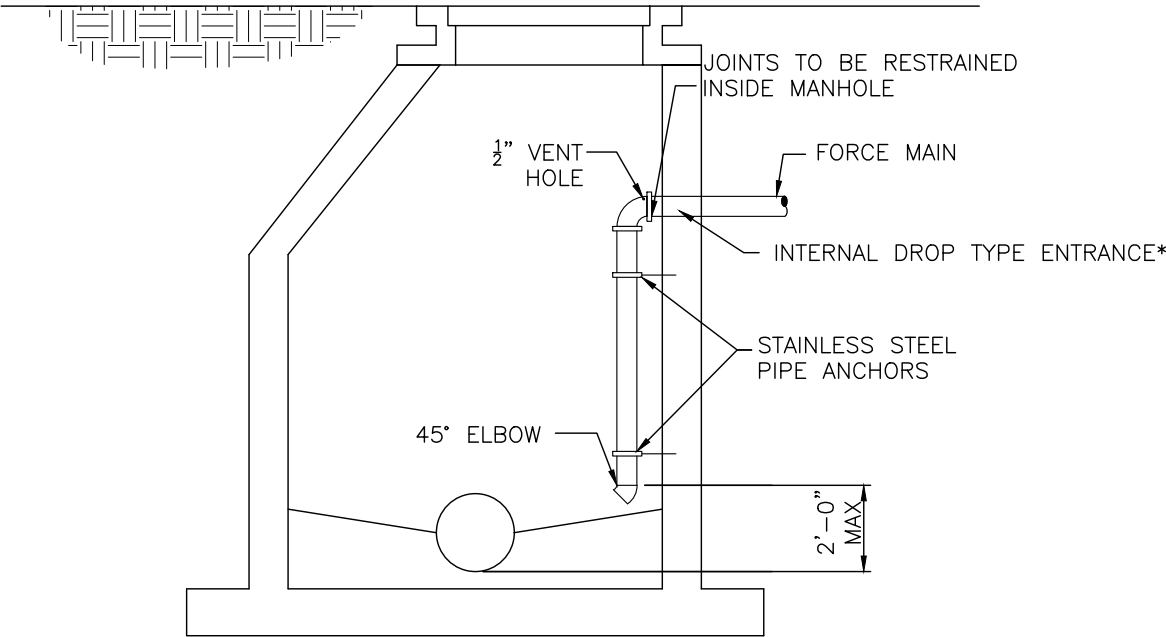
**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

WW-4

EXHIBIT A

NOTE:
FORCE MAIN SHALL BE INSTALLED TO DISCHARGE DIRECTLY INTO FLOW LINE AND NOT ONTO MANHOLE BENCH.

*FOR FORCE MAINS LARGER THAN 6", USE EXTERNAL DROP TYPE ENTRANCE.



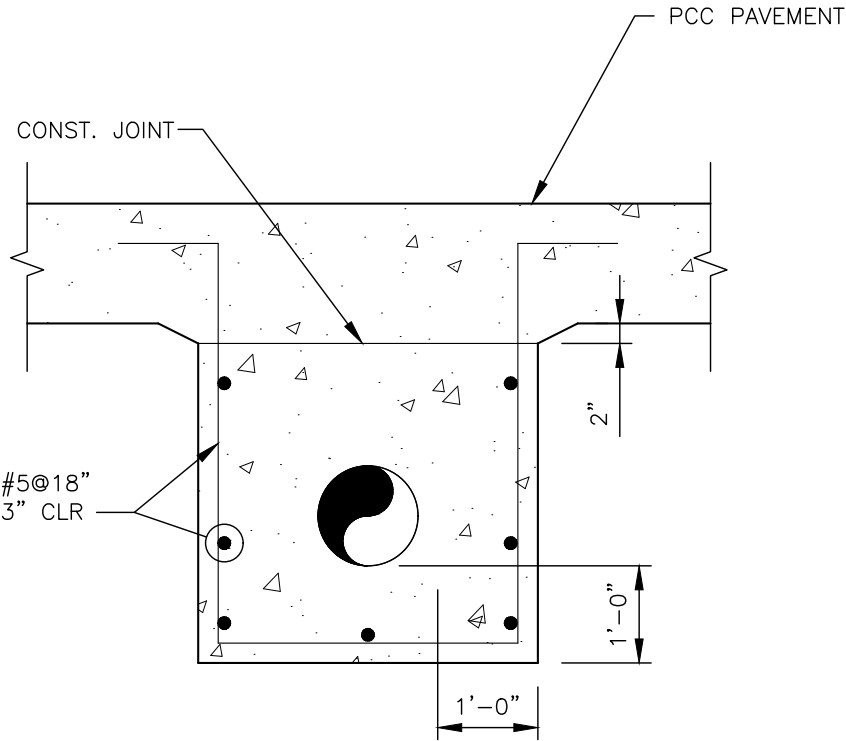
FORCE MAIN TO MANHOLE CONNECTION
NO SCALE

FORCE MAIN TO MANHOLE CONNECTION

**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

WW-5

EXHIBIT A



CONCRETE PIPE ENCASEMENT

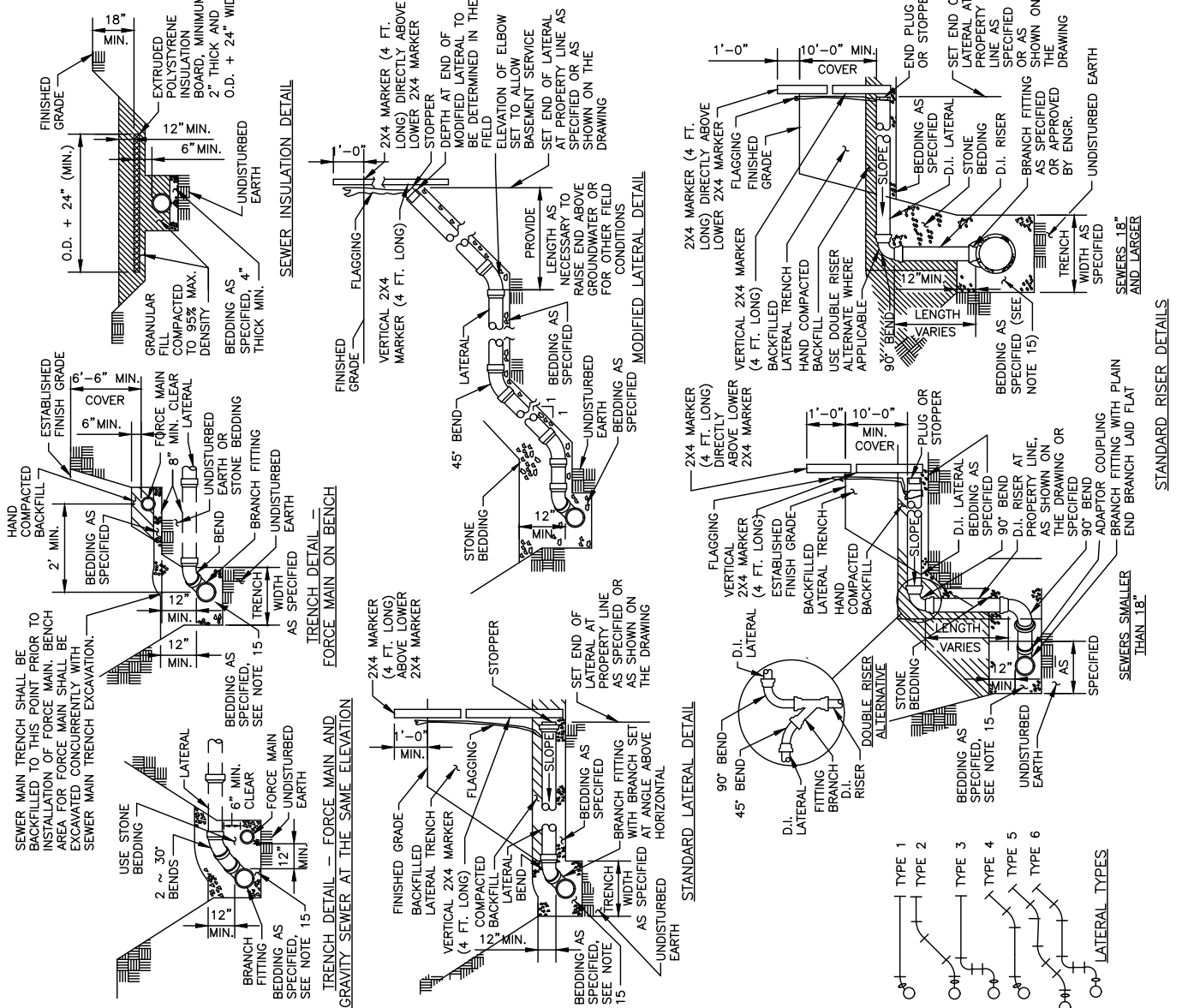
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CONCRETE PIPE ENCASEMENT

**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

NOTES:

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3. VARIATIONS IN DIMENSIONS AND DESIGN MAY BE PERMISSIBLE, PROVIDING EQUIVALENT CAPACITY AND STRENGTH ARE ATTAINED.
4. ALL NEW CONSTRUCTION SHALL BE PLACED ON UNDISTURBED EARTH OR STONE BEDDING.
5. BEDDING CLASSES "B" AND "C" SHALL MEET OR EXCEED ASTM C12 REQUIREMENTS.
6. ALL LATERALS SHALL BE LAID AT A STANDARD SLOPE OF 1/4-INCH PER FOOT UNLESS OTHERWISE NOTED ON THE DRAWINGS, OR SPECIFIED. IN NO CASE SHALL LATERAL SLOPE BE LESS THAN 1/8-INCH PER FOOT. MAXIMUM LATERAL SLOPE SHALL BE 1 TO 1.
7. END PLUGS OR STOPPERS FOR THE ENDS OF LATERALS AND BRANCH FITTINGS SHALL BE PROVIDED.
8. 2x4'S SHALL BE PLACED AT ALL LATERALS ENDS SO THAT ONE PROTRUDES 12 INCHES ABOVE FINISHED GRADE AND ONE IS LOCATED IN THE GROUND AT THE END OF THE LATERAL. 2x4'S SHALL BE PAINTED FLOURESCENT ORANGE. 2x4'S SHALL EACH BE AT LEAST 4 FT. LONG.
9. BAR STEEL REINFORCEMENT SHALL BE IMBEDDED 1 1/2-INCH CLEAR MINIMUM.
10. THE TOP OF ANY MANHOLE STRUCTURE SHALL BE LEFT SUFFICIENTLY LOW TO PERMIT PROPER ADJUSTMENT OF COVER TO GRADE.
11. INSTALL DOUBLE RISERS WHERE SHOWN ON THE DRAWINGS OR SPECIFIED.
12. STANDARD LATERALS AND MODIFIED LATERALS SHALL BE CONSTRUCTED OF MATERIAL AS SPECIFIED.
13. RISERS AND LATERALS FROM RISERS SHALL BE CONSTRUCTED OF DUCTILE IRON. FITTINGS FOR RISERS AND LATERALS FROM RISERS SHALL BE GRAY IRON OR DUCTILE IRON.
14. FLAGGING SHALL BE 4-INCH WIDE STANDARD ORANGE VINYL TAPE. TIE FLAGGING AROUND END OF ALL LATERALS AND EXTEND UNBROKEN TO THE FINISHED GRADE DIRECTLY ABOVE ENDS OF LATERALS.
15. STONE BEDDING SHALL BE USED AROUND AND TO ONE FT. ABOVE TOP OF ALL SEWER MAINS AT LATERAL CONNECTIONS. PROVIDE BEDDING AS SPECIFIED ELSEWHERE.



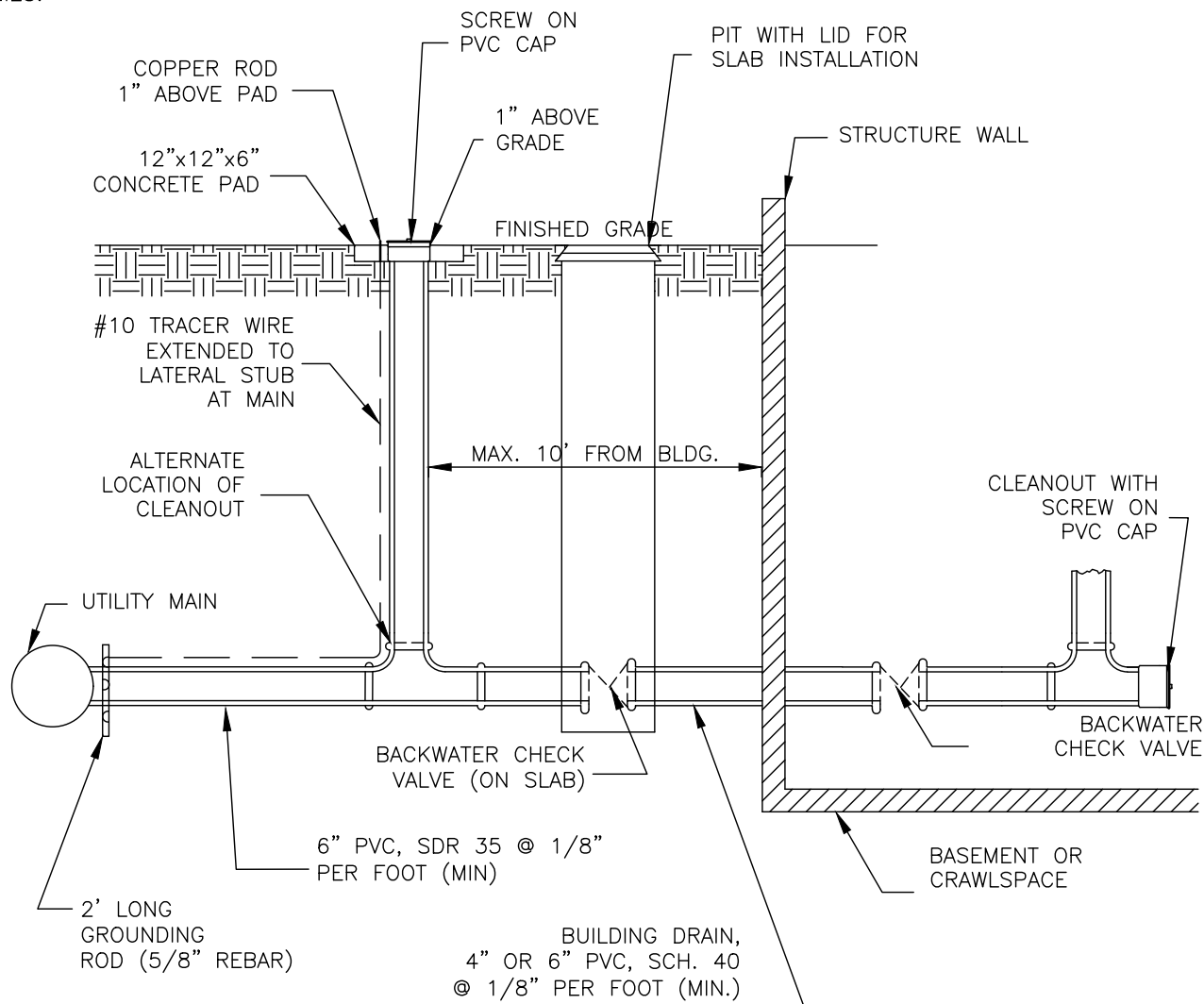
SANITARY SEWER LATERALS

STANDARD CONSTRUCTION DETAILS

CITY OF GREENSBURG
GREENSBURG, INDIANA

EXHIBIT A

NOTE:
TRACER WIRE TO BE WRAPPED
AROUND GROUND ROD MIN. 3
TIMES.



CLEANOUT LOCATIONS:

1. AT THE JUNCTION OF BUILDING DRAIN AND BUILDING SEWER (NEAR EXTERIOR FACE OF BUILDING).
2. IF BUILDING SEWER IS MORE THAN 100 FEET FROM MAIN LINE SEWER, ADDITIONAL CLEANOUT WILL BE REQUIRED. CLEANOUT SPACING SHALL NOT EXCEED 100 FEET.
3. A CLEANOUT IS REQUIRED AT EACH BEND THAT IS GREATER THAN OR EQUAL TO 45 DEGREES.
4. THERE SHALL BE NO BASEMENT DRAINS OR SUMP PUMPS CONNECTED TO SERVICE CONNECTION

GRAVITY SERVICE LATERAL DETAIL

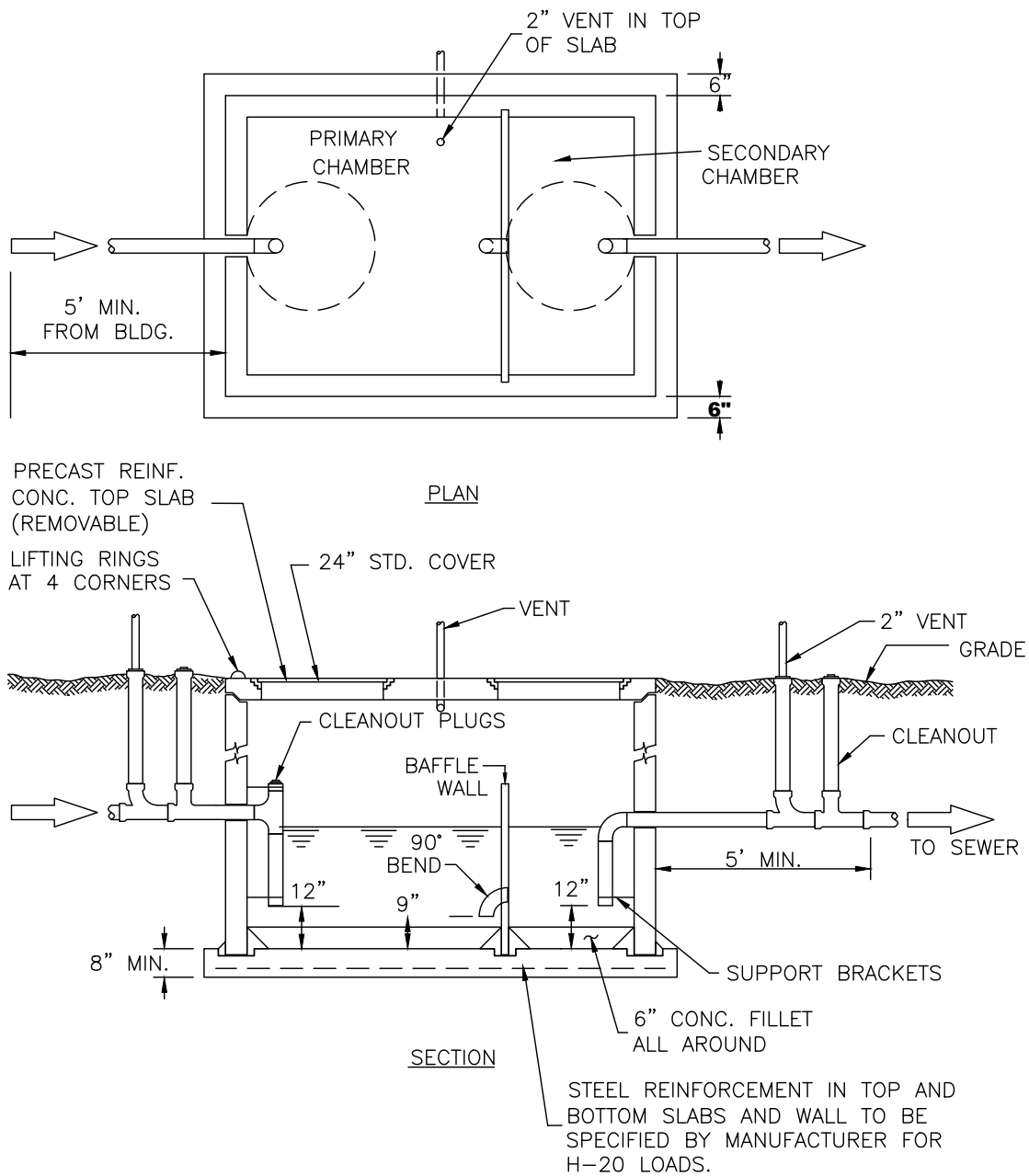
NO SCALE

SANITARY LATERAL CLEAN OUT DETAIL

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

WW-8

EXHIBIT A



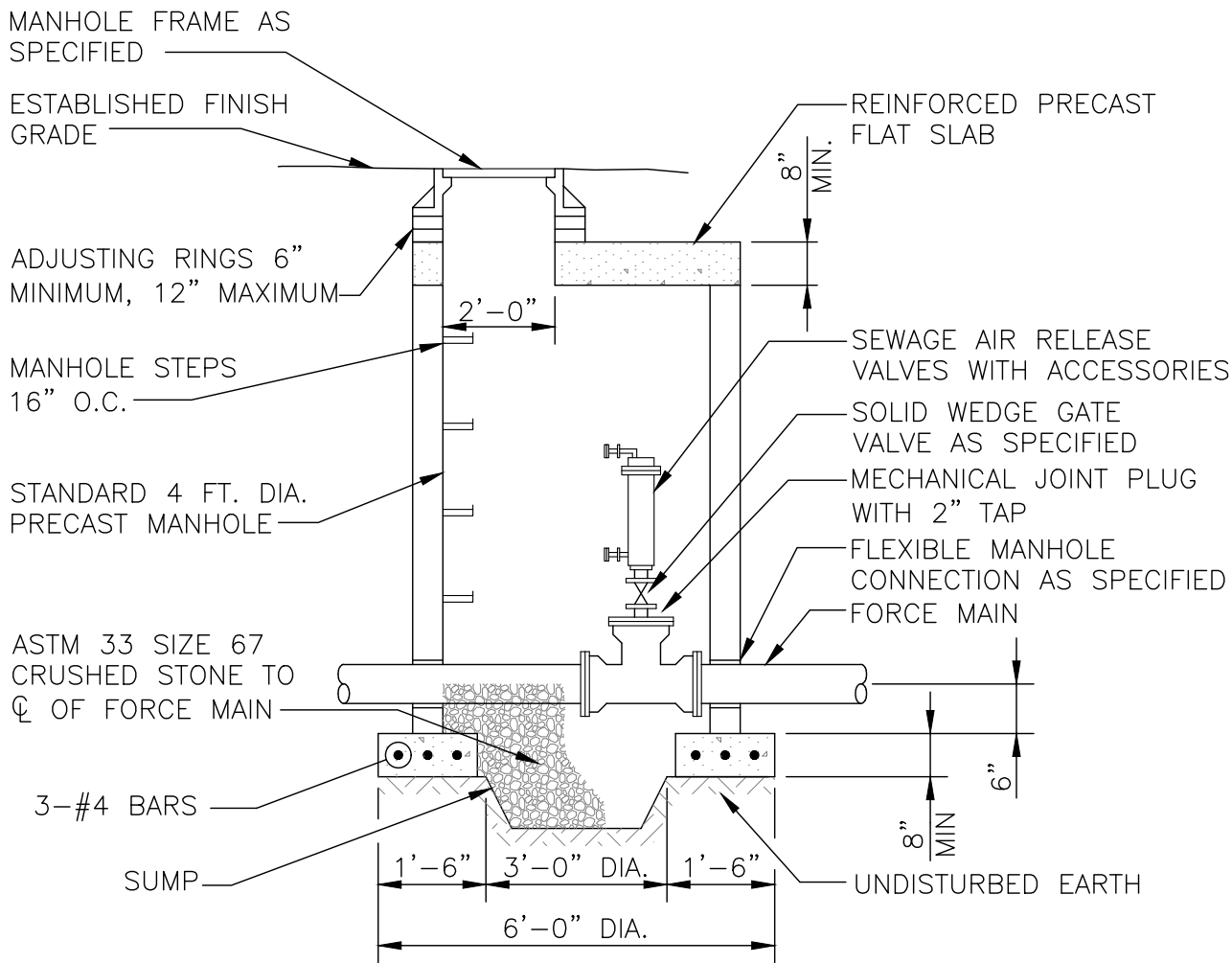
TYPICAL GREASE TRAP
NO SCALE

GREASE TRAP DETAIL

**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

WW-9

EXHIBIT A

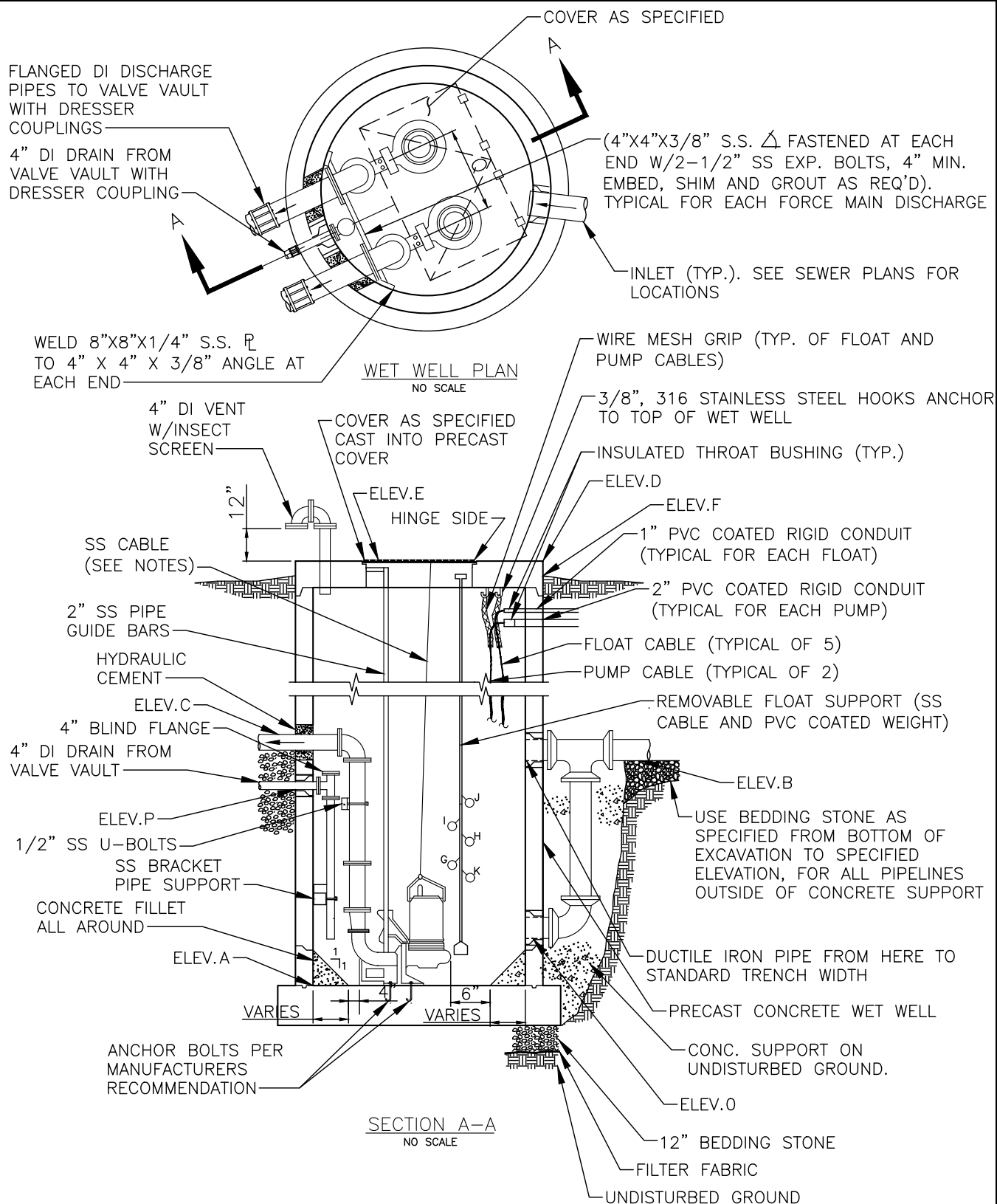


AIR RELEASE VALVE MANHOLE
NO SCALE

AIR RELEASE VALVE MANHOLE

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

EXHIBIT A

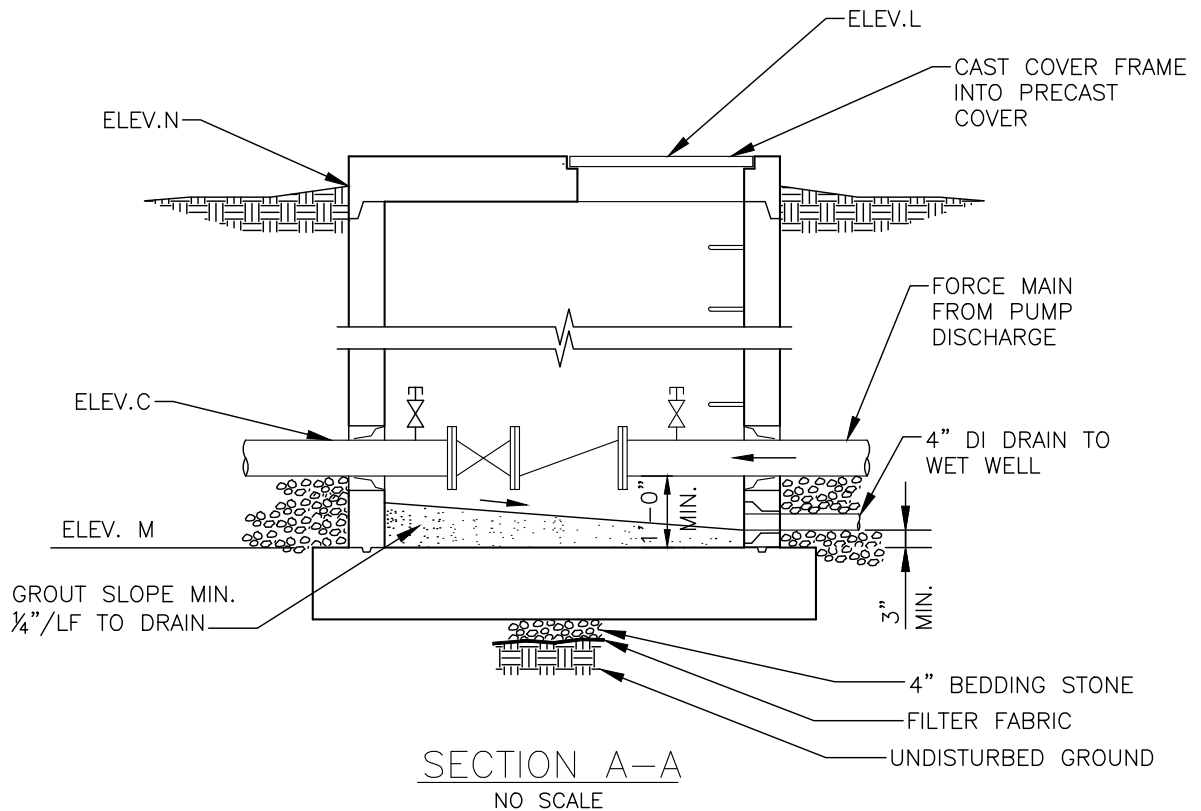
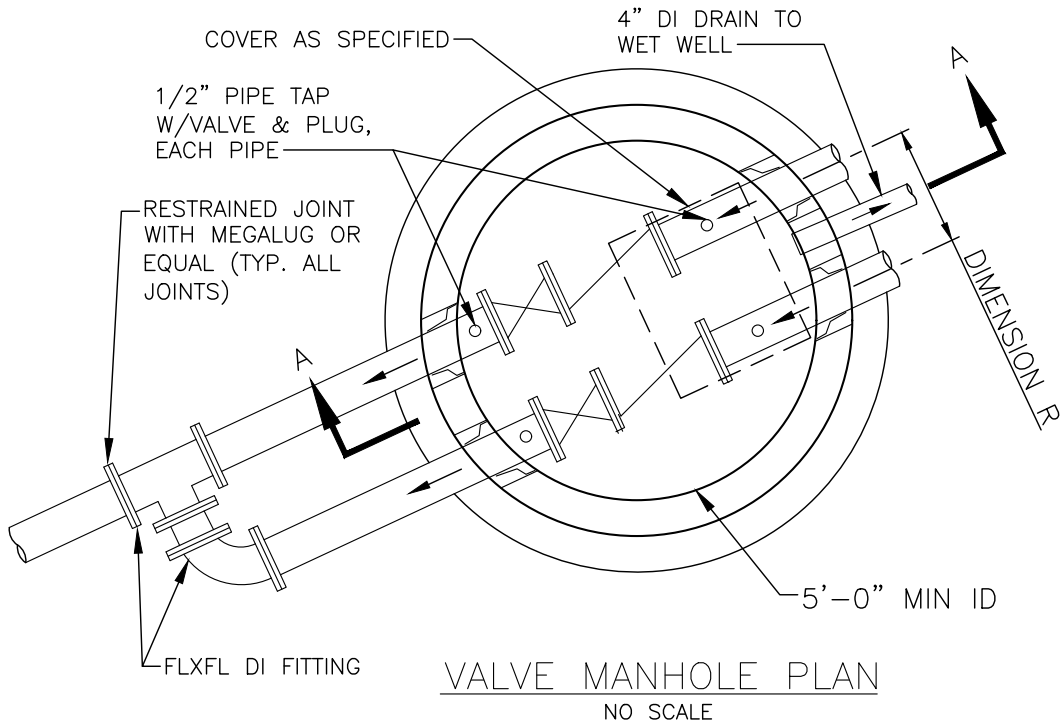


LIFT STATION WET WELL DETAIL

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

WW-11

EXHIBIT A



LIFT STATION VALVE MANHOLE DETAIL

**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

WW-12

EXHIBIT A

PUMPING STATION ELEVATIONS*

TAG	DESCRIPTION	VALUE
A	FLOOR ELEV. OF WETWELL	-----
B	INVERT ELEV. OF SEWER(S)	-----
C	CROWN ELEV. OF FORCE MAIN	-----
D	ELEV. OF TOP OF SLAB	-----
E	ELEV. OF TOP OF ACCESS DOOR	-----
F	ELEV. OF FINISHED GRADE AT P.S.	-----
G	COMMON PUMPS OFF	-----
H	LEAD PUMP ON	-----
I	LAG PUMP 1 ON	-----
J	HIGH WATER ALARM	-----
K	LOW WATER ALARM	-----
L	ELEV. OF VALVE VAULT	-----
M	FLOOR ELEV. OF VALVE VAULT	-----
N	ELEV. OF FINISHED GRADE AT VALVE VAULT	-----
O	BOTTOM INLET TYPICAL ALL PIPES	-----
P	4" DRAIN FROM VALVE VAULT	-----
	WET WELL INTERIOR DIAMETER (MIN.)	-----
	VALVE VAULT INTERIOR DIAMETER (MIN.)	-----
	FORCE MAIN DIAMETER (INCHES)	-----
Q	DIMENSION \varnothing TO \varnothing OF PUMPS	-----
R	DIMENSION \varnothing TO \varnothing OF VALVES	-----

* TO BE FILLED IN TO MATCH PROJECT

LIFT STATION ELEVATIONS

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

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EXHIBIT A

GENERAL NOTES:

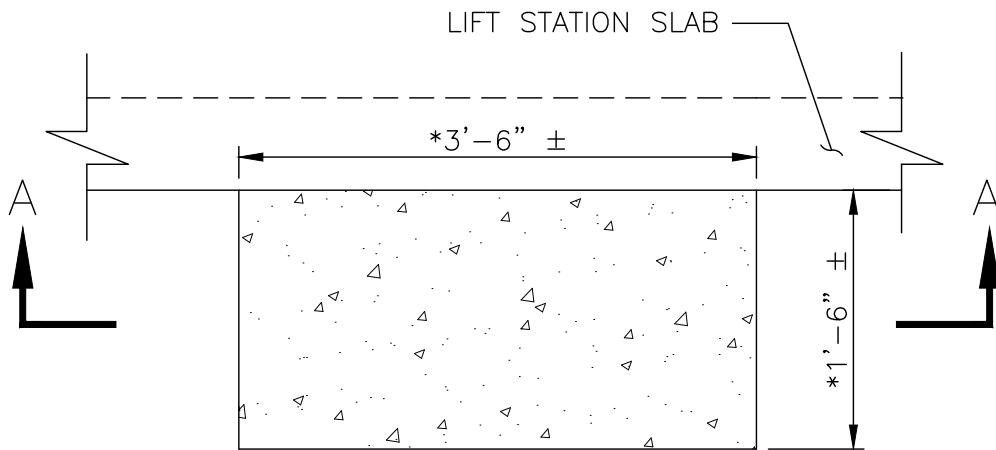
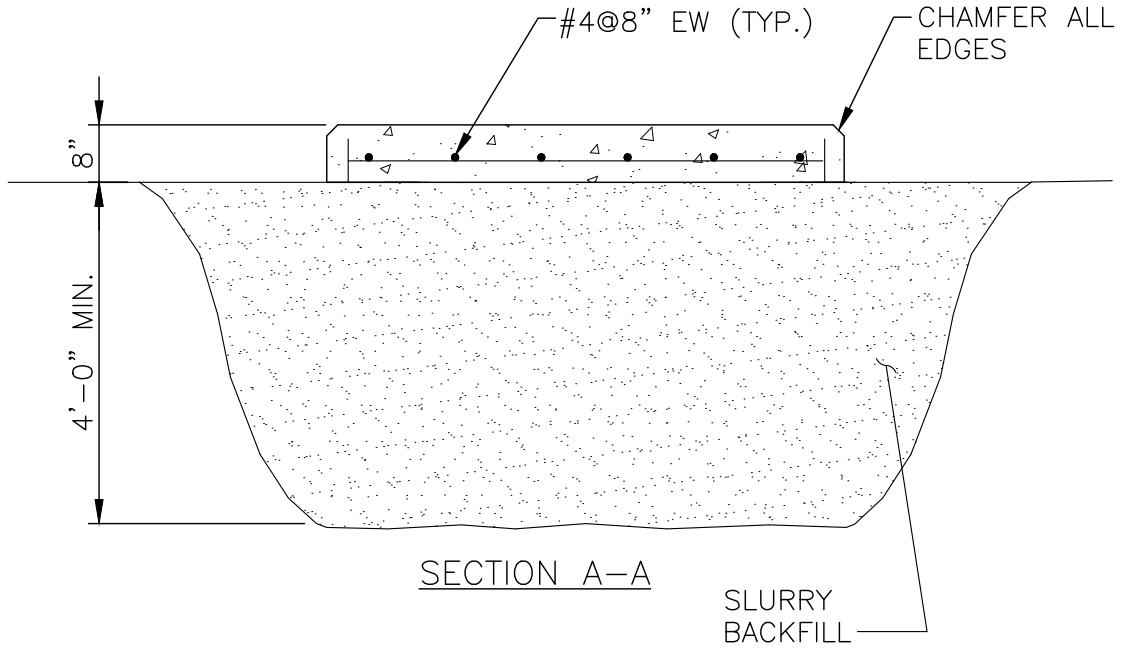
1. DRAWINGS OF PUMPING STATION PIPING, PUMPS AND COVERS ARE DETAILED USING FLYGT EQUIPMENT.
2. ALL JOINTS IN PRECAST STRUCTURES SHALL BE MADE WITH "RAM-NEK", "KENT-SEAL", "MAS-STIK" OR EQUAL JOINT MATERIAL, OR ASTM C-443 CIRCULAR O-RING GASKET.
3. OPENINGS IN NEW PRECAST STRUCTURES SHALL BE PROVIDED BY SUPPLIER AT THE FACTORY.
4. GRAVITY SEWER PIPE OPENINGS INTO WET WELL SHALL BE SEALED USING FLEXIBLE, WATERTIGHT CONNECTIONS SUCH AS "A-LOK", "KOR-N-SEAL" OR EQUAL. ALL FORCE MAIN AND OTHER OPENINGS INTO WET WELL AND VALVE VAULT SHALL BE GROUTED WATERTIGHT WITH HYDRAULIC CEMENT OR MAY BE SEALED WITH "A-LOK" OR "KOR-N-SEAL" CONNECTORS. PROVIDE RUBBER WATERSTOPS ON ALL PIPES THROUGH WET WELL AND VALVE VAULT WALLS SEALED WITH HYDRAULIC CEMENT.
5. STAINLESS STEEL CABLE OR CHAIN FOR HOISTING PUMPS SHALL BE FASTENED TO PRECAST COVER LID PER SPECIFICATIONS.
6. PROVIDE 1/2" TAPS, BALL VALVES AND REMOVABLE PIPE END CAP AS SHOWN FOR PRESSURE GAGE CONNECTIONS.
7. STATION PIPING, FITTINGS, AND VALVES SHALL BE AWWA C151 DUCTILE IRON, SPECIAL THICKNESS CLASS 53, CONFORMING TO SPECIFICATIONS.
8. CONTRACTOR INSTALLING PUMPS SHALL CHECK ALIGNMENT OF PUMPS AND GUIDE BARS WITH CASTINGS BEFORE ASSEMBLY TO ALLOW PROPER REMOVAL OF PUMPS.
9. PRECAST COVER OR ACCESS DOOR SHALL CONFORM TO ASTM C-478, REINFORCING SHALL BE FOR H-20 LOADING. EXACT DIMENSIONS AND POSITION OF PUMP ACCESS HOLE IN TOP SLAB SHALL BE AS PROVIDED BY PUMP MANUFACTURER TO ALLOW PROPER POSITIONING OF GUIDE RAILS AND UNRESTRICTED REMOVAL OF PUMPS.
10. ALL ANCHORS, BOLTS AND FABRICATED METAL WITHIN WET WELL SHALL BE STAINLESS STEEL.
11. SEE SPECIFICATIONS FOR CONDUIT, FITTINGS, AND INSTALLATION REQUIREMENTS OF ELECTRICAL WORK BETWEEN WET WELL AND MOTOR CONTROL PANEL. ALL ELECTRICAL WORK AND EQUIPMENT IN WETWELL SHALL BE RATED FOR A CLASS 1, DIVISION 1, GROUP D LOCATION.
12. BASE SLAB SHALL BE DESIGNED FOR BUOYANT FORCE ASSUMING GROUNDWATER LEVEL AT GRADE AND THE STRUCTURE EMPTY. CONTRACTOR MAY PROVIDE CAST-IN-PLACE SLABS INSTEAD OF PRECAST. IF CAST-IN-PLACE ARE USED, CONTRACTOR SHALL SUBMIT DESIGN CALCULATIONS. USE OF CAST-IN-PLACE SLAB SHALL NOT RELIEVE CONTRACTOR OF REQUIREMENT TO PROVIDE WATERTIGHT JOINTS.
13. CONTRACTOR SHALL FURNISH ALL PIPING AND FITTINGS REQUIRED TO COMPLETE THE INSTALLATION.

LIFT STATION GENERAL NOTES

**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

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EXHIBIT A



*SLAB DIMENSIONS SHALL BE
VERIFIED WITH CONTROL PANEL
MANUFACTURER

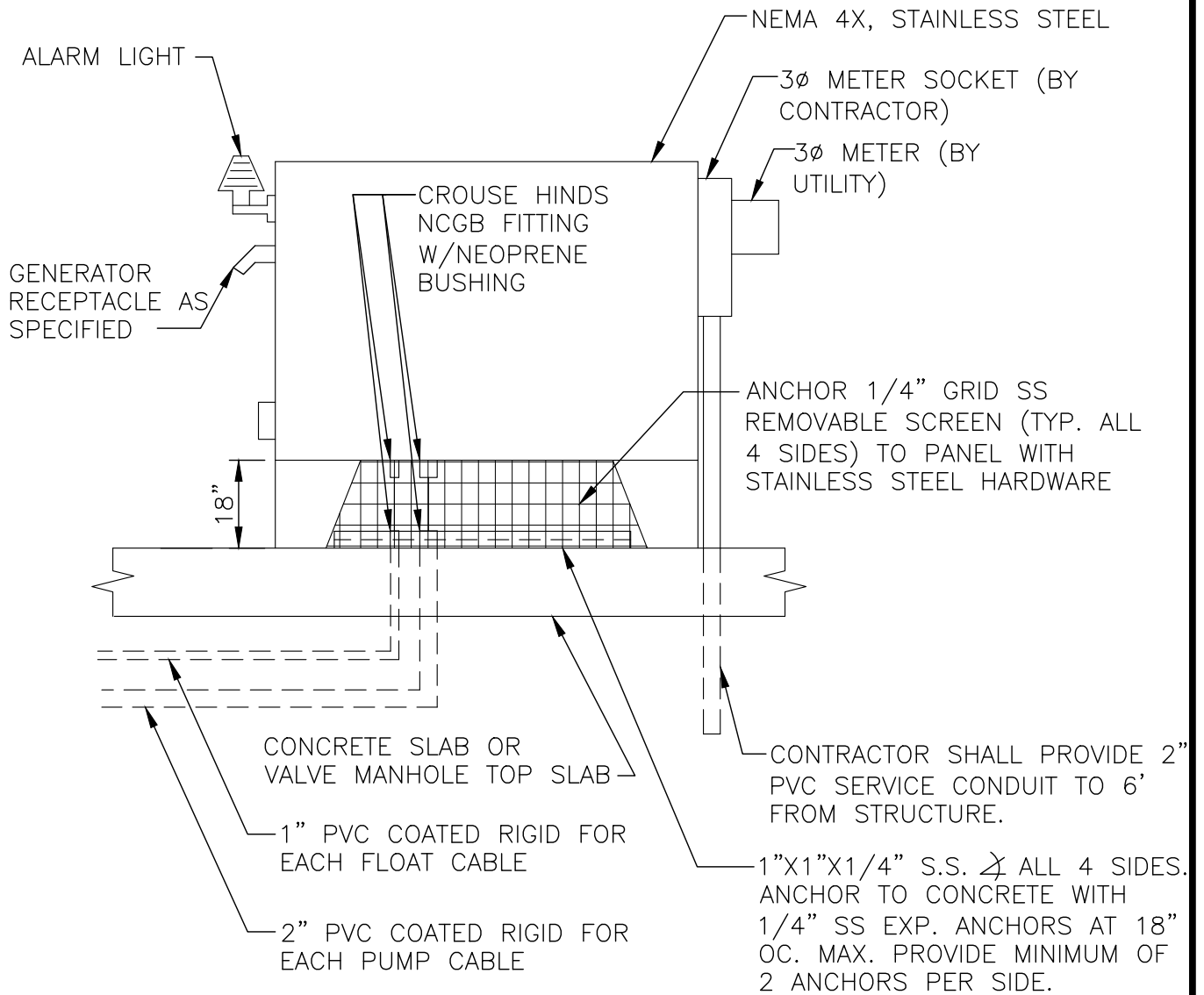
CONTROL PANEL SLAB
NO SCALE

LIFT STATION CONTROL PANEL SLAB DETAIL

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

WW-15

EXHIBIT A



PUMPING STATION CONTROL PANEL (TYP)
NO SCALE

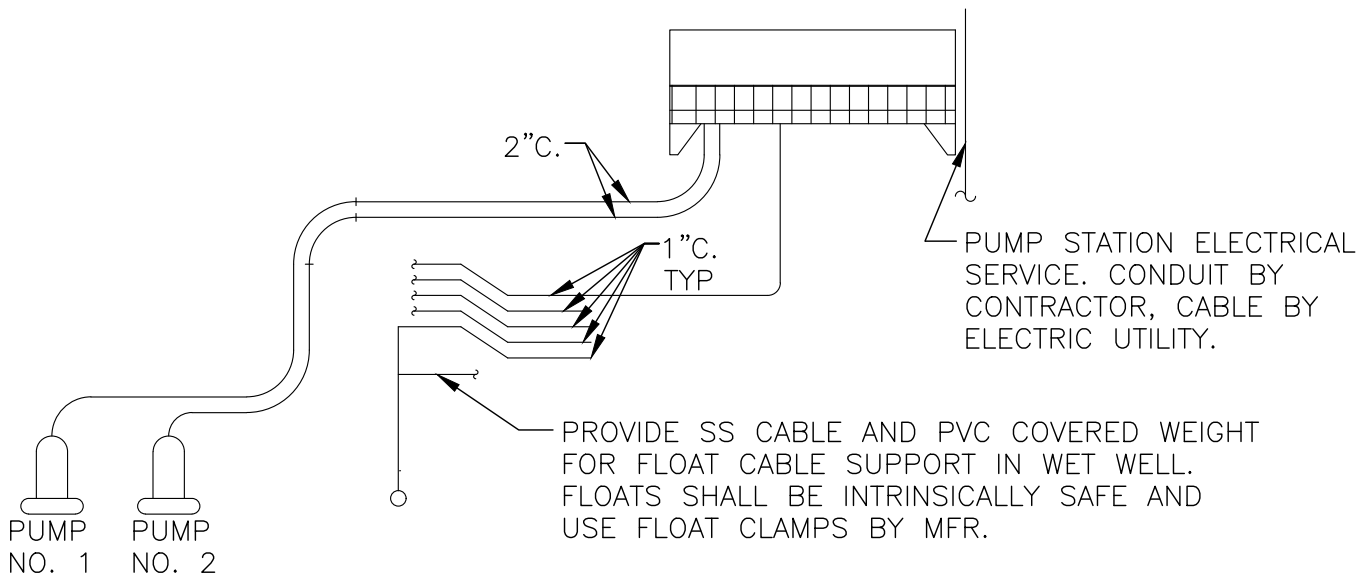
LIFT STATION CONTROL PANEL DETAIL

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

WW-16

EXHIBIT A

File: S:\COL\4000--4099\4054\052\Drawings\CAD\Standard Details\Wastewater Details\Pumping Station Riser.dwg Time: Dec 01, 2023 -- 2:27pm



PUMPING STATION RISER (TYP)
NO SCALE

ELECTRICAL SCHEDULE*				
PUMP	PUMP H.P.	STARTER SIZE	CABLE/CONDUIT	SERVICE
PUMP NO. 1	----	---	#-- -----	----
PUMP NO. 2	----	---	#-- -----	----

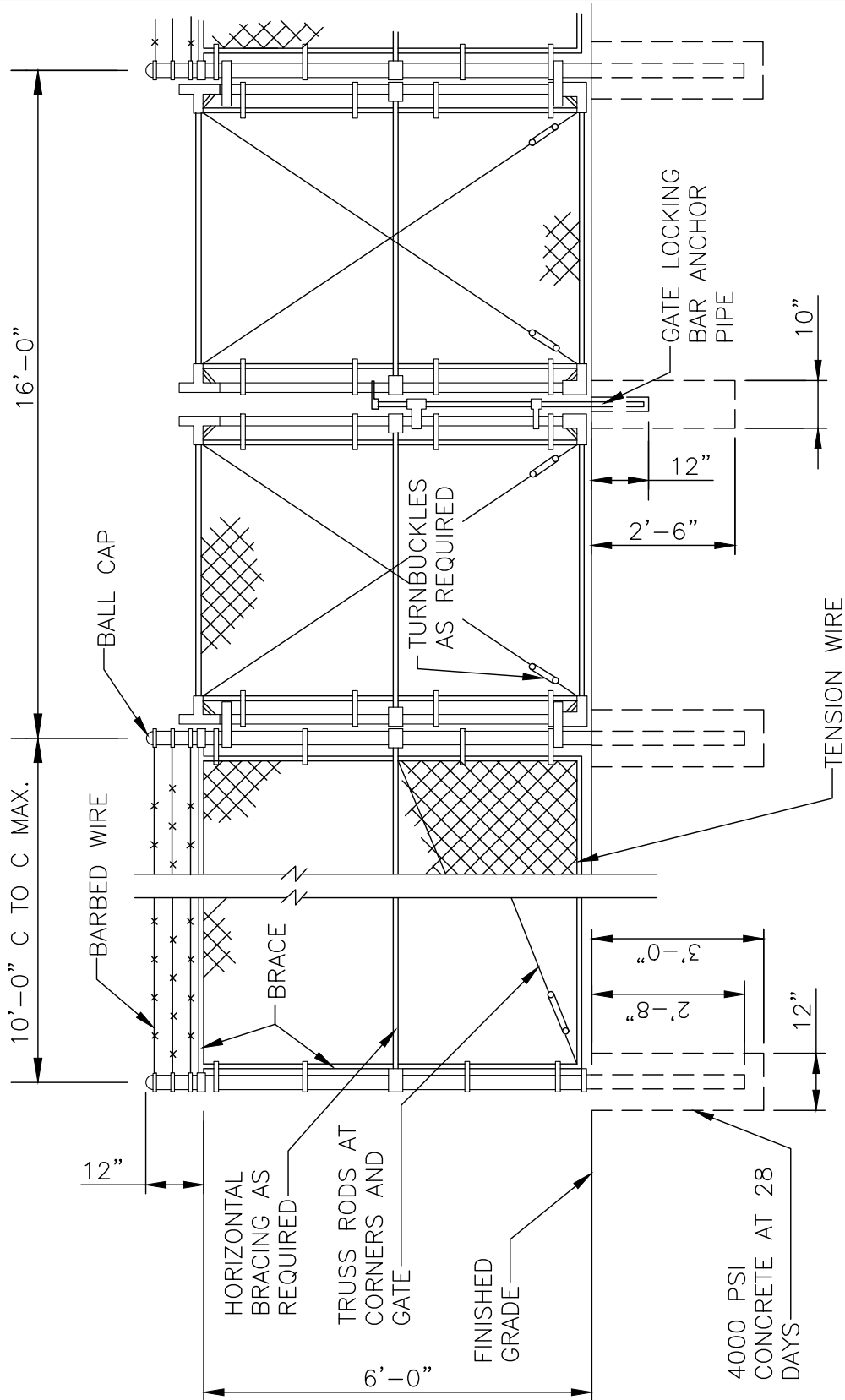
* TO BE FILLED IN TO MATCH PROJECT

LIFT STATION RISER DETAIL

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

EXHIBIT A

File: S:\COL\4000--4099\4054\052\Drawings\CAD\Standard Details\Wastewater Details\Chain Link Fence and Swing Gate.dwg Time: Dec 01, 2023 -- 2:27pm



CHAIN LINK FENCE AND SWING GATE

NO SCALE

CHAIN LINK FENCE AND SWING GATE DETAIL

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

WW-18

EXHIBIT A

EXHIBIT A

4.01 DESIGN STANDARDS

A. General

All stormwater standards shall comply with the City's Stormwater Ordinance and the City Stormwater Technical Standards Manual.

B. In Relation to Water Mains

Storm sewer placement in relation to water mains shall conform to the Ten State standards for Water Works.

C. Contractor's Organization

1. The contractor shall have a competent supervisor on the site during the progress of the Work, acting for the contractor in all matters concerning the Work. The supervisor shall have the authority to receive directions and act upon them for the City through the City's representative.
2. The contractor shall keep a set of drawings and specifications available on-site and in good condition.

5.02 CONSTRUCTION SPECIFICATIONS

A. Materials

1. Piping

Pipe and fittings shall conform to the City's Stormwater Technical Standards Manual. Other materials not specified may be used only when specifically authorized by the City.

2. Manholes and Inlets

Materials, types, construction, and sizing of storm sewer manholes and inlets shall conform to Section 720 of the ISS and Division 700 of the INDOT standard drawings.

3. Channel Lining

Acceptable materials used for channel lining are listed in Chapter 5 of the City's Stormwater Technical Standards Manual.

4. Post Construction Best Management Practices (BMPs)

Post construction BMPs shall conform to the City's Stormwater Technical Standards Manual.

EXHIBIT A

5. Temporary Erosion Control Measures

Temporary erosion control measures shall conform to the City's Stormwater Technical Standards Manual.

B. Installation

1. Piping

- a. Piping shall be installed according to Chapter 4 of the City's Stormwater Technical Standards Manual.
- b. For piping requiring street cuts, see Detail R-9 "Standard Street Cut Repair Detail" and Detail R-10 "Winter Street Cut Repair Detail" in Section 6–Roads and Streets. For all other piping, see Chapter 4 of the City's Stormwater Technical Standards Manual.

2. Manholes and Inlets

Manholes and inlets shall be installed according to Chapter 4 of the City's Stormwater Technical Standards Manual.

3. Channel Lining

Installation of the channel lining materials shall conform to the latest edition of the ISS.

4. Post Construction BMPs

Installation of post construction BMPs shall conform to Chapter 8 of the City's Technical Standards Manual.

5. Temporary Erosion Control Measures

See BMP details in Appendix B3 of the City's Technical Standards Manual.

EXHIBIT A

EXHIBIT A

5.01 DESIGN STANDARDS

A. General

1. This section covers all Work involved in the installation of new pavement, walks, and curbs, and the repair and replacement of existing streets, roads, highways, drives, parking areas, curbs, gutters, sidewalks, and other paved areas damaged or destroyed during construction of the Work.
2. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the reference thereto. Except as specifically modified in this specification, paving, and surfacing operations, materials, and testing will comply with the most current version of applicable sections of the INDOT Standard Specifications.

B. Maintaining Traffic

1. Before shutting down any public street, the contractor shall notify and obtain the necessary permits from the state, county, or city.
2. The contractor shall notify the City of the intention to close 72 hours in advance of the proposed closing. The contractor is responsible for proper signage and barricades before the closing. Traffic control devices and methods to be used on public roadways shall conform to the Federal Highway Administration's (FHWA) Manual on Uniform Traffic Devices (MUTCD), the Indiana MUTCD, and applicable INDOT Standard Drawings.
3. The contractor is responsible for the safety of pedestrian and vehicular traffic in or adjacent to the construction area at all times. The contractor shall furnish and maintain all traffic control devices in accordance with the Indiana MUTCD and the INDOT standard drawings, Division 800. Traffic control devices must be in good condition.
4. The contractor shall conduct Work in such a manner as to not unnecessarily restrict normal traffic through public streets. When possible, do not obstruct roads, alleys, or streets with equipment, excavated material, or material used in construction. If required by the City, the contractor shall, at its own expense, construct bridges or other temporary crossing structures over trenches to not restrict traffic flow. The temporary structures shall be of adequate strength and will be maintained by the contractor to prevent traffic hazards. Private driveways shall not be closed, unless necessary. The City shall be notified in advance when the contractor plans to close a private driveway. The driveway shall be reopened at the earliest opportunity. The contractor shall be liable for any damage to persons or property resulting from this Work.
5. Streets where excavation has occurred shall be temporarily restored to receive traffic as soon as possible. Permission to close additional streets shall be denied if, in the opinion of the City, the restoration on streets where excavation has occurred has not progressed satisfactorily.

EXHIBIT A

C. Quality Assurance

1. Unless otherwise noted, the contractor shall hire the services of an independent testing laboratory to perform necessary field density tests. The contractor shall demonstrate to the City that proper compaction has been obtained and proper asphalt and concrete mix designs are compliant with the ISS.
2. Before placing any HMA pavement or PCCP, the Contractor shall provide the City the name and location of the HMA mixing plant or concrete mixing plant and composition of mixes the Contractor proposes to use in the Work.
3. Paving and surfacing shall comply with the tolerances specified in ISS Sections 401 for HMA and 501 for PCCP.
4. Asphalt and concrete pavement shall be installed by a contractor whose primary business is asphalt or concrete paving.

D. Submittals

Submittals shall be as specified in ISS Sections 401 for HMA and 505 for PCCP.

E. Contractor's Organization

1. The contractor shall have a competent supervisor on-site during the progress of the Work, acting for the contractor in all matters concerning the Work. The supervisor shall have the authority to receive directions and act upon them for the City through the City's representative.
2. The contractor shall keep a set of drawings and specifications available on-site and in good condition.

F. Street Lighting

1. All subdivisions that include new streets shall provide street lighting at each access point to the existing street network, at each street intersection within the subdivision, and along each subdivision street at a maximum spacing of 250 feet placed along one side or alternating sides.
2. Each required streetlight shall be a full cutoff fixture.
3. In dwelling and mixed-use districts, each required street light fixture shall have a color rendering index (CRI) of 70 or higher.
4. All street light fixtures shall produce at least 80 lumens per watt of energy consumed, as documented by manufacturer's specifications of the results of an independent testing laboratory.

EXHIBIT A

5. All streetlights and poles to be installed on public roadways shall be of the current supplied by the applicable electrical utility (Duke Energy or Decatur County REMC).
6. Street lighting for collector and arterial roadways shall be illuminated to the recommended levels in accordance with ANSI/IES RP-8-21 lighting design criteria.
7. The following types of lighting are not subject to the requirements of this section.
 - a. Lighting of public monuments and statuary
 - b. Lighting required and regulated by the Federal Aviation Administration (FAA), another agency of the state, or federal government with authority to regulate that type of lighting
 - c. Temporary lighting for emergency or nighttime work and construction.
 - d. Temporary lighting for theatrical, television, and performance areas, or for special public events
 - e. Lighting for a special area designated for special lighting standards in an adopted plan or ordinance
 - f. Temporary decorative seasonal lighting

5.02 CONSTRUCTION SPECIFICATIONS

A. Materials

1. All aggregate materials shall meet the requirements of ISS Section 904.
2. All asphalt materials shall meet the requirements of ISS Section 902.
3. All PCCP materials shall meet the requirements of ISS Section 901.
4. Joint fillers and sealers shall meet the requirements of ISS Section 906.
5. Reinforcement bars and dowel bars shall meet the requirements of ISS Section 910.
6. Concrete base shall meet the requirements of ISS Section 305.
7. Reinforced concrete for sidewalks and steps shall meet the requirements of ISS Section 604.
8. Reinforced concrete for curbing shall meet the requirements of ISS Section 605.
9. Subgrade material and testing shall conform to ISS Section 207.

EXHIBIT A

10. Flowable backfill shall meet the requirements of Section 213.
11. Underdrains shall meet the requirements of with ISS Section 715.

B. Execution

1. General

- a. The contractor shall be responsible for providing equipment, labor, and materials required to finish the Work specified.
- b. Use compaction equipment suitable to the material placed. Compacting equipment shall be capable of providing a smooth, even surface on the pavement course.
- c. Before placing paving and surfacing materials, shape the subgrade (as required) to produce finished pavement grades and cross sections as shown on the drawings.
- d. Do not place the paving and surfacing material before the subgrade is reviewed and accepted by the City.
- e. Compact the subgrade in accordance with ISS Section 203.23
- f. Provide positive drainage at all times to prevent water from standing on subgrade, pavement or walks.

2. Site Conditions

- a. Do not place the paving and surfacing on a wet surface, pumping subbase, or when weather conditions would prevent the proper construction of paving and surfacing.
- b. Do not place the aggregate on frozen subgrade or when the air temperature is led than 35°F.
- c. HMA courses are to be placed in accordance with Section 401 of the ISS.
- d. PCCP shall be placed in accordance with Section 501 of the ISS.
- e. Do not place the paving and surfacing material when natural light is not sufficient to properly observe Work

EXHIBIT A

3. Adjusting Existing Structures to Grade
 - a. When the grade adjustment of the existing structures is required, the manhole frames, covers, and grating shall be removed and reconstructed to grade as required. The same shall be done for gas and water valve boxes and covers.
 - b. For resurfacing Work, the castings and boxes shall be adjusted to grade after the last intermediate course has been laid and before placing the surface course.
 - c. All castings, frames and valve boxes adjusted to grade shall be installed completely in advance of the final paving.
4. Curbs
 - a. Roll curb is permitted for internal subdivision streets only. Public thoroughfares shall be bordered by combined concrete curb and gutter.
 - b. See INDOT Standard Drawings in E 605-CCCG for combined concrete curb and gutter details.
 - c. See INDOT Standard Drawings in E-605-CCSJ for rolled curb details.
 - d. Sloping concrete curb and gutter shall only be used at the approval of the City.
 - e. The construction of curbs, combination curb and gutter, and integral curb shall be in accordance with ISS Section 605 and as shown on the drawings and shall be reasonably close to conformance with the lines and grades shown on the plans.
 - f. If existing curb is to be removed and replaced with new curb, the existing curb shall be removed to the nearest joint of suitable existing curb.
5. Subgrade treatments shall meet the requirements of ISS Section 207. Subgrade Treatment Types III and V shall not be used on public roadways.
6. Aggregate base, pavements, and shoulders shall comply with all requirements of ISS Section 301.
7. HMA
 - a. This Work shall include the construction of one or more courses of HMA base, intermediate, and wedge leveling or surface mixtures on a prepared foundation in accordance with these specifications and in reasonably close conformance with the lines, grades, thickness, and typical cross sections shown on the drawings or established by the City.

EXHIBIT A

- (1) If the required finish depth of any course is to exceed three times the top size of the aggregate used as shown by actual screen analysis, the course shall be constructed in two or more lifts, as directed.
 - (2) Mix type shall be as indicated on the drawings, without exception, unless otherwise approved in writing by the City. Job mix formulas shall be prepared and submitted for approval to the City, in accordance with ISS 402.
 - (3) Materials and construction requirements shall conform to ISS Division 400.
 - b. Tack coat shall be placed on the existing asphalt pavement or concrete surfaces before a new lift of HMA material is added. Tack coat shall be placed in accordance with ISS Section 406.
8. PCCP
 - a. PCCP shall consist of subbase for PCCP and unreinforced PCCP surface, as shown on the drawings.
 - (1) Subbase for PCCP shall be in accordance with ISS Section 302.
 - (2) Pavement cross-section shall be as shown on the drawings.
 - b. PCCP operations and materials shall be in accordance with ISS Division 500, unless otherwise specified by the City.
9. Sidewalks
 - a. Sidewalks shall consist of 4-inch thick (minimum) nonreinforced PCCP on a prepared natural subgrade. If unsuitable subsurface soils are found, they should be removed and replaced in accordance with ISS Section 203.
 - b. Accessible pedestrian ramps shall be installed at all street intersections. Ramps shall meet Public Right-of-Way Accessibility Guidelines and shall comply with the INDOT Standard Drawings in E 604-SWCR.
 - c. Sidewalks and curb ramp materials and installation shall be in accordance with ISS Section 604.
 - d. If existing sidewalk is to be removed and replaced with new sidewalk, the existing sidewalk shall be removed to the nearest joint of suitable quality or as directed by the City's representative.
 - e. Sidewalks shall conform to the INDOT Standard Drawing series E 604-SDWK.

EXHIBIT A

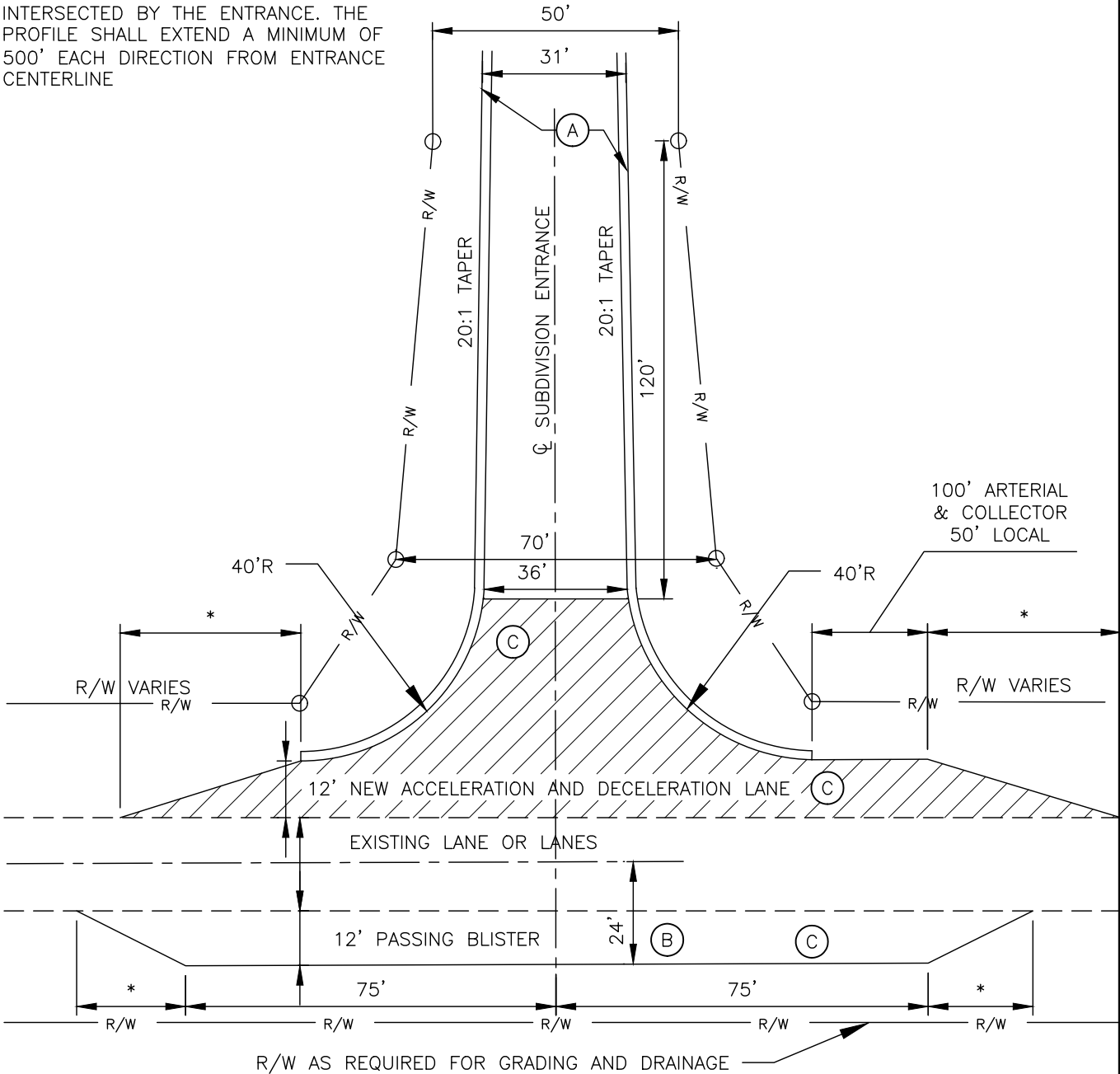
- f. Multiuse HMA paths shall conform to the INDOT Standard Drawings in E-604-NVUF.
- 10. Lane Striping
 - a. Lane striping shall be in accordance with ISS Section 807 and the construction plans.
 - b. The contractor will not permit traffic on any new pavement surface before striping.
 - c. Contractor will clean the new pavement surface to remove all dust, dirt, mud, and debris before striping.
- 11. Protection
 - a. Maintain compacted aggregate subbase and surface true to line and grade and required density. Maintain surface until job is complete.
 - b. Do not permit vehicular traffic of any kind on any asphalt course until the asphalt mixture has hardened sufficiently so as to not distorted beyond specified tolerances. Remove any foreign material that is on the surface of any course before the course is rolled or any subsequent course is placed.
 - c. Do not permit traffic on the concrete pavement or walks until strength requirements are met.
 - d. The contractor shall repair or replace damaged pavement and walks to the satisfaction of the City.
- 12. Cleanup procedure shall be in accordance with Section 104 of the ISS.

5.03 STANDARD DRAWINGS

EXHIBIT A

NOTE:
CONSTRUCTION PLANS SHALL INCLUDE
CENTERLINE PROFILE
OF THE EXISTING ROAD BEING
INTERSECTED BY THE ENTRANCE. THE
PROFILE SHALL EXTEND A MINIMUM OF
500' EACH DIRECTION FROM ENTRANCE
CENTERLINE

NOT TO SCALE



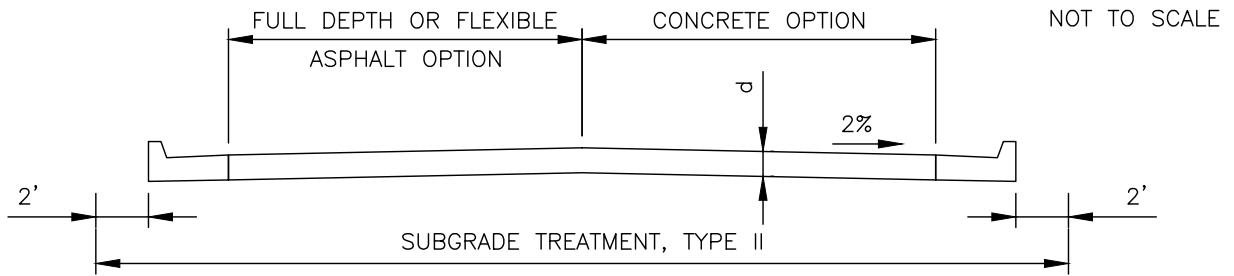
- (A) COMBINED CONCRETE CURB AND GUTTER
- (B) PASSING BLISTER WHEN REQUIRED
- (C) LANE WIDENING SHALL MATCH EXIST. PAVEMENT SURFACE TYPE

* 150' ARTERIAL
100' COLLECTOR
75' LOCAL

**MINIMUM RESIDENTIAL SUBDIVISION ENTRANCE
FROM A THOROUGHFARE**

**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

EXHIBIT A



LOCAL STREETS

$d = 12"$ ASPHALT SECTION
W/AGGREGATE BASE

- ① 165 #/SY HMA, SURFACE, TYPE C
- ② 275 #/SY HMA, INTERMEDIATE, TYPE C
- ③ 8" COMPACTED AGGREGATE
NO. 53 (2-LIFTS)

$d = 9"$ FULL DEPTH ASPHALT

- ① 165 #/SY HMA, SURFACE, TYPE C
- ② 275 #/SY HMA, INTERMEDIATE, TYPE C
- ③ 550 #/SY HMA, BASE, TYPE C

$d = 6"$ PCCP

COLLECTOR STREETS

$d = 16"$ ASPHALT SECTION
W/AGGREGATE BASE

- ① 165 #/SY HMA, SURFACE, TYPE C
- ② 275 #/SY HMA, INTERMEDIATE, TYPE C
- ③ 12" COMPACTED AGGREGATE
NO. 53 (2-LIFTS)

$d = 11"$ FULL DEPTH ASPHALT

- ① 165 #/SY HMA, SURFACE, TYPE C
- ② 275 #/SY HMA, INTERMEDIATE, TYPE C
- ③ 770 #/SY HMA, BASE, TYPE C

$d = 7"$ PCCP

PRIMARY AND SECONDARY ARTERIAL STREETS

WORK ON ARTERIAL ROADWAYS SHALL REQUIRE A PROFESSIONAL GEOTECHNICAL REPORT AND PAVEMENT DESIGN BY AN INDOT PRE-QUALIFIED PAVEMENT DESIGNER.

GENERAL NOTES:

1. CONCRETE PAVEMENT SHALL BE PLACED ON SUBBASE FOR PCCP.
2. DEPTH OF CONCRETE CURB SHALL EQUAL DEPTH OF CONCRETE PAVEMENT.

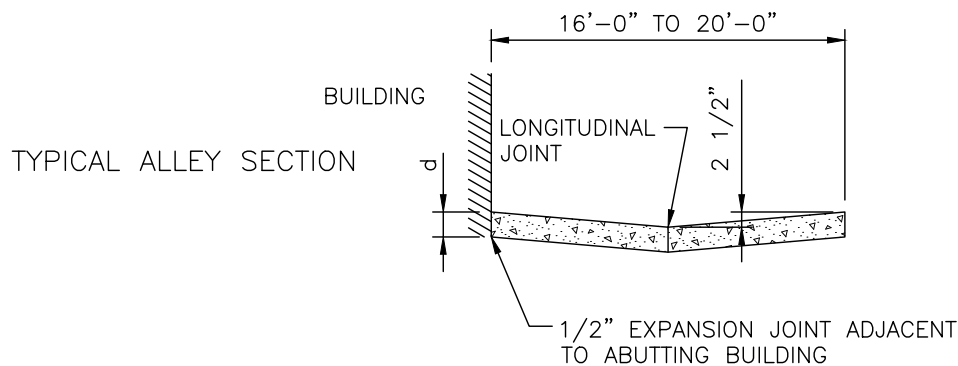
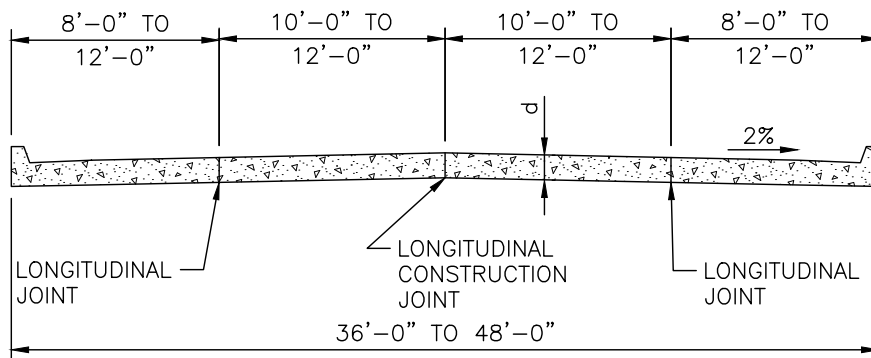
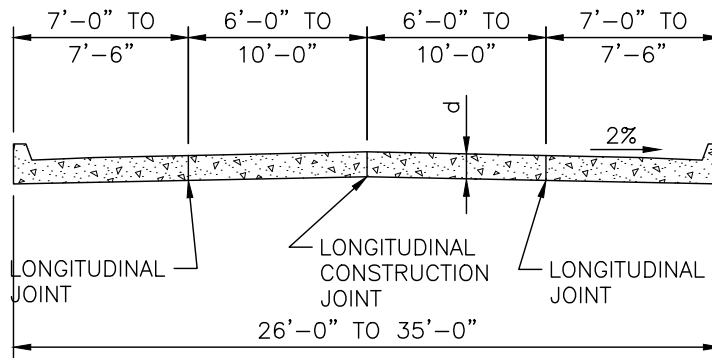
TYPICAL PAVEMENT SECTIONS 1

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

R-2

EXHIBIT A

NOT TO SCALE



NOTE:

1. ALL JOINTS SHALL CONFORM TO INDOT STANDARD DETAILS E 503-CCPJ

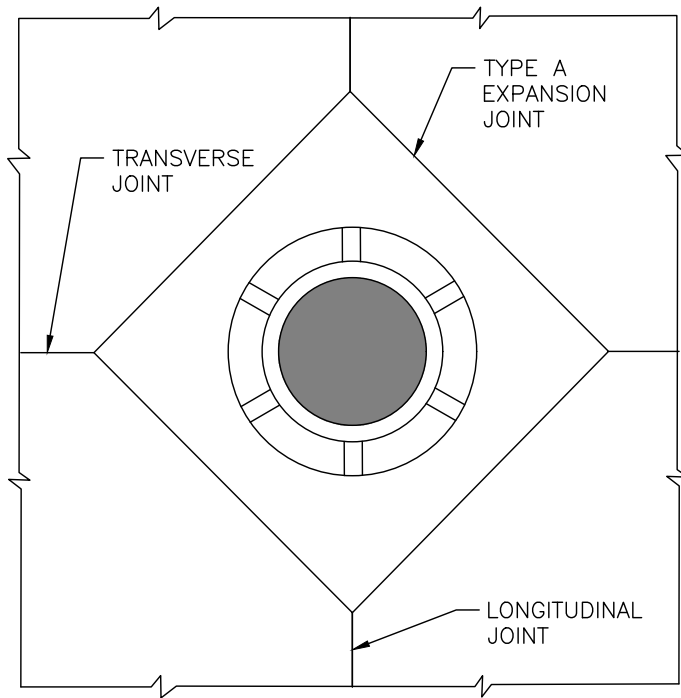
TYPICAL PAVEMENT SECTIONS - JOINT LOCATIONS

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

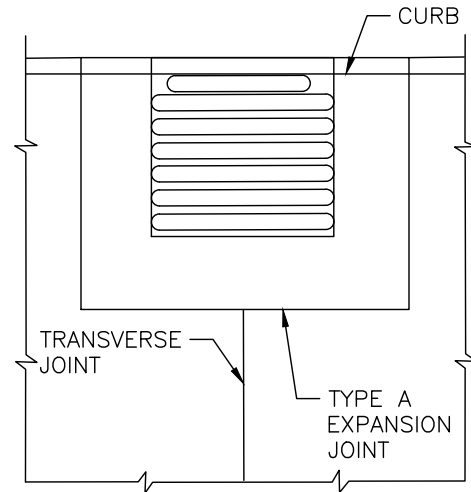
R-3

EXHIBIT A

NOT TO SCALE



MANHOLE BOXOUT



CATCH BASIN BOXOUT

NOTES:

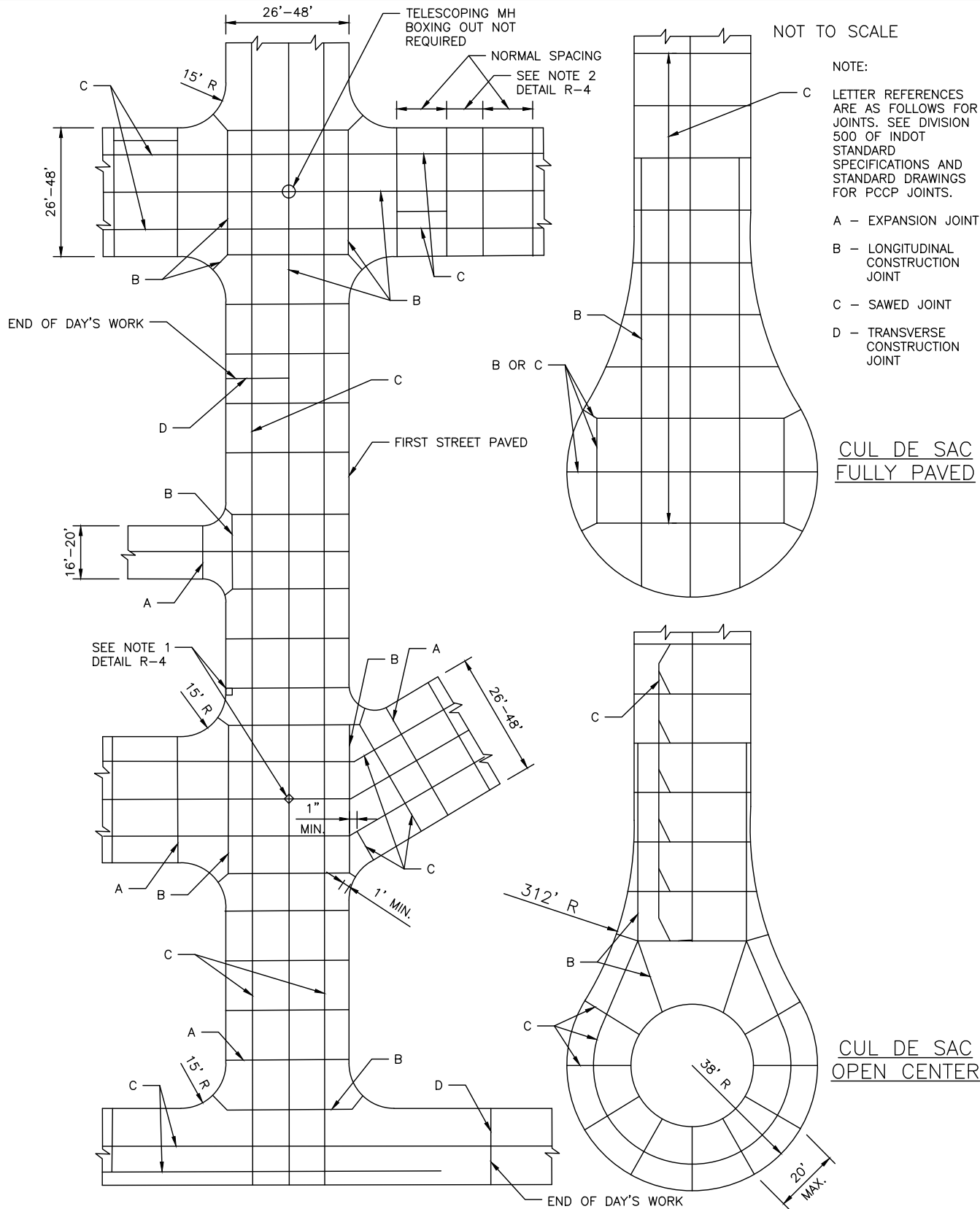
1. ALL CATCH BASINS SHALL BE SEPARATED FROM THE PAVEMENT AND CURB BY BOXING OUT AROUND BASIN AS SHOWN ABOVE. EXPANSION JOINT MATERIAL SHALL EXTEND COMPLETELY THROUGH CURB AND SLAB. MANHOLE CASTINGS WITHIN THE PAVEMENT LIMITS SHALL BE BOXED IN LIKE MANNER EXCEPT WHEN TELESCOPING-TYPE CASTINGS ARE USED.
2. WHEN A JOINT FALLS WITHIN 5 FT. OF OR CONTACTS BASINS, MANHOLES, OR OTHER STRUCTURES, SHORTEN ONE OR MORE PANELS EITHER SIDE OF OPENING TO PERMIT JOINT TO FALL ON ROUND STRUCTURES AND AT OR BETWEEN CORNERS OF RECTANGULAR STRUCTURES.

STRUCTURE JOINTING DETAILS

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

R-4

EXHIBIT A

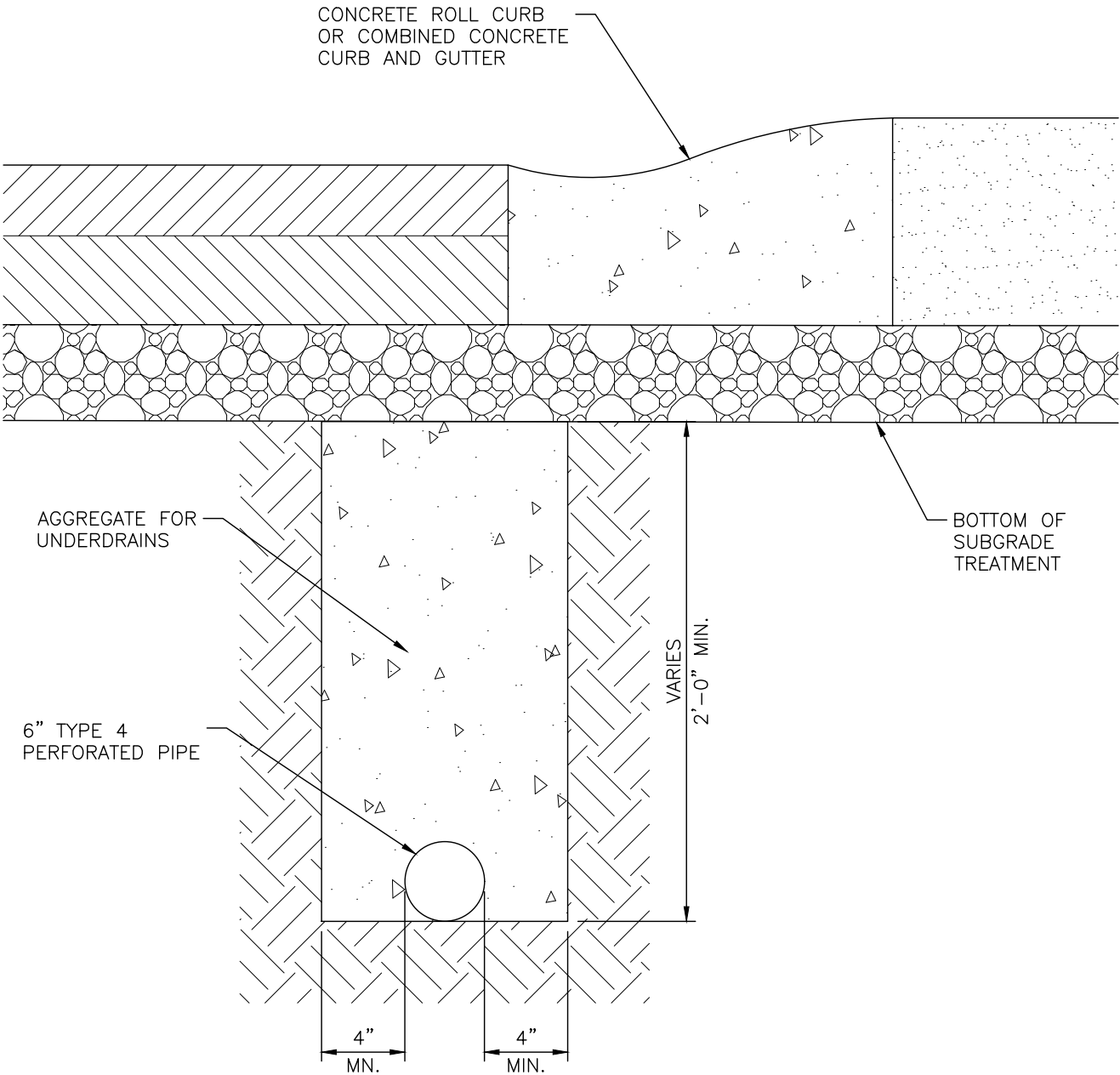


JOINT LOCATIONS

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

EXHIBIT A

NOT TO SCALE



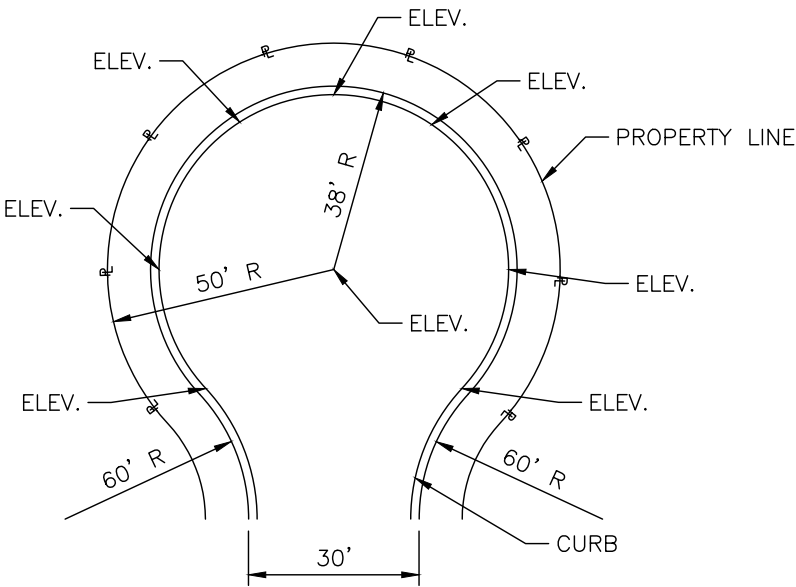
NOTE: MATERIALS AND INSTALLATION SHALL MEET THE INDOT STANDARD AS SPECIFIED IN SECTION 718 "UNDERDRAINS".

PIPE UNDERDRAIN DETAIL

**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

EXHIBIT A

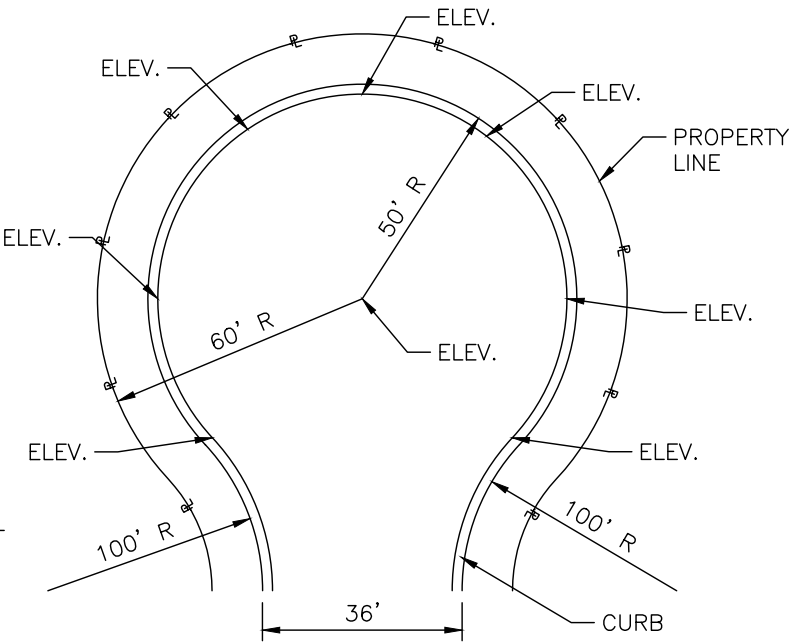
NOT TO SCALE



TYPE-1

GENERAL NOTES:

1. TYPE-1 SHALL BE USED ONLY IN RESIDENTIAL SUBDIVISIONS; ALL OTHER USE TYPE-2.
2. WARNING SIGNS SHALL BE POSTED AT ENTRANCE TO STREET, INDICATING NO OUTLET.
3. DETAIL SHALL BE IDENTIFIED BY STREET NAME.
4. ELEVATIONS PROVIDED SHALL BE PROPOSED FLOW LINE OF GUTTER.
5. ONE DETAIL SHALL BE PROVIDED FOR EACH CUL-DE-SAC.
6. SCALE SHALL BE 1"=40' OR LARGER.



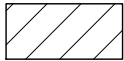
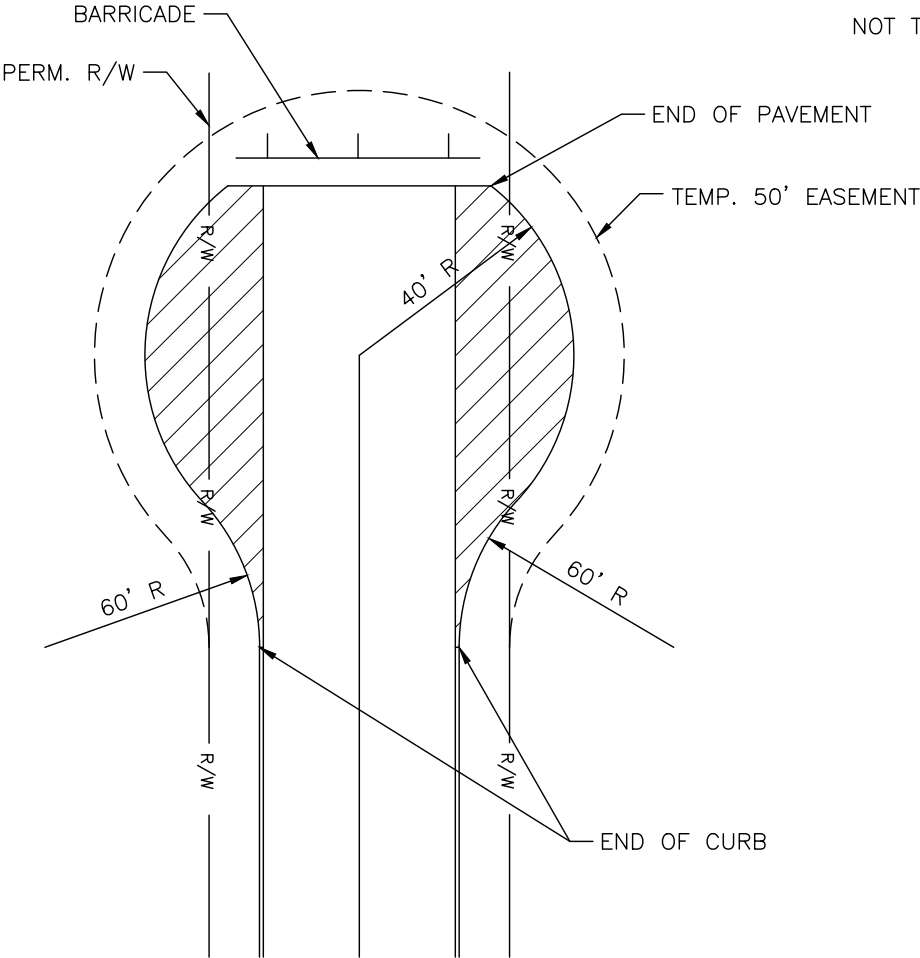
TYPE-2

SUBDIVISION CUL-DE-SAC

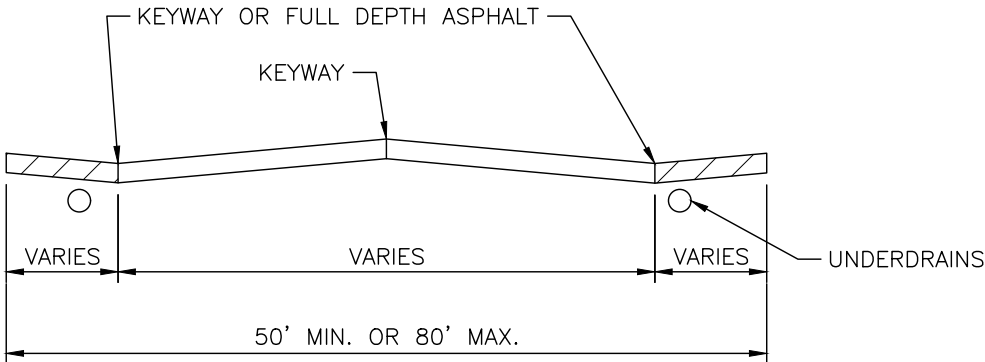
STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

EXHIBIT A

NOT TO SCALE



TO BE REMOVED WHEN THE STREET IS CONTINUED. THICKNESS AND TYPE TO MATCH PERMANENT PAVEMENT.



SUBDIVISION TEMPORARY CUL-DE-SAC

**STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA**

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1. THIS STREET REPAIR PROCEDURE SHALL BE USED FROM APRIL 15TH THROUGH NOVEMBER 15TH OR AS LONG AS HOT-MIX ASPHALT IS AVAILABLE.
2. PIPE OR CONDUIT TO BE BEDDED WITH APPROVED COMPACTED GRANULAR MATERIAL (SAND, PIT RUN, OR B-BORROW). FOR GREENSBURG WATER USE #53 CRUSHED LIMESTONE. FOR SANITARY AND STORM SEWER, USE #9 OR #12 AGGREGATE.
3. FLOWABLE BACKFILL SHALL BE NON-REMOVABLE, IN ACCORDANCE WITH INDOT STANDARD SPECIFICATION 213.
4. ASPHALT STREETS: HMA PATCHING SHALL BE 7-1/2" MIN. DEPTH AS SHOWN ABOVE. ALL PATCHING TO TAKE PLACE WITHIN 24 HOURS OF COMPLETION OF BACKFILLING OPERATIONS.
5. CONCRETE STREETS: CONCRETE PATCH SHALL BE MIN. 6" OR MATCH EXISTING DEPTH PCCP PATCHING WHICHEVER IS GREATER, IN ACCORDANCE WITH INDOT STANDARD SPECIFICATION 506. PATCHING SHALL BE BROOM-FINISHED AT RIGHT ANGLES TO THE FLOW OF TRAFFIC. ALL PATCHING SHALL TAKE PLACE WITHIN 24 HOURS OF COMPLETION OF BACKFILLING OPERATIONS.
6. EDGES OF EXISTING ASPHALT TO BE TACK COATED BEFORE PLACING THE HOT-MIX ASPHALT SURFACE.
7. IF MORE THAN ONE CUT IS MADE ON A CITY STREET, AND THE DISTANCE BETWEEN THE TWO IS 5'-0" OR LESS, THE CONTRACTOR OR PERSONS MAKING THE REPAIRS WILL BE REQUIRED TO REMOVE THE SURFACE BETWEEN THE CUTS AND MAKE A SINGLE REPAIR.
8. CONTRACTOR SHALL NOTIFY THE CITY ENGINEER'S OFFICE AT 812-663-3344 BEFORE PLACING THE HOT-MIX ASPHALT SURFACE.
9. ALL OVERCUTTING AND THE ENTIRE PERIMETER OF FINAL REPAIR TO BE CLEANED AND SEALED WITH ASPHALT CRACK SEALER.
10. CRUSHED STONE COVER MATERIAL #8 OR #9 THAT MEETS ASTM D2321 CLASS I OR II.

STANDARD STREET CUT REPAIR DETAIL

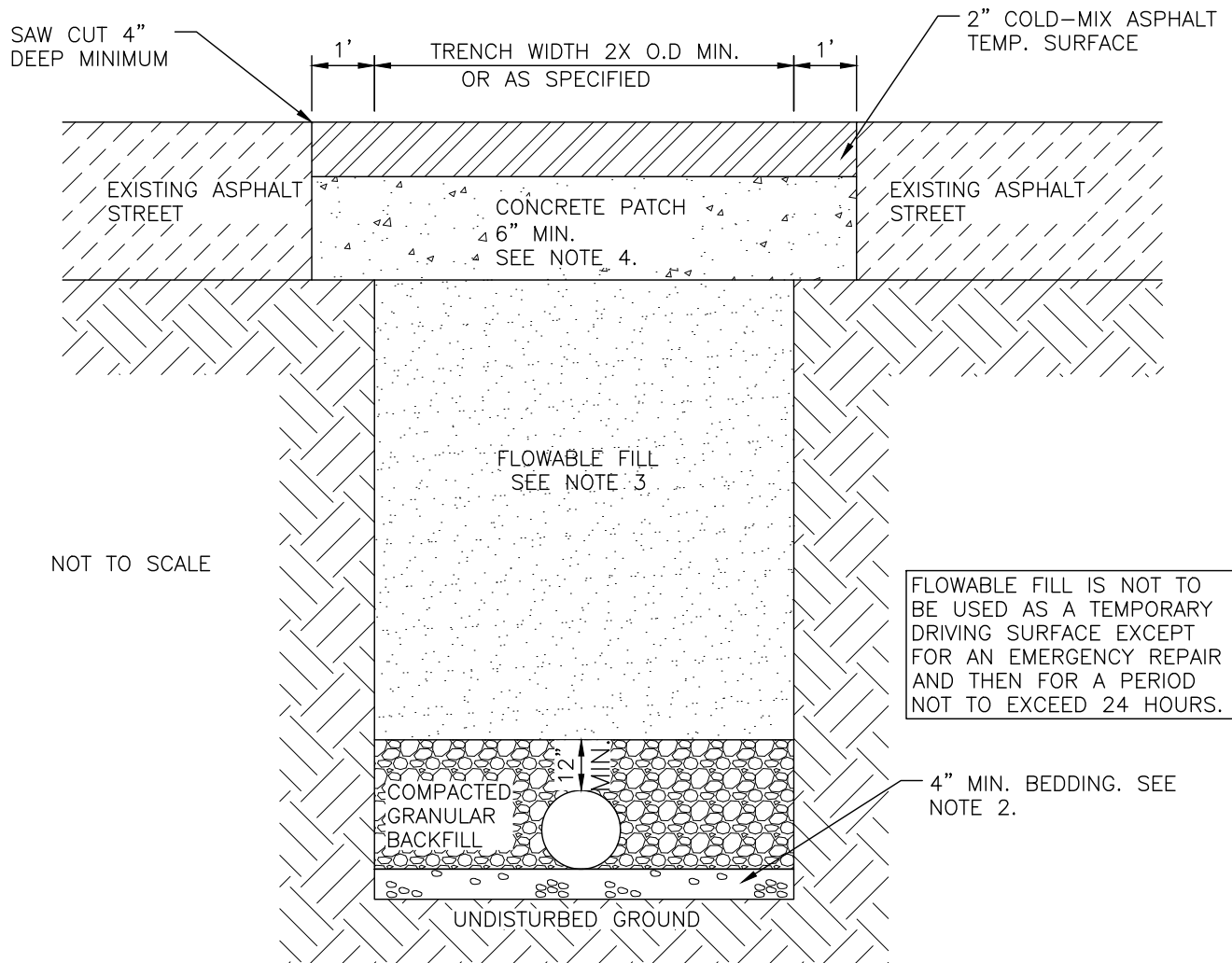
STANDARD CONSTRUCTION DETAILS

CITY OF GREENSBURG

GREENSBURG, INDIANA

R-9

EXHIBIT A



NOT TO SCALE

FLOWABLE FILL IS NOT TO BE USED AS A TEMPORARY DRIVING SURFACE EXCEPT FOR AN EMERGENCY REPAIR AND THEN FOR A PERIOD NOT TO EXCEED 24 HOURS.

4" MIN. BEDDING. SEE NOTE 2.

NOTES:

1. THIS STREET REPAIR PROCEDURE SHALL BE USED FROM NOVEMBER 15TH THROUGH APRIL 15TH OR AS LONG AS HOT-MIX ASPHALT IS UNAVAILABLE.
2. PIPE OR CONDUIT TO BE BEDDED WITH APPROVED COMPACTED GRANULAR MATERIAL (SAND, PIT RUN, OR B-BORROW). FOR GREENSBURG WATER USE #53 CRUSHED LIMESTONE. FOR SANITARY AND STORM SEWER, USE #9 OR #12 AGGREGATE.
3. FLOWABLE BACKFILL SHALL BE NON-REMOVABLE, IN ACCORDANCE WITH INDOT STANDARD SPECIFICATION 213.
4. CONCRETE PATCH SHALL BE 6" DEPTH OR MATCH EXISTING WHICHEVER IS GREATER. PLACED WITHING 24 HOURS.
5. PLACE TEMPORARY 2" PATCH OF COLD MIX FLUSH WITH EXISTING SURFACE WITHIN 24 HOURS. TEMPORARY PATCH SHALL BE REMOVED AND REPLACED WITH 220 #/SY HMA, SURFACE, TYPE C AS HMA BECOMES AVAILABLE.
6. IF MORE THAN ONE CUT IS MADE ON A CITY STREET, AND THE DISTANCE BETWEEN THE TWO IS 5'-0" OR LESS, THE CONTRACTOR OR PERSONS MAKING THE REPAIRS WILL BE REQUIRED TO REMOVE THE SURFACE BETWEEN THE CUTS AND MAKE A SINGLE REPAIR.
7. CONTRACTOR SHALL NOTIFY THE CITY ENGINEER'S OFFICE AT 812-663-3344 BEFORE PLACING CONCRETE OR ASPHALT PATCH.
8. ALL OVERCUTTING AND THE ENTIRE PERIMETER OF FINAL REPAIR TO BE CLEANED AND SEALED WITH ASPHALT CRACK SEALER.
9. FINAL REPAIRS SHALL BE COMPLETED NO LATER THAN MAY 1ST.

WINTER STREET CUT REPAIR DETAIL

STANDARD CONSTRUCTION DETAILS
CITY OF GREENSBURG
GREENSBURG, INDIANA

R-10

For more location information
please visit www.strand.com

Office Locations

Ames, Iowa | 515.233.0000

Brenham, Texas | 979.836.7937

Cincinnati, Ohio | 513.861.5600

Columbus, Indiana | 812.372.9911

Columbus, Ohio | 614.835.0460

Joliet, Illinois | 815.744.4200

Lexington, Kentucky | 859.225.8500

Louisville, Kentucky | 502.583.7020

Madison, Wisconsin* | 608.251.4843

Milwaukee, Wisconsin | 414.271.0771

Nashville, Tennessee | 615.800.5888

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