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(revised 7/10/20)

BOOK 1

CITY OF WILSON, NC
PRE-APPROVED MATERIAL/PRODUCT LIST

Revision: **R7**
Last Revision: October 29, 2019
Effective Date: September 1, 2019

Contract Number: _____

LINKS TO SPECIFIC SEWER PRODUCTS

Aluminum Hatches	Manhole Boots	PVC Pipe Force Mains – Mat'l
Ductile Iron Pipe (Gravity of FM's)	Manholes - Butyl Sealant	PVC Gravity Pipe & Fittings
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Gate Valve - 2" NRS Wedge	Manhole Sealant - Interior	Steel Encasement Pipe & Spiders
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Grade Rings - Concrete	Manhole Step	Wyes
HDPE Gravity Sewer Pipe	Pump Stations	Yard Hydrant

LINKS TO SPECIFIC WATER PRODUCTS

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Cast Couplings	HDPE Pipe (Directional Boring)	Tracer Wire - Copper
Copper Tubing	Meter Setters - 1 ½" & 2"	Valves - Air Release
Corporation Stops	Meter Boxes	Valves - Angle Ball Valve
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DIP TR Flex Restrained Joint DIP	Meters; Small - Ultrasonic	Valves - ¼ Turn SS Ball Valves
Ductile Iron Fittings	Pipe Locator Balls	Valves - Curb
EndoTrace Traceable Tubing	Pipe Saddle Support Stand	Valves –Large
Fire Hydrants	PVC Water Pipe	Warning Tape – Magnetic

Sanitary Sewer
PRE-APPROVED MATERIAL/PRODUCT LIST
City of Wilson

PVC - Gravity Pipe
(Green)

Specification Section: 2530, paragraph 2.1.2.A

Standard Details: N/A

Standard:

- **Mains:** ASTM D3034 (8 inches – 15 inches); SDR 35; ASTM F679 (Large-Diameter Plastic Gravity Sewer Pipe and Fittings, 18- and 21-inch)
- **Services:** ASTM D1785, Sch 40, solid wall (4-inch and 6-inch)

Approved Manufacturer/Product	Supplemental Information	Type	Size
☐ Charlotte Pipe & Foundry Co.		☐ Service	4-inch through 6-inch
☐ Diamond Plastic Corporation		☐ Main	8-inch through 15-inch
☐ Harvel		☐ Main	8-inch through 15-inch
☐ National Pipe & Plastics, Inc.		☐ Main	8-inch through 15-inch
☐ North American Pipe Corp		☐ Main	8-inch through 15-inch
☐ Sanderson Pipe Corporation		☐ Main ☐ Service	8-inch through 15-inch 4-inch through 6-inch
☐ Vulcan Plastics		☐ Main	8-inch through 15-, 18- & 21-inch pipe

LINKS TO MANUFACTURERS:

- Charlotte Pipe & Foundry Co.: http://www.charlottepipe.com/pl_abs_pvc_dwv.aspx
- Diamond Plastic Corporation: http://www.dpcpipe.com/Product/Sani-21-SDR
- JM Eagle: http://www.jmeagle.com/watersewer/gravity-sewer-pipe
- National Pipe & Plastics, Inc.: http://www.nationalpipe.com/products/sewer-5.html
- North American Pipe Corp: https://napcopipe.com/en/product/pipe/astm-d3034sw-pvc-gravity-sewer-pipe#technical-resources
- Sanderson Pipe Corp:
  - Main: http://sandersonpipe.com/wp-content/uploads/2018/08/sewer-071718.pdf
  - Service: http://sandersonpipe.com/wp-content/uploads/2018/08/sch40-dwv-pipe-071718.pdf
- Vulcan Plastics (a Division of Consolidated Pipe & Supply): http://www.consolidatedpipe.com/divisions/vulcan-plastics/

HDPE - Gravity Pipe

(4 single green stripe[s] to identify IPS Sewer)

(Not for New Construction)

Specification Section: 2530, paragraph 2.1.4

Standard Details: N/A

Standard:

- **Mains:** AWWA C906, ASTM D3035, PE 4710 resin, sized and marked in accordance with ASTM F714, IPS, DR17 (ASTM C906, 125 psi), 8 through 24 inches (must be up-sized 1-inch if diameter is > 12 inches), Gray w/ 4 single green stripes – IPS gravity sewer only. Minimum depth of cover = 3 ft/Maximum depth of cover is 25 ft (DR 21 or less).

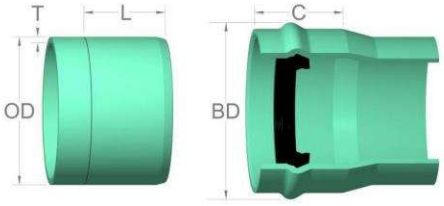
Approved Manufacturer/Product	Supplemental Information	Type	Size
☐ CP Chemical/Performance Pipe	Driscoplex 4600 Series	☐ Main	8-inch through 24-inch
☐ JM Eagle	PE Pipe	☐ Main	8-inch through 24-inch
☐		☐ Main	8-inch through 24-inch

LINKS TO MANUFACTURERS:

- CP Chemical/Performance Pipe: http://www.performancepipe.com/en-us/ww/Pages/default.aspx
- JM Eagle: http://www.jmeagle.com/watersewer/hdpe-water-sewer

PVC/HDPE Pressure Pipe - Force Mains (or Pipe Bursting)

(Green = Wastewater)



C900
(Green)

C906 HDPE
(Green stripes [force main sewer])

Specification Section: 2530, paragraphs 2.1.2. B, C & D; 2.1.3

Standard Details: N/A

Standard: Mains:

AWWA C900-16, Pressure Class 165, DR 25 (4-inches – 24 inches); cell classification 12454B;
This spec also applies to fusible C900 pipe as well except 235-psi operating pressure, DR18, DIP size, square cut plain ends (with no bevel).

AWWA C901 and C906 HDPE, DR9, 200 psi

ASTM D2241, SDR 21 (PR200), solid wall (2- or 3-inch)

Approved Manufacturer/Product	Supplemental Information	Type	Size
☐ Charter Plastics		☐ Main ☐ Small	- 2-inch
☐ Diamond Plastic Corporation		☐ Main	4-inch through 12-inch
☐ Northern American Pipe Products		☐ Main	4-inch through 24-inch
☐ Northern Pipe Products		☐ Main	4-inch through 12-inch
☐ Sanderson Pipe Corporation		☐ Main ☐ Small	4-inch through 12-inch 2-inch and 3-inch
☐ Vulcan Plastics		☐ Main ☐ Small	4-inch through 12-inch 2-inch and 3-inch

LINKS TO MANUFACTURERS:

- Charter Plastics:
  - Main: -
  - 2-inch: http://www.charterplastics.com/pipe/municipal-service-tubing/pe-4710-cts-sewer-tubing/
- Diamond Plastic Corporation:
  - Main: http://www.dpcpipe.com/Product/C900
  - Small: http://www.dpcpipe.com/assets/pdf/prod/prod_ips_spec.pdf
- North American Pipe Products: https://napcopipe.com/en/products/municipal/C900?type%5B32%5D=32
- Northern Pipe Products: http://www.northernpipe.com/pvcProducts/c900c905.html
- Sanderson Pipe Corp:
  - Main: http://sandersonpipe.com/wp-content/uploads/2018/08/c900-082918.pdf
  - Small: http://www.sandersonpipe.com/PDF/SPC007.pdf
- Vulcan Plastics (a Division of Consolidated Pipe & Supply):
  - Main and Small: http://www.consolidatedpipe.com/wp-content/uploads/2018/11/Vulcan-Plastics.pdf

Ductile Iron Pipe – Gravity or Force Main

Interior Linings: Tnemec Series 431 Perma-Shield PL Ceramic Epoxy Lining, SewperCoat®, or Protecto 401™

Specification Section: 2530, paragraph 2.1.1

Standard Details: N/A

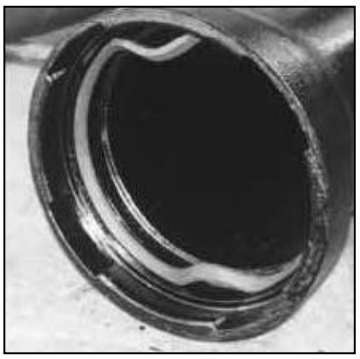
Standard: AWWA C111/A21.11, C151/A21.51, AWWA C111/ANSI A21.11, Pressure Class Eighteen or twenty-foot standard joint lengths.

Approved Manufacturer/Product		Class
☐ American Cast Iron Pipe	☐	Class 50 or greater
☐ McWane Ductile	☐	Class 50 or greater
☐ U.S. Pipe and Foundry Co.	☐	Class 50 or greater

LINKS TO MANUFACTURERS:

- American Cast Iron Pipe: http://www.american-usa.com/products
- McWane Ductile: http://mcwaneductile.com/resources/specifications
- US Pipe and Foundry Co: http://www.uspipe.com/products/ductile-iron-pipe/ty

Ductile Iron Pipe Mains / TR FLEX Restrained Push-On Joint Pipe



Interior Linings: Tnemec Series 431 Perma-Shield PL Ceramic Epoxy Lining, SewperCoat®, or Protecto 401™

Specification Section: 2530, paragraph 2.1.1

Standard Details: N/A

Standard: Ductile Iron locking segments, inserted through a slot (or slots) in the bell face, to provide a positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe; used with standard size Tyton gasket. AWWA C104/A21.4, C111/A21.11, C150/A21.50, C151/A21.51, ASTM A746 *Standard Specification for Ductile Iron Gravity Pipe*, NSF/ANSI 61, NSF/ANSI 372 certified lead free. Eighteen or twenty-foot standard joint lengths. Interior linings to comply with Specification Section 02530 paragraph 2.1.1.

Approved Manufacturer/Product	Size	Thickness/Press Class	Joint Type
☐ American Cast Iron Pipe	6-inch to 36-inch	Min Class 50 up to 16" Dia, Press Cl 300 18" Dia and up	Flex-Ring Restrained Push-On Joints
☐ McWane, Inc.	6-inch to 36-inch	Min Class 50 up to 16" Dia, Press Cl 300 18" Dia and up	TR FLEX Restrained Push-On Joints
☐ U.S. Pipe and Foundry Co.	6-inch to 36-inch	Min Class 50 up to 16" Dia, Press Cl 300 18" Dia and up	TR FLEX Restrained Push-On Joints
☐			

LINKS TO MANUFACTURERS:

- American Cast Iron Pipe: http://www.american-usa.com/products/ductile-iron-pipe-and-fittings/restrained-joint-pipe/flex-ring-joint-pipe
- McWane, Inc.: https://www.mcwaneductile.com/products/catalog/
- US Pipe and Foundry Co: https://www.uspipe.com/products/fittings/tr-flex-restrained-joint-fittings

Precast Concrete Manholes

Specification Section: 2530, paragraph 2.2.14

Standard Details: 516.01, 732.01, 732.02, 732.03, 732.04, 732.05, 732.06, 734.01, 734.08

Standard: ASTM C478, Type II Cement, AASHTO M199

Approved Manufacturer/Product	Detail	Size	Other
☐ Mack Industries			
☐ Concrete Pipe and Precast (formerly Carolina Precast)			
☐ Cape Fear Precast			
☐			

LINKS TO MANUFACTURERS:

- Mack Industries: https://www.mackconcrete.com/
- Concrete Pipe and Precast (formerly Carolina Precast): http://www.concretepipeandprecast.com
- Cape Fear Precast: http://capefearprecast.com/products.html

Concrete Grade Rings

Specification Section: 2530, paragraph 3.3

Standard Details: C06.03

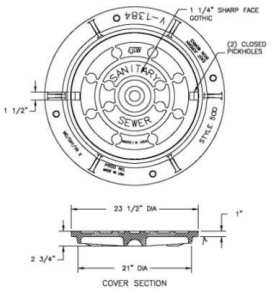
Standard: ASTM C478, Type II Cement. Thickness: Max. 6"; Min. 2". The top grade ring should be 2"; total height not to exceed 18"

Approved Manufacturer/Product	Thickness
☐ Carolina Precast	
☐ Mack Industries	
☐ Cape Fear Precast	
☐	

LINKS TO MANUFACTURERS:

- Concrete Pipe and Precast (formerly Carolina Precast): http://www.concretepipeandprecast.com
- Mack Industries: https://www.mackconcrete.com/
- Cape Fear Precast: http://capefearprecast.com/products.html

Manhole Frame and Cover



Specification Section: 2530 paragraph 2.2.9

Standard Details: C06.01, 633.03, 735.01

Standard: ASTM A48, Grade 35B, AASHTO M105 & M 306, uncoated, domestic made, Heavy Duty

Approved Manufacturer/Product	Use	
	Standard	**Watertight**
☐ Capitol Foundry of Virginia, Inc.	MH 2001-SS-O	2001-WT
☐ East Jordan	V1384 (Product 0NC413800044)	V2384 (Product 42384021W01)
☐ Tricast Masonry Supply	MH-2001-SS*O	MH-2001-WT*O
☐ US Foundry	669KL	-

LINKS TO MANUFACTURERS/SUPPLIERS:

- Capital Foundry of Virginia, Inc.: http://www.capitolfoundry.net/manholes
- EJCO: https://www.ejco.com/am/en/product/details?productid=308116
- Tricast Masonry Supply: https://www.tricastnc.com/municipal-castings
- US Foundry: http://www.usfoundry.com/usfoundry-products/catalog/ringsandcovers/productdetails/669

Manhole & Valve Cast Iron Riser Rings

Specification Section: 2510 paragraph 2.3.5.B; 2530 paragraph 2.2.9.C

Standard Details: C06.04 (manholes), C06.05 (valve boxes)

Standard: ASTM A48, Grad 35B, AASHTO M 306, uncoated, domestic made, locking devices or set screws required.

Approved Manufacturer/Product	Use			
	Manhole Riser Rings w/ Set Screws or locking devices		**Valve Box Riser Rings**	
	Height	**Item No.**	**Height**	**Item No.**
☐ East Jordan	☐ 1-inch ☐ 1 ½-inch ☐ 2-inch	M7235010102R M1235010152R M123501202R	☐ 1-inch ☐ 2-inch ☐ 3-inch	85008011 85008016 85008021
☐	☐		☐	

LINKS TO MANUFACTURERS:

- EJCO: https://www.ejco.com/am/en/products/ (Log in and type in item number in search box for the various items listed above)

Manhole Boots (pipe-to-manhole connectors)

Specification Section: 2530, paragraph 2.2.14.D

Standard Details: 732.01, 732.03, 732.04, 732.06,

Standard: ASTM C923, double-clamped

Approved Manufacturer/Product	Supplemental Information
☐ A-Lok Products, Inc.	☐ Quik-Lok
☐ NPC, Inc.	☐ Kor-N-Seal® Series I & II
☐ Press-Seal Gasket Corp	☐ CAST-A-SEAL 12-08

LINKS TO MANUFACTURERS:

- A-Lok Products, Inc.: http://a-lok.com/bootconnectors.html
- NPC, Inc. (Trelleborg): http://www.trelleborg.com/en/pipe-seals/products--and--solutions/connector--sealing--systems
- Press-Seal Gasket Corp:
- http://www.press-seal.com/products-and-services/underground-products/cast-in-connectors/

Sewer Connection to Existing Sewer Mains (Repair Coupling, GXG, No Pipe Stop)

(Main Line Repair Coupling Used on PVC Pipe when inserting an In-Line Wye)

Specification Section: 2530, paragraph 3.7E

Standard Details: 733.02

Standard: In-line wye with schedule 40 connection (gasketed main or glued service) w/GPK Repair Coupling SDR 35 GXG

Approved Manufacturer/Product	Size	Type of Pipe	Part/Catalog#	L (inches)
☐ GPK Products, Inc. Repair Coupling	☐ 8”	PVC	106-0008	9.25
	☐ 10”	PVC	106-0010	13.00
	☐ 12”	PVC	106-0012	14.00
	☐ 15”	PVC	106-0015	16.50
☐ Multi Fitting	☐ 8”	PVC	063627	9.625
	☐ 10”	PVC	063630	10.00
	☐ 12”	PVC	043631	12.00
	☐ 15”	PVC	043637	13.50

LINKS TO MANUFACTURERS:

- GPK Products, Inc.: http://www.gpk-fargo.com/products/index.php (type in catalog # into search box to locate)
- Multi Fitting.: http://www.multifittings.com/Content/LayLength/Library.aspx

Sewer Saddle

Specification Section: 2530 paragraph 3.7.E

Standard Details: 733.02

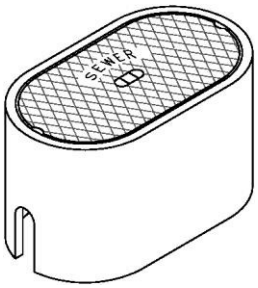
Standard: ASTM A536, Ductile Iron Gland, Grade 65-45-12, coated, Buna-N (NBR) gasket (or approved equal) per ASTM D2000, 304 stainless steel wide strap/band and bolts

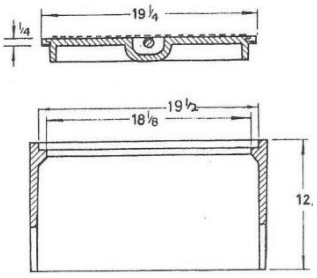
Approved Manufacturer/Product	Model	Sizes
☐ The Ford Meter Box Company, Inc.	Ford Sewer Saddle, FSS series	4 or 6 inch branch outlets
☐ Romac	CB Sewer Saddle	4 or 6 inch branch outlets
☐		

LINKS TO MANUFACTURERS:

- The Ford Meter Box Company, Inc.: http://www.fordmeterbox.com/documents/flyers/FFSEWS_Sewer_Saddle.pdf
- Romac: http://romac.com/cb-sewer

Cleanout Boxes





Specification Section: 2530, paragraph 2.2.10, 3.7.I

Standard Details: 733.01

Standard: ASTM A48, Class 35B, domestic made, stamped "sewer"

Approved Manufacturer/Product	Number	Size	Configurations
☐ Capital Foundry	MBX-1	4-inch and 6-inch services	Lid to read "sewer"
☐ Star Pipe Products	MB-0017 (MBX-1)	4-inch and 6-inch services	Lid to read "sewer"
☐ SIP Industries	6408-6413 (MBX-1)	4-inch and 6-inch services	Lid to read "sewer"

LINKS TO MANUFACTURERS:

- Capital Foundry of Virginia, Inc.: http://www.capitolfoundry.net/meter-boxes
- Star Pipe Products: http://www.starpipeproducts.com/pdf/castings/catalog/USA/mb_usa-1.pdf
- SIP Industries: http://sipindustries.com/dwlpdf/MeterBoxes.pdf

(Soil Tight) Butyl Rubber Sealant

Specification Section(s): 2510, paragraph 2.3.8; 2530 paragraph 2.2.14.B

Standard Details: 516.01, 732.02, 732.03, 732.04, 732.05, 732.06, 734.01, and 734.08

Standard: FS SS-S-00210 (210-A), ASTM C990, Type 1, Rope Form, ¾" diameter (min.)

Approved Manufacturer/Product	Supplemental Information
☐ ConSeal Concrete Sealants, Inc.	☐ CS-102 (only)
☐ Henry Company, Sealants Division	☐ RN103 – Ram-Nek Joint Sealant (Coils) ☐ RN101 – Ram-Nek Joint Sealant (Strips)

LINKS TO MANUFACTURERS:

- ConSeal Concrete Sealants, Inc.: http://conseal.com/concrete-sealant-products/cs-102-butyl-rubber-sealant.html
- Henry Company, Sealants Division.: http://us.henry.com/performance-additives/concrete-joint-sealants/

Bore and Jack Operations

Specification Section: 2510, paragraph 2.1.6.A; 2530 paragraph 2.1.6

Standard Details: C07.03

Standard: ASTM A139, grade B steel pipe casing, ASTM A283, uncoated

Approved Vendors	Casing Spacers/Spiders	End Seals
☐ Advance Products and Systems	☐ SSI w/ EPDM Skids	☐ Brick & Mortar (see detail)
☐ Spider Manufacturing	☐	
	Steel Pipe	
☐ Southland Pipe Corporation	☐	
☐ Spiralco, Inc.	☐	

LINKS TO MANUFACTURERS:

- Advance Products and Systems: http://www.apsonline.com/casing.html
- Spider Manufacturing: http://www.spiderpipesupports.com/polymerskids.htm
- Southland Pipe Corporation: http://www.southlandpipe.com/products.htm#sthash.cLJmiMZv.dpbs
- Spiralco, Inc.: http://www.spiralco.com/English/Produits/Produits.htm

Sewage Combination
Air Release/Vacuum Valves
(A.R.I at left; Crispin at right)

Specification Section: 2530, paragraph 2.2.4

Standard Details: 734.01

Standard:
Iron Body: ASTM A48, Class 35, ANSI/AWWA C512, dual body with back flushing attachment and quick disconnect couplings, NPT Inlet Body, 150 working pressure
Composite: Conical-shaped Reinforced Nylon/Stainless Steel Body and Flange, NPT Inlet Body, 150 psi working pressure

Manufacturer & Product - Composite	Model
☐ A.R.I USA, Inc.	☐ D-025
☐	☐

Manufacturer & Product - Iron Body	Model
☐ Crispin	☐ Crispin S/SL
☐ GA Industries	☐ Fig. 955
☐ Val-Matic	☐ 48A/301A - 49A/302A Dual Body

LINKS TO MANUFACTURERS:

- A.R.I.: http://www.ariusa.com/products/wastewater/item/d-025-combination-air-valve-for-wastewater-short-version
- Crispin: https://crispinvalve.com/air-release-valves/air-release-valve-waste/pressure-air-release/
- GA Industries: http://www.environmental-expert.com/companies/ga-industries-inc-7996/products/family-distributor-automatic-air-vacuum-valves-244856#distributor-automatic-air-vacuum-valves
- Val-Matic: http://www.valmatic.com/combinationairWW.html

Manhole Flexible Exterior Joint Sealant

Specification Section: 2530, paragraph 2.2.11

Standard Details: 732.02, 732.03, 732.04, 732.05, 732.06, 732.10, 732.11

Standard: ASTM C877, C990, and E1745

Manufacturer & Product	Model
☐ Conseal Concrete Sealants, Inc.	CS-212
☐ Sealing Systems, Inc.	Infi-Shield External Sealing System, Infil-Shield Uni-Band

LINKS TO MANUFACTURERS:

- Conseal Concrete Sealants, Inc.: http://conseal.com/concrete-sealant-products/cs-212-polyolefin-backed-exterior-joint-wrap.html
- Sealing Systems, Inc.: http://www.ssisealingsystems.com/gator-wrap.html

Aluminum Hatches (No Vaults Permitted!)

Specification Section: 02530

Standard Details: N/A

Standard: N/A

Manufacturer & Product	Valve Vault (36"x36" Min)	Wetwell
☐ The Bilco Company	☐ J-4AL	☐ JD-2AL (4'x4' min)
☐ Halliday Products, Inc.	☐ S1R	☐ W2S4848 min
☐ US Foundry & Manufacturing Corp.	☐ APS 36x36 w/OP	☐ THD 48x48 w/OP min

LINKS TO MANUFACTURERS:

- Bilco: https://www.bilco.com/category1324/Aluminum_Construction
- Halliday Products, Inc.: http://www.hallidayproducts.com/accesscovers.html
- US Foundry & Manufacturing Corp.: http://www.usffab.com/usffab-products/catalog/sub_categories/1

Freezeless Yard Hydrants

(RPZ required prior to connection or
use USC approved model Yard Hydrant)

Specification Section: 2530, paragraph 2.2.17

Standard Details: 739.01

Standard: 125-psi maximum working pressure

Manufacturer & Product	¾-inch	1-inch
☐ Clayton	☐ Mark #5451, ¾" NPT inlet at base of valve body, ¾" male hose thread	-
☐ Merrill	-	☐ C-1000 Series, Hi-Capacity, 1" NPT inlet at base of valve body, ¾" male hose thread
☐ Woodford Freezeless IOWA	☐ ModelY34: ¾" NPT inlet at base of valve body, ¾" male hose thread	☐ Model Y1: 1" NPT inlet at base of valve body, ¾" male hose thread

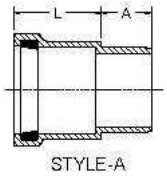
LINKS TO MANUFACTURERS:

- Clayton: http://claytonmarkmfg.com
- Merrill: https://www.merrillmfg.com/shop/frost-proof-hydrants/c-1000
- Woodford Freezeless IOWA: http://www.woodfordmfg.com/woodford/Yard_Hydrant_Pages/Model-y34.html

In-Line Transition Coupling

Romac LSS1
VCP to DIP

Harrington Corp C900 x SDR-35 BXB
PVC to DIP



GPK Products SDR 35 GxG
PVC to PVC

Romac 501 Coupling

Specification Section: 2530, paragraph 2.2.15

Standard Details: 733.03

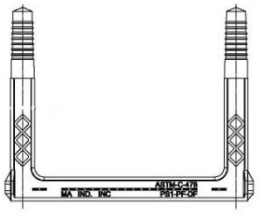
Standard: Fittings that conform to pipe meeting either AWWA C900, ASTM A746, or ASTM D3034

Transition	Manufacturer	Product
☐ **PVC/PVC**	☐ GPK Products, Inc.	SDR35 GxG
☐ **PVC/DIP**	☐ Harrington Corporation	C900 x SDR-35 BxB
☐ **VCP/DIP**	☐ Romac Industries	LSS1 with 6-inch transition bushing
☐ **HDPE/Clay**	☐ Romac Industries	Style RC501 Reducing Coupling
☐ **HDPE/PVC**	☐ Romac Industries	Style "501"

LINKS TO MANUFACTURERS:

- GPK Products, Inc: https://www.gpk-fargo.com/products/?category=SDR35%20Gasketed%20Fittings&subCategory=Repair%20Coupling%20GxG
- Harrington Corporation: http://www.harcofittings.com/Products/PVC/C900
- Romac Industries: http://romac.com/lss1?rq=lss1
- Romac Industries (Transition & Reducing Couplings): http://www.romac.com/couplings/

Manhole Steps



Specification Section: 2530, paragraph 2.2.14.C

Standard Details: C06.06, 732.03, 732.04, 732.05, 732.06

Standard: ASTM C478 and D4101, AASHTO M-199.

Copolymer polypropylene plastic with embedded ½" diameter ASTM A615 Grade 60 steel reinforcement.

Manufacturer & Product	Model	Reinforcement
☐ M. A. Industries, Inc.	PS1-PF	½" dia. grade 60 rebar
☐		

LINKS TO MANUFACTURERS:
- M. A. Industries, Inc. https://precast-supplies.com/category/manhole-products/manhole-steps

Gate Valves 1 ½ inches and smaller

Specification Section: 2530, paragraph 2.2.1.B

Standard Details: N/A

Standard: Bronze Body Gate Valve, ASTM B62 (85-5-5-5), FS WW-V-541, Class A, Type 1 wedge disc, rising stem, Class 200-psi (WOG), Female screw ends threaded according to ANSI B2.1 for pipe threads, malleable iron hand wheel; open counterclockwise

Manufacturer & Product	Model	Size
☐ American	3FG	1 ½-inch and smaller
☐ Hammond	IB645	1 ½-inch and smaller
☐ NIBCO	T-113	1 ½-inch and smaller
☐		

LINKS TO MANUFACTURERS:
- American: https://www.americanvalve.com/product/3fg/
- Hammond Valve: https://www.hammondvalve.com/index.php/results/IB645
- NIBCO: http://www.nibco.com/Valves/Gate-Valves/Bronze-Gate-Valves/T-113-Gate-Valve-Bronze-Non-rising-Stem-Threaded/

2-inch Gate Valves

Specification Section: 2530, paragraph 2.2.1 (02510 paragraph 2.2.6 except applicable to 2-inch GV's as may be modified here)

Standard Details: N/A

Standard: Resilient seat or wedge line valves, AWWA C509 (standard wall thickness) or AWWA C515 for resilient seat gave valve with non-rising stems (NRS), Female IPT, AWWA C550 interior and exterior body and bonnet surfaces to be coated with a fusion bonded epoxy coating, ASTM A126 or A536 cast iron or ductile iron body, Seal & O-rings to be Nitrile Buna-N or EPDM rubber, 200 psi rated pressure, 2-inch operation nut, (open right [clockwise])

Manufacturer & Product	Model	Size
☐ American AFC-2500 series	AFC-2500 Series	2-inch
☐ McWane Ductile (Formerly Clow Valve Company)	2639 & 2640	2-inch
☐ M&H Valve Company	4067-07	2-inch
☐ Mueller	A-2362 RWGV Thd X Thd	2-inch
☐ US Pipe Valve & Hydrant	A-USP2 RWGV Thd X Thd	2-inch

LINKS TO MANUFACTURERS:

- American: https://american-usa.com/products/valves-and-hydrants/2-12-series-2500-resilient-wedge-gate-valves/2-3-resilient-wedge-gate-valves-with-threaded-ends
- McWane: https://www.clowvalve.com/upl/downloads/resources/product-brochures/c509-2-12.pdf
- M&H Valve Company: https://www.mh-valve.com/products/catalog/resilient-wedge-gate-valves/
- Mueller: https://www.muellercompany.com/water-works/valves/resilient-wedge-gate-valves/2-3-inch-2362-rwgv-thdxthd/
- US Pipe Valve & Hydrant: https://www.uspvh.com/products/gate-valves-us-pipe/non-rising-stem-nrs/2-3-inch-usp2-rwgv-thdxthd/

SELF-PRIMING PUMPS & FORCE MAINS

Pumps, Pump Station

Specification Section: 2530, paragraph 3.10

Standard Details: 734.08

Standard:

Approved Manufacturer/Product	Model
☐ Gorman Rupp	☐

LINKS TO MANUFACTURERS:

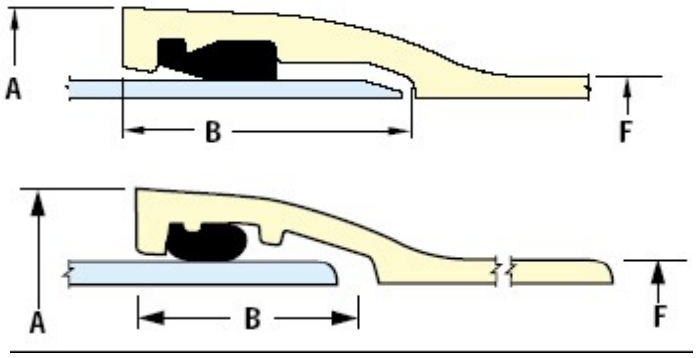
- Gorman Rupp: http://www.grpumps.com/pumptype/product/Self-Priming-Pumps

Water Distribution

PRE-APPROVED MATERIAL/PRODUCT LIST

City of Wilson

Ductile Iron Pipe Mains / Push-On Joint



Specification Section: 2510, paragraph 2.1.3

Standard Details: N/A

Standard: AWWA C104, C111, C151, NSF/ANSI 61, NSF/ANSI 372 certified lead free. Eighteen or twenty-foot standard joint lengths.

Approved Manufacturer/Product	Size	Thickness/Press Class
☐ American Cast Iron Pipe	6-inch to 48-inch	Min Class 50 up to 16" Dia, Press Cl 300 18" Dia and up
☐ McWane Ductile	6-inch to 48-inch	Min Class 50 up to 16" Dia, Press Cl 300 18" Dia and up
☐ U.S. Pipe and Foundry Co.	6-inch to 48-inch	Min Class 50 up to 16" Dia, Press Cl 300 18" Dia and up

LINKS TO MANUFACTURERS:

- American Cast Iron Pipe: http://www.american-usa.com/products
- McWane: http://mcwaneductile.com/resources/specifications
- US Pipe and Foundry Co: http://www.uspipe.com/products/ductile-iron-pipe/ty

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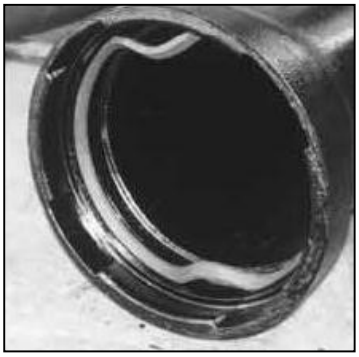
Ductile Iron Pipe Mains / TR FLEX Restrained Push-On Joint Pipe



Specification Section: 2510, paragraph 2.1.3

Standard Details: N/A

Standard: Ductile Iron locking segments, inserted through a slot (or slots) in the bell face, to provide a positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe; used with standard size Tyton gasket. AWWA C104/A21.4, C111/A21.11, C150/A21.50, C151/A21.51, NSF/ANSI 61, NSF/ANSI 372 certified lead free. Eighteen or twenty-foot standard joint lengths.

Approved Manufacturer/Product	Size	Thickness/Press Class	Joint Type
☐ American Cast Iron Pipe	6-inch to 36-inch	Min Class 50 up to 16" Dia, Press Cl 300 18" Dia and up	Flex-Ring Restrained Push-On Joints
☐ McWane, Inc.	6-inch to 36-inch	Min Class 50 up to 16" Dia, Press Cl 300 18" Dia and up	TR FLEX Restrained Push-On Joints
☐ U.S. Pipe and Foundry Co.	6-inch to 36-inch	Min Class 50 up to 16" Dia, Press Cl 300 18" Dia and up	TR FLEX Restrained Push-On Joints
☐			

LINKS TO MANUFACTURERS:

- American Cast Iron Pipe: http://www.american-usa.com/products/ductile-iron-pipe-and-fittings/restrained-joint-pipe/flex-ring-joint-pipe
- McWane, Inc.: https://www.mcwaneductile.com/products/catalog/
- US Pipe and Foundry Co: https://www.uspipe.com/products/fittings/tr-flex-restrained-joint-fittings

Ductile Iron Fittings
Mechanical Joint

Specification Section: 2510, paragraph 2.1.3.B

Standard Details: N/A

Standard: AWWA C110 (Full Body Fittings), C153 (Compact Fittings), NSF/ANSI 61, NSF/ANSI 372 certified lead free

Approved Manufacturer/Product	Size	Press Class	Joint Type
☐ American Cast Iron Pipe	6-inch to 48-inch	350-psi	MJ
☐ McWane Ductile	6-inch to 48-inch	350-psi	MJ
☐ SIP Industries	6-inch to 48-inch	350-psi	MJ
☐ Star Pipe Products	6-inch to 48-inch	350-psi	MJ
☐ U.S. Pipe and Foundry Co.	6-inch to 48-inch	350-psi	MJ

LINKS TO MANUFACTURERS:

- American Cast Iron Pipe: http://www.american-usa.com/products
- McWane Ductile: http://www.mcwaneductile.com/products/
- SIP Industries: http://www.sipindustries.com/main/product_details.asp?id=8
- Star Pipe Products: http://www.starpipeproducts.com/utilities.asp
- US Pipe and Foundry Co: https://www.uspipe.com/products/fittings/mechanical-joint-fittings

PVC Pipe – Water

Specification Section: 2510, paragraph 2.1.4, 2.1.5

Standard Details: N/A

Standard: AWWA C900-16, ASTM D3139, ASTM F477, ASTM D1784, cell classification 12454, minimum Press Class 235, DR18, ANSI/NSF Standard 61
This spec also applies to fusible C900, 235-psi, DR18, DIP size, square cut pain ends (with no bevel)

Approved Manufacturer/Product	Type	Size
☐ Diamond Plastics Corp		6-inch through 12-inch
☐ JM Eagle		6-inch through 12-inch
☐ National Pipe		6-inch through 12-inch
☐ Northern Pipe Products		6-inch through 12-inch
☐ Northern American Pipe Company (NAPCO)		6-inch through 24-inch
☐ Sanderson Pipe Corporation		6-inch through 12-inch
☐ Vulcan Plastics		6-inch through 12-inch

LINKS TO MANUFACTURERS:

- Diamond Plastic Corporation: http://www.dpcpipe.com/Product/C900
- JM Eagle: http://www.jmeagle.com/pvc/watersewer/blue-brute-c900
- National Pipe: http://www.nationalpipe.com/products/water-4.html
- Northern Pipe Products: http://www.northernpipe.com/pvcProducts/c900.html
- North American Pipe Company: https://napcopipe.com/en/product/pipe/c900/awwa-c900ib-pvc-pressure-pipe
- Sanderson Pipe Corp: http://sandersonpipe.com/wp-content/uploads/2018/08/c900-082918.pdf
- Vulcan Plastics (a Division of Consolidated Pipe & Supply): http://www.consolidatedpipe.com/divisions/vulcan-plastics/

HDPE Pipe for Directional Boring Applications – Water

Specification Section: 2510, paragraph 2.1.6

Standard Details: N/A

Standard: AWWA C901 & C906, DR9, 200-psi, ASTM D2239, ASTM F714, NSF approved. All HDPE pipe shall be one size larger than connected pipe (i.e. 8 in PVC to 10" HDPE)

Approved Manufacturer/Product		Size
☐ J.M. Eagle		6-inch through 16-inch
☐ Performance Pipe	Driscoplex 4000	6-inch through 16-inch
☐		

LINKS TO MANUFACTURERS:

- JM Eagle: http://www.jmeagle.com/watersewer/hdpe-water-sewer
- Performance Pipe: http://www.performancepipe.com/en-us/Documents/PP%20524%204000-4100%20Series%20Multi%20Purpose%20Pipe.pdf

Valves

Red Operating Nut →

Specification Section: 2510, paragraph 2.2.6

Standard Details: 513.02, 513.03, 513.07, 514.01, 514.02, 514.03, and 514.04

Standard: Gate Valve: AWWA C509; 6"-24" Resilient seat, open right, MJ; AWWA C509; 30" and Larger, MJ; All exposed nuts/bolts must be stainless steel on all valves, 2-inch red operating nut.

Approved Manufacturer/Product	Gate Valves	Tapping Valves	-
☐ American	☐ 2500 Series	☐ 2500 Series	
☐ Clow Valve Company (McWane Ductile)	☐ F-6100/OR	☐ F-6114/OR	
☐ M & H Valve Co.	☐ 4067-01R	☐ 4751-01R	
☐ Mueller Company	☐ 2360	☐ T-2360	
	-	-	

LINKS TO MANUFACTURERS:

- American: http://www.american-usa.com/products/valves-and-hydrants/2-12-series-2500-resilient-wedge-gate-valves
- McWane Ductile: https://www.clowvalve.com/products/catalog/resilient-wedge-gate-valves/
- M & H Valve Co: https://www.mh-valve.com/products/catalog/resilient-wedge-gate-valves/
- Mueller Company: https://www.muellercompany.com/water-works/valves/resilient-wedge-gate-valves/

Valves, SS ¼-Turn Ball

Specification Section: 2510, paragraph 2.2.5

Standard Details: **516.01**

Standard: AWWA C515, 2-inch and smaller, NSF/ANSI 61, NSF/ANSI 372 certified lead free

Approved Manufacturer/Product	Ball Valves		
☐ Apollo	☐		
☐ Watts	☐ S-FBV-1		

LINKS TO MANUFACTURERS:

- Watts: http://www.watts.com/pages/_products_details.asp?pid=566
- Apollo: http://www.apollovalves.com/products#/criteria?page=1&filter={"categories":["3"]}

Fire Hydrants

Fire Hydrant with
Vertical AquaGrip Shoe

Specification Section: 2510, paragraph 2.2.8

Standard Details: 514.02, 514.03

Standard: AWWA C502, UL 246, FM 1510, AWWA C550, 6" MJ inlet, 5-1/4" valve, (1) 4 ½-inch steamer nozzle, (2) 2 ½-inch nozzles with N.S. threads, 1 ½" open left pentagonal operating nut, NSF/ANSI 61, NSF/ANSI 372 certified lead free, Public hydrants painted Hunter Green with white bonnets. Private hydrants to be painted all red.

Approved Manufacturer/Product	Model	Dewatering	Bury depth[A]
☐ M&H	Style 129		3-foot or 4-foot
☐ McWane Ductile (formerly Clow Valve Company)	F-2545 Medallion		3-foot or 4-foot
☐ Mueller Company	A-423 Super Centurion 250		3-foot or 4-foot

LINKS TO MANUFACTURERS:

- M & H Valve Co.: http://www.mh-valve.com/products/catalog/hydrants/
- McWane Ductile: http://www.clowvalve.com/products/catalog/hydrants/
- Mueller Company: http://catalog.muellercompany.com/viewdocument.ashx?t=d&i=179

[A]For bury depths greater than 4 feet, add the Mueller Vertical Aqua-Grip Fire Hydrant Shoe.

Brass Pipe and Fittings

Specification Section: 2510, paragraph 2.1.1

Standard Details:

Standard: ASTM B43, AWWA C800, Regular Strength, NPT, Sch 40 minimum, NSF/ANSI 61, NSF/ANSI 372 certified lead free

Approved Manufacturer/Product	Supplemental Information
☐ Merit Brass	
☐ United Brass Works, Inc.	

LINKS TO MANUFACTURERS:

- Merit Brass: http://www.meritbrass.com/Dimensions/BrassPipe.pdf
- United Brass Works, Inc.: http://ubw.com/catalogsearch/result/?q=40+min

Blow Off Hydrant

Specification Section: 2510, paragraph 2.2.9

Standard Details: 514.01

Standard: 2", fully serviceable from above ground, self-draining, non-freezing, meets NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content for elements in contact with potable water)

Approved Manufacturer/Product	Model	Bury depth	Size
☐ The Kupferle Foundry Company	TF500	36" for 12" or less 42" for 16" and larger	2-inch

LINKS TO MANUFACTURERS:
The Kupferle Foundry Company: https://hydrants.com/truflo-tf500

Automatic Flushing Device

(Not for New Construction)

Specification Section: 2510, paragraphs 2.2.11 and 3.3.4

Standard Details: -

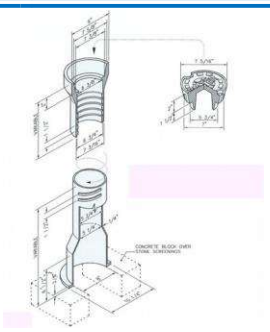
Standard: 2", fully serviceable from above ground, self-draining, non-freezing, minimum rated at minimum 150 gpm, meets NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content for elements in contact with potable water)

Approved Manufacturer/Product	Model	Bury depth	Size
☐ The Kupferle Foundry Company	Eclipse #9400	36" for 12" or less 42" for 16" and larger	2-inch
☐ Mueller Co.	HG-1	36" for 12" or less 42" for 16" and larger	2-inch

LINKS TO MANUFACTURERS:

- The Kupferle Foundry Company: https://hydrants.com/eclipse-9400
- Mueller Co.: https://www.muellercompany.com/water-works/hydro-guard/automatic-flushing-systems/hg-1-0/

Valve Boxes



Specification Section: 2510 paragraph 2.3.11

Standard Details: 513.01

Standard: Cast Iron, Screw Type, 5 ¼" shaft, ASTM A48, Grade 35B, Bituminous coating; slide or slip type is NOT acceptable.

Approved Manufacturer/Product	Number
☐ Capitol Foundry	461S (Range 19-22 inches) 562S (Range 27-37 inches) 564S (Range 39-50 inches) 664S (Range 39-60 inches)
☐ General Foundries, Inc.	32462 (Range 27-32 inches) 32562 (Range 27-37 inches) 32563 (Range 33-43 inches) 32564 (Range 39-50 inches) 32664 (Range 39-60 inches)

LINKS TO MANUFACTURERS:

- Capital Foundry of Virginia, Inc.: *http://www.capitolfoundry.net/valve-boxes---cleanouts*
- General Foundries, Inc.: http://www.generalfoundriesinc.com/catalog/pdf/Valve%20&%20Curb%20Boxes.pdf

Stainless Steel Tapping Sleeve

Specification Section: 2510, paragraph 2.2.7

Standard Details: 513.02

Standard: 18-8 type 304 Stainless Steel MJ, 150 psi minimum working pressure, NSF/ANSI 61, NSF/ANSI 372 certified lead free

Approved Manufacturer/Product	Number	Sizes
☐ Ford Meter Box Company	Style FAST	4-inch through 12-inch
☐ JCM	Model #432	4-inch through 12-inch
☐ Romac Industries, Inc.	Style SST	4-inch through 12-inch
☐ Smith-Blair	Model #663	4-inch through 12-inch

LINKS TO MANUFACTURERS:

- Ford Meter Box Company: http://www.fordmeterbox.com/products/productview.php?catSec=AA
- JCM: http://www.jcmindustries.com/products/branching-fittings/432-ss-tapping-sleeve
- Romac Industries, Inc.: http://www.romac.com/tappingsleeves/sst.html
- Smith-Blair: https://www.smith-blair.com/index.php?mod=prod_search&action=search_result&product_search_id=67&btnProductSearch=Search

Endotrace Traceable Tubing

Specification Section: 2510, paragraph 2.1.2

Standard Details:

Standard:

Tubing: All pipe to be EndoPure water pipe combined with a factory-installed 10 AWG tracer wire, EndroTrace to be manufactured with PE 4710 Bi-Modal HDPE resin. EndoPure to meet NSF/ANSI-14 & 61, AWWA C901, ASTM D3350, tracer wire to not interfere with fittings. CTS (Copper Tube Size) tubing, minimum 160 psi at 73.4ºF.

Fittings: AWWA C800 compression joint fittings that seal with internal gasket and external clamping. Include insert stiffners. NSF/ANSI 6, NSF/ANSI 372 certified lead free.

Approved Manufacturer/Product	Sizes
☐ Endot Industries, Inc.	1-inch to 2-inch
☐	1-inch to 2-inch

LINKS TO MANUFACTURERS:

- Endot Industries, Inc.: https://www.endot.com/products/endotrace

Corporation Stop

Specification Section: 2510, paragraph 2.2.10

Standard Details: 513.04, 515.01, 515.02, 515.03

Standard: AWWA C800, NSF/ANSI 61, NSF/ANSI 372 certified lead free, Ball Valve, 300 psi working pressure, CC tapered threaded inlet by compression outlet. All services require a double strap bronze saddle. Include plastic stiffeners for 1-inch fittings and stainless steel for 1 ½-inch and 2-inch fittings.

Approved Manufacturer/Product	Model Number	Sizes
☐ The Ford Meter Box Co.	☐ FB100-4-G-NL ☐ FB1000-6-G-NL ☐ FB1000-7-G-NL	1-inch 1 ½-inch 2-inch

LINKS TO MANUFACTURERS:

- The Ford Meter Box Company: http://www.fordmeterbox.com/products/productview.php?catSec=A&subSec=Key%20Corporation%20Stops&heading=AWWA%20Inlet&table=F1000

Angle Ball Valves

Specification Section: 2510, paragraph 2.2.2

Standard Details: 515.03

Standard: AWWA C800, NSF/ANSI 61, NSF/ANSI 372 certified lead free, 300 psi working pressure, Compression x IP Thread. Include plastic stiffeners for 1-inch fittings and stainless steel for 1 ½-inch and 2-inch fittings.

Approved Manufacturer/Product	Number	Size
☐ The Ford Meter Box Co.	☐ BA43-444W-G-NL ☐ BFA43-666W-G-NL ☐ BFA43-777W-G-NL	☐ 1-inch ☐ 1 ½-inch ☐ 2-inch

LINKS TO MANUFACTURERS:

- The Ford Meter Box Company: http://www.fordmeterbox.com/catalog/g/gjpeg.pdf

Curb Valves

Specification Section: 2510, paragraph 2.2.4

Standard Details: 515.01, 515.02, 515.03

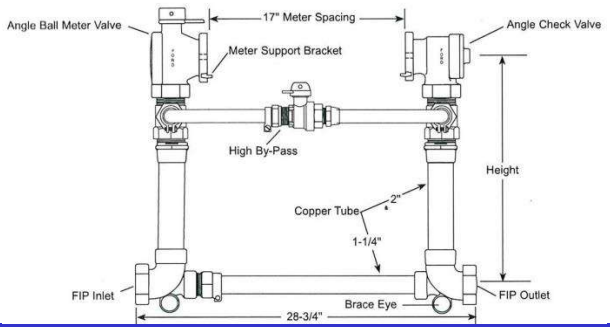
Standard: AWWA C800, NSF/ANSI 61, NSF/ANSI 372 certified lead free, 300 psi working pressure, Compression x FIP. Include plastic stiffeners for 1-inch fittings and stainless steel for 1 ½-inch and 2-inch fittings.

Approved Manufacturer/Product	Number	Size
☐ The Ford Meter Box Co.	☐ B11-333W -NL ☐ B11-444W-NL ☐ B41-444W-G-NL ☐ B41-666W-G-NL or BF43-666W-G-NL ☐ B41-777W-G-NL or BF43-777W-G-NL	☐ ¾-inch (multi-dwelling manifolds only) ☐ 1-inch (multi-dwelling manifolds only) ☐ 1-inch ☐ 1 ½-inch ☐ 2-inch

LINKS TO MANUFACTURERS:

- The Ford Meter Box Company: http://www.fordmeterbox.com/catalog/g/gjpeg.pdf

1 ½" and 2" Meter Setters



Specification Section: 2510 paragraph 2.3.10B

Standard Details: 515.03

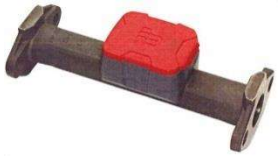
Standard: AWWA C800, (ASTM B62 and ASTM B584, UNS NO C83600 - 85-5-5-5 Brass), NSF/ANSI 61, NSF/ANSI 372 certified lead free

Approved Manufacturer/Product	Number	Size
☐ The Ford Meter Box Co.	☐ VBH76-18HB-11-66-NL ☐ VBH77-18HB-11-77-NL	1 ½-inch 2-inch

LINKS TO MANUFACTURERS:

- The Ford Meter Box Company: http://www.fordmeterbox.com/catalog/f/fjpeg.pdf

Small Meters – Ultrasonic



[A]Red Cap indicates for Fire Flow

Specification Section: 2510, paragraph 2.3.10A and C

Standard Details: 515.01, 515.02, 515.03

Standard: Meets or exceeds the applicable portions of standards of AWWA C700 and C715 and NSF/ANSI 61, Annex G, NSF/ANSI 372 certified (and carry NSF-61 marked on housing) lead free, lead free bronze or 316 stainless steel meter housing with wired lead and in-line connector for Elster AMR/AMI device, meters to be AMI remote readout with Elster AMI module (Model Elster # EW202200000) which is compatible with the Elster Energy Access system. Where applicable, meter UL Listed under UL Subject 327B (inferential type water meters used in residential fire service applications).
*Composite meters are not permitted.

☐ Badger Meter Company	☐ E-Series ☐ E-Series ☐ E-Series ☐ E-Series	☐ 5/8-inch x ¾-inch ☐ ¾-inch x 1-inch ☐ 1 ½-inch ☐ 2-inch
☐	☐	☐

LINKS TO MANUFACTURERS:

- Badger Meter Company: https://www.badgermeter.com/business-lines/utility/e-series-ultrasonic-meters/

Large Meters – Ultrasonic

Specification Section: 2510, paragraph 2.3.10C

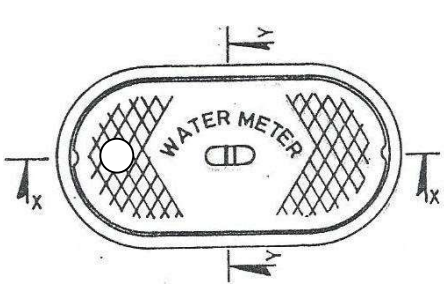
Standard Details: 515.04

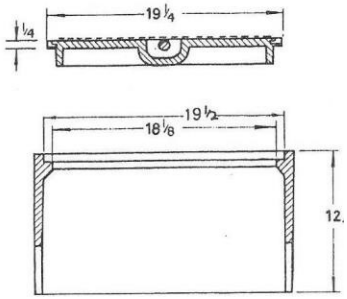
Standard: AWWA C750, NSF/ANSI 61-G, NSF/ANSI 372 certified lead free, working pressure 175 psi
3" - 8" outer cases: Outer cases shall be grade 316 Stainless Steel or Epoxy-coated Ductile Iron alloy meter bodies meeting ASTM A536 or ASTM A126 providing full compliance with ANSI/NSF 372 (AB1953 or NSF61G). Main case protected by a fusion-bonded coating conforming to AWWA C550. 3 and 4-inch to be stainless steel only.
10" - 12" outer cases: Outer cases shall be grade 316 Stainless Steel or Epoxy-coated cast Ductile Iron alloy meter bodies meeting ASTM A536 or ASTM A126 with main case protected by a fusion-bonded coating conforming to AWWA C550. Meter outer cases to provide full compliance with ANSI/NSF 372 (AB1953 or NSF61G).
Meter housing to be have wired lead and in-line connector for Elster AMR/AMI device, meters to be AMI remote readout with Elster AMI module (Model Ester # EW202200000) which is compatible with the Elster Energy Access system.

Approved Manufacturer/Product	Number	Size
☐ Master Meter	☐ Octave Ultrasonic Meter	☐ 3-inch through 12-inch
☐	☐	☐ 3-inch through 12-inch

LINKS TO MANUFACTURERS:
- Master Meter: http://www.mastermeter.com/en/Octave.html

Meter Boxes





Specification Section: 2510, paragraph 2.3.10A and B

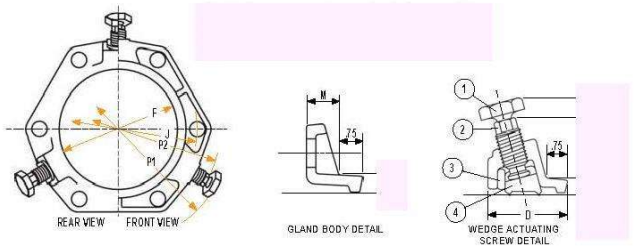
Standard Details: 515.01, 515.02, 515.03, 733.01

Standard: ASTM A-48 Class 35B, lid to be ordered predrilled for 2-inch hole for AMI remote readout.

Approved Manufacturer/Product	Number	Size
☐ Capital Foundry	MBX-1	5/8" x ¾" and 1" meter services
☐ Capital Foundry	MBX-5A	1 ½" and 2" meter services

LINKS TO MANUFACTURERS:
- Capital Foundry of Virginia, Inc.: http://www.capitolfoundry.net/meter-boxes

Mechanical Joint Restraint (Retainer) Glands



Specification Section: 2510, paragraph 2.1.3.B.3

Standard Details: 512.05

Standard: ASTM A536, grade 65-45-12 ductile iron, Working press 350-psi for 3" thru 16"; 250-psi for 18" and larger; AWWA C151, ANSI A21.51

Approved Manufacturer/Product	Product	
	DIP	**PVC**
☐ EBBA Iron Sales, Inc.	Megalug Series 1100	Megalug Series 2000PV
☐ The Ford Meter Box Company, Inc.	Uni-Flange Series 1400	Uni-Flange Series 1300
☐ Sigma	One-Lok Wedge Action Restrainer Gland D-SLDE Series	One-Lok Wedge Action Restrainer Gland D-SLCE Series
☐ SIP Industries	EZ-Grip (4" – 12"), EZDP	EZ-Grip (4"-12"), EZPVC
☐ Smith-Blair	Cam-Lock Series 111	Cam-Lock Series 120
☐ Star Pipe Products	StarGrip Series 3000	PVC StarGrip Series 4000
☐ Tyler Union	TufGrip Series 1000	TufGrip Series 2000

LINKS TO MANUFACTURERS:

- EBBA Iron Sales, Inc.: http://www.ebaa.com/files/pdf/brochures/Brochure.1100.pdf
- Ford: http://www.fordmeterbox.com/submittals/submittals.php?catSec=U&subSec=Restraint+Devices&heading=Series+1400&table=UFR1400
- Sigma: http://www.sigmaco.com/pipe-restraint-products/
- SIP Industries: http://sipindustries.com/dwlpdf/EZGripDI.pdf / http://sipindustries.com/dwlpdf/EZGripPVC.pdf
- Smith-Blair: https://www.smith-blair.com/index.php?mod=prod_search&action=search_result&product_search_id=1&btnProductSearch=Search
- Star Pipe Products: http://www.starpipeproducts.com/joint_restraint_catalog_submittal.asp
- Tyler Union: https://www.tylerunion.com/products/catalog/restraints/

1-Inch and 2-Inch Air Release Valve

Specification Section: 2510, paragraph 2.2.1

Standard Details: 516.01

Standard: AWWA C512, NSF/ANSI 61-G, NSF/ANSI 372 certified lead free

Approved Manufacturer/Product	Size	Model
☐ A.R.I	☐ 1-inch ☐ 2-inch	☐ S-015 ☐ S-015
☐ Crispin-Multiplex Manufacturing Co.	☐ 1-inch ☐ 2-inch	☐ Type “N” PL 10 ☐ Type “N” PL 20
☐ G. A. Industries	☐ 1-inch ☐ 2-inch	☐ Fig 910 ☐ Fig 920
☐ Val-Matic	☐ 1-inch ☐ 2-inch	☐ Model #22.3 ☐ Model # 45
☐	☐ 1-inch ☐ 2-inch	☐ ☐

LINKS TO MANUFACTURERS:

- A.R.I.: http://www.ariusa.com/products/water-supply/item/s-015-s-016-automatic-air-release-valve
- Crispin-Multiplex Manufacturing Co.: https://crispinvalve.com/air-release-valves/air-release-valves/pressure-air-release/pl-series/
- G. A. Industries: http://www.environmental-expert.com/companies/ga-industries-inc-7996/products/family-distributor-automatic-air-release-valves-244851#distributor-automatic-air-release-valves
- Val-Matic: http://www.valmatic.com/airrelease.html

Tapping Service Saddle

Specification Section: 2510, paragraph 2.3.10 A & B

Standard Details: 513.04

Standard: AWWA C800, 85-5-5-5 All Bronze Double Strap Service Saddles, NSF/ANSI 61, NSF/ANSI 372 certified lead free

Approved Manufacturer/Product	Size	Model
☐ AY McDonald Mfg. Company	☐ 1-inch ☐ 1 ½-inch ☐ 2-inch	☐ 3825 ☐ 3825 ☐ 3825
☐ Mueller	☐ 1-inch ☐ 1 ½-inch ☐ 2-inch	☐ BR2B ☐ BR2B ☐ BR2B
☐ Romac Industries, Inc.	☐ 1-inch ☐ 1 ½-inch ☐ 2-inch	☐ 202B / 202BSD (C900) ☐ 202B / 202BSD (C900) ☐ 202B / 202BSD (C900)
☐ The Ford Meter Box Co.	☐ 1-inch ☐ 1 ½-inch ☐ 2-inch	☐ 202B / 202BSD (C900) ☐ 202B / 202BSD (C900) ☐ 202B / 202BSD (C900)
☐	☐ 1-inch ☐ 1 ½-inch ☐ 2-inch	☐ ☐ ☐

LINKS TO MANUFACTURES:

- AY McDonald Mfg. Company: https://aymcdonald.com/search?query=3825
- The Ford Meter Box Co.: http://www.fordmeterbox.com/products/productview.php?catSec=AA&subSec=Brass%20Saddles&heading=Brass%20Saddles%20For%20Ductile%20Iron%20Pipe%20And%20A/C%20Pipe&table=_202B
- Mueller: https://www.muellercompany.com/water-works/service-brass/service-saddles/
- Romac Industries, Inc: http://romac.com/202b

Cast Couplings

Specification Section: 2510, paragraph 2.3.3 (excluding restraint spec)

Standard Details:

Standard: ASTM A536, NSF 61, AWWA C219, Minimum 150 psi working pressure

Approved Manufacturer/Product	Model	Size
☐ EBBA Iron, Inc.	☐ Series 3800 Mega-Coupling (DIP to C900 PVC)	6-inch through 12-inch
☐ Romac	☐ Macro	6-inch through 12-inch
☐ Romac	☐ Alpha	6-inch through 12-inch
☐ Smith-Blair	☐ 441	6-inch through 16-inch
☐ The Ford Meter Box Co.	☐ FC 2W	6-inch through 16-inch

LINKS TO MANUFACTURES:

- EBBA Iron, Inc.: https://ebaa.com/products/coupling/coupling-for-restraining-plain-ends-of-pipe/3800/29
- Romac Industries, Inc: http://romac.com/couplings
  http://romac.com/alpha
- Smith-Blair: https://www.smith-blair.com/index.php?mod=prod_search&action=search_result&product_search_id=47&btnProductSearch=Search
- The Ford Meter Box Co.: http://www.fordmeterbox.com/products/productview.php?catSec=M&subSec=Ductile%20Iron%20Ultra-Flex%20Wide%20Range%20Couplings%20-%20FC2W&heading=Style%20FC2W&table=FC2W

Restrained Flanged Coupling Adapters

(Split Gland for use on existing pipe)

Specification Section: 2510, paragraph 2.3.3		
Standard Details: 515.04		
Standard: ASTM A536, NSF 61, AWWA C219, Minimum 150 psi working pressure		
Approved Manufacturer/Product	**Model**	**Size**
☐ The Ford Meter Box Co.	☐ RFAD for DIP	4-inch through 12 inch
☐ Romac Industries, Inc.	☐ RFCA for DIP	4-inch through 12 inch
☐ Smith-Blair	☐ 911 FCA for DIP	4-inch through 12 inch

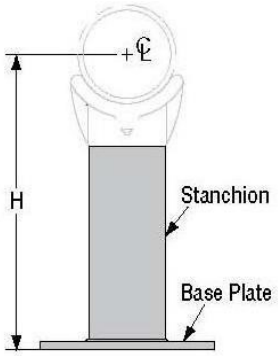
LINKS TO MANUFACTURES:

- The Ford Meter Box Co.: http://www.fordmeterbox.com/documents/flyers/FRFAD-RFAP.pdf
- Romack Industries, Inc.: http://romac.com/restraint
- Smith-Blair: http://smith-blair.com/index.php?mod=solutions&mid=1&sid=3

Bore and Jack Operations

Specification Section: 2510, paragraph 2.1.6A; 2530 paragraph 2.1.4		
Standard Details: C07.03		
Standard: ASTM A139, grade B steel pipe casing, ASTM A283		
Approved Vendors	**Casing Spacers/Spiders**	**End Seals**
See Bore & Jack Operations under Sewer		

Pipe Saddle Support



Specification Section: 2510, paragraph 2.3.9

Standard Details: 515.04, 519.03

Standard: ASTM A36, ASTM A53

Approved Manufacturer/Product	Dry Conditions	Wet or Harsh Corrosive
☐ Grinnell	☐ Figure 259; Fig 63P Pipe Stanchion	☐
☐ Material Resources, Inc.	☐ Standon Model S92	☐ Standon Model S92

LINKS TO MANUFACTURERS:

- Anvil International, Inc.: https://www.anvilintl.com/products/259-pipe-saddle-support-with-u-bolt
- Material Resources, Inc.: http://www.standon.net/pdf/s92specsheet.pdf

Detectable Warning Tape

(required on all open cut service lines)

Specification Section: 2510, paragraph 2.3.12C

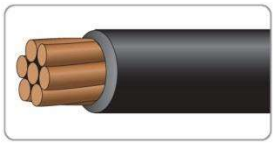
Standard Details: 511.01

Standard: ASTM D2103, ASTM D882, ASTM D2578

Approved Manufacturer	Product	
☐ Empire Level Mfg. Corp.	☐ Magnatec	

LINKS TO MANUFACTURES:

- Empire Level Mfg. Corp: http://www.empirelevel.com/pdf/16-EMP-0106_UndergroundTape_Catalog_v16.pdf

Copper Tracer Wire	Inline Splice Kits
	

(Copper Tracer Wire Required for Sewer Services but not services to main or MH to MH)

Specification Section: 2510, paragraph 2.3.12B	
Standard Details: 511.01	
Standard: #12 AWG Blue insulated solid or stranded copper wire, XLP/USE-2/RHH/RHW-2, direct bury listed.	
Approved Wire Manufacturers:	**Product**
☐ Service Wire Company	
☐ Southwire	
☐ USA Wire & Cable	
☐ Wire & Cable To Go	
Approved Wire Inline Splice Kits	
☐ 3M	☐ Scotchcast Inline Splice Kits 72-N Series
	☐ Scotchcast Inline Resin Power Cable Splice Kits 82-A Series
	☐ Scotchcast Flexible Power Cable Inline Splicing Kits 82-FSeries

LINKS TO MANUFACTURERS:

Wire Manufacturers:

- Service Wire Company: http://www.servicewire.com/Single-Conductors-v2-XHHW.php
- Southwire: https://www.southwire.com/Copper-Bare-%26-Covered/c/copper-bare-and-covered
- USA Wire & Cable: http://www.usawire-cable.com/pdfs/USE-2_XLP.pdf
- Wire & Cable To Go: http://www.wireandcabletogo.com/Copper-Building-Wire/XLP-USE-2-RHH-RHW-2/

Wire Inline Splice Kits:

- 3M:
  1. https://www.3m.com/3M/en_US/company-us/search/?Ntt=scotchcast+inline+splice+kits%2C+72-N+series
  2. https://www.3m.com/3M/en_US/company-us/search/?Ntt=Scotchcast%E2%84%A2+Inline+Splice+Kit+82-A+series
  3. https://www.3m.com/3M/en_US/company-us/search/?Ntt=Scotchcast%E2%84%A2+Inline+Splice+Kit+82-F+series

PRE-APPROVED MATERIAL LIST

Draft Revision: _____
Effective Date: _____

City of Wilson Contract Number: _____

Date: _____

To: City of Wilson
1800 Herring Avenue
Post Office Box 10
Wilson, NC 27894-0010

From: Contractor Name _____
Address _____
City, State, Zip _____

Re: Project Name _____

"Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements." _____ _____
Contractor Signature Date

Note 1: Please denote (highlight, check numbers, or otherwise identify) the materials from the attached list that you intend to use on this project.

Note 2: Failure to provide complete information will result in delays in the approval process and may affect the project schedule.

Note 3: This list and all substitution information shall be submitted to the City Engineer **with the Proposal Package**.

00825 - PRODUCT SUBSTITUTIONS

(Last rev ~~5/5/10~~, 9/18/19) R1

1. Product Substitutions

A. **Product Substitutions**:

1) Trade names, brand names, and/or manufacturer's information used in these specifications are for the purposes of establishing quality. Bids on products or other qualified manufacturers are acceptable provided request is made in writing not less than 10 days prior to scheduled receipt of bids, and provided the product has been previously approved by the City of Wilson's Product and Design Review Committee (PDRC) and provided that:

a. No major changes in the construction, design intent, or to any services or modifications to other equipment of the project would be required. Changes required to accommodate substituted items or the cost to repair and damage resulting from effecting such changes or modifications made necessary or caused by substitution shall be made by the Contractor at no additional cost or time delay.

b. Features of quality, capacity, construction, performance, appearance, size, arrangement, and general utility including economy of operation of substitutes offered, either parallel or exceed those of specified products.

2) Technical data covering the proposed substitution shall be furnished with the request.

2. Product and Design Review Committee

A. **Product and Design Review Committee** (PDRC) – How to have your products and designs approved by the City of Wilson:

1) **Evaluation Process**:

a. Who is Eligible? Anyone interested in having their company's products and designs approved by the City of Wilson.

2) **How to apply**:

a. The committee meets on the second Friday of each month or as needed.

b. **Formal Request**: A formal written request must be submitted to the committee at least 60 days prior to the date of the presentation. This request should include the preferred meeting date as well as an alternate date. In addition, 7 copies of this request must be submitted along with 7 copies of all literature, specifications, and materials that might affect the decision of the committee. The submittal must include the following: detail information

about the product, cost of the product and installation if applicable, discussion of the benefit, detail list of references of current users of the product and a discussion on the product's availability to the City of Wilson and time related to ordering and delivery. A sample of the product, a video and/or photos my also be provided during the presentation.

c. **Presentation**: There will be a 30-minute time limit for each presentation. Questions will be answered in a 15-minute time period after the presentation. You will be notified of your presentation date within 30 days after receipt of your request. Requests should be in writing, but phone calls will be accepted by the PDRC Committee Chairman. Representatives at the meeting should be in a position to offer any type of background on product use and locations, design, and reference checks. These representatives should also have the authority to approve a trial run in our service area.

d. **Applications**: Send all applications to:

Mr. Bill Bass, PE, Public Works Director, City Engineer, Committee Chairman
1800 Herring Avenue
Post Office Box 10
Wilson, NC 27894-0010

3) **Product and Design Review Subcommittee Members**

The PRDC is composed of the following subcommittees and members. Requests for will be forwarded to the applicable subcommittee for review and consideration.

a. **Water**:
   1. City Engineer
   2. Water Resources Manager
   3. Water Distribution ORC
   4. Construction Inspector
   5. Civil Engineer

b. **Sewer**
   1. City Engineer
   2. Sanitary Sewer ORC
   3. Construction Inspector
   4. Civil Engineer

c. **Stormwater Management**
   1. City Engineer
   2. Water Resources Manager
   3. Sanitary Sewer ORC
   4. Construction Inspector
   5. Civil Engineer
   6. Stormwater Project Manager

d. **Traffic**

1. City Engineer
2. Assistant Public Services Director/Administration
3. Traffic Services Supervisor
4. Construction Inspector
5. Civil Engineer

e. **Streets**

1. City Engineer
2. Assistant Public Services Director/Administration
3. Construction Inspector
4. Civil Engineer
5. Street Superintendent

4) **Results**: Within 45 days after the presentation, the committee chairman will notify the designer or vendor in writing about the committee's findings. A two-thirds vote of the members is required to approve that product or design for use in the applicable division/department.

5) The City of Wilson reserves the right to limit the number of approved manufacturers and products as they deem necessary in order to control parts inventory, maintenance, and training requirements.

bj.Wilson.Product_Substitutions_Product_ DR_Comm_FINAL.doc

00950 - MEASUREMENT & PAYMENT (CITY FUNDED PROJECTS)

(Last revised ~~4/23/12~~, 9/10/19) R2

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

1.1 TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES

Measurements for purpose of payment shall be in accordance with the unit quantities stated in the proposal as defined below. Whenever units of measure, (i.e. linear feet, each, and similar units of measurement) are mentioned in a proposal, it shall be interpreted to mean the unit installed in accordance with the plans and specifications, and ready for use. Prices for the following bid items shall include all labor, materials, tools, equipment, and other incidentals necessary to complete the work as shown on the plans and in accordance with these specifications.

A. **Aggregate Backfill:**

Measurement: Coarse granular fill will be measured by the cubic yard in place in the trench.

Payment: Price per cubic yard for coarse granular fill shall include all materials, equipment, and labor required to furnish and install #57 or #67 stone in the locations designated by the City Engineer.

B. **Bedding, Haunching, Crushed Stone for Sewer Mains:**

Measurement: Bedding stone is considered incidental to the cost of the pipe.

Payment: Not a pay item.

C. **Excavation and Backfill:**

Measurement and Payment: All excavation and backfill shall be included in the cost of the other items bid – not a pay item.

When the removal of existing structures or materials is classified separately as a contract pay item, payment will be made in accordance with the contract price; otherwise, such work will be considered as incidental work and will not be paid for directly, but the cost shall be included in the unit price for other items of work. In either case, such price or prices shall be full compensation for all labor, materials, tools, equipment, and incidentals necessary to complete the work.

D. **Exploratory Excavation**

Measurement: Such excavation, where ordered by the City Engineer will be measured by the cubic yard.

Payment: The cost of such excavation, where ordered by the City Engineer, will be paid at the contract unit price bid, per cubic yard.

E. **Foundation Stone:**

Measurement: Foundation stone used in stabilizing the bottom of trenches will be field measured in the trench by the cubic yard, complete in place.

Payment: When the City Engineer directs the use of foundation stone, foundation stone shall be paid for at the contract unit price for foundation stone by the cubic yard. Payment shall include all materials and labor incidental to the placing of the stone and any additional extra depth of trench or excavation necessary to accommodate the stone including disposal of unusable material necessary to allow for placement of the foundation stone.

F. **Pavement Removal and Replacement**

Measurement: Where pavement is encountered, as shown on the plans, pavement removal and replacement will be measured by the square yard regardless of the existing pavement material or depth. See Specification Section 02275 – *Trenching, Backfilling, and Compaction of Utilities*, paragraph 3.7, *Pavement Repair and Replacement*.

Payment: This item will be paid for at the contract unit price per square yard for pavement removal and replacement. The unit price bid shall include all labor, tools, equipment, and material necessary to complete the work and shall include, but is not necessarily limited to, saw cutting the pavement, removal of existing pavement materials which are not suitable for backfilling the trench from the job, placement of suitable backfill material, and the cost for compaction and compaction testing by a certified and approved laboratory. In the case of pavement cut and removal, such price or prices shall include the cost of the required permit for cutting pavement, unless permit fees are included as a bid item in the Contract Documents. Extra width will not be measured for payment and there will be no extra payment for any of the above work, the cost of which shall be included in the unit price bid for pavement removal and replacement.

G. **Portland Cement Concrete Sidewalk**

Measurement: Where existing concrete sidewalk is encountered, as shown on the plans, removal and replacement will be measured by the square yard of sidewalk ordered removed and replaced by the City Engineer, regardless of the depth of the existing sidewalk.

Payment: This item will be paid for at the contract unit price per square yard for removal and replacement of concrete sidewalk, depth to match the depth removed with no extra compensation for depth. The unit price bid shall include all labor, tools,

equipment, and material necessary to complete the work and shall include, but is not necessarily limited to, saw cutting the sidewalk, removal of all existing materials, which are not suitable for backfill in the trench from the job, compaction of the trench and replacement of the sidewalk.

H. **Remove and Replace Asphalt Drive and Remove and Replace Concrete Drive**

Measurement: Where either an existing asphalt or concrete drive is encountered, as shown on the plans, pavement removal and replacement will be measured by the square yard regardless of the existing pavement material or depth.

Payment: This item will be paid for at the contract unit price per square yard for removal and replacement of either asphalt or concrete drives. The unit price bid shall include all labor, tools, equipment, and material necessary to complete the work and shall include, but is not necessarily limited to, saw cutting the pavement, removal of all paving materials which are not suitable for backfill in the trench from the job, and compaction of the trench. There will be no extra payment for any of the above work, the cost of which shall be included in the unit price bid for removal and replacement of asphalt or concrete drives.

I. **Paving and Resurfacing**

[Pay: By the ton using Terminal Prices for adjustment]

Measurement: Asphalt concrete pavement shall be measured by the actual number of tons of plant mix completed and accepted on the job. Measurement for all roadways will be based on plan quantities and field measurements, verified by tonnage tickets unless otherwise directed by the City Engineer. At the discretion of the City Engineer, coring's at quarter points of the street cross-section may be requested to verify thickness and density of asphalt.

Payment: Asphalt concrete pavement will be paid for at the "Contract Unit Price" bid per ton for the type of asphalt concrete specified. However, the "Contract Unit Price" per ton will be adjusted to account for variations either up or down in the price of asphalt binder from a "Base Price Index" to yield an "Adjusted Contract Unit Price." The "Adjusted Contract Unit Price" is the price paid at the time the paving/work is placed or performed. The "Adjusted Contract Unit Price" shall be full compensation for asphalt concrete pavement, complete in place, including all materials, labor, tools, equipment, tack coat, maintenance of traffic, and all other incidentals necessary. Adjusting manholes, cleanouts, valve boxes, etc. will be paid separately at the bid price for each when adjusted by the Contractor. Payment will be made on a per ton basis.

PRICE ADJUSTMENT - ASPHALT BINDER FOR PLANT MIX:

When it is determined that the monthly selling price of asphalt binder on the first business day of the calendar month during which the last day of the partial payment period occurs varies either upward or downward from the "Base Price Index," the "Contract Unit Price" for asphalt binder for plant mix will be adjusted.

The "Base Price Index" provided for asphalt binder for plant mix, per ton, shall be used to compute the "Adjusted Contract Unit Price." The "Base Price Index" to be included

in a proposal/contract along the applicable date will be the Monthly Price Index in effect 2 months prior the month in which the contract is let. The "Base Price Index" will remain fixed throughout the life of the contract. This "Base Price Index" represents an average of F.O.B. selling prices of asphalt binder at supplier's terminals.

Price adjustments for asphalt binder for plant mix will be made in accordance with Section 620 of the NCDOT *Standard Specifications.*

[BIDDING NOTE: In preparation of the bid documents, the City must indicate the "Base Price Index" for asphalt binder for plant mix per ton in the form of proposal. Along with this price, show the date of the selling prices of asphalt binder at supplier's terminal. The price and date is obtained from the NCDOT's website and then inserted into the bid documents.]

The following is a link to the NCDOT website showing the terminal price:

https://connect.ncdot.gov/projects/construction/Pages/Pavement-Construction-Prices.aspx

J. **Rock Excavation, Trench:**

Measurement: Where rock excavation is to be measured for payment, quantities will be as determined by the City. Rock excavation will be measured by the cubic yard. For pay purposes, dimensions shall be computed as the difference in elevation between the top and bottom of the rock (as determined by the City) multiplied by the specified trench width for the pipe size being laid. Where rock is encountered in the bottom of the trench, the maximum depth for payment purposes shall be 6 inches below the bottom of the pipe. Rock excavation shall consist of the removal and satisfactory disposal of all materials, which in the opinion of the City Engineer, cannot be excavated except by a track-mounted power excavator, equivalent to a Caterpillar Model No. 325 or equivalent equipped with new rock teeth. Practical excavation is defined as the ability to remove at least 30 cubic yards during one hour of continuous digging. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.

Payment: Rock excavation will be paid for at the contract unit price per cubic yard for rock excavation and shall include all labor, materials, insurance, mats, signage, traffic control, tools, equipment and incidentals necessary to excavate and dispose of rock off site, backfilling the excavated trench to the bottom of the pipe with select backfill material, and shall include the cost of removing all excavated materials which are not suitable for backfill. No payment will be made for rock that has been excavated subsequent to ripping operations.

K. **Sheeting and Bracing (Piling)**

Measurement and Payment: Payment for sheeting and bracing, except when ordered to be left in place, and all other work incidental to sheeting and bracing, shall not be made separately unless specified or as shown on the plans or as directed by the City Engineer, but shall be included in the bid price for other items.

When specified, payment for "Steel Sheet Piling" shall be made at the contract unit price bid per linear foot (horizontal).

When specified, payment for “Steel Sheet Piling Left in Place” shall be made at the contract unit price bid per linear foot.

L. **Select Fill:**

Measurement: Trench excavation determined to be unusable by the City Engineer, or his representative, resulting from material which may be unsatisfactory (as defined in paragraph 2.1.1F of *Section 02275, Trenching, Backfilling, and Compaction of Utilities*), non-compactable, naturally wet (when removed from trench) and otherwise unusable due to too high a moisture content for compaction (as opposed to unprotected soil exposed carelessly to rain which becomes unusable in which case there is no claim for payment for trench borrow). Measurement shall be made along the centerline of the pipe and the pay quantity shall be determined based upon the depth of fill placed times the maximum trench width (pipe outside diameter plus 2 feet). Selected granular backfill in excess of the maximum quantity, as specified, shall be furnished and placed by the Contractor.

Payment: Select Fill will be paid for at the contract unit price by the compacted cubic yard, in place, and shall include all material, equipment, and labor to furnish, haul, placement, compact the approved material, and haul off unsuitable material, complete in place, in the locations as designated on the drawings or as approved by the City Engineer.

M. **Other:** Other items shall be paid for as stated in the Proposal.

1.2 WATER

Measurements for purpose of payment shall be in accordance with the unit quantities stated in the proposal as defined below. Whenever units of measure, (i.e. linear feet, each, and similar units of measurement) are mentioned in a proposal, it shall be interpreted to mean the unit installed in accordance with the plans and specifications, and ready for use. Prices for the following bid items shall include all labor, materials, tools, equipment, and other incidentals necessary to complete the work as shown on the plans and in accordance with these specifications.

A. **Bedding Stone for Water Pipe:**

Measurement: When called for in the proposal or on the plans or when directed by the City Engineer or Water Resources Manager, aggregate material used for bedding water lines will be measured by the cubic yard of pipe bedding material placed.

Payment: Pipe bedding stone will be paid for at the contract unit price per cubic yard for pipe bedding material, complete and in place.

B. **Blow-Offs:**

Measurement: Blow-offs will be measured on a per each basis for the number of blow-offs installed.

Payment: Blow-offs will be paid for at the contract unit price per blow-off for the size specified, and all materials incidental to the installation of the blow-off, complete in place. This price shall include, but is not necessarily limited to, Kupferles's blow off service, piping, tapped MJ plug, joint restraint system, fittings, valve box(es), sawing asphalt and placement of reinforced concrete valve box collar (per detail 514.02), bedding material, concrete collar, blocking, and other related incidentals as shown on **Standard Detail 514.01**.

C. **Concrete Encasement**

Measurement: Payment for furnishing concrete encasement will be at the unit price bid per cubic yard for the class of concrete stated in the proposal.

Payment: The unit priced stated in the proposal shall include the cost of additional depth of excavation, forming, the furnishing and placing of concrete, cofferdams, laying of pipe line to grade but excluding the cost of the pipe itself, complete in place, including all labor, equipment, and material, necessary and all other work incidental to the complete installation of the concrete encasement in accordance with the specification and details shown on the plans. Payment will be made to neat lines of construction shown on the plans with no allowance being made for extra ditch width.

D. **Concrete Piers**:

Measurement: Reinforced concrete piers shall be measured on an each basis based on the height and the structural details shown on the contract drawings.

Payment: This item will be paid for at the contract unit price bid for concrete piers complete in place, including all labor, equipment, and material, necessary for furnishing, excavating, disposal of excess material, stone bedding, reinforcement, anchor bolts, steel straps, concrete, testing, forming, concrete finishing, backfilling, restoration of grade, and all other work incidental to the complete installation of the concrete piers in accordance with the specification and details shown on the plans. Payment will be made to neat lines of construction shown on the plans with no allowance being made for extra ditch width.

E. **Connecting to Existing Mains**

Not a pay item. Fittings and specialty items used in making the connections will be measured and paid for at the unit price bid by the Contractor for "Fittings" and at the unit price bid for "Tapping Sleeves and Valve."

F. **Dechlorination**

Not a pay item. The associated work, materials, and labor involved in dechlorinating water is incidental to the cost of the water main construction and shall be included in other bid items.

G. **Ductile Iron Pipe (For Mains):**

Measurement*:* Measured horizontally along centerline of pipe by the linear foot of various sizes. All pipes shall be measured from the exact beginning of the pipe to the end of the line without deduction for fittings (i.e. fittings and valves) and shall be made

through casings. 6-inch hydrant leg lead-in pipe is not included but is considered incidental to the cost of hydrant installation.

Payment: The accepted quantities of water line pipe will be paid for at the contract unit price per linear foot of the various types, depths, and size pipe specified (fittings, valves, and specialty items are paid separately), complete in place. This price shall include labor, equipment, materials, trench excavation (excluding select fill and rock as defined in item 1.1 J, of this document), shoring, or use of trench box, installation, concrete thrust blocking, making connections to existing mains, installing in existing casing, pumping, backfilling, compaction, testing of failed trenches, disposal of excess material, pressure testing, chlorinating, dechlorination, bacteriological testing, and all other work incidental to the complete installation of the mains in accordance with these specifications. Fittings, valves, and specialty items are paid separately.

H. **Ductile Iron Pipe, Bored and Jacked**

Measurement: Measurement of Ductile Iron Pipe, bored and jacked, shall be measured by the linear feet of pipe installed. Bored and jacked Ductile Iron Pipe shall include any excavation, any backfill, bore, jacking, the pipe, dewatering, clean up, restoration and any other work required for a complete and acceptable in place installation.

Payment: Ductile Iron Pipe, bored and jacked will be paid for at the contract unit price per linear foot for pipe bored, complete, and acceptable in place. The price shall be full compensations for pipe, labor, equipment, and all other work incidental to the complete installation of the mains in accordance with these specifications. Fittings, valves, and specialty items are paid separately. Payment will only be made upon acceptance by the City of Wilson and the Consulting Engineer that the bore is installed to the proper elevation and grade. Any deviations, errors, or unacceptable conditions noted by the City of Wilson or the Wilson County office of the North Carolina Department of Transportation (if applicable) will be the responsibility of the Contractor to correct to the full satisfaction of the above-mentioned parties without additional compensation.

I. **Encasement Pipe (bored):**

Measurement: Steel casing pipe of the wall thickness and diameter specified will be measured by the linear feet of steel casing pipe installed.

Encasement of water lines by the dry bore and jacking method shall include any excavation, any backfill, the encasement pipe, bore, jacking, spiders, the end seals, dewatering, clean up, restoration and any other work required for a complete and acceptable in place installation.

Payment: Steel casing pipe will be paid for at the contract unit price per linear foot per diameter per thickness for steel casing pipe bored, complete, and acceptable in place. Payment will only be made upon acceptance by the City of Wilson and the Consulting Engineer that the bore is installed to the proper elevation and grade and ready for the installation of the designed carrier pipe without any additional compensation. Any deviations, errors, or unacceptable conditions noted by the City of Wilson or the Wilson County office of the North Carolina Department of Transportation (if applicable) will be the responsibility of the Contractor to correct to the full satisfaction of the above-

mentioned parties. Lines either off on grade or alignment shall be rejected or corrected in a manner approved by the City's Engineer or Water Resources Manager. *Regardless of the number of withdrawal and reattempts, the bore shall be paid one time for a successful bore on a linear foot basis*. The cost of the carrier pipe is not to be included.

J. **Encasement Pipe (open cut):**

Measurement: Steel casing pipe of the wall thickness and diameter specified will be measured by the linear feet of steel casing pipe installed.

Encasement of water lines by the open cut method shall include any excavation, any backfill, the encasement pipe, spiders, the ends seals, dewatering, clean up, restoration and any other work required for a complete in place installation.

Payment: Steel casing pipe will be paid for at the contract unit price per linear foot per diameter per thickness for steel casing pipe installed by the pipe open cut, complete and in place. Lines either off on grade or alignment shall be rejected or corrected in a manner approved by the City's Engineer or Water Resources Manager. The cost of the carrier pipe is not to be included.

K. **Excavation and Backfill:**

Measurement and payment: All excavation and backfill for water mains shall be included in the cost of the other items bid – this is not a pay item.

L. **Fittings and Accessories:**

Measurement: Fittings and specialty items used in conjunction with ductile iron or C900 PVC pipe will be measured per each.

Payment: Payment for ductile iron fittings shall include all labor, equipment and all materials necessary for installing, making connections to existing mains, tie rods, wedge action restrainer glands, backfilling, testing, sterilizing, and all other work incidental to the complete installation of these fittings in accordance with the specifications.

M. **Fire Hydrants:**

Measurement: Fire hydrants will be measured by the number of hydrants installed on an each basis.

Payment: Price shall include all labor, equipment, and all materials (including extensions and fittings), necessary to install the hydrant including construction staking, #57 stone, drainage pit, thrust restraint, 6-inch hydrant leg lead in pipe, testing and disinfecting, complete and in place. Valves will be paid for separately. The cost of surveying for staking hydrant location is to be included in the cost of the hydrant unless an item is provided in the proposal for utility construction staking whereupon the costs shall then be included in that line item. Pavement repair, select fill, and stone for trench stabilization are not to be included in the bid price for the fire hydrant.

N. **Fire Hydrants Removal:**

Measurement: Fire hydrants will be measured by the number of existing fire hydrants removed on an each basis.

Payment: Price shall include all labor, equipment, and all materials necessary to remove the hydrant including excavation, backfilling, topsoil, seeding or sod replacement, capping the hydrant lateral, curb/gutter and sidewalk replacement, and delivery of old hydrant to the Public Services Department (the hydrant shall remain the property of the City). Pavement repair, select fill, and stone for trench stabilization are not to be included in the bid price for the fire hydrant removal.

O. **Fire Vaults and Large Meter Vaults:**

Measurement: Vaults for backflow prevention devices, detector check, RPZ, or large meters (meters larger than 2 inches) shall be paid lump sum. Cost for vault is to include all labor, materials, equipment, backfill, compaction, etc. complete and in place. The cost of the vault is to also include the insulated enclosure (below ground vaults are not permitted) and concrete pad, stone bedding, the backflow prevention device and/or meter, gate valves, post indicator valves (if applicable), fittings, check valves, couplings, sleeves, fire department connection (if applicable), hatch, floor drain (if applicable) and drain line, pipe stands, vents, ladder, painting of pipe and fittings (if applicable), defect repair, testing, etc. necessary to render a complete unit as shown on the contract drawings.

Payment: Vault payment will be paid as lump sum.

P. **Foundation Stone:**

Measurement: Foundation stone used in stabilizing the bottom of trenches will be field measured in the trench by the cubic yard, complete in place.

Payment: When the City Engineer directs the use of foundation stone, foundation stone shall be paid for at the contract unit price for foundation stone by the cubic yard. Payment shall include all materials and labor incidental to the placing of the stone and any additional extra depth of trench or excavation necessary to accommodate the stone including disposal of unusable material necessary to allow for placement of the foundation stone.

Q. **Miscellaneous Fittings**

Measurement: By the piece.

Payment: Payment for ductile iron fittings where specified on the plans shall be made per piece Cost of accessories shall be included in the price of the fitting.

R. **PVC Pipe (when applicable):**

Measurement*:* Measured horizontally along centerline of pipe by the linear foot of various sizes. All pipes shall be measured from the exact beginning of the pipe to the end of the line without deduction for fittings (i.e. fittings and valves) and shall be made through casings. 6-inch hydrant leg lead-in pipe is not included but is considered incidental to the cost of hydrant installation.

Payment: The accepted quantities of PVC water line pipe will be paid for at the contract unit price per linear foot of the various types and size pipe specified (fittings, valves, and specialty items are paid separately), complete in place. This price shall include all labor, equipment, materials, trench excavation (excluding rock and select fill), shoring, or use of trench box, installation, concrete thrust blocking, detectable warning tape, copper wire with valve boxes, making connections to existing mains, installing in existing casing, pumping, backfilling, compaction, testing of failed trenches, disposal of excess material, pressure testing, chlorinating, dechlorination, and bacteriological testing and all other work incidental to the complete installation of the mains in accordance with these specifications. No special payment will be made for fittings, specialty items, or pipe used in making connections to existing mains where such connections are noted on the plans.

S. **HDPE Water Pipe for Horizontal Directional Drilling (HDD) Applications (when applicable):**

Measurement*:* Measured horizontally along centerline of pipe by the linear foot of various sizes. All pipes shall be measured from the exact beginning of the pipe to the end of the line without deduction for lengths of fittings, connections, valves, flushing connections. Air/vacuum and air release valve manholes are paid separately. 6-inch hydrant leg lead-in pipe is not included but is considered incidental to the cost of hydrant installation.

Payment: The accepted quantities of PVC water line pipe will be paid for at the contract unit price per linear foot of the various types, depths, and size pipe specified (fittings, valves, and specialty items are paid separately), complete in place for horizontal directional drilling method of installing HDPE pipe. This price shall include all labor, equipment, materials, trench excavation in open-cut areas (excluding rock and select fill), shoring, or use of trench box, installation, concrete thrust blocking, detectable warning tape or copper wire per applicable specs and details, making connections to existing mains, pumping, backfilling and compaction of open cut areas, testing of failed trenches, disposal of excess material, pressure testing, chlorinating, dechlorination, and bacteriological testing and all other work incidental to the complete installation of the mains in accordance with these specifications. No special payment will be made for fittings, specialty items, or pipe used in making connections to existing mains where such connections are noted on the plans.

T. **Removal and Disposal of Asbestos Cement Pipe**

Measurement: When the amount of pipe to be removed is less than 12 feet, the Contractor shall be paid a lump sum per each event. When the amount removed exceeds 12 feet, the Contractor shall be paid the lump sum plus the bid price per linear foot for pipe removed in excess of 12 feet.

Payment: Asbestos Cement Pipe removal will be paid for at the contract unit price per lump sum and/or by the foot as bid and shall include all labor, materials, and equipment to excavate, remove and properly dispose of pipe. Contractor shall provide documentation to the City as to the legal disposition of the pipe in accordance with the Solid Waste Disposal Act, as amended from time to time.

U. **Tapping Sleeve and Valve:**

Measurement: Tapping sleeve and valve will be measured by the number of each size installed.

Payment: Tapping sleeve and valve price shall include furnishing all materials, equipment, and labor to make a wet tap on an existing line, complete in place, to include valve, valve box, sawing asphalt and placement of reinforced concrete valve collar (per details C06.05 and 516.02), stainless steel tapping tee sleeve, tap, tapping machine, anchor blocks, excavations, backfill, disinfection, and testing of sleeve. Wet taps will be paid for at the contract unit price per tap for the size specified, complete in place.

V. **Testing and Sterilizing**

Not a pay item. The associated work, materials, and labor involved in testing and sterilizing water mains is incidental to the cost of the water main construction and shall be included in other bid items.

W. **Restraint Flange, Retainer Glands and Retainer Clamps:**

Measurement: Wedge action restrainer glands, retainer glands, and retainer clamps are considered incidental to the cost of construction.

Payment: Not a pay item.

X. **Thrust Restraints**

Not a pay item. Concrete blocking shall be installed as required for all tees, bends etc. per the applicable standard details. No separate payment shall be made for thrust restraints. The cost of thrust restraints is considered incidental to the cost of the contract unit price bid for each applicable fitting bid.

Y. **Tunneling:**

Measurement: Tunneling will be measured by the linear feet of tunnel installed.

The tunneling method shall include any and all excavation, shoring and bracing, any backfill, steel liner plates and bolts, ventilation system for workers, lagging, spiders, grout plugs, sand-cement grouting of voids, steel drain pipe, french drain, concrete paved invert, the ends seals, dewatering, clean up, restoration and any other work required for a complete in place installation.

Payment: Tunneling will be paid for at the contract unit price per linear foot for diameter installed by the tunneling cut, complete and in place. Payment will only be made upon acceptance by the City of Wilson and the Consulting Engineer that the tunnel is installed to the proper elevation and grade and ready for the installation of the designed carrier pipe without any additional compensation. Any deviations, errors, or unacceptable conditions noted by the City of Wilson or the Johnston County office of the North Carolina Department of Transportation (if applicable) will be the responsibility of the Contractor to correct to the full satisfaction of the above-mentioned parties. Unit price does not include the carrier pipe.

Z. **Valves – Air Release Valve & Manhole:**

Measurement: Air/Vacuum Release valves will be measured on a per each basis for the number of units installed.

Payment: Air release valves will be paid for at the contract unit price per air release valve and manhole for the size specified, and all materials incidental to the installation of the air release valve and manhole, complete in place. This price shall include, but is not necessarily limited to, bedding stone, the direct tap and/or saddle, brass plumbing valves, brass street ells and screen, including the doghouse manhole, concrete grade rings (if applicable), and frame and cover, grade adjustments to iron frame if necessary, sawing asphalt and placement of reinforced concrete manhole collar (per details C06.04 and 736.02), and other incidentals as shown on **Standard Detail 516.01**.

AA. **Valve with Box:**

Measurement: Gate valves and inserting valves will be measured by the number of each size and type of valve installed.

Payment: Gate valves and inserting valves will be paid for at the contract unit price, complete in place, per valve for the type and size specified, complete in place. This price shall include all labor, equipment, and materials necessary for installing, valve footing (if applicable), sawing asphalt and placement of reinforced concrete valve box collar (per details C06.05 and 516.02), furnishing, backfilling, testing, slot cut in valve box for tracer wire, copper wire with valve box, sterilizing and all other work incidental to the complete installation of the valves, with necessary valve box, in accordance with the specifications. Cost for any accessory kit to be included in price of valve.

BB. **Valve Box Removal:**

Measurement: Valve box removal will be measured by the number of each valve box removed.

Payment: Payment for valve box removal shall be made at the contract unit price for each valve box removed and delivered to the Water Resources Department. Valve box removal shall include removal of valve and, when present, concrete collar, placement of select fill material, compaction, and pavement repair. This price shall include all labor, equipment, materials necessary for removal of valve boxes and all other work incidental to the complete removal of the valve boxes in accordance with the specifications.

CC. **Small Water Services (2" or less), Water Tubing (Pipe) – by open cut:**

Measurement: Measurement of water services shall be made on a per service basis regardless of service pipe material or length.

Payment: The water service pipe shall be paid for at the contract unit bid per service of the size indicated on the drawings, complete and in place, at a minimum depth of 24 inches. The price shall include all equipment, labor, and materials for installation, making tap, furnishing and running service line, setting meter box and setter as applicable, tail piece extension and marker post if applicable, testing and disinfection

complete in place in accordance with **Standard Details 515.01, 515.02 and 519.02,** as applicable, curb/gutter and sidewalk replacement if necessary. The City will furnish and set meter.

DD. **Small Water Services (2" or less), Water Tubing (Pipe) – by Jacking or Boring:**

Measurement: Measurement of jacked water services shall be made on a per service basis regardless of service pipe material or length.

Payment: The jacked service shall be paid for at the contract unit bid price per service of the size indicated on the drawings, complete and in place. The price shall include all equipment, labor, and materials for installation, making tap, running or punching service line, setting meter box and setter as applicable, testing and disinfection complete in place in accordance with **Standard Details 515.01, 515.02 and 519.02**. The City will furnish and set meter.

EE. **Water Service Line Replacement:**

Measurement: Water service line replacement shall be measured on an each basis.

Payment: Water service line replacement shall include all materials, labor, and equipment for installation, furnishing pipe, running service line, removal and reconnection of service, testing, disinfection, sidewalk (if necessary) and curb removal and replacement, complete in place. Payment for pavement removal and replacement is paid under *Pavement Removal and Replacement.*

FF. **Other: Other items shall be paid for as stated in the Proposal.**

1.3 SEWER

Measurements for purpose of payment shall be in accordance with the unit quantities stated in the proposal as defined below. Prices for the following bid items shall include all labor, materials, tools, equipment, and other incidentals necessary to complete the work as shown on the plans and in accordance with these specifications.

A. **Bedding Stone, Granular:**

Measurement: Stone for pipe bedding shall be measured by the ton in place in the trench, as ordered by the City Engineer. Stone tickets are required to be turned in to a City representative at the end of the day.

Payment: Price per ton for granular bedding stone shall include all materials, equipment, and labor required to furnish and place stone in the trench locations designated by the City Engineer.

B. **Building Connections/Service Laterals:**

Measurement: Measurement of building connections/service lateral shall be made on a per service basis, regardless of service pipe material, as required to comply with **Standard Detail 733.01**. A standard service shall be defined as the length of pipe and fittings, with associated materials, labor, and equipment, including the CO box,

required to run from the centerline of the main to the CO box placed 3 feet behind the back of curb or, where no curb and gutter exists, the edge of pavement; all in accordance with **Standard Detail 733.01**.

Measurement of Building Connections/Service Lateral Extensions: When ordered by the City Engineer to lengthen or extend the service beyond that the standard CO box location shown on **Standard Detail 733.01**, building connections/service lateral extensions shall be measured along the center line of the pipe beginning 3 feet from the back of the curb or edge of pavement where no curb and gutter exists, and ending at the centerline of the extended cleanout location.

Payment: Payment for service laterals shall be at the contract unit price bid, per service, for the sized indicated and shall include bedding, bends, wyes, saddles (if applicable), adapters, long sweep wyes, cleanout riser and plugs, cleanout box, brick, stone, and other incidentals as necessary, curb/gutter and sidewalk replacement (if necessary) complete in place as shown on **Standard Detail 733.01.** Any temporary pumps required to by-pass sewer around work areas shall be provided at no additional cost.

Payment for Building Connections/Service Lateral Extensions: Building connections/service lateral extensions shall be paid by the linear foot along the center line of the pipe and shall only include the extra length of pipe, excavation, bedding stone, and fittings, if applicable.

C. **Bypass Pumping:**

Measurement: Bypass pumping is considered incidental to the cost of the pipe unless otherwise shown in the proposal.

Payment: Not a pay item.

D. **Carrier Pipes (Installed in either Steel Encasements or Tunnel Liners)**

Measurement: Measurement shall be along the centerline of the pipe.

Payment: Payment for carrier pipes will be made at the contract unit price bid per linear foot and shall include all necessary materials, tools, and equipment necessary to install the pipe. The unit price does not include the casing pipe (see the individual pay items *Encasement Pipe* and *Tunneling*). The unit price shall include the cost of excavation, bedding, backfilling, cleanup, and testing.

E. **Combination Sewer Force Main Air Valve and Air Release Manhole**

Measurement: Measurement for combination air valve and air release manholes on force mains shall be on an each basis.

Payment: Payment for combination air valve and air release manholes shall be paid for at the contract unit price bid for combination air valve and air release manholes. The price shall include all labor, material, equipment, stone bedding, precast doghouse manhole, cast iron frame and cover, bedding, tap and saddle, valve, concrete grade rings (if applicable), grade adjustments to iron frame if necessary, and

other incidentals and piping as necessary, complete in place as shown on **Standard Detail 734.01**.

F. **Concrete Encasement**

Measurement: Payment for furnishing concrete encasement will be at the unit price bid per cubic yard for the class of concrete stated in the proposal, such price to be paid in addition to that paid per foot of sewer main.

Payment: The unit prices stated in the proposal shall include the cost of additional depth of excavation, forming, the furnishing and placing of concrete, cofferdams, and laying of pipe line to grade but excluding the pipe itself, complete in place, including all labor, equipment, and material, necessary and all other work incidental to the complete installation of the concrete encasement in accordance with the specification and details shown on the plans. Payment will be made to neat lines of construction shown on the plans with no allowance being made for extra ditch width.

G. **Concrete – Miscellaneous Unformed:**

Measurement: Concrete, except that used in manholes, will be measured in cubic yards of unformed concrete actually placed. Typical uses include concrete collars (slope anchors), cradles, and all other miscellaneous concrete related to sewer line installation.

Payment: This item will be paid for at the contract unit price per cubic yard for un-formed concrete for collars, cradles, and all other miscellaneous concrete related to sewer line installation, in place, including all material, equipment, and labor, to place the concrete in the locations shown on the construction drawings and/or as directed by the City Engineer or Water Resources Manager including the cost of removing and disposing of the material replaced by the concrete. Payment will be made only for the quantities and dimensions (made to neat lines of construction) as shown on drawings or applicable details. Price does not include pipe.

H. **Concrete Piers**

Measurement: Reinforced concrete piers shall be measured on an each basis based on the height and the structural details shown on the contract drawings.

Payment: This item will be paid for at the contract unit price bid for concrete piers complete in place, including all labor, equipment, and material, necessary for furnishing, excavating, disposal of excess material, stone bedding, reinforcement, anchor bolts, steel straps, concrete, testing, forming, concrete finishing, backfilling, restoration of grade, and all other work incidental to the complete installation of the concrete piers in accordance with the specification and details shown on the plans. Payment will be made to neat lines of construction shown on the plans with no allowance being made for extra ditch width.

I. **Connections to Other Sewers or to Appurtenances**

Measurement: Measurement shall be made on an each basis for connections made to other sanitary sewers and appurtenances.

Payment: Connections to other sewers or appurtenances shall be made on a lump sum basis and shall be full compensation for removing, repairing, and/or replacing pipe and/or structures and shall be full compensation for the completed work in place including all materials, labor, tools, and equipment.

J. **Ductile Iron Sewer Line**

Measurement: See pay item 1.3.T, Measurement of Sewer Pipe.

Payment: See pay item 1.3.T, Measurement of Sewer Pipe.

K. **Encasement Pipe (bored):**

Measurement: Steel casing pipe of the wall thickness and diameter specified will be measured by the linear feet of steel casing pipe installed.

Encasement of sewer mains by the dry bore and jacking method shall include any excavation, any backfill, the encasement pipe, bore, jacking, spiders, end seals, dewatering, clean up, restoration and any other work required for a complete in place installation.

Payment: Steel casing pipe will be paid for at the contract unit price bid per linear foot per diameter per thickness for steel casing pipe bored, complete and acceptable in place. Payment will only be made upon acceptance by the City of Wilson and the Consulting Engineer that the bore is installed to the proper elevation and grade and ready for the installation of the designed carrier pipe without any additional compensation. Any deviations, errors, or unacceptable conditions noted by the City of Wilson or the Wilson County office of the North Carolina Department of Transportation (if applicable) will be the responsibility of the Contractor to correct to the satisfaction of the above-mentioned parties. Lines either off on grade or alignment shall be rejected or corrected in a manner approved by the City Engineer or Water Resources Manager. *Regardless of the number of withdrawal and reattempts, the bore shall be paid one time for a successful bore on a linear foot basis*. The cost of the carrier pipe is not to be included.

L. **Encasement Pipe (open cut):**

Measurement: Steel casing pipe of the wall thickness and diameter specified will be measured by the linear feet of steel casing pipe installed.

Encasement of sewer mains by the open cut method shall include any excavation, any backfill, the encasement pipe, spiders, the ends seals, dewatering, clean up, restoration and any other work required for a complete in place installation.

Payment: Steel casing pipe will be paid for at the contract unit price bid per linear foot per diameter per thickness for steel casing pipe installed by the pipe open cut, complete and in place. Lines off either on grade or alignment shall be rejected and corrected in a manner approved by the City Engineer or Water Resources Manager. The cost of the carrier pipe is not to be included.

M. **Excavation and Backfill:**

Measurement and Payment: All excavation and backfill shall be included in the cost of the other items bid – not a pay item.

When the removal of existing structures or materials is classified separately as a contract pay item, payment will be made in accordance with the contract price; otherwise, such work will be considered as incidental work and will not be paid for directly, but the cost shall be included in the unit price for other items of work. In either case, such price or prices shall be full compensation for all labor, materials, tools, equipment, and incidentals necessary to complete the work.

N. **Force Mains: Ductile Iron Pipe or C900 PVC Fusible Piper:**

Measurement*:* Measured horizontally along centerline of pipe by the linear foot of various sizes. All pipes shall be measured from the exact beginning of the pipe to the end of the line without deduction for fittings (i.e. fittings and valves) and shall be made through casings where applicable.

Payment: The accepted quantities of sewer force main pipe will be paid for at the contract unit price per linear foot of the material type and size pipe specified (fittings, valves, and specialty items are paid separately), complete in place. This price shall include labor, equipment, materials, trench excavation (excluding select fill and rock as defined in item 1.1 J, of this document), shoring, or use of trench box, installation, concrete thrust blocking, making connections to existing mains, installing in existing casing, pumping, backfilling, compaction, testing of failed trenches, disposal of excess material, pressure testing, and all other work incidental to the complete installation of the mains in accordance with these specifications. Fittings, valves, and specialty items are paid separately.

O. **HDPE Gravity Sewer Pipe**

Measurement: See pay item 1.3.T, Measurement of Sewer Pipe.

Payment: See pay item 1.3.T, Measurement of Sewer Pipe.

P. **Manholes – Standard and Drop:**

Measurement: Manholes shall be measured on an each basis for a basic 6-foot deep manhole inclusive of frame and cover and base. For all depths in excess of 6 feet, manholes shall be measured by the vertical foot of depth of the manhole constructed in 2-foot increments (e.g. 0 to 6', 6.1' to 8.0', 8.1' to 10.0', etc.). For determining the additional depth of manhole to be paid for at the unit price bid per vertical foot, manholes shall be measured from the invert of the pipe outlet to the top of the manhole frame and cover and recorded to the nearest 1/10 of a foot.

Where more than one type or size (diameter) designation is shown on the drawings, or called for in the special provisions, a separate bid item of the following form shall cover each:

1) Type (or Size) Manhole, per each.
2) Depth of Manhole, per vertical foot.
3) Drop Manhole Connection, per vertical foot.

Payment: Manholes shall be paid for at the contract unit price bid for a 6-foot deep manhole on an each basis plus a unit price per vertical foot for all depths in excess of 6 feet deep in 2-foot increments (e.g. 0 to 6', 6.1' to 8.0', 8.1' to 10.0', etc.). Price shall include furnishing and constructing manholes complete-in-place including excavation, connection to existing sewers if necessary (including inside drops where they occur), complete invert forming in accordance with the standards and drawings, rubber boots, bedding stone, furnishing and bolting castings to cone, gaskets, parging interior joints, vent pipe if required (see **Standard Detail 732.10**), grade adjustment and grade rings if applicable (see **Standard Detail C06.03**), sawing asphalt and placement of reinforced concrete manhole collar (per details C06.04 and 736.02), flex-seal sealant at grade ring adjustments (see **Standard Detail 732.11**), exterior sealing system (**Standard Detail 732.11**), vacuum testing, backfill and compaction complete in every detail. See **Standard Details 732.01, 732.03, 732.04,** and **732.05**.

Q. **Manholes – Doghouse:**

Measurement: Manholes shall be measured on an each basis for a basic manhole inclusive of frame and cover and a base constructed in accordance with **Standard Detail 732.02**. For all depths in excess of 6 feet, manholes shall be measured by the vertical foot of depth of the manhole constructed in 2-foot increments (e.g. 0 to 6', 6.1' to 8.0', 8.1' to 10.0', etc.). For determining the additional depth of manhole to be paid for at the unit price bid per vertical foot, manholes shall be measured from the invert of the pipe outlet to the top of the manhole frame and cover and recorded to the nearest 1/10 of a foot.

Where more than one type or diameter designation is shown on the drawings, or called for in the special provisions, a separate bid item of the following form shall cover each:

1) Type (or Diameter) Manhole, per each.
2) Depth of Manhole, per vertical foot.
3) Drop Manhole Connection, per vertical foot.

Payment: Doghouse manholes shall be paid for at the contract unit price bid for a 6 foot deep manhole on an each basis plus a unit price per vertical foot for all depths in excess of 6 feet deep, in 2-foot increments (e.g. 0 to 6', 6.1' to 8.0', 8.1' to 10.0', etc.). Price shall include furnishing and constructing manholes complete-in-place including excavation, base construction, complete invert forming in accordance with the standards and drawings, rubber boots if applicable, bedding stone, inside drops where they occur, furnishing and bolting castings to cone if applicable, gaskets, parging interior joints, vent pipe if required (see **Standard Detail 732.10**), grade adjustment and grade rings, if applicable (see **Standard Detail C06.03**), sawing asphalt and placement of reinforced concrete manhole collar (per details C06.04 and 736.02), flex-seal sealant at grade ring adjustments (see **Standard Detail 732.11**), exterior sealing system (see **Standard Detail 732.11**), vacuum testing, backfill and compaction complete in every detail. See **Standard Detail 732.02**.

R. **Manhole Frames and Covers – Standard and Watertight:**

Measurement and Payment: Not a pay item. The cost, setting, and final adjustment of the standard and watertight manhole frames and covers are covered under the cost of the manhole for the type manhole specified. See **Standard Details C06.01** and **735.01**.

S. **Manhole - Precast Concrete Riser Ring:**

Measurement and Payment: Not a pay item. The cost, setting, and final adjustment of manhole grade rings are covered under the cost of the manhole for the type of manhole specified. See **Standard Detail C06.03**.

T. **Measurement of Sewer Pipe**

Measurement: Sewer pipe shall be measured from center to center of manholes and depth of cut from invert to original ground line at centerline. No deductions in length will be made for branches and appurtenances along the line. For all depths in excess of 6 feet, sewer pipe shall be measured by the vertical foot of depth of the line constructed in 2-foot increments (e.g. 0 to 6', 6.1' to 8.0', 8.1' to 10.0', etc.). The Contractor must determine the original ground line immediately prior to any trench excavation. It is the Contractor's responsibility to provide this information to the City within 24 hours of the beginning of the trench excavation activities.

Payment: Sewer pipe shall be paid for at the contract unit price bid for a 6 foot deep line on a per linear foot basis plus a unit price per vertical foot for all depths in excess of 6 feet deep, in 2-foot increments (e.g. 0 to 6', 6.1' to 8.0', 8.1' to 10.0', etc.). Payment will be made at the contract unit price bid per linear foot as stated in the proposal for the type of pipe specified and shall include trench excavation (excluding rock and select fill), shoring or use of trench box, installation, pumping, backfilling, compaction, testing of failed trenches, disposal of excess material, pressure testing, and cleanup complete in place.

U. **PVC Sewer Line**

Measurement: See pay item 1.3.T, Measurement of Sewer Pipe.

Payment: See pay item 1.3.T, Measurement of Sewer Pipe.

V. **Pump Stations**

Measurement: Sanitary sewer lift stations shall be measured based on an each basis.

Payment: Sanitary sewer lift stations shall be paid for at the contract lump sum price bid based on the contract drawings. Payment shall cover complete installation including, but not necessarily limited to, auxiliary generator or Dri-Prime backup pump as applicable, emergency backup pump valved connection, valve vault, fencing and gates, odor control/water tank pad, wetwell and valve vault, pumps, non-freeze yard hydrant, graveled fenced enclosure, access road, shower and eye wash station, water service and meter, electrical service, disconnect, and meter, area light, control panel, manufacturers start up, witness and operational test, operational manuals, etc. complete in place.

W. **Testing:**

Not a pay item. The associated work, materials and labor involved in testing sewer mains and manholes is considered incidental to the cost of the sewer main construction and shall be included in other bid items.

X. **Tunneling:**

Measurement: Tunneling will be measured by the linear feet of tunnel installed.

The tunneling method shall include any and all excavation including disposal of excavated material, shoring and bracing, any backfill, steel liner plates and bolts, ventilation system for workers, lagging, spiders, grout plugs, sand-cement grouting of voids, steel drain pipe, French drain, concrete paved invert, the ends seals, dewatering, clean up, restoration and any other work required for a complete in place installation.

Payment: Tunneling will be paid for at the contract unit price per linear foot for diameter installed by the tunneling cut, complete and acceptable in place. Payment will only be made upon acceptance by the City of Wilson and the Consulting Engineer that the tunnel is installed to the proper elevation and grade and ready for the installation of the designed carrier pipe without any additional compensation. Any deviations, errors, or unacceptable conditions noted by the City of Wilson or the Nashville office of the North Carolina Department of Transportation (if applicable) will be the responsibility of the Contractor to correct to the satisfaction of the above-mentioned parties. Unit price does not include the carrier pipe.

Y. **Other:** Other items shall be paid for as stated in the Proposal.

1.4 STORM DRAINAGE

A. **Catch Basins and Drop Inlets (Precast or Block):**

Measurement: Precast or block catch basins and drop inlets will be measured on an each basis for the specified size and depth shown on the plans.

Payment: Precast or block catch basins and drop inlets will be paid for at the contract unit price per each for the specified size and depth shown on the plans. Price shall include all labor, material, and equipment necessary for installation, backfill, pouring of concrete invert, cutting or sawing, concrete collars, stone, invert forming, iron castings, and mortaring of required components, etc., complete in place, and in accordance with the requirements of paragraphs 3.3 and 3.4 of Section 02630, *Storm Drainage*.

B. **Flared End Section:**

Measurement: Flared end section, will be measured on an each basis.

Payment: Flared end section will be paid for at the contract unit price per each of the size indicated on the drawings and shall include all equipment, labor, materials for installation, excavation, backfill, stone if required, sealing and mortaring, complete in place.

C. **Head/Endwalls:**

Measurement: Head/endwalls will be measured on an each basis.

Payment: Head/endwalls will be paid for at the contract unit price per each of the size and type indicated on the drawings and shall include all equipment, labor, materials for installation, excavation, weep holes, shoring removal and replacement, curing, finishing, backfill, sealing and mortaring, complete in place.

D. **Manholes - Standard:**

Measurement: Storm drainage manholes shall be measured on an each basis for the specified diameter and depth shown on the plans.

Payment: Standard manholes will be paid for at the contract unit price for the specified diameter and depth shown on the plans, complete in place. Price shall include excavation, bedding stone, complete invert pouring and forming of concrete in accordance with the standard details and drawings, iron castings, concrete grade rings (if required), gaskets, backfill, and compaction, etc.

E. **Manhole Frames and Covers – Standard:**

Measurement: Manhole frames and covers are considered incidental to the cost of the precast structure on which it will be placed.

Payment: Not a pay item.

F. **Manhole, Abandonment:**

Measurement: Manhole abandonment will be measured on an each basis.

Payment: Manhole abandonment will be paid for at the contract unit price per each, complete in place, in accordance with the requirements paragraph 3.4 of *Section 02530, Sanitary Sewer*.

G. **Rip Rap, Dry**:

Measurement: Dry rip rap will be measured by the ton.

Payment: Dry rip rap will be paid for at the contract unit price per ton for the size indicated on the drawings and shall include all materials (including Geotextile fabric), labor, and equipment necessary for a complete in place installation.

H. **Rip Rap, Grouted:**

Measurement: Grouted rip rap will be measured by the ton.

Payment: Grouted rip rap will be paid for at the contract unit price per ton for the size indicated on the drawings, with the top 6 inches grouted, and shall include all materials (including geo-textile fabric), labor, and equipment necessary for a complete in place installation.

I. **Storm Pipe; Reinforced Concrete, Corrugated Aluminum, & HDPE**:

Measurement: Storm pipe will be measured from the exact beginning of the pipe to the end of the pipe for the size and class pipe specified.

Payment: Storm pipe will be paid for at the contract unit price per linear foot for pipe of the wall thickness, class, and pipe size specified, complete in place. This price shall include pipe, trench excavation (excluding rock), stone bedding if specified, shoring or use of trench box, installation, pumping, joint compound, backfilling (excluding select fill), compaction, and disposal of excess material.

J. **Other**: Other items shall be paid for as stated in the Proposal.

1.5 EARTHWORK

A. **Geotextile Stabilization Fabric**

Measurement: Geotextile stabilization fabric will be measured in square yards based on surface measurements of material installed. Material waste will not be included in the measurement.

Payment: Geotextile stabilization fabric will be paid for at the contract unit price bid in square yards for the type of material specified on the plans or by the City Engineer and shall include all labor, equipment, materials, lapping, seaming if applicable, waste disposal, etc. necessary for a complete in place installation.

B. **Offsite Borrow:**

Measurement: Off-site borrow will be measured in its original position by cross sectioning the area excavated for borrow. The number of cubic yards will be computed from cross section measurements by the average end method. When it is impractical to measure the borrow, and if approved by the City Engineer, truck tally measurements will be made in accordance with paragraph A of Section 3.11 – *Method of Volume Measurement*, Division 02200 - *Earthwork*.

Payment: Off-site borrow will be paid at the contract unit price per cubic yard for material placed, compacted, and complete in place, including all excavation, loading, hauling, erosion control of borrow source, placement, spreading and compaction of borrow material.

C. **Onsite Borrow:** Material obtained from the site by cut and fill areas or other areas onsite that are designated to be used as borrow material is not a pay item for material but payment will be made by regular excavation.

D. **Unclassified (Regular) Excavation:**

Measurement: Unclassified regular excavation will be measured in its original position by cross sectioning the excavation area. The number of cubic yards will be computed from cross section measurements by the average end method. When it is impractical to measure by cross-section method, other acceptable methods, involving 3-dimensional measurements may be used if approved by the City Engineer.

In cut sections, excavation of topsoil and root mat and material down to subgrade elevation or to a point of 1 foot below the top of existing natural grade or to the depth specified on the plans, which ever is greater, will be measured as regular excavation. When areas of unsuitable material are shown on the plans, excavation 1 foot below the elevation of such material shown on the plans will be measured as regular excavation.

In fill sections, excavation of topsoil and root mat and material down to subgrade elevation or to an elevation of 1 foot below the bottom of topsoil and root mat, whichever is greater, will be measured as regular excavation. When areas of unsuitable material are shown on the plans, excavation down to a point 1 foot below the elevations of such material shown on the plans will be measured as regular excavation.

Payment: Regular excavation will be paid at the contract unit price per cubic yard of excavation and shall include all labor, equipment, and material required, complete in place, including all excavation, loading, moving of cut and fill material, placement, spreading and compaction of material.

E. **Rock Excavation (other than trenches and pits):**

Measurement: Rock excavation will be measured by the City Engineer or his representative in its original position, after which the rock shall be excavated to the depth specified by the City Engineer and then measured by the cubic yard. Rock excavation shall consist of the removal and satisfactory disposal of all materials, which cannot be dislodged and excavated with modern, track-mounted, heavy-duty excavating equipment without drilling, blasting, or ripping. Rock is defined as material which cannot be effectively excavated during general grading with a D-8 or equivalent dozer drawing a new single-tooth ripper. Effective excavation is defined as the ability to remove 10 cubic yards or more of material after one hour of continuous ripping. Typical of materials classified as Rock in Open Excavation are boulders larger than 1-1/2 cubic yards or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.

Payment: Rock excavation will be paid for at the contract unit price per cubic yard for rock excavation and shall include all labor, materials, insurance, mats, signage, traffic control, storage containers, and equipment to excavate and dispose of rock off site.

F. **Classified Excavation (Undercut):**

Measurement: The material shown on the plans as classified excavation (undercut) or determined by the City Engineer to be unsuitable and designated as classified excavation (undercut) and not included in regular excavation will be measured by cross sectioning the undercut area. The number of cubic yards will be computed by average end method. When it is impractical to measure by cross-section method because of erratic locations of isolated deposits, other acceptable methods, involving 3-dimensional measurements may be used if approved by the City Engineer.

Removal and satisfactory disposal of all unsuitable material located below subgrade elevation or 1 foot below the top of the existing natural grade, whichever is greater, 1 foot below the elevation of unsuitable material shown on the plans, or 1 foot below

original ground in fill sections where topsoil and root mat are not required to be removed, will be measured as undercut excavation.

Payment: Classified excavation (undercut) will be paid for at the contract unit price per cubic yard for classified excavation (undercut) and shall include all labor, equipment, and material required, complete in place, including all excavation and disposal of material.

G. **Unclassified Excavation for Widening of Pavement:**

Measurement: Unclassified excavation for widening of pavement along existing paved areas and removal of existing paved areas will consist of the removal and satisfactory disposal of all materials except solid rock and concrete structures necessary for the construction of street widening projects including sidewalk and curb and gutter projects. Measured will be made by cross sectioning the widened area. The number of cubic yards will be computed by average end method. No payment for materials removed without authorization from the City Engineer or beyond the lines and grades set by the City Engineer.

Payment: Unclassified excavation for pavement widening will be paid for at the contract unit price per cubic yard for unclassified excavation for widening of pavement. The price shall include all labor, equipment, and materials, including sawing or cutting the existing pavement or concrete, excavation of and disposal of material, preparing the grade, etc., complete in place.

H. **Unclassified Excavation for Removal of Existing Concrete Structures:**

Measurement: Unclassified excavation for removal of existing concrete structures shall consist of the removal and satisfactory disposal of all materials in concrete structures that may be designated for removal by the City Engineer or shown to be removed on plans. These structures shall include sidewalks, steps, retaining walls, concrete pavement, and other minor structures; measured by the cubic yard in terms of material removed from its original positions. No payment for materials removed without authorization from the City Engineer or beyond the lines and grades set by the City Engineer.

Payment: Unclassified excavation for removal of existing concrete structures will be paid for at the contract unit price per cubic yard for unclassified excavation for the type listed. The price shall include all labor, equipment, and materials necessary to remove and dispose of, off site, any required structures, complete in place, including sawing or cutting the existing concrete if required.

I. **Other: Other items shall be paid for as stated in the Proposal.**

1.6 BASE COURSE & PAVING

A. **Adjusting Manholes and Valves for Resurfacing:**

Measurement: Manhole and valve box adjusting will be measured on an each basis for the type of structure adjusted.

Payment: Manhole and valve box adjusting by the method of removing and adjusting the frame and cover. Manholes shall be adjusted as shown on **Standard Detail C06.03**. Manhole and valve box adjustments will be paid for at the contract unit price per each for adjusting manholes and valves, and shall include all labor, equipment, materials (inclusive of concrete grade rings for manholes), feathering asphalt to castings if necessary, etc. for a complete in place installation.

B. **Aggregate Base Course:**

Measurement: Aggregate base course will be measured by the ton (or, if approved by the City Engineer, in square yards of the thickness as shown on the plans). The quantity shall be determined on scales equipped with a dial and an automatic printer, all of which have been approved and sealed in accordance with Section 106-7, *Scales and Public Weighmaster,* NCDOT *Standard Specifications for Roads and Structures*, latest revision.

Payment: **Payment**: Aggregate base course will be paid at the contract unit price bid per ton for ABC (or by the square yards of a specified depth as shown on the plans, if approved by the City). Price shall include all material, equipment, and labor required to furnish and install the stone, complete in place.

C. **Asphalt Concrete Pavement:**

[Pay: By the ton using Terminal Prices for adjustment]

Measurement: Asphalt concrete pavement shall be measured by the actual number of tons of plant mix completed and accepted on the job. Measurement for all roadways will be based on plan quantities and field measurements, verified by tonnage tickets unless otherwise directed by the City Engineer. At the discretion of the City Engineer, coring's at quarter points of the street cross-section may be requested to verify thickness and density of asphalt.

Payment: Asphalt concrete pavement will be paid for at the "Contract Unit Price" bid per ton for the type of asphalt concrete specified. However, the "Contract Unit Price" per ton will be adjusted to account for variations either up or down in the price of asphalt binder from a "Base Price Index" to yield an "Adjusted Contract Unit Price." The "Adjusted Contract Unit Price" is the price paid at the time the paving/work is placed or performed. The "Adjusted Contract Unit Price" shall be full compensation for asphalt concrete pavement, complete in place, including all materials, labor, tools, equipment, tack coat, maintenance of traffic, and all other incidentals necessary. Adjusting manholes, cleanouts, valve boxes, etc. will be paid separately at the bid price for each when adjusted by the Contractor. Payment will be made on a per ton basis.

PRICE ADJUSTMENT - ASPHALT BINDER FOR PLANT MIX:

When it is determined that the monthly selling price of asphalt binder on the first business day of the calendar month during which the last day of the partial payment period occurs varies either upward or downward from the "Base Price Index," the "Contract Unit Price" for asphalt binder for plant mix will be adjusted.

The "Base Price Index" provided for asphalt binder for plant mix, per ton, shall be used to compute the "Adjusted Contract Unit Price." The "Base Price Index" to be included in a proposal/contract along the applicable date will be the Monthly Price Index in effect 2 months prior the month in which the contract is let. The "Base Price Index" will remain fixed throughout the life of the contract. This "Base Price Index" represents an average of F.O.B. selling prices of asphalt binder at supplier's terminals.

Price adjustments for asphalt binder for plant mix will be made in accordance with Section 620 of the NCDOT *Standard Specifications.*

[BIDDING NOTE: In preparation of the bid documents, the City must indicate the "Base Price Index" for asphalt binder for plant mix per ton in the form of proposal. Along with this price, show the date of the selling prices of asphalt binder at supplier's terminal. The price and date is obtained from the NCDOT's website and then inserted into the bid documents.]

The following is a link to the NCDOT website showing the terminal price:

https://connect.ncdot.gov/projects/construction/Pages/Pavement-Construction-Prices.aspx

D. **Asphalt Concrete Paved Flumes, Walks, etc.:**

Measurement: Asphalt concrete paved flumes, walks, etc. will be measured in square yards for a depth of 4 inches.

Payment: Asphalt concrete paved flumes, walks, etc. will be paid for at the contract unit price bid in square yards for a depth of 4 inches and shall be installed in accordance with applicable NCDOT details and specifications, including all labor, equipment, and materials necessary for a complete in place installation.

E. **Asphalt Surface Treatment:**

Measurement: Per square yard of area covered.

Payment: Asphalt surface treatment will be paid per square yard of area covered. This price shall include all labor, equipment, and materials to furnish and install, complete in place.

F. **Foundation Stone:**

Measurement: Foundation stone for roadways will be measured by the cubic yard of foundation stone placed.

Payment: Foundation stone, if approved by the City Engineer, will be paid for at the contract unit price for foundation stone by the cubic yard. Price shall include removal and disposal of unusable material and placement of stone, complete in place.

G. **Manhole and Valve Box Adjustment with Iron Riser Rings (for Resurfacing) – Preferred Method:**

Measurement: Manhole and valve box iron riser adjusting rings are required for resurfacing and measured on an each basis with no regard to ring size (1", 1 ½" or 2").

Payment: Manhole and valve box adjustments for resurfacing will be paid on an each basis for the type of riser ring frame installed at the contract unit price and shall include all labor, material, and equipment necessary to install a riser ring, saw cutting the existing/new asphalt after paving, and placement of a reinforced concrete manhole or valve collar (per details C06.04, C06.05, 516.02, and 736.02, as applicable), complete in place.

H. **Manhole Adjustment with Precast Concrete Manhole Riser Rings (for Resurfacing):**

Measurement: When required or ordered by the City Engineer to be raised/adjusted with concrete riser rings, manhole frames and covers, shall be measured per manhole based on Standard Detail C06.03.

Payment: Manhole adjustment , as shown on **Standard Detail C06.03**, will be paid at the contract unit price per manhole and shall include all labor, material, and equipment necessary to raise the existing frame, and once paved, saw cutting the existing/new asphalt and placement of a reinforced concrete manhole collar (per details C06.04 and 736.02), complete in place.

I. **Manhole and Valve Box Replacement for Resurfacing:**

Measurement: Manhole and valve box replacement will be measured on an each basis for the type of frame installed.

Payment: Manhole and valve box replacement for resurfacing will be paid on an each basis for the type of frame installed at the contract unit price and shall include all labor, material, and equipment necessary to remove and install a new frame, saw cutting the existing/new asphalt and placement of a reinforced concrete valve collar (per details C06.05 and 516.02).complete in place.

J. **Pavement Repair or Street Rehab:** This item shall cover pavement repair in areas where it becomes necessary to remove and replace the existing pavement in failed areas or areas where patching is required as part of roadway work or in locations as otherwise requested by the City Engineer.

Measurement: Work and materials for pavement repair will be measured in the following manner.

1). **Unclassified excavation for pavement repair** will be measured in cubic yards of pavement, temporary maintenance stone, or other unclassified material removed.

2). **Aggregate base stone for pavement repair** will be measured in square

yards, generally 6 inches deep, but thickness shall be as shown on the plans or as directed by the City Engineer.

3). **Asphalt base (B 25.0X) for pavement repair** (when specified) will be measured by the ton (see paragraph 1.6C, above). The thickness is generally 4 inches deep, but thickness shall be as shown on the plans or as directed by the City Engineer.

4). **Asphalt surface (S 9.5B) for pavement repair** will be measured by the ton (see paragraph 1.6C, above). The thickness is generally 3" deep, but thickness shall be as shown on the plans or as directed by the City Engineer.

5). **Surface treatment for surface treated pavement repair** will be measured in square yards.

6). **Temporary pavement repair** will be measured in terms of square yards consisting of a combination of material as defined in these specifications.

Payment: Work and materials for pavement repair will be paid for in the following manner.

1). **Unclassified excavation for pavement repair** will be paid for at the contract unit bid price per cubic yard. This price shall include all labor, equipment, and material to saw-cut, excavate, remove and dispose of material, and all work and grading to prepare the surface for paving, complete in place.

2). **Aggregate base stone for pavement repair** will be paid for at the contract unit price bid per square yard generally 6 inches deep, but thickness shall be installed according to the plans for ABC. This price shall include all labor, equipment, and material necessary to furnish and install the stone, complete in place.

3). **Asphalt base (B 25.0X) for pavement repair** will be paid for at the contract unit price bid per ton (see paragraph 1.6C, above) for the type of base mix as shown on the plans or as directed by the City Engineer. This price shall include all labor, materials, and equipment, including tack, necessary to furnish and install the asphalt, complete in place. Core samples shall be taken by the Contractor in areas directed by the City. The average depth of the asphalt will be determined from these samples. The unit price paid will be reduced proportionately for each 1/8 inch thickness below the specified thickness. Thicknesses less than 75% of that specified shall receive an additional overlay at the minimum depth recommended by NCDOT for the type of asphalt specified for this project. No additional payment will be made for thicknesses greater than that designed.

4). **Asphalt surface (S9.5B) for pavement repair** will be paid for at the contract unit price bid per ton (see paragraph 1.6C, above) for a particular thickness and type as shown on the plans or as directed by the City Engineer. This price shall include all labor, materials, and equipment, including tack, necessary to furnish and install the asphalt, complete in place. Core samples shall be taken by the Contractor in areas directed by the City. The average depth of the asphalt will be determined from these samples. The unit price paid will be

reduced proportionately for each 1/8 inch thickness below the specified thickness. Thicknesses less than 75% of that specified shall receive an additional overlay at the minimum depth recommended by NCDOT for the type of asphalt specified for this project as the surface course. No additional payment will be made for thicknesses greater than that designed.

5). **Surface treatment for surface treated pavement repair** will be paid for at the contract unit price bid per square yard for surface treatment for pavement repair. This price shall be full compensation for one prime coat and two seal coats, complete in place.

6). **Temporary pavement repair** will be paid for at the contract unit price bid per square yard for temporary pavement repair. This price shall include aggregate stone to the depth specified on the plans, seal coat, and cold patch, as defined in these specifications and all labor, materials and equipment necessary, complete in place.

K. **Pavement Profiling - Milling:**

Measurement: Pavement profiling will be measured in square yards for the first 2 inches and then by the square yard for each additional inch of depth of material profiled and removed thereafter.

Payment: Pavement profiling will be paid for at the contract unit price bid per square yards for the first 2 inches and then by the square yard for each additional inch of depth and shall include all labor, materials, and equipment necessary to remove and dispose of the material, complete in place.

L. **Petro-mat, or approved equal:**

Measurement: Petro-mat, or approved equal, will be measured in square yards based on surface measurements of area covered.

Payment: Mat will be paid for at the contract unit price bid in square yards for the type of material specified in these specifications and shall include all labor, equipment, and materials necessary for a complete in place installation.

M. **Portland Cement Treated Aggregate:**

Measurement: Portland cement treated aggregate will be measured in square yards of material with thickness as shown on the plans or as directed by the City Engineer.

Payment: Portland cement treated aggregate will be paid at the contract unit price bid for square yards with thickness as shown on the plans or as directed by the City Engineer. This price shall include all material, equipment, and labor required to furnish and install the Portland cement treated aggregate, complete in place.

N. **Prime Coat** (when specified by City Engineer)**:**

Measurement: Liquid asphalt material will be measured by the gallon.

Payment: Liquid asphalt material will be paid for at the contract unit price bid per gallon. This price shall include all labor, equipment, and materials to furnish, install, and maintenance of the treatment until surface course is applied, complete in place.

O. **Tack Coat: (Not a pay item, incidental to other items bid)**

1.7 CURB & GUTTER, DRIVEWAYS, SIDEWALKS, AND MISCELLANEOUS CONCRETE ITEMS

A. **New Concrete Sidewalk, 4 inches thick:**

Measurement: New sidewalk shall be measured per square yard of finished concrete at the width and depth specified in the contract.

Payment: New sidewalk shall be paid for at the contract unit price bid per square yard of finished concrete. This price shall include all labor, equipment, and material for excavation (includes grading), excess spoil removal, backfilling, expansion joint material, formwork, finishing, curing, etc. for a complete in place installation, as shown on **Standard Detail 404.03** and installed at the locations as shown on the construction drawings and/or as directed by the City Engineer.

B. **Replacement of Concrete Sidewalk:**

Measurement: Replacement of sidewalk will be measured per square yard of finished concrete.

Payment: Replacement of sidewalk will be paid for at the contract unit price bid per square yard at a depth specified in the contract. This price shall include all labor, equipment, and material for excavation (includes grading), excess spoil removal, removal and disposal of existing sidewalk, backfilling, expansion joint material, formwork, finishing, curing, etc. for a complete in place installation as shown on **Standard Detail 404.03** and installed at the locations as shown on the construction drawings and/or as directed by the City Engineer.

C. **New Concrete Driveways and Entrances:**

Measurement: New concrete driveways and entrances per design thickness will be measured in square yards of finished concrete.

Driveways formed in conjunction with standard curb, and curb and gutter, shall be measured in square yards as follows:

1) Residential Drives (**Standard Detail 404.01**):
    i. The width shall be taken as the average width (i.e. drive width at the right of way plus 5 feet; allowing for taper width at back of curb).
    ii. The length shall be measured from the back edge of the driveway at the right-of-way or the back edge of the driveway shown on the plans, as applicable, to the back edge of the curb extended.

2) Commercial Drives (**Standard Detail 404.02**):

The area shall be computed based on the radii shown on the plans and confined between the back edge of the curb extended and either the right-of-way or the back edge of the driveway shown on the plans, as applicable.

Payment: New concrete driveways and entrances will be paid for at the contract unit price bid per square yard at a depth as specified in the design. This price shall include all labor, equipment, and material for excavation (includes grading), excess spoil removal, backfilling, expansion material, formwork, finishing, curing, etc. for a complete in place installation, as shown on **Standard Details 404.01** and **404.02** and installed at the locations as shown on the construction drawings and/or as directed by the City Engineer.

D. **Replacement of Concrete Driveways and Entrances:**

Measurement: Replacement of concrete driveways and entrances will be measured in square yards of finished concrete.

Driveways formed in conjunction with standard curb, and curb and gutter, shall be measured in square yards as follows:

1) Residential Drives (**Standard Detail 404.01**):
   i. The width shall be taken as the average width (i.e. drive width at the right of way plus 5 feet; allowing for taper width at back of curb).
   ii. The length shall be measured from the back edge of the driveway at the right-of-way or the back edge of the driveway shown on the plans, as applicable, to the back edge of the curb extended.

2) Commercial Drives (**Standard Detail 404.02**):
   The area shall be computed based on the radii shown on the plans and confined between the back edge of the curb extended and either the right-of-way or the back edge of the driveway shown on the plans, as applicable.

Payment: Replacement of concrete driveways and entrances will be paid for at the contract unit price bid per square yard at depth as specified in the design. This price shall include all labor, equipment, and material for excavation, removal and disposal of existing concrete, backfilling, expansion material, formwork, finishing, curing, etc. for a complete in place installation as shown on **Standard Details 404.01** and **404.02** and installed at the locations as shown on the construction drawings and/or as directed by the City Engineer.

E. **New Concrete Curb and Gutter, City Standard (See Standard Detail 402.01):**

Measurement: New concrete curb and gutter, City standard will be measured per linear foot along the face of the curb for the entire length of the work including portion of curb shaped for curb ramps and through driveways for the type curb and gutter installed.

Payment: New concrete curb and gutter, City standard will be paid for at the contract unit price per linear foot and shall include all labor, equipment, and material for excavation, grading, formwork, stone bedding, backfilling, expansion material, finishing, curing, etc. for a complete in place installation as shown on the **Standard**

Detail 402.01 and installed at the locations as shown on the construction drawings and/or as directed by the City Engineer.

F. **Replacement of Concrete Curb and Gutter, City Standard (See Standard Detail 402.01):**

Measurement: Replacement of concrete curb and gutter, City standard will be measured per linear foot along the face of the curb for the entire length of the work including portion of curb shaped for curb ramps and through driveways for the type of curb and gutter installed.

Payment: Replacement of concrete curb and gutter will be paid for at the contract unit price bid per linear foot. This price shall include all labor, equipment, and material for excavation, removal and disposal of existing concrete, backfilling, stone bedding, expansion material, formwork, finishing, curing, etc. for a complete in place installation as shown on **Standard Detail 402.01** and installed at the locations as shown on the construction drawings and/or as directed by the City Engineer.

G. **Vertical Concrete Curb:**

Measurement: Vertical concrete curb will be measured in linear feet along the face of the curb including curb ramps and driveway openings.

Payment: Vertical concrete curb will be paid in linear foot the contract unit price for 6”X12” curb. Prices shall include all labor, equipment, and material for excavation, formwork, stone bedding, backfilling, expansion joint material, finishing, curing, etc. for a complete in place installation and installed at the locations as shown on the construction drawings and/or as directed by the City Engineer.

H. **Concrete Curb Ramp:**

Measurement: Concrete curb ramps will be measured per ramp for the type ramp designated.

Payment: Concrete curb ramps will be paid for at the contract unit price bid per ramp. This price shall include all labor, equipment, and material for excavation, removal and disposal of existing concrete, backfilling, stone bedding, expansion material, formwork, finishing, detectable warning surface, curing, etc. for a complete in place installation as shown on the standard details and installed at the locations as shown on the construction drawings and/or as directed by the City Engineer.

I. **Formed Concrete for Retaining Walls, Piers, Steps, and other misc. Concrete Structures:**

Measurement: Formed concrete for retaining walls, piers, steps, and other misc. concrete structures will be measured per structure specified on the drawings or applicable details.

Payment: Formed concrete for retaining walls, piers, steps, and other misc. concrete structures will be paid for at the contract unit price bid per structure, complete in place. All backfilling will be included in bid price for concrete. Payment will be made only for the quantities and dimensions as shown on drawings or applicable details.

J. **Concrete Paved Ditches:**

Measurement: Concrete paved ditches will be measured per square yard of paved ditch based on measurements as defined on the applicable details or construction drawings, at the thickness specified

Payment: Concrete paved ditches will be paid for at the contract unit price per square yard and shall include all labor, equipment, and material for excavation, formwork, stone bedding, backfilling, expansion material, finishing, curing, etc. for a complete in place installation and installed at the locations as shown on the construction drawings and/or as directed by the City Engineer, at the thickness specified.

K. **Tree Well in Sidewalk :**

Measurement: Tree wells will be measured on an each basis.

Payment: Tree wells will be paid for at the contract unit price per each and shall include all labor, equipment, and materials to install the tree well, complete in place.

L. **Wheel Bumpers:**

Measurement: Wheel bumpers will be measured on an each basis.

Payment: Wheel bumpers will be paid for at the contract unit price per each and shall include all labor, equipment, and materials to install the wheel block, complete in place.

1.8 ITEMS MISCELLANEOUS TO ALL SECTIONS

A. **Clearing and Grubbing Wooded Areas:**

Measurement: Measurement for clearing and grubbing will be by the acre. The disturbance shall not exceed width as defined in the construction limits criteria.

Payment: Price per acre for clearing and grubbing in wooded areas shall include all material, equipment, and labor required to clear and grub wooded areas in accordance with these specifications. The price shall also include the removal and disposal of items.

B. **Construction Entrance**

Measurement: Construction entrance for erosion control will be measured on an each basis. Size and depth of stone shall be based on the dimensions, type and depth of stone as specified in the NCDENR, Land Quality Section *Erosion and Sediment Control Planning and Design Manual*, latest revision.

Payment: Construction entrance for erosion control will be paid for at the contract unit price per each and shall include all materials, stone, including Geotextile fabric, labor, and equipment necessary for a complete in place installation as well as maintenance.

C. **Flowable Fill Concrete:**

Measurement: Measurement shall be by the cubic yard of concrete placed, regardless of the specified strength.

Payment: Paid for in place by the cubic yard.

D. **Incidental Stone (ABC)**

Measurement:

1. **Incidental stone aggregate** (ABC) will be measured by the ton that has been stockpiled or incorporated into the completed and accepted work; verified by weight tickets. The aggregate will be measured at the quarry by being weighed in trucks on certified platform scales or other certified weighing devices. Weight tickets shall list the date ticket was issued, the location of the quarry or plant where material came from, and the tonnage loaded/delivered. No deductions will be made for any moisture contained in the aggregate at the time of weighing.

   Incidental stone base which has been stockpiled and cross-sectioned or stockpiled and verified by weight tickets will not be measured more than one time.

   When incidental stone is placed in a stone base, this quantity will be measured as provided in paragraph 2, below.

2. **Incidental Aggregate placed in a base course** will be measured by the ton; verified by weight tickets, for the actual number of tons of aggregate which has been incorporated into the completed and accepted work (see paragraph 1 for quarry/weight ticket requirements). Maintenance, repair and restoration of the base course and subgrade is incidental to the work of this section. If segregation during handling, hauling or placing occurs and the Engineer requires a change in methods or mixing on the road to correct this segregation, this work will be incidental to the work of this section. Removal and replacement of aggregate which is contaminated with foreign materials or outside the gradation limits will be incidental to the work of this section.

Payment: Paid at the contract unit price per ton for incidental stone aggregate.

E. **Silt Fence Barrier:**

Measurement: Silt fence barrier for erosion control will be measured by the linear foot.

Payment: Silt fence barrier for erosion control will be paid for at the contract unit price per linear foot and shall include all material, labor, and equipment necessary for a complete in place installation. The price shall also include the removal, maintenance, and disposal of silt fence upon stabilization of ground cover.

F. **Segmental Retaining Walls (SRW)**

Measurement: The unit of measurement for furnishing and fabricating the SRW shall be the vertical square foot of wall surface from the top of the leveling pad to the top of

the wall or wall coping. Guardrails, barriers, and handrails shall be measured separately.

Payment: The accepted quantities of SRW will be paid at the contract unit price, which shall be full compensation for design (if applicable), testing, equipment, tools, labor, and installation of the SRW including face units, caps, leveling pad (stone or concrete), subgrade preparation, unclassified excavation, classified excavation (Undercut), unit drainage fill, soil reinforcement, pins (if applicable), steel tie-backs, steel reinforcing (if applicable), and reinforced backfill and other miscellaneous materials necessary for a complete installation. Foundation stone and off-site select granular borrow will be paid separately.

G. **SRW - Granular fill for**

Measurement: The quantities of off-site granular borrow for backfill material hauled in and placed in the reinforced earth zone will be measured in cubic yards.

Payment: For Contractor furnished granular backfill material for the reinforced earth zone, the Contractor will be paid for the quantity of material furnished, hauled, placed, and compacted for the contract unit price per cubic yard.

H. **SRW - Excavation**

Measurement: Excavation for preparing the reinforced earth zone for construction is considered incidental to the wall construction.

Payment: Not a pay item.

I. **Sodding, Fertilizing, Seeding and Fine Grading:**

Measurement:

1. **Seeding:** Measurement of surfaces to be seeded shall be measured by the acre for the class specified.

2. **Sodding:** Measurement of surfaces sodded shall be measured by the square yard for the type grass specified.

3. Sodding, fertilizing, seeding, and fine grading shall be provided as described section in Section 02920, *Seeding, Sodding, and Groundcover*. Extra compensation will not be made for additional seeding beyond all limits of construction as defined in applicable section.

Payment:

1. **Seeding:** Payment for fine grading, fertilizing, and seeding will be made at the contract unit price per acre for fine grading, fertilizing, and seeding as described in Section 02920, *Seeding, Sodding, and Groundcover*.

2. **Sodding:** Payment for fine grading, sodding, and required soil amendments will be at the contract unit price per square yard for sodding, fine grading, and soil amendments as described in Section 02920, *Seeding, Sodding, and Groundcover*.

3. No compensation will be made for reseeding, if required. The cost of restoring areas located beyond the designated area(s) shall be borne by the Contractor.

J. **Temporary Access or Haul Roads**

Measurement: Any grading or excavation required for equipment travel during the course of construction as well as erosion control, removal, restoration, seeding and ground cover shall be included in other items bid.

Payment: Included in other items bid. Not a pay item.

K. **Work Zone Traffic Control**:

Work Area Traffic Control shall conform to the both the MUTCD, latest revision and Section 1089 *Traffic Control* of the NCDOT Specifications for Roadways and Structures, latest edition.

Measurement: Lump Sum for all Work Area Traffic Control.

Payment: Payment shall be Lump Sum and shall include all devices such as signage (conforming to the MUTCD), barricades, flaggers if needed, reflective garments, lights, light towers if needed, arrow boards, channelizing devices, drums, cones, message boards, temporary crash cushions, attenuators, etc., and all other items shown on the approved traffic control plan. Payment shall include cost of the development of a Traffic Control Plan (if applicable), labor and equipment, safety officer, set up, phasing, take-down and maintenance. Payment will be made at the contract lump sum price for Work Area Traffic Control.

Temporary pavement markings and portable concrete barriers are excluded and, if needed, will be paid as a separate line item.

L. **Undercut Excavation:**

Measurement: The material shown on the plans as undercut excavation or determined by the City Engineer to be unsuitable and designated as undercut excavation, and not included in regular excavation, will be measured by cross sectioning the undercut area. The number of cubic yards will be computed by average end method. When it is impractical to measure by cross-section method because of erratic locations of isolated deposits, other acceptable methods, involving 3-dimensional measurements may be used if approved by the City Engineer.

Removal and satisfactory disposal of all unsuitable material located below subgrade elevation or 1 foot below the top of the existing natural grade, whichever is greater, 1 foot below the elevation of unsuitable material shown on the plans, or 1 foot below original ground in fill sections where topsoil and root mat are not required to be removed, will be measured as undercut excavation.

Payment: Undercut excavations will be paid for at the contract unit price per cubic yard for undercut excavation and shall include all labor, equipment, and material required, complete in place, including all excavation and disposal of material.

END OF SECTION 00950

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02200 – EARTHWORK

(Last revised ~~5/18/10~~, 9/18/19) R1

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Requirements and Supplementary Conditions applicable to this specification.

B. Section 00950 – Measurement & Payment

C. Section 02275 – Trenching, Backfilling, and Compaction of Utilities

D. Section 02510 – Water Distribution

E. Section 02530 – Sanitary Sewer

F. Section 02630 – Storm Drainage

G. Section 02632 – Segmental Concrete Retaining Wall System

H. Section 02920 – Seeding, sodding, and Groundcover

I. NCDEQ Division of Energy, Mineral, and Land Resources, Land Quality Section's "Erosion and Sedimentation Control Planning and Design Manual" latest revision.

J. City of Wilson *Pre-Approved Material/Product List*

K. City of Wilson *Right-of-Way Regulations and Procedures*, latest edition

1.2 SUMMARY

A. This section includes:

1) Site clearing and grubbing.

2) Stripping and stockpiling topsoil.

3) Excavation and embankment placement.

4) Preparing subgrades for pavements, walks, curb & gutter, and turfed areas.

B. Construction and materials related to this section but covered elsewhere:

1) Erosion Control: North Carolina Sediment Control Law.

1.3 DEFINITIONS

For the purposes of this specification, the following definitions refer to earthwork that comes under the authority of the City of Wilson as specified within this division and other divisions of this manual.

A. **Borrow**: Borrow shall consist of approved fill material imported from off-site.

B. **City Engineer**: The City Engineer or his designated representative.

C. **Clearing**: Clearing shall consist in the felling, cutting up, and satisfactory disposal of trees and other vegetation designated for removal in accordance with these specifications.

D. **Competent Person**: Competent Person means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

E. **Contractor**: Refers to a Contractor licensed in the State of North Carolina to perform grading and earthwork construction.

F. **Fill (in terms of volume)**: In terms of volume, fill is defined as a compacted post-construction volume in-place.

G. **Easement**: An instrument that depicts/describes and conveys rights and privileges to the City for the placement, access to and maintenance of a utility line across and/or on the property of a second party. Ownership of the land remains with the second party.

H. **Grubbing**: Grubbing shall consist of the removal of roots 1 ½ inch and larger, organic matter, debris and stumps and the disposal thereof.

I. **Classified Excavation (undercut)**: Classified excavation shall consist of the removal and satisfactory disposal of all unsuitable material located below subgrade elevation. Where excavation to the finished grade section results in a subgrade or slopes of muck, peat, matted roots, etc., the Contractor shall remove such material below the grade shown on the plans or as directed; and areas so excavated shall be backfilled with approved select fill or stone as ordered by the City Engineer. See also paragraph P, Unclassified Excavation.

J. **Rock in Open Excavation**: All boulder, solid ledges, bedded deposits, unstratified masses, and conglomerations of material so firmly cemented as to possess the characteristics of solid rock. Rock in open excavations includes removal and disposal on-site of materials and obstructions encountered in general excavation other than trenches and pits that cannot be dislodged and excavated with modern, track-mounted, heavy-duty excavating equipment without drilling, blasting, or ripping. Rock is defined as material which cannot be effectively

excavated during general grading with a D-8 or equivalent dozer drawing a new single-tooth ripper. Effective excavation is defined as the ability to remove 10 cubic yards or more of material after one hour of continuous ripping. Typical of materials classified as Rock in Open Excavation are boulders larger than 1-1/2 cubic yards or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.

K. **Rock Excavation for Trenches and Pits**: Rock excavation for trenches and pits includes removal and disposal off-site of materials and obstructions encountered that cannot be practically excavated with a track-mounted power excavator, equivalent to a Caterpillar Model No. 325 or equivalent equipped with new rock teeth. Practical excavation is defined as the ability to remove at least 30 cubic yards during one hour of continuous digging. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.

L. **Select Fill Material**: Nonplastic material, free of organic material, used as foundation for subbase, shoulder surfacing, fill, backfill, or other specific purposes.

M. **Structures**: Incidental buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

N. **Subgrade**: Surface or elevation remaining after completing the excavation, or top surface of a fill or backfill immediately below subbase or topsoil materials, as applicable.

O. **Topsoil**: See Section 02920 – *Seeding, Sodding, and Groundcover.*

P. **Unclassified Excavation**: Removal and disposal of any and all material above subgrade elevation or within the 12 inches of existing natural grade, whichever is greater, except solid rock and undercut excavation, located within the limits of construction.

1.4 SUBMITTALS

A. Submit product data and a sample of separation fabric and fully document each with specific location or stationing information, date and other pertinent information.

B. **Material Test Reports**: Provide from a qualified testing agency test results and interpretation for compliance of the following requirements indicated:

1) Classification according ASTM D2487 of each on-site or borrow soil proposed for backfill, unless otherwise directed by the City Engineer.

2) Laboratory compaction curve according to ASTM D698 for each on-site or borrow soil material proposed for fill or backfill.

3) Laboratory compaction curve according to ASTM D1557 for each on-site borrow soil material proposed for fill and backfill.

C. **Blasting**:

1) Insurance Certificate naming the City of Wilson as "Additional Insured." See paragraph 3.4 – Rock for other blasting insurance requirements.

2) Qualifications, proposed procedures, and schedule shall be submitted at least 2 weeks prior to commencing any blasting operations.

3) Permits from City and local Fire Department and City officials.

4) Blasters shall, at all times, have their license and blasting permits on the job site, and shall allow examination of same by any official that may have jurisdiction.

5) If required by the City Engineer, seismic survey agency report, for record purposes.

D. **Product Data**:

1) Stabilization/Separation fabric

1.5 TESTING SERVICES

A. The Testing Laboratory shall be approved by the City Engineer and will be responsible for conducting and interpreting tests. The Testing Laboratory shall state in each report whether or not the test specimens conform to all requirements of the Contract Documents and specifically note any deviation.

B. Specific test and inspection requirements shall be as specified herein.

1.6 QUALITY ASSURANCE

A. **Geotechnical Testing Agency Qualifications**: An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing as documented according to ASTM D3740 and ASTM E548. Testing Lab to be AMRL (AASHTO Materials Reference Laboratory) and CCRL (Cement and Concrete Reference Laboratory) certified.

B. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

C. NCDEQ Division of Energy, Mineral, and Land Resources, Land Quality Section's "Erosion and Sedimentation Control Planning and Design Manual" latest revision.

D. Comply with applicable requirements of NFPA 495, *"Explosive Materials Code."*

1.7 QUALITY STANDARDS

A. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Society for Testing and Materials

ASTM C33 Concrete Aggregates

ASTM C136 Standard Test Method for Sieve Analysis of Fine and

Coarse Aggregates Sieve Analysis of Fine and Coarse Aggregate

ASTM D422 Standard Test Method for Particle-Size Analysis of Soils (for classification purposes only)

ASTM D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (Standard Proctor).

ASTM D1556 Standard Method of Test for Density of Soil in Place by the Sand-Cone Method

ASTM D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (Modified Proctor)

ASTM D1883 Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils

ASTM D2049 Standard Method of Test for Relative Density of Cohesionless Soils

ASTM D2167 Standard Method of Test for Density of Soil in Place by the Rubber-Balloon Method

ASTM D2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

ASTM D2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method

ASTM D4253 Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

ASTM D4254 Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

ASTM D4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

American Association of State Highway & Transportation Officials

AASHTO T99 The Moisture-Density Relations of Soils using a 5.5-pound Rammer and a 12-inch drop.

AASHTO M145 The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.

AASHTO T180 The Moisture Density Relations of Soils using a

10-pound Rammer and an 18-inch drop.

AASHTO T191 Density of Soil In-Place by the Sand-Cone Method

AASHTO T204 Density of Soil In-Place by the Drive Cylinder Method – Replaced by ASTM D2937

AASHTO T205 Density of Soil In-Place by the Rubber-Balloon Method – Replaced by ASTM D2167

1.8 STANDARD ABBREVIATIONS

AASHTO American Association of State Highway & Transportation Officials

ANSI American National Standards Institute

AREA American Railway Engineers Association

ASTM ASTM International, formerly *American Society for Testing and Materials*

EPA Environmental Protection Agency

MSDS Material Safety Data Sheets

MUTCD Manual on Uniform Traffic Control Devices

NCDEQ NC Department of Environment Quality

NCDOT North Carolina Department of Transportation

NPDES National Pollutant Discharge Elimination System

OHSA Occupational Safety and Health Administration

PWS NCDEQ, Water Resources, Public Water Supply

USACE United States Army Corps of Engineers

1.9 PROJECT CONDITIONS

A. **Demolition**: Demolish and completely remove from the site existing utilities, structures or surface features indicated on the plans to be removed. Coordinate with applicable utility companies to shut off services if lines are active.

B. **Environmental** - Wetlands: Before crossing or entering into any jurisdictional wetlands, Contractor shall verify whether or not a wetlands permit has been obtained for the encroachment and whether special restrictions have been imposed. Care shall be taken to prevent draining or otherwise destroying non-permitted wetlands. Restore as stated on either the project drawings, the contract documents, and/or as noted in the permit. All crossings, disturbance, and encroachments into wetlands shall be subject to USACE and NCDEQ Division of Water Resources approval and permitting requirements and conditions.

C. **Environmental - Buffer Crossing Requirements**: Before crossing streams or ditches or working within 50 feet of ponds, lakes, or rivers, the Contractor shall verify whether the project is exempt or if a permit has been obtained to encroach into such buffers or other such regulated waters, and to what extent work is permitted to occur. Unless otherwise permitted, shown on the contract drawings, or exempted by NCDEQ, roadways crossing stream, river, pond, or lake buffers are to be as near perpendicular as possible (the crossing is considered to be perpendicular if it intersects the stream or surface water between an angle of 75 and 105 degrees). Do not disturb more than 40 linear feet (longitudinal) of riparian buffer without approval from NCDEQ. When permitted to encroach into zone one of a buffer (the lower 30 feet beside the stream or water), adhere to all of the following Best Management Practices during construction.

1) Woody vegetation is cleared by hand. No grading allowed.
2) Stumps to remain except in trench where trees are cut. Minimize disturbance to roots in buffer zone.
3) Backfill trench with the excavated soil immediately following installation.
4) Do not use fertilizer except for the one-time application to reestablish vegetation.
5) Minimize removal of woody vegetation, the amount of disturbed area, and the time the disturbed area remains disturbed.
6) Take measures to ensure diffuse flow of water through the buffer after construction.
7) In wetland areas, use mats to minimize soil disturbance.
8) Schedule work in buffers to ensure exposure of denuded surface in the buffer is kept to a minimum

D. **Safety**

The Contractor shall keep the surface over and along the roadways and other excavation in a safe and satisfactory condition during the progress of the work.

E. **Geotechnical Investigation**

1) Where a Geotechnical report has been provided to the Contractor by the City of Wilson, the data on sub-surface soil conditions is not intended as a representation or warranty of the continuity of such conditions between borings or indicated sampling locations. It shall be expressly understood that the City of Wilson will not be responsible for any interpretations or conclusions drawn there from by the Contractor. The data is made available for the convenience of the Contractor.

2) In addition to any report that may be made available to the Contractor, the Contractor is responsible for performing any other soil investigations felt necessary for proper evaluation of the site for the purposes of planning and/or bidding the project, at no additional cost to the City of Wilson.

F. **Protection of pavement**

Debris from the site shall be removed in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt, dust, and debris at all times.

1.10 SERVICE INTERRUPTION

For service interruption, operation of valves, taps, fire hydrant operation, etc., contact the Water Resources Division at 296-3403. Provide a minimum of 48 hours' notice or desired utility interruption or necessary operation of valves or hydrants.

1.11 COORDINATION

A. Coordinate tie-in to municipal water mains with the City Engineer and/or the Water Resources Manager. Except as needed for fire suppression purposes, the City of Wilson will be the sole operator of all valves and hydrants on the City's water distribution system. When no customers will be affected, the City shall be notified at least 24 hours in advance of a request for the City to operate valves.

   Service is to be continuously maintained to customers in the project areas except for the minimum amount of time required to make connections to the existing system. However, if service is to be interrupted by shutting off a main(s), adequate notification to water customers shall be given by the Contractor prior to any interruption of service. Residents are to be notified at least 24 hours in advance of cut off using flyers (contractor's phone number is to be listed first on all notices). if work has not commenced within 1week of notification, Contractor is to renotify residents before starting.

   In the case of an emergency, a Contractor or plumber will be permitted to employ measures with respect to valve and fire hydrant operation as required for the protection of life and property. Notification must be made to the City as soon as possible after the emergency occurs stating what the emergency was and the measures taken to mitigate the emergency.

B. Coordinate tie-ins to municipal roadway system with the City of Wilson.

C. At the direction of the City Engineer and/or Water Resources Manager, temporary bypass pumping of sewerage flow may be required to be provided. See *Section 02530 – Sanitary Sewer* for bypass pumping requirements and procedures.

D. When traffic signals, loops, or their appurtenances are likely to be damaged or interfere with construction, coordinate temporary operation with the applicable agency having jurisdiction of the signals. Provide a minimum of 1 weeks notice prior to anticipated disturbance or interruption. At the discretion of the City Engineer, the notice may be required to be published in the newspaper.

E. **Repair of pavement markings**: When cuts are made through any paved surface and the cuts extend through the pavement markings, the replaced pavement shall be marked to match the existing.

F. **Benchmark/Monument Protection**: Protect and maintain benchmarks, monuments or other established reference points and property corners. If disturbed or destroyed, they must be replaced at own expense by a Licensed Professional Surveyor to full satisfaction of Owner/City of Wilson.

G. Before Digging, contact ***"NC One Call"*** at 811 for location services.

1.12 PUBLIC CONVENIENCE

The contractor shall at all times so conduct his work as to ensure the least possible inconvenience to the general public and the residents in the vicinity of the work. Fire hydrants on or adjacent to the work shall be kept accessible to fire fighting equipment at all times. Temporary provisions shall be made by the Contractor to ensure the proper functioning of all gutters, sewer inlets, drainage ditches, and irrigation ditches, which shall not be obstructed except as approved by the City Engineer.

1.13 TRAFFIC CONTROL

A. When working within any NCDOT System road or highway, conform to the *Manual on Uniform Traffic Control Devices*, latest revision (MUTCD) as well as the NCDOT Standard Specifications for Roads and Structures, latest revision.

B. Traffic Maintenance shall comply with the latest revision of the NCDOT Standard Specifications for Roads and Structures, Division 9 – *Signing* and Division 11 – *Work Zone Traffic Control*, as well as other applicable sections.

C. A traffic control plan shall be submitted to the City Engineer and NCDOT (if applicable) for approval.

D. When traffic signals or their appurtenances are likely to be damaged or interfere with construction, coordinate temporary operation with the NCDOT or the City Engineer. Provide 1 weeks' notice prior to anticipated disturbance or interruption.

E. Whenever it becomes necessary to leave a section of trench open after completion of the days' work, the contractor shall provide barricades and lights to protect the public. Operate warning lights during hours from dusk to dawn each day and as otherwise required for inclement weather and visibility.

1.14 EROSION AND SEDIMENTATION CONTROL AND NPDES MONITORING, CONTROLS, AND LIMITATIONS FOR PERMITTED DISCHARGES

The Project Engineer shall submit a sedimentation and erosion control plan to the appropriate authority and obtain all necessary construction permits. The Contractor shall follow the requirements stipulated in the approved permit and plans as well as all local and state requirements regarding sedimentation and erosion control.

Permittees (owner and/or Engineer) who have an approved E&SC Plan and permit are required to submit an electronic Notice of Intent (e-NOI) form in order to obtain a Certificate of Coverage (COC). Once DEM has issued a Certificate of Coverage (COC) to the owner/permittee, following a preconstruction conference, placement of erosion control measures/construction may commence.

Permittees and their Contractors are required to implement the approved Erosion and Sedimentation Control (E&SC) Plan, adhere to materials handling protocols, inspect their sites and maintain records.

After the completion of a project, the final step is to submit an electronic Notice of Termination (e-NOT) form to end coverage under the NCG01 Permit.

It is the Contractor's responsibility to adhere to the requirements of the approved E&SC permit and plans as well as periodically monitor the Stormwater Discharge Outfall points

at the specified frequency and maintain reports as required under NCG01 and NCG25. See NCDEQ Energy, Mineral and Land website for more information, filing e-NOI, e-NOT, and Modification Forms and for the applicable "Self-Inspection and Monitoring Forms."

PART 2 – PRODUCTS

2.1 SOIL MATERIALS

General: Provide borrow material when sufficient satisfactory soil material is not available from excavations.

2.1.1 MATERIAL CLASSIFICATION

A. **Excavation**: All excavation material shall be classified as Undercut Excavation, Unclassified Earth Excavation, or Rock.

B. **Off-site Borrow** shall be select fill material approved by the City Engineer from an off-site borrow source. See section 1.3 of this specification for the definition of select fill material.

Rip Rap and Rip Rap Bedding: Rip Rap and Rip Rap Bedding shall conform to Section 1042 – *Rip Rap Materials* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Class A, B, 1, and 2 rip rap.

C. **Structures, Backfill around**: Backfill shall be approved by the City Engineer and shall be free from large or frozen lumps, wood, or rocks more than 3 inches in their greatest dimension or other extraneous material. Porous backfill shall be #57 or #67 clean stone.

D. **Topsoil**: Topsoil meeting the definition prescribed in section 1.3 obtained either from on-site or an off-site source.

2.1.2 SOIL CLASSIFICATION

A. **Satisfactory Soils**: ASTM D2487 soil classification group (Unified Soil Classification System) GC, SM, SC, ML, CL, CH and MH or a combination of these group symbols. However CH and MH are permitted provided the soils have a Liquid Limit (LL) of ≤ 60 and a Plasticity Index (PI) of ≤ 30. Soils shall be free of rock or gravel larger than 3 inches in any dimension, debris, organic matter, waste, frozen materials, muck, roots, vegetation, and other deleterious matter.

B. **Unsatisfactory soils**: ASTM D2487 soil classification group (Unified Soil Classification System) CH and MH soils having a LL of > 60 and a PI of > 30, OH, OL, and PT; soils which contain rock or gravel larger than 3 inches in any dimension, debris, organic matter, waste frozen materials, vegetation, and other deleterious matter. Unsatisfactory soils also include satisfactory soils not maintained within +/- 3% of optimum moisture content at time of compaction, unless otherwise approved by the City Engineer.

2.2 MISCELLANEOUS

2.2.1 GEOTEXTILE FABRIC:

Geotextile fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to mildew, rot, insects, and rodents; and biologically and thermally stable. Geotextile fabric for subsurface installation shall not be exposed to direct sunlight for more than 24 hours before or during installation. All geo-fabric to be used within the right-of-way of a City street must be approved by the City Engineer.

A. **Filter Fabric for Rip Rap**: Filter Fabric for Rip Rap and Rip Rap Beddings shall conform to Section 1056 – *Geosynthetics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 2 engineering fabric.

B. **Soil Stabilization Fabric**: Generally, soil stabilization fabric shall conform to the requirements of Section 1056 – *Geosynthetics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 4 engineering fabric. However, provide fabric meeting Geotechnical Engineers recommendations for the application and use intended.

C. **Fabric for Subsurface Drains**: Non-woven needle-punched fabric shall conform to Section 1056 – *Geosynthetics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 1 engineering fabric.

D. **Silt Fence Fabric**: Silt fence fabric shall conform to Section 1056 – *Geosynthetics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 3 engineering fabric, Class A or B as specified or shown on the plans.

PART 3 – EXECUTION

3.1 GENERAL

3.1.1 GENERAL REQUIREMENTS APPLYING TO ALL AREAS

A. Contractor shall plan construction to minimize disturbance to properties adjacent to the project site and be within the construction limits shown on the plans.

B. The City Engineer reserves the right to limit the width of land to be disturbed and to designate on the drawings or in the field certain areas or items within this width to be protected from damage.

C. **Access and/or Haul Roads**: Any grading or excavation required for equipment travel during the course of construction as well as erosion control, access or haul road removal, restoration, seeding and ground cover shall be provided by the Contractor.

D. The Contractor shall be responsible for damage to areas or items designated by the City Engineer to be protected. Repairs to, replacement of, or reparations for areas or items damaged shall be made at the Contractor's expense and to the satisfaction of the City Engineer before acceptance of the completed project.

E. The Contractor shall protect all existing buildings or structures.

F. Any fences disturbed by the Contractor shall be repaired with new materials to a condition equal to or better than their original condition or to the satisfaction of the City Engineer at no additional cost.

G. The Contractor shall obtain written permission from property owners for use of any access other than ones located within rights-of-way or easements. Written permission shall contain conditions for use and restoration agreements between the property owner and the Contractor.

H. All areas disturbed shall be restored to a condition equal to or better than their original condition and shall be graded to drain.

I. The Contractor shall replace or repair all damaged or destroyed hedgerows and property corners using the services of a licensed Professional Surveyor.

3.1.2 CONSTRUCTION LIMITS

A. The Contractor shall not disturb any areas outside the limits contained in this section without express written permission from the City Engineer.

B. Except as indicated on the plans, no “clear cutting” of timber shall be permitted within the construction limits. The Contractor shall make select cutting of trees, taking smallest trees first, that are mandatory for the construction. The decision of the City Engineer shall be final on the determination of which trees are to be cut.

C. Should it become necessary to move the position of any underground structure, the Contractor may be required to do such work and shall be paid on a force account basis or on an extra work basis as directed by the City Engineer. Method of payment shall be agreed upon by the City Engineer and the Contractor prior to commencing work.

D. If existing utilities are found to interfere with the permanent facilities being constructed under this section, immediately notify the City Engineer and secure instructions. Do not proceed with permanent relocation of utilities until instructions are received from the City Engineer.

E. **Specific requirements applying to developed subdivision/lots**

1) Unless directed otherwise by the City Engineer, all trees, shrubs, hedges, or other ornamental plantings located outside of the construction limits, easements, or public rights-of-way shall be protected by the Contractor. The City Engineer reserves the right to designate certain trees located within the construction limits for protection where deemed desirable.

2) The Contractor shall protect septic systems or springs located outside the construction limits.

3) Excavated or blasted rock shall be removed from the site unless otherwise ordered by the City Engineer.

F. **Specific requirements applying to undeveloped areas**

1) In wooded areas, the clearing shall be limited to the easement or right-of-way limits unless indicated otherwise on the City of Wilson approved construction drawings, in which case, the work shall be confined to the limits defined on the plans. All permanent easements and rights-of-way shall be fully cleared as determined by the City Engineer. the City Engineer reserves the right to designate certain trees located within the construction limits for protection where deemed desirable.

3.1.3 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. **Subsurface obstructions**

1) **Subsurface obstructions**: Take necessary precautions to protect existing utilities from damage due to any construction activity. The Contractor shall locate existing utilities, culverts, and structures (above or below ground), before any excavation starts and coordinate work with utility companies. The Contractor shall be responsible for notifying utility companies when working within the vicinity of the existing utilities. Omission from or inclusion of located utility items on plans do not constitute non-existent or definite location. Even though for convenience, the utility may be shown on the plans, the Contractor is responsible for and shall call for utility location a minimum of 48 hours prior to excavations. Contact underground damage protection services NC One Call at 800-632-4949 or current locator service. Secure and examine local utility surveyor records for available location data including building service lines.

Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to excavation. In excavating, care must be taken not to remove or injure any subsurface structure. All existing gas pipes, water pipes, steam pipes, telephone lines, cable TV lines, electrical conduits, sewers, drains, fire hydrants, and other structures which, in the opinion of the utility company, do not require relocation shall be carefully supported, shored up, the flow maintained, if applicable, and the line/main protected from damage by the Contractor. If damaged, the Contractor shall give immediate notice to the proper authorities. The utility shall be restored, at the Contractor's expense, by the appropriate utility to original or better condition. Where pipes, conduits, or sewers are removed leaving dead ends in the ground, such ends shall be carefully plugged or bulk headed by the Contractor at the Contractor's expense. The Contractor shall be responsible for any damage to persons or property caused by such breaks. This includes water taps and sewer cleanouts installed by a contractor during new construction to be taken over by the City of Wilson.

2) The Contractor shall be responsible for anticipating and locating underground utilities and obstructions. When construction appears to be in close proximity to existing utilities, test pits shall be made a sufficient distance ahead of the work to verify the exact locations and inverts of the utility to allow for changes in grade or utility relocation.

3) If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.

4) Should it become necessary to move the position of any underground structure, when approved by the City Engineer, the Contractor may be required to do such work and shall be paid on a force account basis or on an extra work basis.

5) If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the City Engineer and secure his instructions. Do not proceed with permanent relocation of utilities until written instructions are received from the City Engineer.

B. **Protection of Surface Features**

1) Whenever construction is to take place on or near a paved street, the Contractor shall provide pads or take necessary precautions to protect the pavement from damage by the construction equipment. Pavement damaged by cleated or tracked equipment, or by any other means, shall be repaired by the Contractor at his expense to the satisfaction of the City Engineer.

2) Where joining existing pavements, the Contractor shall use care to cut the existing pavement in sharp, neat lines. If the existing road to be cut is located within another jurisdiction other than the City of Wilson or within NCDOT rights of way, the Contractor is responsible for contacting the person or persons responsible for said road about pavement repair/replacement.

3) Avoid overloading or surcharge a sufficient distance back from edge of excavation or fill to prevent sloughing, slides, or caving. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property.

4) Provide full access to public and private premises, to fire hydrants, at street crossings, sidewalks and other points as designated by the City Engineer to prevent serious interruption of travel.

5) Protect and maintain benchmarks, monuments, or other established points and reference points and if disturbed or destroyed, items shall be replaced by a Licensed Land Surveyor to full satisfaction of the City Engineer and the jurisdictional agency.

6) See 1.11 Coordination, paragraph D regarding traffic signal conflicts.

C. **Procedures for repairing damaged utility services**

1) If a located service is interrupted as a result of work performed by a public or private party, immediately repair the damaged utility at no additional cost to the City. Notification shall be made to the Utility owner.

2) **House services**: If a service pipe supplying water or sewer service to an adjoining house is broken, the Contractor shall repair it at once and at his expense. The City may, at the Contractor's expense, repair any such service without prior notice to the Contractor.

3) If damage results from the action of either a public or private party on a newly constructed project to be accepted by the City of Wilson (e.g. water, sanitary sewer, storm sewer, or street), immediate notification shall be given to the City Engineer or City Inspector. All damages or interruption shall be the responsibility of the party causing the damage.

3.1.4 PROTECTION OF PERSONS AND PROPERTY

A. Barricade open holes and depressions occurring as part of the work, and post warning lights on property adjacent to or part of public access.

B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this or other related sections.

C. **Protection and Restoration of Property:** The Contactor shall not enter upon private property for any purpose without first obtaining written permission. He shall use every precaution necessary to prevent damage or injury to any public or private property, trees, fences, monuments, and underground structures, etc., on and adjacent to the site of the work. He shall protect from disturbance or damage all land monuments and property markers until an authorized agent has witnessed or otherwise referenced their locations, and shall not remove them until directed.

The Contractor shall be responsible for all damage or injury to property of any character resulting from any act, omission, neglect, or misconduct in his manner or method of executing said work, from his nonexecution of work, or from defective work or materials, and he shall not be released from said responsibility until the work shall have been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, he shall restore such property, at his own expense, to a condition equal to or better than that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring, and may be directed or he may make good such damage or injury in an acceptable manner.

The Contractor shall, at his own expense, sustain in their places and protect from direct or indirect injury all pipes, poles, conduits, walls, roadways, buildings, and other structures, utilities and property in the vicinity of his work. Such sustaining and supporting shall be carefully done by the Contractor and as required by the Company or party owning the structures or Agency controlling it. The Contractor shall take all risks attending the presence or proximity of pipes, poles, conduits, walls, thereof and any costs associated will be deducted from any monies due the Contractor. **Failure of the City Engineer or his/her authorized representative to direct the correction of unsafe conditions or practices shall not relieve the Contractor of his responsibility hereunder**.

3.2 CLEARING AND GRUBBING

A. **Description**: This work shall consist of clearing, grubbing, removing, and disposing of all vegetation and debris within the limits of construction, as

designated on the plans or as required by the City Engineer. The work shall also include the preservation from injury or defacement of all vegetation or objects designated to remain. Clearing shall consist of cutting, removal, and satisfactory disposal of all trees, down timber, brush, rocks, projected roots, stumps, rubbish, laps, and other material within easement.

B. A preconstruction meeting shall be held with appropriate forestry personnel (if applicable) and the City prior to any clearing, if required. The City Engineer may require tree protection fencing in sensitive areas, where specifically identified trees are desired to be protected, and when required by the landscape ordinance.

C. The area within the limits of construction or as designated shall be cleared and grubbed of all trees, stumps, roots, brush, undergrowth, hedges, heavy growth of grasses or weeds, debris and rubbish of any nature that, in the opinion of the City Engineer, is unsuitable for foundation material. Nonperishable items that are not deleterious to the project and will be a minimum of 5 feet below the finish elevation of the earthwork or slope of the embankment may be left in place.

D. The Contractor shall provide barricades, fences, coverings, or other types of protection necessary to prevent damage to existing improvements, not indicated to be removed, and improvements on adjoining property. All improvements damaged by this work shall be restored to their original condition to a condition acceptable to the owner or other parties or authorities having jurisdiction. Trees and shrubs that are to remain within the construction limits will be indicated on the drawings or conspicuously marked on site. Unless otherwise noted, trees within the construction limits shall become the property of the Contractor and shall be removed from the site.

E. Contractor shall protect existing trees and other vegetation indicated by the City Engineer to remain in place against limb, bark or root damage such as cutting, breaking, or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. When such damage does occur, all rough edges of scarred areas shall be removed in accordance with accepted horticultural practices.

F. Carefully and cleanly, cut roots and branches of trees indicated to remain where the roots and branches obstruct construction of a proposed utility line. If directed by the City Engineer, the Contractor shall provide protection for roots and branches over 1 ½ inches diameter that is cut during construction operations. Coat the cut faces with emulsified asphalt, or other coating especially formulated for horticultural use on cut or damaged plant tissues. Temporarily cover all exposed roots with wet burlap to prevent roots from drying out. Provide earth cover as soon as possible.

G. Trees and vegetation designated to remain shall be repaired or replaced at Contractor's expense in a manner acceptable to the City Engineer if they are damaged by construction operations. Repair tree damage as directed by a qualified tree surgeon.

H. Debris from the site shall be removed in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt, dust, and debris at all times.

I. The method of stripping, clearing, and grubbing the site shall be at the discretion of the Contractor. However, all stumps, roots and other debris protruding through the ground surface or in excavated areas shall be completely removed and disposed of off the site by the Contractor.

J. **Marginal Areas**: In marginal areas, with the City Engineer's permission, remove trees where the following conditions exist.

1) **Root Cutting**: When clearing up to the "clearing limits," the Contractor shall also remove any tree which is deemed marginal such that when the roots are cut and the tree could be rendered unstable by the effects of high winds and in danger of toppling into either the right-of-way or onto private property.

2) **Slender Bending Trees**: Where young, tall, thin trees are left unsupported by the clearing operation, and are likely to bend over into the right-of-way, the Contractor, during the clearing operation, shall selectively remove those trees which are located outside and adjacent to the clearing limits and City right-of-way or easement as well. During the course of construction and during the one-year warranty period, the Contractor shall remove such young trees that overhang into the right-of-way or cleared area.

K. **Stripping of Topsoil**: Remove the existing topsoil to a depth of 6 inches or to the depth encountered from all areas in which excavation will occur. The topsoil shall either be stored in stockpiles separate from the excavated trench material if the topsoil is to be respread or otherwise disposed of off-site. Topsoil stockpiles shall be graded to freely drain surface water, and shall have a silt fence placed around the base of the stockpile.

L. **Disposal**: All brush, treetops, stumps, and debris shall be hauled away and disposed of in accordance with all applicable laws and regulations. The Contactor shall clean up debris resulting from clearing operations continuously with the progress of the work and remove promptly all salvageable material that becomes his property and is not to be reused in construction. Sale of material on the site is prohibited.

Disposal of cleared material shall be in accordance with all local and state laws. Trees cut down on the construction site will be hauled away from the site for proper disposal unless instructed otherwise by the City. Stumps of trees cut down outside of the excavation area will be removed. Perishable material shall not be disposed of at the construction site. Brush, limbs, roots, and stumps from trees shall be disposed of in a NCDEQ approved and permitted land clearing and inert debris type landfill. The Contractor will be responsible for obtaining all applicable permits and paying all fees for the disposal of excess material.

3.3 UNCLASSIFIED EXCAVATION, UNDERCUTTING, BORROW, EMBANKMENT:

3.3.1 DESCRIPTION

Prior to beginning grading or embankment operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with these specifications.

Should the Contractor, through negligence or other fault, excavate below the designated grades, he shall replace the excavation with approved satisfactory

materials, in an approved method, at his own expense. All material determined unsatisfactory shall be disposed of in waste areas as directed. Topsoil shall not be used in embankments but shall be handled and placed as directed.

The Contractor shall satisfy himself as to the character, quantity, and distribution of all materials to be excavated. No payment will be made for any excavated material that is used for purposes other than those designated.

3.3.2 CONSTRUCTION METHODS

A. **Excavation**: Excavation shall be performed as indicated on the plans or as directed by the City Engineer to the lines, grades, and elevations, and shall be finished to a reasonable smooth and uniform surface. During the process of excavation, the grade shall be maintained and surface shall be shaped and rolled so that it will be well drained at all times.

When solid rock is incurred in the excavation, the rock shall be removed to a minimum depth of 12 inches below the surface of the subgrade. Material unsatisfactory for subgrade foundation shall be removed to a depth specified to provide a satisfactory foundation. The portion so excavated shall be refilled with suitable material obtained from the grading operations or borrow area and thoroughly compacted by rolling. The City Engineer must approve material obtained from on site grading operation. For areas that do not require fill, scarify and compact to a depth of 6 inches.

Any removal, manipulation, aeration, replacement, and recompaction of suitable materials necessary to obtain the required density shall be considered as incidental to the construction operations, and shall be performed by the Contractor at no additional cost to the City.

No rock, stone, or rock fragments, larger than 3 inches in their greatest dimension will be permitted in the top 12 inches of the subgrade. No rock, stone, or rock fragments larger than 8 inches in their greatest dimension will be permitted in the remainder of the fill.

B. **Stabilization of soft subgrade with Geotextile**: The use of Geotextile material for subgrade stabilization shall be approved by the City Engineer (or a Geotechnical Engineer if required) and shall meet the requirements of paragraphs 2.2.1.B – *Soil Stabilization Fabric* and 3.9 – *Placement of Soil Stabilization Fabric*.

C. **Borrow**: Borrow shall not be used until all suitable, on-site, excavated material has been placed in the embankment, unless authorized by the City Engineer. Unless otherwise designated on the plans and contract documents, the Contractor shall make his own arrangements for obtaining select fill material for borrow and pay all costs involved. If the Contractor places more borrow than is required, and thereby causes a waste of excavation, the amount of such waste, unless authorized, will not be included for payment.

D. **Embankments**:

1) **Evaluation of Subgrade**: Prior to placement of compacted fill, the City Engineer or his representative shall carefully inspect the exposed subgrade.

2) **Evaluation of Subgrade**: Prior to placement of compacted fill, the City Engineer or his representative shall carefully inspect the exposed subgrade. The Contractor shall then proof roll the exposed subgrade, in the presence of the City Engineer or his representative. The inspection shall include, but not be limited to, proof rolling the prepared subgrade with a rubber-tired fully loaded dump truck that has a minimum gross weight of at least 30,000 pounds (H15). No other method will be acceptable. Any unsatisfactory materials thus exposed shall be removed and replaced with satisfactory select material as approved by the City Engineer. Provide the necessary amount of select fill compacted to the density requirements outlined in this specification. See also paragraph 3.3.2.F.2) g through i ,*Improvement's to Areas Failing a Proofroll*, below regarding repair of failed proofroll areas.

3) **Preparation of Ground Surface for Embankments or Fills**. Before fill is placed, scarify existing grade to a minimum depth of 6 inches. In areas where the existing or proposed ground surface is steeper than one vertical to four horizontal (4:1), plow surface in a manner to bench and break up surface so that fill material will bind with the existing surface.

4) Embankments shall be made of satisfactory soil material and shall be built in successive horizontal layers of not more than 8 inches in loose depth for the full width of the cross sections.

The material entering the embankment in each of the layers shall be within a tolerance of plus or minus +/- 20% of the optimum moisture content before rolling to obtain the prescribed density. Wetting or drying of the material and manipulation when necessary to secure uniform moisture content throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on the embankment shall be delayed until the material has dried to the required moisture content. If high moisture is due to negligence of Contractor due to improper drainage, the City Engineer may require removal and replacement of material.

Fill material shall not be placed on frozen ground or areas covered with ice and/or snow or areas with a moisture content above optimum.

E. **Undercut Excavation**:

Undercut Excavation: Undercut excavation shall consist of the removal and satisfactory disposal of all unsuitable material located below subgrade elevation. Where excavation to the finished grade section results in a subgrade or slopes of muck, peat, matted roots, etc., the Contractor shall remove such material below the grade shown on the plans or as directed; and areas so excavated shall be backfilled with approved select borrow as ordered by the City Engineer.

For definition of undercut excavation, see *paragraph 1.3 I – Classified Excavation (Undercut)*.

F. **Preparation of subgrade areas to receive curb and gutter, stone base or concrete pavement**:

1) **Areas to be surfaced**: After all excavation, undercutting, and backfilling has been completed, the subgrade shall be properly shaped and thoroughly

compacted. The compactive effort shall include all areas beneath curb and gutter, stone base or concrete pavement and shall extend at least a minimum of 1 foot beyond the back of the curb and gutter. Compaction shall be in accordance with Table 02200-2A.

2) **Proofrolling Subgrade**:

Purpose: The purpose of proofrolling the subgrade is to determine the location and extent of areas below the subgrade surface that require corrective undercutting. Proof rolling is not designed or intended to fail an embankment, but to point out areas of non-uniform compaction.

Procedure: The Contractor shall proofroll the exposed subgrade, in the presence of the City Engineer or his representative. The inspection shall include, but shall not be limited to, proof rolling the prepared subgrade with a rubber-tired fully loaded tandem axle (no contact by floating axle[s] if present) dump truck that has a minimum gross weight of at least 30,000 pounds (H15 with tandem axles spaced a minimum of 40 inches and not more than 96 inches apart) with a +2-ton tolerance. The aggregate tonnage will be measured at the quarry by being weighed in trucks on certified platform scales or other certified weighing devices. Weight tickets shall list the date ticket was issued, the location of the quarry or plant where material came from, and the tonnage loaded and provided to the inspector prior to commencement of proofrolling.

Requirements and Limitations of Proofrolling:

a. **Truck Loading During Proofrolling**: Following a passing proofroll of the stone base, all trucks delivering stone or asphalt over an approved stone base shall be limited in weight to a load equal to or less than the proofroll test load and the equivalent tandem axle load.

b. **Exception**:

If the asphalt/stone delivery trucks proposed to pass over an approved and accepted stone base are expected to be greater in weight than the minimum H15 proofroll test load specified above, the contractor shall increase the weight of the proofroll test truck to correspond the anticipated load and number of axles (i.e. the haul in load cannot exceed the proofroll test load).

Trucks with more than a total of 3 axles (triaxles, quads and quints) shall not have an axle load exceeding that permitted by the Bridge Formula Weights (USDOT FHA). In such cases, no single axle shall exceed 20 kips and the total tandem axle load shall not exceed 34 kips. The total gross weight of the truck shall not exceed 80 kips.

Contractor to provide weighmaster ticket and USDOT FHA chart showing the corresponding axle load based on both axle spacing, number of axles, weight distribution, and gross weight. (See Federal Bridge Formula Table) Unless otherwise permitted by the City Engineer, test axles tire pressure

shall be between 68 to 72 psi minimum (tire inflated with air only); assumes tests are being performed on a good subgrade.

c. Alternative Proofrolling Method: As an alternative, and in lieu of the above proofrolling procedures, at the contractor's option the contractor may proofroll the streets in accordance with Section 260, *Proof Rolling* of the NCDOT Standard Specification for Roads and Structures, latest edition.

d. A minimum of 3 non-lapping proofrolling passes shall be made on each street/roadway section.

e. The curb and gutter subgrade shall also be included in the proofrolling with proofrolling extending to 12 inches beyond the back of curb.

f. **Proofrolling Speed Range**: 2.6 mph to 3.4 mph. Average walking speed is 3.1 mph+/-.

g. Proof rolling shall be performed in lengths of not less than one block as measured from center of intersection to center of intersection, from center of intersection to end of cul-de-sac, or 750 linear feet. No other method will be acceptable for verifying roadway stone base or pavement subgrade.

h. **Generally Applied Failure Criteria for New Construction**: Unstable or non-uniform subgrade; soft spots. Rutting 1-inch (1/2" for reconstruction), or the same in elastic (rebound) movement with substantial cracking or substantial lateral movement.

Improvements to Areas Failing a Proofroll:

i. Any unsatisfactory materials thus exposed shall be removed and replaced with satisfactory select material as approved by the City Engineer. Provide the necessary amount of select fill compacted to the density requirements outlined in this specification.

j. Should the developer disagree with the representative of the City about the need for repairs to the subgrade, the developer or his project engineer may hire a Licensed Professional Engineer to perform CBR tests on the prepared subgrade. If the Engineer certifies that the full width and length of the subgrade will provide adequate support for the design pavement section and the anticipated loading for the design life of the paved area, the area may be paved without making repairs to the subgrade.

k. All areas failing proofrolling shall be repaired and re-proofrolled prior to placement of stone base to allow time for bridging/consolidation of the subgrade.

l. See paragraph 3.3 *Aggregate Base Course* in Section 02740 *Base Course and Paving* for stone base compaction and density requirements.

3) **Curb and gutter, sidewalks and driveway aprons**: The subgrade shall be constructed true to grade and cross section as may be shown on the drawings or standard details. Compaction shall be in accordance with Table 02200-2A.

All subgrade shall be graded and protected as to prevent an accumulation of standing water, and consequent subgrade saturation, in the event of rain.

G. **Grading tolerances of finished surface**: Earthwork shall conform to the lines, grades, and typical cross sections shown on the plans, standard details, or as established by the City Engineer. Changes in grade shall be accomplished by smooth curves.

1) Shape subgrade under pavement and curb and gutter to within ½ inch of required subgrade elevations.

2) Finish pavement and curb and gutter to within ¼ inch of required finish elevations.

3) Shape subgrade under sidewalks to within 0.10 foot of required subgrade elevations.

4) Finish sidewalks to within 0.10 foot of required finish elevations.

5) For all other areas, subgrade and finish elevations shall be within 0.10 foot of required corresponding elevations.

H. **Backfill of Curb and Gutter and sidewalks**: Immediately after the removal of forms for curb and gutter, sidewalks and driveways, the space between the back of the curb, sidewalks, and driveways shall be backfilled and smoothed off in a manner to prevent the accumulation of standing water.

3.4 ROCK:

3.4.1 GENERAL

A. Blasting procedures shall conform to all applicable local, state, and federal laws and ordinances and shall be performed in accordance with OSHA *Standard 29 CFR part 1910.109 Explosives and Blasting Agents*, NCDOT Rules for Transporting Explosives, and local Fire Department Regulations. Prior to any blasting, a blasting permit shall be obtained. The approval of the City Engineer and Fire Marshall shall be obtained before any blasting takes place and the City Engineer may fix the hours of blasting if he/she deems it necessary. The use of explosives shall be in accordance with approved methods that safeguard lives and property. Explosives shall only be handled, placed, and detonated by persons licensed in this work. It is the responsibility of the Contractor to provide proper notification to appropriate parties.

B. **Rock Excavation – Definition**: See paragraph 1.3 J for definition of rock excavation in open excavation.

C. The minimum insurance coverage for blasting shall be as specified by current NC Fire Prevention Code or more as determined by the City Engineer and Fire Marshall. The coverage shall include explosion and collapse. If blasting occurs within 200 feet of any underground structure or utility, underground coverage will be required. The City and the property owners shall be named as “additional insured.”

Storage: Store explosives in accordance with the Occupational Safety and Health Act and with other Federal, State and Local ordinances and regulations. The Contractor shall keep explosive materials that are on the job site in special constructed boxes provided with locks. These boxes shall be plainly identified as to their contents. Detonators shall be stored separately from explosives. Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made. No blasting shall be allowed unless a galvanometer is employed to check cap circuits.

D. The City may prohibit blasting when the method of detonation or the means of protection provided is inadequate. Blasting conducted with or without direct supervision of the City will not relieve the Contractor of the responsibilities stipulated herein.

E. Blasters shall not explode or attempt to explode blasting powder or high explosives unless it is performed with a suitable electric blasting machine. Electric current from batteries, telephone, or power lines shall not be used for detonation.

F. A minimum of 3 minutes prior to the detonation, the blaster shall inform competent flagmen, equipped with red flags, stationed at reasonable distances from the blast area at every avenue of approach, to warn all persons.

G. Immediately after the loading and tamping of the drill hole and before fixing the blast, the material to be blasted shall be covered on all exposed sides with blasting mats, or other approved protective material. After the protection has been applied, the blast shall be fired without unnecessary delay.

3.4.2 BLASTING PROCEDURE

A. The Contractor shall provide a blast warning signal system. The blast warning signal system shall consist of one or more air horns located at the blast site. The air horn(s) shall be audible a minimum of 1 mile from the blast site. The signals shall be one long horn five minutes prior to the blast, one short horn 1 minute prior to the blast, and one long horn after the blast to signal all clear. The Contractor shall erect two clear and legible blast warning signal signs at locations determined by the City Engineer and Fire Marshall. The signs shall list the blast warning signal system, the Contractor Superintendent's name and telephone number, and the City representative's name and telephone number.

B. The Contractor shall establish test pits at up to two representative locations along the alignment and up to three locations adjacent to the site proposed to be blasted to determine if the rock is "rippable" with a D-8 or equivalent dozer drawing a new single-tooth ripper (see paragraph 1.3 G for definition of rock excavation in open trenches). If these procedures do not offer reasonable production for rock excavation, then blasting will be allowed unless otherwise indicated.

C. The Contractor shall notify in writing all property Owners within 250 feet of the proposed blast at least 1 week prior to the proposed blast and verbally on the day of the scheduled blast.

D. Blasting shall be limited to mid-morning hours on days of clear-to-partly cloudy skies with increasing surface temperature and light wind. The Contractor shall provide monitoring equipment to monitor all blasting. A copy of monitor record shall be given to the City daily.

E. The use of unconfined explosives shall be prohibited.

F. Unless otherwise stipulated in Title 13 of the NC Administrative Code, chapter 7, the maximum allowable peak particle velocity shall be 1.25 inches per second for all structures located 0 to 300 feet from the blasting site. The maximum allowable peak particle velocity shall be 1.00 inch per second for all structures located 301 to 5,000 feet from the blasting site. The maximum allowable peak particle velocity shall be 0.75 inch per second for all structures located 5,001 feet and beyond from the blasting site.

G. To minimize vibration, minimum-scaled distance (SD) of 50 shall be used to determine maximum explosive weight per delay. A test blast shall be conducted to verify the scaled distance. The maximum explosive weight per delay shall not exceed the distance from the blast to the nearest structure divided by 50 squared. Maximum explosive weight per delay may be revised pending outcome of test blast. The recommendations indicated for blasting criteria in no way relieves the Contractor of his liability.

H. The peak overpressure of air blast shall not exceed 0.015 pound per square inch or 138 decibels.

I. Preblast meetings shall be scheduled with the City Engineer and Fire Marshall to document hole depths and spacing, charge weight per delay, shot scheduling, and weather conditions. The Contractor shall obtain accurate measured distances from structures to center of blast area prior to determining the safe maximum charge-weight per delay and loading blast holes.

J. Preblast and post blast surveys shall be performed by the Contractor. The Contractor may review this data and supplement it as he sees fit or conduct separate survey after written permission is obtained from the property Owners. In this event, the written permission shall be submitted to the City Engineer and Fire Marshall prior to entering upon private property. The preblast and post blast surveys will include all occupied buildings within 250 feet of blasting areas. The Contractor is strongly encouraged to have a representative present during these surveys. The preblast and post blast surveys performed by the City or the property owner in no way relieve the Contractor of his liability.

K. The City reserves the right to monitor production blasting. In this event, the Contractor shall provide the City Engineer and Fire Marshall ample notice of scheduled blasts (minimum of 24 hours) to allow set-up of monitoring equipment.

3.4.3 DISPOSAL OF ROCK

Excavated rock shall be hauled off the site at the Contractor's expense. Borrow required to replace excavated rock shall be provided by the Contractor and shall be included in the unit price bid for rock excavation in open trenches. No rocks or boulders shall be used as backfill in any part of the site unless otherwise approved by the City Engineer. Where rock has scattered over adjoining property as a result of blasting, the Contractor shall remove the rock and restore the area to its original condition at no cost to the City.

3.5 SUBGRADE COMPACTION TESTING AND CONTROL

A. **Testing**

Testing of embankment/borrow shall be performed by an independent laboratory approved by the City and the Contractor. The Contractor shall be responsible for excavation for testing if required.

Quality Assurance vs. Quality Control:

Quality Assurance (QA) testing, and the associated cost, is the responsibility of the City. Quality Assurance testing by the City is used to confirm that the Contractor is generally performing his/her work in compliance with these specifications.

Quality Control (QC) testing is the necessary and required testing that is to be performed by the Contractor to assure that he/she is meeting and complying with the requirements of these specifications. The associated cost for QC testing is the Contractor's responsibility. The Contractor is also responsible for "re-testing" costs incurred by the City when the City tests results (tests for Quality Assurance) results in a "failure."

Quality Control (QC) testing for City funded projects: The City shall pay for the cost of Quality Control by having the Contractor include the cost for testing in the unit cost of the project; not as a separate pay item. The Contractor shall pay for all costs associated with re-testing.

B. **Quality Assurance (QA):**

In the course of placement of embankment fill/borrow or in utility trench backfill, the City Engineer may require additional "Field Density Determinations" or compaction tests. Such tests will be at the City's expense. When compaction tests are called for by the City, the City Engineer will determine the location of the tests and the City shall engage a qualified testing firm to perform the test. A representative of the City will observe tests and a copy of the test results and inspection report will be submitted by the testing firm directly to the City Engineer. When the tests indicate that the density failed to meet the requirements of Tables 02200.2A and 2200.2B, the Contractor shall comply with paragraph 3.6 D, Failure of Compactive Efforts.

Payment for failed QA density tests: For City funded projects, payment for failed in-place density tests shall be made by the Contractor by deducting the testing cost from the forthcoming retainage. For other projects in which the City will ultimately assume ownership and maintenance, the testing costs for failed in-place density tests shall be billed directly to the Contractor.

C. **Quality Control (QC):** The Contractor shall perform in-field density tests in accordance with Table 02200-1. Inspection reports shall be submitted by the testing firm directly to the City Engineer. See paragraph 3.6 C, Passing Test.

1) All test results shall be provided to the City Engineer as they become available from the testing agency.

2) The Geotechnical testing firm is to perform laboratory tests (ASTM D698, Standard Proctor) to establish a moisture-density relationship for all materials that are proposed to be used as fill.

3) Contractor shall give a 24-hour notice to Geotechnical testing firm for subgrade testing, subgrade confirmation, or inspections.

4) **Minimum Compaction Testing Frequency**:

The following testing frequency shall be employed on both City funded projects and projects proposed to be turned over to the City for maintenance and/or ownership.

Table 02200-1	
Testing Frequency	
Location	**Frequency**
Buildings and structures	1 test group[a] for every 5,000 square feet
Road	1 test group[a] for every 300 feet of road
Parking Lots	1 test group[a] for every 10,000 square feet
Unpaved areas	1 test group[a] for every 20,000 square feet
Pipe Trenches in Roadways	1 test group[a] for every 100 feet 1 test in each lateral (not to be taken at surface of trench)
Proof Roll	Entire footprint of roadway to 1-foot beyond back of C&G
Exception: Where additional tests are required to determine the extent of unacceptable compaction (having been determined by the initial QA/QC test).	

[a] One test group consists of compaction tests on each layer of fill and backfill material.

D. **Site access for testing:** Ensure City, at all times, has immediate access to the site for the testing of all soils related work. Ensure excavations are in a safe condition for testing personnel.

3.6 SUBGRADE PREPARATION AND COMPACTION REQUIREMENTS

A. **Confirmation of Initial Geotechnical Report/Design Assumptions** *(for roadway projects to be turned over to the City)*: Prior to placement of stone base over the subgrade, the Geotechnical Engineer or his representative shall confirm the initial test results and design assumptions by visual classification and hand augur borings. If the visual findings are at variance with the initial testing and design assumptions, recommendations for modifications to the subgrade shall be provided to the designer, the Grading Contractor, and the City Engineer. The City Engineer shall approve the proposed recommendations prior to incorporation of the measures. See Table 2200.4.

B. **Minimum Compaction Requirements**: Compaction percentages are percentages of maximum dry density as determined by indicated ASTM Standards. Unless noted otherwise on drawings or more stringently by other sections of these specifications, place and ensure degree of compaction of embankment and borrow materials does not fall below the following percentages of the maximum density at optimum moisture content.

C. **Passing Test:** Average of 3 test results meeting the applicable provisions of tables 2200.2A and 2200.2B (below) with no one test failing by more than -3 percentage points. Moisture content tolerance is to be within +/- 3 percentage points of the optimum moisture content unless otherwise specified by the City Engineer or Geotechnical Engineer.

Table 2200.2A Minimum Compaction Limits		
Location	**Density**	
Site and Public Roadways		
Embankment/borrow under roadway pavement surfaces, sidewalks, and curb and gutter	Top 12 inches	100% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.
	Up to within 12 inches	95% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.
Roadway Shoulders	95% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.	
Under turf, sodded, planted, or seeded non-traffic areas	90% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.	
Stone Base	100% of the maximum dry density by ASTM D698 (Standard Proctor), AASHTO T99.	

Table 2200.2B		
Location	**Density**	
Building Structures		
Embankment/borrow beneath and within 5 feet of buildings, under foundations, and scarified existing subgrade beneath buildings.	Top 12 inches	100% of the maximum dry density by ASTM D698 (Standard Proctor)
	Up to within 12 inches	95% of the maximum dry density by ASTM D698 (Standard Proctor)
Outside structures next to walls and any other structural exterior member	90% of the maximum dry density by ASTM D698 (Standard Proctor)	
Backfill less than 10 feet from exterior retaining walls	90% of the maximum dry density by ASTM D698 (Standard Proctor)	

D. **Failure of compactive efforts or proofrolling**: If compaction efforts should fail to provide a stable subgrade in accordance with the requirements in paragraph 3.6 C, Passing Test after subgrade materials have been shaped and brought to

optimum moisture, such unstable materials shall be removed to the extent directed by the Geotechnical Engineer and/or the City Engineer and replaced and compacted using new material and must pass compaction test prior to proceeding to the next stage of construction and at no expense to the City.

The costs associated with excavation and re-compaction of areas that have failed will be the Contractors responsibility.

See paragraph 3.3.2.F *Preparation of areas to receive asphalt pavement or concrete* of this specification for requirements for repair of areas failing a proofroll. All areas failing proofrolling shall be re-proofrolled following completion of repair.

E. **Compaction Lifts**:

Table 2200.3	
Compaction Lift Thickness of	
Lift Thickness (inches)	**Location**
6	Inside street rights-of-way
12	Outside street rights-of-way

F. In-place testing of soils shall be tested based on the following:

Table 02200.4	
In-Place Density Tests	
Soil Type/Classification	**Reference Standard**
GW, GP, GM, GC, SW, SP	• Sand Cone Method (ASTM D1556) • Nuclear Method ASTM D2922) [by percentage of Standard Proctor Density according to ASTM D 698]
SM, SC, ML, CL	• Sand Cone Method (ASTM D1556) • Rubber Balloon Method (ASTM D2167) • Nuclear Method ASTM D2922) • Drive-Tube Method (ASTM D2937) [by percentage of Standard Proctor Density according to ASTM D 698]

G. **Field Testing Limitations:**

1) When field density testing is incorporated according to Table 02200-1, subgrade adequacy is to be confirmed by proof rolling in the presence of the City Engineer or his representative. I

2) In-place field density tests of the roadway or pad subgrade in cut sections (excavation) is not required.

3) Testing/adequacy of intermittent undercut areas and repair areas (e.g. around manholes and boxes) that have been backfilled with select fill and compacted will be confirmed by proof rolling.

3.7 STRUCTURES: EXCAVATION, FILLING, AND BACKFILLING

A. **General**

See Section 02275 - *Trenching, Backfilling, and Compaction of Utilities* for excavation and backfilling for structures (manholes, catch basins, etc.). See NCDOT *Standard Specifications for Roads and Structures, latest revision* for excavation and backfilling for retaining walls.

B. **Protective Measures for Structures**

1) **Drainage**: Control grading around structures so that the ground is pitched to prevent water from running into excavated areas or damaging structures. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water. Provide pumping required, keeping excavated spaces clear of water during construction. Should any water be encountered in the excavation, notify City Engineer. Provide free discharge of water by trenches, wells, or other means as necessary and drain to point of disposal.

2) **Frost Protection**: Do not place foundations, footings, or fill material on frozen ground. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, footings or fill material can be placed immediately after excavation has been completed and approved. Protect excavation from frost if placing of concrete or fill is delayed.

3) **Protection of Structure:** Prevent new and existing structures from becoming damaged due to construction operations or other reasons. For catch basins, provide temporary weep holes with a non-woven filter fabric to relieve hydrostatic pressure on walls.

3.8 RIP RAP AND RIP RAP BEDDING PLACEMENT

Placement of Rip Rap and Rip Rap Bedding shall conform to Section 876 – *Rip Rap* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision.

3.9 PLACEMENT OF SOIL STABILIZATION FABRIC

Placement of soil stabilization fabric shall conform to the requirements of Section 270 – *Fabric for Soil Stabilization* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision and in accordance with the recommendations and directions of the City Engineer and/or a Geotechnical Engineer for the application and use intended.

3.10 SUBSURFACE DRAINAGE SYSTEMS

See Section 2630 – *Storm Drainage* and Section 02275 – *Trenching, Backfilling, and Compaction of Utilities* for both materials and construction requirements regarding subsurface drainage systems

3.11 METHOD OF VOLUME MEASUREMENT

Contractors are required to furnish accurate counts of all excavation and/or fill moved which is to be paid for under a Contract unit price. The volumes shall be measured by either “truck tally” or by “cross-sectioning,” whichever method is approved by the City

Engineer or stated in the proposal and/or bid documents. When a truck count is used, the City Engineer or their representative shall verify the count independently.

A. **Truck Tally Method:**

Excavation: When unclassified excavation or undercut volumes are to be counted by the truck tally method, "swell" is to be incorporated into the truck volume in the amount of 15%. Unless otherwise agreed to or justified by a Geotechnical Engineer, the following pay volumes are to be used for either unclassified or undercut excavation:

Tandem:	13 CY
Tri-axle:	15 CY

Borrow: When either off-site or on-site borrow is to be counted by the truck tally method, "shrinkage" is to be incorporated into the truck volume in the amount of 15% (shrinkage of truck volume placed compared to compacted fill volume) utilizing the following pay volumes:

Tandem:	10 CY
Tri-axle:	12 CY

Loading Truck: A qualified truckload is one that is loaded up to within approximately 6" of the top of the dump bed, prior to dumping.

B. **Average-End-Method:**

Excavation and fill can be computed using the average-end-method. When used, this method is to be employed using the existing contours shown on the Contract Drawings and the Contractors actual surveyed finished contours (surveyed by a licensed Professional Surveyor). In so doing, the finished contours are to be plotted at the same scale as the original drawing and a transparency furnished to the Engineer for comparison to design grades. The volume computations are also to be submitted along with the Surveyors seal and a certification as to the volumes measured.

The Contractor, at his discretion and with the prior approval of the Engineer, may survey the "stripped" site (the site after topsoil has been removed) and compute the volumes based on the stripped site and the "designed" finished grade as shown on the Contract Drawings. As before, a transparency to the same scale and the Surveyors computations and certification are to be submitted to the Engineer for comparison and verification.

C. **Volume Formulas:**

Unless otherwise approved, the following formulas are to be used in computing cut and fill:

Fill Formula

Net Fill = Raw Fill Vol. – Unclassified Excavation X (1 - Shrink Factor) + Strip Vol. - Undercut or waste Fill placed in Fill Slopes X (1 - Shrink Factor) - Pavement Section or Building Floor Pad

Cut Formula

Net Cut = Raw Cut - Strip Vol. + Pavement Section or Building Floor Pad

3.12 CLEANUP AND RESTORATION OF SITE

A. During the progress of the work, the Contractor shall keep the premises and the vicinity of the work clear from unsightly and disorderly piles of debris. Suitable locations shall be specified for the various construction materials and for debris. The materials shall be kept in their storage locations, except as needed for the work and debris shall be promptly and regularly collected and deposited in the specified location.

B. Upon completion of grading operations, the Contractor shall fine grade the site, removing all surplus excavated material, leaving the area free from surface irregularities. He shall dispose of all surplus material, dirt, and rubbish from the site and shall keep the site free of mud and dust to the satisfaction of the City Engineer. The Contractor may be required to sprinkle the street to prevent dust nuisance and/or sweep the street to remove mud or debris.

C. When working on the shoulders of paved roads, the Contractor shall keep the pavement clean of all loose earth, dust, mud, grave, etc., and shall restore roadway shoulders and ditches as required by either the NCDOT or the right-of-way owner.

D. After all work is completed, the Contractor shall remove all tools and other equipment, leaving the site free, clean, and in good condition.

E. The Contractor shall keep the surface over and along the roadways and other graded areas in a safe and satisfactory condition during the progress of the work.

3.13 SEEDING, SODDING, AND GROUNDCOVER

3.13.1 GENERAL

A. Seeding, Sodding, and Groundcover shall comply with the applicable provisions and requirements of Section 02920, *Seeding, Sodding and Groundcover*.

B. Seeding and groundcover includes seedbed preparation, liming, fertilizing, seeding, and mulching of all disturbed areas. Areas inside or outside the limits of construction that are disturbed by the Contractor's operation and activity shall be seeded and mulched.

Unless called for otherwise on the Erosion and Sedimentation Control Plan, in areas where natural sod or vegetation has been disturbed, the area shall be seeded in accordance with **Standard Detail 350.01**.

If the construction activity disturbed a landscaped lawn, the seeding shall be modified to restore ground cover comparable to the existing lawn.

C. Seeding shall be carried out as soon as practical after the construction in any one area, and shall be maintained against erosion through the completion of the project. Seeding shall be accomplished as work progresses.

The Contractor shall be responsible for proper care of the seeded area during the period that vegetation is being established. In the event of an erosive rain before an adequate stand of vegetation has been established, damaged areas shall be repaired, fertilized, seeded, and mulched at the Contractor's expense.

Seeding on rights of way of NCDOT maintained roads shall be in accordance with NCDOT specifications and the requirements of the approved encroachment permit.

D. **Temporary Seeding**: Temporary and permanent seeding shall be carried out in accordance with the approved E&SC permit and plans as well as the applicable requirements of the NCDEQ Land Quality Erosion and Sediment Control Planning and Design Manual. Unless otherwise noted as more restrictive on either the approved E&SC plans and permit or in the Erosion and Sediment Control Planning Design Manual, denuded areas to be graded during the construction phases that are not to be brought to final grade within 21 calendar days shall receive temporary seeding and mulching. Areas to be stabilized with permanent vegetation must be seeded or planted within 15 working days or 90 calendar days after final grade is reached, unless temporary stabilization is applied. Temporary seeding shall also be used to stabilize finished grade areas if the time of year is outside the specified permanent seeding periods.

E. **Stockpile Area**: The Contractor is responsible for securing equipment storage, material lay down, and stockpile storage area for his work. As such, the Contractor is responsible for the necessary erosion control measures, including but not necessarily limited to, a construction entrance, silt fence, protection of streams/buffers, clean up and restoration of site to the satisfaction of the City and the NCDEQ, Department of Water Quality, Land Quality Section. Stockpile and/or waste areas must be maintained within the limits of the areas protected by the proposed measures and otherwise temporarily seeded if to be left stockpiled over 21 days.

3.14 MISCELLANEOUS

3.14.1 DUST CONTROL

The Contractor shall be required to sprinkle with water or to apply dust-allaying materials to ensure that dust is held to an absolute minimum. Dust control is considered incidental and shall be carried out at the Contractor's expense.

3.14.2 SALVAGE OF USEABLE MATERIALS

All materials such as iron castings, paving blocks, brick, pipe and etc., removed during excavation that is useable on this project shall be used after approval of its use by the City Engineer or the applicable owner of the street right-of-way. Such material shall be stockpiled on site. Unnecessary abuse and damage to these items shall be the Contractors responsibility and the cost of replacement may be deducted from the retainage.

End of Section 02200

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02275 - TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES

(Last revised ~~8/22/13~~, 9/18/19) R4

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1 – GENERAL

1.1 GENERAL:

A. The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the furnishing and installation, complete, of all operations in connection with excavation, trenching, and backfilling of underground utilities as shown on drawings and as specified, in accordance with provisions of the Contract Documents, and completely coordinated with work of all other trades.

Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation.

Work included in the project consists of, but is not necessarily limited to, methods of installation of the following:

1) Sanitary Sewer Pipe Installation & appurtenances.

2) Water Distribution Pipe Installation & appurtenances.

3) Relocation of piping systems.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. AWWA C600: *Standard for Installation of Ductile-Iron Water Mains and their Appurtenances*

C. AWWA C605: *Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings*

D. AWWA C900: *Pressure Pipe and Fabricated Fittings (4" through 12") for Water Distribution*

E. City of Wilson *Pre-Approved Material/Product List*

F. City of Wilson *Right-of-Way Regulations and Procedures*, latest edition

G. Section 00825 – Product Substitutions

H. Section 00950 – Measurement and Payment

I. Section 02530 – Sanitary Sewer

J. Section 02510 – Water Distribution

K. Section 02630 – Storm Drainage

L. Section 02920 – Seeding, Sodding, and Groundcover

M. NCDEQ Division of Energy, Mineral, and Land Resources, Land Quality Section's *Erosion and Sedimentation Control Planning and Design Manual*, latest revision.

N. Standard *29 CFR Part 1926, OSHA Subpart P "Excavation and Trenching*," latest edition.

O. UNI-PUB-06: *Installation Guide for PVC Solid-Wall Sewer Pipe (4-60 inch)*

P. UNI-PUB-09: *Installation Guide for PVC Pressure Pipe*

1.3 SUMMARY

A. This section includes:

1) Excavating and backfilling trenches for buried water, sewer, storm drainage, buried utility structures, and appurtenances.

2) Preparing subgrade for buried water and sewer, buried utility structures, and appurtenances.

B. Construction and materials related to this section but covered elsewhere:

1) Erosion Control: *North Carolina Sediment Control Law*.

1.4 DEFINITIONS

For the purposes of this specification, the following definitions refer to sanitary sewer, water distribution, and storm drainage systems that come under the authority of the City of Wilson as specified within this section and other sections of this manual.

A. **Backfill**: Soil materials used to fill an excavated trench.

1) **Initial Backfill** (Carefully Compacted Select Earth Backfill): Backfill placed beside and over the top 12-inches of the pipe in a trench, including haunches to support sides of pipe.

2) **Final Backfill** (Common Trench Backfill): Backfill placed over the initial backfill to fill a trench.

In terms of volume, backfill is defined as a compacted post-construction volume in-place.

B. **Bedding Course**: Layer of clean coarse stone placed over the excavated subgrade in a trench to bring the trench bottom up to grade before laying pipe. When natural materials encountered in trenches are of fine grains and migration of material into the bedding is possible, use well graded bedding material without voids (coarse sand; [Unified Soil Classification System] SC, SM).

C. **Borrow**: Borrow shall consist of approved fill material imported from off-site.

D. **City Engineer**: The Director of Engineering or his designated representative.

E. **City**: Refers to the City of Wilson

F. **Classified Excavation (undercut)**: Classified excavation shall consist of the removal and satisfactory disposal of all unsuitable material located below subgrade elevation. Where excavation to the finished grade section results in a subgrade or slopes of muck, peat, matted roots, etc., the Contractor shall remove such material below the grade shown on the plans or as directed; and areas so excavated shall be backfilled with approved select fill or stone as ordered by the City Engineer. See also paragraph AA, Unclassified Excavation.

G. **Clearing**: Clearing shall consist in the felling, cutting up, and satisfactory disposal of trees and other vegetation designated for removal in accordance with these specifications.

H. **Competent Person**: Competent Person means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

I. **Contractor**: Refers to a Contractor licensed in the State of North Carolina to perform public utility construction.

J. **Easement**: An instrument that depicts/describes and conveys rights and privileges to the City for the placement, access to and maintenance of a utility line across and/or on the property of a second party. Ownership of the land remains with the second party.

K. **Force Main**: Pressurized sanitary sewer main.

L. **Foundation Stone**: Clean well-graded stone, authorized by the City Engineer, used to strengthen and/or provide support to an otherwise weak subgrade. Foundation stone is placed and the subgrade improved before bedding stone is placed. Where voids may cause migration of native or backfill material, use well graded material without voids (coarse sands; [Unified Soil Classification System] SC, SM).

M. **Grubbing**: Grubbing shall consist of the removal of roots 1 ½ inch and larger, organic matter, debris and stumps and the disposal thereof.

N. **Haunching:** Layer of clean coarse stone placed and compacted up to the springline of the pipe. Where voids may cause migration of native or backfill material, use well graded material without voids (coarse sands; [Unified Soils Classification System] SC, SM).

O. **Public Sanitary Sewer System**: Any sewer facility or line owned and maintained by the City of Wilson.

P. **Rock Excavation for Trenches and Pits**: Rock excavation for trenches and pits includes removal and disposal off-site of materials and obstructions encountered that cannot be practically excavated with a track-mounted power excavator equivalent to a Caterpillar Model No. 325 or equivalent equipped with new rock teeth. Practical excavation is defined as the ability to remove at least 30 cubic yards during one hour of continuous digging. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.

Q. **Rock in Open Excavation**: All boulder, solid ledges, bedded deposits, unstratified masses, and conglomerations of material so firmly cemented as to possess the characteristics of solid rock. Rock in open excavations includes removal and disposal on-site of materials and obstructions encountered in general excavation other than trenches and pits that cannot be dislodged and excavated with modern, track-mounted, heavy-duty excavating equipment without drilling, blasting, or ripping. Rock is defined as material which cannot be effectively excavated during general grading with a D-8 or equivalent dozer drawing a new single-tooth ripper. Effective excavation is defined as the ability to remove 10 cubic yards or more of material after one hour of continuous ripping. Typical of materials classified as Rock in Open Excavation are boulders larger than 1-1/2 cubic yards or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.

R. **Shall**: Means a mandatory requirement.

S. **Structures**: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

T. **Subgrade**: Surface or elevation remaining after completing the trench excavation or, the top surface of a backfill (stone or soil) immediately below the pipe conduit or pipe bedding, as applicable.

U. **Topsoil**: See Division 02920 – *Seeding, Sodding, and Groundcover*.

V. **Trench Borrow**: Trench borrow shall consist of approved material imported from off-site for use as fill or backfill required to be placed in trenches either as initial carefully controlled select earth backfill or final common trench backfill. Trench borrow shall not be used until all suitable trench excavation material has been placed in the trench, unless authorized by the City Engineer. Unless otherwise designated on the plans and in the contract documents, the Contractor shall make his own arrangements for obtaining borrow and pay all costs involved.

W. **Water Main**: Exterior water systems for both domestic water and fire suppression needs.

X. **Water Distribution ORC**: The City's *Operator in Responsible Charge* over the City of Wilson's water distribution system; a manager in the Water Resources Department.

Y. **The Director of Water Resources**: The Director of Water Resources, Water Distribution ORC or their authorized representative.

Z. **Wastewater Collection ORC**: The City's *Operator in Responsible Charge* over the City of Wilson's wastewater collection system; a manager in the Water Resources Department Division.

AA. **Unclassified Excavation**: Removal and disposal of any and all material above subgrade elevation, except solid rock and undercut excavation, located within the limits of construction. See also paragraph F, Classified Excavation.

BB. The following are industry abbreviation for various pipe materials:

1) **AC**: Asbestos Cement Pipe

2) **CAP**: Corrugated Aluminum Pipe

3) **CI**: Cast Iron Pipe

4) **DIP**: Ductile Iron Pipe

5) **HDPE**: High Density Polyethylene Pipe

6) **PCP**: Plain Concrete Pipe

7) **PVC**: Polyvinyl Chloride Plastic Pipe

8) **RCP**: Reinforced Concrete Pipe.

1.5 SUBMITTALS

A. Submit product data and a sample of drainage fabric or separation fabric and fully document each with specific location or stationing information, date, and other pertinent information.

B. **Material Test Reports**: Provided from a qualified testing agency which either indicate or interpret test results for compliance of the following requirements indicated:

1) Classification according ASTM D2487 of each on-site or borrow soil proposed for backfill, unless otherwise directed by City Engineer.

2) Laboratory compaction curve according to ASTM D698 for each on-site or borrow soil material proposed for backfill.

C. **Blasting**:

1) Insurance Certificate naming the City as "additional Insured." See paragraph 3.8.1 – *Blasting* for other blasting insurance requirements.

2) Qualifications, proposed procedures, and schedule shall be submitted at least 2 weeks prior to commencing any blasting operations.

3) Permits from local Fire Department and City officials.

4) Blasters shall, at all times, have their license and blasting permits on the job site, and shall allow examination of same by any official that may have jurisdiction.

5) If required by the City Engineer, seismic survey agency report, for record purposes.

B. **Product Data**:

1) Each type of plastic warning tape

2) Stabilization/Separation fabric

3) Drainage Fabric

1.6 QUALITY ASSURANCE

A. **Geotechnical Testing Agency Qualifications**: An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing as documented according to ASTM D3740 and ASTM E548. Testing Lab to be AMRL (AASHTO Materials Reference Laboratory) and CCRL (Cement and Concrete Reference Laboratory) certified.

B. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

C. The contractor shall comply with North Carolina Department of Environment and Natural Resources, *Erosion and Sedimentation Control Handbook*, latest revisions.

D. Comply with applicable requirements of NFPA 495, *Explosive Materials Code,* latest revisions.

E. ASCE Manuals and Reports on Engineering Practice, Manual of Practice No. 60; WEF Manual of Practice No. FD-5: *Gravity Sanitary Sewer Design and Construction*, latest edition.

F. Comply with the Uni-Bell PVC Pipe Association *Handbook of PVC Pipe: Design and Construction,* latest edition. Dallas: for the installation of PVC piping, latest revisions.

1.7 QUALITY STANDARDS

A. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Society for Testing and Materials

ASTM C33	Concrete Aggregates
ASTM D698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (Standard Proctor).
ASTM D1556	Standard Method of Test for Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (Modified Proctor).
ASTM D2049	Withdrawn and replaced with D4253
ASTM D2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
ASTM D2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
ASTM D3740	Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
ASTM D4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
ASTM D4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E548	Standard Guide for General Criteria Used for Evaluating Laboratory Competence

American Association of State Highway & Transportation Officials

AASHTO T99	The Moisture-Density Relations of Soils using a 5.5-pound Rammer and a 12-inch drop.

AASHTO T180	The Moisture Density Relations of Soils using a 10-pound Rammer and an 18-inch drop.
AASHTO M145	The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.
AASHTO T204	Density of Soil In-Place by the Drive Cylinder Method – Replaced by ASTM D2937
AASHTO T205	Density of Soil In-Place by the Rubber-Balloon Method – Replaced by ASTM D2167

American Water Works Association

AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances.

North Carolina Administrative Code

13 NCAC 07	NC Office of Occupational Safety and Health

B. Standard Abbreviations:

AASHTO	American Association of State Highway Transportation Officials.
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
ANSI	American National Standards Institute
AREA	American Railway Engineers Association
ASCE	American Society of Civil Engineers
ASTM	ASTM International, formerly American Society for Testing and Materials
AWWA	American Water Works Association
BATFE	Bureau of Alcohol, Tobacco, Fire Arms and Explosive
CISPI	Cast Iron Soil Pipe Institute
DWQ	Division of Water Quality
FS	Federal Specifications
MSDS	Material Safety Data Sheets
MSHA	Mine Safety and Health Administration (MSHA) regulations.
NCDEQ	NC Department of Environment Quality

NCDOT	North Carolina Department of Transportation
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NSF	National Sanitation Federation International
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
PWS	NCDEQ, Water Resources, Public Water Supply
USACE	United States Army Corps of Engineers
WEF	Water Environment Federation

1.8 TESTING SERVICES

A. The testing laboratory shall be approved by the City Engineer and will be responsible for conducting and interpreting tests. The testing laboratory shall state in each report whether or not the test specimens conform to all requirements of the Contract Documents and specifically note any deviation.

B. Specific test and inspection requirements shall be as specified herein.

1.9 PROJECT CONDITIONS

A. **Demolition**: Demolish and completely remove from the site existing underground utilities indicated on the plans to be removed. Coordinate with applicable utility companies to shut off services if lines are active.

B. Environmental - Wetlands: Before crossing or entering into any jurisdictional wetlands, contractor shall verify whether or not a wetlands permit has been obtained for the encroachment and whether special restrictions have been imposed in that permit. Care shall be taken to prevent draining or otherwise destroying non-permitted wetlands. Restore as stated on either the project drawings, the contract documents, and/or as noted in the permit. All crossings, disturbances, and encroachments into wetlands shall be subject to US Army COE and NCDEQ Division of Water Quality approval and permitting requirements and conditions.

C. **Environmental - Buffer Crossing Requirements:** Before crossing streams or ditches or working within 50 feet of ponds, lakes, or rivers, the Contractor shall verify whether either the line is exempt or a permit has been obtained to encroach into a nutrient sensitive river basin buffer and if so, to what extent work is permitted to occur. Unless otherwise permitted, shown on the contract drawings, or exempted by NCDEQ or other proper authority, water and sewer crossing stream, river, pond, or lake buffers are to be as near perpendicular as possible (the crossing is considered to be perpendicular if it intersects the stream or surface water between an angle of 75 and 105 degrees). Do not disturb more than 40

linear feet (longitudinal) of riparian buffer. When permitted to encroach into zone 1 (the lower 30 feet beside the stream or water), adhere to all of the following minimum, but not necessarily limited to, Best Management Practices in during construction.

1) Woody vegetation is cleared by hand. No grading allowed.
2) Stumps to remain except in trench where trees are cut. Minimize disturbance to roots in buffer zone.
3) Backfill trench with the excavated soil immediately following installation.
4) Do not use fertilizer except for the one-time application to reestablish vegetation.
5) Minimize removal of woody vegetation, the amount of disturbed area, and the time the disturbed area remains disturbed.
6) Take measures to ensure diffuse flow of water through the buffer after construction.
7) In wetland areas, use mats to minimize soil disturbance.
8) Schedule work in buffers to ensure exposure of denuded surface in the buffer is kept to a minimum

D. **Safety**

The contractor shall keep the surface over and along the trenches and other excavation in a safe and satisfactory condition during the progress of the work.

E. **Geotechnical Investigation**

1) Where a Geotechnical report has been provided to the Contractor by the City of Wilson, the data on sub-surface soil conditions is not intended as a representation or warranty of the continuity of such conditions between borings or indicated sampling locations. It shall be expressly understood that the City of Wilson will not be responsible for any interpretations or conclusions drawn there from by the Contractor. The data is made available for the convenience of the Contractor.

2) In addition to any report that may be made available to the Contractor, the Contractor is responsible for performing any other soil investigations felt necessary for proper evaluation of the site for the purposes of planning and/or bidding the project, at no additional cost to the City of Wilson.

F. **Protection of pavement**

Debris from the site shall be removed in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt, dust, and debris at all times. Employ the necessary measures required to meet this requirement.

1.10 SERVICE INTERRUPTION

For service interruption, operation of valves, taps, fire hydrant operation, etc, contact the Water Resources Department at 296-3403. Provide a minimum of 48 hours notice or desired utility interruption or necessary operation of valves or hydrants.

1.11 COORDINATION

A. Coordinate tie-in to municipal water mains with the City Engineer and/or the Director of Water Resources. Except as needed for fire suppression purposes, the City of Wilson will be the sole operator of all valves and hydrants on the City's water distribution system. When no customers will be affected, the City shall be notified at least 24 hours in advance of a request for the City to operate valves.

   Service is to be continuously maintained to customers in the project areas except for the minimum amount of time required to make connections to the existing system. However, if service is to be interrupted by shutting off a main(s), adequate notification to water customers shall be given by the Contractor prior to any interruption of service. Residents are to be notified at least 24 hours in advance of cut off using flyers.

   In the case of an emergency, a Contractor or plumber will be permitted to employ measures with respect to valve and fire hydrant operation as required for the protection of life and property. Notification must be made to the City as soon as possible after the emergency occurs stating what the emergency was and the measures taken to mitigate the emergency.

B. Coordinate tie-ins to municipal roadway system with the City of Wilson.

C. At the direction of the City Engineer and/or Director of Water Resources, temporary bypass pumping of sewerage flow may be required to be provided. See paragraph 3.6, *Bypass Pumping* of Specification *Section 02530 – Sanitary Sewer* for bypass pumping requirements and procedures.

D. When traffic signals, loops, or their appurtenances are likely to be damaged or interfere with construction, coordinate temporary operation with the applicable agency having jurisdiction of the signals. Provide a minimum of 1 weeks' notice prior to anticipated disturbance or interruption. At the discretion of the City Engineer, the notice may be required to be published in the newspaper.

E. **Repair of pavement markings**: When cuts are made through any paved surface and the cuts extend through the pavement markings, the replaced pavement shall be marked to match the existing.

F. **Benchmark/Monument Protection**: Protect and maintain benchmarks, monuments or other established reference points and property corners. If disturbed or destroyed, they must be replaced at Contractor's own expense by a Licensed Professional Surveyor and to the full satisfaction of Owner/City of Wilson.

G. Contact ***"NC One Call"*** at 811 before digging.

1.12 PUBLIC CONVENIENCE

The contractor shall at all times so conduct his work as to ensure the least possible inconvenience to the general public and the residents in the vicinity of the work. Fire hydrants on or adjacent to the work shall be kept accessible to fire fighting equipment at all times. Temporary provisions shall be made by the Contractor to ensure the proper functioning of all gutters, sewer inlets, drainage ditches, and irrigation ditches, which shall not be obstructed except as approved by the City Engineer.

1.13 TRAFFIC CONTROL

A. When working within any NCDOT System road or highway, conform to the *Manual on Uniform Traffic Control Devices*, latest revision (MUTCD) as well as the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

B. Traffic Maintenance shall comply with the latest revision of the NCDOT *Standard Specifications for Roads and Structures*, Division 9 – *Signing* and Division 11 – *Work Zone Traffic Control*, as well as other applicable sections.

C. A traffic control plan shall be submitted to the City of Wilson Police Department and NCDOT (if applicable) for approval.

D. When traffic signals or their appurtenances are likely to be damaged or interfere with construction, coordinate temporary operation with the NCDOT or the City Engineer. Provide a 1 week notice prior to anticipated disturbance or interruption.

E. Whenever it becomes necessary to leave a section of trench open after completion of the days work, the contractor shall provide barricades and lights to protect the public. Operate warning lights during hours from dusk to dawn each day and as otherwise required for inclement weather and visibility.

1.14 EROSION AND SEDIMENTATION CONTROL AND NPDES MONITORING, CONTROLS, AND LIMITATIONS FOR PERMITTED DISCHARGES

The Project Engineer shall submit a sedimentation and erosion control plan to the appropriate authority and obtain all necessary construction permits. The Contractor shall follow the requirements stipulated in the approved permit and plans as well as all local and state requirements regarding sedimentation and erosion control.

Permittees (owner and/or Engineer) who have an approved E&SC Plan and permit are required to submit an electronic Notice of Intent (e-NOI) form in order to obtain a Certificate of Coverage (COC). Once DEM has issued a Certificate of Coverage (COC) to the owner/permittee, following a preconstruction conference, placement of erosion control measures/construction may commence.

Permittees and their Contractors are required to implement the approved Erosion and Sedimentation Control (E&SC) Plan, adhere to materials handling protocols, inspect their sites and maintain records.

After the completion of a project, the final step is to submit an electronic Notice of Termination (e-NOT) form to end coverage under the NCG01 Permit.

It is the Contractor's responsibility to adhere to the requirements of the approved E&SC permit and plans as well as periodically monitor the Stormwater Discharge Outfall points at the specified frequency and maintain reports as required under NCG01 and NCG25. See NCDEQ Energy, Mineral and Land website for more information, filing e-NOI, e-NOT, and Modification Forms and for the applicable "Self-Inspection and Monitoring Forms."

PART 2 – PRODUCTS

2.1 SOIL, BEDDING AND BACKFILL

2.1.1 MATERIAL CLASSIFICATION

A. **Bedding Material**: NCDOT #57 stone. For concrete pipe bedding material, see **Standard Detail 631.01**.

B. **Excavation**: All excavation material shall be classified as either Rock or Unclassified Earth Excavation. Prices bid for the various sizes of pipe shall include excavation and backfilling.

C. **Flowable Fill Concrete Backfill** (Controlled Low Strength Material): Concrete strength shall be liquid enough to flow, be self-leveling, excavatable, and have a minimum 28-day compressive strength of 30-psi but not more than 100-psi. Non-excavatable flowable fill concrete shall have a minimum 28-day compressive strength of 125-psi but no more than 200-psi (to be excavatable by machine equipment). Materials shall comply with the recommendations within chapter 4 – Materials of ACI 229R, latest revision, which include cement, aggregates, fly ash, water, admixtures, slag and other non standard materials).

   Excavatable is an application where it may be necessary to remove the flowable fill at a later date. Non-excavatable is an application where it is not necessary to remove or otherwise excavate the flowable fill at a later date.

D. **Foundation Stone**: Foundation/Trench Stabilization Material: #57 stone. For Concrete Pipe foundation stone, see **Standard Detail 631.01**.

E. **Select Earth Backfill**: Select earth backfill shall be free of debris, roots, frozen materials, organic matter, rock, or gravel larger than 1-inch in any dimension, or other harmful matter and shall generally meet NCDOT *Standard Specifications for Roads and Structures*, Section 1016 – *Select Material* for properties and gradation, Class II or III unless otherwise approved by the City Engineer. Stone screenings meet the intent of this specification.

F. **Common Trench Backfill**:

   1) **Satisfactory Soils**: ASTM D2487 soil classification group (Unified Soil Classification System) GW, GP, GM, SW, SM, SC, ML, and CL (Classes IA, IB, II, III and IVA soils; see **Standard Detail 511.02**) or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste frozen materials, vegetation, and other deleterious matter.

   2) **Unsatisfactory soils**: ASTM D 2487 soil classification group GC, CH, MH, OH, OL and PT (Classes IVA & V soils; see **Standard Detail 511.02)**; soils which contain rock or gravel larger than 3 inches in any dimension, debris, waste frozen materials, vegetation, clumps of clay larger than 3 inches in any dimension, and other deleterious matter. Unsatisfactory soils also include satisfactory soils not maintained within +/- 3% of optimum moisture content at time of compaction, unless otherwise approved by the City Engineer.

G. **Structures, Backfill around**: Backfill shall be approved by the City Engineer and shall be free from large or frozen lumps, wood, or rocks more than 3 inches in their greatest dimension or other extraneous material. The top 12 inches are to be free

of material greater than 1-inch in their greatest dimension. Porous backfill shall be either #67 or #57 clean stone.

H. **Topsoil**: Topsoil shall consist of friable clay loam, free from roots, stones, and other undesirable material and shall be capable of supporting a good growth of grass. Topsoil shall be free of material greater than 1-inch in any dimension. See division 02920 – Seeding, Sodding, and Groundcover.

2.1.2 PIPE BEDDING DEFINITIONS

A. **Pipe Bedding Definitions (Water & Sewer)**

1) **Class D Bedding** is that condition existing when the ditch is excavated slightly above grade by excavation equipment and cut to finish grade by hand. Bell holes are dug, to prevent point loading the pipe bells, so that pipe bears uniformly upon the trench bottom. Existing soil should be shovel sliced or otherwise compacted under the hunching of the sewer pipe to provide some uniform support. Soil is tamped to 90% of the standard Proctor maximum dry density around the pipe to a point one foot above the pipe. The remainder of the soil to the ground surface is to be compacted to the density specified in Table 2275.3. In poor soils, granular bedding material is generally a more practical, cost effective installation. The bedding factor for class D bedding is 1.1.

   A Class D bedding generally equates to a Type 1 Laying Condition as shown on **Standard Detail 511.02**.

2) **Class C Bedding** is that condition where the sewer pipe is bedded in compacted granular material. The granular bedding has a minimum thickness of one-eighth the outside sewer pipe diameter, but not less than 4 inches or more than 6 inches, and shall extend up the sides of the sewer pipe one-sixth of the pipe outside diameter. The remainder of the sidefills, to a minimum depth of 6 inches over the top of the pipe, consists of lightly compacted backfill. The remainder of the soil to ground surface is to be compacted to the density specified in Table 2275.3. The bedding factor for class C bedding is 1.5.

   A Class C bedding is similar to a Type 3 Laying Condition as shown on **Standard Detail 511.02** except that the pipe has a minimum of 4 inches of stone bedding that extends up one-sixth of the pipe OD.

3) **Class B Bedding** is that condition where the sewer pipe is bedded in carefully compacted granular material. The granular bedding has a minimum thickness of one-eighth the outside sewer pipe diameter, but not less than 4 inches or more than 6 inches, between the barrel and the trench bottom, and covering the full width of the trench.

   The haunch area of the sewer pipe must be fully supported; therefore, the granular material should be shovel sliced or otherwise compacted under the pipe haunch to the springline of the pipe. Both granular haunching (to the springline) and initial backfill to a minimum depth of 12 inches above the top of the sewer pipe should be placed and compacted. The initial backfill material, to a depth of 12 inches above the top of the pipe, should be compacted to no less than 90% of the standard Proctor maximum dry

density. The remainder of the soil to the ground surface is to be compacted to the density specified in Table 2275.3. The bedding factor for class B bedding is 1.9.

A Class B bedding generally equates to a Type 4 Laying Condition as shown on **Standard Detail 511.02** except that the haunches are backfilled with stone up to the springline of the pipe.

4) **Class B-1 Bedding** (*PVC pipe applications*) is the same as Class B Bedding except that granular backfill is placed to the ***top of the pipe*** rather than to the springline of the pipe. The remainder of the soil to the ground surface is to be compacted to the density specified in Table 2275.3.

   A Class B-1 bedding generally equates to a Type 5 Laying Condition as shown on **Standard Detail 511.02**.

5) **Class A Bedding** is that condition when the sewer pipe is bedded in a cast-in-place concrete cradle of either plain or reinforced concrete having a thickness equal to one-fourth the inside pipe diameter, with a minimum of 4 inches and a maximum of 15 inches under the pipe barrel and extending up the sides for a height equal to one-fourth the outside pipe diameter. The cradle width shall have a width at least equal to the outside diameter of the sewer pipe barrel plus 8 inches. The bedding factor for class A bedding is 2.2.

   The haunching and initial backfill material above the concrete cradle should be crushed stone or a well graded granular material and carefully compacted to 12 inches above the crown of the sewer pipe. The remainder of the soil to the ground surface is to be compacted to the density specified in Table 2275.3.

2.2 MISCELLANEOUS

2.2.1 GEOTEXTILE FABRIC

Geotextile fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to mildew, rot, insects, and rodents; and biologically and thermally stable. Geotextile fabric for subsurface installation shall not be exposed to direct sunlight for more than 24 hours before or during installation.

A. **Filter Fabric for Rip Rap**: Filter Fabric for Rip Rap and Rip Rap Beddings shall conform to Section 1056 – *Geosynthetics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 2 engineering fabric.

B. **Soil Stabilization Fabric**: Generally, soil stabilization fabric shall conform to the requirements of Section 1056 – *Geosynthetics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 4 engineering fabric. However, provide fabric meeting Geotechnical Engineers recommendations for the application and use intended.

C. **Fabric for Subsurface Drains**: Non-woven needle-punched fabric shall conform to Section 1056 – *Geosynthetics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 1 engineering fabric.

D. **Silt Fence Fabric**: Silt fence fabric shall conform to Section 1056 – *Geosynthetics* of the NCDOT *Standard Specifications for Roadways and* **Structures**, latest revision for Type 3 engineering fabric, Class A or B as specified or shown on the plans.

2.2.2 WARNING TAPE

Metallic Underground Warning Tape: Metallic detectable underground warning tape shall consist of a solid aluminum foil core, 35-gauge minimum, encased on each side with plastic (minimum overall thickness 5 mils) and be 3 inches wide with black lettering imprinted on a color coded background that conforms to APWA uniform color code specification (BLUE) and silver with black ink letters. Minimum tensile strength shall be 22 lbs/inch. Soil tolerance range to be pH 2.5 to pH 11.0. On one side of the tape, the text shall include the wording "WATER (or SEWER if a sewer force main) LINE BELOW" repeated along the length of the tape. A detectable warning tape shall be used with all water and sewer mains. Underground warning tape is to be placed 12 to 18 inches above top of pipe. See **Standard Detail 511.01**.

Standard color code for tape and wire.

Blue:	Water Systems
Green:	Sewer Force Mains

2.2.3 LOCATOR WIRE:

Number 12 AWG blue insulated single-strand solid or stranded copper locator wire shall be installed above all non-ferrous water and sewer mains; attached every 5 feet to the mains with zip ties. Electrical conductivity along the pipe shall be continuous and uninterrupted between valve boxes. Clamps used to bond wire to conductor to metal (in instances where both PVC and ductile iron are used in the same run of pipe) shall be heavy-duty stainless steel approved by the City Engineer. A sufficient excess length of wire shall be left in each valve box to provide at least a 6 to 12 inches length of wire above finished grade. See **Standard Detail 511.01**.

2.2.4 DEFORMED REINFORCING STEEL

Reinforcing Steel bars shall meet ASTM A615 *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement*, Grade 60, latest revision.

2.2.5 WELDED WIRE FABRIC

Welded wire fabric shall meet ASTM A185 *Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete*, latest revision.

PART 3 – EXECUTION

3.1 PREPARATION

3.1.1 GENERAL REQUIREMENTS APPLYING TO ALL AREAS

A. Contractor shall plan construction to minimize disturbance to properties adjacent to the water or sewer lines.

B. The City Engineer reserves the right to limit the width of land to be disturbed and to designate on the drawings or in the field certain areas or items within this width to be protected from damage.

C. **Access and/or Haul Roads**: Any grading or excavation required for equipment travel during the course of construction as well as erosion control, access or haul road removal, restoration, seeding and ground cover shall be provided by the Contractor.

D. The Contractor shall be responsible for damage to areas or items designated by the City Engineer to be protected. Repairs to, replacement of, or reparations for areas or items damaged shall be made to the satisfaction of the City Engineer and affected property owners before acceptance of the completed project.

E. The Contractor shall protect all buildings or structures located along the utility line. Hand trenching, shoring, or other methods may be required.

F. Any fences disturbed by the Contractor shall be repaired to a condition equal to or better than their original condition or to the satisfaction of the City Engineer. This may require the use of new material.

G. Contractor shall limit width of disturbed area through garden areas to a width absolutely necessary for construction of utility line.

H. Contractor shall obtain written permission from property owners for use of any access other than ones located within public rights-of-way or easements. Written permission shall contain conditions for use and restoration agreements between property owner and Contractor.

I. All areas disturbed shall be restored to a condition equal to or better than their original condition and shall be graded to drain.

J. The Contractor shall replace or repair all damaged or destroyed hedgerows and property corners using the services of a licensed Professional Surveyor.

3.1.2 CONSTRUCTION LIMITS

A. Contractor shall not disturb any areas outside the limits contained in this section without express written permission from the City Engineer.

B. Except as indicated on the plans, no “clear cutting” of timber shall be permitted within the construction limits. Contractor shall make select cutting of trees, taking smallest trees first, that are mandatory for the construction of the utility line. The decision of the City Engineer shall be final on the determination of which trees are to be cut.

C. Should it become necessary to move the position of any underground structure, the Contractor may be required to do such work and shall be paid on a “force account” basis or on an “extra work” basis as directed by the City Engineer.

Method of payment shall be agreed upon by the City Engineer and the Contractor prior to commencing work.

D. If existing utilities are found to interfere with the permanent facilities being constructed under this section, immediately notify the City Engineer and secure instructions. Do not proceed with permanent relocation of utilities until instructions are received from the City Engineer.

E. The widths measured from the centerline of the water or sewer lines shall be as shown on the contract drawings. The Contractor shall protect all areas outside these construction limits unless written variations are granted by the City Engineer.

F. **Specific requirements applying to developed subdivision/lots**

1) Unless directed otherwise by the City Engineer, all trees, shrubs, hedges, or other ornamental plantings located outside of the construction limits, easements, or public rights-of-way shall be protected by the Contractor. The City Engineer reserves the right to designate certain trees located within the construction limits for protection where deemed desirable.

2) The contractor shall protect septic systems or springs located outside the construction limits.

3) Excavated or blasted rock shall be removed from the site unless otherwise ordered by the City Engineer.

G. **Specific requirements applying to undeveloped areas**

1) In wooded areas, the clearing shall be limited to the easement or right-of-way limits unless indicated differently on the City of Wilson approved construction drawings, in which case, the work shall be confined to the limits defined on the plans. All permanent easements and rights-of-way shall be fully cleared as determined by the City Engineer. The City Engineer reserves the right to designate certain tree located within the construction limits for protection where deemed desirable.

2) In areas where livestock and pets are kept, the Contractor shall notify property owner prior to commencing work and keep owner advised of progress of work. Fences shall be kept secure at all times and livestock and pets protected from open ditches, machinery, blasting, and other hazards.

3.1.3 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. **Subsurface obstructions**

1) **Subsurface obstructions**: Take necessary precautions to protect existing utilities from damage due to any construction activity. The Contractor shall locate existing utilities, culverts, and structures (above or below ground), before any excavation starts and coordinate work with utility companies. The Contractor shall be responsible for notifying utility companies when working within the vicinity of the existing utilities. Omission from or inclusion of located utility items on plans do not constitute non-existent or definite location. Even though for convenience, the utility may be shown

on the plans, the Contractor is responsible for and shall call for utility location a minimum of 48 hours prior to excavation. Contact underground damage protection services NC One Call or current locator service. Secure and examine local utility surveyor records for available location data including building service lines.

2) Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. In excavating, care must be taken not to remove or injure any subsurface structure. All existing gas pipes, water pipes, steam pipes, telephone lines, cable TV lines, electrical conduits, poles, sewers, drains, fire hydrants, and other structures which, in the opinion of the utility company, do not require relocation shall be carefully supported, shored up, the flow maintained, if applicable, and the line/main/obstruction protected from damage by the Contractor. If damaged, the Contractor shall give immediate notice to the proper authorities. The utility shall be restored, at the Contractor's expense, by the appropriate utility to original or better condition. Where pipes, conduits, or sewers are removed leaving dead ends in the ground, such ends shall be carefully plugged or bulk headed by the Contractor at the Contractor's expense and in accordance with the requirements of the affected utility agency. The Contractor shall be responsible for any damage to persons or property caused by such breaks. This includes water taps and sewer cleanouts installed by a contractor during new construction to be taken over by the City of Wilson.

3) The Contractor shall be responsible for anticipating and locating underground utilities and obstructions. When construction appears to be in close proximity to existing utilities, the trench(es) shall be opened a sufficient distance ahead of the work or test pits made to verify the exact locations and inverts of the utility to allow for changes in line and grade.

4) If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.

5) Should it become necessary to move the position of any underground structure, when approved by the City Engineer, the Contractor may be required to do such work and shall be paid on a "force account" basis or on an "extra work" basis.

6) If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the City Engineer and secure instructions. Do not proceed with permanent relocation of utilities until written instructions are received from the City Engineer.

B. **Protection of Surface Features**

1) Whenever the utility line is to be placed in or near a paved street, the Contractor shall provide pads or take necessary precautions to protect the pavement from damage by the construction equipment. Pavement damaged by cleated or tracked equipment, or by any other means, shall be

repaired by the Contractor at his expense to the satisfaction of the City Engineer.

2) Where a utility line is placed in an existing paved area, the Contractor shall use care to cut in sharp, neat lines ahead of the excavating/ditching equipment and parallel to the pipe on each side as may be applicable. If the existing road to be cut is located within another jurisdiction other than the City of Wilson or within NCDOT rights of way, the Contractor is responsible for contacting the local representative or NCDOT, respectively about pavement repair/replacement.

3) Avoid overloading or surcharge by keeping equipment and material a sufficient distance back from edge of excavation to prevent slides or caving. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property.

4) Provide full access to public and private premises, to fire hydrants, at street crossings, sidewalks and other points as designated by the City Engineer to prevent serious interruption of travel.

5) Protect and maintain benchmarks, monuments, or other established points and reference points, and if disturbed or destroyed, items shall be replaced by a Licensed Professional Surveyor to the full satisfaction of the City Engineer and/or the jurisdictional agency.

6) See paragraph 1.11 D, *Coordination*, regarding traffic signals.

C. **Procedures for repairing damaged utility services**

1) If a located service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the City. Notification shall be made to the Utility owner.

2) **House services**: If a service pipe supplying water or gas to an adjoining house is broken, the Contractor shall have service repaired it at once and at his expense. The City may, at the Contractor's expense, repair any such service without prior notice to the Contractor.

3) If damage results from the action of either a public or private party on a newly constructed project to be accepted by the City of Wilson (e.g. water, sanitary sewer, storm sewer, or street), immediate notification shall be given to the City Engineer or City Inspector. All damages or interruption shall be the responsibility of the party causing the damage.

4) Notify the City or PNG if services or mains are damaged. Gas repairs are to be made by either the City or PNG. The repairs made to services or mains damaged by either the Contractor's or his/her subcontractors will be at Contractor's expense.

3.1.4 PROTECTION OF PERSONS AND PROPERTY

A. Barricade open holes and depressions occurring as part of the work, and post warning lights on property adjacent to or part of public access.

B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this or other related sections.

C. **Protection and Restoration of Property:** The contactor shall not enter upon private property for any purpose without first obtaining permission. He shall use every precaution necessary to prevent damage or injury to any public or private property, trees, fences, monuments, and underground structures, etc., on and adjacent to the site of the work. He shall protect carefully from disturbance or damage all land monuments and property markers until an authorized agent has witnessed or otherwise referenced their locations, and shall not remove them until directed.

The Contractor shall be responsible for all damage or injury to property of any character resulting from any act, omission, neglect, or misconduct in his manner or method of executing said work, from his nonexecution of work, or from defective work or materials, and he shall not be released from said responsibility until the work shall have been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, the contractor shall restore such property, at his own expense, to a condition equal to or better than that existing before such damage or injury was done. The contractor shall make good such damage or injury in an acceptable manner by repairing, rebuilding or otherwise restoring as directed.

The Contractor shall, at his own expense, sustain in their places and protect from direct or indirect injury all pipes, poles, conduits, walls, roadways, buildings, and other structures, utilities and property in the vicinity of his work. Such sustaining and supporting shall be carefully done by the Contractor and as required by the Company or party owning the structures or Agency controlling it. The Contractor shall take all risks attending the presence or proximity of pipes, poles, conduits, walls, thereof and any costs associated will be deducted from any monies due the Contractor. Failure of the City Engineer or his/her authorized representative to direct the correction of unsafe conditions or practices shall not relieve the Contractor of his responsibility hereunder.

3.1.5 CLEARING AND GRUBBING

A. **Description**: This work shall consist of clearing, grubbing, removing, and disposing of all vegetation and debris within the limits of construction, as designated on the plans or as required by the City Engineer. The work shall also include the preservation from injury or defacement of all vegetation or objects designated to remain. Clearing shall consist of cutting, removal, and satisfactory disposal of all trees, down timber, brush, rocks, projected roots, stumps, rubbish, laps, and other material within the limits of construction.

B. A preconstruction meeting shall be held with appropriate urban forestry personnel (as may be applicable) and the City prior to any clearing, if required. The City Engineer may require tree protection fencing in sensitive areas, where specifically

identified trees are desired to be protected, and when required by the landscape ordinance.

C. The area within the limits of construction or as designated shall be cleared and grubbed of all trees, stumps, roots, brush, undergrowth, hedges, heavy growth of grasses or weeds, debris and rubbish of any nature that, in the opinion of the City Engineer, is unsuitable for foundation material. Nonperishable items that are not deleterious to the project and will be a minimum of 5 feet below the finish elevation of the earthwork or slope of the embankment may be left in place.

D. The Contractor shall provide barricades, fences, coverings, or other types of protection necessary to prevent damage to existing improvements, not indicated to be removed, and improvements on adjoining property. All improvements damaged by this work shall be restored to their original condition and to a condition acceptable to the owner or other parties or authorities having jurisdiction. Trees and shrubs that are to remain within the construction limits will be indicated on the drawings or conspicuously marked on site. Unless otherwise noted, trees within the construction limits shall become the property of the Contractor and shall be removed from the site.

E. Contractor shall protect existing tress and other vegetation indicated by the City Engineer to remain in place against limb, bark or root damage such as cutting, breaking, or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. When such damage does occur, all rough edges of scarred areas shall be removed in accordance with accepted horticultural practices.

F. Carefully and cleanly, cut roots and branches of trees indicated to remain where the roots and branches obstruct construction of the proposed utility line. If directed by the City Engineer, the Contractor shall provide protection for roots and branches over 1 ½ inches diameter that are cut during construction operations. Coat the cut faces with emulsified asphalt, or other coating especially formulated for horticultural use on cut or damaged plant tissues. Temporarily cover all exposed roots with wet burlap to prevent roots from drying out. Provide earth cover as soon as possible.

G. If they are damaged by construction operations, trees and vegetation designated to remain shall be repaired or replaced at Contractor's expense in a manner acceptable to the City Engineer. The City Engineer may require that the tree and/or vegetation damage be repaired as directed by a qualified tree surgeon.

H. Debris from the site shall be removed in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt, dust, and debris at all times.

I. The method of stripping, clearing, and grubbing the site shall be at the discretion of the Contractor. However, all stumps, roots and other debris protruding through the ground surface or in excavated areas shall be completely removed and disposed of off the site by the Contractor.

A. **Marginal Areas**: In marginal areas, with the City Engineer's permission, remove trees where the following conditions exist.

1) **Root Cutting**: When clearing up to the "clearing limits," the Contractor shall also remove any tree which is deemed marginal such that when the roots are cut a tree could be rendered unstable by the affects of high winds and thus in danger of toppling into either the right-of-way or onto private property.

2) **Slender Bending Trees**: Where young, tall, thin trees are left unsupported by the clearing operation, and are likely to bend over into the right-of-way, the Contractor, during the clearing operation, shall selectively remove those trees which are located outside and adjacent to the clearing limits and City right-of-way or easement as well. During the course of construction and during the one-year warranty period, the Contractor shall remove such young trees that overhang into the right-of-way or cleared area. Removal outside of a public right-of-way or easement require permission from a private property owner. Coordinate owner contact with the City's inspector.

J. **Stripping of Topsoil**: Remove the existing topsoil to a depth of 6 inches or to the depth encountered from all areas in which excavation will occur. The topsoil shall either be stored in stockpiles separate from the excavated trench material if the topsoil is to be respread or otherwise disposed of off-site. Topsoil stockpiles shall be graded to freely drain surface water, and shall have a silt fence placed around the base of the stockpile and/or other measures required by the Erosion and Sedimentation Control Plan/Permit.

K. **Disposal**: All brush, tree tops, stumps, and debris shall be hauled away from site or otherwise disposed of in a manner acceptable to the City Engineer. The contactor shall clean up debris resulting from clearing operations continuously with the progress of the work and remove promptly all salvageable material that becomes his property and is not to be reused in construction. Sale of material on the site is prohibited.

Disposal of cleared material shall be in accordance with all local and state laws. Trees cut down on the construction site will be hauled away from the site for proper disposal unless instructed otherwise by the City. Stumps of trees cut down outside of the excavation area will be removed. Perishable material shall not be disposed of at the construction site. Brush, laps, roots, and stumps from trees shall be disposed of in a NCDEQ approved and permitted land clearing and inert debris type landfill. The Contractor will be responsible for obtaining all applicable permits and paying all fees for the disposal of excess material.

3.1.6 DEWATERING

A. **Water in trenches**: When ground water in encountered, the contractor shall remove the water that accumulates in the trenches or pits, which would affect the construction of the lines or their appurtenances, by pumping, bailing, well-pointing, or other approved dewatering method and shall perform all work necessary to keep the trenches or pits entirely clear from water while bedding is being placed, the pipe is being laid, masonry units are being placed, and structures are either being set or constructed. All water removed from the trench shall be conveyed in a proper manner to a suitable point of discharge and shall comply with applicable erosion and sedimentation control laws. Pipe laying and pipe jointing shall be made in the "dry."

B. Maintain dewatering systems until dewatering is no longer required.

C. No pipe shall be constructed in water and water shall not be allowed to drain through the pipe. The open end of the pipe shall be kept closed with a tight fitting plug to prevent washing of any foreign matter into or through the line.

D. No structure shall be constructed in water and water shall not be allowed to flow over or rise upon any concrete masonry structure until the work has been accepted or permission has been otherwise granted by the City Engineer.

E. The contractor shall dispose of water from the trenches in such a manner to cause no injury to public health, pubic or private property, work completed or in progress, street surfaces, or which may cause any interference with the use of the streets. Water, if odorless and stable, may be discharged into an existing storm drain, channel, or street gutter in a manner approved by the City Engineer. When required by the City Engineer, a means shall be provided for desilting (filtering) the water before discharge. Under no circumstances shall water be discharged to a sanitary sewer main or structure.

F. Prevent surface water from ponding on prepared subgrades and from flooding project site and the surrounding area. Reroute surface water runoff away from or around excavated areas.

G. Do not allow water to accumulate in excavations. Unless otherwise directed by the City Engineer, the cost of shoring, sheeting, well pointing, gravel bedding and other dewatering devices shall be included in the unit price of each respective item bid. Do not use excavated trenches as temporary drainage ditches.

H. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation. Include cost of de-watering in proposal for water or sewer lines. No additional remuneration for this item is permitted.

I. Where underground streams or springs are encountered, provide temporary drainage, well pointing, or bailing. Notify the City Engineer of such conditions.

J. Backfilling shall not take place when the trench contains water in an amount to create soupy conditions.

3.2 TRENCH EXCAVATION

3.2.1 GENERAL

A. **Classification of Excavated Material**: All excavated material shall be classified as either earth or rock. Prices bid for the various sizes of pipe shall include excavation and backfilling; such excavation shall be classified as earth. Rock excavation shall be paid for as a separate item.

B. Remove all material of whatever nature, including but not limited to clay, silt, and gravel. Provided the material meets the requirements of paragraph 2.1.1 *Material Classification*, subparagraph F, *Common Trench Backfill*, material of a compactable nature that can be re-used as trench backfill shall be replaced and re-compacted to the requirements set forth in these specifications.

C. **Unsuitable Material and Wasting**: When directed by the Owner's Engineer or the City Engineer, unsuitable material in the trench shall be removed to an

appropriate depth and width. At the contractor's expense, dispose of all unsuitable material, of whatever nature, to a site which legally can accept such material as fill. Adhere to all applicable laws and ordnances regarding permitting of waste site, erosion control, zoning, etc. as may be applicable.

D. Excavation shall be performed in accordance with OSHA Standard *29 CFR Part 1926, Subpart P - Excavations*.

E. **Sanitary and Storm Sewer Alignment and Grade**: Offset stakes set at each manhole, catch basin, or curb inlet shall indicate the line and grade of the sewer. Alignment and grade of the pipe by the Contractor shall be established by laser beam. The contractor shall employ personnel experienced in the use of laser beams. The alignment and grade of the sewer shall be constructed as indicated on the approved plans. Prior to making changes in the field, the City Engineer shall approve any change in grade or alignment which deviates from the approved plans.

F. Concrete collars shall be installed when either shown on the approved plans or directed by the City Engineer.

3.2.2 PIPE COVER

A. **General**: Where lines transverse public property or are subject to other governmental or utility company jurisdiction, provide depth, bedding, cover, and other requirements as set forth by the legally constituted authority having jurisdiction, but in no case less than the depth shown in the Contract Documents.

B. **Minimum Cover**: Unless shown otherwise on the construction documents, provide minimum trench depth indicated below to maintain a minimum cover over the top of the installed item. Minimum cover on pipe is measured perpendicular from top of pipe or fittings to original ground or proposed finished grade as applicable and shall be per **Table 2275.1**, below. Where the minimum cover is not provided, either use Ductile Iron Pipe or encase the pipe(s) in concrete as indicated. Provide NCDOT Class A concrete.

Table 2275.1 Minimum Cover Above Top of Main Pipe Lines			
Utility	**Condition**		
	Subject to vehicular traffic	**NOT subject to vehicular traffic**	**With Concrete Encasement**
Sanitary Sewer	36[b] inches (use DIP if < 36 inches of cover)	24[b] inches (use DIP if < 36 inches of cover)	As Designed
Sewer Services	At depth shown on plans but no less than 36[b] inches (use DIP if < 36 inches of cover)	At depth shown on plans but no less than 12[b] inches	As Designed
Water Distribution	36[a] inches for lines 8 inches and smaller; 42 inches for lines larger than 8 inches	36[a] inches for lines 8 inches and smaller; 42 inches for lines larger than 8 inches	24 inches (encasement, if required, shall extend to at least 5 feet beyond each side of a ditch or culvert crossing)
Water services	30[a] inches	30[a] inches	As Designed
Storm Drainage	As designed but no less than 12[c] inches for reinforced concrete pipe	As designed	As Designed

[a]**Minimum/Maximum Cover for Water Pipe**: The City Engineer must approve all installations of water line with less than 30 inches of cover or greater than 72 inches of cover. Lines which have less than 30 inches of cover at ditch or culvert crossings shall be Ductile Iron and encased in a steel casing. The casing shall extend through all areas until the depth of cover above the DIP is greater than 30 inches.

[b]**Minimum/Maximum Cover for Sewer Pipe**: The City Engineer must approve all installations of sewer lines with 24 inches of cover or less or with greater than 18 feet of cover. Ductile iron pipe is required where depth of pipe exceeds 12 feet or the line is placed in fill.

[c]**Minimum/Maximum Cover for Storm Drainage Pipe**: The City Engineer must approve all installations of storm drainage lines in areas subject to traffic load with less than 12 inches of cover or with greater than 12 feet of cover. The pipe class, trench width, and/or the bedding class shall be modified for the depths exceeding 12 feet of cover to accommodate the extra depth/loads. Pipe subject to vehicular traffic shall be reinforced concrete pipe. No plain concrete pipe is permitted in traffic areas.

C. Water lines which have less than 30 inches of cover at ditch or culvert crossings shall be required by the City Engineer to be encased. The casing shall extend through all areas until the depth of cover above the DIP is greater than 30 inches.

3.2.3 TRENCHING

A. **General**: The trench for gravity pipe shall be excavated to conform to **Standard Details 511.02** (water and sewer pipe embedment), **631.01** (storm drainage), and **731.01** (sewer) as applicable. Where it is necessary to remove existing pavement, prepared road surfaces, sidewalks and curbs, these structures/surfaces must be replaced by the Contractor. When making a pavement cut, the Contractor shall use care to saw cut in sharp, neat lines ahead of the excavating/ditching equipment and parallel to the pipe on each side as may be applicable. If necessary due to damage, edges of existing pavement shall be re-cut and trimmed to square, straight edges after the pipe system has been installed and prior to placement of the new base and pavement. See **Standard Detail C01.03**.

All trenching shall be open-cut from the surface. No tunneling or boring will be allowed without the consent of the City Engineer. All trenches shall be excavated to the lines and grades as shown on the plans. Where utility lines are in an existing paved area, the edges of the pavement for the utility line shall be cut in a straight line, parallel to the pipe.

Trenches shall be excavated in straight lines, in general, following the contour of the ground, and shall be accurately graded in order to establish a true elevation of the invert of the pipe. Trenches for water lines may be curved within the limits of curvature of the pipe as allowed by AWWA C600. In no case shall the trench alignment exceed the allowable vertical or horizontal pipe deflection of offset recommended by the pipe manufacturer.

1) **Trench Width**: The sides of trench shall be uniform and vertical. The width of the trench at the top of the pipe shall be a width that will permit the proper construction of joints and compaction of backfill around the pipe and shall be equal to the largest outside diameter of the pipe plus 12 inches on each side of the pipe, measured transverse to the pipe at the top of the pipe. The sides of the trenches shall be vertical unless otherwise approved by the City Engineer. Unless otherwise shown in the standard details, vertical walls should project at least 2 feet above the top of the pipeline laid to existing construction grade unless the finished grade fill depth is less than 2 feet. Lowering trench wall height may necessitate a change in either pipe or bury classification. Notwithstanding, this section is subject to OSHA guidelines and regulations regarding trench protection and shoring.

   Every effort shall be made to maintain the width of the pipe plus 24 inches but trench width must also be wide enough to provide adequate space for laying and connecting pipe and appurtenances. Sufficient space shall be allowed at the joints for the free use of wrenches for tightening of bolts.

   The minimum trench width should generally be no less than 36 inches in order to accommodate a “Rammax” walk behind or infrared remote controlled trench roller/compactor (24- to 33-inch drum).

   In excavating for the trench, it is essential that the trench bottom be uniform in grade and remains static during backfilling and under all subsequent trench conditions. To ensure a uniform depth of stone, the grade of the bottom of the trench shall be graded to within 0.04 foot (1/2-inch) of the plan specified grade. The stone shall be graded to the same tolerance.

   Care shall be taken not to over excavate the trench. All trenches excavated below grade (over excavated) shall be refilled to grade with clean #57

stone. No extra compensation shall be allowed for this work unless such excavations are ordered by the City Engineer.

2) **Trench Depth**:

   a. **General**: All trenches shall be excavated to accommodate the bedding as shown in **Standard Details 511.01, 511.02,** (water and sewer), **631.01** (storm drainage), and **731.01** (sanitary sewer) as applicable. No extra compensation will be made for stone bedding used to bring the trench up to grade other than that required in **Standard Detail C01.02** where yielding or wet subgrade is encountered.

   b. **Water**: Trench depth shall generally conform to that shown on the plans and in conformity to the requirements of Table 2275.1, *Minimum Cover above top of Main Pipe Lines*.

   c. **Gravity sewer**: Excavate to the depth and grades shown on the plans. Trench depth shall generally conform to the requirements of Table 2275.1, *Minimum Cover above top of Main Pipe Lines*.

   d. **Storm drainage**: Excavate to the depth and grades shown on the plans. Trench depth shall generally conform to the requirements of Table 2275.1, *Minimum Cover above top of Main Pipe Lines*.

3) **Open trench exposure**: Once trench is opened, proceed immediately and with dispatch to place specified materials in trench, or to otherwise utilize trench for intended purpose. Long stretches of open trench ahead of pipe laying shall be avoided. Excavating, pipe laying, and backfilling must move forward at approximately equal rates of progress. The contractor shall only open as much ditch as he can completely install pipe, backfill, compact, and cleanup within that working day. The contractor shall string out the pipe that can be installed in one day, and unless approved otherwise by the City Engineer, no more than 300 feet of trench shall be open in advance of the completed work in any section. There shall be no trenches left open without proper supervision during working hours or after work has been completed for day. Any exception to this construction practice must be approved, in writing, by the City Engineer. Schedule work and order materials so that trenches are not left open for a longer period than is reasonably necessary. If the contractor should fail to heed the aforementioned requirement, the City Engineer may refuse payment until these conditions are complied with.

4) **Containment of Sediment (solids and mud)**: The contractor shall at all times so conduct his work to ensure that all solids and mud are contained within the trench. This containment shall be by the employment of a brick or block weir at the junction of new construction and the existing City system in order to trap material for the Contractor's removal and City's inspection prior to acceptance. The installation and removal of this dam shall be at the Contractor's expense and shall be removed before the line is televised.

3.2.4 SHEETING AND BRACING, TRENCH BOXES

A Certified Competent Person designated by the Contractor shall be on-site at all times excavation or pipe installation is being conducted.

Provided there is no indication of a potential cave-in, trench walls may generally have vertical sides if less than 5 feet in depth (measured from subgrade elevation to existing grade). In excess of this depth, the entire side must be laid back or either shoring or a trench box, certified for the depths being used, must be used. The contractor shall be required to furnish, put in place, and maintain such sheeting, bracing, etc. as may be required to support the sides of the trenches. Brace and sheet trenches in full observation of the requirements of OSHA *Subpart P – Excavations*. Trench wall slopes and/or benching shall conform to the requirements of OSHA based on Soil Classification (Stable Rock, type A, B, or C type) and account for trench depth, surcharge loads, stored equipment or material, traffic, etc. When trenches are 4 feet or more in depth, a safe means of egress (stairway, ladder, ramp or other safe means) from the trench excavations shall be provided. Such egress shall be placed so that no more than 25 feet of lateral travel by employees is required to the egress.

Brace trenches running near walls or columns, to prevent any settlement or other disturbance of walls or columns.

Do not remove sheeting until backfilling has progressed to the stage that no damage to piping, utility service, or conduit will result due to removal of sheeting. All shoring and form material shall be removed before backfilling. When sheeting, bracing, or trench boxes are required, in order to prevent damage to existing facilities or structures, or as a matter of safety, or as directed by the City Engineer, the costs are to be included in the unit prices as bid for sanitary sewers, storm drains, water lines or structures as applicable and there shall be no additional cost for these items.

Sloping trench walls: If trench walls are to be sloped or benched, contractor is responsible for determining the proper and applicable slope based on soil type in order to meet OSHA requirements. Laying back slopes also applies for areas where the top of the trench box is lower than the top of the bank. Contractor shall employ the services of a Geotechnical Engineer for direction and guidance if unstable or difficult soils are encountered. In any event, the Contractor shall hold the City harmless for injuries and/or damages resulting from failure to properly adhere to trench protection regulations/requirements in force at the time of a failure or mishap including, but not limited to, damage to utilities, equipment, structures, paving, etc.

3.2.5 ROCK:

A. **Rock Excavation**: See paragraph 1.4 P, Rock Excavation for Trenches and Pits and paragraph 1.4 Q, Rock in Open Excavations for definition of rock excavation.

B. When rock is encountered in the trench, the City Engineer must be notified before any rock is blasted or removed. Do not perform rock excavation work until rock has been cross-sectioned, classified, and approved for removal by the City Engineer. The City Engineer will measure the rock, after which, the rock shall be excavated to a depth 6 inches below the grade of pipe and the bottom of trench brought back to grade by using an approved fill material. See paragraph 3.8, *Blasting* for other requirements regarding rock excavation.

C. Intermittent drilling, blasting, or ripping performed to increase production and not necessary to permit excavation of material encountered will be deemed to be unclassified excavation

D. All over blasted rock which has been loosened must be removed prior to backfilling.

E. The Contractor must use overburden, mats, or other means to minimize flyrock. Any damage caused by flyrock or excessive vibration will be the responsibility of the Contractor.

F. **Cushioning pipe in rock**: Special precautions shall be exercised to prevent any pipe from resting on rock or any other hard projection that might cause breakage of pipe. At no time shall the pipe bell or the pipe barrel rest on rock. A minimum of 6 inches of sand or soil (select earth) cushioning is required between the barrel of the pipe and rock. A minimum of 12 inches of clearance is required between the sides of the pipe and the rock. Thicker cushioning may be required for deeper pipe on a case-by-case basis. See **Standard Detail C01.01**.

G. **Disposal of Rock:** Rock excavated from the trench shall be hauled off the site at the Contractor's expense. Borrow required to replace excavated rock shall be provided by the Contractor and shall be included in the unit price bid for rock excavation. No rocks or boulders shall be used as backfill in any part of the trench. Where rock has scattered over adjoining property as a result of blasting, the Contractor shall remove the rock and restore the area to its original condition at no cost to the City.

3.2.6 PREPARATION OF FOUNDATION FOR PIPE LAYING

A. Excavation of trenches for all pipes lines shall be done to line and grade as established by the design Engineer. The bedding surface shall provide a firm, stable, and uniform support through the entire length of the pipe. Recesses shall be excavated to accommodate bells and joints. When bedded firmly on the subgrade, the pipe shall be on the exact grade of the completed water, sewer, or storm drainage line.

In excavating for the trench, it is essential that the trench bottom be uniform in grade and remains static during backfilling and under all subsequent trench conditions. To ensure a uniform depth of stone, the grade of the bottom of the trench shall be graded to within 0.04 foot (1/2-inch) of the plan specified grade. The stone shall be graded to the same tolerance.

Excavation in Class II, III, or IV soils shall be made to grade to provide undisturbed bedding in accordance with AWWA C600. (See **Standard Detail 511.02, sheets 2 & 3** for classification definitions.)

B. **Unsuitable Trench Subgrade/Foundation Improvement**: Excavation in Class V, wet, yielding, unstable, inadequately supporting, or mucky soils shall be excavated 6 inches or more below the specified grade. The material shall be removed for the full width of the trench and the excavated area strengthened for foundation purposes. The over excavated material shall be replaced with thoroughly compacted Class I, II, or III materials as directed by the City Engineer. The trench bottom shall provide a stable and continuous support for the pipe system with bell holes provided to permit jointing. See **Standard Detail C01.02.**

Whenever the bottom of the trench is such that it cannot be reasonably stabilized, the City Engineer may require the utility to be laid in a concrete mud mat, concrete encasement, cradles, in cradles supported on piles, or a combination of these materials. When necessary, the Contractor shall provide for the temporary diversion of water in order to maintain the pipe foundation in a dry condition.

Observe the following requirements when unstable trench bottom materials are encountered:

1) Notify the City when unstable materials are encountered and define by drawing station locations and limits when encountered.

2) Remove unstable trench bottom materials as directed and replace with subgrade stabilization material specified.

B. **Over-excavation**: Unauthorized over-excavation consists of removal of material beyond indicated subgrade elevations or side dimensions, without specific approval of the City Engineer. Exercise care to avoid excavations below established grade where firm earth conditions exist. Where unauthorized excavations have been carried beyond points required, restore these areas to the elevations and dimensions shown on the drawings with approved fill material and compact as specified (as noted in the preceding paragraph). In no case shall the pipe be brought to grade by blocking under the barrel of the pipe. A uniform support shall be provided for the entire length of the pipe. Unauthorized excavation shall be replaced at Contractor's expense.

3.2.7 TRENCH PREPARATION FOR PIPE

A. **Preparation of trenches for Gravity Sewer pipelines**

The bottom of the trench for gravity pipelines shall be excavated to a minimum over depth as shown on **Standard Detail 731.01** to provide for improved pipe bedding material for the entire length of the gravity pipeline, including sewer lateral connections, except in rock where bedding shall be a minimum of 3 inches deep (see **Standard Detail C01.01** and paragraph 3.2.5 F, above). The bedding shall be shaped so that the bottom of the pipe rests on the bed. Bell holes and depressions as required of the joint shall be dug after the bedding has been graded and shaped, and shall be only of such length, depth, and width as required for properly making the particular type of joint. The trench for gravity sewers and lateral connections shall then be backfilled and compacted as indicated in Table 2275.3.

B. **Preparation of Trenches for Storm Drainage Pipelines**

The bottom of the trench for storm drainage pipelines shall be excavated to a minimum over depth as shown on the construction drawings in accordance with the applicable type laying condition specified (as shown on **Standard Detail 631.01**) to provide for pipe bedding for the entire length of the gravity pipeline, including lateral connections if any, except in rock where foundation bedding shall be prepared as specified on **Standard Detail 631.01**. Unless otherwise directed by the City Engineer, the bedding shall be shaped to conform to **Standard Detail 631.01**. Bell holes and depressions as required of the joint shall be dug after the bedding has been graded and shaped, and shall be only of such length, depth,

and width as required for properly making the particular type of joint. Rock larger than 3 inches shall be removed from the trench bottom and any voids filled with compacted NCDOT Class II or III material. The trench for storm drainage and lateral connections, if any, shall then be backfilled and compacted as indicated **Standard Detail 631.01, Table 2** taking care to compact in no more than 8-inch lifts with the fill brought up evenly on both sides of the pipe at the same time to avoid unbalanced pressures. The balance of the trench backfill up to pavement subgrade, or finished grade as applicable, shall conform to Table 2275.3 of this specification.

Where an unsuitable foundation is encountered, provide a stone foundation with NCDOT Type 4 soil stabilization fabric as shown on **Standard Detail 631.01**.

C. Preparation of trenches for Water Mains and Force Mains

The trenches for water lines and sewage force mains shall be graded to avoid local high points. Trenches shall be graded either level or on a continuous upslope to the high points designated on the drawings. Trenches shall be of such depth as to provide a minimum cover over the top of the pipe as noted in Table 2275.1. The trenches shall have 4 inches of loose soil in the bottom before pipe is placed, so pipe is firmly and continuous in contact with the soil. Pipe shall not bridge any areas. Rock larger than 3 inches shall be removed from the trench bottom and any voids filled with soil or clean stone. Bell holes shall be provided at each joint to permit proper joint assembly and proper pipe support. Rock shall be removed 6 inches below pipe and the void filled with coarse sand (SC, SM).

Unless directed otherwise by the City Engineer, DIP water mains and force mains shall have a **Type 1** laying condition with Class **D bedding**. Bedding for DIP water mains shall conform to **Standard Details 511.01** and **511.02** as applicable. PVC water main pipe bedding shall conform to **Standard Detail 731.01**. (See also paragraph 2.1.2, Bedding Definitions)

D. Surface or Ground Water in Trenches/Pipe

When ground water is encountered, the Contractor shall pump, or otherwise remove any water that accumulates in the trenches and shall perform all work necessary to keep the trenches clear from water while pipe is being laid. No pipe shall be laid in water and the pipe shall not be used as a means of draining ground water from the trench. All water removed from the trench shall be conveyed in a proper manner to a suitable point of discharge and shall comply with the applicable erosion and sedimentation laws. See paragraph 3.1.6 – *Dewatering*, of this specification.

The open end of water or sewer pipe shall be kept closed with a watertight plug to prevent washing of any foreign matter into the line. At the conclusion of the workday, or at any other time when pipe laying is not in progress, a watertight plug shall be placed in the bell of the last joint of pipe laid.

Storm drainage pipe shall either be plugged and/or an appropriate sediment trap placed at the upstream end to prevent siltation.

3.2.8 TRENCHING IN FILL

In areas where trenching for pipe will be in fill, the fill shall be brought to an elevation of at least 12 inches above the top of the pipe, and then the trench excavated in the compacted fill, as herein specified for trench excavation.

3.2.9 SUBSURFACE DRAINAGE

Installation of subsurface drainage systems shall conform to the requirements of Section 815 – *Subsurface Drainage* of the NCDOT *Standard Specifications for Roadways and Structures*

3.2.10 EXCAVATION FOR STRUCTURES

A. Excavate to provide a minimum of 12 inches of horizontal clearance between outer surface of structure and trench wall.

B. Where rock is encountered so that a built-in-place manhole, precast structure (such as a manhole or vault), or other structure will bear over rock, remove the rock to a minimum of 8 inches below the foundation or footing of the structure and place an 8 inch cushion of clean #57 stone over the rock.

3.2.11 WATER MAIN BEND BLOCKING INSTALLATION

A. Excavate area to receive poured-in-place concrete blocking to exact dimensions shown in **Standard Detail 512.01**. Blocking is to be placed in undisturbed residual soils. If blocking is to be placed in areas where boulders or stumps have been removed or in areas of loosely compacted fills, such as in landscaped areas (outside of pavements or parking lots), contact the City Engineer for directions.

B. Concrete shall be minimum NCDOT Class A Concrete plain concrete.

C. Wrap bolts in plastic or provide other acceptable means of protection, approved by the City Engineer before pouring concrete blocking.

3.2.12 DEPOSITION OF EXCAVATED MATERIAL

A. All excavated material shall be placed on one side of the trench (a minimum of 2 feet from the edge of excavation but no less that that specified/required by OSHA regulations) away from the roadway unless permission is given by the City's representative to place it on both sides. Excavated materials shall be so placed as not to endanger the work and so that free access may be had at all times to all parts of the trench and to all fire alarm boxes, fire hydrants and gate valves on water pipes, which are located in the vicinity. Excavated material shall be placed to in such a way as to inconvenience the public as little as possible. All fences and walls shall be protected and, if damaged, shall be repaired or replaced in as good or better condition as before it was disturbed. Protect shade trees from stockpiling of material.

B. Exercise care when stockpiling excavated material on the bank in order to prevent surcharging the bank of the trench and potentially rendering the excavation unstable.

C. **Wasting of Unsuitable Material:** Material of an uncompactable nature, material unsatisfactory for backfill, trash, and excess material shall be removed from project site and disposed at the Contractor's expense. Where removal of unsatisfactory

material is due to negligence on the part of the Contractor (i.e. resulting from inadequate shoring or bracing, failure to dewater, improper material storage exposing it to rain or flooding, or other failure to meet specified requirements), work shall be performed at no additional cost to the City. If additional material is required, the contractor shall supply same from an approved borrow pit at no additional cost to the City. Rock excavated from the trench shall be hauled off the site at the Contactor's expense.

3.3 BEDDING

3.3.1 BEDDING DEFINITIONS: see paragraph 2.1.2, *Pipe Bedding Definitions* (Water & Sewer).

3.3.2 MINIMUM BEDDING REQUIREMENTS (by utility type):

A. **Sewer Pipe Bedding**: Unless otherwise noted below, provide #57 or smaller stone trench bedding material.

1) **Minimum Bedding Allowed DIP Gravity Pipe**: Minimum Type 4 Laying Condition (**Standard Detail 511.02)**. The minimum bedding depth shall be 3 to 4 inches under the pipe with an additional 1 inch depth of cushioning material added for each additional 2 feet of depth in excess of 16 feet up to a maximum of 12 inches of cushioning material.

2) **Haunching DIP Gravity Pipe**: The remainder of bedding for DIP shall be brought up to a depth of 1/8 the OD of the pipe. However, when the foundation is determined by the City Engineer or his representative to be unsuitable, the pipe shall be bedded to the spring line of the pipe. See **Standard Detail 511.02**, Type 4 laying condition.

3) **Bedding and Haunching SDR 35 PVC and C900 PVC Gravity Pipe**: PVC pipe to have Type 5 laying condition (**Standard Detail 511.02**) with the remainder of bedding shall be brought to the top of pipe. The minimum bedding depth shall be 3 to 4 inches under the pipe with an additional 1 inch depth of cushioning material added for each additional 2 feet of depth in excess of 16 feet up to a maximum of 12 inches of cushioning material. See also **Standard Detail 731.01**.

4) **Minimum Bedding Allowed for DIP and C900 PVC Force Mains**: Bedding for DIP force mains shall be Type 1 Laying Condition with excavation of trench bottom for bells as shown on **Standard Detail 511.02**. Bedding for C900 PVC force mains shall be Type 5 laying Condition as shown on **Standard Detail 511.02**.

5) **Minimum Bedding Allowed for PVC Services**: Bedding for PVC services shall be Type 5 laying Condition as shown on **Standard Detail 511.02** except the total trench width may no less than 24 inches.

D. **Bedding Water Pipe and Water Service Pipe**: Unless otherwise directed by the City Engineer, do not bed water pipe and water service pipe in stone. DIP water mains to be Type 1 Laying Condition with excavation of trench for bottom of bells as shown on **Standard Detail 511.02**. Bedding for C900 PVC water mains shall be Type 4 laying Condition as shown on **Standard Detail 511.02**.

E. **Bedding in Rock**: For rock areas, bed pipe in accordance with paragraph 3.2.5 F *Cushioning pipe in rock* and **Standard Detail C01.01**.

F. **Bedding for Storm Drainage Pipe**: See paragraph 3.2.7.B, above.

G. **Bedding for Structures**: The bottom of manhole bases and other precast structures and appurtenances shall be excavated to minimum over depth of 6 inches, but no less than as indicated in the applicable standard details, below the bottom of the structure. The structures shall be placed on clean stone bedding that has been firmly consolidated. Bedding material shall be shaped, graded, and compacted so that the entire bottom of the structure rests level on the material for its entire area.

3.3.3 BEDDING MATERIAL PLACEMENT

A. Unless otherwise specified, the bottom of the pipe trench for sanitary sewer (gravity and pressure), and where indicated by the City Engineer, storm drainage pipe shall be excavated to below the bottom of the pipe, to provide for the compacted bedding materials, except as specified in rock. Bedding material shall be placed, shaped, and compacted so that at least the bottom of the pipe rests uniformly upon the material for the entire length of the pipe. Bell holes and depressions required for the jointing of pipe shall be dug after the compacted bedding material has been graded and shaped and shall be only of the length, depth, and width required to make the joint properly. Care shall be taken to ensure bedding fills the voids beneath the pipe haunches, by poking with a shovel or tamper. See **Standard Details 511.01, 511.02, 631.01,** and **731.01,** as applicable.

3.4 BACKFILLING (MATERIALS AND METHODS)

3.4.1 BACKFILLING

A. **GENERAL**:

1) **Materials**: See *paragraph 2.1.1 - Material Classification* for Select Earth Backfill and Common Trench Backfill classification. In areas of extensive rock excavation, where there is a shortage of suitable backfill, the contractor shall, at his own expense, haul suitable material in to be placed over the pipe.

2) Pipe and fittings shall be inspected before backfilling.

3) Except as otherwise specified or directed for special conditions, backfill trenches to the ground surface with Common Trench Backfill material approved by the City Engineer. After the pipe has been brought to grade on a proper foundation, earth fill shall be placed carefully about the pipe and tamped properly to hold the pipe in position. Exercise extreme care in backfilling operations to avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion. Repair damages, distortions, or misalignments to the full satisfaction of the City Engineer. Pipe shall be removed if broken or damaged during installation. Backfill shall closely follow the pipe installation. Unless otherwise directed or permitted by the City Engineer, all pipe laid shall be

backfilled during the same day, and prior to the completion of the day's work, to provide a firm continuous support and covering for the pipe.

4) Reopen trenches that have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified, or otherwise correct to the approval of the City Engineer.

5) Do not allow or cause any of the work performed or installed to be covered up or enclosed by work prior to required inspections, tests, and approvals. Should any of the work be so enclosed or covered up before it has been approved, uncover all such work and, after approvals have been given, refill and compact as specified, all at no additional cost to the City.

6) Observe specific pipe manufacturer's recommendations regarding methods of backfilling and compaction.

7) Ensure compaction of each lift to requirements stated in these specifications.

8) All pipe areas shall be graded and maintained in such a condition that erosion or saturation will not damage the pipe bed or backfill.

9) Heavy equipment shall not be operated over any pipe until it has been properly backfilled and compacted with a vibratory compaction device (i.e. Rammax walk behind or infrared remote controlled trench roller/compactor (24- to 33-inch drum), NOT A PLATE TAMP) and has a minimum cover as required by the plans. Pipe that is misaligned, shows excessive settlement, or has been otherwise damaged by the Contractor's operations, shall be removed and replaced at no cost to the City.

10) **Installation of Warning Tape:** See paragraph 3.17.2, Identification of Water Lines for installation requirements. See paragraph 2.2.2 Warning Tape for product specifications.

B. **METHODS**:

Provide backfill and compaction methods of following types:

1) **Carefully Compacted SELECT EARTH BACKFILL**: Furnish carefully compacted select earth backfill where indicated on drawings and specified for compacted backfill conditions up to 12 inches above top of pipe. See paragraph 2.1 *Soil, Bedding, and Backfill* for definition of Select Earth Backfill. Comply with the following:

Care shall be taken to prevent any disturbance of the pipe or damage to newly made joints. The filling of the trench shall be carried on simultaneously on both sides of the pipe in such a manner that injurious side pressures do not occur such that the pipe could be displaced or dislodged. Do not backfill on muddy or frozen soil.

Sheeting and shoring generally should be removed only when the trench below it has become substantially filled, and every precaution shall be taken to prevent any slides of material from the sides of the trench onto or against the pipe.

a. Unless otherwise approved by the City Engineer, place backfill in lifts not exceeding 6 inches (loose thickness).

b. Hand place, shovel slice, and hand tamp carefully compacted backfill solidly around pipe. Only hand tamping shall be used to compact earth around the pipeline. When the backfill has been brought to 12 inches above the top of the barrel, vibratory compaction devices (i.e. Rammax Trench Compactor walk behind or infrared remote controlled trench roller/compactor (24- to 33-inch drum), NOT A PLATE TAMP) shall be used to compact the remainder of the soil.

2) **COMMON TRENCH (FINAL) BACKFILL** Perform remaining backfill in accordance with drawings or as directed by the City Engineer. See paragraph 2.1 *Soil, Bedding, and Backfill* for definition of Common Trench Backfill. Comply with the following:

a. Unless otherwise specified or approved by the City Engineer, backfill the remainder of the trench, from 12 inches above the pipe to grade, with clean earth fill free of stones larger than 3 inches in diameter. Top 12 inches to be free of material greater than 1 inch. Material shall be free from all perishable and objectionable materials (organic). Before placing any backfill, all rubbish, forms, blocks, wires, or other unsuitable material shall be removed from excavation. The backfilling shall be placed in layers not over 6 inches thick in the street right of way and 12-inch layers outside of the street right of way. See Table 2275.4. Final backfill shall be tamped with a vibratory compaction device (i.e. Rammax Trench Compactor walk behind or infrared remote controlled trench roller/compactor (24- to 33-inch drum), NOT A PLATE TAMP). See Table 02275.3 below, for specific density requirements.

b. All areas within the limits designated on the drawings, including adjacent transition areas, shall be uniformly graded. The contractor shall finish surfaces within the specified tolerances with uniform levels or slopes between points where elevations or existing grades are shown.

1. Finish subgrade areas that are to receive topsoil. Bring such areas to within 0.10 foot of required subgrade elevations.

2. Shape subgrade under sidewalks to line, grade, and cross-section. Subgrade is to be brought to within 0.10 foot of required subgrade elevations.

3. Shape subgrade under pavement to line, grade, and cross-section. Bring to within ½ inch of required subgrade elevations.

c. **Surface Protection – Traffic**: The contractor shall protect newly graded areas from traffic and erosion, repair, and re-establish grade in settled, eroded, or rutted areas. Where compacted areas are disturbed by subsequent construction or adverse weather, the contractor shall scarify the surface, reshape, and re-compact to the required density.

On City funded projects, should the contractor fail to maintain any trench within 2 days after notice from the City Engineer, the City may address/remediate the trench problem and the cost of such work may be retained from monies due the contractor. In case of emergency, the City Engineer may refill any dangerous trench failures or depressions without prior notice to the Contractor.

3) **Structure Backfill**: Backfill placed within 2 feet of manholes and other special structures shall be of the same quality as that specified for backfill around water, sewer or storm drainage lines. Take care to prevent wedging action of the backfill against structure by carrying the material uniformly around the structure so approximately the same elevation is maintained in each lift. If necessary to prevent damage to structure, provide temporary bracing of structure walls. Material shall be solidly tamped with a mechanical or pneumatic tamper in such a way as to avoid damaging the structures or producing unequal pressures. The Contractor shall refill all excavations as rapidly as practical after completion of the structural work therein, or after the excavations have served their purpose.

3.5 COMPACTION/DENSITY

Soil shall be compacted using equipment suitable for the material and the work area location. Power driven hand tampers shall be used for compacting materials adjacent to structures. Use hand tamper for recompaction over underground utilities.

A. **Testing**

Testing of backfill shall be performed by an independent laboratory approved by the City and the Contractor. The Contractor shall be responsible for excavation for testing.

Quality Assurance vs. Quality Control:

Quality Assurance (QA) testing, and the associated cost, is the responsibility of the City. Quality Assurance testing by the City is used to confirm that the Contractor is generally performing his/her work in compliance with these specifications.

Quality Control (QC) testing is the necessary and required testing that is to be performed by the Contractor to assure that he/she is meeting and complying with the requirements of these specifications. The associated cost for QC testing is the contractor's responsibility. The contractor is also responsible for "re-testing" costs incurred by the City when the City's test results (tests for Quality Assurance) results in a "failure."

Quality Control (QC) testing for City funded projects: The City shall pay for the cost of Quality Control by having the Contractor include the cost for testing in the unit cost of the project; not as a separate pay item. The Contractor shall pay for all costs associated with re-testing.

B. **Quality Assurance (QA):**

In the course of backfilling trenches for utility installations, the City Engineer may require "Field Density Determinations" or compaction tests. When compaction tests are called for, the City Engineer will determine the location of the tests and

the City shall engage a qualified testing firm to perform the test. A representative of the City will observe tests and a copy of the test results and inspection report will be submitted by the testing firm directly to the City Engineer. When the tests indicate that the density failed to meet the requirements of Table 2275.3, the Contractor shall comply with paragraph 3.5 G, Failure of Compactive Efforts.

Payment for failed QA density tests: For City funded projects, payment for failed in-place density tests shall be made by the Contractor by deducting the testing cost from the forthcoming retainage. For other projects in which the City will ultimately assume ownership and maintenance, the testing costs for failed in-place density tests shall be billed directly to the Contractor.

C. **Quality Control (QC):** The Contractor shall perform in-field density tests in accordance with Table 02275.2. Inspection reports shall be submitted by the testing firm directly to the City Engineer. See paragraph 3.5 F, Passing Test.

1) All test results shall be provided to the City Engineer as they become available from the testing agency.

2) The Geotechnical testing firm is to perform laboratory tests (ASTM D698, standard Proctor) to establish a moisture-density relationship for all materials that are proposed to be used as fill.

3) Contractor shall give a 24-hour notice to Geotechnical testing firm for subgrade testing, subgrade confirmation, or inspections.

4) **Minimum Compaction Testing Frequency**:

The following testing frequency shall be employed on both City funded projects and projects proposed to be turned over to the City for maintenance and/or ownership.

Table 2275.2
Testing Frequency

Location	Frequency
Trench areas in road crossings	1 test group[a] per road crossing, and/or
Trench areas	1 test per 200 linear feet per two feet of fill thickness
Exception: Where additional tests are required to determine the extent of unacceptable compaction (having been determined by the initial QA/QC test). In this case, the costs for these additional tests are the responsibility of the Contractor.	

[a]One test group consists of a compaction test on each layer of backfill material in the trench segment.

D. **Site access for testing**: Ensure the City, at all times, has immediate access to the site for the testing of all soils related work. Ensure excavations are in a safe condition for testing personnel.

E. **Minimum Compaction Requirements:** Compaction percentages are percentages of maximum dry density as determined by indicated ASTM

Standards. Unless noted otherwise on drawings or more stringently by other sections of these specifications, place and ensure degree of compaction of trench backfill and/or borrow material does not fall below the following percentages of the maximum density at optimum moisture content.

Table 2275.3 Minimum Compaction Limits (Cohesive Soils)		
Location	**Density**	
Beneath and within 5 feet of buildings	100% of the maximum dry density by ASTM D698 (standard Proctor), AASHTO T-99.	
Areas under roadway pavement surfaces, curb and gutter, and sidewalks	Top 12 inches	100% of the maximum dry density by ASTM D698 (standard Proctor), AASHTO T-99.
	Up to within 12 inches	95% of the maximum dry density by ASTM D698 (standard Proctor), AASHTO T-99.
Roadway shoulders	95% of the maximum dry density by ASTM D698 (standard Proctor), AASHTO T-99.	
Under turf, sodded, planted, or seeded non-traffic areas	90% of the maximum dry density by ASTM D698 (standard Proctor), AASHTO T-99.	

F. **Passing Test:** Average of 3 test results meeting the applicable provisions of Table 2275.3 (above) with no one test failing by more than -3 percentage points. Moisture content tolerance is to be within +/- 3 percentage points of the optimum moisture content unless otherwise specified by the City Engineer or Geotechnical Engineer.

G. **Failure of compactive efforts:** If compaction efforts should fail to provide a stable subgrade in accordance with the requirements in paragraph 3.5 F, Passing Test after subgrade materials have been shaped and brought to optimum moisture, such unstable materials shall be removed to the extent directed by the Geotechnical Engineer and/or the City Engineer and replaced and compacted using new material and must pass compaction test prior to proceeding to the next stage of construction and at no expense to the City.

The costs associated with excavation and re-compaction of areas that have failed will be the Contractors responsibility.

H. **Compaction Lifts:**

Table 2275.4 Compaction Lift Thickness	
Lift Thickness (inches)	**Location**
6	Inside street rights-of-way
12	Outside street rights-of-way

I. In-place testing of soils shall be tested based on the following:

Table 02275.5	
In-Place Density Tests	
Soil Type/Classification	**Reference Standard**
Crushed Rock	ASTM D2049 by percentage of relative density ASTM D1557 or D698 (standard Proctor)
GW, GP, SW and SP	ASTM D2049 by percentage of relative density ASTM D1557 or D698 (standard Proctor)
GM, GC, SM, SC, ML, CL	ASTM D2167, D1556, D2922, or D2937 by percentage of standard Proctor Density according to ASTM D698 or AASHTO T-99

3.6 SERVICE CUTS, DIRECTIONAL BORED OR PUNCHED SERVICES

A. **Open trenches**: Sewer lateral and water service connections that cross paved streets shall be installed by saw cutting the pavement and opening the trench. The open trench width shall be no wider than 36 inches.

Lateral connection trenches in non-paved areas shall be buried as specified for gravity sewers and for water lines, as applicable. See Table 2275.1.

Do not bed water service pipe, except when rock is encountered.

B. **Directional Boring or Punching**: At the direction of the City Engineer, service pipes may be required to be "punched" or "directionally bored" beneath the pavement.

3.7 PAVEMENT REPAIR AND REPLACEMENT

A. **General**: This work shall consist of replacing subbase stone, and bituminous material in the street in areas where it becomes necessary to remove the original pavement for sewer, water main, and storm drainage trenches. Pavement repair shall be as shown on the drawings or as determined by the City Engineer. However, the pavement surface repair shall conform to the minimum requirements shown on **Standard Detail C01.03**. The pavement patch shall provide a uniform and smooth driving surface free of humps or depressions.

B. **Construction in Public Rights of Way**: Water, sewer, and storm drainage lines installed in or across NCDOT roads shall be installed in accordance with, if applicable, the requirements stipulated in the approved encroachment permit and the latest requirements of both the NCDOT *Standard Specifications for Roads and Structures* and the *Roadway Standard Drawings*. All water, sewer and storm drainage lines installed in or across City streets shall be in accordance with these specifications and the applicable standard details.

When it is necessary to remove the existing pavements, prepared road surfaces, sidewalks, or curbing, it shall be the responsibility of the Contractor to replace these surfaces to original or better condition. The Contractor shall be responsible for contacting the City or the NCDOT, as applicable. Unless specified more

stringently by the owner of the right of way, the backfill shall be compacted in accordance with Table 2275.3.

Contractor shall replace pavement base such that there is a minimum of 36 inches of compacted stone screenings immediately below the proposed pavement surface compacted to 100% of the maximum dry density (ASTM D698). Pavement shall be S-9.5B and shall match the existing asphalt depth but may be no less than 2 inches in thickness. All patches greater than 2 inches in thickness shall be placed in appropriate lifts. See **Standard Detail C01.03**.

C. When water, sewer and/or storm drainage lines are installed in or across roadways that have been macadamized or graveled, the Contractor shall save the gravel or stone, refill the upper 12 inches of the trench with the material, and supply sufficient new stone or gravel to return the roadway to the original grade. It shall be the Contractor's responsibility to maintain the original grade by adding gravel or ABC until the ditch is stable and the pipeline accepted by the City. Maintain area as outlined in paragraph *3.4.1 B.2).c - Surface Protection - Traffic*.

D. **Cutting Pavement**: See also **Standard Detail C01.03** and paragraph *3.1.3 B – Protection of Surface Features*. Perform cutting operations prior to installation of line to avoid excessive removal of asphalt.

E. **Protection of Pavement**: See paragraph *3.1.3 B – Protection of Surface Features*.

3.8 BLASTING

3.8.1 GENERAL

A. Blasting procedures shall conform to all applicable local, state, and federal laws and ordinances and shall be performed in accordance with OSHA *Standard 29 CFR Part 1910.109*, NCDOT Rules for Transporting Explosives, and local Fire Department Regulations. Prior to any blasting, a blasting permit shall be obtained. The approval of the City Engineer and Fire Marshall shall be obtained before any blasting takes place and the City Engineer may fix the hours of blasting if he/she deems it to be necessary. The use of explosives shall be in accordance with approved methods that safeguard lives and property. Explosives shall only be handled, placed, and detonated by persons licensed in this work. It is the responsibility of the Contractor to provide proper notification to appropriate parties.

B. **Rock Excavation**: See *paragraph 3.2.5 - Rock* for the definition of rock.

C. The minimum insurance coverage for blasting shall be as specified by current NC Fire Prevention Code or more as determined by the City Engineer and Fire Marshall. The coverage shall include explosion and collapse. If blasting occurs within 200 feet of any underground structure or utility, underground coverage will be required. The owner and the property owners shall be named as "additional insured."

D. No blasting shall be allowed unless a galvanometer is employed to check cap circuits.

E. The City may prohibit blasting when the method of detonation or the means of protection provided is inadequate. Blasting conducted with or without direct

supervision of the City will not relieve the Contractor of the responsibilities stipulated herein.

F. Blasters shall not explode or attempt to explode blasting powder or high explosives unless it is performed with a suitable electric blasting machine. Electric current from batteries, telephone, or power lines shall not be used for detonation.

G. A minimum of 3 minutes prior to the detonation, the blaster shall inform competent flagmen, equipped with red flags, stationed at reasonable distances from the blast area at every avenue of approach, to warn all persons.

H. Immediately after the loading and tamping of the drill hole and before fixing the blast, the material to be blasted shall be covered on all exposed sides with blasting mats, or other approved protective material. After the protection has been applied, the blast shall be fired without unnecessary delay.

I. **Storage of Explosive Materials**:

1) Magazines sites shall be secured in accordance with OHSA, Bureau of Alcohol, Tobacco, Fire Arms and Explosive (BATFE) and Mine Safety and Health Administration (MSHA) regulations.
2) Magazine sites must be labeled with appropriate warning signs that indicate the contents and are visible from each approach. The signs shall be placed so that a bullet passing through them will not strike the magazine. The magazines areas shall be fenced and locked with a single lock.
3) Only explosive material and essential non-sparking equipment (pens and inventory records) used for the operation of the magazine may be stored in the magazines.
4) A current BATFE Storage permit will be posted in each magazine.
5) Metal magazines will be grounded and equipped with electrical bonding connections between all conductive portions so the entire structure is at the same electrical potential.
6) Ground checks shall be conducted on the blast magazines and prill silos at least annually. Records shall be kept with the electrical department.
7) All explosive material must be stored in approved magazines according to the Institute of Makers of Explosives (IME) safety publication 22.
8) Magazine keys shall be kept in the key card box and accessed only by authorized personnel approved by the Blast Foreman.
9) Metal magazines will be grounded and equipped with electrical bonding connections between all conductive portions so the entire structure is at the same electrical potential.
10) Magazines must be a sufficient distance from power lines so that the power lines, if damaged, would not contact the magazine.
11) Explosive material storage areas and magazines including nitrate storage areas shall be kept clean and clear of rubbish, brush, dry grass, and trees for 25 feet in all directions. Other combustibles will not be allowed to accumulate within 50 feet of these magazines.
12) Only authorized personnel shall be allowed access to blasting material storage areas.
13) Explosive material, blasting agents, and detonator (blasting caps) shall be stored in separate magazines.

14) Magazines shall only be used for the storage of explosives materials. Only explosive material and essential non-sparking equipment used for the operation of the magazine may be stored in the magazines.
15) The explosives shall be stored in their own containers (boxes).
16) Explosive material will be stored to facilitate use of oldest stock first and stacked in a stable manner, but not more than eight (8) feet high.
17) Explosives and Detonator Magazines shall be secured with two locks at all times when unattended and protected with covers to deter access.
    a. The locks shall be case hardened with a minimum of 3/8 inch shank and no less than five (5) tumblers.
18) Drop trailers containing blasting agents must be kept locked with a single lock when unattended and king pins must be secured against transport.
19) Nitrate Silos.
20) Must be well ventilated, located in a secure place.
21) The diesel oil storage and fuel depot must always be separated from the ammonium nitrate area to avoid the danger of explosion in the event of a fire.
22) The ammonium nitrate must be kept dry.
23) If present, the electrical wiring located in the nitrate silo must be equipped with the relevant safety devices to prevent hazards and losses.
24) Water should be used to facilitate nitrate spillage clean-up when necessary
25) Detonators shall be stored separately from explosives.

Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made.

J. **Explosive Transport**:

1) Explosive material will be transported without undue delay to the storage area or blasting site.
2) Closed non-conductive containers (cargo areas/spaces) will be used to carry explosives and detonators to and from blast sites. Separate containers will be used for explosives and detonators.
3) Explosive material and detonators will not be transported on the same vehicle unless they are separated in compartments by 4 inches of hardwood or the equivalent per IME Safety Publication 22 and the detonators are kept in closed non-conductive container. The hardwood partition must be fastened to the vehicle or conveyance.
4) The vehicles used to transport explosives will be:
    a. Equipped with a minimum of two multipurpose dry chemical fire extinguishers or one such extinguisher and an automatic fire suppression system.
    b. Posted with warning signs that indicate the contents and are visible from all four sides. The signs must be removed when explosive material is not being transported.
    c. Equipped with side and end enclosures higher than the explosive being transported.
    d. Equipped with a cargo space that has no sparking material exposed in the compartment. Explosive material must never be transported in the operator's compartment.
    e. Occupied only by qualified persons necessary for handling the explosive material.
    f. Attended at all times while explosives are present:

1. Attended means qualified persons are present or the cargo areas/spaces are locked.
2. In no instance will explosives be left in the cargo areas/spaces of the blasting truck overnight.
3. Must be secured with parking brake applied and bermed or chocked when not being operated.

5) The explosive (prill) mixing truck shall be calibrated so that the mixture is appropriate for the product being used and the required powder factor needed.
6) Only qualified personnel shall attempt removal of rocks lodged between the dual tires of vehicles.

3.8.2 BLASTING PROCEDURE

A. The Contractor shall provide a blast warning signal system. The blast warning signal system shall consist of one or more air horns located at the blast site. The air horn(s) shall be audible a minimum of 1 mile from the blast site. The signals shall be one long horn five minutes prior to the blast, one short horn 1 minute prior to the blast, and one long horn after the blast to signal all clear. The Contractor shall erect two clear and legible blast warning signal signs at locations determined by the City Engineer and Fire Marshall. The signs shall list the blast warning signal system, the Contractor Superintendent's name and telephone number, and the City's representative's name and telephone number.

B. The Contractor shall establish test pits at up to two representative locations along the alignment and up to three locations adjacent to the site proposed to be blasted to determine if the rock is "rippable" with a track backhoe Caterpillar No. 325 or equivalent and the feasibility of rock excavation by "hoe ramming" (see paragraph 1.4 P, above for definition of rock excavation in open trenches and pits). If these procedures do not offer reasonable production for rock excavation, then blasting will be allowed unless otherwise indicated.

C. The Contractor shall notify in writing all property Owners within 250 feet of the proposed blast at least 1 week prior to the proposed blast and verbally on the day of the scheduled blast.

D. Blasting shall be limited to mid-morning hours on days of clear-to-partly cloudy skies with increasing surface temperature and light wind. The Contractor shall provide monitoring equipment to monitor all blasting. A copy of monitor record shall be given to the City daily.

E. The use of unconfined explosives shall be prohibited.

F. Unless otherwise stipulated in Title 13 of the NC Administrative Code, chapter 7, the maximum allowable peak particle velocity shall be 1.25 inches per second for all structures located 0 to 300 feet from the blasting site. The maximum allowable peak particle velocity shall be 1.00 inch per second for all structures located 301 to 5,000 feet from the blasting site. The maximum allowable peak particle velocity shall be 0.75 inch per second for all structures located 5,001 feet and beyond from the blasting site.

G. To minimize vibration, minimum scaled distance (SD) of 50 shall be used to determine maximum explosive weight per delay. A test blast shall be conducted to verify the scaled distance. The maximum explosive weight per delay shall not exceed the distance from the blast to the nearest structure divided by 50 squared.

Maximum explosive weight per delay may be revised pending outcome of test blast. The recommendations indicated for blasting criteria in no way relieves the Contractor of his liability.

H. The peak overpressure of air blast shall not exceed 0.015 pound per square inch or 138 decibels.

I. Preblast meetings shall be scheduled with the City Engineer and Fire Marshall to document hole depths and spacing, charge weight per delay, shot scheduling, and weather conditions. The Contractor shall obtain accurate measured distances from structures to center of blast area prior to determining the safe maximum charge-weight per delay and loading blast holes.

J. Preblast and post blast surveys shall be performed by the Contractor. The Contractor may review this data and supplement it as he sees fit or conduct separate survey after written permission is obtained from the property Owners. In this event, the written permission shall be submitted to the City Engineer and Fire Marshall prior to entering upon private property. The preblast and post blast surveys will include all occupied buildings within 250 feet of blasting areas. The Contractor is strongly encouraged to have a representative present during these surveys. The preblast and post blast surveys performed by the City or the property owner in no way relieve the Contractor of his liability.

K. The City reserves the right to monitor production blasting. In this event, the Contractor shall provide the City Engineer and Fire Marshall ample notice of scheduled blasts (minimum of 24 hours) to allow set-up of monitoring equipment.

3.9 HIGHWAY CROSSING

A. Pipeline crossing shall be installed in a steel casing pipe installed by the “dry bore and jacking” method. Length of steel pipe shall be welded to the preceding length installed. The carrier pipe shall be protected by spiders constructed as shown on **Standard Detail C07.03**. The ductile iron carrier pipe shall be as specified for sewer and water pipe and shall be mechanical joint ductile iron pipe. If, in the opinion of the Contractor, boring and jacking of the highway crossing is not possible due to rock, he shall test drill, in the presence of the City Engineer at the proposed crossing locations, at least 3 evenly spaced points in the placement along the crossing alignment. Upon verifying the presence of rock at a depth that would conflict with the boring and jacking operation, the Contractor shall make application to the City or the NCDOT, as applicable, to allow open cutting of the crossing. The Contractor shall be responsible for providing all data and shall pay any fees required for this application. If the trench is allowed to be open cut, casing pipe shall be provided and the trench shall be backfilled entirely with flowable fill concrete to the bottom of the pavement base course and the pavement restored within one day of placing the pipe.

B. The steel casing pipe shall be of the thickness as specified in **Standard Detail C07.03**. Refer to specification Division 02530, *Sanitary Sewer* and Section 02510, *Water Distribution* for casing pipe specifications.

C. Installation shall be in accordance with AREA.

D. The jacking operation shall be carried on in such a manner that settlement of the ground or the highway above the pipeline will not occur. The use of water or other

fluids in connection with the boring and jacking operation shall not be allowed. Excavation shall be made by auger or manual methods, at the Contractor's option, to suit the conditions encountered. The contractor shall repair or replace, as directed by the City Engineer, at his own expense, casing pipe damaged during the jacking operation.

E. After installation of the casing pipe, the carrier pipe, if required, shall be installed. The ends of the casing shall be plugged in accordance with **Standard Detail C07.03**.

F. All operations of the Contractor shall be subordinate to the free and unobstructed use of the highway right of way for passage of traffic without delay or danger to life, equipment, or property. The contractor shall provide all necessary bracing, bulkheads, and shields to ensure complete safety to all traffic at all times.

3.10 RAILROAD CROSSING/TRACKS

Crossing of railroad tracks with water, sewer or storm drainage lines shall be by the method shown on the contract drawings and approved by the applicable Railroad Company. It is the responsibility of the Project Engineer and Contractor to contact the Railroad Company and to comply with all Railroad Company requirements for specifications, drawings, permits, etc. All water, sewer, and storm drainage lines installed beneath railroad tracks shall be in accordance with the Railroad Company's policies, procedures, and permits requirements. The railroad right of way and track structure shall be fully restored to its original pre-existing condition and to the full satisfaction of the Railroad Company. The work shall not interrupt the use of the railroad tracks or in any way endanger the traffic on them.

3.11 UNDERGROUND RIVER OR CREEK CROSSINGS

In accordance with the contract drawings, underground river or creek crossings shall be made either by horizontal directional drilling (HDD) with HDPE pipe or constructed in the dry by providing a temporary cofferdam or bulkhead. River or creek crossings shall be in accordance with the requirements of the City Engineer, NCDEQ, The US Army Corps of Engineers, and all other agencies having jurisdiction. Unless horizontal directional drilling is specified in the contract documents, river or creek crossings shall be made by providing a temporary cofferdam or bulkhead using ductile iron pipe for the crossing.

River or creek crossings shall be as near to perpendicular as possible to the stream.

A. **Cofferdam Method**: The Contractor shall construct the river crossing in the "dry" by providing a temporary cofferdam or bulkhead of non-erodible material. The cofferdam shall not obstruct more than one-half of the water surface at any time and shall not extend more than 3 feet above the normal water surface. The Contractor shall not be allowed to operate construction equipment on the native steam bottom, except during removal of the cofferdam. The contractor shall be advised that the level in the river can fluctuate rapidly.

1) Non-erodible material shall be defined as heavy coarse aggregate as specified on the plans. An earth core for the cofferdam may be constructed over the propose excavations; however, the non-erodible materials shall be in place prior to the placement of the earth, so that the erodible earth does not come in contact with the flowing water.

2) A bulkhead may be constructed in lieu of the cofferdam. The bulkhead shall be made of wood, steel or some like material suitable to withstand the hydraulic forces to permit construction in a dry trench.

3) Construct the crossings as indicated. The Contractor shall then remove the cofferdam, bulkhead, or whatever equipment or material that was used to construct the crossing. The bottom of the river in the construction area shall be restored to its original cross section. All disturbed areas on the banks of the river shall be seeded and mulched in accordance with *paragraph 3.16 – Seeding and Groundcover*.

4) Comply with all terms and conditions of all permits issued by the US Army Corps of Engineers and/or NCDEQ for this work.

5) The pipe and joints of water or sewer main entering or crossing streams shall be tested in place and shall exhibit zero infiltration. This testing shall be done prior to encasing in concrete.

B. **Horizontal Directional Drilling (HDD) Method**: HDPE pipe shall be installed by horizontal directional drilling using a surface mounted rig, first to drill a guided hole along a bore path consisting of a shall arc and then to pull a string of pipe into the hole. Pull back is facilitated by a back-reamer, which enlarges the hole to approximately one and a half times the pipe diameter. Drilling fluids are injected into the bore hole to stabilize the hole and lubricate the pipe and drilling string. Tracking equipment is used to guide and direct the drilling. See Division 02510, *Water Distribution* for installation, testing and other requirements for horizontal directional drilling.

3.12 SURFACE/SUBSURFACE WATER CROSSINGS

Surface water crossings, with pipe above the water, shall be adequately supported by pipe support piers or beams. Subsurface water crossings, with pipe under the streambed, shall have the pipe encased in concrete or steel when the cover is less than 3 feet. For subsurface water main stream crossings, see **Standard Details C07.04 and C07.05** for additional limitations on cover and for other requirements relating to stream subsurface stream crossings.

3.13 CONCRETE COLLARS ON SEWER MAINS

Concrete collars shall be used on sewer lines with slopes 10% or greater. When concrete collars are specified or shown on the drawings, at least one concrete collar shall be placed before the bell of each joint of pipe. Additional collars may be required by the City.

3.14 PLACEMENT OF RIP RAP AND RIP RAP BEDDING

Placement of Rip Rap and fabric shall conform to Section 876 – *Rip Rap* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision.

3.15 CLEANUP AND RESTORATION OF SITE

A. During the progress of the work, the Contractor shall keep the premises and the vicinity of the work clear from unsightly and disorderly piles of debris. Suitable locations shall be specified for the various construction materials and for debris. The materials shall be kept in their storage locations, except as needed for the

work and debris shall be promptly and regularly collected and deposited in the specified location.

B. Upon completion of section of pipeline and appurtenances, the Contractor shall fine grade the ground adjacent thereto, removing all surplus excavated material, leaving the area free from surface irregularities. He shall dispose of all surplus material, dirt, and rubbish from the site; and shall keep the site free of mud and dust to the satisfaction of the City Engineer. The contractor may be required to flush or sprinkle the street to prevent dust nuisance.

C. When working on the shoulders of paved roads, the Contractor shall keep the pavement clean of all loose earth, dust, mud, gravel, etc., and shall restore road surfaces, shoulders, and ditches as required by either the NCDOT or the right-of-way owner.

D. **Grading Easements**: Easements shall be graded to have cross slopes of 4% or less. The ground surfaces of easements shall be graded and cleared in such a way to promote proper drainage and allow mowing by vehicular equipment without damage to equipment from rock(s) and other debris.

E. After all work is completed, the contractor shall remove all tools and other equipment, leaving the site free, clean, and in good condition.

F. The contractor shall keep the surface over and along the trenches and other excavation in a safe and satisfactory condition during the progress of the work and for a period of one year after the work has been competed. He shall be held responsible for any accidents that may occur on the account of the defective condition of such surface.

3.16 SEEDING & GROUNDCOVER

Seeding and groundcover includes seedbed preparation, liming, fertilizing, seeding, and mulching of all disturbed areas. Areas inside or outside the limits of construction that are disturbed by the Contractor's operation and activity shall be seeded and mulched.

A. Seeding, Sodding, and Groundcover shall comply with the applicable provisions and requirements of Division 02920, *Seeding, Sodding and Groundcover*.

B. Seeding and groundcover includes seedbed preparation, liming, fertilizing, seeding, and mulching of all disturbed areas. Areas inside or outside the limits of construction that are disturbed by the Contractor's operation and activity shall be seeded and mulched.

Unless called for otherwise on the Erosion and Sedimentation Control Plan, in areas where natural sod or vegetation has been disturbed, the area shall be seeded in accordance with **Standard Detail 350.01**.

C. Seeding and groundcover includes seedbed preparation, liming, fertilizing, seeding, and mulching of all disturbed areas. Areas inside or outside the limits of construction that are disturbed by the Contractor's operation and activity shall be seeded and mulched.

Unless called for otherwise on the Erosion and Sedimentation Control Plan, in areas where natural sod or vegetation has been disturbed, the area shall be seeded in accordance with **Standard Detail 350.01**.

If the line is installed through a landscaped lawn, sod shall be placed to restore ground cover to the existing lawn.

D. Seeding shall be carried out as soon as practical after the construction in any one area, and shall be maintained against erosion through the completion of the project. Seeding shall be accomplished as work progresses and shall be in accordance with Sediment and Erosion Control regulations.

The Contractor shall be responsible for proper care of the seeded area during the period that vegetation is being established. In the event of an erosive rain before an adequate stand of vegetation has been established, damaged areas shall be repaired, fertilized, seeded, and mulched at the Contractor's expense.

Seeding on rights of way of NCDOT maintained roads shall be in accordance with NCDOT specifications and the requirements of the approved encroachment permit.

E. **Temporary Seeding**: Temporary and permanent seeding shall be carried out in accordance with the approved E&SC permit and plans as well as the applicable requirements of the NCDEQ Land Quality Erosion and Sediment Control Planning and Design Manual. Unless otherwise noted as more restrictive on either the approved E&SC plans and permit or in the Erosion and Sediment Control Planning Design Manual, denuded areas to be graded during the construction phases that are not to be brought to final grade within 21 calendar days shall receive temporary seeding and mulching. Areas to be stabilized with permanent vegetation must be seeded or planted within 15 working days or 90 calendar days after final grade is reached, unless temporary stabilization is applied. Temporary seeding shall also be used to stabilize finished grade areas if the time of year is outside the specified permanent seeding periods.

F. **Stockpile Area**: The contractor is responsible for securing a material lay down and stockpile storage area for this contract. As such, the contractor is responsible for the necessary erosion control measures, including but not necessarily limited to, a construction entrance, silt fence, protection of streams/buffers, clean up and restoration of site to the satisfaction of both the City of Wilson and the NCDEQ, Department of Water Quality, Land Quality Section. Stockpile and/or waste areas must be maintained within the limits of the areas protected by the proposed measures and otherwise temporarily seeded if to be left stockpiled over 21 days.

3.17 MISCELLANEOUS

3.17.1 DUST CONTROL

The contractor shall be required to sprinkle with water or to apply dust allaying materials in the vicinity of dwellings, schools, churches, stores, or other places, where in the opinion of the City Engineer, it is necessary to ensure that dust is held to an absolute minimum. Dust control is considered incidental and shall be carried out at the Contractor's expense.

3.17.2 IDENTIFICATION OF NEW WATER LINES & FORCE MAINS

Underground Warning Tape

For all pipe, a metallic warning tape shall be placed 12 to 18 inches directly above the top of the pipe. See **Standard Detail 511.01**.

The metallic warning tape shall be per paragraph 2.2.2, *Warning Tape* of this specification. No separate payment will be made for warning tape as it is considered to be incidental to the cost of construction of the line being installed.

3.17.3 FLOWABLE FILL CONCRETE BACKFILL

When directed by the City Engineer, the Contractor shall backfill trenches or undercut areas with excavatable flowable fill concrete plant mix to allow for future re-excavation of filled area (see paragraph 2.1.1.C for flowable fill specifications). Except for structural applications, traffic can be placed on mixture within an hour or two after placement. Final surfacing of pavements; however, should be delayed if possible at least 24 hours to allow for shrinkage and hydration of concrete. Depending on depth, a settlement of 2" to 3" is to be expected.

3.17.4 SALVAGE OF USEABLE MATERIALS

All materials such as paving blocks, brick, castings, and pipe etc., removed during excavation that is useable on this project shall only be reused after approval of its use by the City Engineer or the applicable owner of the street right-of-way. Such material shall be stockpiled on site. Unnecessary abuse and damage to these items shall be the Contractors responsibility for replacement at Contractors expense.

End of Section 02275

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02400 - CURB & GUTTER, DRIVEWAYS & SIDEWALKS

(Last Revised 5/2/16, 9/16/19) R5

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. Section 00825 – Product Substitutions

C. Section 00950 – Measurement and Payment

D. Section 02200 – Earthwork

E. Section 02275 – Trenching, Backfilling, and Compaction of Utilities

F. Section 02920 – Seeding, Sodding, and Groundcover

G. City of Wilson List of Approved Manufacturers and Products

1.2 SUMMARY

This section includes concrete curbs, combination curb and gutters, ramps, sidewalks, driveways, flumes, valley gutters, median strips, islands, retaining walls, steps, and headwalls on municipal roadways and its appurtenances.

1.3 DEFINITIONS

A. **General**:

For the purposes of this specification, the following definitions refer to the streets and roadway system that comes under the authority of the City of Wilson, North Carolina as specified within this section and other sections of this manual.

1) **Aggregate Base Course**: A layer of graded aggregate materials of a specified thickness placed between the subgrade and the concrete structure or appurtenance.

2) **Public Road System**: Roadway, streets, and their appurtenances required for the conveyance of the motoring public that are maintained by either the City of Wilson or the North Carolina Department of Transportation.

3) **Subgrade**: The top surface of a sidewalk, curb and gutter or driveway shaped to conform to the typical section on which the concrete structure or appurtenance is constructed.

4) **Suitable Subgrade**: A subgrade that consists of a material type and density that is approved by the City Engineer for placement of a subsequent concrete structure or appurtenance.

B. The following are industry abbreviations for various materials and items:

1) **C&G**: Concrete Curb and Gutter

2) **D/W** Driveway

3) **S/W** Sidewalk

4) **WWF**: Welded Wire Fabric

1.4 SUBMITTALS

A. Submit product data, reports, and/or shop drawings, as applicable, for the following:

1) Air Entrainment
2) Concrete cylinder break tests
3) Concrete admixtures
4) Joint Sealants and expansion joint material
5) Job mix formula
6) Other embedded items

1.5 QUALITY ASSURANCE

A. **Geotechnical Testing Agency Qualifications**: An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing as documented according to ASTM D3740 and ASTM E548.

B. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

C. The Contractor shall comply with North Carolina Department of Environment and Natural Resources, “Erosion and Sedimentation Control Handbook,” latest revision.

D. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Society for Testing and Materials

ASTM A82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A185	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A497	Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C1116	Standard Specification for Fiber-Reinforced Concrete and Shotcrete
ASTM C1315	Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils (for classification purposes only)
ASTM D448	Standard Classification for Sizes of Aggregate for Road and Bridge Construction

ASTM D545	Standard Test Methods for Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types)
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D3740	Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D4397	Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D5893	Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM D8139	Standard Specification for Semi-Rigid, Closed-Cell Polypropylene Foam, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E548	Standard Guide for General Criteria Used for Evaluating Laboratory Competence
ASTM E1745	Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

American Association of State Highway & Transportation Officials

AASHTO M145	The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.
AASHTO T99	The Moisture-Density Relations of Soils using a 5.5-pound Rammer and a 12-inch drop
AASHTO T180	The Moisture Density Relations of Soils using a 10-pound Rammer and an 18-inch drop.

AASHTO T191 Density of Soil In-Place by the Sand-Cone Method

AASHTO T204 Density of Soil In-Place by the Drive Cylinder Method – Replaced by ASTM D2937

AASHTO T205 Density of Soil In-Place by the Rubber-Balloon Method – Replaced by ASTM D2167

1.6 STANDARD ABBREVIATIONS

ACI American Concrete Institute

ADA Americans with Disabilities Act

ANSI American National Standards Institute

ASCE American Society of Civil Engineers

AASHTO American Association of State Highway Transportation Officials.

ASTM American Society for Testing and Materials

CRSI Concrete Reinforcing Steel Institute

FS Federal Specifications

MSDS Material Safety Data Sheets

NCDOT North Carolina Department of Transportation

Note: Designations such as ASTM, AASHTO, NCDOT, etc. referenced throughout this specification imply the latest revision.

1.7 PRODUCT, PRODUCT DELIVERIES, STORAGE AND HANDLING

A. **Concrete Handling/Transportation**

1) Cement concrete plant operations shall comply with the applicable sections of NCDOT *Standard Specifications for Roads and Structures*, Section 1000, *Portland Cement Concrete Production and Delivery*.

2) Time limitations and intervals between deliveries shall be in accordance with Section 1000-4(E), *Elapsed Time for Placing Concrete* of the NCDOT *Standard Specifications for Roads and Structures*.

3) See Part 3 - EXECUTION of these specifications for handling of materials during placement of hydraulic cement concrete.

B. **Steel Handling/Examination**:

1) **Steel Reinforcing Inspection**:

a. **Plain Steel Reinforcing**: Inspect materials thoroughly upon arrival. Examine materials for damage or excessive rust. Remove damaged or rejected materials from site. A light coat of rust is permitted to develop on steel bars and fabric; however, rust scaling and flaking is not permitted

b. **Coated Steel Reinforcing**: Handling and storage of coated bars shall conform to the requirements of AASHTO M284. Visible damage to the coating shall be patched or repaired with materials compatible to the existing coating in accordance with AASHTO M284.

2) **Pre-Installation Inspection**: Prior to being installed, inspect each bar of steel reinforcing for the presence of dirt, paint, oil, rust scaling, flaking or other foreign matter. Remove such matter with appropriate methods and to the satisfaction of the City Engineer.

C. Observe manufacturer's directions for delivery and storage of materials and accessories.

D. Reinforcing steel shall be stored on platforms, skids, or other supports that will keep the steel above ground, well drained, and protected against deformation. Upon delivery to site, epoxy coated steel shall be covered with an opaque covering. Coverings shall be placed to provide air circulation and prevent condensation.

1.8 PROJECT CONDITIONS

1.8.1 PROTECTION OF STREAMS

Do not discharge excess concrete into a drainage pipe, catchbasin, ditch, stream, river, pond, or lake.

1.8.2 PROTECTION OF ROADWAYS

Do not discharge or allow concrete to spill onto any roadway or appurtenances either during placement or while in transit. Remove spills immediately or otherwise repair street as directed by the City Engineer.

1.8.3 PROTECTION FROM GRAFFITI:

Newly poured concrete roads, streets, curbs, or sidewalks shall be protected AND guarded from graffiti from passersby until the concrete has sufficiently cured to resist such molestation. Failure to prevent graffiti, or other such vandalism, shall result in the new concrete having to be removed and replaced. This requirement shall mandate the Contractor to take the necessary steps in preventing such incidents including, but not limited, to guarding the project after normal working hours.

1.8.4 WASHOUT HANDLING

A concrete washout shall be identified and preapproved for use. The area shall be maintained and restored prior to acceptance of the project.

1.9 COORDINATION

Coordinate placement of sidewalk and driveway connections to municipal streets and roadways with the City of Wilson City Engineer.

PART 2 – PRODUCTS

2.1 MISCELLANEOUS

2.1.1 PORTLAND CEMENT CONCRETE

A. Ready mixed concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete.* Cement concrete shall meet the requirements of Section 1000, *Portland Cement Concrete Production and Delivery* and Section 1024, *Materials for Portland Cement Concrete* of the NCDOT Standard Specifications for Roads and Structures.

All exposed concrete shall be air entrained with an air content conforming to the requirements of Section 1000-4(B), *Air Entrainment* of the NCDOT *Standard Specifications for Roads and Structures*. Air entrained admixtures for use in Portland cement concrete shall meet the requirements of AASHTO designation M 154, *Air-Entraining Admixtures for Concrete*. Only those admixtures shall be used which have been approved by the City Engineer.

If approved by the City Engineer, calcium chloride may be used as an admixture subject to the requirements of Section 1000-4(H), *Use of Calcium Chloride* of the NCDOT *Standard Specifications for Roads and Structures*. Calcium chloride shall conform to AASHTO M144, Calcium Chloride, type 2. Do not use calcium chloride in reinforced concrete construction.

Concrete admixtures, when specified, shall conform to Section 1024-3, *Admixtures* of NCDOT *Standard Specifications for Roads and Structures*.

Concrete strength shall be as specified on Standard Details and drawings. Unless otherwise specified, all concrete shall be NCDOT Class A Concrete, minimum.

B. **Concrete Classes**

1) Concrete referenced throughout the City's Manual of Specifications Standards and Design (MSSD) refer to the NCDOT concrete classes and mix requirements referenced in Table 1000-1, *Requirements for Concrete* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision. Such concrete is required to be used on public rights-of-ways and easements or property otherwise either owned or maintained by the City of Wilson.

2) Where minimum concrete compressive strength is specified or referenced in this Manual (i.e. concrete that will typically be used in private developments projects or is referenced by other applicable building codes relative to the type structure proposed [NC State Building Code, Brick Institute of America, Masonry Institute of America, etc.]) the concrete referenced shall conform to ACI 318-14 or later.

3) Concrete Class and corresponding Minimum Compressive Strength Table:

NCDOT Class of Concrete[A]	Minimum Compressive Strength of Concrete (f'c) at 28 days
Units	psi
AA	4,500
A	3,000
B	2,500

[A]Refer to Table 1000-1 for specific properties/requirements relating to the particular Concrete Class

C. **Mixing and Delivery**:

1) During batching and delivery, the City's inspector will receive and sign all concrete batch tickets (NCDOT Materials and Tests Form 903) or approved delivery tickets. Delivery tickets will be permitted instead of batch tickets (NCDOT Materials and Tests Form 903) provided they have been reviewed and approved by a NCDOT Materials and Tests Unit.

2) NCDOT *Daily Plant Report On Ready Mixed Concrete Operations* (NCDOT Materials and Tests Form 250) is to be completed by a certified batcher and the original (white) copy is to be sent with the final load of concrete delivered to project site and, in turn, to the project inspector. If M & T Form 250 is not completed and received on site, concrete is subject to rejection.

2.1.2 HANDRAILS

Handrails shall conform to the applicable sections and requirements of Section 460, *Bridge Railing* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision. Handrails for trail projects shall comply with the applicable subsections of Section 1074, *Miscellaneous Metals and Hardware* of the NCDOT *Standard Specifications for Roads and Structures*.

2.1.3 JOINT FILLER

A. **EXPANSION JOINT FILLER**

Material shall be approximately ½ inch in thickness and a width and depth equal to those of the incidental structure. However, unless otherwise directed by the City Engineer, install expansion joint filler 1/2-inch below the concrete surface and, when called for by project specific contract/special conditions, seal joints for maximum protection from water infiltration, weathering and to assure proper performance.

Use a wider joint filler to obtain the required thickness when a thickness wider than the typical ½-inch width is specified on the plans.

1) **Polypropylene Joint Filler Planks and Sheet:** Joint fillers to be a closed-cell polypropylene foam expansion joint that can be used in residential, commercial, civil, municipal and industrial applications. Joint filler must not absorb water, swell and disintegrate, impede sealant cure time and used

without bond breaker. Joint filler to be a nonstick and resistant to oils, gas, salts, acetone and other chemicals. Joint filler to comply with ASTM D8139 *Standard Specification for Semi-Rigid, Closed-Cell Polypropylene Foam, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction*, D1751 *Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)*, and D545Standard *Test Methods for Preformed Expansion Joint Fillers for Concrete Construction (Nonextruding and Resilient Types)*.

See paragraph 2.1.11 for concrete joint sealer requirements.

2.1.4 CURING MATERIALS

Liquid membrane curing compound, PE film, burlap, or water for curing shall meet the requirements of Section 1026, *Curing Agents for Concrete* of the NCDOT *Standard Specifications for Roads and Structures*.

2.1.5 INSULATION BLANKET

In cold weather operations, insulated blankets must retain or supply moisture and maintain the temperature at the outermost surfaces of concrete above 50º F for at least 72 hours and above 32º F for at least an additional 48 hours. For other measures pertaining to placing concrete in cold weather, see Section 420-7, *Placing Concrete in Cold Weather* of the NCDOT *Standard Specifications for Roads and Structures*.

2.1.6 POROUS BACKFILL AND WEEP HOLES

Porous backfill material and drainpipes for weep holes for retaining walls shall conform to requirements of Section 420-11, *Drains in Walls and Culverts* of the NCDOT *Standard Specifications for Roads and Structures*.

2.1.7 PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specification for Portland Cement*.

2.1.8 REINFORCEMENT

D. REINFORCING BARS

Steel reinforcing bars shall be minimum Grade 60 and shall conform to the requirements of AASHTO M31, *Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcing and ASTM A615.* Reinforcing bars shall also conform to the applicable requirements of Section 1070, *Reinforcing Steel*, of the NCDOT *Standard Specifications for Roads and Structures*.

E. WELDED WIRE FABRIC

Welded wire mesh shall be of the size specified by the City Engineer but shall be minimum 6 x 6, W2.9 x W2.9 and shall conform to the requirements of AASHTO M32, *Cold-Drawn Steel Wire for Concrete Reinforcement* and the applicable

sections of Section 1070, *Reinforcing Steel* of NCDOT *Standard Specifications for Roads and Structures*.

2.1.9 AGGREGATE BASE MATERIAL

Aggregate base materials for foundation support shall be #57, compacted, and in compliance with Table 1005-1, *Aggregate Gradation, Coarse Aggregate* of the NCDOT *Standard Specifications for Roads and Structures*.

2.1.10 CONCRETE ADMIXTURES

Concrete admixtures, when specified by the City Engineer, shall conform to Section 1024-3, *Admixtures* of NCDOT *Standard Specifications for Roads and Structures*.

2.1.11 CONCRETE JOINT SEALER

[Note: Joint Sealants to be applied as required by project specific contract/special conditions call for it.]

1) **Cold-Applied Polysulfide (self-leveling) Joint Sealant:** A two-part premium pourable, self-leveling, highly resilient polysulfide-based joint sealant meeting ASTM C922, Type M, Grade P, Class 25, NT and Federal Spec A-A-1556A, Type M, Grade P, Class 25, NT, to be used in horizontal applications. Joint sealant to provide a uniform watertight seal with excellent recovery characteristics. Sealant to stay flexible and will not become brittle or crack due to ultraviolet exposure. Sealant to resists abrasion, weathering, moisture, is not affected by chemicals, will retain joint soundness in service once cured, and can be stretched or compressed up to 25%. Product to be applied in accordance with manufacturers recommendation.

2) **Cold Applied Silicone Joint Sealant** (to be used in pedestrian traffic areas): Silicone expansion joint filler material shall be in accordance with the applicable parts of Section 1028-3 *Low Modulus Silicone Joint Sealant* of the NCDOT *Standard Specifications for Roads and Structures*, latest edition.

   Sealant to be low modulus silicone sealant meeting ASTM D5893, *Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements;* Type NS (non-sag) for sealing horizontal and vertical joints in Portland cement concrete pavements and structures and Type SL (self-leveling) used in horizontal joints in Portland cement concrete pavements and structures.

3) **Hot Applied Joint Sealer:** Asphalt expansion joint filler material shall be in accordance with the applicable sections of Section 1028-2 *Hot Applied Joint Sealer* of the NCDOT *Standard Specifications for Roads and Structures, latest edition*.

   Hot applied joint sealer shall be a rubberized/asphalt project meeting ASTM D6690, *Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements,* Type 3. Hot applied Joint sealer is not to be used in areas of a heavy pedestrian traffic.

PART 3 – EXECUTION

3.1 CONSTRUCTION – ALL CONCRETE ITEMS

3.1.1 CONSTRUCTION OF SUBGRADE

A. **SUBGRADE PREPARATIO**N: Excavation and subgrade preparation shall be in strict compliance with Section 02200, *Earthwork*. The subgrade upon which this work is to be placed shall be shaped and compacted to a firm, even surface conforming to the elevation and cross-sections shown on the plans, the standard drawings, or as directed by the Engineer. All soft, frozen, and unsuitable material shall be removed and replaced with approved material. The subgrade shall be moist when the concrete is placed.

B. **BICYCLE/GREENWAY SUBGRADE**:

1) Pavement subgrade should be prepared in accordance with paragraph 3.1.1 A, above and shall conform to the grade and cross-section shown on the plans.

2) Herbicides shall conform to Section 1060-13, *Herbicides* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision shall be applied to the aggregate base course and/or subgrade immediately prior to paving. The rate of application shall be as recommended by the herbicide manufacturer. ***Herbicides shall not be left uncovered for longer than 15 minutes***. Herbicides shall not be used where they may contaminate water used for irrigation or drinking purposes.

C. **SUBGRADE FINE GRADING (Trimming)**: When forms have been set to exact grade and secured, fine grading to exact sub-grade elevation shall be completed by hand. Before pouring operations begin, the Contractor shall have forms set and grade tested and approved by the Contractor ahead of pouring operations. Subgrade fine grading shall be the responsibility of the Contractor to ensure that the subgrade conforms to the Standard Details.

3.1.2 FORMS

A. **GENERAL**: Forms for this work shall be of wood (except curb and gutter), metal, or other approved material, shall extend to the full depth of the concrete and shall be straight, free from warps and of sufficient strength to withstand the pressure of the concrete without springing. Bracing and staking of the forms shall be such that the forms will remain in both horizontal and vertical alignment until their removal. Forms shall be cleaned of foreign matter and oiled before concrete is placed. No concrete shall be poured into forms which have not been checked and approved.

3.1.3 PLACING – ALL CONCRETE ITEMS

The concrete shall be placed in the forms in such a manner as to prevent the segregation of the mortar and the aggregate. The concrete shall be spaded, tamped, or vibrated sufficiently to bring the mortar to the surface. Concrete shall not be dropped a distance of more than 5 feet.

Prior to and during pouring operations, the Contractor's foreman or formsetter shall carefully watch all alignment and grades to detect any errors in grade or misalignment. In the event any of the work is damaged from any cause or prove defective in any way, or is out of alignment or grade, the Contractor shall remove such work and replace at his own expense. The detection of poor subgrade shall also be his responsibility.

When sufficient concrete has been placed in the forms, it shall be well spaded along all areas in contact with the forms in order to eliminate all honeycombing. Mix shall be rodded or vibrated to eliminate voids. Concrete shall be floated to the proper grade and alignment, free from depressions or other irregularities, after which the exposed surfaces shall then be screeded with a straight edge and finished with a steel or wooden trowel. The concrete shall be troweled smooth and, before the concrete obtains full set, very lightly brushed with a brush moistened with clear water. No mortar shall be used in the finishing. Immediately following finishing operations, the finished concrete shall be cured and protected in accordance with these specifications.

3.1.4 COORDINATION OF POURS

It will be the responsibility of the Contractor to coordinate the times of pours with the Inspector. Sufficient notice shall be given to the Inspector so that he/she can check all aspects of the work before the pouring operations begin. Under no circumstances shall the Contractor pour concrete until the Inspector has had sufficient time to make checks of the work. An inspection shall be requested at least 4 hours prior to any pouring operation.

The maximum interval between the placing of batches at the work site shall not exceed 20 minutes. See also Section 1000-4(E), *Elapsed Time for Placing Concrete* and Table 1000-2 of the NCDOT *Standard Specifications for Roads and Structures.*

3.1.5 FINISHING

Concrete for curb, curb and gutter, sidewalks and driveways shall have a broomed finish. This finish shall be accomplished as follows: the surface shall be screeded and tamped to force the course aggregate away from the surface, floated to bring the surface to the required finish level, steel-troweled to an even smooth surface and broomed with a fiber-bristle brush. The surface shall be uniform in texture.

3.1.6 CURING

A. CURING – YEAR AROUND

Curing shall be accomplished by preventing loss of moisture, rapid temperature change, and mechanical injury from rain or flowing water for a period of 3 days when normal Portland cement has been used or 7 days when pozzolan mix designs are used. Curing shall be started as soon as placing, finishing, and free water has disappeared from the surface of the concrete. One of the following methods of curing are required year round:

1) **Liquid membrane compound**: Apply membrane–curing compound for curing, sealing, and moisture retention. The entire exposed surface of the

structure shall be sprayed uniformly with a white pigmented membrane-forming compound immediately following the texturing operation. The curing compound shall be applied in 2 coats by hand.

Do not expose newly placed concrete for more than 30 minutes before being covered with curing compound. Failure to cover the surfaces of the concrete shall be cause for immediate suspension of the paving operations.

Perform application in accordance with manufacturer's directions but at a minimum rate of 100 to 150 square feet per gallon and not more than 350 square feet per gallon (total for both coats). Application shall be by a sprayer or long-nap roller and shall be an even, continuous membrane produced on the concrete surface. The second coat shall be applied in a direction approximately at right angles to the direction of the first coat. No puddling shall be produced. At the time of use, the compound shall be in a thoroughly mixed condition, with pigment uniformly dispersed through the vehicle. The compound shall form a uniform, continuous, coherent film that will not check, crack or peel and shall be free from pinholes or other imperfections.

The membrane shall harden 30 minutes after application. Personnel and equipment shall be kept off the freshly applied material to prevent damage to the seal. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected for 7 days from pedestrian and vehicular traffic and from any other action witch might disrupt the continuity of the membrane. If the membrane becomes damaged within the initial 72 hours, damaged portions shall be repaired immediately with additional compound.

If removal of forms is required, exposed sections shall be protected immediately to provide a curing treatment equal to that provided for the surface.

2) **PE Film**: Spread the section of the film in a manner that will not damage the finished pavement surface. Securely tape or provide lap joints for the sections that are at least 12 inches wide and take suitable precautions to prevent the circulation of air beneath the film. Use black or dark plastic sheets when the daily high ambient temperature is between 40ºF - 60ºF. Use white opaque reflective plastic sheet when the daily ambient temperature is above 60ºF. Plastic sheets shall meet the requirements of ASTM C171, *Standard Specification for Sheet Materials for Curing Concrete*.

Check the film for damage when it is spread and during the curing period. Repair or replace any damaged section immediately.

B. **COLD WEATHER CURING**

Ensure that the concrete temperature at the time of placement in the forms is at least 50°F and no more than 95°F, except where other temperatures are required by NCDOT Articles 420-7 *Placing Concrete in Cold Weather* of the NCDOT *Standard Specifications for Roads and Structures*.

No concrete is to be poured when the outside ambient temperature is 40º F and falling. Cold weather curing shall be applied when the outside temperature is 50ºF and falling. When the temperature falls to or below 35º F, no concrete work of any kind is to be performed.

1) Concrete Temperature: Conform to the requirements of paragraph 420-7, *Placing Concrete in Cold Weather* of the NCDOT *Standard Specifications for Roads and Structures*, for the required temperatures of concrete.

2) Cold subgrade: No concrete is to be placed on a frozen subgrade.

3) In addition to year round curing, install insulated blankets that will retain or supply moisture and maintain the temperature of concrete at the outermost surfaces above 50º F for at least 72 hours and above 32º F for at least an additional 48 hours. Blankets shall be left in place for a minimum of 7 days.

4) In cold weather applications, calcium chloride may be used as an admixture, if approved by the City Engineer, provided the concrete is not reinforced.

C. **HOT WEATHER CURING**

Maintain the concrete temperature at the time of placing in the forms not less than 50°F nor more than 95°F unless otherwise directed by the City Engineer.

Hot weather curing shall be applied when the outside temperature is 75°F and rising. Care shall be taken in hot, dry, or windy weather to protect the concrete from shrinkage cracking by applying at a minimum liquid membrane compound and PE film as described in Section 3.1.6 A, above.

Routine hot weather measures shall include cooling forms and wetting subgrade in addition to any of the other measures.

Other measures for curing may be required by the City Engineer, such as: fog spraying, sprinkling, ponding, windbreaks, shading, or wet covering with an approved light colored material. Such curing may be required to remain in place for a minimum of 7 days. No extra compensation will be made for curing of concrete.

D. **ELAPSED TIME FOR PLACING CONCRETE**:

ELAPSED TIME FOR PLACING CONCRETE		
Air or Concrete Temperature Whichever is Higher	**No Retarding Mixture Used**	**Retarding Admixture Use**
90°F or above	30 minutes	1 hr. 15 minutes
80°F through 89°F	45 minutes	1 hr. 30 minutes
79°F or below[A]	60 minutes	1 hr. 45 minutes
70°F through 79°F[B]	60 minutes	1 hr. 45 minutes
69°F or below[B]	1 hr. 30 minutes	2 hr. 15 minutes

[A]Applicable to Class AA, A.
[B]Applicable to Class B concrete.
Ref: Table 1000-2 NCDOT Standard Specifications for Roads and Structures

E. **DAMAGED CONCRETE**

Any work damaged due to improper curing, freezing, or rain, shall be replaced at the Contractor's expense.

3.1.7 PROTECTION OF CONCRETE

A. Protect new concrete sidewalks and appurtenances from pedestrian traffic for a minimum of 24 hours and do not open to pedestrian traffic for the first 5 days. Vehicular traffic shall be excluded for the first 14 days or until the minimum design compressive strength is attained, whichever is the lesser time.

Protect new concrete driveway surfaces and curb and gutter from vehicular traffic for minimum of 7 days or until the minimum design compressive strength is attained, whichever is the lesser time, unless otherwise approved by the City Engineer. Erect and maintain warning signs, lights, and watchmen to protect pedestrian and to direct traffic as needed.

B. Protect concrete against public traffic, construction equipment and traffic caused by employees and agents. Repair or replace parts of concrete damaged from such prior to final acceptance.

C. No equipment shall be driven or moved across newly concreted surfaces unless such equipment is rubber-tired and only if paved surface is designed for and capable of sustaining loads to be imposed by the equipment.

D. Protect concrete from graffiti.

3.1.8 TESTING

A. **Testing:**

On a case-by-case basis, at the discretion of the City Engineer, the Contractor may be required to perform concrete testing in accordance with the following provisions.

1) **Initial Test**: The initial test (from first ready mix truck) is to be taken after the second yard is dispatched from the mixer and is to consist of the following:

   a. One slump test
   b. Pull, prepare and store 3 cylinders on-site for 24 hours
   c. Temperature

2) **Second Test**: After the above tests are pulled from the initial truck, every 5th truck thereafter is to be tested in the same manner as noted above.

3) **Subsequent Test**: Slump tests may be required at any time during the pour if for any reason the City Representative or Contractor feels the conditions of the concrete have changed. If the slump test fails, test cylinders of that section shall be taken by the Contractor.

4) The City Engineer shall require any concrete that fails to meet the required compressive strength to be removed from any portion of a sidewalk, curb & gutter or driveway and that it be replaced at the Contractor's expense.

5) **Testing Costs**: The cost of Quality Control (QC) tests, tests to assure the Contractor that he/she is meeting and complying with the requirements of these specifications, is the Contractor’s responsibility. The cost of Quality

Assurance (QA) tests, tests performed independently by the City of Wilson to confirm that the Contractor is generally performing his/her work in compliance with these specifications, is the responsibility of the City of Wilson.

6) See also paragraph 2.1.1.C Mixing and Delivery.

3.1.9 DEFECTIVE WORK

The City will require the removal and replacement of any concrete items where they have structural cracks, have been broken, chipped, have become misaligned, grades are incorrect, does not meet dimensions as shown in the Standard Details, improperly cured, or of a substandard or non-approved product. Such areas designated by the City Engineer shall be repaired at no cost to the City. Items replaced shall conform to the requirements for new work as to strength and construction. During removal of defective work, an amount equal to the required lengths of construction joints must be removed and replaced.

Public jobs shall have cracked or defective curb replaced prior to paving.

The Engineer may drill cores from completed slabs of concrete to make depth measurements. Sections showing a deficiency of more than 3/8 inch shall be removed and replaced to the specified depth at the Contractor's expense.

3.1.10 CONCRETE CLASS

Concrete class for combined curb and gutter, curbs, sidewalks, driveways, flumes, ditches, steps, headwalls, and islands shall be a minimum of NCDOT Class A, concrete or as designated in the specifications or drawings. However, NCDOT Class AA is recommended machined formed curb. See paragraph 2.1.1B for Concrete Class Definition.

3.2 STANDARD CONCRETE CURB AND GUTTER

3.2.1 GENERAL REQUIREMENTS

This work shall consist of a single course of Portland cement concrete, constructed on a prepared subgrade in accordance with these specifications. It shall have the dimensions, cross-section, and location as shown on the plans or as directed by the City Engineer. See **Standard Detail 402.01** for standard vertical curb & gutter and roll curb.

Horizontal alignment of curbs and combined curb and gutter shall be in reasonably close conformity to the lines shown on the plans. Vertical alignment shall not exceed +/- 3/8 inch in 10 feet from plan grade.

Before concrete obtains full set, all exposed surfaces shall be finished with a brush moistened with clear water.

When constructing curb and gutter, the Contractor will be responsible for filling and compacting material in the space left behind the curb and gutter after the forms are removed. This shall take place within 3 to 7 days from pour and the material

shall be compacted to the grade of the back of the curb. No extra compensation shall be made for this work.

Dowels shall be placed in the throat plate, to tie gutter to plate as required in the use of conventional forms.

A. **JOINTS FOR CURB AND GUTTER:**

1) Transverse joints:

a. Transverse joints for crack control for fixed forms shall be provided at the following locations:

1. At approximately 10 foot intervals;

2. At the gutter where the curb and gutter ties to the gutter apron of drop inlets;

3. When time elapsing between consecutive concrete placements exceeds 45 minutes, and

4. Where no section shall be less than 6 feet in length.

b. Transverse joints for crack control may be formed by using one of the following methods:

1. Removable 1/8 inch thick templates.

2. Scoring or sawing for a depth of not less than 3/4 inch when using curb machine.

3. Approved “leave-in” type insert or may be formed or created using other approved methods which will successfully induce and control the location and shape of the transverse cracks.

4. Place a joint sealant in cracks after removal of templates. Fill joints in gutter with joint sealer to the top surface of the gutter. Seal all joints except for joints in curb sections not having an integral gutter. Joints are to be sealed before backfilling or performing adjacent operations. See paragraph 2.1.11, Concrete Joint Sealer for material spec. Exception: Joint sealant to be applied only when required by project specific contract/special conditions.

If templates are used for transverse joints, templates shall be removed by stages, but not entirely until the concrete has become thoroughly hard. After removal of the templates, there must be a clear division throughout between these sections. Edging tools will be used to form an edge along the back and front form and at each template.

2) Expansion joints:

a. See Section 2 – PRODUCTS of these specifications for approved expansion materials.

Expansion joints shall be formed at intervals of approximately 90 feet on centers, at all radii points at concrete entrances and curb returns, at locations no less than 3 feet and no more than 10 feet from drop inlets, at the end of days work, and or all cold joints.

3.2.2 FORMS –CURB & GUTTER

A. FIXED FORMS

Steel forms shall be used for the construction of curb and gutter. Fixed forms shall be straight, free from warp, and of such construction that there will be no interference with the inspection of grade and alignment. Metal templates, not more than 3/16 inch in thickness and manufactured in accordance with the curb and gutter section, shall be set in the places provided in the forms not more than 10 feet apart. Templates shall be adjusted to prevent short sections (less than 5 feet). Forms shall extend the entire depth of the item and shall be braced and secured so that no deflection from alignment or grade will occur during concrete placement. Radial forms shall be sufficiently flexible or otherwise designed to provide a smooth, uniform, curved surface of the required radius. When sufficient concrete has been placed in the forms, it shall be well spaded along all areas in contact with the forms in order to eliminate all honeycombing. Face forms shall be removed as soon as concrete has attained sufficient set for the curb to stand without slumping. The exposed surface shall then be smoothed by the use of a suitable finishing tool.

B. SLIP FORMS

In some places the Contractor may desire to use the slip form method to pour curb and gutter. In such cases approval from the City Engineer will be required. The Contractor's proposed equipment must receive the approval of the City Engineer.

1) **Equipment**: The slipform equipment shall be self-propelled and shall be equipped to consolidate, form, extrude, and finish the freshly placed concrete in such a manner that a minimum of hand finishing is required to produce a dense, consolidated, homogenous product. Slipform equipment shall be controlled to line and grade by automatic sensing, guidance, and control devices such that the machine automatically senses and follows taut guidelines or other stable reference, performing any necessary corrective action to ensure the correct grade and alignment is achieved.

   The Contractor shall plan and stage the work to eliminate the need for the slipform machine to be stopped during placement operations.

2) **Attachments**: The forms on the equipment must meet the precise dimensions shown on **Standard Detail 402.01** for the different types of curb. A sufficient number of vibrators shall be provided on the machine and be in good working order.

3) **Line and Grade Controls**: It shall be the Contractor's responsibility to set the line and grade controls for his machine. These controls shall be checked by the City's Contractor before any "trimming" or pouring occurs. However, approval of these controls by the City's Contractor shall not relieve the

Contractor of the responsibility of obtaining the planned grade or alignment according to the construction stakes.

4) **Subgrade Trimming**: It shall be the responsibility of the Contractor to ensure that the subgrade conforms to the Standard Details. No extra payment shall be made to the Contractor for "trimming" the subgrade if such "trimming" is less than the 6-inch limit allowed for unclassified excavation as defined in Section 02200, *Earthwork*. Before pouring operations begin, the subgrade shall be checked by the City's Contractor.

5) **Pouring Operations**: Before the machine starts a pour, the slump of the concrete will be checked in the presence of the City's Contractor. This slump must be between 0 and 2 inches. In the event that the slump exceeds 2 inches, the concrete will be rejected.

   If it is determined by the City's Contractor that the poured curb or gutter does not meet the exact dimensions of the "standard drawings" or for some other reason it does not conform to these specifications, (alignment, grade, materials, etc.) then the Contractor, at his own expense, shall remove the faulty work before concrete obtains full set. No compensation shall be made for unsatisfactory work.

   The Contractor shall make sure that sufficient vibration of the concrete occurs. If vibrators fail to function, all operations shall cease until they are satisfactorily repaired.

   Where storm inlets are designated, the Contractor shall either leave a sufficient blank space to be hand formed later or work concrete to the exact dimensions for the standard inlet specified.

6) **Defective Curb & Gutter**: Honeycombed concrete shall be filled with a sand/cement paste and allowed to cure prior to backfilling curb. If in the opinion of the City Engineer the honeycombing, blemish or damage by construction equipment is extensive to the point of rendering a weak, cracked or otherwise questionable section of curb, in strength or appearance, the City Engineer will require the curb section to be replaced at the Contractor's expense.

3.3 STANDARD PORTLAND CEMENT CONCRETE SIDEWALK AND DRIVEWAY ENTRANCES

3.3.1 GENERAL REQUIREMENTS

This work shall consist of the construction of Portland cement concrete sidewalk 4 inches thick and in accordance with these specifications and to the widths shown in the applicable Standard Details. Sidewalks crossing driveway entrances shall be constructed 6 inches thick. See **Standard Detail 404.03** for sidewalk.

All driveways shall have a 6-inch-thick concrete apron from street to right-of-way. The width of residential driveways, measured at the right-of-way, shall be 12 feet minimum to 24 feet maximum. See **Standard Detail 404.01**. The width of commercial driveways shall be 20 feet minimum, measured face to face at the

throat of the opening, up to a maximum width approved by the City of Wilson. See **Standard Detail 404.02**.

Unless otherwise shown on the plans and approved by the City Engineer, all sidewalks shall maintain a ¼ inch per foot (2%) transverse slope.

Curb cuts for driveways and curb ramps shall be constructed as shown on the City's Standard Details for the type driveway or ramp specified on the plans or as directed by the City Engineer.

Curb ramps shall be constructed at all street intersection corners and at other major points of pedestrian crossing. The ramps shall be constructed as shown on the City's standard drawings for the type shown on the plans or as directed by the City Engineer to meet ADA/ABA requirements.

Wire mesh or reinforcing steel will be used if recommended by the City Engineer or shown on plans. For installation of mesh or steel, see Section 425, *Fabricating and Placing Reinforcement* of the NCDOT *Standard Specifications for Roads and Structures.*

The foundation shall be thoroughly moistened immediately prior to concrete placement. Concrete shall be placed in forms by methods that will prevent segregation. Concrete shall be spread to the full depth and brought to grade by screeding and straightedging. Concrete shall be spaded adjacent to forms to prevent a honeycomb appearance, and the surface shall be floated with a wooden float to produce a surface free from irregularities. The final finish shall be obtained with an approved hand float that will produce a uniform surface texture. Light brooming may be used to hide trowel marks. Outside edges of the sidewalk slab and joints shall be edged with an edging tool having a radius of 1/4 inch.

When required as part of construction, reinforcing steel shall be properly spaced and thoroughly tied before concrete is placed.

All sidewalks (new or existing) fronting a new development shall be free of cracks, breaks, or other defects prior to receiving a Certificate of Occupancy.

See also paragraph 3.1.7, *Protection of Concrete*.

Tolerances: Horizontal alignment of sidewalks shall be to the lines and grades as shown on the plans and details. Vertical alignment shall not exceed +/- 3/8 inch in 10 feet from the plan grade.

A. JOINTS FOR CONCRETE SIDEWALK AND DRIVEWAY ENTRANCES

Transverse expansion joints shall be constructed at intervals of approximately 32 feet. Slabs shall be separated by transverse preformed joint filler 1/2 inch in thickness that extends from the bottom of the slab to approximately 1/4 inch below the top surface.

The slab between expansion joints shall be divided into sections equal in width to the sidewalk by transverse score joints formed by a jointing tool, trowel, or other

approved means. Transverse control joints shall also be provided when the time period between consecutive concrete placements is more than 45 minutes. Control joints shall extend into concrete for at least 1/4 of the depth (e.g. 1 inch for 4-inch concrete sidewalk) and shall be approximately 1/8 inch in width. Where slabs are more than 7 feet in width, the City Engineer may require that scored control joints shall be formed longitudinally to obtain secure uniform blocks that are approximately square. Transverse control joints shall also be installed where the corners of the drop inlets project into the sidewalk.

Preformed joint filler shall also be installed between concrete sidewalk and any adjacent fixed structure which is not tied to the sidewalk with steel dowels.

Place a joint sealant in cracks after removal of templates. Fill joints with joint sealer to the top surface of the sidewalk. See paragraph 2.1.11, Concrete Joint Sealer for material spec. Exception: Joint sealant to be applied only when required by project specific contract/special conditions.

B. **PLACING CONCRETE**

See paragraph 3.1.3, *Placing*, above.

C. **FINISHING**
See paragraph 3.1.5, *Finishing*, above.

D. **CURING**

See *paragraph 3.1.6 Curing* for requirements for curing concrete.

E. **FORMS**

1) **Fixed forms**: See paragraph 3.2.2 A *Fixed Forms*, above.

2) **Slip forms**: Slip form pouring shall be allowed with approval of the City Engineer. All portions of paragraph 3.2.2 B, *Slip Forms*, above, concerning pouring operations with slip forms shall apply.

3.4 PORTLAND CEMENT CONCRETE RETAINING WALLS, HEADWALLS, STEPS, PIERS FOR STREAM CROSSINGS, FLUMES AND DITCHES, MEDIAN BARRIERS, MEDIAN STRIPS, ISLANDS, ETC.

3.4.1 GENERAL REQUIREMENTS

This work shall consist of Portland cement concrete retaining walls, headwalls, steps, piers for stream crossings, flumes and ditches, median barriers, median strips, islands, etc. constructed in accordance with these specifications. These structures shall be constructed to the dimensions, cross-section, and located as shown on the plans, shown on the Standard Details, or as directed by the City Engineer.

A. **REINFORCING STEEL**

Reinforcement steel shall be placed in accordance with the drawings, the Concrete Reinforcing Steel Institute's *Placing Reinforcing Bars Recommended Practices,* the latest edition of ACI 318, *Building Code Requirements for Reinforced Concrete,*

latest edition and Section 425, *Fabricating and Placing Reinforcement* of the NCDOT *Standard Specifications for Roads and structures*. See also paragraph 2.1.8, *Reinforcing* of this specification.

B. **HANDRAILS**

Handrails shall be placed in accordance with Section 1074, *Miscellaneous Metals and Hardware* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

C. **FLUMES AND DITCHES**

Concrete flumes and ditches shall be constructed in accordance with Section 850, *Concrete Paved Ditch* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

D. **MEDIAN BARRIERS, MEDIAN STRIPS AND ISLANDS**

Concrete median barriers, median strips, and islands shall be constructed in accordance with Section 852, *Traffic Islands and Medians* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

E. **PIERS FOR STREAM CROSSINGS, STEPS, HEADWALLS AND RETAINING WALLS**

Concrete retaining walls shall be constructed in accordance with Sections 420, *Concrete Structures* of the NCDOT *Standard Specifications for Roads and Structures*.

3.5 CONSTRUCTION METHODS FOR BRICK SIDEWALKS

See paragraph 2.6.4 of the Street Design Section for allowable locations for brick sidewalks. When permitted, the construction shall comply with the following.

A. **Subgrade Preparation**: The subgrade for sidewalks shall be shaped to the proper cross-section and thoroughly compacted by rolling or tamping. Tree roots shall be removed to a depth of 12-inches below subgrade for the full width of the walk. All soft and spongy material shall be removed and replaced with suitable and approved borrow material (on-site or off-site). Borrow material shall be compacted in lifts not exceeding 8 inches in thickness.

B. **Base:** Base to be 4-inch thick NCDOT Class A concrete with a minimum of 1-inch thick stone screenings or sand. Concrete shall be 6-inches thick when crossing driveways.

C. **Sidewalk Width and Grade**: Except when repairing a non-conforming brick sidewalk, the width shall be as specified by the city engineer and shall be laid to grade with a smooth uniform surface with a slope of ¼-inch per foot toward the street.

D. **Material**: Brick shall conform to ASTM C902 *Standard Specification for Pedestrian and Light Traffic Paving Brick*.

E. **Filling Voids**: The voids between the brick shall be filled with a mixture of sand and cement broomed into the voids. The sand-cement ratio shall be 1/3 cement and 2/3 sand well mixed before brooming into the voids. After the voids are well filled, the brick surface shall be cleaned of all excess sand and cement.

F. See paragraph 3.6 below regarding maintenance of brick paved walks.

3.6 DECORATIVE (STAMPED OR TINTED) CONCRETE OR BRICK PAVED WALKS, DRIVES, AND PAVEMENTS

The City of Wilson does not maintain decorative concrete (stamped or tinted) or brick paved walks, drives, or roadway pavements other than to replace them with City standard hardscape elements. This includes maintenance or replacement due to damages arising from root heave or acts of God. Decorative concrete or brick walks and drives will be replaced with non-pigmented plain concrete with industry standard broomed or brushed finishes. In roadways, the hardscape will be replaced with asphalt.
If the abutting homeowner, developer or homeowner association desires to retain the decorative finish, the abutting homeowner, developer or homeowners association my opt to replace the hardscape at their expense provide the hardscape is replaced within 30 days of written notification from the City.

END OF SECTION 02400

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02510 - WATER DISTRIBUTION

(Last revised 9/1/19) R5

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

The latest edition or version of the following shall apply.

A. Drawings and general provisions of the Contract, including the General Requirements and Supplementary Conditions apply to this specification.

B. AWWA C510: *Double Check Valve Backflow Prevention Assembly*

C. AWWA C511: *Reduced-Pressure Principle Backflow Prevention Assembly*

D. AWWA C550: *Protective Interior Coatings for Valves and Hydrants*

E. AWWA C600: *Standard for Installation of Ductile-Iron Water Mains and their Appurtenances*

F. AWWA C605-13: *Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings*

G. AWWA C715: Standard for Cold Water Meter-Electromagnetic and Ultrasonic Type for Revenue Applications

H. AWWA C750: Transit-Time Flowmeters in Full Closed

I. AWWA C800: *Underground Service Line Valves and Fittings*

J. AWWA C900-16: *Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-in. through 60 in. (100 mm through 1,500 mm)*

K. AWWA C901: *Polyethylene (PE) Pressure Pipe and Tubing, ½ In. Through 3 In. for Water Service*

L. AWWA C906: *Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. for Waterworks*

M. City of Wilson *Backflow Prevention and Cross Connection Control Ordinance*

N. City of Wilson *Pre-Approved Material/Product List*

O. City of Wilson *Right-of-Way Regulations and Procedures*, latest edition

P. North Carolina State Building Code: Plumbing Code, latest Edition

Q. NC Administrative Code Title 15A, NCDEQ, Division of Water Resources:
   1) Separation Requirements:
      i. Subchapter 02T, Section .0300 *Sewer Extensions*.
      ii. 18C, Section .0900 *Distribution Systems*.

R. National Sanitation Foundation:
   1) NSF/ANSI 61 - Drinking Water System Components - Health Effects
   2) NSF/ANSI 372 – Drinking Water System Components – Lead Content

S. Section 00825 PRODUCT SUBSTITUTION

T. Section 02275 – TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES.

U. Uni-Bell Handbook, Latest Edition

V. UNI-B-8: *Recommended Practice for Direct Tapping of PVC Pressure Pipe (Nominal Diameters 6-12 inch)*

W. Uni-Pub 08: *PVC Pressure Pipe Tapping Guide*

1.2 SUMMARY

This section includes all equipment, labor, material, and services required for complete installation of water distribution piping and specialties for municipal water and fire-service mains and services.

1.3 DEFINITIONS

For the purposes of this specification, the following definitions refer to water distribution systems that come under the authority of City as specified within this and other sections of this manual.

A. **City Engineer**: The City Engineer or his or her authorized representative.

B. **City**: Refers to the City of Wilson.

C. **Contractor**: Refers to a Contractor licensed in the State of North Carolina to perform public utility construction.

D. **Easement**: An instrument that depicts/describes and conveys rights and privileges to the City for the placement, access to and maintenance of a utility line across and/or on the property of a second party. Ownership of the land remains with the second party.

E. **Fire Service**: Exterior firefighting/suppression water piping.

F. **Shall**: Means a mandatory requirement.

G. **Water Distribution ORC**: The City's "Operator in Responsible Charge" over the City of Wilson's water distribution system in the Water Resources Department.

H. **Director of Water Resources:** The City's Director of Water Resources, Water Distribution ORC or their authorized representative.

I. **Water Main**: Exterior water systems for both domestic water and fire suppression needs.

J. **Water Service**: Exterior water piping used to provide water for domestic purposes.

The following are industry abbreviation for various pipe materials:

A. **AC**: Asbestos Cement Pipe
B. **CI**: Cast Iron Pipe
C. **DIP**: Ductile Iron Pipe
D. **PVC**: Polyvinyl Chloride
E. **RCP**: Reinforced Concrete Pipe

1.4 SUBMITTALS

A. Submit product data for the following:

3) Pipe and Fittings
4) Valves and accessories.
5) Water meters and accessories.
6) Detector Check Valves
7) Backflow preventers and assemblies.
8) Fire Hydrants.
9) Fire Department Connections.
10) Castings
11) All appurtenances proposed for use on a project that may not be listed here.

B. Submit shop drawings:

1) For precast concrete vaults including frames and covers, drains, access hatches, wall sleeves, valve support stands, prefabricated above ground vaults, and backflow prevention devices.

2) Upon request, valve manufacturers shall furnish certified copies of test reports.

3) For any product submitted as an *"or approved equal"* that is not specifically specified in this specification.

1.5 QUALITY ASSURANCE

A. Materials and operations shall comply with the latest revision of all applicable Codes and Standards.

B. Piping materials shall be marked clearly and legibly.

1) Ductile Iron Pipe shall show identification marks on or near bell as follows:
   a. Weight,
   b. Class or nominal thickness,
   c. The letters "DI" or "Ductile,"
   d. Manufacturer's identifying mark,
   e. Year in which pipe was made,
   f. Casting period.

2) PVC Pipe shall show proper marking of pipe as required in the applicable product specification and shall remain legible during normal handling, storage, and installation. The manufacture date of the pipe must be within 1 year of the proposed date of installation. Marking of PVC pipe commonly includes:
   a. Manufacturer's Name,
   b. Nominal Pipe Size and Size Base,
   c. PVC Cell Classification or Material Code,
   d. Dimension Ratio or Standard Dimension Ratio,
   e. Product Type, Pressure Class or Pressure Rating,
   f. Standard Specification Designation,
   g. Production Record Code,
   h. Seal of the testing agency that verified the suitability of the pipe and the materials for potable water or fire prevention (NSF, FM),
   i. UL approval indicated by a green UL sticker applied to pipe.

C. Comply with Factory Mutual's *"Approval Guide*" and Underwriters Laboratories, Inc. "*Fire Protection Equipment Directory*" for fire-service main products.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, and flushing; and valve and hydrant supervision for fire mains.

E. Comply with the Rules Governing Public Water Systems North Carolina Administrative Code Title 15A Department of Environmental Quality Public Water Supply Section, latest revision.

F. Comply with NSF 61 for materials for water service piping and specialties for domestic water.

G. Comply with all applicable AWWA and ANSI standards.

H. Comply with ANSI/NSF 372 (low lead)

1.6 QUALITY STANDARDS

A. Materials and operations shall comply with the latest revision of the Codes and Standards listed within this specification. The use of ASTM standard specification references without a year designation implies the most current applicable specification.

B. Standard Abbreviations:

AASHTO	American Association of State Highway Transportation Officials.
ANSI	American National Standards Institute
AREA	American Railway Engineers Association
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
FDA	Food and Drug Administration
FCCCHR	Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California
FM	Factory Mutual System
FS	Federal Specifications
MSDS	Material Safety Data Sheets
NCDEQ	North Carolina Department of Environment Quality
NCDOT	North Carolina Department of Transportation
NSF	National Sanitation Federation International
NFPA	National Fire Protection Association
ORC	System “Operator in Responsible Charge”
OSHA	Occupational Safety and Health Administration
UL	Underwriters Laboratories, Inc.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

Materials used for the construction of water mains and appurtenances in the City's water distribution system shall be new, free of defects, and meet the highest standards set forth. An authorized City representative must inspect, review, and approve all materials to be used for water lines and appurtenances prior to installation. At the option of the City, any material installed without inspection will have to be sufficiently removed for inspection and review. Any additions, deletions, or changes from the City approved plan set must be submitted to City Engineer for approval, prior to making changes in the field.

A. **Pipe Conditions/Pipe Examination**:

1) **New pipe inspection upon arrival**: Inspect each truckload of materials thoroughly upon arrival at the site. Examine material for damage and to ensure that the right pipe has been delivered to the site. Pipe shall be protected during handling against impact shocks and free fall. Care shall be taken when unloading pipe to avoid damaging the pipe lining. Pipe that has been damaged either in transit or during unloading shall be plainly marked and shall not be used in the construction of the utility. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM specifications.

2) **Prior to laying pipe**: Prior to being installed, each section of the pipe shall be carefully examined for damage and conformity with theses specifications. All pipe in which spigots and bells cannot be made to fit properly, or pipe, which has chipped bells or spigots, will be rejected. All pipe damaged or deemed not to conform to these specifications, shall be plainly marked and shall not be used in the construction of the utility. The faces of all spigot ends and all shoulders on the bells must be true, without lumps or rough edges, and be brought in fair contact. Examine bell and spigot for uniformity and smoothness of liner and barrel.

B. Inspect fittings and structures thoroughly upon arrival for damage. Remove damaged or rejected materials from site.

C. Observe manufacturer's directions for handling, delivery, and storage of materials and accessories.

D. Protect pipe coating during handling using methods recommended by the manufacturer. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

E. Protect stored piping from entry of water or dirt into pipe. Store pipe on shoulders and not in ditch lines. String out no more pipe than can be installed in a day. Also, protect bells and flanges of special fittings from entry of moisture and dirt in accordance with AWWA C600-10 or later which requires end covers on pipes to reduce contamination during normal transit and storage unless the requirements of AWWA C600 and AWWA C651 are adhered to. If pipe is provided with end protectors, do not remove protectors until ready for installation or for inspection. Once inspected, replace protectors.

F. Support pipe to prevent sagging or bending.

G. Use slings to handle valves and fire hydrants if size requires handling by crane or other type of lift. Do not use hand wheels or stems to lift or for rigging points.

H. Store fire hydrants and valves in such a way as to prevent entry of water and dirt into openings. Support on skids or pallets off the ground or pavement. If fire hydrants or valves are provided with end protectors, do not remove protectors until ready for installation or for inspection. Once inspected, replace protectors. Protect valves against damage to threaded ends or flanges.

1.8 PRODUCT SUBSTITUTIONS

The City Engineer or Water Resources will approve materials not specified but deemed equal, on a case-by-case basis. The City's Product and Design Review Committee (PDRC) meets monthly or on an "as-needed" basis to evaluate new products for incorporation into these specifications. If submitting new products, submit in accordance with Section 00825 *Product Substitution*. New materials approved for the water distribution system will be incorporated into these specifications after approval by the PDRC.

1.9 PROJECT CONDITIONS

1.9.1 SEPARATION OF WATER AND SANITARY AND/OR COMBINED SEWERS.

A. Follow the NCDEQ standards for separation of water mains and sanitary sewers lines. See also 15A NCAC 02U .0403 *Design Criteria,* 15A NCAC 02T .0305 *Design Criteria* and .0909 *Design Criteria* for requirements relating to other reclaimed water mains separation requirements for both potable water and sanitary sewer mains. See also **Standard Detail C01.04**.

B. **PARALLEL INSTALLATIONS**:

1) **Preferred/Normal Condition** – Water lines shall be constructed at least 10 feet horizontally from a sewer or sewer manhole whenever possible. The distance shall be measured edge-to-edge.

2) **Unusual Conditions** – When local conditions prevent a horizontal separation of at least 10 feet, the water line may be laid closer to a sewer provided that:

a. The water main shall be placed in a separate trench, with elevation of the bottom of the water line at least 18 inches above the top of the sewer; or

b. The water main shall be placed in the same trench as the sewer, and located to one side, on a bench of undisturbed earth, and the elevation of the bottom of the water main shall be at least 18 inches above the top of the sewer; or

c. If it is impossible to obtain proper horizontal and vertical separation as described above or anytime the sewer is above the water main, both the water main and sewer must be constructed of DIP complying with public water supply design standards and must be pressure tested to

150-psi to assure watertightness before backfilling. The sewer manhole shall be of watertight construction and tested in place.

C. **WATER MAINS CROSSING ABOVE SEWERS**:

1) **Preferred/Normal Condition** – Water lines shall be constructed to cross over sewers whenever possible and shall be laid to provide a vertical separation of at least 18 inches between the bottom elevation of the water line and the top of the sewer.

2) **Unusual Conditions** – When local conditions or barriers prevent an 18 inch vertical separation as described in *Crossing, Preferred/Normal Conditions* (paragraph above), one of the following construction methods shall be used:

a. Both the water main and sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. Both the water main and sewer shall be pressure tested at 150-psi to assure watertightness before backfilling.

or

b. Either the water main or the sewer main may be encased in a watertight encasement pipe which extends 10 feet on both sides of the crossing, measured perpendicular to the water main. The encasement pipe shall be of materials approved by NCDEQ for use in water main construction (e.g. DIP, steel). If the sewer main is encased, the DIP sewer carrier pipe shall be DIP continuous from manhole to manhole. If the water main carrier pipe is encased, the water shall be constructed of either DIP or PVC meeting these specifications.

D. **WATER MAINS CROSSING BELOW SEWERS**:

1) **Unusual Conditions** – When local conditions prevent an 18 inch vertical separation, as described in paragraph C, *Water Mains Crossing Above Sewers, Preferred/Normal Conditions*, above, the following construction shall apply:

a. Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing. Both the water main and sewer shall be pressure tested at 150-psi to assure watertightness before backfilling.

b. Provide adequate structural support for the sewers to prevent excessive deflection of the joints, which can result in settling on and/or breaking the water line.

E. **WATER MAINS AND OTHER UTILITIES**

1) **Horizontal Separation – Preferred/Normal Condition** – Water lines shall be constructed to provide at least 3 feet of horizontal separation

from other utilities whenever possible. The distance shall be measured edge-to-edge. For existing asbestos cement lines, provide a minimum of 5 feet of clear horizontal separation.

a. Reclaimed water mains shall be constructed at least 10 feet horizontally from potable water mains.

2) **Vertical Separation – Preferred/Normal Condition** – Whenever it is necessary for another utility to cross a water main, a 12-inch vertical separation shall be maintained between the lines. When local conditions prevent a 12-inch vertical separation, the following construction shall apply:

a. Provide adequate structural support for the utility to prevent excessive deflection of the joints, which can result in settling on and/or breaking the water line.

b. Reclaimed Water: Reclaimed water mains shall be constructed with at least an 18-inch vertical separation with the potable water mains above the reclaimed mains.

F. **SANITARY SEWER MANHOLES** – No water mains shall pass through or come in contact with any part of a sewer manhole. A minimum of 3 feet of horizontal separation shall be maintained between water mains and sanitary sewer manholes provided that the applicable provisions of paragraph B, *Parallel Installations, Unusual Conditions*, above, are also met.

G. **SANITARY SEWER AND WATER SERVICES**: The separation requirements for water and sewer services fall under the requirements the *NC State Building Code: Plumbing Code (IPC with North Carolina Amendments),* Section 603.2 *Separation of Water Service and Building Sewer*, latest revision. Those provisions are generally as follows:

a. Water service pipe and the building sewer shall be separated by 5 feet of undisturbed or compacted earth.

b. A minimum 12-inch vertical separation with bottom of water above top of sewer and pipe material meets the provisions of this specification.

c. Water can be located in same trench with sewer if pipe material meets the provisions of this specification.

d. Separation is not required if water is sleeved to a point 5 feet either side of the sewer centerline with pipe material meeting Table 605.3, Table 702.2 or Table 702.3 of the NC State Building Code: Plumbing Code, latest revision.

e. Water Service pipes shall not be located in, under or above cesspools, septic tanks, drainage fields or seepage pits.

H. **NEW UTILITIES AND EXISTING WATER MAINS** – When installing a new utility adjacent to or in close proximity to an *existing* water main, the new utility line shall be installed to provide the minimum horizontal and vertical clearances

specified in paragraph 1.9.1 E, *Water Mains and other Utilities*. The protection of the Drinking Water Quality is the primary and ultimate goal.

1.10 CROSS-CONNECTION CONTROL

Refer to the City of Wilson Backflow Prevention Cross Connection Control Ordinance (Section 44-30 of the City Code) latest adoption as applicable. See paragraph 2.2.3 for Backflow Preventers device specifications.

Responsibility for Water Quality: The City of Wilson water meters on private property; however, the responsibility for water quality ends at the backflow prevention device.

1.10.1 Work Specified: Divisions of Jurisdiction in the City of Wilson shall be part of the approval process regarding Cross Connection and Backflow Prevention.

1.10.2 Potable, Fire, Irrigation and Non-potable water service application

A. Reduced Pressure Backflow Assembly (ASSE 1013) shall be required on all commercial and Industrial water services. Depending on the Degree of Hazard, a Double Check Valve Assembly (ASSE 1015) may be required in place of The RPZ Assembly.

B. Reduced Pressure Assemblies are required on all new irrigation tied to the potable water distribution system.

C. Reduce Pressure Detector Assembly (ASSE 1047) on fire services for severe hazards: booster pump and chemical additives.

D. Double Detector assembly (ASSE 1048) for moderate hazards: systems without booster pumps or chemical additives. (Note: Fire pumper trucks are not booster pumps.)

E. Non-potable water services no backflow assembly required at this time. (Note: If non-potable water is supplied to a facility the potable water service shall have a backflow assembly.)

F. No type II Fire Line Approved Backflow Assemblies at this time without prior approval.

1.10.3 Backflow Shutoff Valves:

OSY - outside stem and yoke, full port, resilient seated gate valves shall be

UL/FM approved.

NRS – not allowed without prior approval.

Ball Valves – Resilient seated, full port, with blow out proof stems.

1.10.4 Location of Assemblies

Agencies having Jurisdiction shall have final authority to the location, observation of DOT set-backs, sight triangles for driveways, sight triangles for intersecting

City Streets, other utilities, installation of enclosures, serviceability of backflow, and type of backflow assembly required.

1.10.5 General Design

A. The design, construction, and installation of the backflow assembly shall meet the requirements in this specification. No modifications to original equipment manufacturer. Repairs provided to assembly shall be with original manufactured repair parts only.

B. The nominal size of backflow assembly shall be equal to or greater than the size of purchased service but not less than 1 inch.

C. Approved backflow Assembly shall be equipped with the same size shutoff valve located on both ends of assembly.

D. The nominal size Backflow Detector Assembly shall be shown on the approved Plans directed by the Fire Department division having jurisdiction.

E. Enclosures and concrete slabs shall be shown on approved plans required by the division having jurisdiction.

F. Delivery, Storage and handling on site shall be done in a manor not to damage assembly. The port openings shall be covered and kept free of dirt and debris.

G. Covers shall be kept in place until installation. Backflow assemblies shall not be contact with the bare ground during storage.

1.11 SERVICE INTERRUPTION

Contact the City of Wilson to coordinate interruption of service, operation of valves, line cut-ins, or placement of a tapping sleeve and valve. If interruption is necessary, the interruption shall be arranged to occur at such a time to cause the least disruption and minimize loss of service. At the direction of City Engineer and Water Resources, temporary service may be required to be provided. Provide a minimum of **48** hours notice of the proposed utility interruption or necessary operation of valves.

1.12 COORDINATION

A. Coordinate tie-in to municipal water mains with the City Engineer and Water Resources. Except as needed for fire suppression purposes, the City of Wilson will be the sole operator of all valves and hydrants on the City's water distribution system. Adequate notification to water customers will be given by the Contractor prior to any interruption of service. Service is to be continuously maintained to customers in the project areas except for the minimum amount of time required to make connections with the existing system. Only in the case of an emergency may a valve be closed by a Contractor. Records shall be kept of any valves closed during an emergency and the City Engineer and Water Resources shall be notified of the specific valves closed at the earliest reasonable time following such valve closure.

Before shutting off any main, Contractor shall be responsible for notifying residents in writing at least **48** hours in advance of cut off. For City force projects, the City shall notify residents. The City

shall be notified at least **48** hours in advance of request for operation of valves and making either a wet tap or cut-in.

B. Contact ***"NC One Call"*** at 811 before digging.

C. When traffic signals, loops, or their appurtenances are likely to be damaged or interfere as a result of the construction, coordinate temporary operation with the applicable agency having jurisdiction of the signals. Provide a minimum of **48** hours notice prior to anticipated disturbance or interruption. At the discretion of the City Engineer, the notice may be required to be published in the newspaper.

D. Repair of pavement markings: When cuts are made through any paved surface and the cuts extend through the pavement markings, the replaced pavement shall be marked to match the existing.

E. Water Service Shut-off

The City of Wilson requires adherence to the following procedures prior to shutting off water service on any existing City line:

1) The Contractor must receive approval for shut-off from the City Engineer. Generally, shut-offs must occur from 9:00 AM to 11:00 AM and 2:00 PM to 4:00 PM on weekdays.

2) After receiving approval, Contractor shall notify affected residents in writing **48** hours in advance of beginning operation.

PART 2 – PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 BRASS PIPE

Brass Pipe shall meet ASTM B43 *Standard Specification for Seamless Red Brass Pipe, Standard Sizes*, schedule 40 or 80, with ANSI B1.20.1 pipe threads and AWWA C800 *Underground Service Line Valves and Fittings.* Brass pipe shall comply with NSF/ANSI 61 and NSF/ANSI 372 (certified lead free). Threads shall be NPT.

2.1.2 ENDOTRACE TRACEABLE TUBING

All PE 1-inch to 2-inch diameter water tubing/pipe to be EndoPure water pipe combined with a factory-installed 10 AWG tracer wire. EndoTrace to be manufactured with PE 4710 Bi-Modal HDPE resin. EndoPure to meet NSF/ANSI-14 & 61, AWWA C901, and ASTM D3350. Tracer wire to not interfere with fittings. CTS (Copper Tube Size) tubing, minimum 160 psi at 73.4ºF. Permanently mark tube/pipe with indent printing. Do not use lubricants, other than water, with pipe.

Fittings: AWWA C800 compression joint fittings that seal with internal gasket and external clamping. Provide insert stiffeners. Follow manufacturer's directions. NSF/ANSI 6, NSF/ANSI 372 certified lead free.

2.1.3 DUCTILE IRON PIPE

Ductile iron pipe shall be manufactured in accordance with all applicable requirements of AWWA C151/ANSI A21.51 *Ductile-Iron Pipe, Centrifugally Cast, for Water* for 4-inch and larger diameter pipe, pressure class rated, 350 minimum (rated working pressure plus 100 psi allowance for surge) and shall be in 18 or 20-foot lengths. The thickness of Ductile Iron Pipe shall be determined by considering trench load and internal pressure *(the pressure zone and variances in which the pipe will be used)* separately in accordance with AWWA C150/ANSI A21.50 *American National Standard for Thickness Design of Ductile-Iron Pipe.*

The ductile iron pipe shall be cement mortar lined with a seal coat in accordance with AWWA C104/ANSI 21.4 *Standard for Cement–Mortar Lining for Ductile-Iron Pipe and Fittings*. Outside coat shall be a minimum of 1-mil bituminous paint according to AWWA C151/ANSI A21.51 Section 51-8.1. Pipe shall be stamped as required by AWWA C151.

Ductile iron pipe shall also comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water.

Each joint of ductile iron pipe shall be hydrostatically tested before the outside coating and inside lining are applied at the point of manufacturer to 500 psi. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture or leakage of the pipe wall.

All materials used in production of the pipe are to be tested in accordance with AWWA C151 for their adequacy within the design of the pipe, and certified test results are to be provided to City upon request. All certified tests, hydrostatic and material are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.

Push-on and mechanical joint pipe shall be as manufactured by the American Cast Iron Pipe Company, Griffin Pipe Products Company, or United States Pipe and Foundry Company.

Pipe shall be furnished complete with accessories per AWWA C111/ANSI A21.11 *Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*.

A. **Ductile Iron Joints**

Pipe joints may be either mechanical joint or push-on pipe sizes 4 inches through 48 inches. Acceptable types of pipe joints are as follows:

1) **Push-on Joint, Ductile Iron Pipe** shall conform to AWWA C151/ANSI A21.51 *Ductile-Iron Pipe, Centrifugally Cast, for Water* (such as "Fastite," "Tyton," or "Bell-Tite."). The dimensions of the bell, socket, and plain end shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be of such size and shape to provide an adequate compressive force against the plain end and socket after assembly to affect a positive seal. Gaskets shall be vulcanized natural or vulcanized

synthetic rubber, and comply with AWWA C111/ANSI A21.11 *Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*.

2) **Mechanical Joint, Ductile Iron Pipe** shall be used only at the specific locations indicated on the drawings or as approved by City's Engineer.

   a. The mechanical joint shall consist of:

      i. A bell cast integrally with the pipe or fitting and provided with an exterior flange having cored or drilled bolt holes and interior annular recesses for the sealing gasket and the spigot of the pipe or fitting;

      ii. A pipe or fitting spigot;

      iii. Mechanical Joint Gaskets to be plain rubber (Styrene Butadiene [SBR]) per AWWA C111/ANSI A21.11;

      iv. Separate ductile iron follower gland having cored or drilled bolt holes; and

      v. Alloy steel Tee Head bolts and hexagon nuts. All threads are Coarse-Thread Series Class 2A, External and Class 2B, Internal, per ANSI B1.1. Nuts to be furnished in accordance with ASTM A563, *Standard Specification for Carbon and Alloy Steel Nuts*.

   b. The joint shall be designed to permit normal expansion, contraction, and deflection of the pipe or fitting while maintaining a leak proof joint connection. The mechanical joint shall conform to the requirements of Federal Specification WW-P-421 and AWWA C111/ANSI A21.11.

   c. Mechanical Joint Bolt Torque

      See section 3.1.1 below, paragraph B, item b, *Installing Mechanical Joint Pipe*.

3) **Mechanical Joint Restraint**: Acceptable types of joint restraints shall be:

   a. Restrained Joints shall consist of the use of a mechanical joint restraint system. Bolt heads are to be "auto-torque" twist off. See paragraph 2.1.3.B.3 for specific specs on restraint system and for approved manufacturers and models.

4) **Flanged Joints** shall be firmly bolted with machine bolts; however, where valves or special fittings are attached to a flange pipe, stud or tap bolts may be used, providing the number used and diameter for each joint is the same for each respective size of pipe or valve, as recommended by the latest AWWA Standard for flanged drilling. Bolts are specified in ANSI B18.2.1 and nuts are specified in ANSI B18.2.2. Bolts and nuts are to be cold worked 304 stainless steel meeting ASTM F593 *Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs* for sizes up to 1.5 inches. Stainless steel bolts and nuts shall have a minimum yield strength of 50,000 psi. For high strength applications, use 304L stainless steel bolts. Bolts shall be of sufficient length to pass through two flanges and the nut threads shall be accurately cut, close fitting, and the prevailing standard. Bolt heads shall be

cut square and nuts hexagon in shape, both the heads and nuts being chamfered. Gaskets to be of 1/8-inch thick plain rubber (Styrene Butadiene [SBR]) per AWWA C111/ANSI A21.11 or equal as approved by City's Engineer.

B. **Ductile Iron Fittings**

Fittings shall be ductile iron, grade 70-50-05, and shall conform to AWWA C110/ANSI A21.10 *Standard for Ductile-Iron and Gray-Iron Fittings* or AWWA C153/ANSI 21.53 *American National Standard for Ductile-Iron Compact Fittings for Water Service*, pipe sizes 4 inches through 48 inches with the exception of manufacturer's proprietary design dimensions and thicknesses for iron, in accordance with AWWA C110/ANSI A21.10. All ductile iron fittings shall have a minimum working pressure rating of 350 psi and shall be cement mortar lined and bituminous coated (minimum 1-millimeter), in accordance with AWWA C104/ANSI A 21.4 *Standard for Cement–Mortar Lining for Ductile-Iron Pipe and Fittings*. The fittings shall be tested and the manufacturer shall provide certified test results when requested by City. This testing shall include hydrostatic proof testing of fittings. Glands, gaskets, and bolts shall conform to AWWA C111/ANSI A 21.11 *Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*. The use of push on fittings is not permitted.

Ductile iron fittings shall also comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water.

Acceptable manufacturers are: American Cast Iron Pipe Company, Griffin Pipe Company, or U. S. Pipe & Foundry Company. Acceptable types of fittings are:

1) **Full Body Mechanical Joint Fittings:** Full body ductile iron mechanical joint fittings shall be minimum class 350 for pipes sizes 4 through 24 inches, class 250 for pipe sizes 30 through 48 inches, and shall conform to AWWA C110/ANSI A21.10. Glands, Gaskets and Bolts shall conform to AWWA C111/ANSI A21.11.

2) **Mechanical Joint Fittings – Compact:** Compact fittings shall be minimum class 350 for pipes sizes 4 through 24 inches, class 250 for pipe sizes 30 through 48 inches, and shall comply with AWWA C 153/ANSI A21.53, pipe sizes 4 inches through 48 inches. Glands, Gaskets and Bolts shall conform to AWWA C111/ANSI A21.11.

3) **Mechanical Joint Restraint Systems** (3-inch through 48-inch)**:** Mechanical joint restraint systems shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWA C110/A21.10. Mechanical joint restraint systems (gland body, wedges and wedge actuating components) shall be constructed of grade 65-45-12 ductile iron material in accordance with ASTM 536. For applications requiring restraint 30 inches and greater, an alternate grade of iron meeting the material requirements of ASTM A536 is acceptable provided the device meets all the end product performance requirements. An identification number consisting of the year, day, plant and shift, shall be cast into each gland body. Sizes 3-inch through 16-inch shall be rated at 350-psi minimum working pressure and sizes 18 inches and larger rated at 250-psi minimum working pressure. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes. Bolt heads are to be "auto-

torque" twist off. Mechanical joint restraint systems shall accommodate all classes of ductile iron pipe (pressure class 350 through pressure class 150 and class 56 through 50) and appurtenances such as valves and hydrants without damage to the fitting, pipe or cement linings. Consult with manufacturer when use is intended for grey iron pipe. All components shall be manufactured and assembled in the United States. See **Standard Detail 512.07** for a common application of the restraint system.

See Pre-Approved Product List for acceptable manufacturers and models of mechanical joint restraint systems.

2.1.4 PVC PIPE – C900 (6" THROUGH 24" MAINS)

PVC pressure pipe, 6-inch through 12-inch, with bell end with gasket and spigot end shall comply with AWWA C900, manufactured from compounds conforming to PVC 1120 material with a cell classification of 12454-B as defined in ASTM D1784 *Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds*, Pressure Class 150, DR 18. Pipe shall bear the seal of the National Sanitation Foundation for potable water pipe. Pipe OD shall be equivalent to ductile iron pipe of the same nominal size (see table below). Pipe joints shall include elastomeric gaskets and shall be integral bell type coupling. The integral bell coupler shall meet the requirements of ASTM D3139 *Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals* and utilizes the gasket sealing system meeting the specification defined in ASTM F477 *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*. Lubricant and gaskets are to be supplied with the pipe by the manufacturer of the pipe.

The minimum pipe stiffness shall be 364 psi.

In accordance with ASTM D1599, *Standard Test Method for Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings,* a minimum pipe burst of 755 psi shall be withstood without failure.

The pipe must be able to withstand an impact of 100 foot-pounds without visible evidence of shattering or splitting as specified in ASTM D2444, *Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight*).

C900 pipe shall be used with ductile iron fittings (restrained joint).

Nominal Size (in)	Pipe OD (in)	Min Wall Thickness (in)
6	6.900	.383
8	9.050	.503
10	11.100	.617
12	13.200	.733

Fusible C900 pipe, used for directional drilling, shall only be used with written approval from the City Engineer. See paragraph 3.1.7. *Horizontal Directional Drilling of PVC C900 Fusible Water Pipe*.

2.1.5 Fusible C900 Pipe Pressure Pipe for Water Mains Conforming to AWWA C900 Dimensionality (6 to 12 inches):

1) Fusible PVC pipe shall conform to AWWA C900-16 standard, ASTM D1784 *Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds* with cell classification 12454. Pipe to be rated at 235-psi operating pressure at 73°F. Pipe to be DIPS O.D., DR-18.

2) Fusible PVC pipe shall be manufactured in standard joint lengths of 20', 30', 40' or custom lengths as may be specified.

3) Fusible PVC shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.

4) Fusible PVC pipe shall be green in color for wastewater use.

5) Pipe shall be marked as follows:
   a. Nominal size
   b. PVC
   c. Dimension Ratio or SDR
   d. AWWA Pressure Class
   e. Extrusion production-record code
   f. Trademark or trade name
   g. Cell Classification 12454

6) Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or visible deleterious faults.

7) Fusible C900 pipe shall be joined per the manufacturer's recommendations.

8) Installation shall not exceed manufacture's bending radius and safe pulling force.

9) No solvent cement weld pipe or fittings will be accepted.

10) Affidavit of compliance to this specification shall be available upon request.

11) Fusion Joints: Unless otherwise specified, fusible PVC pipe lengths shall be assembled in the field with butt-fused joints. The Contractor shall follow the pipe manufacturer's written guidelines for this procedure.

12) Fittings: See paragraph 2.1.3.B, above.

13) See paragraph 3.1.3 Fusible C900-16 PVC Pressure Pipe (6 TO 12 Inches).

2.1.6 HIGH DENSITY POLYETHYLENE WATER PIPE FOR HORIZONTAL DIRECTIONAL DRILLING (HDD) APPLICATIONS

A. All polyethylene pipe, tubing, and fittings shall conform to all applicable provisions and requirements of the latest revision of AWWA C906 (*4" through 8"*), CSA B137.1, and/or ASTM F714 and, by inclusion, all appropriate standard references therein. Polyethylene compounds utilized in the manufacture of products furnished under this specification shall have a grade of PE34 with a minimum cell classification of PE 345464C for PE3408/PE3608 materials, as defined in ASTM D3350. In conformance with AWWA C906, CSA B137.1, and/or ASTM F714 they shall have a PPI recommended Hydrostatic Design Basis (HDB) of 1600 psi (PE3408/PE3608) at a temperature of 73.4°F (23°C).

All materials which come in contact with water, including lubricants, shall be evaluated, tested, and certified for conformance with ANSI/NSF Standard 6.1.

Clean re-work material of the same type grade, and cell classification generated from the manufacturer's own pipe and fitting production may be used by the same manufacturer as long as the pipe, tubing, and fittings produced meet the requirements of AWWA C906 or CSA B137.1.

B. **Reference standards**

AWWA C901: Polyethylene (PE) Pressure Pipe and Tubing, 1/2-inch through 3-inch for Water Service.

AWWA C906: Polyethylene (PE) Pressure Pipe and Tubing, 4-inch through 65-inch for Water Service.

ASTM D2657: Standard Practice for Heat Joining Polyolefin Pipe and Fittings.

ASTM D2683: Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

ASTM D2837: Standard Test Method for Obtaining Hydrostatic Design Basis of Thermoplastic Pipe Materials.

ASTM D3261: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

ASTM D3350: Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.

ASTM F714: Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

ASTM F1055: Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

PPI TR-3: Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

PPI TR-4: Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fitting Compounds.

ANSI/NSF: Standard Number 61 for Drinking Water Systems Components – Health Effects.

NSF Standard #14: Plastic Piping Components and Related Materials.

CSA B137.1: Polyethylene Pipe, Tubing, and Fittings for Cold Water Pressure Services.

C. **Qualification of Manufactures**

The manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications. Given reasonable notice, the manufacturer's production facilities shall be open for inspection by City or their representative. Qualified manufacturers shall be verified by the Project Engineer.

D. **Manufacturer's Quality Control**

The manufacturer of the Polyethylene pipe and fittings shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier. Incoming materials shall be approved by Quality Control before processing into finished goods. Outgoing products shall be tested as required in AWWA C901 or AWWA C906, as applicable.

E. **Pipe and Tubing**

Pipe and tubing furnished under this specification shall be manufactured using compounds complying with the requirements of paragraph A above. Dimensional performance characteristics shall conform to the requirements of AWWA, C906 or CSA B137.1. The pipe's DR (Dimension Ratio) and Working Pressure (WPR) shall be as specified or shown on the drawings.

F. **Fittings**

Polyethylene fittings furnished under this specification shall be manufactured using compounds complying with the requirements of paragraph A above and all appropriate requirements of AWWA C906 or CSA B137.1; PPI-PE3408. Socket type fittings shall comply with ASTM D2683. Butt fusion fittings shall comply with ASTM D3261. Electrofusion fittings shall comply with ASTM F1055. Mechanical fittings produced from material not listed in paragraph A above, shall be approved only after submission of appropriate test data and service histories indicating their acceptability for the intended service. Certifications by Factory Mutual System approvals (FM) and National Sanitation Foundation (NSF). In all cases, the specifications and requirements of the fittings supplied shall comply with the appropriate section of AWWA C906 or CSA B137.1. The pipe manufacturer shall supply all fittings and adapters.

Joints shall be heat fusion per ASTM 2657 and per manufacturer's written instructions.

G. **Pressure Class**

The Pressure Class of the Polyethylene pipe and fittings shall be specified on the basis of the Working Pressure Rating of the water system as defined in AWWA C906. Recurring positive pressure surges of up to one half of the pipe's nominal pressure class and occasional pressure surges of up to 100% of the pipe's nominal pressure class may be ignored due to the fatigue endurance of the polyethylene materials. Non-polyethylene fittings shall be specified and used in accordance with the surge tolerance of the particular appurtenance in use. The minimum shall be Class 150, pressure rating 150 for pipe 4-inch through 8-inch.

H. **Marking**

Pipe and tubing shall be marked in accordance with either of AWWA C906 or CSA B137.1, whichever applies. Marking shall be legible and shall remain legible under normal handling and installation practices. Indent marking may be utilized provided; 1) the marking does not reduce the wall thickness to less than the minimum value for the pipe or tubing, 2) it has been demonstrated that these marks have no effect on the long term strength of the pipe or tubing and, 3) the marks do not provide leakage channels when elastomeric gasket compression fittings are used to make the joints.

Fittings shall be marked on the body or hub. Marking shall be in accordance with either ASTM D2683, ASTM D3261, AWWA C906, or ASTM F1055, depending on fitting type and the standard that applies. Mechanical fittings shall be marked with size, body material designation code, pressure rating and manufacturer's name or trademark.

I. **Workmanship**

Pipe, tubing, and fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, blisters, dents, or other injurious defects. The pipe, tubing, and fittings shall be as uniform as commercially practicable in color, opacity, density, and other physical prosperities.

J. **Drilling Fluid**

Bentonite drilling mud compatible with the environment shall be used unless otherwise approved by the City Engineer. Waste oil or environmentally non-compatible polymers cannot be part of composition.

2.1.7 STEEL CASING PIPE

A. **Steel Casing Pipe**: Pipe shall be high strength steel, spiral welded or smooth-wall seamless manufactured in accordance with ASTM A139 *Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)* and ASTM A283/A283M *Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates* and consisting of grade "B" steel with a minimum yield strength of 35,000 psi. All encasement pipes shall meet the applicable NCDOT, City, or AREA specifications but shall be no less than 6 inches larger than the outside diameter of the carrier pipe bell. The steel pipe shall be capable of withstanding the design load. No interior lining and exterior coating shall be required except that all exposed metal is to be coated with epoxy or asphaltic material. The pipe shall have welded joints and be in at least 18-foot lengths. Casing pipe shall include pipe carriers (spiders) to support carrier pipe. The

steel encasement pipe shall be of leak proof construction and shall include end caps.

B. **Spiders/Skids for Encasement Pipes**: See Pre-Approved Product List for acceptable spider/skid manufacturers and models. Also see paragraph 3.1.4.B and **Standard Detail C07.03** for location of spiders. For bolted connections, bolts, and nuts shall be 304 stainless steel.

C. **Steel Casing End Seals**: Casing end seals shall be 8-inch thick brick masonry with a 1-inch diameter weep hole constructed as shown on **Standard Detail C07.03**.

2.1.8 TUNNEL LINERS AND APPURTENANCES

A. Grout mix for filling voids in between carrier pipe and tunnel shall consist of the following materials properly mixed in proportions by weight.

1) 1.0 Part Cement.

2) 3.0 Parts Fine Sand, 100 Percent Shall Pass No. 16 Sieve.

3) 0.5 to 0.6 Part Water – water should be sufficient to provide a consistency of thick cream when well mixed.

4) 2% approved additive (Bentonite, Septamine Seaex, Hydrocide liquid, etc.)

B. Tunnel lining construction shall comply with the "*Specification for Steel Tunnel Liner Plates"* in the American Railway Association (AREA) Manual for Railway Engineering, latest revision and AASHTO *Standard Specification for Highway and Bridges*, latest edition. The design and shape of the liner plates shall be such that erection and assembly of the liner plate structure can be completely and readily effected from inside the tunnel. Plates shall be accurately curved to suit the tunnel cross section, and all dimensions shall be of the size and accuracy that plates of similar curvature shall be interchangeable. All plates shall be connected by bolts on both longitudinal and circumferential joints.

C. The steel lining shall consist of plates 16, 18, or 24 inches wide. Each circumferential ring shall be composed of the number and length plates necessary to complete the required shape shown on the drawings. The nominal tunnel diameter shall be of sufficient size to install the carrier pipe.

D. Plates shall be one-piece steel meeting the requirements of ASTM A1011 *Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength*, or ASTM A1008 *Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable*. Plates shall have an ultimate tensile strength of at least 42,000 psi and yield strength of 28,000 psi. Nominal plate dimensions shall provide the sectional properties shown in Article 1.13.9 (or latest update) of the AASHTO Standard Specifications for Highway Bridges. Thickness tolerances shall conform to Paragraph 14 of AASHTO M167 *Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches*.

Gage thickness shall be a minimum of 8 gage. The liner plate and bolts shall be galvanized in accordance with ASTM A153 *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*. In addition, the liner plates shall be asphalt coated to meet AREA Article 1.14.13 (or latest update). For two flange plates, the minimum thickness shall be 0.135 inches. Plates shall be manufactured by Armco Steel Corporation, Commercial Shearing, Incorporated, Republic Steel Corporation, or equal.

E. Grout holes 1½ inches or 2 inches (or larger) in diameter shall be provided in each ring to permit grouting as the erection of the tunnel liner plates progresses. Grout hole screw plugs shall be provided in plates.

   The minimum provision for grouting openings shall be one opening in a top plate of the tunnel at locations not to exceed 54" apart. Additional plates with grouting openings are to be installed at the top quarter points on each side between the top openings. The opening shall be staggered, but shall not exceed 54" in any one line. Grout vent pipes will be required at a minimum of one per monolithic pour.

F. Steel bolts shall meet requirements of ASTM A449 *Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use* for plate thickness equal to or greater than 0.209 inch and ASTM A307 *Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength* for plate thickness less than 0.209 inch. The nut shall meet requirements of ASTM A307, Grade A.

G. Steel casing pipe for boring through soil shall be grade B, meet requirements of ASTM A139 *Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)*, and have wall thickness to meet AREA Specifications. No interior lining and exterior coating shall be required.

2.1.9 CARRIER PIPE FOR CASINGS AND TUNNELS

Carrier pipe shall be mechanical joint or restrained joint ductile iron pipe of the class indicated on the drawings but no less than pressure class 250 psi (minimum thickness class 50). See paragraph 2.1.3, Ductile Iron Pipe.

2.2 VALVES AND FIRE HYDRANTS

2.2.1 AIR RELEASE VALVE

Air release valves shall be 2-inch Pressure Air Release Valves with cast iron bodies, ASTM A240 *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*, type 302 stainless steel floats, bronze trim and buna-n seats. Air release cast iron bodies shall conform to ASTM A48 *Specification for Gray Iron Castings,* Class 35 and/or ASTM A126*, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings*, as applicable. Air release valves shall also meet AWWA *C512 AWWA Standard for Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service*. Size and location shall be as indicated on the drawings. Valves shall be rated for working and corresponding test pressure as indicated on the drawings. These valves shall be suitable for a minimum 200 psi working pressure but shall be no less than the working pressure indicated on the drawings. The valves are to be designed to allow air to

escape automatically while the main is in service and under pressure. The valves are to relieve large volumes of air as the lines are filled and also release small quantities of entrained air under pressure.

Air release valves shall comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water.

Manhole units shall consist of standard modular precast riser sections, modular riser sections, and a base. Where conditions do not favorably accommodate the use of an eccentric flat top, eccentric precast reinforced cones are to be used. However, the use of an eccentric cone must first be approved by the City Engineer or Water Resources. See **Standard Detail 516.01**.

See Pre-Approved Product List for acceptable air release valve manufacturers and models.

2.2.2 ANGLE VALVES

Angle valves must comply with AWWA C800 *Underground Service Line Valves and Fittings* as manufactured by Ford for 1-inch through 2-inch services, 300-psi minimum working pressure, compression x IP thread. Angle valves must be a ball type valve and must be accessible for operation from the surface of the ground for routine interruption of flow through the service line. See **Standard Details 515.01, 515.02** and **515.03**.

Angle valves shall comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water.

See Pre-Approved Product List for acceptable angle valve manufacturers and models.

2.2.3 BACKFLOW PREVENTERS:

A. **Backflow Assemblies List:**

Backflow Assemblies shall be provided on the list of approved assemblies by the Foundation for Cross Connection Control and Hydraulic Research at the University of Southern California or agency equal to.

1) Installation shall comply with water main thrust blocking detail. See **Standard Detail 512.03**.

2) Installation shall comply with the latest edition and revision to the NC State Plumbing Code.

3) Backflow assembly shall be installed in accordance with the standard installation details for City of Wilson. See **Standard Details 519.02** (¾- to 2-inch) and **519.03** (2 ½- to 10-inch).

B. **Double Check Detector Valve Assemblies:** Heavy duty double check detector valve assemblies shall conform to the requirements of these specifications with a minimum working pressure of 175-psi. Assemblies shall meet the basic requirements of ASSE 1048 and AWWA Standard C510 for Double Check Valves. Double check detector valve assemblies shall be approved by the

Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California, be listed by *Underwriters Laboratories, Inc*., and approved by *Associated Factory Mutual*. The unit shall be a complete assembly including UL Listed shut off valves and ball type test cocks. The bypass line shall consist of an approved backflow preventer equal to the fire line assembly and the water meter on the bypass meeting these specifications. The bypass meter on double check detector valve assemblies may be trimmed either right or left. A meter trim package shall be furnished containing all nipples, bushings, elbows and related fittings needed to construct by-pass line.

Provide bolted cover with air-bleed device for access to internal parts. All parts must be replaceable without having to remove the device from the line. All internal metal parts shall be either bronze or stainless steel. Include threaded bypass taps in inlet and outlet for bypass meter connection.

Double check valve assemblies shall be approved for installation in the horizontal position with an external arrow cast into the body indicating the direction of flow during system operation.

Set valves to allow minimal water flow though bypass meter when major flow is required.

4) **Test Cocks**: All assemblies shall be equipped with 4 test cocks located as required by the *Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California*. All test cocks shall be the lever-type bronze ball valves or bronze ball valves with raised slotted operating stems. All test cocks shall be of a resilient seated design. The number 1 test cock shall be a required part of the assembly upstream of the number 1 shut off valve of an approved assembly.

5) **¾" to 2" Double Check Detector Valve Assemblies**: Devices shall have bronze body or stainless steel bodies and bonnets. Valves shall be resilient seat full port, line size, lever type, ¼ turn bronze ball valves with a blowout proof stem with a pressure rating of 400-psi (water, oil, or gas).

6) **2 ½" to 10" Double Check Detector Valve Assemblies**: Devices shall have bronze, stainless steel, or epoxy coated ductile iron bodies and bonnets. Valves shall have flanged, hand-wheel operated, resilient wedged gate valves that open left, close right. Double check detector valve assemblies shall have flanged ends complying with the dimensional requirements of ANSI B16.1. Double check detector valve assemblies for fire line applications shall have flanged OS&Y operated gate valves on the main line and ball valves on the bypass line. Unless valves are bronze or stainless steel, the interior and exterior surfaces of all large body cast iron valves shall be coated with 5 to 10 mils of a fusion bonded epoxy coating. Epoxy coatings shall comply with AWWA *C550 Protective Epoxy Interior Coating for Valves and Hydrants*.

If special tools or devices are required to repair or maintain an assembly, they shall be supplied to the City by the manufacturer at no extra cost to the City.

C. **Double Check Valve Assemblies:** Heavy duty double check valve assemblies shall conform to the requirements of these specifications with a minimum working pressure of 175-psi. Assemblies shall meet the basic requirements of ASSE

1015 and AWWA Standard C510 for Double Check Valves. Double check valve assemblies shall be approved by the *Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California,* be listed by *Underwriters Laboratories, Inc*., and approved by *Associated Factory Mutual*. The unit shall be a complete assembly including UL Listed shut off valves and ball type test cocks.

Each assembly shall consist of two positive seating tight closing check modules with captured springs and rubber seat discs. The check modules seat and seat disc shall be replaceable. Provide bolted cover with air-bleed device for access to internal parts. All parts must be replaceable without having to remove the device from the line. All internal metal parts shall be either bronze or stainless steel.

Double check valve assemblies shall be approved for installation in the horizontal position with an external arrow cast into the body indicating the direction of flow during system operation.

1) **Test Cocks**: All assemblies shall be equipped with 4 test cocks located as required by the *Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California*. All test cocks shall be the lever-type bronze ball valves or bronze ball valves with raised slotted operating stems. All test cocks shall be of a resilient seated design. The number 1 test cock shall be a required part of the assembly upstream of the number 1 shut off valve of an approved assembly.

2) **¾" to 2" Double Check Valve Assemblies**: Devices shall have bronze body or stainless steel bodies and bonnets. Valves shall be resilient seat full port, line size, lever type, ¼ turn bronze ball valves with a blowout-proof stem with a pressure rating of 400-psi (water, oil, or gas).

3) **2 ½" to 10" Double Check Valve Assemblies**: Devices shall have bronze, stainless steel, or epoxy coated ductile iron bodies and bonnets. Valves shall have flanged, hand-wheel operated, resilient wedged gate valves that open left, close right. Double check valve assemblies shall have flanged ends complying with the dimensional requirements of ANSI B16.1. Unless valves are bronze or stainless steel, the interior and exterior surfaces of all large body cast iron valves shall be coated with 5 to 10 mils of a fusion bonded epoxy coating. Epoxy coatings shall comply with AWWA C550 *Protective Epoxy Interior Coating for Valves and Hydrants*.

If special tools or devices are required to repair or maintain an assembly, they shall be supplied to the City by the manufacturer at no extra cost to the City.

D. **RPZ (Reduced Pressure Zone) Assemblies**

RPZ Backflow preventers are to be unique patented design of air-in/water-out principle high capacity relief valve discharge during the emergency conditions of combined backsiphonage and backpressure with both checks fouled meeting.

The reduced pressure backflow preventer shall consist of two independently operating, spring loaded, "Y" pattern check valves, and one hydraulically dependent differential relief valve.

Operation:
In a nonflow condition, check valves on the by-pass and mainline units are closed with pressure between the checks, called the relief valve zone, being maintained at least 5 PSI lower than the inlet pressure and the relief valve is maintained closed. If the differential between the zone and the upstream pressure drops to 2 PSI, the differential relief valve will open, maintaining proper zone differential. The by-pass reduced pressure backflow preventer will operate identically to the mainline assembly.

By-pass: The by-pass opens to detect initial flow and the mainline opens for all other flows.

1) **3/4" to 2" RPZ Assemblies**:

The assembly shall meet the requirements of ASSE Standard 1013; AWWA Standard Code C511; CSA Standard B64.4; and approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California, UL Listed and FM approved. The assembly shall be rated for minimum 175 PSI water working pressure and water temperature range from 32°F to 140°F.

Valve body and caps including relief valve body and cover shall be bronze or stainless steel. Check valve moving members shall be center stem guided. All hydraulic sensing passages shall be internally located within the mainline and relief valve bodies and relive valve cover. Diaphragm to seat area ratio shall be 10:1 minimum. Relief valve shall have a removable seat ring. Check valve and relief valve components shall be constructed so they may be serviced without removing the valve body form the line. All seat discs shall be reversible. Shut-off valves shall be resilient seat full port, line size, lever type, ¼ turn bronzes ball valves with blowout-proof stem with a pressure rating of 400-psi (water, oil, or gas).

If special tools or devices are required to repair or maintain an assembly, they shall be supplied to the City by the manufacturer at no extra cost to the City.

2) **2 ½" to 10" RPZ Assemblies:**

The assembly shall meet the requirements of ASSE Standard 1013; AWWA Standard Code C511; CSA Standard B64.5; and approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California, UL Listed and FM approved. RPZ backflow preventers shall conform to the requirements of these specifications suitable for supply pressures of 175-psi and water temperatures of 110°F.

Mainline RPZ is to be flanged, ANSI B 16.1, Class 125, heavy valve bodies manufactured of ductile iron ASTM A536, Grade 65-45-12 with bronze seats, internal and external fusion epoxy coating, epoxy coated cast iron relief valve with stainless steel trim and with bronze body ball valve test cocks in parallel with a reduced pressure by-pass assembly. Unless valves are bronze or stainless steel, the interior and exterior surfaces of all large body cast iron valves shall be coated with 5 to 10 mils of a fusion bonded epoxy coating.

Epoxy coatings shall comply with AWWA C550 *Protective Epoxy Interior Coating for Valves and Hydrants*.

RPZ's are to be furnished with flanged hand-wheel operated OS&Y gate valve shutoffs. Valves shall have resilient wedged gate valves that open left, close right. RPZ assemblies and valves shall have flanged ends complying with the dimensional requirements of ANSI B16.1, Class 125.

Provide bolted cover with air-bleed device for access to internal parts. Include threaded bypass taps in inlet and outlet for bypass meter connection.

Reduced pressure detector assemblies are to be factory assembled and tested to assure proper mainline/by-pass balance and cross over performance.

RPZ assemblies shall be approved for installation in the horizontal position with an external arrow cast into the body indicating the direction of flow during system operation.

By-pass meter: All low flow demands up to a minimum of 3 GPM are to pass only through the by-pass meter and meter-size reduced pressure assembly and be accurately recorded. All flows above that of 3 GPM will pass through both the line-size reduced pressure assembly and by-pass with out accurate registration by or damage to the meter. Shut off valves and testcocks shall be resilient seats with full flow characteristics and are to be considered integral to the assembly. The mainline shut-offs are to OS&Y, UL/FM for fire line service.

The by-pass meter may be trimmed either right or left. A meter trim package shall be furnished containing all nipples, bushings, elbows and related fittings needed to construct by-pass line. A meter shall be installed meeting City or Wilson specifications as noted elsewhere in these specifications.

If special tools or devices are required to repair or maintain an assembly, they shall be supplied to the City by the manufacturer at no extra cost to the City.

4) **RPZ Test Cocks**: All assemblies shall be equipped with 4 test cocks located as required by the *Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California*. All test cocks shall be the lever-type bronze ball valves or bronze ball valves with raised slotted operating stems. All test cocks shall be of a resilient seated design. The number 1 test cock shall be a required part of the assembly upstream of the number 1 shut off valve of an approved assembly.

E. **Low Lead Content**: All backflow preventers shall comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water.

F. **Responsibility for Water Quality**: The City of Wilson water meters on private property; however, the responsibility for water quality ends at the backflow prevention device. See also paragraph 1.10 of this specification for a link to the City of Wilson's *Backflow Prevention Cross Connection Control Ordinance*.

2.2.4 CURB VALVES

Curb valves must comply with AWWA C800 *Underground Service Line Valves and Fittings* as manufactured by Ford for 1-inch through 2-inch services, 300 psi minimum working pressure. Curb valves must be a full port opening and a ball type valve. Ball valves must be accessible for operation from the surface of the ground for routine interruption of flow through the service line. See **Standard Details 515.01, 515.02, 515.03** and **516.01**.

Curb valves shall comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water.

See Pre-Approved Product List for acceptable curb valve manufacturers and models.

2.2.5 BALL VALVES: ¼ TURN STAINLESS STEEL BALL VALVES

One-quarter (1/4) turn stainless steel ball valves (used for air relief valves) with NPT threaded ends shall have a full port 316 stainless steel body, stems and balls with PTFE seals, seats and stem thrust bearing. Handles shall also be stainless steel. Valve shall be non-shock cold water rated for no less than 200-psi (water, oil, or gas). Acceptable stainless steel gate valves are those manufactured by Apollo and Watts (Watts Series S-FBV-1), or approved equal.

Ball valves shall comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water.

2.2.6 GATE VALVES

A. **Gate Valves, Ductile Iron Resilient Wedge (4 inches through 30 inches)**: All gate valves shall be iron body of the resilient wedge type complying with AWWA C509 *Resilient-Seated Gate valves for Water Supply Service* and shall be UL listed and FM approved for a working pressure of 200-/250-psi and hydrostatically tested at twice the working pressure (400-/500-psi) to the requirements of both AWWA and UL/FM. All internal parts shall be accessible without removing the body from the line. The wedge shall be of cast iron completely encapsulated with resilient material. The resilient sealing material shall be permanently bonded to the cast iron wedge with a rubber tearing bond to meet ASTM D429 *Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates* and AWWA C550 *Protective Epoxy Interior Coatings for Valves and Hydrants* and shall be certified to NSF 61.

The valve body and bonnet shall be coated interior and exterior with fusion bonded thermosetting plastic or epoxy meeting ASTM D429 *Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates,* AWWA C550 *Protective Epoxy Interior Coatings for Valves and Hydrants* and shall be certified to NSF 61. Interior coating material shall be formulated from materials deemed acceptable in the FDA document, Title 21, *Food and Drugs*, Chapter 1, Subchapter B, Part 175.300 *Resinous and Polymeric Coat*ings (latest revision). Coatings shall not contain coal tar. Minimum thickness of interior and exterior coating shall be 5 to 10 mils.

Non-Rising Stems (NRS) shall be cast bronze with internal collars in compliance with AWWA. OS&Y stems shall be bronze. The NRS stuffing box shall have two

"O"-Ring seals above the thrust collar. These rings shall be field replaceable without removing the valve from service.

Gate valves shall comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water.

NRS for 16-inch and larger valves: Non-Rising Stems (NRS) shall be cast bronze with internal collars in compliance with AWWA. Stem and stem nut shall be high-strength bronze. Stem shall be sealed by three O-rings. The NRS stuffing box shall have the top two O-ring seals to be replaceable with valve fully open and while subject to full rated working pressure. O-rings set in a cartridge shall not be allowed. Valve shall have thrust washers located with 1 above and 1 below the thrust collar to ensure trouble-free operation of the valve.

All gate valves 4 through 30 inches shall be of the mechanical joint type. 2-inch gate valves shall be iron pipe threads.

All exposed bolts and nuts shall be stainless steel.

Valves shall open clockwise (right) and shall be equipped with a 2-inch "red" square AWWA operating nut.

All resilient seat gate valves furnished for a project shall be from the same manufacturer.

B. **Inserting Valves**: Inserting valves shall meet requirements of gate valves specified above for valve mechanism and AWWA C110/ANSI A21.10 for the sleeve for pressure ratings shown on the drawings.

See Pre-Approved Product List for acceptable gate valve manufacturers.

2.2.7 TAPPING SLEEVES AND VALVES

The tapping sleeve and valve shall be suitable for wet installation without interrupting water service.

Stainless Steel Tapping Sleeve: Sleeve body, flange, bolts, nuts, test plug, and any other structural components shall be constructed of Grade 18-8 Type 304 stainless steel. Stainless steel bolt and nut threads to be NC threads, fluorocarbon coated with Nylatron GS self-lubricating washers. The sleeve and gasket shall provide full wrap-around (360 degree) pipe coverage, 150-psi maximum working pressure/maximum 200-psi test pressure. Sleeve to be provided with a full gasket of gridded virgin GBR compounded for water service per ASTM D2000-80M4AA607 *Standard Classification System for Rubber Products in Automotive Applications*.

18-8 stainless steel flange to have recessed edge to be able to accept the standard tapping valves. A carbon steel flange is not acceptable. Flange must conform to AWWA C207 *AWWA Standard for Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In.*, class D, ANSI 150 lb (ANSI B16.5) drilling. Test plug to be 18-8 stainless steel ¾" with standard square head. Gasket to be gridded virgin GPR compound for water service.
Outlet gasket to be gridded virgin Buna-N compounded for water service per ASTM D2000.

Tapping sleeves shall comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water.

See **Standard Detail 513.02**.

Tapping Valves: Resilient seat iron body tapping valves shall be epoxy coated (minimum 5-mil thickness) and otherwise meet the requirements of Part 2-PRODUCTS, *Gate Valves*, paragraph 2.2.6 except that the seat openings shall be larger than nominal size with a raised alignment ring on the flange. Tapping valves without the raised lip on the tapping flange side are not permitted. Valve ends shall be mechanical joint by flange. Valves shall open clockwise (right) and shall have a 2-inch operator nut. See **Standard Detail 513.02**.

All exposed bolts and nuts are to be stainless steel.

Tapping valves shall be "O" ring type a mechanical joint end conforming to AWWA non-rising stem construction. Inlet flange end shall be Class 125 (ANSI B16.1).

See Pre-Approved Product List for acceptable tapping sleeve and valve manufacturers and models.

2.2.8 FIRE HYDRANTS

A. Fire hydrants shall comply with ANSI/AWWA C502 Dry-Barrel Fire Hydrants, latest revision, UL 246 and Factory Mutual 1510. Hydrants shall be hub end, triple nozzle, improved AWWA type. Interior coating to be in accordance with AWWA C550. Fire hydrants shall comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water. Minimum working pressure shall be 200-psi. Hydrants shall consist of the following:

1) Hydrants shall be of the compression type closing with line pressure and shall be of the traffic model breakaway type (breakaway coupling designed to fracture when the hydrant is impacted). The breakaway coupling shall be made of either cast iron or a steel tube that will allow for the rotation of the upper barrel to position the nozzle in any direction without removing the breakaway coupling or shutting down the hydrant.
2) Two 2½-inch fire nozzles and one 4½-inch steamer nozzle, National Standard fire-hose coupling screw threads.
3) Hydrants shall open left and shall have a National Standard pentagon-type operating nut (1 ½" point to flat). The operating nut shall be of one-piece bronze construction. A thrust washer shall be supplied between the operating nut and stem lock nut. The valve stem shall have a safety flange and a safety coupling.
4) Hydrant to be dry top. Hydrant cap and stuffing box shall be of unitized, one-piece design creating a watertight cavity without the use of gaskets. The combination of O-Rings to a crimped brass ferrule around the stem shall seal the cavity from contact with water. Hydrant shall have an o-ring sealed lubrication reservoir for providing periodic lubrication of the operating threads.
5) The downward travel of the main valve assembly shall be controlled by a travel stop device that sits in the bottom of the shoe.

6) Bronze to bronze threads shall be provided between the hydrant seat or seat ring and the seating attaching assembly. Seat ring to shoe shall be bronze to bronze.
7) The main valve shall be of synthetic rubber reinforced with steel. The seat shall be of a bronze ring threaded to a bronze insert in the hydrant shoe, with O-Rings to seal the drain way and barrel from leakage of water in the shoe.
8) All O-rings that seal the main valve seat shall bear against a non-corrodible and non-abrasive metallic surface.
9) The hydrant foot valve opening shall be 5¼ inches.
10) Hydrant Shoe:
    a. Material – 6" Mechanical Joint Shoe and AquaGrip Shoe: Ductile Iron, ASTM A-536, Grade 65-45-12.
    b. Shoe to have lugs for strapping anchors on Mechanical Joint.
11) The mains valve assembly shall include double drain outlets design to operate each time the hydrant is operated. The hydrant drain holes shall momentarily force flush with each operation.
12) All hydrants must include cast or ductile epoxy lined shoe (minimum 5 mils), rubber drain seals and positive protective valve stop device. Hydrants shall have a 6-inch mechanical joint inlet elbow.
13) The hydrant barrel shall be of sufficient length to provide a minimum bury of 4 feet.
14) All nozzles shall be provided with caps and chains.
15) All hydrant extension kits, flange kits, stems, couplings or other repair parts must be of the original hydrant manufacturer. Only two 12-inch extension kits are allowed up to a maximum of 24 inches.
16) Factory Paint: All iron surfaces inside and out are to be coated with two-part epoxy to resist corrosion and provide a firm base for exterior paints. Upper barrel to be polyurethane enamel over-coat to resist fading and provide extended gloss retention. See paragraph 3.2.5.D for paint color requirements.

B. Bury Depths Greater than 4 Feet: As an alternate to ordering specific hydrant barrel lengths for specific bury depths, one bury depth can be ordered using the Mueller Vertical AquaGrip Fire Hydrant Shoe and then easily adapted for any trench depth at each installation site. The vertical AquaGrip shoe fits standard Ductile Iron Pipe which can be cut to the appropriate lengths to bring the hydrant to the proposed grade level.

All hydrants furnished for a project shall be from the same manufacturer.

See **Standard Details 514.02** and **514.03.**

See paragraph 3.2.5, Fire Hydrants for installation requirements.

See Pre-Approved Product List for acceptable fire hydrant manufacturers and models.

2.2.9 BLOW OFF – SERVICEABLE

Blow off units for mains up through 12 inches shall be a 2-inch non-freezing and self-draining blow off hydrant. The bury depth of the blow off hydrant shall be specified to match the bury depth of the main being serviced by the blow off hydrant but shall not have a bury depth greater than 42 inches. Blow off hydrant shall have a 2-inch vertical FIP inlet and a 2-inch NPT nozzle outlet. The hydrant

shall be operated by turning a top-mounted 9/16-inch square operating nut counterclockwise to open; clockwise to close. Hydrant must seal the drain outlet in all positions from ¼-turn open to fully open. All internal working parts, the inlet and the outlet, shall be low-lead brass complying with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water. All working parts shall be serviceable from above with no digging required. All wear parts (o-rings and valve seat) shall be commonly available dimensions and materials; none may be of vendor-unique design. See **Standard Detail 514.01**.

See paragraph 3.2.6 for blow off hydrant installation requirements.

See Pre-Approved Product List for acceptable blow off hydrant manufacturers and models.

2.2.10 CORPORATION STOPS

Compression Fittings: Corporation stops for 1-inch through 2-inch taps only shall be all bronze tapered or CC tapered threaded inlet by compression copper outlet, complying with AWWA C800 *Underground Service Line Valves and Fittings* as manufactured by Ford. Corporation stops shall be full port opening with a ball type valve, 300 psi working pressure. Corporation stops shall comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water.

See **Standard Details 513.04, 515.01, 515.02** and **515.03**.

See Pre-Approved Product List for acceptable corporation stop manufacturers.

2.2.11 AUTOMATIC FLUSHING DEVICE – SERVICEABLE

Automatic Flushing station to be minimum 2 inches and designed and engineered specifically for automatic flushing in all climates. Flushing hydrant to be permanently installed to provide flow rates of up to 150 gallons per minute to improve and maintain chlorine residual levels and flush disinfectant byproducts (DBPs). The flushing hydrant is to be installed on a main waterline and flushes directly to the ground.

The unit is to come with a standard UV resistant locking cover. The unit shall contain a double valve, all brass sampling point, UV resistant ground plate, solenoid valve and self-contained digital controller. Unless otherwise directed by the City Engineer or Director of Water Resources, valve to be rated at 200 psi/150 gpm. The stations shall allow for 12 flushing cycles per day at up to 6 hours of flush time per cycle. The unit shall operate on one 9-Volt battery (with compartment holding two batteries). The unit is to be self-draining, non-freezing and all working parts fully serviceable from above with no digging required.

All internal working parts, the inlet and the outlet, shall be low-lead brass complying with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water. All wear parts (o-rings and valve seat) shall be commonly available dimensions and materials; none may be of vendor-unique design.

When the unit is used for blowing off heavily chlorinated water, a dechlorinating basket device is required.

Bury depth to be minimum 36 inches for 12-inch and smaller mains and 42 inches for mains 16 inches and lager. Determine required bury depth before ordering device.

2.3 MISCELLANEOUS APPURTENANCES

2.3.1 BEDDING – COARSE AGGREGATE

Coarse aggregate bedding material, when specified, shall be clean coarse aggregate No. 57 and shall meet the requirements of Table 1005-1, *Aggregate Gradation, Coarse Aggregate* of the *NCDOT Standard Specifications for Roads and Structures*, latest revision.

2.3.2 BEDDING – FINE AGGREGATE

Fine aggregate bedding material, when specified, shall be well graded from coarse to fine and consist of stone screenings. It shall be composed of rough surfaced and angular grains of quartz or other hard durable rock.

Stone screenings shall be so graded that no more than 20 percent by weight will pass the No. 200 sieve when tested by dry sieving in accordance with AASHTO T27, *Sieve Analysis of Fine and Coarse Aggregates*.

Stone screenings shall be produced from stone which has a maximum percentage of wear of 55 percent when tested in accordance with AASHTO T96 using test grading A.

When subjected to 5 cycles of the soundness test, the weighted average loss shall be not more than 15 percent.

2.3.3 FLANGED COUPLING ADAPTERS, RESTRAINED

Restrained Flanged coupling adapters shall comply with AWWA/ANSI C219 *Bolted, Sleeve-Type Couplings for Plain-End Pipe* and NSF 61 listed, minimum 150-psi working pressure. Cast iron flanges shall comply with ASTM A536 and delivered coated with a factory applied fusion bonded epoxy coating.

The flanged coupling adapter shall have a follower flange and body that is made of cast iron per ASTM A536. The follower flanges shall be color coded to identify the general type of pipe the flange is to fit (blue for ductile iron, red for IP sizes).

The mating flange shall have a bolt circle, bolt size, and spacing to AWWA C207 class D, ANSI 150 pound flange drilling dimensions. The restraint gland shall be high strength ductile iron per ASTM A536 with auto-torque breakaway head design. Restraint gland, restraint ring segments/wedges shall be delivered coated with a factory-applied fusion bonded epoxy coating. A split restraint gland is permitted on existing pipe.

The coupling gasket and O-ring mating flange gasket shall be Nitrile (Buna-N) NSF 61 listed, compounded to resist water, oil, acids, and alkalis. The temperature range of the gasket shall be -20ºF to +180ºF.

The gaskets shall have the color of follower flange it is compatible with molded into it.

Bolts and nuts to be 304 stainless steel.

Flanged coupling adapters shall comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water.

See Pre-Approved Product List for acceptable coupling manufacturers.

2.3.4 HYDRAULIC CEMENT

Hydraulic cement shall meet the requirements of ASTM C465, *Standard Specification for Processing Additions for Use in the Manufacture of Hydraulic Cements*, ASTM C595, *Standard Specification for Blended Hydraulic Cements and* ASTM C1157, *Standard Performance Specification for Hydraulic Cement,* as applicable.

2.3.5 MANHOLE FRAME AND COVERS

A. Manhole frames and covers shall be manufactured from Class 35B gray iron, meeting the requirements of ASTM A48*, Standard Specification for Gray Iron Castings,* as noted in section 3.1 of AASHTO M306 *Standard Specification for Drainage, Sewer, Utility, and Related Castings*. Standard manhole frames and covers shall be built to the dimensions and configurations shown on **Standard Detail C06.01.** Minimum inside diameter of the opening shall be 21 13/16 inches. Manholes castings are to be uncoated. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Covers are to be embossed along the perimeter with the name “CITY OF WILSON.” Cover shall read “WATER” in the center and “Confined Space”.

   Weights shall not vary more than 5% +/- of the weight shown on **Standard Detail C06.01**.

B. **Cast Iron Riser Rings** (for non-watertight applications): Manhole riser rings shall be manufactured from Class 35B gray iron, meeting the requirements of ASTM A48, Standard Specification for Gray Iron Castings, as noted in section 3.1 of AASHTO M306. Rings shall be uncoated and provided in 1-inch, 1 ½-inch and 2-inch heights. Placement of rings in combination is not acceptable. A ring must bed/nest in the original frame and not in another ring. See **Standard Detail C06.04**.

B. See Pre-Approved Product List for acceptable casting manufacturers and models.

2.3.6 MISCELLANEOUS CONCRETE WORK

Concrete class (NCDOT) correlation to design compressive strength at 28 days (f’c):

Class	28-day Compressive Strength (f’c)

AA	4500 psi
A	3000 psi

Concrete shall be constructed of a minimum of 3000 psi concrete at 28 days. Ready mixed concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete.* This applies to valve box stabilizing pads, thrust collars and concrete encasement. All exposed concrete shall be air entrained.

2.3.7 PRECAST CONCRETE MANHOLE STRUCTURES

Structures of precast reinforced concrete manholes shall be designed and manufactured in accordance with ASTM C478, *Standard Specification for Precast Reinforced Concrete Manhole Sections*, latest revision ("O" ring joints), or AASHTO M 199 *Standard Specification for Precast Reinforced Concrete Manhole Sections* (gasketed joints). The standard joint shall be sealed with hydraulic cement both on the inside and outside of the riser joints. An "O" ring or "mastic" joint seal may be used. The "O" ring joint shall conform to the requirements of ASTM C443 *Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.* Type Concrete used in the construction of the manholes shall have a minimum 28-day compressive strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 *Standard Specification for Concrete Aggregates* and ASTM C94 *Standard Specification for Ready-Mixed Concrete*. Manholes shall have eccentric flat top as applicable. See **Standard Detail 516.01**. Structures are not permitted to have steps.

See Pre-Approved Product List for acceptable casting manufacturers.

2.3.8 PREFORMED PLASTIC GASKETS (JOINT SEALER)

Preformed plastic gaskets shall meet federal specification SS-S-00210 (210-a) *Sealing Compound, Preformed Plastic, For Expansion Joints And Pipe Joints*, Type 1, Rope Form or Type 2, Flat Type and ASTM C990. Sag or flow resistance and chemical resistance shall meet ASTM C990 *Standard Specification For Joints For Concrete Pipe, Manholes, And Precast Box Sections Using Preformed Flexible Joint Sealants*, latest revision. Preformed butyl gaskets shall be used with structures meeting ASTM C478, ASTM C990 and AASHTO M199. Minimum rope diameter to be 3/4-inch or as required for the size structure.

See Pre-Approved Product List for acceptable joint sealer manufacturers.

2.3.9 PIPE SADDLE SUPPORT - ADJUSTABLE

Adjustable Pipe Saddle Support - For Dry Conditions 3-inch through 36-inch pipe: Material to be cast iron or aluminum saddle formed to ductile iron pipe, with lock nut, and special cast iron reducer. Vertical adjustment range to be from 0 up to 4½ inches. Adjustable pipe saddle supports shall comply with Federal Specification WW-H-171E (Type 39).

See Pre-Approved Product List for acceptable pipe saddle support manufacturers and models.

Adjustable Pipe Saddle Support For Wet or Harsh Corrosive Conditions 2-inch through 24-inch pipe: Material to be steel saddle formed to ductile iron pipe, lock nut, and special steel reducer. Vertical adjustment range to be from 0 up to 4½ inches. Material to be 100% 304 stainless steel with saddles formed of ductile iron pipe. Saddle strap to meet ASTM A36/A36M *Standard Specification for Carbon Structural Steel*. Collar and base cups ASTM A53 *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless* D.O.M. tubing. Thread Stud to meet ASTM A36/A36M, rolled thread, grade ASTM A307 *Standard Specification for Carbon Steel Bolts and Studs, 60,000-PSI Tensile Strength*. Base Plate to meet ASTM A36/A36M sheet steel, 0.25-inch.

See Pre-Approved Product List for acceptable pipe saddle support manufacturers and models.

2.3.10 SERVICES

A. **Small Services: 1-inch Water Services**:

Water service pipe for 1-inch service pipe to be EndoTrace PE4710 water tubing. See paragraph 2.1.2. EndoTrace Traceable Tubing for water tubing specifications/requirements.

Services shall be 1-inch and shall be one continuous run from main to meter with no joints or couplings in between. On these water services, the fittings shall be brass AWWA C800, compression copper type fittings. See **Standard Details 515.01** and **515.02** and paragraphs 2.2.2 Angle Valves, 2.2.4 Curb Valves and 2.10 Corporation Stops.

Taps shall be made with a service saddle.

Service Saddles (required on all service taps**)**: Saddles 1-inch or greater shall be all bronze saddle with a double bronze strap and a grade 60 neoprene "O" ring gasket attached to the body complying with AWWA C800 *Underground Service Line Valves and Fittings*. The saddle casting, straps, and nuts shall be water works bronze 85-5-5-5. The saddle shall have CC tapered threaded outlet and a seal providing a drip tight connection when used on cast iron, ductile iron, PVC, and asbestos cement pipe. See **Standard Detail 513.04**. See Pre-Approved Product List for acceptable service saddle manufacturers and models.

1-inch service: 1-inch services shall serve single family dwellings with a ¾-inch x 1-inch meter minimum. The single-family service is comprised of a bronze double strap service saddle, a 1-inch corporation stop, 1-inch type K copper tube service, and an angle valve.

Meter boxes - Standard Cast Iron: Meter boxes shall be 12-inch deep cast iron boxes having the same approximate weight as, and lids interchangeable with, the MBX-1 as manufactured by Capitol Foundry or approved equal. Meter box lids shall be ordered predrilled for MI remote readout. Meter boxes shall be supported on 6 standard concrete bricks, which shall in turn be supported by a minimum of 6 inches of compacted granular material. One standard solid brick shall be placed vertically on the end of the box over the unused inlet/outlet slot. Boxes shall be set in such a manner that the top of the angle valve is 6 to 10

inches below the bottom of the meter box cover to provide adequate clearance for the meter. All meter boxes shall also be backfilled and supported outside the box with native material or, if required by the City Engineer or Water Resources, fine graded sand. The City will not set water meters until such time as meter setters and boxes are set to proper grade. Meter boxes shall **not** be installed in driveways, roads, closer than 3 feet to a fire hydrant, or in parking lots or sidewalks unless prior approval has been obtained from the City Engineer or Water Resources.

Small Meters: The Ultrasonic meter shall be one-piece electronic meter and register that are integral to the meter body with solid-state technology in a compact, totally encapsulated, tamper-protected, weatherproof, and UV-resistant housing, suitable for residential and commercial applications. Ultrasonic meters shall comply with the applicable portions of AWWA C700 and NSF/ANSI 61, Annex G, NSF/ANSI 372 certified lead free, lead free bronze or 316 stainless steel meter housing, with wired lead and in-line connector for Elster AMR/AMI device. The main case shall withstand a working pressure of 175 psi without leakage. Where applicable for fire service, meter shall be UL Listed under UL Subject 327B (inferential type water meters used in residential fire service applications). Meters shall wired for AMI remote readout with Itron 100W series Encoder Receiver Transmitter (ERT) module compatible with Itron radio read system.

See Pre-Approved Product List for approved manufacturers and models.

Meter Register: Meter register shall be straight reading, permanently sealed electronic LCD. Register housing and lid to be engineered polymer. Electronic metering shall indicated rate of flow and reverse flow indication. For fire service applications, meters shall have a red polymer lid. Display to read in cubic feet.

B. **1 ½ and 2-Inch Water Services:**

Water service pipe for 1 ½-inch and 2-inch service pipe to be EndoTrace PE4710 water tubing. See paragraph 2.1.2. EndoTrace Traceable Tubing for water tubing specifications/requirements.

Unless shown otherwise on the details, the brass fittings on these water services shall have AWWA C800 compression type joints. The services shall be one continuous run from main to meter with no joints or couplings in between.

The service line for a 1 ½-inch and 2-inch meter shall consist of a bronze double strap saddle (**Standard Detail 513.04**), a type K soft drawn copper service line, a corporation stop, and a meter setter and meter box. See **Standard Detail 515.03**.

Service saddles: Service saddles shall be 2-inch all bronze saddle with double bronze straps and with a grade 60 neoprene "O" ring gasket attached to the body (**Standard Detail 513.04**). The saddle casting, straps, and nuts shall be water works bronze 85-5-5-5. The saddle shall have 2-inch iron pipe threads.

See Pre-Approved Product List for acceptable service saddle manufacturers and models.

1 ½-inch and 2-inch metersetter: Metersetters shall be constructed from 85-5-5-5 Brass (AWWA C800 *Underground Service Line Valves and Fittings*) and copper tubing, and factory tested for water-tightness before shipping. The meter setter/yoke shall be comprised of all brass and copper padlock wing inlet ball valve (lockable cut-off) inlet, angled check valve outlet, high by-pass line with a stop ball valve, stabilizer bars, and brace pipe eyelets for 1-inch pipe. Outlet connections are to be compression. See **Standard Detail 515.03**.

1 ½-inch and 2-inch Meters: See Small Meters.

See Pre-Approved Product List for acceptable metersetter manufacturer and model.

Meter Boxes, Standard Cast Iron: Meter boxes shall be cast iron boxes having the same approximate weight as, and lids interchangeable with, the MBX-5A as manufactured by Capitol Foundry for 1 ½-inch and 2-inch meters. Meter box lids shall be ordered predrilled for AMI remote readout. Meter boxes shall be supported by standard concrete bricks, and the blocks infilled with a minimum of 3 to 4 inches of #57 washed stone. Unless a traffic model box is used, meter boxes shall not be installed in driveways, roads of closer than 3 feet to a fire hydrant and shall not be installed in parking lots or sidewalks unless shown on the plan or prior approvals are obtained from the City Engineer. Meter box and meter to be provided by the City and installed by contractor. The City will not set water meters.

C. **Large Meter Services (3-inch and larger)**

Piping: For services greater than 2 inches, the water service pipe shall be 4, 6, 8, 10, or 12 inches in diameter and shall be constructed of ductile iron pipe. 3-inch meters shall be served by a minimum 4-inch tap and 4-inch service line. Ductile iron fittings shall be used on these services. Taps on existing lines may be made by using the appropriate size tapping sleeve and valve. On a new line, the connection shall be made with a tee and valve.

Large Meter Enclosures: All large meter applications are to be installed in a freeze-proof enclosure. Underground vaults are not permitted. Meter installation shall have a straight pipe (spool) 5 times the diameter of the meter before and 3 times the diameter after the meter with a 2-inch test port installed between the meter and outlet valve. The meter is also to have a by-pass line the same size as the meter. A strainer is not required on Ultrasonic transit-time meters. All valves to be OS&Y resilient seat wedge with rising stems. Meters must be installed 18 inches above concrete floor. Pipe entering and exiting must be ductile iron pipe.

See sheet 1 of **Standard Detail 515.04**.

Large Meters: All meters 3 inches and larger must be Ultrasonic Transit-Time meter. Ultrasonic meters shall comply with AWWA C750 *Transit-Time Flowmeters in Full Closed Conduits* and shall be NSF/ANSI 61-G and NSF/ANSI 372 certified lead free.

Meter Cases:

2" meter housing: Outer cases to be stainless steel SAE Grade 316 meeting ASTM A269. Ultrasonic meters meet and exceed ANSI/AWWA C715 standards. The meters comply with the lead-free provisions of the Safe Drinking Water Act, are certified to NSF/ANSI Standards 61 and 372 and carry the NSF-61 mark on the housing.

3" - 8" meter outer cases: Outer cases shall be grade 316 Stainless Steel or Epoxy-coated Ductile Iron alloy meter bodies meeting ASTM A536 or ASTM A126 providing full compliance with ANSI/NSF 372 (AB1953 or NSF61G). Main case protected by a fusion-bonded coating conforming to AWWA C550. 3 and 4-inch to be stainless steel only.

10" - 12" meter outer cases: Outer cases shall be grade 316 Stainless Steel or Epoxy-coated cast Ductile Iron alloy meter bodies meeting ASTM A536 or ASTM A126 with main case protected by a fusion-bonded coating conforming to AWWA C550. Meter outer cases to provide full compliance with ANSI/NSF 372 (AB1953 or NSF61G).

All external bolts and nuts shall be made of bronze or stainless steel.

The main case shall withstand a working pressure of 175 psi without leakage, seepage in the castings, or distortion affecting the free and accurate operation of the measuring unit.

The size of the meter and the direction of flow shall be cast in raised letters on the outer surface of the case.

Metrological Compliance: Meets ANSI/AWWA Standard C750-10, ISO 4064 rev. 2005.

Meter Register: Register shall be non-fogging, moisture and dust-proof, electronically driven by the measuring section transit time sensors. Register shall indicate reverse flow, rate of flow, low battery indication, leak alert as well as no flow condition. An effectively tamper proof meter with displayed tamper indication symbol is required. The measuring section shall be a unitized unit, completely integral to the meter body. The performance of the measuring chamber shall be guaranteed to meet required Compound meet accuracy standards of AWWA M6 Manual for a prior of two years from date of manufacturer's shipment. Meters shall exceed current AWWA C702 test flow, head loss and accuracy standards. Meter shall be provided with a plastic cover with the manufacturer's serial number inside the register lid. Serial number shall be permanently programmed in the electronic register. Register to read in cubic feet.

Meters shall be provided with AMI remote readout with the Elster Energy Access system (readout compatible with gas and electric).

See Pre-Approved Product List for acceptable meter manufacturer and model.

D. **Low Lead Content**: All service pipe, fittings, valves, and meters shall comply with NSF/ANSI 61 Annex G and NSF/ANSI 372 (low lead content) for elements in contact with potable water.

E. **Construction Responsibility/Duties When Making Service or Main Taps.**

The following process describes the conventional process for making service taps on existing lines:

1. 1-inch, 1 ½-inch and 2-inch Taps: Upon payment of a fee, the City of Wilson will make the tap.

2. Taps 4-inches and larger:
   a. The Contractor excavates to expose the line.
   b. The Contractor provides all materials and places tapping sleeve and valve on all existing mains. City of Wilson makes tap and tests.
   c. The City makes the tap and invoices the Contractor for labor, equipment and a tap fee.
   d. The Contractor backfills, compacts and closes trench; replacing pavement if applicable.

2.3.11 VALVE BOXES

A. **Valve Boxes**: Adjustable valve boxes shall be manufactured from iron conforming to ASTM A48, Class 35B as noted in section 3.1 of AASHTO M 306 *Standard Specification for Drainage, Sewer, Utility, and Related Castings*. Valve box dimensions shall conform to **Standard Detail 513.01** *(Standard Screw Valve Box Detail)* of these specifications. Lids shall be heavy duty traffic weight with the word "water" cast into the lid. Lids shall be ordered predrilled for AMI remote readout. Provide cast-iron telescoping top section of length required for depth of burial of valve and bottom section with base of size to fit over valve.

B. **Cast Iron Riser Rings**: Valve box adjusting rings shall be manufactured from Class 35B gray iron, meeting the requirements of ASTM A48*, Standard Specification for Gray Iron Castings,* as noted in section 3.1 of AASHTO M306. Valve box adjusting rings shall be provided in 1-inch, 2-inch, and 3-inch heights. Placement of rings in combination is not acceptable. A ring must bed/nest in the original frame and not in another ring. See **Standard Detail C06.05**.

See Pre-Approved Product List for acceptable valve box and adjusting ring manufacturer and model.

2.3.12 WARNING TAPE, LOCATOR WIRE, AND TRACEABLE TUBING

A. EndoTrace Traceable Tubing for Water Servicdes: Water service tubing is comprised of EndoPure water pipe combined with a factory-installed 10 AWG tracer wire. See paragraph 2.1.2 EndoTrace Traceable Tubing.

B. **Locator Wire**: Size 12 insulated single-strand solid or multi-strand copper wire, direct bury listed XLP/USE-2/RHH/RHW-2. Wire shall be installed above all non-ferrous water mains and force mains; attached every 5 feet to the water main with zip ties. Electrical conductivity along the pipe shall be continuous and uninterrupted between valve boxes. A sufficient excess length of wire shall be left in each valve box to provide at least a 6 to 12 inches length of wire above finished grade. See **Standard Detail 511.01**.

C. **Metallic underground warning tape**: Metallic detectable underground warning tape shall consist of a solid aluminum foil core, 35 gauge minimum, encased on each side with plastic (minimum overall thickness 5 mils) and be 3 inches wide

with black lettering imprinted on a color coded background that conforms to APWA uniform color code specification (ANSI Z535.1 Safety Colors) BLUE and silver with black ink letters. Minimum tensile strength shall be 22 lbs/inch. Soil tolerance range to be pH 2.5 to pH 11.0. On one side of the tape, the text shall include the wording "WATER LINE BELOW" repeated along the length of the tape. A detectable warning tape shall be used with all water mains. Underground warning tape is to be placed directly over the pipe 12 to 18 inches above the top of the pipe. See **Standard Detail 511.01**.

Standard color code for tape and wire:

Blue: Water Systems
Green: Sewer Force Mains

See Pre-Approved Product List for acceptable underground warning tape manufacturers.

PART 3 – EXECUTION

INSTALLATION – PIPE AND FITTINGS

3.1 PIPE & FITTINGS

Refer to Section 02275, TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES.

3.1.1 DUCTILE IRON PIPE

A. **DIP Installation**

1) **Trenching & Bedding**: Refer to section 02275, *Trenching, Backfilling, and Compaction of Utilities*.

2) **Installation of DIP Water Mains**: Comply with AWWA C600, *Installation of Ductile Iron Water Mains and Their Appurtenances*.

3) **Pipe Laying - Separation**: The contractor shall comply with the NCDEQ standards for separation of water mains from sanitary sewers or storm drainage lines. See Part 1 – GENERAL, *paragraph 1.9 – Project Conditions* of this specification.

4) **Materials, Storage, and Handling:** See paragraph 1.7 – *Product Delivery, Storage and Handling*.

B. **Construction:**

1) **Construction**: DIP Water mains and fittings shall be installed with approved tools in accordance with the requirements of ANSI/AWWA Standard Specification C600, *Installation of Ductile Iron Water Mains and Their Appurtenances*, which is herein made part of the specification by reference.

Construct piping to accurate lines and grades avoiding localized high points and support as required on drawings or described in specifications. When

temporary supports are used, ensure that sufficient rigidity is provided to prevent shifting or distortion of pipe.

Due care shall be taken in the storing and handling of pipes, fittings and valves to avoid contamination with the ground and prevent foreign matter from entering pipe and fittings. String out no more pipe than can be installed in a day. Gaskets shall be lubricated as per manufacturer's recommendations.

Pipe shall be laid with bell ends upgrade and facing the direction of laying.

Pipe, fittings, and valves shall be carefully handled and lowered into the trench. Under no circumstances shall any pipe or fitting be dumped or rolled into the trench, or be allowed to drop against the pipe or a fitting already in the trench. Great care shall be taken to prevent the pipe lining and coating from being damaged, and the Contractor shall not install any damaged pipe. The contractor shall be responsible for removal and disposal of damaged pipe.

Prior to being lowered in to the trench, all pipes shall be carefully inspected to see that each pipe is clean. If necessary, pipes shall be fitted together to ensure sufficient opening for the gasket or joint compound and smooth inside flow line.

Special care shall be taken to ensure that the pipe is well bedded on a solid foundation, and any defects due to settlement shall be made good by the Contractor at his own expense. Bell holes shall be dug sufficiently large to ensure the making of proper joints. Special precautions shall be exercised to prevent any pipe barrel or bell from resting on rock. A minimum of 6 inches is required between rock and the bottom of pipe (see **Standard Detail C01.01** and paragraph 3.2.5 F – *Cushioning Pipe in Rock*, of Section 02275 – *Trenching, Backfilling, and Compaction of Utilities*). If the bed formed in the bottom of the trench is too low, the pipe shall be removed, clean stone placed in the bottom, and a new bed prepared for the pipe. In no case shall the pipe be brought to grade by blocking under the barrel of the pipe. A uniform support shall be provided for the entire length of the pipe.

Cutting Pipe: Whenever a pipe requires cutting, to fit in the line or to bring it to the required location, the work shall be done in a satisfactory manner with an approved cutting tool or tools which will leave a smooth end at right angles to the axis of the pipe, and not otherwise damage the pipe or liner. When the cut end is to be assembled in a *Fastite* bell, an adequately smooth (without sharp edges) bevel should be ground or filed on the cut edge to prevent damage to or dislodgement of the gasket during assembly. Generous bevels are advantageous in the assembly of field prepared ends. The approved methods of cutting pipe are: rotary type, abrasive wheel, and snapcutter on DIP. No welding, flame cutting or flame tapping will be allowed.

The Contractor shall be required at the end of the day's work to keep the end of the line, under construction, plugged to prevent foreign matter from entering pipe and fittings. A watertight plug shall be placed in the bell of the last joint of pipe laid. The pipe shall not be used as a means of draining ground water from the area.

Maximum horizontal deflections for ductile iron pipe shall meet AWWA C600, latest revision or pipe manufacturer's recommendation.

Allowable Joint Deflection of Slip Joint Pipe			
Size (inches)	Nominal Laying Length (feet)	Maximum Allowable Deflection	
		Offset per Length (inches)	Deflection Angle (degrees/radius,ft)
6	18	19	5°/205
8	18	19	5°/205
12	18	19	5°/205
16	18	15	4°/260
20	18	11	3°/340
24	18	11	3°/340

Ref: AWWA C600

a) **Minimum Pipe Bury**: Mains shall be installed to the depth that provides 36 inches of cover below finished grade for mains 12 inches and smaller. Mains 16 inches and larger shall be provided with a minimum of 42 inches of cover below finished grade. In the event site conditions prevent adherence to minimum cover requirements, approval of an alternate design by the City Engineer or Water Resources is required. See Table 02275.1 of section 02275 – *Trenching, Backfilling, and Compaction of Utilities*.

b) **Installing Mechanical Joint Pipe**

i. Gaskets shall not be exposed to oil, grease, ozone, extensive heat, sunlight, or other elements that would degrade the gasket. Store gasket in a cool dark place until installation in accordance with manufacturer's recommendations.

ii. Clean socket and plain end thoroughly, removing mud, oil, gravel, or any other foreign matter. Gaskets shall be lubricated. Paint the bell and the spigot with soap solution (half cup granulated soap dissolved in 1 gallon of water). Slip ductile iron gland on spigot end with the lip extension of the gland toward the end of the pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.

iii. Push the spigot end forward to seat in the bell. Then, press the gasket into the bell so that it is located evenly around the joint. Move the gland into position, insert bolts, and screw nuts up finger tight. Then tight all nuts to torque listed below (excerpted from Table 1 of AWWA C600):

Bolt Size (Inches)	Torque (Ft. – Lbs)
5/8	45-60
3/4	75-90
1	100-120
1 1/4	120-150

Tighten nuts on alternate sides of the gland until pressure on the gland is equally distributed.

iv. Permissible deflection in mechanical joint pipe shall not be greater than listed in Table 3 of AWWA C600.

Allowable Joint Deflection Mechanical Joint Pipe			
Size (inches)	Nominal Laying Length (feet)	Maximum Allowable Deflection	
		Offset per Length (inches)	Deflection Angle (degrees/radius,ft)
6	18	27	7°-07'/145
8	18	20	5°-21'/195
12	18	20	5°-21'/195
16	18	13.5	3°-35'/285
20	18	11	3°-00'/340
24	18	9	2°-23'/450

Ref: AWWA C600

c) **Installation of Mechanical Joint Restraint Systems**

i. Comply with the requirements of AWWA C600 *Standard for Installation of Ductile-Iron Water Mains and their Appurtenances*.

ii. The mechanical joint restraint system is intended for use on ductile iron pipe conforming to ANSI/AWWA C151/A21.51. Mechanical joint restraint systems are not to be used on PVC unless the joint restraint system is designed for PVC pipe.

iii. In cold weather, the gasket should be warmed to facilitate assembly of the joint.

iv. Unless otherwise required by Restraint System manufacture, bolts are to be torqued in accordance with the requirements of the restraint system manufacturer using a torque-indicating wrench.

d) **Installing Slip Joint Pipe**

i. Gaskets shall not be exposed to oil, grease, ozone, extensive heat, sunlight, or other elements that would degrade the gasket. Store gasket in a cool dark place until installation in accordance with manufacturer's recommendations.

ii. Clean the socket and 8 inches of the outside of the plain end thoroughly, removing mud, gravel, or any other matter that might cause the front of the gasket to protrude into the path of the entering spigot. Flex rubber gasket and apply lubricant supplied with the pipe to the plain end and to the inside surface of the gasket before assembly. Start the spigot end of the pipe in to the socket with care. The circumferential stripe on the plain end provides a visual indication for checking the proper insertion of the joint. Insert gasket fully in the gasket recess of the socket, large end of the gasket entering first. For assurance of proper gasket positioning, a thin automotive, blade-type feeler gauge can be used for quick and easy probing to confirm a properly installed gasket position around the joint. Then complete the joint by forcing the plain end to the bottom of the socket with a forked tool or jack-type device.

2) **Cutting Pavement/Driveways**

Where the water line is in an existing paved area, the edges of the pavement for the water line shall be cut in a straight line, parallel to the pipe on each side. Perform cutting operations prior to installation of water line to avoid excessive removal of asphalt. Care shall also be taken during installation of pipe to avoid damage to adjoining paved surfaces.

For cuts made on City maintained streets, refer to the City of Wilson *Backfilling Compaction, & Patching Policy* as well as Standard **Detail C01.03**. If the cut is on an NCDOT roadway, the applicable NCDOT standard pavement repair details pavement width and patching requirements shall apply.

Driveway crossings shall be completed within 48 hours after the initial cutting of the pavement.

Concrete Pavement: If a section of pavement is to be removed, and the cut is within 2 feet of an existing control or expansion joint, remove the concrete to the nearest control joint or expansion joint. Replace concrete pavement with a thickness of at least 1-inch greater than the thickness of the original section removed. All replaced concrete, expansion joints, or reinforcing (if any) shall meet the applicable requirements of the Manual of Specification Standards, and Design. Where the pavement exhibits signs of significant distress in the form of extensive cracks, notify the City Engineer for directions and/or guidance on the extent of concrete pavement removal and repair.

C. **Protection of Pavement**

Whenever the water line is to be placed in or near a paved street, the contractor shall provide pads or take necessary precautions to protect the pavement from damage by construction equipment. Pavement damage by cleats or tracked equipment, or by any other means, shall be repaired by the contractor.

D. **Connections to Existing Mains**

The Contractor shall furnish all materials for connection to existing water mains. City shall be the sole operator of all valves and fire hydrants except in emergency cases followed by notification of City Engineer and Water Resources.

In making connections to the existing distribution system, valves shall be set as shown on the plans.

See paragraph 1.12, Coordination for limitations on valve operation and system shut down.

Before shutting off any main, residents are to be notified in writing at least 48 hours in advance of cut off. The Contractor is responsible for notification distribution. City shall be notified at least 1 week in advance of request for making a wet tap or cut-in.

E. **Removal of Asbestos Cement Pipe**

The contractor is hereby advised that some of the pipe within the City distribution system may contain asbestos. Removal, handling, and disposal of asbestos cement pipe shall be performed in accordance with applicable EPA and OSHA regulations and applicable Federal, State and local regulations. Documentation and paperwork as well as a chain of custody are to be provided to City.

F. **Utility Protection**

Take necessary precautions to protect existing utilities from damage due to any construction activity. The contractor shall locate existing utilities, culverts, and structures (above or below ground), before any excavation starts and coordinate work with utility companies. Protect, maintain in service, and prevent damage to utilities not designated to be removed. Omission from or inclusion of located utility items on plans does not constitute non-existent or definite location. Secure and examine local utility surveyor records for available location data including building service lines. Contact underground damage protection services by contacting **NC One Call Center** at least 48 hours before you dig.

811 Know what's below. Call before you dig.

When utilities are encountered and are not shown on drawings or when locations differ from those shown on drawings, notify the Project Engineer for instruction before proceeding. In the event that a gas line, water line, power cable or conduit, or telephone cable or conduit is broken or damaged, the contractor shall give immediate notice to the proper authorities and shall be responsible for any damage to persons or property caused by such breaks. If a service pipe supplying water or gas to an adjoining house is broken, the contractor shall repair same at once. City may, at the contractor's expense, repair any such service without prior notice to Contractor.

Should it become necessary to move the position of any underground structure, the contractor may be required to do such work.

The Contractor shall be responsible for protecting all existing utilities that could be damaged by excavation near the proposed line. Trench boxes may be necessary to prevent sloughing, etc., as well as to protect workmen, the motoring public, and the pavement. Failure to use a box, which subsequently results in damage to an existing line or other public improvements, shall be cause for liability against the Contractor for the repair costs.

G. **Surface or Ground Water in Trenches/Pipe**

When ground water is encountered, the contractor shall pump, or otherwise remove any water that accumulates in the trenches and shall perform all work necessary to keep the trenches clear from water while pipe is being laid. No pipe shall be constructed in water and water shall not be allowed to drain through the pipe. At the end of the day, the open end of the pipe shall be kept closed by placing a watertight fitting plug into the bell end to prevent washing of any foreign matter into the line. All water removed from the trench shall be conveyed in a proper manner to a suitable point of discharge and shall comply with the applicable erosion and sedimentation laws. See also paragraph 3.1.6, *Dewatering* of section 02275 – *Trenching, Backfilling, and Compaction of Utilities*.

H. **Abandoning of an Existing Water Services/Lines**

Removal of Lines from Service: The Contractor shall remove abandoned lines from active service upon completion of replacement line, and after transfer of service to a replacement line. Under circumstances where the line to be abandoned is 2 inches or less in diameter and threaded galvanized pipe is screwed into a mechanical joint plug, the line may be deleted from active service through removal of the galvanized line from the mechanical joint plug and replaced with a threaded brass plug. Under circumstances where the line to be abandoned is connected to a lead joint cross or tee, the section of line being intercepted which contains the lead joint cross or tee shall be replaced with mechanical joint fittings or straight pipe using mechanical joint sleeves. All plastic fittings shall be replaced with ductile iron or other fittings approved by the City Engineer or Water Resources.

Services: When abandoning services 2-inch or less in diameter, the service shall be cut 1-foot from main. The saddle and corporation stop shall be removed and replaced with a repair clamp.

Mains (3 inches or larger): When an existing water main is replaced with a new water main, abandonment of the existing line is required once it is no longer in service. All mains are to be abandoned at source, valve removed, and the “tee” or tapping sleeve plugged with a mechanical plug or the tee or tapping sleeve can be removed. The abandoned main is to be either removed or pumped full of a cementitious flowable fill grout. Location of abandonment shall be approved by a City Engineer or Water Resources.

3.1.2 C900 PVC PIPE

A. **Use of PVC Water Pipe**: PVC water pipe shall only be used with 12-inch or smaller pipe.

B. **PVC Pipe Installation**

1) **Trenching & Bedding**: Refer to section 02275, *Trenching, Backfilling, and Compaction of Utilities* except no stone bedding is to be used beneath PVC water pipe.

2) **Installation of PVC Water Mains**: Comply with AWWA C605, *Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for* Water

and the *Uni-bell Handbook of PVC Pipe*, latest edition. Tapping of PVC pressure pipe shall be in strict accordance with *AWWA C605, UNI-B-8 and UNI-PUMB-8.*

Unless directed otherwise by the City Engineer, C900 PVC water pipe bedding shall be Type 4 minimum (see **Standard Detail 511.02**). Pipe subgrade and bedding is to be prepared per paragraph 3.1.1.B except that AWWA C605 shall apply where reference is made to AWWA C600 in paragraph 3.1.1.B.

Remove any mud, sand, or other foreign matter from the bell and spigot ends of the pipe. Carefully clean the gasket area.

With a clean applicator (brush or hand) lubricate the entire surface of the pipe from the spigot end to the depth of entry mark and contact surface of the gasket with lubricant.

Brace the bell to avoid disturbing the already installed joints. Align the pipe, insert the spigot into the bell and push until the entry mark is reached. Do not insert past the entry mark line.

3) **Locator Tape and Wire:** When installing PVC C900 pipe, a metallic locator tape is to be installed over the center line at 12 to 18 inches above the top of water main. A tracer wire shall also be placed on top of the pipe, tied to the pipe at 5-foot intervals with zip ties, with the terminal ends of the wire located at valves for accessibility. See **Standard Detail 511.01** and paragraph 2.3.12 for detectable tape, tracer wire and Traceable Tubing specifications.

4) **Pipe Laying - Separation**: The contractor shall comply with the NCDEQ standards for separation of water mains from sanitary sewers or storm drainage lines. See Part 1 – GENERAL, *paragraph 1.9 – Project Conditions* of this specification.

5) **Materials, Storage, and Handling:** See paragraph 1.7 – *Product Delivery, Storage and Handling*.

3.1.3 FUSIBLE C900-16 PVC PRESSURE PIPE (6 TO 12 INCHES):

A. GENERAL

1) Fusible C900 PVC pipe shall be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.

2) Fusible PVC pipe will be fused by qualified fusion technicians, as documented by the pipe supplier.

3) Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.

4) Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:

a. Heat Plate: Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.

b. Carriage: Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.

c. General Machine: Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.

d. Data Logging Device: An approved data logging device with the current version of the pipe supplier's recommended and compatible software shall be used. Datalogging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.

5) Other equipment specifically required for the fusion process shall include the following:

a. Pipe rollers shall be used for support of pipe to either side of the machine.

b. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement weather, extreme temperatures, and /or windy weather, per the pipe supplier's recommendations.

c. An infrared (IR) pyrometer for checking pipe and heat plate temperatures.

d. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.

e. Only facing blades specifically designed for cutting fusible PVC pipe shall be used.

B. Joint Recording:

Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride pipe. The software shall register and/or record the parameters required by the pipe supplier and these specifications.

Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

C. General Installation:

1) Installation guidelines from the pipe supplier shall be followed for all installations.

2) The fusible PVC pipe will be installed in a manner so as not to exceed the recommended bending radius.

3) Where fusible PVC pipe is installed by pulling in tension, the recommended Safe Pulling Force established by the pipe supplier shall not be exceeded.

D. Preparation Prior to Making Connections into Existing Piping Systems:

1) Approximate locations for existing piping systems are shown in the construction documents. Prior to making connections into existing piping systems, the contractor shall:

a. Field verify location, size, piping material, and piping system of the existing pipe.

b. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents.

c. Have installed all temporary pumps and/or pipes in accordance with established connection plans.

2) Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

E. Pipe System Connections:

1) Unless otherwise approved by the City Engineer or Water Resources, for conventional connections, use standard DIP fittings conforming to paragraph 2.1.3.B *Ductile Iron Fittings*.

2) Transition Fittings: See the Approved Products List for transition fittings approved transitioning from C900-16 to DIP pipe.

3) Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents.

F. Tapping for Potable Water Mains

1) Tapping shall be performed using standard double band tapping saddles

designed for use on PVC piping in accordance with AWWA C605 (See Pre-Approved Product List). Tapping shall be performed only with use of tap saddles or sleeves. NO DIRECT TAPPING WILL BE PERMITTED. Tapping shall be performed in accordance with the applicable sections for Saddle Tapping per Uni-Pub 08-16 (or latest version). See **Standard Detail 513.04**.

2) All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.

3) Equipment used for tapping shall be made specifically for tapping PVC pipe:

a. Tapping bits shall be slotted "shell" style cutters, specifically made for PVC pipe. “Hole saws” made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.

b. Manually operated or power operated drilling machines may be used.

4) Taps may be performed while the pipeline is filled with water and under pressure (“wet” tap,) or when the pipeline is not filled with water and not under pressure (“dry” tap).

G. Testing:

1) Testing shall comply with all applicable statutes, standards, regulations, and laws.

2) Hydrostatic Testing and Leakage Testing for Pressure Piping:

a. Hydrostatic and leakage testing for piping systems that contain mechanical jointing as well as fused PVC jointing shall comply with AWWA C605. See paragraph 3.4.3 Pressure Tests & Leakage.

3) DISINFECTION OF THE PIPELINE FOR POTABLE WATER PIPING

a. After installation, the pipeline, having passed all required testing, shall be disinfected prior to being put into service. See paragraph 3.4.4 Disinfection & Bacteriological Testing.

4) PARTIAL TESTING

a. Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the City Engineer or Water Resources.

3.1.4 STEEL ENCASEMENT PIPE – DRY BORING & JACKING OR OPEN CUT

A. **General**: Where required, steel encasement pipe shall meet the length as shown on the plans and the thickness and diameter as shown on **Standard Detail**

C07.03. Boring across roads and railways shall be performed by dry boring and jacking a steel encasement pipe under the pavement or rail. The encasement shall be located in an area that is relatively free from material such as rock and stone that may hamper the boring operation. If requested by the City Engineer, the Contractor shall submit a complete plan and schedule for pipe installation prior to the commencement of such work. The submission shall include complete details of the sheeting, shoring and bracing for the protection of the roadbed and the materials and equipment pertinent to the boring operation. The Contractor shall not proceed with the pipe installation until he has received approval of the plan and schedule from the City Engineer.

Construction shall be executed in such a manner as to prevent settlement of the ground surface above the pipeline. The installation of the pipeline shall follow the heading or tunneling excavation as closely as possible.

All operations of the contractor shall be subordinate to the free and unobstructed use of the right of way of the passage of traffic without delay or danger to life, equipment, or property. Installation shall be in accordance with of the *NCDOT Standard Specifications for Roads and Bridges*, latest revision or AREA, as applicable.

The pipe shall be beveled and prepared for field welding at the circumferential joints. Joining of steel casing pipe shall meet the requirements of AWWA C206, *AWWA Standard for Field Welding of Steel Water Pipe*. Field welded joints shall be performed by ANSI/AWS D1.1 certified welders and shall be full penetration single vee groove, butt type welds around the entire circumference of the pipe. The pipe shall be in at least 18-foot lengths. Casing shall be installed either by dry boring and jacking or open cut, as indicated on the drawings.

Encasement ends shall be enclosed using enclosed using brick and mortar as shown on **Standard Detail C07.03**. The steel encasement pipe shall be of leak proof construction. All exposed metal is to be coated with epoxy or asphaltic material.

All carrier piping shall be mechanical joint ductile iron pipe with restrained joints supported by spiders.

B. **Manufactured Spiders/Skids**: The spiders necessary to support the carrier pipe inside of the steel encasement pipe shall be in accordance with *paragraph 2.1.7 B, Spiders/Skids for Encasement Pipes*. Unless otherwise shown on the drawings, one spider shall be placed at each bell end, one at each spigot end, and one at centered between the two pipe ends (3 spiders per joint) of the carrier pipe. A spider is also required at each end of the encasement pipe (see **Standard Detail C07.03** for location of spiders). Spiders are to be bolted together using stainless steel bolts and nuts.

See Pre-Approved Product List for acceptable spider/skid manufacturers and models.

3.1.5 TUNNELING METHOD

A. **GENERAL**:

1) The contractor shall submit shop drawings to City Engineer for approval prior to construction. All liner plates and ribs used in the tunnel shall be of one type. All material removed shall be disposed of off the site, at an approved location, by the Contractor.

2) All operations of the Contractor shall be subordinate to the free and unobstructed use of the rights of way for passage of traffic without delay or danger to life, equipment, or property. The Contractor shall provide all necessary bracing, bulkheads, and shields to ensure complete safety to all traffic at all times. The Contractor shall provide all traffic control devices as necessary and as shown on the approved traffic control plan at no additional cost.

B. **TUNNELING (BORING METHOD):**

1) Commence boring operation from a pit, with the bottom excavated to grade, and sheeted or shored if necessary. Boring through soil shall have a steel pipe jacked in place as a casing pipe. Boring through rock shall be oversized to allow installation of carrier pipe but no casing pipe shall be required unless liner plate is necessary for safety reasons.

2) Smoothly pave the bottom of the tunnel with concrete. Pull the carrier pipe in place a joint at a time. Securely block each section in place.

C. **TUNNELING (HAND MINING)**

1) Commence tunneling operation from a pit, with the bottom excavated to plan grade, and sheeted or shored if necessary.

2) Trim the periphery of the tunnel smoothly to fit the outside of the steel liner plate as nearly as practical. All blasting shall conform to requirements for blasting in *Section 02275 – Trenching, Backfilling and Compaction of Utilities*.

3) Install the steel liner plates immediately after the excavated material has been removed, and remove the material not more than 24 inches ahead of the installed liner plates.

4) Grout all voids between the soil and tunnel liner plates. Start grouting at the bottom of the tunnel liner plates and proceed upward progressively and simultaneously on both sides of the tunnel. Install liner plates no more than 6 feet ahead of grout section. Prohibit traffic over ungrouted sections of tunnel unless this section is in solid rock. Thoroughly dry-mix grout ingredients before adding water. After adding water, mix the batch for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. Placing shall be quick and continuous. Placement shall be under pressure with a grout pump. The period between installation of the tunnel liner plate and the placing of grout shall not exceed 7 hours, without the approval of the City. Upon completion of grouting, fill grout plugs with provided grout hole plugs.

   A pump shall be provided for placing the grout which shall be capable of exerting sufficient pressure to assure the filling of all voids between the liner

plate and the undisturbed ground. Minimum acceptable pressure to fill voids will be 5 psi. The maximum grouting pressure shall be 30 psi.

Pumping of grout shall be done:

i. At the completion of the installation of approximately each 6' of liner plate,
ii. At more frequent intervals than 6' if conditions indicate the necessity, and
iii. At the end of a work shift or for stopping of work for any reason.

5) Smoothly pave the bottom of the tunnel with concrete: After installation of the tunnel liner plates, the contractor shall pour concrete pavement on the bottom quadrant (invert) of the tunnel, the surface of the pavement being parallel to the liner plate, with screed rails embedded in it, on line and grade for the installation of pipe in the tunnel.

6) The periphery of the tunnel shall be trimmed smooth to fit the outside of the steel liner plate as nearly as is practical, so that the void outside the plates is a minimum.

7) After installation of the casing pipe or the tunnel liner, pull the carrier pipe in place a joint at a time. Securely block each section in place. Each joint of the carrier pipe shall be supported at three points by steel saddles or by steel spiders, strapped to the carrier pipe with steel straps. The carrier pipe shall be blocked, in place to the prevent flotation.

8) Close tunnel liner ends to protect against entrance or foreign matter. The open ends of the casing pipe or tunnel shall be closed off by an 8-inch grout or masonry block wall prior to backfilling. A steel drain line to a 1 cubic yard French drain or to daylight shall be provided.

9) If installation is under railway tracks, all permits shall be obtained and Railway Company shall be notified prior to such installation. The same shall apply to contacting the applicable City or NCDOT if installation is under roadway.

D. See also **PART 2 – PRODUCTS**, Section 2.1.8, "*Tunnel Liners and Appurtenances.*"

3.1.6 HORIZONTAL DIRECTIONAL DRILLING (HDD) OF HDPE WATER PIPE

A. HDPE pipe shall be installed by Horizontal Directional Drilling (HDD) using a surface mounted rig, first to drill a guided hole along a bore path consisting of a shallow arc and then to pull a string of pipe into the hole. Pull back is facilitated by a back-reamer, which enlarges the hole to approximately one and a half times the pipe diameter. Drilling fluids are injected into the bore hole to stabilize the hole and lubricate the pipe and drill-string. Tracking equipment is used to guide and direct the drilling.

1) Mechanical Restraint

When Polyethylene pipe is pressurized, it expands slightly and shortens slightly. Shortening may be enough to disjoin unrestrained mechanical joints that are in line with PE pipe. Disjoining can be prevented by installing external joint restraints at mechanical connections, by installing line anchors, or by a combination of both. Contractor shall install mechanical connections with joint restraint at each connection to mechanical joint pipe.

Note: Poisson Effect pipe shortening must be taken into account whenever the pipe is pressurized, both during the pressure testing, and when it is placed in service. Because pressures are usually higher during pressure testing (up to 150% of the system pressure rating), pipe expansion and Poisson Effect pipe shortening may be slightly greater during pressure testing. Before pressure testing, all mechanical joint restraints must be completely installed and secured per manufacturer's instructions. Concrete in-line anchors and thrust blocking (if used) must be fully cured (minimum of 21 days for 3,000 psi or 7 days for 4,500 psi concrete) and properly backfilled before testing. Restraint is not required at PE to PE butt fusion joints. Restraint is not required at bolted flanged joints.

Mechanical coupling: Stainless steel internal stiffeners shall be used on all couplings to increase the seal. All couplings shall have restraint devices per the manufacturer's recommendation and installed per the Manufacturer's direction.

B. **Installation and Testing**

The Manufacturer shall supply an Installation Manual to City Engineer, which outlines guidelines for handling, joining, installing, embedding, and testing of the Polyethylene Pipeline. These guidelines shall be used as reference material by City's Engineer or Water Resources in their determination of the required procedures.

Joints between plain ends of Polyethylene pipe shall be made by butt fusion when possible. The pipe manufacturer's fusion procedures shall be followed at all times as well as the recommendations of the fusion machine manufacturer. The wall thicknesses of the adjoining pipes and fittings shall have the same DR at the point of fusion.

When saddle connections are fusion welded, the Manufacturer's recommended saddle fusion procedures shall be used.

If mechanical fittings (which are designed for, or tested and found acceptable for use with Polyethylene pipe) are utilized for transitions between pipe materials, repairs, joining pipe sections, saddle connections, or at other locations; the recommendation of the Mechanical Fitting manufacturer must be followed. These procedures may differ from other pipe materials.

On each day butt fusions are to be made, the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, and then fusion test straps shall be cut out. The test strap shall be 12 inches long or 30 times the wall thickness in length (minimum) and 1 inch or 1.5 times the wall thickness in width (minimum). Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trail fusion shall be made, cooled completely, and

tested. Butt fusion of pipe to be installed shall not commence until a trail fusion has passed the bent strap test.

Socket and Straddle fusions shall be tested by a bent strap test as described by the Pipe manufacturer. The pipe manufacturer shall provide visual guidelines for inspecting the butt, saddle, and socket fusion joints.

Pressure testing shall be conducted in accordance with manufacturer's recommended procedure. Pressure testing shall use water as the test media. Pneumatic testing is prohibited.

C. **Shop Drawings**

Contractor shall submit shop drawings and details on the proposed HDPE pipe, fittings, bore methods, etc., for review and approval of City Engineer or Water Resources before ordering material or beginning installation of the HDPE. Contractor shall also submit to City Engineer or Water Resources proposed subcontractor's name as well as references on who he/she plans to use on this project. All subcontractors/installers must be approved by City Engineer or Water Resources.

3.1.7 HORIZONTAL DIRECTIONAL DRILLING OF PVC C900 FUSIBLE WATER PIPE (6- through 12-inch pipe)

A. PVC C900 pipe shall be installed by Horizontal Directional Drilling (HDD) using a surface mounted rig; first to drill a guided hole along a bore path consisting of a shallow arc and then, to pull a string of pipe into the hole. Pull back is facilitated by a back-reamer, which enlarges the hole to approximately one and a half times the pipe diameter. Drilling fluids are injected into the borehole to stabilize the hole and lubricate the pipe and drill-string. Tracking equipment is used to guide and direct the drilling.

B. **Installation and Testing**

The Manufacturer shall supply an Installation Manual to the City Engineer, which outlines guidelines for handling, joining, installing, embedding, and testing of the Fusible C900 Pipeline. These guidelines shall be used as reference material by the City Engineer in his determination of the required procedures.

Joints between plain ends of Fusible C900 pipe shall be made by butt fusion when possible. The pipe manufacturer's fusion procedures shall be followed at all times as well as the recommendations of the fusion machine manufacturer. The wall thicknesses of the adjoining pipe and fittings shall have the same DR at the point of fusion.

When saddle connections are fusion welded, the Manufacturer's recommended saddle fusion procedures shall be used.

If mechanical fittings are utilized for transitions between pipe materials, repairs, joining pipe sections, saddle connections, or at other locations; the recommendation of the Mechanical Fitting manufacturer must be followed.

Pressure testing shall be conducted in accordance with City of Wilson specifications.

C. **Shop Drawings**

Contractor shall submit shop drawings and details on the proposed Fusible C900 pipe, fittings, bore methods, etc., for review and approval of the City Engineer or Water Resources before ordering material or beginning installation of the Fusible C900 pipe. Contractor shall also submit to the City Engineer or Water Resources proposed Subcontractor's name as well as references regarding whom he/she plans to use on this project. All subcontractors/installers must be approved by the City Engineer or Water Resources.

3.2 VALVES AND FIRE HYDRANTS

A. **Valve Applications**

Above Ground Vault Applications		
Use	**Size**	**Type**
Valves	2-inch and smaller	¼-turn Stainless Steel Ball Valve
	3-inch and larger	OS&Y, NRS
Relief Valves	1- and 2-inch	Air/Vacuum Release Valves
Regulating	All	Pressure-regulating Valves, Flow-regulating valves
Detecting Unauthorized Water Usage	All	Double Detector Check Valves
Backflow Prevention	All	USC approved RPZ and Double Check Valve Assemblies (UL/FM rated)
Below Ground		
Use	**Size**	**Type**
Isolation Valves	All	Non-Rising Stem

3.2.1 GATE VALVES

A. **Setting of valves and valve boxes**: Valves shall be installed with stems in a vertical plane through the pipe axis and perpendicular to the pipe axis. The contractor shall clean the valves before installation and check for satisfactory operation. Valve nut extensions will be required on 16-inch and larger mains unless, at the discretion of the City Engineer or Water Resources, excepted otherwise.

Valves must match line size.

B. **Setting Valve Boxes**: All underground valves without gearing or operators shall be equipped with a 2-piece valve box with lid (see **Standard Detail 513.01**). Valve boxes shall be centered plumb over the operating nut of the valve. The valve must be set so that it does not transmit shock from traffic or stress to the valve.

Valve boxes set on blow offs shall be set on concrete brick placed beneath the bottom outstanding flange of the valve box. Place a minimum of 1 inch of earth cushion beneath the concrete brick and the valve and the valve box set in

alignment with the valve stem centered on the valve nut, set in a manner to prevent transmitting shock or stress to the valve. See example in **Standard Detail 514.03**.

Valve box cover must be set flush with the finished ground surface or pavement. All valve boxes installed in the shoulder of the road in rough terrain must have a precast concrete collar set around the valve box (see **Standard Detail 516.02**).

The contractor shall be responsible for keeping valve boxes clean and free of any foreign matter until acceptance of the project.

C. **Valve Box Adjustment**: The Contractor shall adjust valve boxes to final grade at the time designated by the City Engineer. As shown on the drawings, the Contractor shall construct a concrete pad set flush with grade and top of the box in a 12 inch thick x 2' x 2' concrete stabilizing pad placed around the valve box in paved areas. No extra payment will be made for this item. Valve boxes placed in unpaved areas shall be provided with a precast shoulder slab "donut" (**Standard Detail 516.02**).

D. **Valve Box Removal:** When shown on the drawings or directed by the City Engineer, the Contractor shall remove existing valve box(es), place select fill, stone or other material and repair pavement. Salvaged valve box(es) are to be delivered to the Division of Water Resources.

3.2.2 TAPPING SLEEVES AND VALVES

Tapping sleeves and valves shall be installed in accordance with the manufacturer's recommendations at locations shown on the plans. The Contractor shall make connection to existing water mains in the manner shown on the plans or otherwise in a manner which is satisfactory to the City. With prior approval, when taps are made on asbestos cement pipe, the Contractor shall excavate at the location of the tap and measure the diameter of the pipe prior to selecting a tapping sleeve to ensure the sleeve will fit the pipe (this information shall be provided to the City of Wilson on the as-built drawings). See **Standard Detail 513.02**. Contactor is responsible for traffic control, excavating, dewatering, and safe access in the trench at the time of tap. The Contractor is to provide the tapping sleeve and valve and all other materials required, place the tapping sleeve and valve on the main. However, the City of Wilson will make the tap and test.

A variable level tapping sleeve connection, shown on **Standard Detail 513.03**, may only be used when approved by the City Engineer or Water Resources.

3.2.3 VALVE AND FIRE HYDRANT OPERATION

A. **New Construction**

1. Except in emergencies, it shall be unlawful for any contractor to operate on the City of Wilson's water distribution system except in the present of the Water Distribution/Wastewater Collection Manager or Distribution Personnel, or the City Engineer or his representative and then only with prior notification and approval as outlined in paragraph E below. The Water Distribution/Wastewater Collection Manager may require that the valve only be operated by Water Distribution Division Personnel. Failure to comply with

these requirements shall be grounds for suspension of pipe-laying operations until written assurance can be obtained from the company official that such non-compliance will not occur again.

2. Contractors should be aware that the City of Wilson regards any violation of these requirements as ground to justify punitive measures.

B. **Existing Mains**

It shall be unlawful for any person to operate any valve in the City of Wilson's water distribution system. If a valve needs to be operated, the notification procedure in paragraph E below shall be followed and personnel from the Water Distribution Division will operate the valve.

C. **Hydrants and Valves on Private Property**

It shall be unlawful for any person to operate any valve which controls fire hydrants or fire protection lines in private property such as shopping centers, group house, etc. after these lines and hydrants have been tested and accepted by the City. If maintenance is needed for any part of the private system, the Water Distribution ORC should be notified following the procedures outlined in paragraph E below. In addition, any fire hydrant that is out of service must be reported to the Fire Department. A serious safety problem could arise if hydrants are inoperable due to valves being fully or partially closed without the knowledge of the Fire Department.

D. **Emergencies**

In the case of an emergency, a contractor or plumber shall be allowed to take measures with respect to valve and fire hydrant operation as are necessary for the protection of life and property. Notification must be made to the City as soon as possible after the emergency, stating what the emergency was and the measures taken to correct it.

E. **Notification Procedur**es

1. The contractor shall notify the Water Distribution ORC to request the operation of any valves. Twenty-four hours' notice is requested if no water customers will be affected. Forty-eight hours' notice is required if any customers will be affected (i.e. out of water for any period of time). It is the responsibility of the contractor to notify the affected customer(s) **48**-hours in advance of disrupting the water service prior to work.

2. The following information is requested:
    a. Name of person calling
    b. Company name
    c. Location of valves
    d. Date and time needed
    e. Reason for the operation of valve(s)
    f. Whether to open or close

F. **Enforcement**

Due to the potential seriousness associated with the unauthorized operation of valves, the City of Wilson will pursue any violations of this section to the fullest extent allowed by law.

3.2.4 AIR RELEASE VALVES

Air release valves are to be used to bleed air during filling of a water line and to automatically vent air that collects in the water lines. Pressure air release valves shall be constructed as shown on the drawings. The valve shall be housed in a precast concrete eccentric flattop manhole and shall be installed in accordance with **Standard Details 516.01** (Air Release Manhole for Water Mains). All pipe and fittings are to be brass (meeting NSF/ANSI 372, certified lead free). Ball valves are to be stainless steel ¼-turn. Air release valve locations shall be as shown on the plans and as otherwise directed by City Engineer. See also paragraph 3.3.3 *Manhole Installation for Air Release Valves*.

3.2.5 FIRE HYDRANTS

A. **Construction**: Fire hydrants shall be installed where shown upon the plans or as directed by the Fire Marshall and/or City Engineer. Place the hydrant on #57 stone base. Hydrants must be set with the stem vertical/plumb and the flange above grade. Backfill the hydrant with 3 cubic feet of loose #57 stone ensuring that the stone is placed at least 6 inches above the weep hole opening in the hydrant. See **Standard Details 514.02 and 514.03**.

B. Hydrants are to be located within the right of way and set to the height prescribed by **Standard Details 514.02 and 514.03** with the pumper nozzle facing or pointing to the street or fire access lane. The Contractor is responsible for determining barrel length and ordering to meet conditions. Where adjustments in height are needed, as an alternate to ordering specific hydrant barrel lengths for specific bury depths, one bury depth can be ordered using the Mueller Vertical AquaGrip Fire Hydrant Shoe and then easily adapted for any trench depth at each specific installation site. The vertical AquaGrip shoe fits standard Ductile Iron Pipe which can be cut to the appropriate lengths to bring the hydrant to the proposed grade level. When hydrants are approved by the City Engineer or Water Resources to be set behind guardrails, the pumper nozzle shall be set with its centerline a minimum of 12 inches and a maximum of 18 inches above the top of the guardrail.

   When set in the lawn space between the sidewalk and the curb or between the sidewalk and the property line, no portion of the hydrant or nozzle cap may be within 6 inches of the sidewalk. A clear space of not less than 3 feet shall be provided on all sides of a fire hydrant.

   A resilient seat gate valve shall be installed with an approved mechanical joint restraint system.

C. Mechanical joint restraint systems are to be used in anchoring the hydrant to the leg valve and main. Mechanical joint restraint systems are to be used on all fittings.

   A City representative must inspect fire hydrants prior to backfilling.

D. **Operation and Painting**:

1. Operation: Hydrants, upon installation and prior to acceptance of the project, shall be painted and greased, the cap is to be sprayed (non-petroleum based) after installation, and individually operated in front of a City representative to verify the hydrant is wet. See **Standard Detail 514.02** and **514.03**. Do not remove chains.

2. Hydrant Painting: Hydrants shall be ordered pre-painted by the manufacturer (see paragraph 2.2.8.A.16). Public hydrant barrels are to be painted Forest Green (or the equivalent) with the bonnet painted white. Hydrants within private enclosures shall be painted Federal Safety Red. Where the hydrant manufacturer does not offer hydrants painted to conform to the City of Wilson's standard color scheme, the hydrants are to be field painted using Tnemec, Sherwin-Williams, or an approved equal paint applied as follows.
   a. Hydrants come pre-painted typically with two-part epoxy paint and a polyurethane enamel over-coat over the upper barrel. Prior to applying field paint, the exposed upper barrel surface is to be uniformly and mechanically abraded to dull the sheen of the existing coating. Loose flakes are to be removed and both flaked and chipped areas leaving exposed metal are to be sanded smooth to eliminate hard edges.
   b. Surfaces to be painted shall be free of oil, dirt, and rust per SSPC-SP 1 Solvent Cleaning.
   c. Following barrel preparation, apply two field-bonding coats of Sherwin-Williams Epoxy Polyamide Fast Cure, Tnemec Series 27 FC Polyamide Epoxy, or an approved equal; 3-4 dry mils each.
   d. Apply one surface coat of Sherwin Williams Acrylic Polyurethane gloss, Tnemec Series 740 Modified Polycarbamide (gloss), or an approved equal; 3-4 dry mils.
   e. Paint can be rolled, brushed, or sprayed.
   f. City Wilson Standard Color Scheme: The hydrant barrel is to be painted Sherwin-Williams SW 6454 (Shamrock) or Tnemec 08SF (Hunter Green) and the bonnet white. Submit paint chip for approval.

E. **Hydrant Bagging**: Hydrants not in service shall be bagged. Notify Water Resources if a fire hydrant is bagged.

F. **Valving of Main**: A leg valve is required on all hydrant legs. Install hydrant valve on mechanical joint hydrant tee or with a standard tee with an approved joint restraint system. When valve is placed outside the pavement, provide a concrete stabilizing pad in accordance with **Standard Detail 516.02**.

G. Fire hydrants are to be pressure tested with the main.

3.2.6 BLOW OFF INSTALLATION

Blow-Off Assembly for Mains (6-inch to 12-inch): Blow-off assemblies for either permanent or future extensions shall consist of a minimum of one 18-foot long joint of DIP (actual length of restraint as required per **Standard Detail 512.06**), a standard MJ plug with joint restraint system tapped (I.P. threads) for a 2-inch pipe, a 2-inch I.P. threaded schedule 40 brass pipe (with elbow) connection between the blow off hydrant and the cap, 2-inch I.P. threaded vertical outlet blow off hydrant, and a valve box (see **Standard Detail 513.01**; minimum ID = 5 ¼ inches), and concrete stabilization pad. The valve box to be set on concrete brick and the hydrant on a 4x4x16 solid concrete block.

Provided a minimum of 3 cubic feet of #67 stone around drain and base of blow off as shown on **Standard Detail 514.01**.

Ensure that the hydrant is free to move vertically within the valve box to prevent transmission of traffic loads to the hydrant. The hydrant should not be jammed or wedged against the valve box interior.

The blow off is to be set such that the top of the operating nut is 6 inches +/- below finished grade.

For units set in unpaved areas, the contractor is responsible for providing the necessary temporary outlet protection to prevent erosion of both stabilized and unstabilized earthen surfaces.

When the unit is used for blowing off heavily chlorinated water, a dechlorinating device is required. Disposal of heavily chlorinated water shall meet the applicable sections of AWWA C651, latest revision.

See paragraph 3.3.4 for Automatic Flushing Device Installation.

3.2.7 BACKFLOW PREVENTERS

A. See sections within this document as well as the City of Wilson Backflow Prevention Cross Connection Control Ordinance latest adoption as applicable.

B. Disinfection:

1) If required by Engineering, sections of pipe supplying potable water to the backflow assembly shall first be pressure tested and flushed to remove any solids or contaminated material that may become lodged in assembly before assembly is put in service.

C. Hydrostatic Testing:

1) Backflow Assemblies shall not be hydrostatically tested as part of or in conjunction with potable water or fire mains services or an irrigation service to which they are connected.

D. Testing:

1) After inspection of proper installation is complete. Test report will be turned into the Water Resources Division.

2) Required maintenance and annual testing shall be the owner's responsibility.

3.3 MISCELLANEOUS APPURTENANCES

3.3.1 SERVICES

A. **General**: All fees must be paid and work scheduled with the City before the tap can be made. All materials must be on-site, trenches open, and shoring and traffic control devices in-place before the tap is made. Contractor may be required to provide traffic control plan that meets all MUTCD regulations.

3) **Allowable Tapping Methods and Tap Requirements:**

a. 1-inch, 1 ½-inch and 2-inch taps are to be made using an all bronze double strap tapping saddle. The service saddled shall provide a drip tight connection when used on DIP or PVC water mains. See **Standard Detail 513.04**.
b. Taps 4-inches and larger are to be made using an all stainless steel tapping sleeve or a fitting. Iron body sleeves are not permitted. See **Standard Detail 513.02.**
c. Tap Location: Taps made on the same side of the main shall be no closer than 24 inches apart and staggered a minimum of 1-inch vertically to avoid damage to main. Taps may not be placed closer than 24 inches from end of pipe for pipe up to 16 inches in diameter. See **Standard Detail 513.04** for typical tap detail on water main.
d. Service taps made on ductile iron pipe shall also be subject to the requirements of AWWA C600, *Installation of Ductile Iron Water Mains and their Appurtenances, latest revision.*
e. Service taps made on PVC C900 shall also be subject to:
   i. The requirements of AWWA C605, *Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings*.
   ii. UNI-PUB-08: Tapping Guide for AWWA C900 Pressure Pipe

Service Connections on "In-Service" water mains.	
Size Connection	**Responsibility**
1-inch through 2-inch services	Upon payment of a fee, the City will make the tap, run service line and set meter box and setter (as applicable). City will also set meter when requested for construction or after final plumbing inspection.
3-inch and larger services	Contractor excavates line, provides all materials. City makes tap and invoices Contractor for labor, equipment and a tap fee. Contractor backfills, compacts and closes trench; replaces pavement, etc. Contractor sets meter.

4) **Tap Location**: Water service pipe shall be one continuous run, from main to meter angle stop/curb valve. Line shall have no joints or couplings in between. Service lines shall run perpendicular to the main in a straight line to the meter box/property served. No sharp bend of the service line will be permitted. **Service lines shall not be located beneath driveways**.

5) **Tap Bedding/Backfill:** Firm bedding with at least 18 inches of cover shall be provided from the corporation to near the meter setter. Copper service lines shall have a minimum of 24 inches of cover from the water line to the top of the back of curb or centerline of the drainage ditch.

Backfill shall be free of rocks or large objects that could crimp or damage the line. Service line trenches in traffic areas shall be tamped to conform to the requirements of Table 2275.3 of 02275 *Trenching, Backfilling, and Compaction of Utilities*. In landscaped areas, the surface shall be left smooth and uniform with the adjacent surface.

B. **1-inch Service Taps**: All 1-inch taps into water mains shall be made using an all bronze double strap tapping saddle with an all bronze corporation stop (compression fitting on service pipe). Pipe must be Type K copper with compression fittings. Corporation stop for saddles shall have AWWA Standard CC tapered threads. Taps shall be made at a 45° angle above the horizontal on the upper half of the pipe. A bend or "gooseneck" in the service line shall be provided in the service line as it leaves the corporation stop to provide for expansion/contraction and flexibility. Multiple taps in the same section of the pipe shall be staggered (see **Standard Detail 513.04**).

C. **1 ½-inch and 2-inch Service Taps**: 1 ½-inch and 2-inch taps shall be made using all bronze double strap saddle. Water service pipe shall be type K soft copper with compression fittings. Taps shall be made at a 45° angle to the pipe. See sheet **Standard Detail 515.03** and paragraph 2.3.10 B.

All 1 ½-inch and 2-inch services as well as the meter installation are to be inspected by the Water Distribution Division.

D. **Large taps**: Taps 4-inch and larger shall be made using all stainless steel tapping sleeves and tapping valves for existing lines or a tee and valve on new lines. A City representative must inspect all service connections prior to backfilling. Only one 4-inch or larger tap shall be made per joint of pipe on AC and/or pit cast (gray iron) pipe. The outside diameter of the pipe must be measured at the location of the tap to determine the appropriately sized tapping saddle.

E. **Meter Boxes and Setters – Installation**:

1) **Small Meter Boxes**: Meter boxes for 5/8-inch x ¾-inch and 1-inch meters shall be installed within the utility strip behind the curb. Meter boxes shall be set on concrete brick with one brick set vertical at each end to cover the elongated slot. The box and brick shall be set on undisturbed grade. All meter boxes shall be set so that there is 6 to 10 inches of clearance between the top of the box and the top of the curb or angle valve. The meter setter shall be straight, level and centered in the box. Meter boxes shall be set to avoid inflow of surface water into the box. See **Standard Detail 515.01**.

2) **2-inch Meter Boxes**: Meter boxes for 2-inch meters shall be placed with a concrete brick on each end to cover elongated slot. Concrete bricks shall be placed underneath meter box for support. The box and brick shall be set on 6 inches of #57 stone. Meter boxes shall be set so that there is 12 inches of clearance between the top of the box and the cut-off nut on the meter setter. The meter setter shall be straight, level and centered in the box. Meter boxes shall be set to avoid inflow of surface water. See **Standard Detail 515.03**.

Meter setters with high by-pass lines for 2-inch meters shall be provided with a section of copper pipe extending buried 24 inches and extending 2 feet horizontally out the back of the meter box, or 2 feet beyond the edge of the sidewalk when meter box is set in or near the street side edge of the sidewalk, and the end either plugged or crimped. Setters are to be perpendicular to meter and vertical. Meter shall be set by contractor at time

the tap is installed for proper spacing. Stabilizer bars are required to be provided on setter.

3) Lids are to be ordered predrilled for AMI remote readout.

F. **Large Above Ground Meter Vaults**: Meter vaults for 3-inch and larger meters shall be placed level in an insulated enclosure with locking access doors and heater. See **Standard Detail 515.04**. Meters and fittings shall be supported by pipe stands.

G. **Grounding to Water Services**: Grounding shall not be allowed to be connected to meter boxes or vaults. As a minimum, place meter boxes/vaults no closer than 10 feet from a building. If unavoidable, place a grounding jumper around meter box/vault.

H. **Abandoning Water Services**: see paragraph *3.1.1 H Abandoning of Existing Water Services/Mains*.

I. **Water Service Replacement:** All existing water services along the water main are to be reconnected to the new water main. Contractor shall install a new corporation stop, service line between proposed water line and existing service at the water meter box, and a new meter setter and new water meter, if necessary. All taps in PVC pipe shall be accomplished through the use of shell type hole cutter which will retain the coupon or plugs. Existing meter setters will be the property of the City and be delivered to the Water Resources Department. *Water services shall be classified for payment as to their location in relation to the new water main and the centerline of the street.*

J. **Testing**: All taps and services shall be pressure tested with the main.

3.3.2 RESTRAINTS: THRUST COLLARS & JOINT RESTRAINT SYSTEMS

A. **Thrust Collars:** Thrust collars shall be constructed as shown in **Standard Detail 512.05** for pipes up through and including 36 inches in diameter. The thrust collar shall consist of a wedge action restrainer gland (see paragraph 2.1.3 Ductile Iron Fittings, paragraph B. 3 of this specification for manufacturer and model number of approved restrainer gland) placed around a joint of ductile iron pipe encased in a reinforced 3000 psi concrete block. Where the blocking provides thrust resistance for fittings, provide one full joint of ductile iron pipe with restraint joint fittings. On dead end lines, the thrust collars must be placed on a full joint of ductile iron pipe just after the terminal end line valve.

B. **Joint Restraint System:** A joint restraint system shall consist of a wedge action restrainer gland placed at a fitting or length of pipe sufficient to resist the thrust imposed on the fitting or line. Unless designed otherwise, the length of pipe for a particular fitting shall be as shown in **Standard Detail 512.06**. Joint restraint systems are to be installed in accordance with the manufacturers written requirements.

See Pre-Approved Product List for acceptable manufacturers and models of mechanical joint restraint systems).

3.3.3 MANHOLE INSTALLATION FOR AIR RELEASE VALVES

Provide a minimum 5-foot inside diameter precast manhole with a minimum inside vertical clearance of 6 feet. Flat tops shall be used for air release manholes. Provide a 6-inch diameter drain hole in the bottom of the manhole base and form the manhole invert such that it slopes to the drain. Manhole bases for air release valves shall be placed on a level 12-inch bed of #57 stone that has been thoroughly and firmly consolidated. Voids around the pipe, joints, grade rings, and other openings in the manhole shall be thoroughly and neatly grouted inside and outside with a non-shrink gout or hydraulic cement to prevent infiltration. A maximum of 2 grade rings or one grade ring and one course of concrete bricks will be allowed to bring the rim and cover to finished grade. If additional height is required, a riser must be installed. See also paragraph 3.2.4, Air Release Valves.

Hydraulic cement shall be applied both on the inside and outside of at all riser joints.

See **Standard Details 516.01** (Air Release Manhole for Water Mains).

3.3.4 AUTOMATIC FLUSHING DEVICE INSTALLATION

2-inch Flushing Devices for Mains (6-inch to 12-inch): Single unit flushing devices shall consist of an upper UV resistant above ground cylindrical enclosure with water outlets at the ground level, a UV resistant ground plate, and a PVC buried enclosure and debris plate. Determine bury depth before ordering (i.e. 36" or 42"). The 2" Brass FIP inlet is to be set on a concrete block that, in turn, is set on undisturbed subgrade. Once the flushing unit has been set and stabilized, backfill based of flushing device housing, concrete block, and elbow with 3 cubic feet of #67 stone (similar to that shown for the blow off valve shown in **Standard Detail 514.01**) with the remaining backfill being predominantly granular (i.e. clayey sand, silty sand or stone screenings).

Service line from the flushing device to the main is to consist of a 2" threaded brass nipple, a 2-inch curb stop and valve box and a service line connected to the main with a saddle and corporation stop (see **Standard Detail 515.03** service line construction).

Water line to be flushed and free of debris before installation.

The ground plate is to be set on a minimum 3-foot square by 4" thick concrete stabilization pad unless otherwise approved by the City Engineer or Director of Water Resources.

The unit shall be set in a non-traffic area where directed by the City Engineer or Director of Water Resources.

When the unit is used for blowing off heavily chlorinated water, order unit with a dechlorinating basket device. Disposal of heavily chlorinated water shall meet the applicable sections of AWWA C651, latest revision.

3.4 TESTING AND DISINFECTION

3.4.1 GENERAL

Pipelines shall be tested, in sections between valves, as soon as the respective section is complete. Using this method, errors in workmanship can be identified immediately and leaks can be fixed quickly and with minimum expense. Prerequisite Conditions for Testing and Disinfection shall be as follows:

A. Pipelines and appurtenances have been laid and the trench backfilled.

B. Hydrants shall be properly located, operable and plumb and at correct elevation.

C. Valves shall be properly located, operable and at correct elevation. Valve boxes or manhole shall be centered over operating nuts and the top of the box or manhole shall be at proper elevation.

D. All 1 ½" and 2" services shall be installed complete with setters (Contractor shall provide a meter, approved by City, for pressure testing). There shall be no bypass around the meter used for pressure testing.

E. Lines shall be properly vented where entrapped air is a consideration.

F. All visible leaks, broken or cracked pipe, valves, hydrants, etc. shall be repaired.

G. Air release valves shall be installed complete and in place after pressure test.

H. Pressure testing is to be performed before pavement is put down.

I. Approval shall come from City's Inspector on section of line to be tested.

J. Contractor may install smaller services either prior to or after testing and disinfection.

3.4.2 ORDER OF OPERATIONS

A. **Pretest Inspection**: Perform pretest inspection with a City representative. The City representative is to request scheduling of this inspection and testing. The City representative shall visually inspect the installation prior to testing to ensure that all fire hydrants, valves and other appurtenances are properly located, operable and installed at proper grade. All defects shall be corrected prior to any testing.

B. **Flush Main**: Prior to performing the pressure test, the main shall be flushed. Flushing of water mains shall be done in the presence of the City representative. No valve or hydrants owned by the City of Wilson should be operated by contractors without the express written permission of the City representative, City Engineer, Water Distribution ORC, or the Assistant Director of Public Services/Water Resources.

C. **Fill Line:** After all prerequisites are met, fill the system slowly with water, at a velocity of approximately 1 foot per second, while necessary measures are taken to eliminate all air at the highest points of the system where air may collect in pockets. After filling, shut off system in order to prevent contaminated water from flowing back in the line supplying the water.

D. **Pressure Test**: A pressure test shall be scheduled with a City representative performing the test 48 hours in advance. Testing shall be in accordance with section 3.4.3, *Pressure Tests & Leakage*. Testing on holidays or weekends to be done with prior approval of City Engineer. ***If an existing gate valve is known to be leaking, chlorination must be performed prior to pressure testing.***

E. **Flushing:** Allow filled system to set undisturbed for a minimum of 24 hours, then begin flushing operations. The section of main to be disinfected shall be flushed through blowoff assemblies. Flushing shall be a velocity of not less than 2.5 feet per second to remove sediment and other foreign matter until the water runs clear. The contractor shall be responsible for making adequate provisions for drainage of large volume of flushing water, including proper dechlorination/disposal of chlorinated water. Any damages that may occur from this operation shall be the sole responsibility of the contractor. In conjunction with beginning flushing, a City representative will perform a high range chlorine concentration test. Chlorine concentration of 50 mg/l minimum must be provided. Allow chlorinated water to set in the test section for 24 hours. The chlorine concentration shall not drop below 20 ppm within a minimum period of 24 hours. See section 3.4.4, *Disinfection and Bacteriological Testing*.

F. **Sampling**: Check chlorine and turbidity. After allowing the system to flush so that at least two volumes of water pass through the main, the bacteria sample shall be collected at regular intervals not exceeding 1,200 feet, and tested for bacteriological quality. The contractor shall be responsible for making adequate provisions for drainage of large volume of flushing water, including proper dechlorination/disposal of heavily chlorinated water. See section 3.4.4, *Disinfection and Bacteriological Testing*. Take bacteriological samples with bottles received from the City's Water Treatment Facility lab.

1) Pipe subjected to contaminating materials shall be treated as directed by City Engineer. Should such treatment fail to cleanse the pipe, replacement shall be required. The City shall bear no portion of any cost sustained by the contractor in meeting this specification.

2) Services shall be included in the main line disinfection process. The contractor shall have the same responsibility for laterals as for the mains in regard to bearing full cost of any corrective measures needed to comply with either the bacteriological test or other such requirements.

3) After As-Builts have been submitted and reviewed, and NC State Certification of the water main has been received, the water main shall be placed in service.

G. **Final**: After final flushing, flow all hydrants to confirm the valves are open.

3.4.3 PRESSURE TESTS & LEAKAGE

The contractor shall test and disinfect completed sections of water line, including service lines, fire hydrants, and fittings with water. City reserves the right to test all lines. This testing, however, does not relieve the contractor of his responsibility to repair or replace any cracked or defective pipe within the 12-month warranty period. All work necessary to secure a tight line shall be done at

the contractor's expense. Testing shall be performed in the presence of City Engineer or his designated representative.

All additions or replacements to water system, including fire lines and backflow prevention devices, shall be tested and chlorinated before being placed in service. Such work must take place under the supervision of City Engineer.

The newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for two hours to a leakage test with a constant test pressure of 150% of design working pressure, but no less than 150 psi. The test pressure shall be allowed to build up slowly using a hand pump or power pump to the test pressure. Only City personnel shall operate water valves on City's existing water system. Extreme care shall be used to prevent backflow into the potable water supply. The lines should be allowed to stand under slight pressure for a period of 24 hours prior to the test. Air should be vented from all high points just prior to the test. Only clean water, free of dirt and other debris, from a clean container shall be used for testing. The contractor shall notify City's inspector 48 hours in advance of any expected test. The contractor shall pretest all mains for a period of 2 hours before notifying City for a final pressure test. No final pressure test will begin after 2:00 PM. The maximum allowable leakage shall be no greater than the allowances shown in Table 4A excerpted below (in accordance with Section 5.2, Table 4A - Hydrostatic Testing of AWWA C 600-10, *AWWA Standard for Installation of Ductile Iron Water Mains and Their Appurtenances*). For PVC pipe, the maximum allowable leakage shall be no greater than the allowances shown in Table 2, excerpted below (in accordance with Section 7.3, Table 2 – AWWA C605-05 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water). No leakage shall be allowed for services.

Tapping sleeve and valve shall be pneumatically tested by Water Resources in place prior to tapping of the existing line in accordance with the manufacturer's recommendations.

The City's inspector will verify 1 pressure test – the final observation of the test section. A fee may be charged if the City inspector is required to make more than 1 trip to verify a pressure test or conduct purity sampling on the same section of main being tested.

A. **Acceptance Tests:**

1) **Pressure Test**: Subject the pipe system to a hydrostatic pressure test. Raise the pressure by pump to 150 psi, 150% of design working pressure, or test pressure as shown on the drawings, whichever is greater. Measure pressure at the low point on the system compensating for gauge elevation. Maintain this pressure (+ or – 5 psi) for 2 hours. If pressure cannot be maintained using reasonable pumping rate, determine cause, repair, and repeat the test until successful. Contactor shall be responsible for all labor, materials, and equipment to perform the testing.

2) **Leakage Test**: Test makeup water allowances shall be defined as the quantity of water that must be supplied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure after all air in the pipeline has been expelled and the pipe has been tested for

a duration of 2 hours. Leakage for DIP shall not exceed the quantity shown in Table 4A (excerpted from AWWA C600-10), attached. For PVC C900 Pipe, allowable leakage shall not exceed the quantity shown in Table 2 (excerpted from AWWA C605-05).

If leakage exceeds allowances, the contractor shall be responsible for locating and repairing leaks, and retesting of line until successful.

No leakage will be allowed for all welded steel pipe. If leaks are revealed by test, repair by rewelding. Peening of leaks will not be allowed. A certified welder must perform all welding.

3.4.4 DISINFECTION AND BACTERIOLOGICAL TESTING

Pipe Disinfection and Bacteriologic Testing: Comply with ANSI/AWWA C-651, *Disinfecting Water Mains*. The contractor shall disinfect water mains and accessories in accordance with the procedures listed below and meet the requirements of City. Bacteriological testing shall comply with Section 5 of AWWA C651. All samples shall be tested for bacteriological (chemical and physical) quality in accordance the *Standard Methods for the Examination of Water and Wastewater*; and shall show the absence of coliform organisms and the presence of chlorine residual. The lines shall not be placed in service or pressure tested until a negative bacteriological report has been received.

Samples cannot be collected if any type of precipitation is falling.

All sampling pipe shall be copper, brass, PVC, or EndoTrace.

The contractor is responsible for furnishing all material and construction sampling points and for taking the samples. Temporary pipes used for sampling shall be composed of sections of vertical pipe terminating into a 90-degree horizontal bend and nipple at least 18 inches above ground level. Copper tubing used for sampling shall terminate horizontally with the ground, at least 18 inches above ground level. It may be difficult to obtain passing samples from outlets other than those listed above. Samples shall not be taken from a hose.

The Contractor will prepare a Sampling Log, including a sketch of the sampling points, as specified by the City. The samples shall be taken in standard sterilized bacteria sample bottlers marked with the sample location. The Contractor is responsible for collecting samples and doing so in the presence of a City representative. Samples can only be taken Monday through Thursday no later than 1:00 PM. Chlorine injected on Friday yielding a 48-hour contact time will be reviewed and approved on a case by case basis.

Samples shall be delivered by the City Inspector to the City of Wilson Water Treatment Facility for analysis. Results of the analyses shall be furnished to the Contractor and City representative directly from the testing laboratory with the project name and the testing location(s) referenced on each result. In the event that two successive bacteriological tests fail for any given section(s), that section(s) of the main shall be re-chlorinated, re-sampled, and re-analyzed.

Sampling Costs: Contractor is responsible for all testing costs.

A. **Forms of chlorine for disinfecting**

1) Calcium hypochlorite – One form is permitted – granular (with 65% available chlorine). It will normally require 6.5 lbs. of Calcium Hypochlorite to produce a concentration of 50mg/L of available chlorine in 10,000 gallons of water.
(Warning Note: *This chemical must not be used on solvent-welded or on screwed-joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite*!)

2) Sodium hypochlorite – is supplied in strengths of 5.25% to 16% available bleach. The required amount of sodium hypochlorite to produce a 50mg/L concentration of available chlorine in 10,000 gallons of water can be calculated from the following formula:

Gallons of Sodium Hypochlorite needed = 50 ÷ % of available chlorine

B. **Method of chlorine application**

The contractor will inject a chlorine solution as specified in AWWA Standard C651, latest revision, into the water main. Chlorination shall be in accordance with the following guidelines for calcium hypochlorite granules:

Pounds of calcium Hypochlorite granules per 1000 feet of pipe to provide 50 ppm	
6-inch diameter pipe	0.93 lbs.
8-inch diameter pipe	1.68 lbs.
12-inch diameter pipe	3.77 lbs.
16-inch diameter pipe	6.71 lbs.
20-inch diameter pipe	10.50 lbs.
24-inch diameter pipe	15.11 lbs.
30-inch diameter pipe	23.61 lbs.

The chlorine solution shall be injected in the section of the main nearest an existing main. The chlorine solution shall result in a chlorination concentration of 50 ppm or greater. Chlorine injected on Friday yielding a 48-hour contact time will be reviewed and approved on a case by case basis. Manually operated pumps shall not be used to inject the solution into the main.

1) **Continuous feed method** – Potable water shall be introduced into the pipe main at a constant flow rate. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is a least 50mg/L. The chlorinated water shall remain in the main at least 24 hours, after which, the chlorine concentration in the water shall be at least 10mg/L. All valves and appurtenances shall be operated while the chlorinated water remains in the main.

C. **Bacteriologic Tests - General**: Before the water main is placed in service, all samples shall be collected at regular intervals not exceeding 1,200 feet and

tested for bacteriologic quality and shall show the absence of both background growth and coliform organisms.

Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate. A chain of custody shall accompany the samples delivered to the Water Treatment laboratory. Test results cannot be read until **48** hours after sample has been run by lab. If laboratory results indicate the presence of coliform bacteria, the samples are unsatisfactory. If laboratory results indicate background growth masking the detection of coliform bacteria, the sample will be considered unsatisfactory. If the line fails the second sampling, the main shall be re-chlorinated by the contractor and new tests performed prior to moving to the next section of main. Cleaning and disinfecting will be the responsibility of the contractor. City will furnish necessary water for these operations. The contractor shall be responsible for loading, hauling, discharging of water, and dechlorinating device.

Samples for bacteriological analysis shall be collected for each section of pipe between main line valves after flushing is completed or as directed by the City representative.

Primary sampling points are blow-offs, 2-inch setters and all fire lines. Sampling will be allowed at hydrants if available to flush and sample the entire section of newly laid pipe. Otherwise, the contractor shall install a flushing and sampling tap consisting of a corporation cock installed in the pipe with a temporary copper pipe. Such additional work required for this shall be at the contractor's expense and is to be properly abandoned in place, after acceptance, by the placement of a repair clamp.

D. **New Water Mains Disinfection and Purity Testing - Procedure**

STEP 1: Disinfection

The contractor is responsible for furnishing all taps and materials required to satisfactorily disinfect the water system. The following steps will be completed by City and the Contractor cooperatively.

1) The City's inspector will witness the flushing of the section of main to be disinfected until the water appears clear.

   The contractor is responsible for adequate disposal of the large volumes of water generated from flushing and dechlorinating device.

2) The contractor will inject a chlorine solution as specified in Section 4 of the AWWA Standard C651, latest revision, into the water main.

   a. Do not use manually operated pumps to inject the solution into the main.
   b. The chlorine solution shall result in a chlorine concentration of 50 ppm or greater.
   c. The chlorine solution should be injected in the section of main nearest an existing water main.

3) The City's Inspector will draw water from the following areas until at least 50 ppm chlorine concentration has been measured at all points of discharge at which time each point will be closed:
    - end of the main
    - hydrants
    - lateral lines
    - other connections

    a. The City's Inspector will close all control valves feeding water into the main.
    b. The chlorine concentration shall not drop below 20 ppm within a minimum period of 24 hours.
    c. Sometime after the 24-hour period expires, the City's inspector will check the chlorine concentration to confirm that it has not dropped below 20 ppm.

STEP 2: Preparing for Purity Testing

The contractor is responsible for furnishing all material and constructing sample points.

1) The Contractor is responsible for preparing a Sampling Log that includes a sketch of sampling points.

2) The contractor must ensure that each sample point terminates horizontally at least 18" above ground level.

3) **SAMPLES WILL NOT BE TAKEN FROM A HOSE.**

Samples are to be taken on Monday through Thursday, no later than 1:00 PM.

STEP 3: Purity Testing

The Contractor is responsible for collecting and submitting samples to the City of Wilson Water Treatment Facility laboratory. Samples cannot be collected if any type of precipitation is falling.

SAMPLING

1) Before chlorinating is performed, the Contractor will first flush the new water main. The main must be flushed so that two volumes of water pass through the main.

2) The City's inspector will check both chlorine concentration.

    a. The chlorine concentration must be less than 4ppm for consumption purposes but greater than or equal to 0.2 ppm free chlorine for testing purposes.

If the chlorine concentration is not within these limits, the Contractor must flush and rechlorinate the water line and resample at a later date.

3) If the chlorine concentration is within limits, the Contractor will collect samples from the new main and from an approved/control water main in the distribution system.

   Obtaining a control sample allows the laboratory to compare the water quality in the distribution system with that in the new water main.

4) On the day of collection, the Contractor will deliver the collected sample to the City's Water Treatment Facility laboratory. Samples may be delivered only Monday through Thursday no later than 1:00 PM.

5) The laboratory personnel will conduct a total coliform test using the Colilert® method. The test must yield a negative plate count. This test requires 48 hours of incubation before the result is obtained.

6) The test results must be negative for fecal coliform.
   a. If the samples from the water main are positive, the main must be disinfected again which means Step 1 must be repeated in its entirety. This will prolong testing.
   b. In the rare event that the samples from the control main are positive, the control main must be flushed and resampled at a later date. This will prolong testing.

E. Dechlorination: No discharge of heavily chlorinated water into a storm sewer or a stream will be permitted unless the discharge is first treated by a neutralizing chemical applied to the water to be wasted to neutralize throughly the residual chlorine. A dechlorinating device is required. Disposal of heavily chlorinated water shall meet the applicable sections of AWWA C651, latest revision.

3.5 FINAL ACCEPTANCE

Upon completion of water main installations and prior to acceptance, the Contractor shall provide adequate and competent personnel to conduct, in conjunction with City, an inspection of each valve and hydrant on the newly completed main. The purpose of this inspection shall be to ensure the operability and location of each valve and to further ensure that all valves are left in the open position.

Fire hydrants shall be greased and painted.

Flow tests are to be performed on each hydrant to verify both that flows are in line with the design flows and that all line and leg valves are open.

Upon receipt of State Certification, the main valve serving the new section of main(s) shall be turned on and placed into service.

AWWA C600-10 TABLE 4A
HYDROSTATIC TESTING ALLOWANCE PER 1,000 FT OF PIPELINE
(U. S. gallons per hour)

(This table is excerpted from AWWA C600-10, Section 5.2 Table 4A)

AVG. TEST PRESSURE PSI	NOMINAL PIPE DIAMETER-IN.																
	2	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450	0.29	0.43	0.57	0.86	1.15	1.43	1.72	2.01	2.29	2.58	2.87	3.44	4.30	5.16	6.02	6.88	7.74
400	0.27	0.41	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70	3.24	4.05	4.86	5.68	6.49	7.30
350	0.25	0.38	0.51	0.76	1.01	1.26	1.52	1.77	2.02	2.28	2.53	3.03	3.79	4.55	5.31	6.07	6.83
300	0.23	0.35	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21	4.92	5.62	6.32
275	0.22	0.34	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03	4.71	5.38	6.05
250	0.21	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85	4.49	5.13	5.77
225	0.20	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65	4.26	4.86	5.47
200	0.19	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44	4.01	4.59	5.16
175	0.18	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22	3.75	4.29	4.83
150	0.17	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98	3.48	3.97	4.47
125	0.15	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72	3.17	3.63	4.08
100	0.14	0.20	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43	2.84	3.24	3.65

[a]**AWWA C600-10** ***Installation of Ductile-Iron Mains and Their Appurtenances*****.**

[b]**The testing allowance shall be defined as the quantity of water that must be supplied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure.**

[c]**If the pipeline under test contains sections of various diameter, the allowable leakage will be the sum of the computed leakage for each size.**

TABLE 2
AWWA C605-05[a] TABLE 2
HYDROSTATIC TEST MAKEUP WATER ALLOWANCES[b] PER 1,000 FT OF PVC PIPE[c]

(U.S. gallons per hour)

(This table is excerpted from AWWA C605-05, Section 7.3, Table 2)

AVG. TEST PRESSURE (PSI)	NOMINAL PIPE DIAMETER-IN.													
	4	6	8	10	12	14	16	18	20	24	30	36	42	48
300	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21	4.92	5.62
275	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03	4.71	5.38
250	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85	4.49	5.13
225	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65	4.26	4.86
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44	4.01	4.59
175	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22	3.75	4.29
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98	3.48	3.97
125	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72	3.17	3.63
100	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43	2.84	3.24
75	0.23	0.35	0.47	0.59	0.70	0.82	0.94	1.05	1.17	1.40	1.76	2.11	2.46	2.81
50	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.96	1.15	1.43	1.72	2.01	2.29

[a]AWWA C605-05 ***Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water*****.**

[b]The testing allowance shall be defined as the quantity of water that must be supplied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure.

[c]If the pipeline under test contains section of various diameters, makeup water allowance will be the sum of the test allowance for each size.

City of Wilson
Water Pressure Test Report

Location: _____

Test Made by: _____ Time: _____ Date: _____

Test Requested by: _____

Make of Hydrant: _____

Nozzle Size: _____

Static Pressure: _____ psi

Residual Pressure: _____ psi

	Hydrant #1	Hydrant #2	Hydrant #3
Pitot Reading:			
Flow (GPM):			

Sketch:

END OF SECTION 02510

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02530 – SANITARY SEWER

(Last revised 9/1/19) R5

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

The latest edition or version of the following shall apply:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. American Concrete Institute (ACI) 308, *Guide to Curing Concrete*

C. American Concrete Institute (ACI) 318, *Building Code Requirements for Structural Concrete*

D. AWWA C600: *Standard for Installation of Ductile-Iron Water Mains and their Appurtenances*

E. AWWA C900-16: *Pressure Pipe and Fabricated Fittings (4" through 60") for Water Distribution*

F. AWWA C906: *Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. for Waterworks*

G. City of Wilson *Pre-Approved Material/Product List*

H. City of Wilson *Right-of-Way Regulations and Procedures*, latest edition

I. National Electrical Code (NEC)

J. National Electrical Manufacturers Association (NEMA)

K. North Carolina State Building Code: *Building Code*, Section 1609 *Wind Loads*

L. North Carolina State Building Code: *Plumbing Code*

M. Section 02275 – TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES.

N. Standard Rules of American Institute of Electrical Engineers

O. Uni-Bell Handbook, Latest Edition

P. UNI-B-6: *Installation Guide for Solid-Wall PVC Sewer Pipe*

Q. Uni-B-6-98: *Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe*

R. UNI-B-9-90: *Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4-48 inches)*

S. UNI-PUB-06: *Installation Guide for PVC Solid-Wall Sewer Pipe (4-60 inch)*

T. UNI-PUB-09: *Installation Guide for PVC Pressure Pipe*

1.2 SUMMARY

A. This section includes sanitary sewer piping and specialties for municipal sewer and services outside of building structures.

1.3 DEFINITIONS

For the purposes of this specification, the following definitions refer to sanitary sewer collection and pressure systems that come under the authority of City of Wilson as specified within this section and other sections of this manual.

A. **City Engineer**: The City Engineer or his or her authorized representative.

B. **City**: Refers to the City of Wilson.

C. **Cleanouts**: A riser pipe off of a service line that provides access to the line for the purpose of line cleaning.

D. **Contractor**: Refers to a Contractor licensed in the State of North Carolina to perform public utility construction.

E. **Force Main**: Pressurized sanitary sewer main.

F. **Lift/Pump Station:** A combination wetwell/pump station and appurtenances.

G. **Easement**: An instrument that depicts/describes and conveys rights and privileges to the City for the placement, access to and maintenance of a utility line across and/or on the property of a second party. Ownership of the land remains with the second party.

H. **Interceptor/Outfall**: Sewer that receives flow from a number of gravity mains or trunk sewers; usually placed along a stream or river. Ordinarily, interceptors are not permitted to be tapped except at existing or new manholes.

I. **Main or Trunk Sewer**: Exterior gravity sanitary sewer systems receiving flow from one or more laterals or mains.

J. **Public Sanitary Sewer System**: Any sewer facility or line owned and maintained by the City of Wilson.

K. **Sewer Service**: Exterior domestic sewer piping serving a private residence, business, commercial facility, or industrial user. This line beyond the right-of-way, easement line, or cleanout in its entirety, belongs to the customer/user for operation and maintenance.

L. **Shall**: Means a mandatory requirement.

M. **Wastewater Collection ORC**: The City's "Operator in Responsible Charge" over the City of Wilson's wastewater collection system; a manager in the Water Resources Department.

N. **Director of Water Resources:** The City's Director of Water Resources, Water Distribution ORC or their authorized representative.

O. The following are industry abbreviation for various pipe materials:

1) **AC**: Asbestos Cement Pipe
2) **CI**: Cast Iron Pipe
3) **DIP**: Ductile Iron Pipe
4) **HDPE:** High Density Polyethylene
5) **RCP**: Reinforced Concrete Pipe
6) **PVC**: Polyvinyl Chloride Pipe

1.4 PERFORMANCE

A. Gravity Flow, Nonpressure Piping Pressure Ratings: At least equal to the system test pressure.

B. Force Main Pressure Ratings: At least equal to the system operating pressure plus 50 psi, but no less than 150 psi.

1.5 SUBMITTALS

A. Submit product data for the following. For third party projects, the Developer/Project Engineer shall perform all product review/certification and make a submittal at the end of the project to the City. The engineer shall be duly licensed in North Carolina.

1) Piping Specialties.
2) Air & vacuum release valves and accessories.
3) Autodialers.
4) Sewage Pumps and appurtenances, operating manuals.
5) Auxiliary Generators.
6) Alarm Devices.
7) Precast Concrete Manhole Castings.
8) Piping Paint.

B. Submit shop drawings for the following:

1) Precast Concrete Vaults and wetwells, including frames and covers, ladders, drains, access hatches, wall sleeves, valve support stands, pumps, and motors.

C. **Coordination Drawings**: Show manholes and other structures in vicinity, pipe sizes and elevations, elevations of lift station elements such as influent lines, floats, etc.

D. **Computations**:

1) Buoyancy calculations for wetwells, manholes, interceptor/outfalls, and mains with shallow cover.

2) Provide structural calculations for any elevated main and pier system where span of the main exceeds the joint length. Provide calculations for all aerial mains, and their supporting structures that are subject to hydrodynamic forces.

E. **Bypass Pumping**: Bypass pumping operations must be approved by the City before starting. Provide a detailed written plan of how the bypass pumping operation shall be performed two weeks prior to the operation. See Section 3.6 of this specification.

F. **Project Closeout**: Submit 3 copies of manufacturer's maintenance and operation manuals on all sewage pumps and/or package lift stations and appurtenant devices.

1.6 QUALITY ASSURANCE

A. Materials and operations shall comply with the latest revision of the Codes and Standards listed in Section 1.7, below.

B. Piping materials shall be marked clearly and legibly.

1) Ductile Iron Pipe shall show on or near bell:

a. Weight,
b. Class or nominal thickness,
c. The letters "DI" or "Ductile,"
d. Manufacturer's identifying mark,
e. Year in which pipe was made, and
f. Casting period.

2) PVC pipe shall show identification marks, at intervals not to exceed 5 feet, as follows:

a. Nominal pipe diameter,
b. PVC cell classifications,
c. Company, plant, shift, ASTM, SDR and date designation,
d. Service designation or legend.

e. All PVC pipe shall bear the National Sanitation Foundation seal of approval.

3) Steel pipe shall be marked as follows. Each length of pipe and each special section shall be legibly marked by paint stenciling, die stamping or hot-roll marking to show the following:

a. Manufacturer's name or mark,
b. Size and weight of the pipe or special section,
c. The type of steel from which the pipe or special section was made.

C. *Gravity Sanitary Sewer Design and Construction*, ASCE Manuals and Reports on Engineering Practice – NO. 60, WPCF Manual of Practice NO. FD-5.

D. AWWA C600: Installation of Ductile Iron Water Mains and Appurtenances.

E. NC Department of Environmental Quality (NCDEQ), Division of Water Resources, NCAC Title 15A 2T *Waste Not Discharged to Surface Waters*, latest revision.

1.7 QUALITY STANDARDS

A. Materials and operations shall comply with the latest revision of the Codes and Standards listed within this specification. The use of ASTM standard specification references without a year designation implies the most current applicable specification.

B. Standard Abbreviations:

AASHTO	American Association of State Highway Transportation Officials.
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
ANSI	American National Standards Institute
AREA	American Railway Engineers Association
ASCE	American Society of Civil Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
CRSI	Concrete Reinforcing Steel Institute
FS	Federal Specifications

MSDS	Material Safety Data Sheets
NCDEQ	North Carolina Department of Environmental Quality
NCDOT	North Carolina Department of Transportation
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NSF	National Sanitation Federation International
OSHA	Occupational Safety and Health Administration
UL	Underwriters Laboratories, Inc.
WEF	Water Environment Federation

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

Materials used for the construction of gravity sewer, pressure mains and appurtenances in the City's sewer collection system shall be new, free of defects, and meet the highest standards set forth. The City's authorized representative must inspect, review, and approve all materials to be used for sewer main and appurtenances prior to installation. At the option of the City, any material installed without inspection will have to be sufficiently removed for inspection and review. Any additions, deletions, or changes from the City's approved plan set must be submitted to the City for approval, prior to making changes in the field.

A. **PIPE CONDITION/PIPE EXAMINATION:**

1) **New Pipe Inspection**: Inspect materials thoroughly, including the interior, upon arrival. Examine materials for damage and to ensure that the right pipe has been delivered to the site. Remove damaged or rejected materials from site. Pipe shall be protected during handling against impact shocks and free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM Specifications.

2) **Pre-Installation Inspection**: Prior to being installed, each section of the pipe shall be carefully examined for damage and conformity with these specifications. All pipe damaged or deemed not to conform to these specifications shall be rejected and removed from site. All pipe in which the spigots and bells cannot be made to fit properly, or pipe, which has chipped bells or spigots, will be rejected. The faces of all spigot ends and all shoulders or sockets on the bells must be true. Examine bell and spigot for uniformity and smoothness of liner and barrel.

B. Protect pipe coating during handling using methods recommended by the manufacturer. Use of bare cables, chains, hooks, metal bars, or narrow skids in contact with coated pipe is not permitted.

C. Prevent damage to pipe during transit. Repair abrasions, scars, and blemishes to the satisfaction of the City. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

D. Observe manufacturer's directions for delivery and storage of materials and accessories.

E. Protect stored piping from entry of water or dirt into pipe. Protect bells and flanges of special fittings from entry of moisture and dirt.

F. Support pipe to prevent sagging or bending as recommended by manufacturer. Do not store plastic pipe, structures, and fittings in direct sunlight for more than one week.

G. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

H. Construct piping to accurate lines and grades and support as shown in drawings or prescribed in specifications. When temporary supports are used, ensure that sufficient rigidity is provided to prevent shifting or distortion of pipe.

1.9 PRODUCT SUBSTITUTIONS

The City Engineer or Water Resources will approve materials not specified but deemed equal, on a case-by-case basis. The City's Product and Design Review Committee (PDRC) meets monthly or on an "as-needed" basis to evaluate new products for incorporation into these specifications. If submitting new products, submit in accordance with Section 00825 *Product Substitution*. New materials approved for the sewer collection system will be incorporated into these specifications after approval by the PDRC.

1.10 PROJECT CONDITIONS

1.10.1 SEPARATION OF WATER AND SANITARY AND/OR STORM SEWERS

A. Follow the NCDEQ standards for separation of water mains and sanitary sewers lines. The following separations pertain to potable water mains. See also 15A NCAC 02U .0403 *Design Criteria for Distribution Lines,* 15A NCAC 02T .0305 *Design Criteria* and .0909 *Design Criteria for Distribution Lines* for requirements relating to other reclaimed water mains separation requirements for both potable water and sanitary sewer mains. See also **Standard Detail C01.04**.

B. **PARALLEL INSTALLATIONS:**

1) **Preferred/Normal Conditions** – Sewer mains or sewer manholes shall be constructed at least 10 feet horizontally from water lines whenever possible. The distance shall be measured edge-to-edge.

2) **Unusual Conditions** – When local conditions prevent a horizontal separation of at least 10 feet, the sewer main or sanitary sewer manhole may be laid closer to a water line provided that:

a. The sewer line shall be placed in a separate trench, with elevation of the top of the sewer line at least 18 inches below the bottom of the water line; or

b. The sewer shall be placed in the same trench as the water, and located to one side, on a bench of undisturbed earth, and the elevation of the top of the sewer line at least 18 inches below the bottom of the water main; or

c. If it is impossible to obtain proper horizontal and vertical separation as described above or anytime the sewer line is above the water main, both the water main and sewer line must be constructed of DIP complying with public water supply design standards and must be pressure tested to 150-psi to assure watertightness before backfilling. The sewer manhole shall be of watertight construction and tested in place.

C. **SEWER MAINS CROSSING BELOW WATER MAINS:**

1) **Preferred/Normal Condition** – Sewer line shall be constructed to cross below water lines whenever possible and shall be laid to provide a vertical separation of at least 18 inches between the bottom elevation of the water line and the top of the sewer.

2) **Unusual Conditions** – When local conditions or barriers prevent an 18-inch vertical separation as described in *Preferred/Normal Conditions* (paragraph immediately above), one of the following construction methods shall be used:

a. Both the water main and sewer line shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. Both the water main and sewer shall be pressure tested at 150-psi to assure water tightness before backfilling.

or

b. Either the water main or the sewer main may be encased in a watertight encasement pipe which extends 10 feet on both sides of the crossing, measured perpendicular to the water main. The encasement pipe shall be of materials approved by NCDEQ for use in water main construction (e.g. DIP, steel). If the sewer main is encased, the DIP sewer carrier pipe shall be DIP continuous from manhole to manhole. If the water main carrier pipe is encased, the water shall be constructed of either DIP or PVC meeting these specifications.

D. **SEWER MAINS CROSSING ABOVE WATER MAINS:**

1) **Unusual Conditions** – When local conditions prevent an 18 inch vertical separation, as described in paragraph C, *Sewer Mains Crossing Below Water Mains*, *Preferred/Normal Condition*, above, the following construction shall apply:

a. Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing. Both the water main and sewer shall be pressure tested at 150-psi to assure watertightness

before backfilling. The sewer line shall be ductile iron from manhole to manhole.

b. Provide adequate structural support for the sewers to prevent excessive deflection of the joints, which can result in settling on and/or breaking the water line.

E. **SEWER MAINS AND OTHER UTILITIES:**

1) **Horizontal Separation – Preferred/Normal Condition** – Sewer lines shall be constructed to provide at least a 10-foot of horizontal separation from a water main and 3 feet of horizontal separation from other utilities whenever possible. The distance shall be measured edge-to-edge.

a. Reclaimed water mains shall be constructed with a 2-foot minimum horizontal separation from a sewer main or manhole.

2) **Vertical Separation – Preferred/Normal Condition** – Whenever it is necessary for storm sewers or another utility (excluding reclaimed water) to cross a sewer main, a 24-inch vertical separation shall be maintained between the lines (see paragraph H, *Storm Drainage System*) for vertical clearances between sanitary sewers and storm sewers). When local conditions prevent a 24-inch vertical separation, the following construction shall apply:

b. For storm sewers, engineering solutions such as Ductile Iron Pipe or structural bridging to prevent crushing of the underlying pipe shall be employed.

c. Similarly, for other utilities, provide adequate structural support for the utility to prevent excessive deflection of the joints, which can result in settling on and/or breaking the sewer line.

d. The sewer line shall be constructed of AWWA approved Ductile Iron Pipe and shall be continuous from manhole to manhole.

e. Reclaimed Water Mains: Reclaimed water mains shall be constructed with at least an 18-inch vertical separation with the reclaimed water mains above the sewer mains.

f. Gas: Sanitary sewers crossing gas mains 6 inches and larger shall be constructed of DIP and shall run continuous from manhole to manhole.

F. **SANITARY SEWER MANHOLES**: No water main shall be allowed to pass through or come in contact with any part of a sewer manhole. A minimum of 3 feet of horizontal separation shall be maintained between water mains and sanitary sewer manholes provided that the applicable provisions of paragraph B, *Parallel Installations, Unusual Conditions*, above, are also met.

G. **SANITARY SEWER AND WATER SERVICES**: DWQ permits the collection system, not the taps into the sewer main except in the case of private permits. The Minimum Design Criteria for Gravity Sewers does not mention taps nor are they

shown on the as-built drawing plan and profiles. As such, 15 NCAC 02T rules define a sewer service as follows:

> *Building Sewer* means that part of the drainage system that extends from the end of the building drain and conveys the discharge from a single building to a public gravity sewer, private gravity sewer, individual sewage disposal system or other point of disposal.

The NC State Plumbing Code has an identical definition. Consequently, the separation requirements for water and sewer services fall under the requirements the *NC State Building Code: Plumbing Code (IPC with North Carolina Amendments),* Section 603.2 *Separation of Water Service and Building Sewer*, latest revision. Those provisions are generally as follows:

a. Water service pipe and the building sewer shall be separated by 5 feet of undisturbed or compacted earth.

b. A minimum 12-inch vertical separation with bottom of water above top of sewer and pipe material meets the provisions of this specification.

c. Water can be located in same trench with sewer if pipe material meets the provisions of this specification.

d. Separation is not required if water is sleeved to a point 5 feet either side of the sewer centerline with pipe material meeting Table 605.3, Table 702.2 or Table 702.3 of the NC State Building Code: Plumbing Code, latest revision.

H. **STORM DRAINAGE SYSTEM**: Sewers shall have a minimum horizontal separation of 10 feet from surface drainage ditches, streams, lakes or impoundments. A 24-inch vertical separation shall be provided between a storm sewer and a sanitary sewer line. If unable to meet this separation, DIP sewer must be specified with the DIP running continuous from manhole to manhole. See 15A NCAC 02T .0305 for other setbacks pertaining to reservoirs used as a source of drinking water and certain other classified waters.

A distance of 50 feet shall be maintained between sewers and water classified as wetlands.

No gravity sewer or sewer lateral shall pass through a storm drain pipe or manhole system unless a hardship is proven to exist.

I. **NEW UTILITIES AND EXISTING SEWER MAINS**: When installing a new utility adjacent to or in close proximity to an *existing* sewer main, the new utility line shall be installed to provide the minimum horizontal and vertical clearances specified in paragraph E, *Sewer Mains and other Utilities*.

J. **PROTECTION OF WELLS** – A distance of 100 feet shall be maintained between any private well and a gravity sewer, force main or manhole structure. If this separation cannot be maintained, DIP with joints equivalent to public water supply design standards and pressure tested to 150-psi to assure weathertightness, shall be used. However, given the sewer meets these requirements, no gravity sewer,

force main, or manhole structure shall pass or be placed within 25 ft of a private well or 50 feet of a public water supply well, source or structure.

1.11 SERVICE INTERRUPTION

A. Contact the City to coordinate interruption of services. If interruption is necessary, the interruption shall be arranged to occur at such a time to cause the least disruption and minimize loss of service. At the direction of the City Engineer, or Water Resources temporary service may be required to be provided. Provide a minimum of 48 hours' notice of the proposed utility interruption.

1.12 COORDINATION

A. Coordinate tie-in to municipal sewer mains and manholes with the City Engineer who will arrange with Water Resources. Connections to the City's sewer systems (manholes, wetwells, force mains or any other part of the sewer system) must be witnessed by a representative of the City; otherwise, the City will not accept the new system.

B. Service is to be continuously maintained to customers in the project areas except for the minimum amount of time required to make connections with the existing system. At the direction of the City Engineer or Water Resources, temporary pumping/bypass of sewerage flow may be required to be provided. See paragraph 3.6, Bypass Pumping for bypass pumping requirements and procedure.

C. When traffic signals, loops, or their appurtenances are likely to be damaged or interfere as a result of the construction, coordinate temporary operation with the applicable agency having jurisdiction of the signals. Provide a minimum of a 1-week notice prior to anticipated disturbance or interruption. At the discretion of the City Engineer or Water Resources, the notice may be required to be published in the newspaper.

D. **Repair of pavement markings**: When cuts are made through any paved surface and the cuts extend through the pavement markings, the replaced pavement shall be marked to match the existing.

E. Contact ***"NC One Call"*** at 811 before digging.

Know what's **below.** **Call** before you dig.

PART 2 – PRODUCTS

2.1 PIPE & FITTINGS

The following references provide the minimum standards as they apply to the specific item listed. In all cases, the latest revision shall apply.

2.1.1 DUCTILE IRON PIPE

Ductile iron pipe shall be Grade 60-42-10 and manufactured in accordance with all applicable requirements of AWWA C151/ANSI A21.51 *American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water* and ASTM A746, *Standard Specification for Ductile Iron Gravity Sewer Pipe* for 8-inch and larger diameter pipe, thickness class rated, class 50 minimum. The thickness of Ductile

Iron Pipe shall be determined by considering trench load in accordance with ANSI C150 and AWWA A21.50. (Public Sewers shall be no less than 8-inch diameter).

Interior Lining:

Lining shall be 100% solids, ceramic epoxy lining that is abrasion-resistant and specifically designed for wastewater immersion and fume environments. Lining shall provide low permeation to H_2S gas, protect against microbiological influenced corrosion (MIC), and provide chemical resistance to ductile iron pipe and fittings for severe wastewater.

Unless otherwise permitted herein, all internal surfaces of ductile iron pipe and fittings shall be lined with Tnemec Series 431 Perma-Shield PL, a 100% solids epoxy liner, for sewer pipe only. Series 431 Perma-Shield PL is a modified polyamine ceramic epoxy containing 20% by volume of ceramic microspheres for abrasion resistance (no silica fume, fly ash, or alumina dust). Pipe to be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface. All oils, small deposits of asphalt paint, grease, and soluble deposits shall be removed in accordance with NAPF 500-03-01 Solvent Cleaning prior to abrasive blasting. Surface shall be coated within eight hours of surface preparation. Dry finish thickness to be 40 mils minimum and 60 mils maximum. Finish is to be glossy 5024 Sewer Pipe Green.

SewperCoat Alternate: SewperCoat calcium aluminate mortar lining, as manufactured by Lafarge Calcium Aluminates (or approved equal), is an acceptable alternative to Tnemec Series 431 Perma-Shield PL when pipe is to be used for sewer only. SewperCoat is a calcium aluminate mortar made of fused calcium aluminate cement and fused calcium aluminate aggregates. The thickness of the lining shall be the thickness identified on AWWA C104, Sec. 4.7, paragraph 4.7.1, latest revision but no less than 0.125 inch for 6-inch through 12-inch and 0.1875 inch for 14-inch through 24-inch pipe. The lining thickness may taper to less than the specified at the ends of the pipe. Cracks, other than closed hairline cracks and/or fine crazing shall not be acceptable. Loose areas of cement lining are not allowable. A seal coat shall be applied to the lining as identified on AWWA C104, Sec. 4.11.

Protecto 401 Ceramic Epoxy Alternate: Protecto 401Ceramic Epoxy lining, as manufactured by Induron Protective Coatings (or an approved equal), is an acceptable alternative to Tnemec Series 431 Perma-Shield PL.

Lining Material

Protecto 401 Ceramic Epoxy material shall be an amine cured novolac epoxy containing at least 20% by volume of ceramic quartz pigment. Lining material minimum requirements:

- Pipe Preparation Prior to Lining: Prior to lining, all pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface. The entire interior of the ductile iron pipe and fittings shall not have been lined with any substance prior to application of the

Protecto 401 lining and no coating shall have been applied to the first 6 inches of the exterior of spigot ends.

- Protecto 401 shall have a permeability rating of 0.00 when tested according to Method A of ASTM E96, Procedure A with at test duration of 30 days.

- After surface preparation and within 12 hours of surface preparation, the interior shall receive 40 mils nominally dry film thickness when pipe is to be used for sewer only. No lining shall take place when the substrate or ambient temperature is below 40 degrees F. The surface must be dry and dust free. When flange pipe or fittings are included in the project, the lining shall not be used on the face of the flange.

- Abrasion Resistance: No more than 3 mills loss after one million cycles using European Standard EN 598: 1994 Section 7.8 Abrasion Resistance.

- Coating of Bell Sockets and Spigot Ends: Due to the tolerances involved, the gasket area and spigot end up to 6 inches back from the end of the spigot end must be coated with 6 mils nominal, 10 mils maximum using Protecto 401 Joint Compound. The Joint Compound shall be applied by brush to ensure coverage. Care should be taken that the Joint Compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be done after the application of the lining.

- Touch-Up and Repair: Protecto 401 Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.

- Protecto 401 is not for use as a Potable Water Lining.

Outside Coating:

Outside coat shall be a minimum of 1 mil bituminous paint according to ANSI/AWWA C151/A21.21 Section 51-8.1.

Each joint of ductile iron pipe shall be hydrostatically tested, before the outside coating and inside lining are applied, at the point of manufacturer to 500 psi. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture or leakage of the pipe wall.

All materials used in production of the pipe are to be tested in accordance with AWWA C151 for their adequacy within the design of the pipe, and certified test results are to be provided to the City upon request. All certified tests, hydrostatic and material, are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.

Push-on and mechanical joint pipe shall be as manufactured by the American Cast Iron Pipe Company, McWane Ductile, United States Pipe and Foundry Company.

Handling:

Line pipe and fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying. The pipe shall not be dropped or unloaded by rolling.

Care should be taken not to let the pipe strike sharp objects while swinging or being off loaded. Ductile iron pipe should never be placed on grade by use of hydraulic pressure from an excavator bucket or by banging with heavy hammers.

B. **DUCTILE IRON JOINTS:**

Pipe joints may be either push-on or mechanical joint pipe sizes 8 inches through 48 inches in diameter. Rubber Gasket Joints and Mechanical Joints shall comply with AWWA C111/ANSI A21.11, *American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*, ASTM A536 *Standard Specification for Ductile Iron Castings*. Acceptable pipe joints are as follows:

1) **Push-on Joint, Ductile Iron Pipe** shall conform to AWWA C151/ANSI A21.51 *Ductile-Iron Pipe, Centrifugally Cast, for Water* (such as *"Fastite," "Tyton,"* or *"Bell-Tite."*). The dimensions of the bell, socket, and plain end shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be of such size and shape to provide an adequate compressive force against the plain end and socket after assembly to affect a positive seal. Gaskets shall be vulcanized natural or vulcanized synthetic rubber, and comply with AWWAC111/ANSI A21.11 *American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*.

2) **Mechanical Joint, Ductile Iron Pipe** shall be used only at the specific locations indicated on the drawings or as approved by the City.

   a. The mechanical joint shall consist of:

      i. A bell cast integrally with the pipe or fitting and provided with an exterior flange having cored or drilled bolt holes and interior annular recesses for the sealing gasket and the spigot of the pipe or fitting;

      ii. A pipe or fitting spigot;

      iii. Mechanical Joint Gaskets to be plain rubber (Styrene Butadiene [SBR]) per AWWA C111/ANSI A21.11;

      iv. Separate ductile iron follower gland having cored or drilled bolt holes; and

      v. Alloy steel Tee Head bolts and hexagon nuts. All threads are Coarse-Thread Series Class 2A, External and Class 2B, Internal, per ANSI B1.1. Nuts to be furnished in accordance with ASTM A563, *Standard Specification for Carbon and Alloy Steel Nuts*.

   b. The joint shall be designed to permit normal expansion, contraction, and deflection of the pipe or fitting while maintaining a leak proof joint connection. The mechanical joint shall conform to the requirements of Federal Specification WW-P-421 and AWWA C111/ANSI A21.11.

   c. **Mechanical Joint Bolt Torque**: See Section 3.1.2, paragraph B, *Mechanical Joint Bolt Torque*, below.

C. **DUCTILE IRON FITTINGS:**

Fittings shall be ductile iron at least class 54 thickness and shall conform to AWWA C110/ANSI A21.10 *American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids* or AWWA C153/ANSI 21.53 *American National Standard for Ductile-Iron Compact Fittings, 3-inch through 24-inch and 54-inch through 64-inch, for Water Service,* pipe sizes 4 inches through 48 inches with the exception of manufacturer's proprietary design dimensions and thicknesses for iron, in accordance with AWWA C110/ANSI A21.10. All ductile iron fittings shall have a minimum working pressure rating of 350 psi and minimum iron strength of 25,000 psi. All fittings shall be lined with the same type coating as being provided with the pipe. *Do not mismatch pipe to fitting coatings.* See paragraph 2.1.1, above. The fittings shall be tested and the manufacturer shall provide certified test results when requested by the City. This testing shall include hydrostatic proof testing of fittings. Glands, gaskets, and bolts shall conform to AWWA C111/ANSI A 21.11 *Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*. Acceptable types of fittings include Push-On Joint and Mechanical Joint.

1) **Full Body Mechanical Joint Fittings:** Full body ductile iron mechanical joint fittings shall conform to AWWA C110/ANSI A21.10. Glands, Gaskets and Bolts shall conform to AWWA C111/ANSI A21.11.

2) **Mechanical Joint Fittings – Compact:** Compact fittings shall comply with AWWA C153/ANSI A21.53. Glands, Gaskets and Bolts shall conform to AWWA C111/ANSI A21.11.

3) **Mechanical Joint Restraint Systems:** Mechanical joint restraint systems shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWA C110/A21.10. Mechanical joint restraint systems (gland body, wedges and wedge actuating components) shall be constructed of grade 65-45-12 ductile iron material in accordance with ASTM 536. For applications requiring restraint 30 inches and greater, an alternate grade of iron meeting the material requirements of ASTM A536 is acceptable provided the device meets all the end product performance requirements. An identification number consisting of the year, day, plant and shift, shall be cast into each gland body. Sizes 3-inch through 16-inch shall be rated at 350-psi minimum working pressure and sizes 18 inches and larger rated at 250-psi minimum working pressure. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes. Bolt heads are to be "auto-torque" twist off. Mechanical joint restraint systems shall accommodate all classes of ductile iron pipe (pressure class 350 through pressure class 150 and class 56 through 50) and appurtenances such as valves and hydrants without damage to the fitting, pipe or cement linings. Consult with manufacturer when use is intended for grey iron pipe. All components shall be manufactured and assembled in the United States. See **Standard Detail 512.07** for a common application of the restraint system.

   See Pre-Approved Product List for acceptable manufacturers and models of mechanical joint restraint systems.

2.1.2 PVC PIPE

A. **PVC SOLID WALL PIPE AND FITTINGS (GRAVITY PIPE)**

1) **PVC Solid Wall Gravity Pipe**: PVC Solid Wall Sewer Gravity Pipe and Fittings, Bell and Spigot Joints shall comply with ASTM D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings, SDR 35 minimum (8 inches - 15 inches). Pipe shall be made of PVC plastic having a cell classification of 12454 B or 12454 C or 12364 C or 13364 B, with a minimum tensile modulus of 500,000 psi as defined in ASTM D1784, *Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds*, and shall be appropriately marked. Laying lengths shall be a minimum of 12.5 feet for pipes 15 inches or less and 11 feet for the pipes greater than 15 inches.

   PVC pipe strength shall be capable of withstanding stiffness, flattening, and impact test as scheduled or referenced in ASTM D3034 or ASTM F949. Smooth wall pipe shall have a Standard Dimension Ratio (SDR) of 35 or less. All PVC pipe shall have a minimum pipe stiffness of 46 psi when measured at 5 percent vertical ring deflection and tested in accordance with ASTM F477, *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*.

   With the exception of services, PVC Fittings shall not be used with pipes 8 inches and larger in diameter.

2) **PVC GRAVITY PIPE JOINTS:** Joints for solid wall PVC sewer gravity pipe and fittings and elastomeric flexible seals (Gaskets) shall be compatible with pipe and shall meet the requirements of ASTM D3212 *Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals*. Rubber Gaskets shall be used which conform to the requirements of ASTM F477, *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*.

B. **C900 PVC PIPE FOR GRAVITY SEWER AND SEWER FORCE MAINS (4-inch through 24-inch)**

1) C900-16 PVC gravity and pressure pipe, 4-inch through 24-inch, with bell end with gasket and spigot end shall comply with AWWA C900, Pressure Class 165, DR 25. Pipe shall also meet ASTM D2122, *Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings*, and ASTM D3139, *Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals*. Pipe shall have a bell with an integral wall section with a factory installed, solid cross section elastomeric ring in accordance with ASTM F477, *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.*

2) The pipe shall be extruded from Class 12454-A or 12454-B PVC compound as defined in ASTM D1784. Stress due to working pressure cannot exceed the HDB[1] (4000 psi) ÷ 2.5 safety factor (HDS = 1,600 psi). The pipe outside

[1] Hydrostatic Design Basis

diameters shall conform to dimensions of Ductile Iron Pipe. All pipe furnished shall be in conformance with AWWA C900, latest revision.

3) The minimum pipe stiffness shall be 364 psi.

4) In accordance with ASTM D1599, *Standard Test Method for Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings,* a minimum pipe burst of 755 psi shall be withstood without failure.

5) The pipe must be able to withstand an impact of 100 foot-pounds without visible evidence of shattering or splitting as specified in ASTM D2444, *Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight*).

6) Pipe shall be homogenous throughout. It shall be free from voids, cracks, inclusion, and other defects. It shall be as uniform as commercially practical in color, density, and other physical properties. Pipe surfaces shall be free from nicks and scratches. Joining surfaces of spigots and joints shall be free from gouges and imperfections that could cause leakage.

7) Each length of pipe furnished shall bear identification marking that will remain legible after normal handling, storage, and installation. Markings shall be applied in a manner that will not weaken or damage the pipe. Markings shall be applied at intervals of not more than 5 feet on the pipe. The minimum required markings are given in the list below. Marking requirements shall be in conformance with AWWA C900.

   a. Nominal Size and OD Base (e.g. 12CI)
   b. PVC
   c. Dimension Ratio (e.g., DR 18)
   d. AWWA pressure rating (e.g. PR 150)
   e. AWWA designation number (AWWA C900)
   f. Manufacturer's name or trademark
   g. Manufacturer's production code, including day, month, year, shift, plant, and extruder of manufacture.

8) C900 pressure pipe for force mains shall be used with ductile iron fittings (restrained joint).

C. **Fusible C900 Pipe Pressure Pipe for Wastewater (Force Mains) Conforming to AWWA C900 Dimensionality (4 to 12 inches)**:

1) Fusible PVC pipe shall conform to AWWA C900-16 standard, ASTM D1784 *Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds* with cell classification 12454. Pipe to be rated at 235-psi operating pressure at 73°F. Pipe to be DIPS O.D., DR-18.

2) Fusible PVC pipe shall be manufactured in standard joint lengths of 20', 30', 40' or custom lengths as may be specified.

3) Fusible PVC shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.

4) Fusible PVC pipe shall be green in color for wastewater use.

5) Pipe shall be marked as follows:
   a. Nominal size
   b. PVC
   c. Dimension Ratio or SDR
   d. AWWA Pressure Class
   e. Extrusion production-record code
   f. Trademark or trade name
   g. Cell Classification 12454

6) Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or visible deleterious faults.

7) Fusible C900 pipe shall be joined per the manufacturer's recommendations.

8) Installation shall not exceed manufacture's bending radius and safe pulling force.

9) No solvent cement weld pipe or fittings will be accepted.

10) Affidavit of compliance to this specification shall be available upon request.

11) Fusion Joints: Unless otherwise specified, fusible PVC pipe lengths shall be assembled in the field with butt-fused joints. The Contractor shall follow the pipe manufacturer's written guidelines for this procedure.

12) Fittings: See paragraph 2.1.1.C, above.

D. **PVC PIPE FOR SMALL SEWER FORCE MAINS (2-inch and 3-inch)**

2-inch and 3-inch PVC pressure pipe, bell end with gasket and spigot end shall comply with ASTM D2241, *Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)*, SDR 21, Class 200 minimum. Materials shall meet ASTM D1784, *Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds*.

Joints for solid wall PVC sewer gravity pipe and fittings and elastomeric flexible seals (gaskets) shall be compatible with pipe and shall meet the requirements of ASTM D3212 *Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals*. Rubber gaskets shall be used which conform to the requirements of ASTM F477, *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*.

2.1.3 DIRECTIONALLY BORED HDPE PIPE FOR SEWER FORCE MAINS

A. All polyethylene pipe, tubing, and fittings shall conform to all applicable provisions and requirements of the latest revision of AWWA C901, AWWA C906, or CSA B137.1 and, by inclusion, all appropriate standard references therein. Polyethylene compounds utilized in the manufacture of products furnished under this specification shall have a grade of PE24 with a minimum cell classification of

PE 234363(C, D, or E) for PE2406-2606 materials, or a grade of PE34 with a minimum cell classification of PE 345464(C or E) for PE3408/PE3608 materials, as defined in ASTM D3350. In conformance with AWWA C901, AWWA C906, or CSA B137.1, they shall have a PPI recommended Hydrostatic Design Basis (HDB) of 1250 psi (PE2406/2606) or 1600 psi (PE3408/PE3608) at a temperature of 73.4°F (23°C).

All materials which come in contact with water, including lubricants, shall be evaluated, tested, and certified for conformance with ANSI/NSF Standard 6.1.

Clean re-work material of the same type grade, and cell classification generated from the manufacturer's own pipe and fitting production may be used by the same manufacturer as long as the pipe, tubing, and fittings produced meet the requirements of AWWA C901, AWWA C906, or CSA B137.1.

B. **Reference standards**

AWWA C901: Polyethylene (PE) Pressure Pipe and Tubing, 1/2-inch through 3-inch for Water Service.

AWWA C906: Polyethylene (PE) Pressure Pipe and Tubing, 4-inch through 63-inch for Water Service.

ASTM D2657: Standard Practice for Heat Joining Polyolefin Pipe and Fittings.

ASTM D2683: Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

ASTM D2837: Standard Test Method for Obtaining Hydrostatic Design Basis of Thermoplastic Pipe Materials.

ASTM D3261: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

ASTM D3350: Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.

ASTM F714: Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

ASTM F1055: Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

PPI TR-3: Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

PPI TR-4: Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fitting Compounds.

ANSI/NSF: Standard Number 61 for Drinking Water Systems Components – Health Effects.

NSF Standard #14: Plastic Piping Components and Related Materials.

CSA B137.1: Polyethylene Pipe, Tubing, and Fittings for Cold Water Pressure Services.

C. **Qualification of Manufactures**

The manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications. Given reasonable notice, the manufacturer's production facilities shall be open for inspection by City or their representative. Qualified manufacturers shall be approved by the Project Engineer. Approved manufacturers include Plexco Performance Pipe Division-Chevron Chemical Company.

D. **Manufacturer's Quality Control**

The manufacturer of the Polyethylene pipe and fittings shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier. Incoming materials shall be approved by Quality Control before processing into finished goods. Outgoing products shall be tested as required in AWWA C901 or AWWA C906, as applicable.

E. **Pipe and Tubing**

Pipe and tubing furnished under this specification shall be manufactured using compounds complying with the requirements of paragraph A above. Dimensional performance characteristics shall conform to the requirements of AWWA C901, C906, or CSA B137.1. The pipe's DR (Dimension Ratio) and Working Pressure (WPR) shall be as specified or shown on the drawings.

F. **Fittings**

Polyethylene fittings furnished under this specification shall be manufactured using compounds complying with the requirements of paragraph A above and all appropriate requirements of AWWA C901, C906, or CSA B137.1 Socket type fittings shall comply with ASTM D2683. Butt fusion fittings shall comply with ASTM D3261. Electrofusion fittings shall comply with ASTM F1055. Mechanical fittings produced from material not listed in paragraph A above, shall be approved only after submission of appropriate test data and service histories indicating their acceptability for the intended service. In all cases, the specifications and requirements of the fittings supplied shall comply with the appropriate section of AWWA C901, C906, or CSA B137.1.

G. **Pressure Class**

The Pressure Class of the Polyethylene pipe and fittings shall be specified on the basis of the Working Pressure Rating of the water system as defined in AWWA C906. Recurring positive pressure surges of up to one half of the pipe's nominal pressure class and occasional pressure surges of up to 100% of the pipe's nominal pressure class may be ignored due to the fatigue endurance of the polyethylene materials. Non-polyethylene fittings shall be specified and used in accordance with the surge tolerance of the particular appurtenance in use.

H. **Marking**

Pipe and tubing shall be marked in accordance with either of AWWA C901, AWWA C906, or CSA B137.1, whichever applies. Marking shall be legible and shall remain legible under normal handling and installation practices. Indent marking may be utilized provided; 1) the marking does not reduce the wall thickness to less than the minimum value for the pipe or tubing, 2) it has been demonstrated that these marks have no effect on the long term strength of the pipe or tubing and, 3) the marks do not provide leakage channels when elastomeric gasket compression fittings are used to make the joints.

Fittings shall be marked on the body or hub. Marking shall be in accordance with either ASTM D2683, ASTM D3261, AWWA C906, or ASTM F1055, depending on fitting type and the standard that applies. Mechanical fittings shall be marked with size, body material designation code, pressure rating and manufacturer's name or trademark.

Pipe to be marked with green stripe(s) for sewer.

I. **Workmanship**

Pipe, tubing, and fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, blisters, dents, or other injurious defects. The pipe, tubing, and fittings shall be as uniform as commercially practicable in color, opacity, density, and other physical prosperities.

J. **Pipe Cover/Bury:** See paragraph 2.1.4.B, below.

2.1.4 HIGH DENSITY POLYETHYLENE (HDPE) GRAVITY SEWER PIPE (OR PIPE BURSTING)

A. Materials used for the manufacture of polyethylene pipe shall be PE4710 high density polyethylene meeting ASTM D3350 cell classifications 445574E (Gray) with a standard grade HDB rating of 1600 pounds per square inch at 73 °F.

Polyethylene pipe shall be manufactured in accordance the requirements of ASTM D3035 and ASTM F714 and AWWA C906 (IPS) for pipe sizes 4-inch through 18-inch.

Pipe diameter shall be as indicated on the Contract Drawings. However, in order to maintain the internal pipe diameter relatively equal to DIP sizes, pipe greater than 12 inches shall generally be up-sized 1-inch greater than the nominal pipe diameter. Gravity applications shall be a minimum of DR 17 unless otherwise indicated on the Contract Drawings. Molded fittings shall be manufactured and tested in accordance with ASTM D 3261 and shall be so marked.

Pipe shall be legibly marked in accordance with the requirements specified in ASTM F714.

Pipe lengths shall be as from the manufacturer. Length shall be such that the pipe is easily transportable in accordance with both the manufacturer's recommendations and all applicable laws and regulations.

Pipe to be marked with 4 single green stripes denoting IPS sewer and 3 sets of dual stripes for DIPS sewer.

B. Pipe Cover/Bury: AWWA M55 Pipe Design and Installation describes a Design Window, for which minimal calculations are necessary to verify if the pipe can withstand the anticipated external loads. Furthermore, no calculations are required for HDPE operating within the Design Window and having a DR21 (or less). The Design Window specifications are:

- Pipe made from stress-rated PE material.
- Essentially no surcharge (surface) load imposed over the pipe, no ground water above the surface, and provisions for preventing flotation of shallow cover pipe have been provided.
- The embedment materials are coarse-grained, compacted to ≥ 85% Standard Proctor Density and have an E' (modulus of soil reaction) value ≥ 1000 psi. The native soil must be stable; i.e., the native soil must have an E' ≥ 1000 psi.
- The unit weight of the native soil ≤ 120 pcf.
- The pipe is installed in accordance with manufacturer's recommendations for controlling shear and bending loads and minimum bending radius, and installed in accordance with ASTM International D2774, Standard Practice for Underground Installation of Thermoplastic Pressure Piping for pressure pipes, or ASTM International D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications for non-pressure pipes.
- Minimum depth of cover is 2 ft; except when subject to AASHTO H20 truck loadings, in which case the minimum depth of cover is 3 ft or one pipe diameter.
- Maximum depth of cover is 25 ft.

2.1.5 PIPE FOR SERVICE CONNECTIONS

A. **PVC Pipe**: Pipe for 4-inch and 6-inch service connections shall be schedule 40 solid wall PVC pipe with solvent cement weld joints meeting ASTM D1785, *Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 or* ASTM D2665 *Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings,* and meeting ASTM D2564, *Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.*

B. **Ductile Iron Pipe Service and Fittings**: Ductile iron pipe for sewer services, when permitted by the City Engineer, shall be minimum thickness class 51 for 4-inch service pipe and minimum class 50 for 6-inch service, slip joint pipe with mechanical joint fittings. Pipe and fittings shall meet the requirements of paragraph 2.1.1 Ductile Iron Pipe.

High-density polyethylene (HDPE) service pipe for horizontal directional drilling: High-Density Polyethylene pipe shall be manufactured in accordance the requirements of ASTM D3035 and ASTM F714 and AWWA C906 (DIPS) for pipe sizes 4-inch through 6-inch. Materials used for the manufacture of polyethylene pipe shall be PE 4710 high density polyethylene meeting ASTM D3350 cell classifications 445574E with a standard grade HDB rating of 1600 pounds per square inch at 73 °F.

The minimum pressure class/SDR rating acceptable shall be Class 200/SDR 9. The pipe shall be DIPS and shall have an interior diameter no less than the piping that it is connected to.

Joints: Joints shall be of a heat fusion joining system. Pipe and fittings shall be thermal butt fusion, saddle fusion, or socket fusion in accordance with manufacturer recommended procedures and ASTM D2161. At the point of fusion, the outside diameter and minimum wall thickness of the fitting shall match the outside diameter and minimum wall thickness specifications of ASTM D1248 for the same size pipe.

Joining of the pipes and fittings shall be performed in accordance with ASTM D2774. Depending upon the installation requirements and site location, joining shall be performed within or outside the excavation. Joints of the pipe sections shall be smooth on the inside and internal projection beads shall not be greater than 3/16 inch.

The tensile strength at yield of the butt-fusion joints shall not be less than the pipe. A specimen of the pipe cut across the butt-fusion joints shall be tested in accordance with ASTM D638.

2.1.6 STEEL PIPE (Use of steel pipe - approved on a case-by-case basis)

A. **STEEL PIPE FOR AERIAL CREEK CROSSINGS, ENCASEMENT, BORING APPLICATIONS, AND VENT PIPES:**

Pipe shall be unwrapped high strength steel, spiral welded or smooth-wall seamless manufactured in accordance with ASTM A139 *Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over) and ASTM A283/A283M Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates,* Grade "B" steel with a minimum yield strength of 35,000 psi or ASTM A252 *Standard Specification for Welded and Seamless Steel Pipe Piles*, Grade 2 steel with a minimum yield strength of 35,000 psi. All encasement pipes shall meet the applicable NCDOT, Municipal, or AREA specifications but shall be no less than 6 inches larger than the outside diameter of the carrier pipe bell. The steel pipe shall be capable of withstanding the design load. Unless otherwise shown on the approved drawings, no interior lining and exterior coating shall be required except that all exposed metal is to be coated with epoxy or asphaltic material. The pipe shall have welded joints and be in at least 18-foot lengths.

1) **Steel Encasement Pipe for Aerial Creek Crossings** (*without encasement and carrier pipe*): The outside of the pipe shall have one coat of zinc chromate primer conforming to Federal Specification TT-P-1757 and afterwards painted with coal-tar enamel.

2) **Steel Encasement Pipe for Boring Applications:** Encasement pipe shall meet applicable NCDOT and AREA specifications. Casing pipe shall include pipe carriers (spiders) to support carrier pipe (interior of pipe to be uncoated).

   a. **Spiders/Skids for Encasement Pipes**: See Pre-Approved Product List for acceptable spider/skid manufacturers and models. Also, see paragraph 3.1.4B and **Standard Detail C07.03** for location of spiders. For bolted connections, bolts, and nuts shall be stainless steel.

b. **Casing Wall Thickness**: Refer to **Standard Detail C07.03** for standard wall thickness based on diameter and location (i.e. highway, rail).

c. **Steel Casing End Seals**: Casing end seals shall be 8-inch thick brick masonry with a 1-inch diameter weep hole constructed as shown on **Standard Detail C07.03**.

d. **Rail Applications**: Encasement for rail applications, encasement pipe to be coal-tar coated, lined and wrapped except, if permitted by Rail agency, the interior shall be left unlined to permit ease of carrier pipe/spider installation.

3) **Steel Vent Pipes for Sanitary Sewer Manholes**: The vent pipe shall be made from Schedule 40 Stainless Steel. See **Standard Detail 732.10**.

2.1.7 TUNNEL LINERS

A. Grout mix for filling voids in between carrier pipe and tunnel shall consist of the following materials properly mixed in proportions by weight.

1) 1.0 Part Cement.

2) 3.0 Parts Fine Sand, 100 Percent Shall Pass No. 16 Sieve.

3) 0.5 to 0.6 Part Water – water should be sufficient to provide a consistency of thick cream when well mixed.

4) 2% approved additive (Bentonite, Septamine Seaex, Hydrocide liquid, etc.).

B. Tunnel lining construction shall comply with the "*Specification for Steel Tunnel Liner Plates"* in the American Railway Engineering Association (AREA) Manual for Railway Engineering, latest revision and AASHTO Standard Specification for Highway and Bridges, latest edition. The design and shape of the liner plates shall be such that erection and assembly of the liner plate structure can be completely and readily effected from inside the tunnel. Plates shall be accurately curved to suit the tunnel cross section, and all dimensions shall be of the size and accuracy such that plates of similar curvature shall be interchangeable. All plates shall be connected by bolts on both longitudinal and circumferential joints.

C. The steel lining shall consist of plates 16, 18, or 24 inches wide. Each circumferential ring shall be composed of the number and length plates necessary to complete the required shape shown on the drawings. The nominal tunnel diameter shall be of sufficient size to install the carrier pipe.

D. Plates shall be one-piece steel meeting the requirements of ASTM A1011 *Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength*, or ASTM A1008 *Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable*. Plates

shall have an ultimate tensile strength of at least 42,000 psi and yield strength of 28,000 psi. Nominal plate dimensions shall provide the sectional properties shown in Article 1.13.9 (or latest update) of the AASHTO Standard Specifications for Highway Bridges. Thickness tolerances shall conform to Paragraph 14 of AASHTO M167 *Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches*. Gage thickness shall be a minimum of 8 gage. The liner plate and bolts shall be galvanized in accordance with ASTM A153 *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*. In addition, the liner plates shall be asphalt coated to meet AREA Article 1.14.13 (or latest update). For two flange plates, the minimum thickness shall be 0.135 inches. Plates shall be manufactured by Armco Steel Corporation, Commercial Shearing, Incorporated, Republic Steel Corporation, or equal.

E. Grout holes 1½ inches or 2 inches (or larger) in diameter shall be provided in each ring to permit grouting as the erection of the tunnel liner plates progresses. Grout hole screw plugs shall be provided in plates.

   The minimum provision for grouting openings shall be one opening in a top plate of the tunnel at locations not to exceed 54" apart. Additional plates with grouting openings are to be installed at the top quarter points on each side between the top openings. The opening shall be staggered, but shall not exceed 54" in any one line. Grout vent pipes will be required at a minimum of one per monolithic pour.

F. Steel bolts shall meet requirements of ASTM A449 *Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use* for plate thickness equal to or greater than 0.209 inch and ASTM A307 *Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength* for plate thickness less than 0.209 inch. The nut shall meet requirements of ASTM A307, Grade A.

G. Steel casing pipe for boring through soil shall be grade B, meet requirements of ASTM A139 *Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)*, and have wall thickness to meet AREA Specifications. No interior lining and exterior coating shall be required.

2.1.8 CARRIER PIPE FOR CASINGS AND TUNNELS

Carrier pipe shall be mechanical joint or restrained joint ductile iron pipe of the class indicated on the drawings but no less than pressure class 250 psi (minimum thickness class 50). See paragraph 2.1.1, Ductile Iron Pipe.

2.1.9 FORCE MAINS:

Force mains 4-inch and larger shall be ductile iron, PVC C900 or HDPE. For 3-inch and smaller force mains, comply with ASTM D2241 per paragraph 2.1.2.C. For HDPE force mains, pipe shall comply with paragraph 2.1.2 D.

Pipe joints shall be push on or mechanical joint type. Fittings shall be mechanical joint with appropriate restraints.

2.2 MISCELLANEOUS APPURTENANCES AND MATERIAL

2.2.1 GATE VALVES

A. Gate valves (4 inches through 12 inches) shall follow the specifications as written in Section 02510 – *Water Distribution*, paragraph 2.2.6.

B. Gate Valves 1-1/2 Inches in Diameter and Smaller: 125 psi; bronze; rising-stem; single wedge; disc type; screwed ends.

C. Gate Valves 2 Inches in Diameter: Stainless Steel Body; non-rising stem, single wedge disc, 200 WOG, and handwheel. ASTM/ASME B16.34, API 598, ANSI B1.20.1 (NPT threaded connections).

2.2.2 PLUG VALVES

Plug valves shall be non-lubricated, eccentric type with resilient faced plugs and with mechanical joint ends for buried service. Port area shall be at least 80% of the full pipe area. Bodies shall be semi-steel or cast iron. Seats shall have a welded in overlay of not less than 90% pure nickel on all surfaces contacting the plug face. Valve shall have stainless steel permanently lubricated upper and lower plug stem bushings. Valves shall be of the bolted bonnet design, and shall be designed so that they can be repacked without removing bonnet from valve. All nuts, bolts, springs, and washer shall be cadmium plated.

All plug valves 6" and greater shall be equipped with an actuator. All gearing shall be enclosed, suitable for running in oil, and the actuator shall be submersible with seals provided on all shafts to prevent entry of water into actuator shall clearly indicate valve position and an adjustable stop shall be provided with a nut operator and extension stem of suitable length.

Valves for buried or submerged service to be provided with handwheel or cylinder actuators extended above ground.

Valves shall be as manufactured by Dresser, DeZurik, Keystone, Kennedy or approved equal.

2.2.3 VALVE BOXES

Valve boxes valves shall follow the specifications as written in Section 02510 – *Water Distribution*, paragraph 2.3.11.

2.2.4 AIR RELEASE AND VACUUM VALVES

Iron Body: Combination air release and vacuum valves are to be used to bleed air during filling of force mains and to automatically vent air that collects in the force mains. The valve shall be a NPT threaded cast iron body with a stainless steel float assembly and stainless steel trim. Air/Vacuum and air release cast iron body and cover shall conform to ASTM A48 *Specification for Gray Iron Castings,* Class 35 and/or ASTM A126*, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings*, as applicable. The valve outlet is to be protected from debris entering the outlet of the valve. Plumbing valves shall be all brass. The air release and vacuum valves shall be furnished with a back flushing hose with quick disconnect and brass valve assembly. Valves shall be designed for a maximum cold water pressure of 300 psig. Combination air release and vacuum valves shall be located as shown on the drawings or as otherwise directed

by the City. The valve shall be housed in a precast concrete manhole and shall be installed in accordance with **Standard Detail 734.01**.

Composite Body – Short Version: The air valve is intended for use with raw wastewater liquids carrying solid particles. The valve shall have a 2-inch NPT male threaded connection and a 1 ½" NPT female discharge orifice. The body shall be a conical-shaped reinforced nylon/stainless steel SAE 316 body with foamed polypropylene float assembly and with stainless steel SAE 316 spring, washer, stem, and ball valve. The air release and vacuum valves shall be furnished with a discharge outlet to enable connection of a vent hose/pipe. Valves shall be designed for a 150-psi working pressure and a test pressure of 250 psi. The valve outlet is to be protected from debris entering the outlet of the valve. Plumbing valves shall be all brass.

See Pre-Approved Product List for acceptable air release valve manufacturers and models.

2.2.5 BEDDING

A. Bedding material, shall be clean coarse aggregate No. 57 or smaller, and shall meet the requirements of Section 1005 of the NCDOT *Standard Specifications for Roads and Structures*.

1) **Minimum Bedding Allowed DIP Gravity Pipe**: Minimum Type 4 Laying Condition (**Standard Detail 511.02)**. The minimum bedding depth shall be 3 to 4 inches under the pipe with an additional 1-inch depth of cushioning material added for each additional 2 feet of depth in excess of 16 feet up to a maximum of 12 inches of cushioning material.

2) **Haunching DIP Gravity Pipe**: The remainder of bedding for DIP shall be brought up to a depth of 1/8 the OD of the pipe. However, when the foundation is determined by the City Engineer or Water Resources to be unsuitable, the pipe shall be bedded to the spring line of the pipe. See **Standard Detail 511.02**, Type 4 laying condition.

3) **Bedding and Haunching SDR 35 PVC and C900 PVC Gravity Pipe**: PVC pipe to have Type 5 laying condition (**Standard Detail 511.02**) with the remainder of bedding shall be brought to the top of pipe. The minimum bedding depth shall be 3 to 4 inches under the pipe with an additional 1-inch depth of cushioning material added for each additional 2 feet of depth in excess of 12 feet up to a maximum of 12 inches of cushioning material. See also **Standard Detail 731.01**.

4) **Minimum Bedding Allowed for DIP and C900 PVC Force Mains**: Bedding for DIP force mains shall be Type 1 Laying Condition with excavation of trench bottom for bells as shown on **Standard Detail 511.02**. Bedding for C900 PVC force mains shall be Type 5 laying Condition as shown on **Standard Detail 511.02**.

5) **Minimum Bedding Allowed for PVC Services**: Bedding for PVC services shall be Type 5 laying Condition as shown on **Standard Detail 511.02** except the total trench width may be no less than 24 inches.

6) **Unsuitable Subgrade**: When unsuitable subgrade is encountered, foundation and bedding stone shall be placed as shown on **Standard Detail C01.02**.

7) **Manholes**: Manholes are to be placed on a minimum of 12 inches of #57 stone. See **Standard Details 732.02, 732.03, 732.04, 732.05,** and **732.06**.

2.2.6 SOLID CONCRETE BRICK (for modifications to manholes)

Solid concrete brick, standard and jumbo, shall conform to the requirements of ASTM C90, *Standard Specification for Loadbearing Concrete Masonry Units* for Type II and ASTM C139, *Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes*, nominal dimensions 4" x 4" x 8". Brick is to be substantially free from chips and cracks.

2.2.7 CONCRETE

Concrete class (NCDOT) correlation to design compressive strength at 28 days ('C):

Class	28-day Compressive Strength (f'c)
AA	4500 psi
A	3000 psi
B	2500 psi

Ready mixed concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete.* All exposed concrete shall be air entrained. Concrete strength shall be as specified on the Standard Details and drawings. Unless otherwise specified, all concrete shall be minimum class A.

2.2.8 MORTAR FOR CONCRETE BLOCK & CLAY BRICK

Mortar shall be type M, ASTM C270, *Standard Specification for Mortar for Unit Masonry* and ASTM C144, *Standard Specification for Aggregate for Masonry Mortar.* Mortar shall be prepared from cement in perfect condition and shall be prepared in boxes for that purpose. No mortar that has stood beyond forty-five minutes shall be used. In the absence of premixed mortars meeting the preceding ASTM standards, proportion by volume for the different types of application shall be as follows:

Brick masonry = 1 part cement to 2 parts sand

Pointing = 1 part cement to 1 part sand

2.2.9 IRON CASTINGS: MANHOLE FRAMES AND COVERS

A. **General**: Standard manhole frames and covers shall be manufactured from Class 35B gray iron, meeting the requirements of ASTM A48*, Standard Specification for Gray Iron Castings,* as noted in section 3.1 of AASHTO M306 *Standard Specification for Drainage, Sewer, Utility, and Related Castings*. Standard manhole frames and covers shall be built to the dimensions and configurations

shown on **Standard Detail C06.01.** The minimum inside diameter of the opening shall be 21 13/16 inches. Manholes castings are to be uncoated. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Covers are to be with the words "Sanitary Sewer." See **Standard Details C06.01** and **735.01**.

Watertight Frames and Covers: Watertight bolt-down frames and covers shall have 4 stainless steel bolts at 90 degrees. Frame is to have four 1-inch diameter holes in flange at 90 degrees. Bolt down frames and covers are to be utilized whenever a manhole top is set lower than 2-foot above the 100-year base flood elevation. Minimum inside diameter of the opening shall be 20 ½ inches. See **Standard Detail 735.01**.

Weights shall not vary more than 5% +/- of the weight shown on **Standard Detail C06.01** and **735.01**.

B. **Bolting Down Watertight Frames to Manhole**: For units not cast into the manhole top, frame shall otherwise be drilled and bolted into cone sections with a minimum of 4 bolts. Bolts shall be stainless steel expansion bolts by manufacturers such as Hilti, Rawl or Liebig. This requirement shall apply for watertight frames and covers only. See **Standard Detail 732.04**.

C. **Cast Iron Riser Rings** (for non-watertight applications): Manhole riser rings shall be manufactured from Class 35B gray iron, meeting the requirements of ASTM A48*, Standard Specification for Gray Iron Castings,* as noted in section 3.1 of AASHTO M306. Manhole riser rings shall be uncoated and provided in 1-inch, 1 ½-inch and 2-inch heights. Placement of rings in combination is not acceptable. A ring must bed/nest in the original frame and not in another ring. See **Standard Detail C06.04**.

D. See Pre-Approved Product List for acceptable casting manufacturers and models.

2.2.10 IRON CASTINGS: SEWER CLEANOUT BOX

General: Sewer cleanout frames and covers shall be manufactured from Class 30 gray iron, meeting the requirements of ASTM A48, *Standard Specification for Gray Iron Castings*. Standard sewer cleanout frame and covers shall be built to the dimensions and configurations shown on **Standard Detail 733.01**. The lid is to read "sewer".

See Pre-Approved Product List for acceptable sewer cleanout boxes manufacturers.

2.2.11 MANHOLE (PRECAST) EXTERIOR JOINT SEALANT

Mating precast concrete castings shall be sealed with an external sealing system (external joint wrap/water vapor retarder) as shown on **Standard Detail 732.11**. The seal shall be a continuous seamless bands made of high quality material meeting ASTM E1745, *Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs*, Type III with a minimum thickness of 60 mils. Exterior joint sealing system shall also meet ASTM C877, *Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections*. Each unit shall have a 2-inch wide mastic

strip on the top and bottom of the band. The mastic shall be non-hardening butyl rubber sealant.

See Pre-Approved Product List for acceptable manufacturers of manhole exterior joint sealant systems.

2.2.12 MANHOLE FLEXIBLE INTERIOR COATING SEALANT (FLEX-SEAL)

Internal sealant system shall prevent leakage of water into the manhole though the frame joint area and the area above the manhole cone including all extensions to the chimney area. The seal shall remain flexible allowing for repeated vertical or horizontal movements of the frame due to frost lift, ground movement, or the thermal movement of pavement. The product shall have a minimum elongation of 800% and a Durometer hardness of 75. The manhole sealant shall conform the physical requirements of ASTM D412 *Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension* with a minimum of 170 mils thickness for durability and resistance elongation and tearing. The lining product shall have an aromatic urethane primer resin on the complete surface. Sealant shall equal or exceed "Flex-Seal" as manufactured by Sealing Systems, Inc., Loretto, MN. See **Standard Detail 732.11**.

See Pre-Approved Product List for acceptable manufacturers of manhole interior coating sealants.

2.2.13 PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specification for Portland Cement*.

2.2.14 PRECAST REINFORCED CONCRETE STRUCTURES

A. Manholes of precast reinforced concrete shall be designed and manufactured in accordance with ASTM C478, *Standard Specification for Precast Reinforced Concrete Manhole Sections*, or latest revision. Manhole diameters shall be 4-ft. minimum. The wall shall be a minimum of 5 inches thick and have a 6-inch minimum base. Rubber boot and stainless steel clamps, meeting the requirements of ASTM C923, *Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals*, shall be supplied with the manhole bases to tie the pipe to the base section of the manhole. Concrete used in the construction of the manholes shall have a minimum 28-day strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33*, Standard Specification for Concrete Aggregates* and ASTM C94 *Standard Specification for Ready-Mixed Concrete*. Manhole units shall consist of standard modular precast riser sections, modular riser sections, and a monolithic base (except doghouse bases are to be used when placing manholes over existing mains). Where conditions do not favorably accommodate the use of an eccentric cone, eccentric precast reinforced concrete flat tops are to be used. In areas of high H_2S concentration, provide protection of manhole by providing linings or coatings on the interior of the manhole such as Polyethylene, PVC, Reinforced Thermosetting Resin (RTR), or "Strong-Seal".

Unless otherwise permitted by the City, manholes will be precast reinforced concrete. Brick or block manholes are not permitted.

Refer to the **Standard Detail 732.01** for boot to pipe connection detail.

Extended Bases: Manholes over 12 feet in depth, as measured from top of casting to effluent invert, shall have extended bases with appropriate reinforcing.

Manhole Diameter based on pipe size:

Line Size	Minimum Diameter
8 inches	4-foot in diameter[b]
12 through 18 inches	5-foot in diameter
24 inches through 36 inches	6-foot in diameter
42 inches	7-foot in diameter
48 inches	8-foot in diameter
54 inches	9-foot in diameter
Exceptions will be made when there is a conflict with existing utilities. In such cases, the manhole diameter must be approved by the City Engineer.	

[a]NOTE: The number of connections or angle of connections may require a larger diameter manhole.
[b]Manholes over 12 feet in depth shall also be a minimum of 5-foot diameter.

See **Standard Details 732.03, 732.04, 732.05,** and **732.06**.

Joint Seal: All buried joints shall also have an external joint sealing system placed around the exterior perimeter of the manhole joint. See paragraph 2.2.11 of this specification. See also **Standard Details 732.03, 732.04, 732.05,** and **732.11**.

See Pre-Approved Product List for acceptable precast concrete structure/manhole manufacturers.

B. **Joint Sealant**: Either an "O" ring or "mastic" joint seal shall be used.

The "O" ring joint shall conform to the requirements of ASTM C443, *Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets,* latest revision.

Preformed plastic gaskets shall meet Federal Specification SS-S-00210 (210-A) *Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints*, Type 1, Rope Form or Type 2, Flat Type. Sag or flow resistance and chemical resistance shall meet ASTM C990 *Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants*, latest revision. Preformed butyl gaskets shall be used with structures meeting ASTM C478 and ASTM C990. Minimum rope diameter to be 3/4-inch or as required for the size structure.

See Pre-Approved Product List for acceptable joint sealer manufacturers.

C. **Manhole Steps**

Manhole steps shall be steel reinforced polypropylene. Steps shall have a footing surface at least 10 inches wide and shall protrude at least 5 inches away from the manhole wall. The step surface shall have a tread plate or other safety surface.

Steps shall be provided on 16-inch centers and be located directly below the manhole cover on the eccentric cone section. Steps shall be located directly over the outlet pipe on the base. See **Standard Detail C06.06**.

D. **Flexible Pipe-to-Manhole Connector**: A flexible Pipe-to-Manhole connector shall be employed in the connection of the sanitary sewer to precast manholes.

The connector shall be the sole element relied on to assure a flexible watertight seal of the pipe to the manhole. No adhesives or lubricants shall be employed in the installation of the connector into the manhole. The rubber for the connector shall comply with ASTM C923 *Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals*, and consist of EPDM and elastomers designed to be resistant to ozone, weather elements, chemicals, including acids, alkalis, animal and vegetable fats, oils and petroleum products from spills.

All stainless steel elements of the connector shall be totally non-magnetic Series 304 Stainless, excluding the worm screw for tightening the steel band around the pipe, which shall be Series 305 Stainless. The worm screw for tightening the steel band shall be torqued by a breakaway torque wrench available from the precast manhole supplier, and set for 60-70 inch/lbs.

The connector shall be of a size specifically designed for the pipe material and size being utilized on the project.

See **Standard Detail 732.01**.

See Pre-Approved Product List for acceptable manufacturers and models of flexible pipe-to-manhole connectors.

E. **Joints at Existing Manholes (Clay Brick and Concrete Brick)**

For 12 inch and smaller pipe, a virgin PVC waterstop concrete manhole adapter (Fernco Joint Sealer Company - CMA series or equal), sized for the respective pipe, shall be placed over the pipe, centered horizontally within the manhole wall and the space between the pipe and manhole completely filled with non-shrink grout (water plug or approved equal).

For 15-inch and larger sewers, the annular space shall be complete filled with nonshrink grout. Standard brick and mortar shall then be place completely around the pipe outside the manhole, supported on the extended base and entirely coated with at least 3/4 inch of mortar. Particular care shall be exercised in placing the bedding in order to achieve adequate and uniform support of the manhole and the pipe through the first joint outside the manhole.

2.2.15 TRANSITION COUPLINGS

A. Where it is necessary to join different types of pipe (e.g. DIP to SDR 35 PVC, and only when approved by the City Engineer or Water Resources, rigid couplings encased in stone shall be used. Couplings shall conform to the applicable proportions of ASTM A746, Standard Specification for Ductile Iron Gravity Sewer Pipe, and ASTM D3034, *Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings*, *and* AWWA C900, *Polyvinyl Chloride (PVC) Pressure Pipe.* See **Standard Detail 733.03**.

B. See Pre-Approved Product List for acceptable coupling manufacturers and models.

C. Poured concrete collars are not permitted.

D. Fernco couplings are not permitted.

2.2.16 WARNING TAPE, LOCATOR WIRE

A. **Locator Wire**: Size 12 gauge insulated single-strand solid or multi-strand copper wire shall be installed above all non-ferrous force mains; attached every 5 feet to the main with zip ties. Electrical conductivity along the pipe shall be continuous and uninterrupted between valve boxes. A sufficient excess length of wire shall be left in each valve box to provide at least a 6 to 12 inches length of wire above finished grade. See **Standard Detail 511.01**.

B. **Metallic underground warning tape**: Metallic detectable underground warning tape shall consist of a solid aluminum foil core, 35 gauge minimum, encased on each side with plastic (minimum overall thickness 5 mils) and be 3 inches wide with black lettering imprinted on a color coded background that conforms to APWA uniform color code specification (ANSI Z535.1 Safety Colors) GREEN and silver with black ink letters. Minimum tensile strength shall be 22 lbs/inch. Soil tolerance range to be pH 2.5 to pH 11.0. On one side of the tape, the text shall include the wording "SEWER LINE BELOW" repeated along the length of the tape. A detectable warning tape shall be used with all water mains. Underground warning tape is to be placed directly over the pipe 12 to 18 inches above the pipe. See **Standard Detail 511.01**.

Standard color code for tape and wire:

Green: Sewer Systems

See Pre-Approved Product List for acceptable underground warning tape manufacturers.

2.2.17 YARD FLUSHING HYDRANTS – NON-FREEZE

Yard hydrants are to be comprised of a galvanized steel riser with heavy cast iron head assembly with a removable ¾-inch brass male discharge hose fitting. Head to be equipped with an adjustable link, rod guide, long life graphite packing, and a one-piece variable flow plunger with automatic drain feature to prevent freezing. Valve body to have a Buna-N plunger with a solid brass core, integral valve seat cast into a bronze valve body and a 1/8-inch drain hole on the valve body. Valve body to have female iron pipe thread. Rated maximum working pressure to be 125-psi. See **Standard Detail 739.01**.

See Pre-Approved Product List for acceptable freezeless yard flushing hydrant manufacturers.

PART 3 – EXECUTION

INSTALLATION – PIPE AND FITTINGS

3.1 PIPE AND FITTINGS

3.1.1 CONSTRUCTION – ALL PIPE

A. **Trench width shall be per Standard Detail 731.01**.

B. **Bedding Pipe**: Bedding for gravity pipe to be in accordance with the approved plans but no less than the minimum bedding and bedding type stated in paragraph 2.2.5 Bedding.

C. Unless otherwise shown on the approved plans, and approved by the City Engineer or Water Resources, the minimum cover shall not be less than 3 feet. See also Table 2275.1 of Specification *Section 02275 Trenching, Backfilling and Compaction of Utilities*.

D. **Protection of Existing Sewers**: Sewer lines under construction shall be plugged with a mechanical plug at the first manhole upstream from the point of connection. Plug shall be placed in the outlet connection and secured with a steel cable. Plug shall remain in place until acceptance of lines by the City's authorized representative. Water, stone, dirt, or any other debris shall not be allowed to enter the City's sanitary sewer system during flushing operations or at any other time. Construction taking place in the vicinity of any existing City sewer lines or manholes shall not cause any inflow of surface water or debris to enter the City's sanitary sewer system. Existing City manholes located in construction sites are to remain accessible at all times. The Owner and/or Contractor shall be responsible for any damages incurred to the City's sanitary sewer system and any fines imposed by NCDEQ, Division of Water Quality due to sewer spills or overflows.

E. **Pipe Laying Direction**: Place piping beginning at low point and progress uphill. Place on grade, with unbroken continuity in invert, horizontally and vertically, and on alignment as indicated on plans. Place bell ends of piping facing upstream. Install gaskets, seals, sleeve, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

F. **Directional changes in gravity lines**: Use manholes for changes in direction of gravity lines.

G. **Handling New Pipe**: Lined pipe and fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying. The pipe shall not be dropped or unloaded by rolling. Care should be taken not to let the pipe strike sharp objects while swinging or being off loaded. Ductile iron pipe should never be placed on grade by use of hydraulic pressure from an excavator bucket or by banging with heavy hammers.

H. **Stringing out Pipe**: Only the amount of pipe that will be used in one day may be strung out. When pipe is strung out, it shall be set on high ground and in a position to prevent silt deposits, storm water, or other matter from entering the pipe prior to its placement in the trench.

I. **Pipe Laying**: The foundation for sewer pipe shall be a firm flat bottom trench with a minimum of 4-inches of compacted stone for gravity sewer mains. The pipe and fittings shall be laid in the trench so that its interior surface shall conform to the grade and alignment as shown on the plans. Pipe laying shall be done in such a way as to disturb as little as possible the pipe that has already been laid. The alignment and grade of the sewer main may be field adjusted whenever, in the opinion of the City, it is necessary, so long as the adjustments are within that allowed by NCDEQ based on regulations in affect at the time of the change and so long as the changes are consistent with City's policy in affect at the time of the change.

Before laying, the bell and spigot is to be wiped free from any dirt or other foreign matter. All surfaces of the portion of the pipe to be joined, and the factory-made jointing material, shall be clean and dry. Lubricants, primer, adhesives, etc., shall be used as recommended by the pipe or joint manufacturer's specifications. The jointing material or factory-fabricated joints shall then be placed, fitted, and adjusted in such workmanlike manner as to obtain the degrees of water tightness required.

Trenches shall be kept as dry as possible during bedding, laying and jointing and for as long a period as required until the trench is backfilled. As soon as possible after the joint is made, sufficient bedding material shall be placed along each side of the pipe to offset conditions that might tend to move the pipe off line or grade. The greatest care shall be used to secure water tightness and to prevent damage to or disturbing of the joints during the backfilling process, or at any other time.

All special fittings, such as wyes and other connections, shall be installed at the points indicated on the plans, in accordance with the Standard Detail drawings. Use appropriate adaptors to tie connection pipe to wyes or saddles. Plug end of connection with appropriate plug.

After the trench foundation has been properly graded to receive the pipe, the pipe shall be carefully lowered into the trench with approved methods. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. All damaged pipe shall be replaced.

Any defects due to settlement shall be corrected by the Contractor.

J. **Temporary Suspension of Work**: When the trench is left for the night or if pipe laying is suspended, the upper end of the pipe shall be plugged to keep out dirt, water, animals and other foreign matter or substances. This plug shall be kept in the end of the pipe line at all times when laying is not in actual progress.

K. **Cutting or Fitting Pipe**: Whenever a pipe requires cutting, to fit in the line or to bring it to the required location, the work shall be done in a satisfactory manner with an approved cutting tool or tools which will leave a smooth end at right angles to the axis of the pipe and not otherwise damage the pipe or liner. When the cut end is to be assembled in a *Fastite* bell, an adequately smooth (without sharp edges) 15º bevel should be ground or filed on the cut edge to prevent damage to or dislodgement of the gasket during assembly. The method of cutting pipe shall be in accordance with manufacturer's recommendations. No welding, flame cutting or flame tapping will be allowed. Such cuts shall be made by the Contractor.

L. **Surface Water Crossings**: Surface water crossings (wet lands, floodplains, etc.) with pipe underground shall be ductile iron pipe with a steel encasement. Pipe material shall remain constant between manholes. No transition of pipe material between manholes is permitted. See **Standard Details C07.04** and **C07.05**.

M. **Ravine/Channel Crossings**: Ravine and channel crossings are typically to be made perpendicular to the ravine or channel crossed. However, construction shall conform to the approved plans and permits; a copy of the latter the contractor shall have in his/her possession prior to beginning construction. Pipe support piers, as shown on **Standard Detail 736.01**, or steel girders, as applicable, shall adequately support surface water crossings with pipe above the water. Crossings shall be in a steel encasement pipe. Kraft paper shall be placed between pipe and all points of contact with concrete and stainless steel straps. Disturbed banks are to be stabilized with rip rap placed over a non-woven fabric or as shown on the approved plans and permit.

N. **Crossing Conflicts**: All drains, gutters, culverts, and sewers for surface drainage are to be kept open or if unavoidably closed, other provisions are to be made for this drainage.

3.1.2 DUCTILE IRON PIPE

A. **CONSTRUCTION:**

Gravity DIP shall conform to the same foundation and backfill requirements as those prescribed for water mains. Minimum laying length shall be 18 feet except for tie-in at a structure. However, bury limitations shall govern as follows. Refer to paragraph 2.2.5 Bedding for minimum bedding and bedding type for DIP.

Table 02530.1
Bury Limitations on DIP

Pipe	Maximum Bury to Invert of Pipe[a]	
	Type 4 Laying Condition[b]	Type 5 Laying Condition[c]
8-inch DIP, Class 50	34 feet	50 feet
10-inch DIP, Class 50	28 feet	45 feet
12-inch DIP, Class 50	28 feet	44 feet
14-inch DIP, Class 50	28 feet	44 feet
16-inch DIP, Class 50	28 feet	44 feet

[a]See **Standard Detail 511.02** for a description of Types 4 and 5 Laying Condition.
[b]Type 4 laying condition is equivalent to a class C bedding.
[c]Type 5 laying condition is equivalent to a Class B Bedding (stone backfilled to top of pipe).

Maximum bury for pipe diameters 18 inches and larger to be per approved plans for the depth of bury and pipe class shown on the drawings.

See **Standard Detail 731.01** for typical DIP gravity sewer laying conditions (type 4 laying condition minimum per **Standard Detail 511.02**).

B. **MECHANICAL JOINT BOLT TORQUE:**

Where mechanical joint fittings are required, unless otherwise advised by the manufacturer, the minimum bolt torque shall comply with Table 2 of AWWA C600 for mechanical joints, as follows:

Bolt Size (Inches)	**Torque** (Ft-Lbs)
5/8	45-60
3/4	75-90
1	100-120
1 1/4	120-150

C. See also Section 02275 – Trenching, Backfilling, and Compaction of Utilities.

3.1.3 PVC PIPE

A. Installation shall comply with *Underground Installation of Flexible Thermoplastic Sewer Pipe*, ASTM D2321, *Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications*. .

B. **Bury Limitations**:

Table 02530.2		
Bury Limitations on all PVC		
Pipe	**Bedding**	**Maximum Bury to top of pipe**
PVC SDR 35	Class B-1[a] w/ DOT # 57 or #67 stone (Type 5[b] Laying Condition)	12 feet
PVC C900	Class B-1[a] w/ DOT #57 or #67 stone (Type 5[b] Laying Condition)	12 feet

[a]See paragraph 2.1.2 for Pipe Bedding Definitions in Specification Section 02275.
[b]See **Standard Detail 511.02** for description of Type Laying Condition.

Minimum cover shall not be less than 3 feet.

3.1.4 HORIZONTAL DIRECTIONAL DRILLING (HDD) OF HDPE PIPE FORCE MAINS

A. HDPE pipe shall be installed by Horizontal Directional Drilling (HDD) using a surface mounted rig, first to drill a guided hole along a bore path consisting of a shallow arc and then to pull a string of pipe into the hole. Pull back is facilitated by a back-reamer, which enlarges the hole to approximately one and a half times the pipe diameter. Drilling fluids are injected into the bore hole to stabilize the hole and lubricate the pipe and drill-string. Tracking equipment is used to guide and direct the drilling.

1) Mechanical Restraint

When Polyethylene pipe is pressurized, it expands slightly and shortens slightly. Shortening may be enough to disjoin unrestrained mechanical joints that are in line with PE pipe. Disjoining can be prevented by installing external joint restraints at mechanical connections, by installing line anchors, or by a

combination of both. Contractor shall install mechanical connections with joint restraint at each connection to mechanical joint pipe.

Note: Poisson Effect pipe shortening must be taken into account whenever the pipe is pressurized, both during the pressure testing, and when it is placed in service. Because pressures are usually higher during pressure testing (up to 150% of the system pressure rating), pipe expansion and Poisson Effect pipe shortening may be slightly greater during pressure testing. Before pressure testing, all mechanical joint restraints must be completely installed and secured per manufacturer's instructions. Concrete in-line anchors and thrust blocking (if used) must be fully cured (minimum of 21 days for 3,000 psi or 7 days for 4,500 psi concrete) and properly backfilled before testing. Restraint is not required at PE to PE butt fusion joints. Restraint is not required at bolted flanged joints.

Mechanical coupling: Stainless steel internal stiffeners shall be used on all couplings to increase the seal. All couplings shall have restraint devices per the manufacturer's recommendation and installed per the Manufacturer's direction.

B. **Installation and Testing**

The Manufacturer shall supply an Installation Manual to City Engineer, which outlines guidelines for handling, joining, installing, embedding, and testing of the Polyethylene Pipeline. These guidelines shall be used as reference material by the City Engineer or Water Resources in their determination of the required procedures.

Joints between plain ends of Polyethylene pipe shall be made by butt fusion when possible. The pipe manufacturer's fusion procedures shall be followed at all times as well as the recommendations of the fusion machine manufacturer. The wall thicknesses of the adjoining pipes and fittings shall have the same DR at the point of fusion.

When saddle connections are fusion welded, the Manufacturer's recommended saddle fusion procedures shall be used.

If mechanical fittings (which are designed for, or tested and found acceptable for use with Polyethylene pipe) are utilized for transitions between pipe materials, repairs, joining pipe sections, saddle connections, or at other locations; the recommendation of the Mechanical Fitting manufacturer must be followed. These procedures may differ from other pipe materials.

On each day butt fusions are to be made, the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, and then fusion test straps shall be cut out. The test strap shall be 12 inches long or 30 times the wall thickness in length (minimum) and 1 inch or 1.5 times the wall thickness in width (minimum). Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trail fusion shall be made, cooled completely, and tested. Butt fusion of pipe to be installed shall not commence until a trail fusion has passed the bent strap test.

Socket and Straddle fusions shall be tested by a bent strap test as described by the Pipe manufacturer. The pipe manufacturer shall provide visual guidelines for inspecting the butt, saddle, and socket fusion joints.

Pressure testing shall be conducted in accordance with manufacturer's recommended procedure. Pressure testing shall use water as the test media. Pneumatic testing is prohibited.

C. **Shop Drawings**

Contractor shall submit shop drawings and details on the proposed HDPE pipe, fittings, bore methods, etc., for review and approval of City Engineer or Water Resources before ordering material or beginning installation of the HDPE. Contractor shall also submit to City Engineer or Water Resources proposed subcontractor's name as well as references on who he/she plans to use on this project. All subcontractors/installers must be approved by City Engineer or Water Resources.

3.1.5 HIGH DENSITY POLYETHYLENE (HDPE) GRAVITY SEWER PIPE

1) Laying: Refer to paragraph 3.1.1 Construction – All Pipe.

2) Joining:

a. Joints between plain end pipes shall be made by butt fusion techniques in accordance with ASTM D2657 Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings. However, the recommendations of the pipe manufacturer shall govern the fusion process, including the specification for the ideal temperature for fusion.

b. Butt fusion shall be performed between pipe ends that have the same outside diameter and are not different in wall thickness.

c. Saddles: Joints between the main and saddle branch fittings shall be made either using saddle fusion technique or tapping saddles. The butt fusion and saddle fusion procedures used shall be procedures that are recommended by the pipe and fitting Manufacturer.

d. The contractor shall ensure that persons making heat fusion joints have received training in the Manufacturer's recommended procedure.

e. Fittings shall not be joined to mainline piping using heat fusion joining techniques.

f. Polyethylene pipe may be joined to other materials by means of mechanical couplings or mechanical joint adapters.

g. External and internal beads shall not be removed unless otherwise directed by the City Engineer or Water Resources.

3.1.6 FUSIBLE C900 PVC PIPE (FOR FORCE MAINS):

A. General:

1) Fusible C900 PVC pipe shall be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.

2) Fusible PVC pipe will be fused by qualified fusion technicians, as documented by the pipe supplier.

3) Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.

4) Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:

a. Heat Plate: Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.

b. Carriage: Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.

c. General Machine: Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.

d. Data Logging Device: An approved data logging device with the current version of the pipe supplier's recommended and compatible software shall be used. Datalogging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.

5) Other equipment specifically required for the fusion process shall include the following:

a. Pipe rollers shall be used for support of pipe to either side of the machine.

b. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement weather, extreme temperatures, and /or windy weather, per the pipe supplier's recommendations.

c. An infrared (IR) pyrometer for checking pipe and heat plate

temperatures.

d. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.

e. Only facing blades specifically designed for cutting fusible PVC pipe shall be used.

B. Joint Recording:

Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride pipe. The software shall register and/or record the parameters required by the pipe supplier and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

C. General Installation:

1) Installation guidelines from the pipe supplier shall be followed for all installations.

2) The fusible PVC pipe will be installed in a manner so as not to exceed the recommended bending radius.

3) Where fusible PVC pipe is installed by pulling in tension, the recommended Safe Pulling Force established by the pipe supplier shall not be exceeded.

D. Preparation Prior to Making Connections into Existing Piping Systems:

1) Approximate locations for existing piping systems are shown in the construction documents. Prior to making connections into existing piping systems, the contractor shall:

a. Field verify location, size, piping material, and piping system of the existing pipe.

b. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents. See also paragraph 2.1.1.B (Ductile Iron Fittings).

c. Have installed all temporary pumps and/or pipes in accordance with established connection plans.

2) Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

E. Pipe Systems Connections:

1) Pipe connections shall be installed per applicable standards and

regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.

F. Tapping Fusible C900 Pipe:

1) NO taps allowed on Force mains.

G. Testing:

2) Testing shall comply with all applicable statutes, standards, regulations, and laws.

3) Hydrostatic Testing and Leakage Testing for Pressure Piping:

a. Hydrostatic and leakage testing for piping systems that contain mechanical jointing as well as fused PVC jointing shall comply with AWWA C605. See paragraph 3.9.13 *Pressure Tests & Leakage* of this Specification for testing and leakage requirements.

b. If hydrostatic testing and leakage testing are performed at separate times, follow procedures as outlined in AWWA C605.

4) Partial Testing:

a. Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the City Engineer or Water Resources.

3.1.7 STEEL PIPE

All operations of the Contractor shall be subordinate to the free and unobstructed use of the right of way of the passage of traffic without delay or danger to life, equipment, or property.

A. **ENCASEMENT PIPE (Stream Crossings and Aerial):**

General: Where required, steel encasement pipe shall meet the length as shown on the plans and the thickness and diameter as shown on **Standard Detail C07.03**. Boring across roads and railways shall be performed by dry boring and jacking a steel encasement pipe under the pavement or rail. The encasement shall be located in an area that is relatively free from material such as rock and stone that may hamper the boring operation. If requested by the City Engineer or Water Resources, the Contractor shall submit a complete plan and schedule for pipe installation prior to the commencement of such work. The submission shall include complete details of the sheeting, shoring and bracing for the protection of the roadbed and the materials and equipment pertinent to the boring operation. The Contractor shall not proceed with the pipe installation until he/she has received approval of the plan and schedule from the City Engineer or Water Resources.

Construction shall be executed in such a manner as to prevent settlement of the ground surface above the pipeline. The installation of the pipeline shall follow the heading or tunneling excavation as closely as possible.

All operations of the Contractor shall be subordinate to the free and unobstructed use of the right of way of the passage of traffic without delay or danger to life, equipment, or property. Installation shall be in accordance with the *NCDOT Standard Specifications for Roads and Bridges*, latest revision or AREA, as applicable.

The pipe shall be beveled and prepared for field welding at the circumferential joints. Joining of steel casing pipe shall meet the requirements of AWWA C206, AWWA *Standard for Field Welding of Steel Water Pipe*. Field welded joints shall be performed by ANSI/AWS D1.1 certified welders and shall be full penetration single vee groove, butt type welds around the entire circumference of the pipe. The pipe shall be in at least 18-foot lengths. Casing shall be installed by either dry boring and jacking or open cut, as indicated on the drawings.

Encasement ends shall be enclosed using enclosed using brick and mortar as shown on **Standard Detail C07.03**. The steel encasement pipe shall be of leak proof construction. All exposed metal is to be coated with epoxy or asphaltic material.

All carrier piping shall be mechanical joint ductile iron pipe with restrained joints supported by spiders.

Aerial Crossings: Kraft paper shall be placed between pipe and all points of contact with concrete and stainless steel straps. Upon completion of intallation, paint the exteior of the pipe with coal tar enamel.

Creek Crossings: Sewers crossing creeks shall be encased in a steel casing with concrete anchors placed at each end of steel casing. Depending on clearance from stream bed, City Engineer or Water Resources may require full concrete encasement of steel casing on sewer lines. Concrete anchors shall be set to provide a minimum of 12 inches of projection beyond the anchor for attachement of end seals. Creek crossings chall conform to **Standard Details C07.04** and **C07.05**, as applicable.

B. **Manufactured Spiders/Skids**: The spiders necessary to support the carrier pipe inside of the steel encasement pipe shall be in accordance with paragraph *2.1.4A 2a, Spiders/Skids for Encasement Pipes*. Unless otherwise shown on the drawings, one spider shall be placed at each bell end, one at each spigot end, and one centered between the two pipe ends (3 spiders per joint) of the carrier pipe. A spider is also required at each end of the encasement pipe (see **Standard Detail C07.03** for location of spiders). Spiders are to be bolted together using stainless steel.

See Pre-Approved Product List for acceptable spider/skid manufacturers and models.

3.2 TUNNELING METHOD

A. **GENERAL**:

1) The contractor shall submit shop drawings to City Engineer for approval prior to construction. All liner plates and ribs used in the tunnel shall be of one type. All material removed shall be disposed of off the site, at an approved locations, by the Contractor.

2) All operations of the Contractor shall be subordinate to the free and unobstructed use of the rights of way for passage of traffic without delay or danger to life, equipment, or property. The Contractor shall provide all necessary bracing, bulkheads, and shields to ensure complete safety to all traffic at all times. The Contractor shall provide all traffic control devices as necessary and as shown on the approved traffic control plan at no additional cost.

B. **TUNNELING (BORING METHOD):**

1) Commence boring operation from a pit, with the bottom excavated to grade, and sheeted or shored if necessary. A steel pipe shall be jacked in place as a casing pipe. Boring through rock shall be oversized to allow installation of carrier pipe but no casing pipe shall be required unless liner plate is necessary for safety reasons.

2) Smoothly pave the bottom of the tunnel with concrete. Pull the carrier pipe in place a joint at a time. Securely block each section in place.

C. **TUNNELING (HAND MINING):**

1) Commence tunneling operation from a pit, with the bottom excavated to grade, and sheeted or shored if necessary.

2) Trim the periphery of the tunnel smoothly to fit the outside of the steel liner plate as nearly as practical. All blasting shall conform to requirements for blasting in *Section 02275 – Trenching, Backfilling and Compaction of Utilities*.

3) Install the steel liner plates immediately after the excavated material has been removed, and remove the material not more than 24 inches ahead of the installed liner plates.

4) Grout all voids between the soil and tunnel liner plates. Start grouting at the bottom of the tunnel liner plates and proceed upward progressively and simultaneously on both sides of the tunnel. Install liner plates no more than 6 feet ahead of grout section. Prohibit traffic over ungrouted sections of tunnel unless this section is in solid rock. Thoroughly dry-mix grout ingredients before adding water. After adding water, mix the batch for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. Placing shall be quick and continuous. Placement shall be under pressure with a grout pump. The period between installation of the tunnel liner plate and the placing of grout shall not exceed 7 hours, without the approval of the City. Upon completion of grouting, fill grout plugs with provided grout hole plugs.

   A pump shall be provided for placing the grout which shall be capable of exerting sufficient pressure to assure the filling of all voids between the liner

plate and the undisturbed ground. Minimum acceptable pressure to fill voids will be 5 psi. The maximum grouting pressure shall be 30 psi.

Pumping of grout shall be done:

i. At the completion of the installation of approximately each 6' of liner plate,
ii. At more frequent intervals than 6' if conditions indicate the necessity, and
iii. At the end of a work shift or for stopping of work for any reason.

5) Smoothly pave the bottom of the tunnel with concrete. After installation of the tunnel liner plates, the Contractor shall pour concrete pavement on the bottom quadrant (invert) of the tunnel, the surface of the pavement being parallel to the inner plate, with screed rails embedded in it, on line and grade for the installation of pipe in the tunnel.

6) The periphery of the tunnel shall be trimmed smooth to fit the outside of the steel liner plate as nearly as is practical, so that the void outside the plates is a minimum.

7) After installation of the casing pipe or the tunnel liner, pull the carrier pipe in place a joint at a time. Securely block each section in place. Each joint of the carrier pipe shall be supported at three points by steel saddles or by steel spiders, strapped to the carrier pipe with steel straps. The carrier pipe shall be blocked, in place to prevent flotation.

8) Close up tunnel liner ends to protect against entrance or foreign matter. The open ends of the casing pipe or tunnel shall be closed off by an 8-inch grout or masonry block wall prior to backfilling. A steel drain line to a 1 cubic yard French drain or to daylight shall be provided.

9) If installation is under railway tracks, all permits shall be obtained and Railway Company shall be notified prior to such installation. The same shall apply to contacting the applicable Municipality or NCDOT if installation is under a roadway.

3.3 MANHOLE CONSTRUCTION

A. **Standard Manholes:** Manholes shall be constructed in accordance with **Standard Details 732.02, 732.03, 732.04, 732.05, 732.06, 732.10,** and **732.11**. The Contractor shall exercise care in the ordering of manholes so that the use of grade rings for leveling and adjustments can be minimized. Contractor is to seal all riser/riser and riser/cone joints, both on the inside and the outside of the manhole, with hydraulic cement. Flex-seal sealant is to be used on the interior of the cone section at the interior adjustment ring area. **Infi-Shield**® external sealing systems are then to be placed on the exterior joints of manholes. See **Standard Detail 732.11**.

1) **Standard Manholes**: Standard manholes shall be those greater than 5 feet in depth measured from the base of the cover frame to the top of the concrete footing.

2) **Shallow manholes**: Shallow manholes shall be 5 feet or less in depth measured from the base of the cover frame to invert out, shall have an

eccentric cone section, and shall be capable of supporting HS-20 traffic loading. See **Standard Detail 732.05**.

Non-shrink grout shall be placed around pipe where pipe meets precast invert in manhole to provide for a smooth transition for sewage flow.

Manholes shall be installed plumb.

In the case of either integrally cast or expanding sleeve boots, the pipe exterior and boot interior shall be thoroughly lubricated prior to pipe insertion. The exterior of the boot under the bands shall be thoroughly lubricated with pipe soap. Puckering of boots shall not be allowed.

Flexible sleeve boots shall not be used with concrete pipe or on pipe larger than 18 inches in diameter.

When applicable, during installation of manhole, if frame and cover is near or within wheel path in roadway, turn cone to place out of wheel path.

B. **Drop Manholes:**

Exterior drop manholes shall be installed per **Standard Detail 732.06**. Exterior drop connections on new manholes shall consist of Ductile Iron Pipe and joint fittings. Exterior drop connections on existing manholes shall be in accordance with **Standard Detail 732.06**. Interior drops are not permitted on existing manholes unless approved by the City Engineer or Water Resources and then on a case-by-case basis.

Manholes shall conform to PART 2 - PRODUCTS.

C. **Flexible Pipe-to-Manhole Connector**: When it is necessary to field core a manhole and install a flexible pipe-to-manhole connector in precast concrete sanitary sewer manholes, the connector shall be installed per the manufacturer's recommendations. See **Standard Detail 732.01**.

D. **Precast Concrete Doghouse Manholes**: When it is necessary to install a manhole over an existing sewer main, a precast concrete doghouse manhole shall be installed over the main. A 12-inch thick base of #57 stone is to be placed over firm subgrade and shall extend a minimum of 12 inches beyond the exterior wall of the riser. Four 8x8x16 solid concrete blocks are be centered with the riser and the riser set upon the block. A minimum of an 8-inch thick reinforced concrete base shall be poured over the #57 stone base and around the base of doghouse manhole riser that has been set over the existing sewer. The annular space of the precast manhole, around the main, shall be filled with grout and a shelf formed to the springline of the existing main. The crown/top of the main shall be removed once the shelf has been formed and has set sufficiently and all upstream lines tested and approved by the City. See **Standard Detail 732.02**. See paragraph 3.5 Connecting Existing Sewers for modifying existing sewers and controlling existing flow.

E. **Manhole Inverts**:

When a precast invert or Moorbase is not used, inverts shall be formed (with a doghouse only). Manhole inverts may be formed using either brick covered with

grout or formed entirely of grout. Inverts shall be constructed a shown on **Standard Details 732.01, 732.03, 732.04, 732.05,** and **732.06**. The depth of the channel shall be 3/4 of the pipe ID with vertical wall from the springline of the pipe up. The bench shall then be sloped to the manhole walls at ½ inch per foot. The channel shall be "U" shaped (see sheet 3 of **Standard Detail 732.03** for example). Curved channels due to changes in pipe alignment shall be constructed in such a way as to provide gentle curves as shown on **Standard Detail 732.01**.

The internal cavity between the boot and the manhole wall will be completely filled with non-shrink grout and filleted at the manhole wall. The face where the pipe enters or leaves the manhole shall be struck smooth and the channel shall form a smooth flow line from the pipe entry to pipe exit.

F. **Combination Air Valve/Air Release Manholes:** Combination air valve/air release manholes shall be installed per **Standard Detail 734.01**. Manholes shall be minimum 8'-0" inside diameter for cuts of up to 10 feet with 30" minimum clearance provided around valves as shown in the detail. To provide the minimum 30-inch clearance between the top of the air valves and the bottom of the flat top, the force main will have to be lowered accordingly as shown in the "Force Main Profile Example" in the detail to provide a uniform positive or negative grade up to and down from the air valves, respectively. A full joint of ductile iron pipe shall be centered in the manhole. All annular spaces of pipe penetrating the manhole shall be grouted. A maximum of two 6-inch precast concrete risers will be allowed on top of the flat top section. Air testing of the manhole is not required.

G. **Installation of Manhole frames and Covers**: Frames and covers shall be installed to manhole in accordance with **Standard Details C06.03, 732.03, 732.04, 732.05, 732.10** and **732.11**, as applicable. Frame and covers shall be installed to finished elevation. Adjustments shall be made as necessary to achieve finished elevation. On all manholes, an approved butyl rubber (mastic) sealant is to be placed between the iron frame and concrete casting or grade adjustment ring. Frames are to be mortared to the manhole cone as shown on the standard detail applicable to the location/situation. Frames are to be bolted for watertight applications only.

H. **Manhole Steps:** Steps **(Standard Detail C06.06)** are to be located over the outlet pipe. Steps shall be firmly anchored in the riser/cone/base sections by the precast manhole manufacturer. See the applicable standard manhole detail.

I. **Grade Rings/Adjustments**: In street rehabilitation work, the combination of grade rings and/or brick shall not exceed 3 precast rings or a maximum of 12 inches for brick riser rings nor more than 24 inches from the top of the iron casting and the first step inside the cone section before removal of the cone is necessary to effect adjustment. See **Standard Detail C06.03**.

J. **Replacement/Rehabilitation of Existing Manholes:**

Replacement of manholes: The City reserves the right to require replacement of the existing manhole with a new manhole. The City will provide the manhole but the Contractor shall pick up and install it. When a new manhole is necessary, the old manhole must be completely removed and a new precast manhole constructed in its place.

Any tie-in's performed on sanitary sewer manholes must be machine-core drilled with a neoprene flexible boot and adjustable band, except brick manholes. The core shall be the size specified with a smooth finish. If connecting to existing brick manhole, seal penetration and add "Strong-Seal" on perimeter of manhole. Coordinate with the City.

K. **Connection to Existing Manholes**

Connection to existing sewer shall be made at manholes whenever possible. For connection of encased pipe, the casing shall be flush with the outside wall and shall be encased with at least 8 inches of stone on the outside of the manhole. Existing manholes to which connections are made shall be rehabilitated, as directed by the City Engineer or Water Resources, to the degree necessary to correct any apparent signs of infiltration or inflow. See paragraph 3.3 I, *Replacement/Rehabilitation of Existing Manholes* and paragraph 3.5 Connecting to Existing Sewers.

Upon completion of the connection to existing sewers, existing lines no longer needed shall be sealed or plugged and the invert rebuilt to reflect the new flow patterns.

L. **Testing of New Manholes**: Manholes are to be subjected to a vacuum test. Manholes shall be vacuum tested after installation in accordance with the manhole vacuum testing procedures outlined in Section 3.9.1, paragraph F, item 11. Service connections tied into manholes shall be tested in conjunction with the manhole.

3.4 ABANDONING SEWER LINES & MANHOLES

A. **Sewer lines**: When an existing sewer line is designated to be abandoned in place, the low end of the line is to be plugged and lean concrete grout (flowable fill) pumped into the line until it is completely filled.

B. **Manholes**: When an existing manhole, either partially or wholly, is designated to be abandoned and the sewer lines, either entering or exiting the manhole, have been abandoned according to the preceding paragraph, the upper portion of the manhole is to be removed to within 36 inches of the proposed finished grade, or as determined by the City Engineer or Water Resources. Below pavement, backfill with flowable fill concrete. Outside of pavement, backfill with stone screenings, compacted in place.

3.5 CONNECTION TO EXISTING SEWERS

A. Unless otherwise required or shown on the plans, connection to existing sewer mains shall be made at manholes. See paragraph 3.3 J, *Connection to Existing Manholes*.

B. **Setting New Manhole on and Existing Line**

1. Whenever a new line extension requires a new manhole to be set on an existing line, the existing line inside the new manhole shall not be broken out until the new line has been accepted by the City.

2. If the line is accidentally broken during the setting of the new manhole, the new line in the manhole shall be plugged. Contactor shall furnish plugs and the labor required to install the plugs.

3. If plugs are installed and/or water still enters the existing line, the amount of flow shall be estimated and the contractor billed for treatment of the flow.

4. See also paragraph 3.3.D Precast Doghouse Manhole for doghouse manhole construction and **Standard Detail 732.02**.

C. Where required or shown on the plans, connection to existing sewer shall be made in a manner that will maintain existing sewage flow on a continuous basis. The new line shall be plugged in the existing manhole immediately upon finishing the line to the next manhole. The plug is to ensure that no water from any source enters the existing system and has to be treated by the wastewater treatment plant. The plug will be removed only upon acceptance of the new line by the City after a final TV inspection. Any water which accumulates in the pipe shall be pumped out prior to the TV inspection and may not be pumped into any existing sewer line.

D. **Bypass Pumping**: Where existing flow cannot be maintained, interruption of service shall be minimized such that no by-pass of sanitary sewage to any natural waterway or storm drain occurs nor shall such interruption create a public health hazard by sewage back up or overflows. Sewage by-pass pumping shall comply with the requirements of *paragraph 3.6, Bypass Pumping*, below.

3.6 BYPASS PUMPING

A. The bypass system shall be of sufficient capacity to handle peak flow of the pipe. Provide the necessary labor and supervision to set up and operate the pumping and bypassing system. Contractor shall comply with local City sound ordinance. If pumping is required between the hours of 8:00 PM and 6:00 AM, engines shall be equipped as specified in paragraph E, below, in order to keep noise to a minimum. The equipment shall be manned continuously. During bypass pumping operations, the Contractor shall provide the necessary labor to continually monitor the operation and ensure uninterrupted and sufficient pumping at all times.

B. Contractor shall provide all materials and labor as necessary to maintain flows in the existing sewer interceptor and all collector and lateral lines at all times and under all weather conditions. Interruption of flows will not be permitted. Overflows from bypass operations will not be permitted to enter into any streams or bodies of water. **The Contractor will be solely responsible for any legal actions taken by the state regulatory agencies if such overflows occur during construction**.

C. Bypass pumping equipment shall include pumps, conduits, engines, and related equipment necessary to divert the flow or sewage around the section in which work is to be performed. In addition, the Contactor shall maintain at the same location and in operable condition, duplicate equipment to be used in case there is equipment failure. In this event, the Contractor shall promptly repair or replace the failed equipment to the satisfaction of the City Engineer.

D. The new sewer line may be used by the Contractor to carry the sanitary flows after the new pipe has passed inspection and testing. Any "temporary" connections to the new sewer line shall be approved by the City.

E. Engine driven equipment for bypass pumping equipment shall have "critical grade mufflers." If equipment is operated between the hours of 8:00 PM and 6:00 AM, this equipment shall also be provided with sound attenuation enclosure consisting of a three sided enclosure with roof constructed of 2 x 4 frame with ½-inch plywood sheathing and 2-inch Styrofoam panels attached to the inside of the entire enclosure. The enclosure shall be portable in order to allow the enclosure to be moved when bypass pumping equipment is moved. These conditions are subject to any other additional stipulations that may be required by local City sound ordinances.

F. **Plan Requirements**: The plan should include, but is not necessarily limited to, the following details:

1) Staging areas for the pumps.
2) Sewer plug method and type of plugs or gates to be used.
3) Number, size, material, locations, and method of installation of suction piping.
4) Bypass pump sizes, capacity, number of each size to be on site, and power requirements.
5) Calculations of static lift, friction loss, and flow velocity.
6) Stand-by power.
7) Downstream discharge plan.
8) Method of noise control for each pump.
9) Temporary pipe supports and anchoring required.
10) Heavy equipment needed for installation of pumps and piping.
11) Stand-by/back-up pumpset for the bypass application.
12) Detail plan for 24-hour monitoring.
13) Fueling of pumpsets on demand.

G. **Sewer Overflows – Penalties**: The Contractor shall make every effort to avoid causing sewer overflows. All sewer overflows shall result in the following disciplinary actions:

Incident	Penalty
First Violation	$2,000
Second Violation	$5,000
Third Violation	$10,000
Fourth Violation	Termination of Contract

For all sewer overflows, the Contractor shall be responsible, and shall reimburse the City, for any damages, operational costs, fines, or other effects.

1) **Unplanned Service Outages**: The Contractor shall make every effort to avoid causing unplanned service outages. All Contractor caused service outages shall be investigated by the City Engineer or Water Resources. If the investigation determines that the Contractor could have avoided the service outage, then the outage shall result in disciplinary action as shown above.

3.7 SERVICE CONNECTIONS

A. **Service Connections**: Six-inch and larger line service connections shall be made at manholes only using core boring and a rubber boot. 4-inch sewer laterals shall be connected to both new mains and mains under construction that have not been accepted by means of an in-line monolithic wye (see **Standard Details 733.01**). The service shall include the in-line wye, bends, combination wye, and clean-out stack with meter box constructed as shown on **Standard Detail 733.01**. Both the cleanout and the service material shall be capped or plugged to exclude entry of water or earth. See **Standard detail 733.01** for requirements for plugging both the stack and the service line.

B. Location of Service: Unless directed otherwise by the City Engineer, service connections shall extend to a point within the right-of-way or easement. In streets with curb and gutter, the preferred cleanout location is 3 feet from back of clean out box to back of curb. In easements, the preferred cleanout location is at the easement line. Service connections shall not be located in driveways, sidewalks, or the street. See **Standard Detail C07.01**.

C. **New Services**: Unless otherwise permitted by the City Engineer, all sewer services shall be PVC Schedule 40 pipe solvent cement joint pipe and fittings. The laying and joining of service connection pipe shall conform to the same requirements as stipulated for main installation. Sewer services are to be connected to main except at manholes on cul-de-sacs. When connecting to manholes, services are to come in at the bottom of the manhole or as shown on the approved plans. See paragraph G, below for service connections to manholes.

D. **Bored Services**: Where laterals are bored, the face of the bore cut shall be a minimum distance of five feet from the edge of the pavement on either side unless the City Engineer or Water Resources gives approval to the contrary.

E. **Service Connections to Existing Sewer Mains (Service Saddles):** Service connections to existing mains shall be made by cutting in a hole with a mechanical circular-type saw cutter, designed for the particular use, and rendering a smooth uniform cut with no damage to the main and is one that retrieves the plug (coupon). Saddle service coupon shall be given to the City's Inspector for review and approval. Service saddles shall be fully encased with #57 stone and special attention shall be given to embedment of the service pipe from the saddle through the lateral trench. The cost for such cut-ins shall be included in the cost of the lateral.

The remainder of the service shall match the configuration required for a new service (**Standard Detail 733.01**). Backfill under and around wye with #57 stone. The cost for such cut-ins shall be included in the cost of the lateral. See **Standard Detail 733.02**.

Service Saddle Properties:

The service saddle body is to be cast from ductile (nodular) iron, meeting or exceeding ASTM A 536, Grade 65-45-12. Gasket is to be made from Buna-N (NBR) for sewer service applications in accordance with ASTM D2000. Unless otherwise approved, the saddle to have a pipe stop molded into the inside wall of the gasket.

Strap is to be type 304 (18-8) Stainless Steel, 3 1/2 inches wide to spread out clamping forces on the pipe. M.I.G. and T.I.G welds. Bolts and Nuts to be type 304 (18-8) Stainless Steel. Bolts to have 1/2" National Coarse roll thread. Nuts coated to prevent galling. Straps, nuts and bolts to be passivated for resistance to corrosion. Acetyl and stainless steel washers are used to reduce friction.

Shop coat to be fusion bonded epoxy, liquid epoxy applied to cast parts for corrosion protection.

The saddle shall be capable of a 7-psi working pressure when properly installed on a pipe within the correct outside diameter range.

F. **Service Connection to Manholes**: Service connections must enter at the bench of the manhole whenever possible but shall not enter a manhole lower than the top of the effluent main. If not practical, services may be located above the bench but may not enter the cone or any joints. Service connections in manholes shall also be core bored and booted and shall be separated by a minimum of 2 times the pipe OD (either vertically or horizontally) from other services or mains. No taps shall be made by knocking a hole into the manhole wall. When connections are made at deep manholes, a standard drop connection shall be provided. The invert of manhole service connections shall be located such that a pipe half-diameter channel formed through the bench shall be required.

Service connections shall not be made to manholes located in intersections unless directed otherwise by the City Engineer or Water Resources.

G. **Deep Sewer Service Connections**: For service connection to deep sewer with confined trenches, the service shall extend from the connection upward at a 45 degree angle to a point near the trench wall, shall then bend 45 degrees up to a vertical riser which shall parallel the vertical trench wall to a point no less than 36 inches below finished grade and shall then turn using 2 consecutive 45 degree bends to provide a lateral service to match the grade and slope of the building sewer. For all other service connections, the service shall extend from the connection upward at 45 degrees to a point where it shall bend 45 degrees to match the grade and slope of the building sewer. Vertical stacks or standpipe services are not allowed. See **Standard Detail 733.01**, sheet 2.

H. **Final Cleanout Grade Adjustment**: When final grade has been achieved, a cast iron meter box is to be set over the cleanout. The top of the cleanout plug is to be set 2 inches below the bottom of the meter box lid. The lid is to read “sewer”. See **Standard Detail 733.01**.

I. **Cleanout Spacing:** Cleanouts shall also be provided at all horizontal or vertical changes in direction. Cleanout spacing shall meet the requirements of the *NC State Building Code, Plumbing Code*, latest edition.

J. **Grade**: Minimum grade for 4-inch services preferably shall be ¼-inch per foot but no less than 1.0%. Minimum grade for 6-inch services are to be laid preferably at a 1/8-inch per foot, but no less than 0.6%.

K. During service installation or line rehabilitation on existing mains, the Contractor shall be responsible for the maintenance of all sewer house connections and the proper treatment and/or by-pass of effluent sewer around work areas.

L. Any services or utilities damaged by the Contractor shall be properly repaired.

M. Sewer lines shall be **air tested** (low-pressure air test) after the complete installation of all sewer services. Laterals shall be tested with the main line.

3.8 CONCRETE ENCASEMENTS

All concrete encasements shown on the plans shall be constructed per **Standard Detail C07.05**.

The earth may be used for side and bottom forms provided such sides can be excavated uniformly smooth and to the size and shape specified. Care must be taken during the pouring operation to ensure that the pipe does not float or move from the buoyant affects of the concrete. Misalignments of the crossings shall be cause for total removal and replacement of the encasement by the Contractor.

Once the concrete is set, measures shall be taken to cure the concrete by covering it with plastic. Water shall not be allowed to run over the concrete for at least 48 hours.

Forms will be required if the subgrade and sides are not firm, or will not hold shape.

Exercise care to avoid spilling concrete into creek.

See also paragraph 3.1.4 A for steel encasement construction requirements.

3.9 TESTING

3.9.1 GENERAL

A. Unless otherwise specified (see also paragraph 1.10.1 B2c), all sanitary sewer pipe shall be tested after backfilling has been completed and before final acceptance by the City. Upon completion of entire pipe installation, the City shall inspect the work in part or as a whole and make such tests as necessary to verify that the work has been carried out in accordance with the plans and specifications.

B. All manholes shall be of the specified size, shape, and material, and shall have their tops set to the grade as shown on the approved drawings provided by the designer.

C. The Contractor shall provide all equipment, material, water, labor, etc. needed to perform any and all tests in accordance with the procedures listed herein. All equipment, materials, etc. used shall be checked and approved by the City prior to its use. It shall be the responsibility of the Contractor to ensure pipe to be tested is clean before any tests are made. Frame and covers shall be tested with manhole tests.

D. The following tests shall apply for the respective pipe materials as required by the following specifications.

Table 02530.3 Table of Testing Applications				
Material	**Air Test**	**Vacuum Test**	**Mandrel Test**	**TV Inspection**
PVC/HDPE Gravity pipe[a]	X		X	X
DIP	X			X
Manholes		X		

[a]PVC/HDPE Pressure Pipe (Force Mains) Pressure & Leakage Testing: See paragraph 3.9.13 *Pressure Test & Leakage*

E. Testing and inspection shall promptly follow installation of wastewater pipe including services.

F. **TEST AND INSPECTION:**

1) **General Testing Requirements**:

All services shall be installed complete.

All visible leaks, broken or cracked pipe shall be repaired prior to testing.

Testing is to be performed before stone base or pavement is put down.

2) **Contractor to Furnish Testing Equipment and Personnel**: Furnish all pumps, gauges, instruments, test equipment and personnel required for inspections and testing operations.

Provide lights and mirrors and inspect lines in presence of the City's authorized representative.

3) **Final Inspections/Tests**: All final testing and inspections shall be performed in the presence of the City's authorized representative. The City requires a 48-hour notice prior to inspection and testing. If the desired inspection will land on a weekend or holiday, contact the City Engineer to determine if the inspection or test can be scheduled at that time.

4) **Flushing**: Contractor shall flush all sand, dirt and debris from lines prior to inspection. If during any of the inspections sewer lines and manholes are found to contain mud and other debris, the Contractor shall be required to re-flush or clean this material from the system by whatever means necessary. Mud and other debris shall not be allowed to enter the existing sanitary sewer system. The Contractor shall be responsible for the cost of water used to flush the system.

5) Contractor is to inspect the system for conformance with line and grade shown on the plans and provide record drawing measurements on Record Drawings.

6) Also see Section 5 *Acceptance* and Section 6 *Specific Information Regarding Record Drawings* as well as the Sewer Inspection Checklist in

the *City of Wilson Plan Review, Permitting, Construction and Acceptance, Appendix B* for other applicable requirements.

7) **Backfill Testing**: Testing of backfill shall be performed during construction as follows:

Compaction Testing Frequency:

Table 2230.2	
Testing Frequency	
Location	**Frequency**
Trench areas in road crossings	1 test group[a] per road crossing, and/or
Trench Areas	As determined by the City Engineer
Exception: Where additional tests are required to determine the extent of acceptable compaction (having been determined by the initial QA/QC test). In this case, the costs for these additional tests are the responsibility of the Contractor.	

[a]One test group consists of a compaction test on each layer of backfill material in the trench segment.

Refer to Table 2275.3 of *Trenching, Backfilling, and Compaction of Utilities* for the minimum compaction limits for trench backfill, Table 2275.4 for the required compaction lift thickness, and Table 2275.5 for the ASTM/AASHTO reference standard applicable to the soil type/classification.

Quality Control (QC) compaction tests are the responsibility of the Contractor. The City will perform such additional Quality Assurance (QA) tests they may deem necessary at their expense.

8) **Visual Line Inspection**: Visual inspections are required by the City. When required, sewer lines shall be visually inspected from every manhole by use of television cameras. The lines shall exhibit a fully circular pattern when viewed from one manhole to the next. Lines, which do not exhibit a true line and grade, have obstruction or structural defects, shall be corrected to meet these specifications and the sewer barrel left clean for its entire length. See paragraph 12, below for method of recording inspection.

9) **Pipe Deflection Test**: Deflection testing shall be performed for all semi-rigid and flexible pipe 8 inches or larger. Deflection shall not exceed 5% (95% of the ASTM base inside diameter). Testing shall be conducted in the presence of the City's authorized representative and shall utilize a mandrel go/no-go gauge complete with proving ring. Mandrel shall be approved by the City for this test. Arm mandrels shall have a minimum of 9 arms.

The mandrel device shall be cylindrical in shape and constructed with a minimum of nine evenly spaced arms or prongs. Mandrels with less than nine arms will not be approved for use. The "D" mandrel dimension shall

carry a tolerance of plus or minus 0.01 inch. Allowance for piping wall thickness tolerances or ovality (from heat, shipping, poor production, etc.) shall not be deducted from the "D" dimension but shall be counted in as a part of the 5% or lesser deflection allowance.

The mandrel shall be hand pulled through by the Contractor in the presence of the City's authorized representative. Any sections of the sewer not passing the mandrel shall be uncovered and the Contractor shall re-round or replace the sewer to the satisfaction of the City's authorized representative. The repaired section shall be retested.

The inspection shall be conducted no earlier than 30 days after reaching final trench backfill grade.

Contact length shall be measured between points of contact of the mandrel arm.

The inspector shall be responsible for approving the mandrel. Proving rings may be used to assist in this. Drawings of the mandrel with complete dimensions shall be furnished by the Contractor to the City for each diameter and specification of pipe.

10) **Primary test method – Low Pressure Air Test**: Sewer lines shall be **air tested** after the complete installation of all sewer services. Sewer laterals are to be tested along with main. The Contractor shall be responsible for furnishing all equipment and labor for the low pressure air test at no additional cost to the City.

The portion of the line being tested shall be accepted if the portion under the test meets or exceeds the requirements of ASTM F1417 *Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air*. This requirement shall be accomplished by performing the test as follows: the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig greater than the average back pressure of any groundwater that may be over the pipe shall not be less than the time shown for the given diameters in Table I *Line Pressure Air Test Table.* If the system does not meet the foregoing requirements, the Contractor will be required to locate and repair the leaks at no cost to the City and repeat the tests until the allowable leakage is obtained.

Procedure:

It is imperative that proper plugs be installed on the laterals at the cleanout stack. All plugs should be properly installed to withstand the test pressures without requiring external bracing or blocking. Before tests are made, all wyes, tees, or end of side sewer stubs shall be plugged with flexible-joint caps, or acceptable alternate, securely fastened to withstand the internal test pressures. Such plugs or caps shall be readily removable, and their removal shall provide a socket suitable for making a flexible-jointed lateral connection or extension.

Air leakage testing of installed system shall be performed with a continuous monitoring gauge no less than 4 inches in diameter with minimum divisions

of 0.10 psi and an accuracy of plus or minus 0.04 psi. All air used shall pass through a single, above ground control panel visible to the City.

Individual air hoses shall be used from control panel to pneumatic plugs, from control panel to sealed line for introducing low pressure air, and from sealed line to control panel for continually monitoring the air pressure rise in the sealed line. After all pipes are cleaned, air shall be slowly supplied to the plugged pipe installation until the internal air pressure reaches 4.0 psig (greater than average groundwater backpressure that may submerge the pipe). Throttle the air supply to maintain that constant pressure for at least 2 minutes. The air pressure supply shall then be disconnected from the system or shut-off. Do not enter manhole during test. Do not exceed 9.0 psig in the system.

Observe the continuous monitoring gauge while decreasing the pressure to no less than 3.5 psig (greater than groundwater pressure). At a reading of 3.5 (adjusted), or any convenient observed pressure reading between 3.5 and 4.0 psig (adjusted), timing shall commence with a stopwatch or other timing device that is at least 99.8% accurate. Regulate the pressure for at least 2 minutes to permit the air/ground temperature to reach equilibrium before commencing test.

Measure the time interval for pressure to drop 1.0 psig.

If the time, shown in Table I for the designated line size and length, elapses before the air pressure drops 1.0 psig, the section undergoing the test may be discontinued once the prescribed time has elapsed even though the 1.0-psig drop has not occurred. Record all readings.

If the pressure drops 1.0 psig before the appropriate time shown in Table I has elapsed, the air loss rate shall be considered excessive, and the section of pipe has failed the test. Record all readings.

If service lateral sewers are included in the test section, their lengths may be ignored for computing the required test times. The test will be slightly more severe. In the event a test section, having a total surface area less than 625 square feet, fails to pass the air test when lateral sewers have been ignored, the test time shall be recomputed to include all laterals.

If the sections fail the air test, the Contractor shall determine the source or sources of leakage and shall repair or replace all defective material and workmanship. No sealant shall be used in the newly installed sewers to correct the leaks.

The extent and type of repair that may be allowed shall be subject to the approval of the City. The repaired pipe installation shall be retested and required to meet the requirements of this test.

Safety Note: The air pressure test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. A force of 250 lbs is exerted on an 8-inch plug by an internal pressure of 5 psi. It should therefore be realized that sudden expulsion of a poorly installed plug, or a plug that is partially deflated before

the pressure is released, can be dangerous. As a safety precaution, pressurizing equipment should include a pressure regulator set at, for example, 10 psi to avoid over-pressurizing and damaging an otherwise acceptable line. **No one shall be permitted in the manholes during testing**.

TABLE I
Line Pressure Air Test Using Low-Pressure Air
SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015
(Excerpted from ASTM F 1417)

Pipe Diameter (in.)	Minimum Time (min:sec)	Length For Minimum Time (ft.)	Time For Longer Length (sec.)	Specification Time for Length (L) Shown (min:sec)							
				100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33

11) **Manhole Vacuum Testing**

Either the manholes alone, or the manholes with the main and services together may be vacuum tested as indicated below unless otherwise allowed by the City. Vacuum testing shall meet ASTM C1244 *Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.* Only new manholes are to be vacuum tested. Vacuum testing of existing manholes is not required.

The same test times applicable for manholes shall apply to the combined and simultaneous testing of manholes, mains and services (i.e. no increase in test times shall be employed by adding the sewer mains in the combination test).

The test shall be made using an inflatable compression band, vacuum pump, and appurtenances specifically designed for vacuum testing manholes. Equipment to be manufactured by Peter A Glazier & Associates, Worcester, MA or approved equal. The Contractor shall be responsible for furnishing all equipment and labor for the vacuum test at no additional cost to the City.

Manholes and mains may be tested by vacuum test immediately after assembly of the manhole, frames and connecting pipes, and before any backfill is placed around the manholes. However, the final test and acceptance shall be based only upon a test after the manhole is backfilled and the cover frame castings are grouted in place. Testing devices shall be installed on the iron manhole frame.

All lift holes shall be plugged with nonshrink grout and all pipes shall be plugged, taking care to securely brace the plugs and pipe. Stubouts, manhole boots, and pipe plugs shall be secured to prevent movement while the vacuum is drawn.

Manholes shall be tested from the top of the casting, including the casting-to-cone joint (adjusting ring).

Installation and operation of vacuum equipment and indicating devices shall be in accordance with manufacturer's recommendations.

After the testing equipment is in place, a measured vacuum of 10 inches of mercury (Hg) shall be established in the manhole. The time for the vacuum to drop to 9 inches of mercury shall be recorded.

Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from 10 inches to 9 inches of mercury[1]. See Table II, *Vacuum Test Table for Manholes*.

If the manhole/main fails the test, the Contractor shall locate the leakage, make the proper repairs, and the vacuum test shall be repeated until the manhole/main(s) passes the test. After the manholes have been backfilled

[1] 2.036 inches of Mercury = 1 psi

and the cover frame casting sealed in place, and prior to final acceptance of the project, any signs of leaks or weeping visible from the inside of the manhole shall be repaired and the manhole made watertight and tested. The extent and type of repairs that may be allowed shall be subject to the approval of the City. Leaks shall be repaired on the outside of the manhole unless approved otherwise by the City.

If a manhole joint mastic material is completely pulled out during the vacuum test, the manhole shall be disassembled and the mastic replaced.

12) **Televising of Sanitary Sewers**

TV Inspection: Upon completion of the mandrel test for deflection, the contractor shall request a final inspection by the City. The Contractor will TV the mainline using a TV inspection truck and all services inspected using a mini-cam. It is the responsibility of the contractor to flush all lines and manholes to ensure there is no sediment or debris in the lines at the time of inspection. The contractor and/or Engineer or their designated representative shall be present during the TV inspection. All inspections will be placed on a CD or flash drive. All debris should be removed.

Inspection Criteria:

a. The main lines and wyes will be checked for leaking joints, deformed pipe, cracked pipe, grade problems, excessive infiltration and overall appearance.

b. Services will be checked for leaks, cracks, broken, or missing pipe, deformed pipe, and grade**.** If defective pipe or conditions are discovered they shall be corrected at no cost to the City.

TV inspections are required following placement and compaction of backfill and completion of other required testing, but prior to placement of pavement. The City of Wilson will televise all sewer lines for conformance to the project drawings and specifications. A tape and log of the televising shall be prepared.

When the City Engineer or the Wastewater Collection ORC permits, contractors may TV their lines and deliver the tape or disk and log to the City for review. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the City; and if unsatisfactory, equipment shall be removed and no payment will be made for an unsatisfactory inspection.

The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions

shall be used to move the camera through the sewer line. If, during the inspection operation, the television camera will not pass through the entire manhole section, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire manhole section, the inspection shall be considered complete and no additional inspection will be required.

The City will also televise sewer lines prior to the expiration of the one-year warranty. If a defective condition is found, it shall be presumed to be caused by defective workmanship or materials. The Contractor shall be notified and shall correct the work in a manner approved by the City.

13) **Force mains**

a. **Order of Operations**: Except for chlorination and tests for purity, the installation of sewer force mains shall be set forth on the plans and shall meet the requirements for water mains and as set forth in these specifications. Fill the system with water at a velocity of approximately 1 foot per second while necessary measures are taken to eliminate all air. Do not leave fill line connected to sewer line unless an RPZ backflow preventer is placed between the potable water supply and the line being filled.

b. **Pressure Tests & Leakage**: The Contractor shall test completed sections of line, including fittings, with water. This testing, however, does not relieve the Contractor of his responsibility to repair or replace any cracked or defective pipe. All work necessary to secure a tight line shall be performed by the Contractor. Testing shall be performed in the presence of the City's authorized representative and the Contractor. Cost for testing shall be incidental to line construction. Final acceptance from the City shall be contingent upon all pressure and leakage tests yielding satisfactory results.

Pressure Test: The newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for two hours to a leakage test. Raise the pressure by pump to 150 psi, 150% of design working pressure, or test pressure as shown on the drawings, whichever is greater. Measure the pressure at the low point on the system compensating for gauge elevation. Maintain this pressure (+ or – 5-psi) for 2 hours. If pressure cannot be maintained using reasonable pumping rate, determine cause, repair, and repeat the test until successful. The allowable leakage shall be no greater than allowances shown in Table 4A - Hydrostatic Testing Allowance, Section 5.2, of AWWA C600-10, *AWWA Standard for Installation of Ductile Iron Water Mains and Their Appurtenances and Table2 – Hydrostatic Test Makeup Water Allowances, Section 7.3 of AWWA C605-05 AWWA Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water*. A copy of these charts is located at the rear of the City of Wilson specification Section 02510 – *Water Distribution*. Contractor shall be responsible for all costs, labor, materials, and equipment to perform the testing. All visible leaks, broken or cracked pipe, valves, etc. shall be repaired.

i. Prerequisite conditions for testing shall be as follows:

- All pipe has been laid and the trench backfilled.
- Valves shall be properly located, operable and at correct elevation.
- All reaction anchors have had sufficient set of 3 days. High early strength concrete, 4500 psi or greater, may be used to reduce number of days.
- Lines shall be properly vented where entrapped air is a consideration.
- All construction activities on the project, that requires trenching or excavation within the limits of the line location, shall be completed prior to pressure testing of line.

3.10 PUMP STATIONS AND FORCE MAINS

3.10.1 GENERAL:

A. **Self Priming Pumps**: Pumps shall be self-priming pumps with electro-mechanical controls. Pumps shall be designed for continuous duty pumping raw, unscreened wastewater. Pumps shall be capable of handling a 3-inch solid and any trash or stringy material that can pass through a 4-inch hose unless mechanical means of solids reduction is installed at the pump. Pumps shall be made non-clog by passing solids, trash, and stringy material through a non-clog or vortex-type impeller. Impellers shall have blades that are generally forward rounded or otherwise configured to avoid catching solids, trash, and stringy material.

Sewage pump selection should allow for up sizing or downsizing of impellers as dictated by sewage flows.

B. **Station Layout**: See **Standard Detail 734.02** for typical pump station site layout. Also, see **Standard Details 732.03, 732.04, 732.05, 732.06**, and **732.08** for additional information pertaining to typical installation requirements. The City of Wilson approved and permitted plans shall govern construction with regard to layout provided the minimum requirements of this section have been included, as applicable, or otherwise excepted by the City Engineer.

C. **Backup Pump/Generator**: All stations shall include a backup generator. See paragraph 3.10.3 Auxiliary Generator for specific requirements and specifications for each option.

3.10.2 MINIMUM FEATURES REQUIRED IN PUMP STATION

Lift stations shall include but are not necessarily limited to the following minimum equipment, controls, features and elements:

Lift Station Checklist

☐	1.	Inspection and Testing: Wetwell same as manhole. See paragraph 3.9.1.F.11 Manhole Vacuum Testing for manhole testing requirements.
☐	2.	Underground service preferred. When overhead service is necessary, provide a service head. Meter base, service connection, disconnect, and area light with photo cell are required.
☐	3.	Audible and visual high water alarm and alarm silence. High water alarm circuitry. Provide dual high water alarm bubbler system.
☐	4.	Provide mercury float switch type control system for high level alarm backup to SCADA and to local alarm.
☐	5.	As an alternate, a SCADA System required by Water Resources or the City Engineer and reviewed for compatibility with the City of Wilson system.
☐	6.	Primary level control shall be a bubbler system with hand-off-automatic (H-O-A) switches and an automatic alternator.
☐	7.	Automatic air release valves, as applicable.
☐	8.	Independent high water alarm circuitry.
☐	9.	3-phase power with 3-phase voltage monitor, if applicable. Indication of 3-phase power fail.
☐	10.	Suction and discharge gauges
☐	11.	Elapsed time indicators
☐	12.	High pump temperature protection
☐	13.	Pump run lights
☐	14.	Motor overload resetter
☐	15.	TLVSS Surge suppressor
☐	16.	Duplex service receptacles on GFCI installed external to the NEMA 4X enclosure
☐	17.	Surge relief valve and return piping to wetwell
☐	18.	Dual power supply auto switchover, etc.
☐	19.	Freezeless Yard Hydrant. See paragraph 2.2.17, paragraph 3.10.4, **Standard Detail 739.01**.
☐	20.	Service to hydrant with meter and RPZ backflow preventer in an insulated enclosure with locking access and heater (if applicable)
☐	21.	Cold-weather ballast fluorescent lighting and heater(s).
☐	22.	Provide condensate heater on thermostat inside pump control panel.
☐	23.	All control panels must be minimum NEMA 4X weatherproofed, constructed of stainless steel, and have weatherproof identifying labels attached with stainless steel screws.
☐	24.	Buildings designed to house pumps shall be equipped with thermostatically controlled ventilation (fan and louver) with no-spark fan (see Water and Sewer Design, paragraph 4.1.6). Building to be designed to 100 mph wind speed or meet current building specs (see Water and Sewer Design, paragraph 4.1.1.C).
☐	25.	Unless uninterruptable power supply is available, the lift station is to include back-up alarm system that operates off a 12-volt battery connection in the event of power failure. The battery system is to include a trickle charger to ensure battery integrity.
☐	26.	Control Panel Dead Front: Panels on the primary pump station and generator shall comply with NFPA 70E. The following elements, when applicable for the type system under consideration, at a minimum, shall be accessible and located in front of the dead front panel and/or barriers

		installed to make the following accessible without being exposed to live conductors: Control/programming keyboards, all hand operated switches, H-O-A switches, disconnects, pump run lights and run time gauges, alarm silence, duplex receptacles, motor overload resetter, gauges (such as ammeter, temperature, fuel level indicator), indication of 3-phase power fail, handles, GFCI switch (on/off), circuit breakers, area light, autodialer, etc.
☐	27.	Provide a permanent weatherproof sign stating the pump station identifier, 24-hour emergency number and instructions to call in case of emergency.
☐	28.	Screened vent for wetwell.
☐	29.	Emergency pump connection with 90-degree elbow, gate valve, and quick connect with gap.
☐	30.	Backup Systems: A backup generator shall be provided.
☐	31.	Provide programmable auto-exercise cycle for generator
☐	32.	Station Start-up assistance and certification: Station start-up and certification shall include an operational/witness/drawdown test
☐	33.	Provide 2,000 gallon emergency overflow tank for stations up to 1,000 gpm and 3,000 gallon emergency overflow tank for flows 1,001 to 2,000 gpm.

3.10.3 BACKUP GENERATOR OPTION

Provide auxiliary natural gas, LP gas, or diesel fired automatically activated stand-by power generator source with automatic reset, placed on site. Generator must be duel fuel. The engine set and generator shall be from the same manufacturer. Pump manufacturer to provide power demand/ratings to Contractor before ordering pump and the power demand appropriately marked on the pump shop drawings. Generator shall have the capacity sufficient to sequentially start and run all pumps in the pump station. The Contractor shall provide a complete engine driven generator set. The generator set shall consist of four-cycle, radiator-cooled, engine direct connected to an alternating current generator, a unit-mounted control panel, all mounted on a common sub-base. The control panel shall be complete with engine controls and instruments, safety controls and panel lights and include, but not necessarily limited to, the following:

A. The generation unit shall be capable of powering the pump motors starting current, electrical systems, instrumentation/controls and alarm systems, and other auxiliary equipment as may be necessary to provide for the safe and effective operation of the pump station. The generation unit shall have the appropriate power rating to start and continuously operate under all connected loads plus 10%.
B. The generation unit shall be provided with special sequencing controls to delay lead and lag pump starts unless the generating unit has the capacity to start all pumps simultaneously while the auxiliary equipment is operating.
C. The generation unit shall be capable of shutting down and activating the audible and visual alarms and telemetry if a damaging operating condition develops.
D. The generation unit shall be protected from damage when restoration of power supply occurs.

E. The generator shall be equipped with an automatic transfer switch to start generator and transfer load to emergency in case of utility under voltage, over voltage, power loss, phase reversal, or phase loss. Response time on transfer switch, due to loss of utility power, needs to be adjustable by owner.
F. The control panel shall be complete with run-stop-remote switch; remote start-stop terminals; cranking limit; battery charge rate ammeter, oil pressure gauge, temperature gauge; low oil pressure shutdown; high engine temperature shutdown; over speed shutdown; AC voltmeter; voltage adjustment; frequency meter; and running time meter. Switches and gauges shall be located in front of the dead front and/or barriers to make them accessible without being exposed to live conductors and shall comply with NFPA 70E.
G. Circuit breakers shall be provided with a built in control panel.
H. Provide manufacturer's recommended anti-freeze, engine heaters, and suitable trickle battery charger. All accessories shall be engine-mounted and within the weatherproof sound attenuated housing.
I. The manufacturer of the unit shall completely assemble and test the unit before shipment. He shall be one who is regularly engaged in the production of such equipment, and who has spare parts and service facilities.
J. The controls must indicate engine run, common engine fail, transfer switch position, low fuel level, and fuel tank leak for remote telemetry purposes. Lights and gauges must be located in front of the dead front and/or barriers to make them accessible without being exposed to live conductors and shall comply with NFPA 70E.
K. The automatic transfer switches must have a disconnect on the utility service main side.
L. The generator shall comply with the following minimum requirements:
    1. Engine: Four-cycle, 4 cylinder, radiator cooled, at 1800 RPM. Starting shall be from batteries, with capability to start the unit at 32 degrees temperature.
    2. Generator: Rating shall be continuous standby service at 0.8 power factor, at 1800 RPM.
    3. Voltage: Three-phase. KW rating to match facility needs plus 10%.
    4. Engine shall be equipped with an isochronous governor.
    5. Frequency regulation shall be less than 3-cycles from no-load to full load.
M. All accessories needed for the proper installation of the system shall be furnished. Included should be batteries, battery cables, exhaust piping, mufflers, and vibration mounting. Batteries should be lead acid.
N. The generator set shall be enclosed with a factory-installed weather-protective housing (sound abating enclosure to 68db @ 23 ft.) Housing shall provide easy access to the engine-generator and instrument panel. Muffler to be designed so exhaust is not blown or sucked across the set by cooling air.
O. Included with the generator shall be a complete fuel system consisting of a fuel tank, fuel gauge, fuel lines, fuel pumps (if applicable), valves and any and all other items incidental to a first-quality installation.
P. Diesel Option: Provide integral sub-base double-walled diesel tank. The tank is to be UL approved closed-top dike type. The tank shall also be fitted with a leak sensor device. The tank must have a capacity to run the generator for a minimum of 24 hours at 100% load.
    Tank shall consist of the fuel tank separate and contained within the frame. No generator weight is to be supported by the tank. Provide a drain plug at one end of the rupture basin. Provide vibration isolators between generator set and tank assembly. Provide fuel low-level alarm remote mounted.

Q. LP Option: The tank must have a capacity to run the generator for a minimum of 24 hours at 100% load.
R. Provide manufacturer's recommended anti-freeze and engine block heater with thermostatic controls to maintain engine coolant at proper temperature to fulfill start-up requirements, adjustable if possible. Provide suitable trickle battery charger. All accessories shall be engine-mounted and within the weatherproof sound attenuated housing.
S. Provide annunciator panels with visual and audible alarms to monitor and warn of emergency operation conditions affecting line and generator power sources.
T. Provide stainless steel super critical grade type exhaust silencer mounted inside of the generator enclosure for corrosion protection.
U. Provide amp meter, voltmeter, and frequency meters with phase switches. Meter gauges shall be located in front of the dead front and/or barriers to make them accessible without being exposed to live conductors and shall comply with NFPA 70E.
V. Provide fuses or circuit breakers for battery charger and engine.
W. Provide an automatic battery charger, static type, magnetic amplifier control with DC voltmeter, DC ammeter and potentiometer for voltage adjustment. The charger is to be completely automatic and rated for the type of battery use. The charging rate is to be determined by the state of the battery and reducing to milliamp current on fully charged battery. The charger shall be 120 V., single-phase, 60 cycle, AC input with 6-amp maximum output.
X. Operation and Maintenance instructions: The Contractor shall provide a minimum of four continuous hours of operation and maintenance instructions for the Owner's personnel.
Y. The City must be furnished with one complete set of air, oil and fuel filters.
Z. Provide 5-year warranty from manufacturer of Generator and Engine.
AA. Provide three bound (3-ring binder) sets of Operation and Maintenance Manual with parts list for all components relative to lift station generator.

3.10.4 MISCELLANEOUS REQUIREMENTS

A. **Pump Certification**: Manufacturer's representative shall be present at pump start-up. See paragraph G, *Pump Station Operational/Witness Test/Start-up* requirements, below.

B. **Wetwell Coating**: Wetwell interiors shall be coated with a two component elastomeric, hydrophobic, corrosion resistant polyurea coating where the primer can be applied to damp or dry surfaces. Primer coat film thickness shall be 1.5 to 3 mils. The top coat film range shall be from 8 to 12 mils. Shore hardness D shall be minimum 75. Coating shall equal or exceed Duramer K-2002 by Innovative Polymer Solutions, LLC. Contractor to follow all applicable safety measures for handling and application as recommended by the Manufacturer of the coating. Comply with applicable confined space safety requirements.

C. **Setting Non-Freeze Yard Hydrants**

1. Contractor to provide elbow and transition fittings for connection to water service. Yard hydrants to be set with the hose nozzle a minimum of 18 inches above finished grade. Bury depth to be minimum 24 inches. Elbow is to rest on a 4" x 24" x 24" concrete pad.

2. Place 1 cubic foot of #57 stone around valve with stone placed a minimum of 4 inches above the drain hole. Prior to backfilling stone, place a layer of non-woven separation fabric over stone. Backfill and compact.

3. Once the hydrant has been set, construct a 4" x 24" x 24" concrete pad around hydrant.

4. See **Standard Detail 739.01**.

D. **Force mains**: Force mains shall be constructed in accordance with the plans and in accordance with the requirements applicable to water main construction. Pipe joints shall be push on, mechanical joint type, or as indicated on the approved drawings for the type pipe required. 3-inch and larger fittings shall be mechanical joint with appropriate restraint.

E. **Manuals/Parts**: The City must be furnished with three bound copies (3-ring binder) of the Operation and Maintenance and Parts Manuals with parts list for the pumps/motors and/or station, pump controls, the generator unit, and the automatic transfer switch as well as all other components relative to lift station generator. Also, provide a spare impeller, key, nut, washer, and mechanical seal for each pump.

F. **Safety Placards**: Provide safety placards as required for structure (e.g. confined access entry) and equipment as required by OSHA shall be posted and readily visible.

G. **Pump Station Operation/Witness Test/Start-up:**

1) **Witnessed Testing**: Witness testing shall be performed in the presence of the City's authorized representative and the results of the testing maintained as part of the construction record documentation. Witnessed testing shall include start-up assistance by a qualified factory representative and certification. Prior to acceptance by the City, an operational test of all pumps, drive, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

After construction debris and foreign material has been removed from the wetwell, the Contractor shall supply an adequate amount of clear water volume to operate station through several pumping cycles. Observe and record operation of pumps, suction (if applicable) and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration, or other operational problems.

2) **Drawdown test**: The Contractor shall conduct a drawdown test to confirm that the pump is operating at or near the required design operating point and to determine the actual pumping rate of each pump. This test shall be conducted in the presence of the City's authorized representative, the Contractor and a representative of the pump manufacturer. The rate shall be determined by subtracting the starting static surface elevation of the water in the wetwell from

the “off” elevation and multiplying the difference by the volume per vertical foot of wetwell. That number shall then be divided by the number of minutes of pump run time to affect the drop measured. This test shall be performed for each pump and the rates recorded for each pump and included as part of the record in the certified pump test.

3) **Manufacturers Start-up Services**: The manufacture’s representative shall be present at pump start up. Co-ordinate station start-up with manufacturer’s technical representative. The representative or factory service technician shall inspect the completed installation. He shall calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

3.11 PIPE DESIGN LIFE

In addition to the above noted specifications, the Contractor shall secure and the manufacturer shall furnish and warrant that sanitary sewer pipe is designed for a 50-year life.

3.12 CLEANUP AND RESTORATION OF SITE

After the backfill is completed, the contractor shall dispose of all surplus material, dirt and rubbish from the site, and shall keep the site free of mud and dust to the satisfaction of the City. The Contractor may be required to flush or sprinkle the street to prevent dust nuisance. It is important that clean up and restoration of the site follows the work closely. The Contractor shall dispose of surplus material and clean the street at the end of each day for the portion of work completed that day unless additional cleaning is required. After all work is completed, the Contractor shall remove all tools and other equipment, leaving the site free, clean, and in good condition.

TABLE II VACUUM TEST TABLE FOR MANHOLES BASED ON ASTM C1244					
MINIMUM TEST TIMES FOR VARIOUS manhole DIAMETERS FOR PRESSURE DROP FROM 10 INCHES TO 9 INCHES HG.					
	DIAMETER (FEET)				
Depth (FT)	4	4.5	5	5.5	6
	TIME (SECONDS)				
6	15				
8	20	23	26	29	33
10	25	29	33	36	41
12	30	35	39	43	49
14	35	41	46	51	57
16	40	46	52	58	67
18	45	52	59	65	73
20	50	53	65	72	81
22	55	64	72	79	89
24	59	64	78	87	97
26	64	75	85	94	105
28	69	81	91	101	113
30	74	87	98	108	121

END OF SECTION 02530

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02630 – STORM DRAINAGE

(Last revised 9/18/19) R1; R2 4/11/23, Section 3.12

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1 – GENERAL

1.1 GENERAL

A. The Contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the furnishing and installation, complete, of all operations in connection with excavation, trenching, and backfilling of underground stormwater utilities and appurtenances as shown on drawings and as specified, in accordance with provisions of the Contract Documents, and completely coordinated with work of all other trades.

Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation.

Work included in the project consists of, but is not necessarily limited to, methods of installation of the following:

1) Storm sewer pipe Installation & appurtenances.

2) Precast, cast-in-place, and masonry storm sewer structures & appurtenances.

3) Drainage ditches, channels, swales, BMP's and appurtenances.

4) Relocation of piping systems.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. Section 00825 – *Product Substitions*

C. Section 00950 – Measurement and Payment

D. Section 02275 – Trenching, Backfilling, and Compaction of Utilities

E. Section 02530 – Sanitary Sewer

F. Section 02632 – Segmental Concrete Retaining Wall System

G. Section 02920 – Seeding, Sodding, and Groundcover

H. NCDEQ Division of Energy, Mineral, and Land Resources, Land Quality Section's "Erosion and Sedimentation Control Planning and Design Manual" latest revision.

I. City of Wilson List of Approved Manufacturers and Products

J. City of Wilson *Right-of-Way Regulations and Procedures*, latest edition

1.3 SUMMARY

This section includes all equipment, labor, material, appurtenances, and services required for complete installation of storm drainage piping, ditches, structures, and specialties for municipal drainage systems.

1.4 DEFINITIONS

A. General

For the purposes of this specification, the following definitions refer to storm water drainage systems and structures that come under the authority of the City of Wilson, North Carolina as specified within this section and other sections of this manual.

B. **City Engineer:** The City Engineer or his designated representative.

C. **Contractor**: Refers to a Contractor licensed in the State of North Carolina to perform grading and earthwork construction.

D. **Public Storm Drainage System**: Drainage systems and their appurtenances required for the conveyance of public storm water from and across publicly maintained streets, roads, highways, and other public property and located within public rights-of-way and/or easements.

E. See also paragraph 1.4, Definitions of section 02275, *Trenching, Backfilling and Compaction of Utilities.*

F. The following are industry abbreviations for various pipe materials.

1) **CAP**: Corrugated Aluminum (Alloy) Pipe

2) **RCP**: Reinforced Concrete Pipe

3) **HDPE**: High Density Polyethylene (NCDOT Approved) double walled pipe.

1.5 SUBMITTALS

A. Submit shop drawings on all non-standard or alternate products/materials to the City Engineer in accordance with Section 00825 – *Product Substitions*.

B. Submit product data and shop drawings for the following.

1) Drop/curb inlets
2) Frame and covers
3) Head/end walls
4) Inlet grates
5) Concrete pipe and piping specialties
6) Precast concrete manhole castings
7) Corrugated Aluminum Pipe
8) HDPE fittings

1.6 QUALITY ASSURANCE

A. Materials and operations shall comply with the latest revision of all applicable Codes and Standards.

B. **Geotechnical Testing Agency Qualifications**: An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing as documented according to ASTM D3740 and ASTM E548. Testing Lab to be AMRL (AASHTO Materials Reference Laboratory) and CCRL (Cement and Concrete Reference Laboratory) certified.

C. Piping materials shall be marked clearly and legible on the outside of each section of pipe and pipe end.

1) Reinforced Concrete Pipe shall be marked as follows:

a. Pipe Class and wall type,
b. Inside diameter of pipe product
c. Manufacturer name or trademark of manufacturer
d. Date of Manufacture
e. State assigned plant number

2) Corrugated Aluminum Pipe shall show identification marks on pipe as follows:

a. Manufacturer's Name or Trade Mark,
b. Nominal thickness and type of aluminum
c. Specification Designation
d. Plant Designation Code
e. Date of Manufacture

3) Double walled corrugated HDPE pipe, end sections, tees, elbows and accessories shall be marked as follows:
a. AASHTO Designation
b. The date of manufacture
c. Name or trademark of the manufacturer

1.7 QUALITY STANDARDS

A. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Society for Testing and Materials

ASTM C33	Concrete Aggregates
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates Sieve Analysis of Fine and Coarse Aggregate
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C990	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils (for classification purposes only)
ASTM D698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (Standard Proctor).
ASTM D1556	Standard Method of Test for Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (Modified Proctor).
ASTM D2049	Standard Method of Test for Relative Density of Cohesionless Soils
ASTM D2167	Standard Method of Test for Density of Soil in Place by the Rubber-Balloon Method
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
ASTM D2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
ASTM D3740	Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
ASTM D4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
ASTM D4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection and/or Testing
ASTM E548	Standard Guide for General Criteria Used for Evaluating Laboratory Competence
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F2306	Standard Specification for 12 to 60 in. Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications

American Association of State Highway & Transportation Officials

AASHTO M86	Concrete Sewer, Storm Drain, and Culvert Pipe
AASHTO M170	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
AASHTO M198	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets.
AASHTO M199	Precast Reinforced Concrete Manhole Sections
AASHTO M206	Reinforced Concrete Arch Culvert Storm Drain and Sewer Pipe
AASHTO M207	Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
AASHTO M242	Reinforced Concrete D-Load Culvert, Storm Drain and Sewer pipe
AASHTO M259	Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers

AASHTO M273	Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less than 2 feet of Cover Subject to Highway Loadings
AASHTO M294	Corrugated Polyethylene Pipe, 12- to 24-inch Diameter for Type S.
AASHTO T99	The Moisture-Density Relations of Soils using a 5.5-pound Rammer and a 12-inch drop.
AASHTO M145	The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.
AASHTO T180	The Moisture Density Relations of Soils using a 10-pound Rammer and an 18-inch drop.
AASHTO T191	Density of Soil In-Place by the Sand-Cone Method
AASHTO T204	Density of Soil In-Place by the Drive Cylinder Method – Replaced by ASTM D2937
AASHTO T205	Density of Soil In-Place by the Rubber-Balloon Method – Replaced by ASTM D2167

B. Standard Abbreviations:

AASHTO	American Association of State Highway Transportation Officials.
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
AREA	American Railway Engineers Association
ASCE	American Society of Civil Engineers
ASTM	ASTM International, formerly *American Society for Testing and Materials*
CRSI	Concrete Reinforcing Steel Institute
FS	Federal Specifications
MSDS	Material Safety Data Sheets
NCDOT	North Carolina Department of Transportation
NCMA	National Concrete Masonry Association

NCSPA National Corrugated Steel Pipe Association

OSHA Occupational Safety and Health Administration

USACE United States Army Corps of Engineers

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. **Pipe Condition/Pipe Examination**:

1) **New Pipe Inspection – All pipe**: Inspect materials thoroughly upon arrival. Examine materials for damage. Remove damaged or rejected materials from site. Pipe shall be protected during handling against impact shocks and free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM Specifications.

a. **Concrete Pipe:** Check bells and spigots closely for smoothness, roundness, and honeycombing (concrete pipe), which may be a source of infiltration. Check for cracks, chips, etc. on both ends. Reject any pipe that will not provide soil-tight seal or is otherwise structurally deficient.

b. **Corrugated Aluminum Pipe, Coupler Bands, Terminal Sloped End Section and other Special Fittings**: All corrugated aluminum pipe, fittings and coupler bands shall be unloaded and handled with reasonable care. Pipe and fittings shall not be dragged over gravel or rock and shall be prevented from striking rock or other hard objects during placement on bedding. Pipe with protective coatings shall be handled with special care to avoid damage. Pipe on which such coatings have been damaged shall, unless repaired to the satisfaction of the City Engineer, be rejected at the site of the work regardless of previous approvals. Pipe having any localized bends in excess of 5 percent of the specified pipe diameter or any dent in excess of ½ inch shall be rejected. Rejected damaged pipe may be used if repaired to the satisfaction of the City Engineer. Repair may be made by jacking or by any other method meeting the approval of the City Engineer.

2) **Pre-Installation Inspection**: Prior to being installed, each section of the pipe shall be carefully examined for damage and conformity with these specifications. All pipes damaged or deemed not to conform to these specifications shall be rejected and removed from site.

a. **Concrete Pipe**: All concrete pipes in which the spigots and bells cannot be made to fit properly, or pipe, which has chipped bells or spigots, will be rejected. The faces of all spigots ends and of all shoulders on the bells of rigid pipe must be true.

b. **Corrugated Aluminum Pipe**: All aluminum pipes in which the pipe and bands cannot be made to fit properly shall be repaired as directed by the City Engineer, and if it cannot, it will be rejected. Protect pipe coating during handling using methods recommended by the manufacturer. Use of bare cables, chains, hooks, metal bars, or narrow skids in contact with coated pipe is not permitted.

c. **Double Walled HDPE Pipe**: All double walled corrugated HDPE pipe in which the pipe and fittings cannot be made to fit properly shall be rejected. Protect pipe during handling using methods recommended by the manufacturer.

B. Observe manufacturer's directions for delivery and storage of materials and accessories.

C. Protect stored piping from entry of water or dirt into pipe. Protect bells and flanges of special fittings from entry of moisture and dirt.

D. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.9 PROJECT CONDITIONS

Storm Drainage Manholes – No water mains shall pass through or come in contact with any part of a storm drainage manhole. A minimum of 3 feet of horizontal separation shall be maintained between water mains and storm drainage manholes unless otherwise approved by the City Engineer or Stormwater Program Manager. Interference/conflict manholes will not be permitted unless otherwise approved by the City Engineer or Stormwater Program Manager.

See also paragraph 1.9 "Project Conditions" of section 02275, *Trenching, Backfilling and Compaction of Utilities*.

1.10 SERVICE INTERRUPTION

For service interruption, operation of valves, taps, fire hydrant operation, etc, contact the Water Resources Division at 296-3403. Provide a minimum of 48 hours notice or desired utility interruption or necessary operation of valves or hydrants.

1.11 COORDINATION

A. Coordinate tie-in to municipal or NCDOT junction boxes or catch basins with the City Engineer or Stormwater Program Manager.

B. Coordinate water service interruption with the City Engineer or Stormwater Program Manager. See paragraphs 1.11 and 1.12 of Section 02510 – *Water Distribution* for other requirements and procedures.

C. At the direction of the City Engineer or Stormwater Program Manager and/or Water Resources Manager, temporary pumping/bypass of sewerage flow may be required to be provided. See Section 02530 - *Sanitary Sewer* for by pass pumping requirements and procedures.

D. When traffic signals, loops, or their appurtenances are likely to be damaged or interfere with construction, coordinate temporary operation with the applicable agency having jurisdiction of the signals. Provide a minimum of 1 weeks' notice prior to anticipated disturbance or interruption. At the discretion of the City Engineer or Stormwater Program Manager, the notice may be required to be published in the newspaper.

E. **Repair of pavement markings**: When cuts are made through any paved surface and the cuts extend through the pavement markings, the replaced pavement shall be marked to match the existing.

F. **Benchmark/Monument Protection**: Protect and maintain benchmarks, monuments or other established reference points and property corners. If disturbed or destroyed, they must be replaced at contractor's expense by a Licensed Professional Surveyor to full satisfaction of Owner/City of Wilson.

G. Before Digging, contact ***"NC One Call"*** at 811 for location services.

811 Know what's below. Call before you dig.

1.12 PUBLIC CONVENIENCE

The contractor shall at all times so conduct his work as to ensure the least possible inconvenience to the general public and the residents in the vicinity of the work. Fire hydrants on or adjacent to the work shall be kept accessible to firefighting equipment at all times. Temporary provisions shall be made by the Contractor to ensure the proper functioning of all gutters, sewer inlets, drainage ditches, and irrigation ditches, which shall not be obstructed except as approved by the City Engineer or Stormwater Program Manager.

1.13 TRAFFIC CONTROL

A. When working within any NCDOT System road or highway, conform to the *Manual on Uniform Traffic Control Devices*, latest revision (MUTCD) as well as the NCDOT Standard Specifications for Roads and Structures, latest revision.

B. Traffic Maintenance shall comply with the latest revision of the NCDOT Standard Specifications for Roads and Structures, Division 9 – *Signing* and Division 11 – *Work Zone Traffic Control*, as well as other applicable sections.

C. A traffic control plan shall be submitted to the City Engineer or Stormwater Program Manager and NCDOT (if applicable) for approval.

D. When traffic signals or their appurtenances are likely to be damaged or interfere with the construction, coordinate temporary operation with the NCDOT or the City Engineer or Stormwater Program Manager. Provide 1 weeks' notice prior to anticipated disturbance or interruption.

E. Whenever it becomes necessary to leave a section of trench open after completion of the day's work, the contractor shall provide barricades and lights to protect the public. Operate warning lights during hours from dusk to dawn each day and as otherwise required for inclement weather and visibility.

F. Any work performed on a municipal public right-of-way or easement is required to obtain an encroachment permit from the City of Wilson. Refer to the *City of Wilson Right of Way Regulations and Procedures*. A copy of the approved permit is required to be on the project site at all times.

1.14 EROSION AND SEDIMENTATION CONTROL AND NPDES MONITORING, CONTROLS, AND LIMITATIONS FOR PERMITTED DISCHARGES

See paragraph 1.14 of section 02275, *Trenching, Backfilling and Compaction of Utilities*.

PART 2 – PRODUCTS

2.1 PIPE & FITTINGS

2.1.1 CORRUGATED ALUMINUM ALLOY PIPE

A. CORRUGATED ALUMINUM ALLOY PIPE

Corrugated aluminum alloy pipe must meet the requirements of AASHTO M196 except that Type IA pipe will not be permitted. The pipe sizes, gauges, and corrugations shall be as shown on the plans. Handling and assembly shall be in accordance with NCSPA's (National Corrugated Steel Pipe Association) recommendations.

B. JOINTS & FITTINGS IN CORRUGATED ALUMINUM ALLOY PIPE

Corrugated aluminum alloy pipe end sections and other fittings shall meet the requirements of AASHTO M196.

2.1.2 CONCRETE PIPE

A. PLAIN CONCRETE PIPE (NOT PERMITTED)

B. REINFORCED CONCRETE PIPE

Reinforced concrete culvert pipe shall meet the requirements of AASHTO M170 for the class of pipe called for on the plans. The design wall thickness shall be the wall thickness shown in AASHTO M170 for the applicable class and wall.—RCP shall be a minimum of Class III, Wall. Concrete pipe joints shall be tongue and groove type unless otherwise specified. RCP shall conform to the requirements of applicable sections of the latest revision of the NCDOT *Standard Specifications for Roads and Structures*.

RCP Class III or IV shall also meet ASTM C76, *Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe*.

Gasketed joints in concrete pipe shall meet the requirements of paragraph *2.2.15, Preformed Plastic Gaskets*. Mortar joints shall meet the requirements of paragraph 3.1.1 G 1), *Mortar Joints*.

2.1.3 HDPE CORRUGATED POLYETHYLENE PIPE (ALLOWED OUTSIDE OF R/W ONLY)

Pipe shall be high-density polyethylene corrugated exterior/smooth interior pipe. 15-inch through 36-inch diameters shall meet all the requirements of AASHTO M294, Type S *Specification for Corrugated Polyethylene Pipe, 12- to 36-inch diameter.* 42-inch and 48-inch diameters shall have minimum pipe stiffness of 20

and 17 psi, respectively, at 5% deflection; and shall meet all other requirements of AASHTO M294.

Pipe coupling bands and end treatments shall conform to AASHTO M294.

2.1.4 CORRUGATED METAL PIPE (NOT PERMITTED)

2.2 MISCELLANEOUS APPURTENANCES

2.2.1 BEDDING

See Section 02275, *Trenching, Backfilling, and Compaction of Utilities*.

2.2.2 BRICK

Brick shall be hard clay, grade SM, ASTM C 32, *Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)* and AASHTO M91.

2.2.3 CATCH BASIN DROP INLETS & COMBINATION CURB OPENING INLETS

A. Catch basin drop inlet or combination curb inlet boxes may be either precast reinforced concrete or concrete block. Precast inlet boxes shall conform to the requirements of *paragraph 2.2.14, Precast Underground Concrete Utility Structures*, as well as all applicable sections of the latest revision of the *NCDOT Standard Specifications for Roads and Structures*. Refer to **Standard Details 633.02 633.03, 634.02, and 639.01**.

B. Inlet grates shall conform to the requirements of paragraph *2.2.8, Miscellaneous Gray Iron Castings*, and the applicable sections of the latest revision of the NCDOT *Standard Specifications for Roads and Structures*.

C. See the *City of Wilson List of Approved Manufacturers and Products* for a list of acceptable manufacturers and models.

2.2.4 CONCRETE BLOCK

Concrete block shall conform to the requirements of ASTM C139, *Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes*.

2.2.5 CONCRETE FLARED END SECTIONS

Concrete flared end sections shall meet all applicable requirements of AASHTO M170 except those pertaining to design. All concrete flared end sections shall be reinforced. The concrete used in flared end sections shall be air entrained and shall attain strength of 3500 psi when tested in accordance with AASHTO T22. 3:1 slopes are required on flared ends.

2.2.6 CONCRETE PIPE TEES AND ELBOWS (NOT PERMITTED)

2.2.6 GEOTEXTILE FABRIC:

Geotextile fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to mildew, rot, insects, and rodents; and biologically and thermally stable. Geotextile fabric for subsurface installation shall not be exposed to direct sunlight for more than 24 hours before or during installation.

A. **Filter Fabric for Rip Rap**: Filter Fabric for Rip Rap and Rip Rap Beddings shall conform to Section 1056 – *Geosynthetics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 2 engineering fabric.

B. **Fabric for Subsurface Drains**: Non-woven needle-punched fabric for subsurface drains shall conform to Section 1056 – *Geosynthetics* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Type 1 engineering fabric.

2.2.7 MANHOLE FRAMES AND COVERS

A. **Standard Frames and Covers:** Manhole frames and covers shall meet ASTM A48 *Standard Specification for Gray Iron Castings*, Class 35B, traffic frame and cover. See the *City of Wilson List of Approved Manufacturers and Products* for a list of acceptable manufacturers and models. Standard manhole frames and covers shall be manufactured to the dimensions and configurations shown on **Standard Detail C06.01** and shall have a minimum of four 1-inch diameter holes in the flange of the frame. Minimum inside diameter of the opening shall be 23 1/2 inches. Manholes castings may be either bituminous coated or plain. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Weights shall not vary more than 5%+/- of the weight shown on **Standard Detail C06.01**.

B. **Cast-in-Place Frames and Covers**: Manhole frames and covers shall meet ASTM A48 *Standard Specification for Gray Iron Castings*, Class 35B, traffic frame and cover. See the *City of Wilson List of Approved Manufacturers and Products* for a list of acceptable manufacturers and models. Cast-in-place manhole frames and covers shall have a minimum inside opening diameter of 24 inches. Frames shall be plain un-coated. Manholes covers may be either bituminous coated or plain. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking.

See the *City of Wilson List of Approved Manufacturers and Products* for a list of acceptable manufacturers and models.

2.2.8 MISCELLANEOUS GRAY IRON CASTINGS

Catch basin frames and grates: Supply gray iron castings meeting the requirements of ASTM A48 *Standard Specification for Gray Iron Castings*, Class 35B of AASHTO M306 as manufactured by Capitol Foundry, US foundry or East Jordan Iron Works. Boldly fillet castings at angles, and provide rises that are sharp and perfect. No sharp, un-filleted angles or corners are permitted. Provide castings that are true to pattern in form and dimension, free from pouring faults, sponginess, cracks, blowholes, and other defects affecting their strength and value for the service intended. Welding is not allowed for the purpose of making a casting structurally sound. Welding for cosmetic or other purposes is not allowed without approval of the City Engineer or Stormwater Program Manager. The iron

material used in products provided shall have a minimum recycled material content of 75%. The recycled material shall consist of post-consumer material.

2.2.9 MISCELLANEOUS CONCRETE

A. Ready mixed concrete shall comply with ASTM C94, Standard Specification for *Ready-Mixed Concrete.* All exposed concrete shall be air entrained. Concrete strength shall be as specified on standard details and drawings. Unless otherwise specified, all concrete shall be NCDOT Class B concrete, minimum.

B. Concrete Class and corresponding Minimum Compressive Strength Table:

NCDOT Class of Concrete[A]	Minimum Compressive Strength of Concrete (f'c) at 28 days
Units	psi
AA	4,500
A	3,000
B	2,500

[A]Refer to Table 1000-1 for specific properties/requirements relating to the particular Concrete Class

2.2.10 MISCELLANEOUS STORMWATER APPURTENANCES

All miscellaneous stormwater appurtenances including but not limited to Endwalls, Headwalls, and Flared end sections shall conform to all applicable sections of the latest revision of the NCDOT *Standard Specifications for Roads and Structures*.

2.2.11 MORTAR FOR CONCRETE BLOCK & BRICK

Mortar shall be type M, ASTM C270, *Standard Specification for Mortar for Unit Masonry* and ASTM C144, *Standard Specification for Aggregate for Masonry Mortar.* Mortar shall be prepared from cement in perfect condition and shall be prepared in boxes for that purpose. No mortar that has stood beyond 45 minutes shall be used.

When specified by the City Engineer or Stormwater Program Manager, grout for cellular fill of block or voids shall be comprised of 3000-psi ready mix concrete with pea gravel aggregate. Do not provide air entrainment unless specified by the City Engineer or Stormwater Program Manager.

2.2.12 PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specification for Portland Cement*.

2.2.13 PRECAST REINFORCED CONCRETE MANHOLES

A. Precast reinforced concrete manholes shall be designed and manufactured in accordance with ASTM C478, *Standard Specification for Precast Reinforced Concrete Manhole Sections*, latest revision and AASHTO M199. Either an "O" ring joint conforming to the requirements of AASHTO M198 and ASTM C443 *Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets* or joints conforming to AASHTO M199 and ASTM C990 *Standard*

Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants may be used.

Type Concrete used in the construction of the manholes shall have a minimum 28-day compressive strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 *Standard Specification for Concrete Aggregates* and ASTM C94 *Standard Specification for Ready-Mixed Concrete*. Manholes shall have monolithic base and eccentric cone flattop as applicable. Structures are to have steps. Manholes will have extended bases with appropriate reinforcing as directed by the City Engineer or Stormwater Program Manager. See the *City of Wilson List of Approved Manufacturers and Products* for a list of acceptable manufacturers and models.

2.2.14 PRECAST UNDERGROUND CONCRETE UTILITY STRUCTURES

A. Structures of precast reinforced concrete shall be designed and manufactured in accordance with ASTM C913, *Standard Specification for Precast Concrete Water and Wastewater Structures* and ASTM C858, *Standard Specification for Underground Precast Concrete Utility Structures*, latest revision with preformed butyl rubber joint sealant meeting ASTM C990, *Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed flexible Joint Sealants*, latest revision. Type Concrete used in the construction of the Utility Structures shall have a minimum 28-day compressive strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 *Standard Specification for Concrete Aggregates* and ASTM C94 *Standard Specification for Ready-Mixed Concrete*. Unless shown otherwise on the drawings, structures are to have steps. Steel reinforcing shall conform to the requirements of ASTM C857, *Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures,* latest revision. Structures shall be designed for an H20-44 loading in traffic areas. See the *City of Wilson List of Approved Manufacturers and Products* for a list of acceptable manufacturers and models.

B. Concrete to be minimum 4000 PSI. Provide all reinforcing steel which meets ASTM A615 for Grade 60 and welded wire fabric conforming to ASTM A185. Welded wire fabric may be substituted for rebar as long as the same area of steel is provided.

C. Place lift holes or pins in accordance with OSHA standard 1926.704, *Requirements for Precast Concrete*.

D. Provide Precast structures over 4’-0” in depth with steps as directed by the City Engineer or Stormwater Program Manager.

E. All junction boxes that are not grated are to be manufactured to receive manhole iron castings. No blind manholes are permitted.

2.2.15 SOIL TIGHT PREFORMED PLASTIC GASKETS (JOINT SEALER)

Soil-Tight Gaskets: Preformed plastic gaskets shall meet federal specification SS-S-210 (210-A) AASHTO M198, Type B/ASTM C990 Type 1, Rope – Butyl Rubber. Preformed butyl gaskets shall be used with structures meeting ASTM C478, ASTM C990 and AASHTO M199.

2.2.16 REINFORCING STEEL

Reinforcing steel shall conform to ASTM A615 *Specification for Deformed Billet-Steel Bars for Concrete Reinforcement,* Grade 60.

2.2.17 RIP RAP AND RIP RAP BEDDING

Rip Rap and Rip Rap Bedding shall conform to Section 1042 – *Rip Rap Materials* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision for Class A, B, 1 and 2 rip rap.

2.2.18 SUBSURFACE DRAINAGE

Subsurface drains shall conform to Section 1044 – *Subsurface Drainage Materials* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision.

PART 3 – EXECUTION

3.1 PIPE INSTALLATION - GENERAL

3.1.1 CONSTRUCTION – ALL PIPE

A. **Trench Width**: Trench width shall be per **Standard Detail 511.02** unless approved otherwise by the City Engineer or Stormwater Program Manager.

B. **Minimum Pipe Bedding Requirements**: See paragraph

C. **Pipe Laying Direction**: Place piping beginning at low point and progress uphill. Place on grade, with unbroken continuity in invert, horizontally and vertically, and on alignment as indicated on plans. Place bell or groove ends of piping facing upstream. Install gaskets, seals, sleeve, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Place non-woven Geotextile fabric around joints as specified in paragraph 3.3.1.G .3), Wrapping Joints.

D. **Directional changes in gravity lines**: Use manholes for changes in direction of gravity lines. The City Engineer or Stormwater Program Manager may permit horizontal curves in pipe alignment for pipe greater than 48 inches in diameter where pipe has been manufactured with a beveled end.

E. **Stringing out Pipe**: When pipe is strung out during unloading, it shall be set on high ground and in a position to prevent silt deposits, storm water, or other matter from entering the pipe prior to its placement in the trench.

F. **OSHA Trench Protection**: Adhere to all OSHA requirements for trench slope protection, particularly Subpart P, *Excavations*, of 29 CFR 1926, latest revision. Trench walls may have vertical sides up to a maximum height of 5 feet above subgrade elevation. Beyond this depth, the entire sides must be laid back or a trench box, certified for the depths being used, must be used. Contractor is responsible for determining the proper and applicable slope based on type soil in order to meet Subpart P, *Excavations*, latest requirements. Laying back slopes

also applies for areas where the top of the trench box is lower than the top of the bank. Contractor shall employ the services of a Geotechnical engineer for direction and guidance if unstable or difficult soils are encountered. In any event, the Contractor shall hold the City of Wilson harmless for injuries and/or damages resulting from failure to properly adhere to trench protection regulations/requirements in force at the time of a failure or mishap.

G. **Pipe Laying**: Pipe shall be bedded per paragraph 3.2.7 *Trench Preparation For Pipe*, Section 02275, *Trenching, Backfilling and Compaction of Utilities*. The pipe and fittings shall be laid in the trench so that its interior surface shall conform to the grade and alignment as shown on the plans. Pipe laying shall be done in such a way as to disturb as little as possible the pipe that has already been laid. The alignment and grade of the storm main may be field adjusted whenever, in the opinion of the City Engineer or Stormwater Program Manager, it is necessary, so long as the changes are consistent with the City of Wilson policy in affect at the time of the change. Changes in either grade or alignment may only occur at manholes. Where necessary, the invert grade shall be cambered by an amount sufficient to prevent the development of sag or back slope in the flow line. The developer's engineer will determine the amount of camber used. Where bell and spigot pipe is used, recesses shall be excavated to receive the pipe bells.

Before laying, the bell and spigot will be wiped free from any dirt or other foreign matter. All surfaces of the portion of the pipe to be joined, and the factory-made jointing material, shall be clean and dry. Jointing material shall be used as recommended by the pipe or joint manufacturer's specifications. The jointing material or factory-fabricated joints shall then be placed, fitted, and adjusted in such skillful manner as to obtain the degrees of water tightness required. Each joint shall be completely wrapped in geo-fabric overlapping itself and the joint at least 18". Lifting holes shall be plugged according to the manufacturer's recommendations. A sheet of geo-fabric shall be placed over the plugged lifting hole and pipe extending 18" from either side of the hole.

Trenches shall be kept as dry as possible during bedding, laying and jointing and for as long a period as required until the trench is backfilled. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to offset conditions that might tend to move the pipe off line or grade. The greatest care shall be used to secure water tightness and to prevent damage to or disturbing of the joints during the backfilling process, or at any other time.

After the trench foundation has been properly graded to receive the pipe, the pipe shall be carefully lowered into the trench with approved methods. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. All damaged pipe shall be replaced at the Contractor's expense.

All joints shall be left exposed for inspection purposes during the working day and a suitable ladder affording easy and safe access for such inspection shall be furnished.

The Contractor at his own expense shall make any defects due to settlement good.

1) **Mortar Joints:** The mortar in the joints shall be composed of 1 part Portland cement and two parts clean sharp sand with 15% hydrated lime, by volume, added to the mixture. The pipe shall be clean and moist when mortar is applied. The lower portion of the bell or groove shall be filled with mortar sufficient to bring the inner surface flush and even when the next joint is fitted into place. The remainder of the joint shall then be filled with mortar and a bead or ring of mortar formed around the outside of the joint. The application of mortar to the inside of joints may be delayed until fill is completed where the pipe is in excess of 30 inches in diameter. The inside of all mortar joints shall be clean and smooth upon completion of the work. Competed mortar joints shall be cured and protected by permanently wrapping the exposed outside of the mortar joint with a layer of 30# roofing felt or a nonwoven Geotextile fabric.

2) **Soil-Tight Flexible Plastic Joint:** Flexible joints meeting the requirements of paragraph 2.2.15, Preformed Plastic Gaskets may be used in lieu of mortar joints. The outside of the pipe may be required to be wrapped in fabric. See paragraph 3 *Wrapping Joints*, below.

3) **Wrapping Joints**: In silts and sandy soils, wrap each storm drainage pipe joint with a non-woven Geotextile fabric. Fabric is to be placed a minimum of 18 inches on each side of the joint and shall lap itself a minimum of 18 inches.

H. **Use of Storm Drainage Pipe for Dewatering Subsurface of Streets** (applies to pipe located inside public rights-of-way): For subgrade drainage purposes, the pipe shall be bedded in #57 stone (see **Standard Detail 631.01**) and the invert of the pipe joint, comprising the bottom 1/8th of the circumference of the pipe, is to be left open. Prior to placement of the pipe on the stone bedding place an 18-inch wide strip of non-woven Geotextile fabric along the perimeter of the open pipe joint to prevent migration of fine into the pipe. The fabric shall extend past the open portion of the joint at least 18 inches. Attach to pipe wall with tape or mastic to hold in place during backfill.

I. **Temporary Suspension of Work**: When the trench is left for the night or if pipe laying is suspended, all exposed ends of the pipe shall be plugged to keep out dirt, water, animals and other foreign matter or substances. This plug shall be kept in the ends of the pipeline at all times when laying is not in actual progress.

J. **Cutting or Fitting Pipe**: Whenever a pipe requires cutting to bring a pipe to the required location, the work shall be done in a satisfactory manner with an approved cutting tool or tools that will leave a smooth end at right angles to the axis of the pipe and not otherwise damage the pipe. The method of cutting pipe shall be in accordance with manufacturer's recommendations. Such cuts shall be made by the Contractor without extra compensation.

K. **Joining Pipe of Different Size or Material:** A drainage structure box is required at all pipe intersections (vertical and horizontal) and changes in pipe size or pipe material. Lateral taps and branches are not permitted without a junction box.

3.1.2 REINFORCED CONCRETE PIPE

A. Pipe support for pipe shall provide uniform bearing for the pipe barrel along its entire length. The pipe shall be carefully laid on the prepared foundation/bedding, groove end upgrade with the tongue fully inserted and each joint checked for alignment and grade as the work proceeds.

B. **Pipe bedding**: See **Standard Detail 631.01** for minimum bedding requirements.

C. Pipe with varying wall class must not be mixed between manholes or boxes.

D. **Bury Limitations**: Table 2630.1 shall govern as the maximum allowable bury for reinforced concrete storm pipe. However, Design Engineer to verify and be responsible for maximum bury limitations based on jobsite conditions!

Table 2630.1

Bury Limitations on RCP (15 through 60 inches)

Pipe	Maximum Depth of Bury			
	Class III wall (feet)	**Class IV wall** (feet)	**Class V wall** (feet)	**Comments**
RCP	20	30	40	Notes a, b
Minimum Depth of Bury				
RCP	2	1	1	-

[a]Fill height is measured from the top of the pipe to the bottom of the pavement structure.
[b]Based on between a Type 1 and Type standard installation [as depicted in **Standard Detail 631.01**]) and on NCDOT Standard Detail 300.01, rigid pipe, sheets 2 & 3.
[c]Refer to AASHTO M170 and to ACPA Design Data 9, latest revision.

E. Join concrete pipe using either mortar or bitumastic material to seal joint.

F. Each joint shall be wrapped in a non-woven geo-fabric overlapping the joint and itself by at least 18". Geo-fabric shall also be placed over lifting pinholes after they have been properly plugged in accordance with the manufacturers' recommendations.

G. As each joint is laid, visually inspect to be certain that no jointing compound gasket, or trash is protruding from the joint or lying inside the pipe.

3.1.3 DOUBLE WALLED CORRUGATED HDPE PIPE:

A. Pipe support shall provide uniform bearing for the pipe barrel along its entire length. The pipe shall be carefully laid on the prepared foundation/bedding and each joint checked for alignment and grade as the work proceeds. Each joint shall be wrapped in a non-woven geo-fabric overlapping the joint and itself by at least 18".

B. Installation of double walled corrugated exterior/smooth interior HDPE pipe shall be in accordance with ASTM D2321, *Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications, latest revision* and as directed by the City Engineer or Stormwater Program Manager.

C. Pipe Bedding and Backfill: Pipe embedment for HDPE pipe shall be minimum Type 5 Laying condition as shown on **Standard Detail 511.02**.

D. Backfill and compaction shall conform to the applicable provisions of Section *02275, Trenching, Backfilling, and Compaction of Utilities*. To prevent displacement of pipe, backfill shall be brought up evenly on both sides of the pipe. Backfill shall be suitable material such as free-draining sands and gravel conforming to ASTM D2321, Class I, II or III (see also Division *02275, Trenching, Backfilling, and Compaction of Utilities*, paragraph 2.1.1.F for Satisfactory Soils). Lift thickness and compaction requirements for backfill shall conform to the requirement of Section *02275, Trenching, Backfilling, and Compaction of Utilities*, Tables 2275.3 and 2275.4.

E. **Bury Limitations**: Minimum cover over pipe shall be 18 inches in a quality backfill envelope and where subject to light traffic loads. Non-traffic areas shall have a minimum of 12 inches of fill in a quality backfill envelope. Maximum cover over pipe shall be limited to 10 feet. At the discretion of the City Engineer or Stormwater Program Manager, deeper bury may be permitted provided calculations are submitted and sealed by a NC Professional Engineer for the proposed application.

F. **Leakage testing**: Leakage rates of pipe shall not exceed 50 gallons/inch diameter/mile/day.

3.1.4 FLEXIBLE ALUMINUM PIPE (ROUND AND ARCH)

A. **Laying Flexible Aluminum Pipe**: Installation shall be in accordance with AASHTO *Standard Specifications for Highway Bridges*, Section 26, Division II or ASTM A798, *Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications* and in conformance with the project plans and specifications. If there are any inconsistencies or conflicts, the Contractor must bring them to the attention of the City Engineer or Stormwater Program Manager. Flexible pipe shall be carefully placed on the foundation/bedding at the downstream end with the inside circumferential laps pointing downstream and with the longitudinal laps at the side or quarter points.

Aluminum alloy pipe and paved invert pipe shall be handled with special care to avoid damage to pipe and/or coatings. When paved inverts are specified, paved invert pipe shall be installed with the paved invert centered on the bottom.

The pipe sections shall be joined with coupling bands, fully bolted. Coupling bands for annular and helical corrugated aluminum pipe shall provide circumferential and longitudinal strength sufficient to preserve the alignment, prevent separation of the sections, and prevent infiltration.

B. Pipe bedding and installation for flexible metal pipe shall meet the requirements of NCDOT Standard Detail 300.01 for both trench and embankment applications, sheets 2 and 3.

C. Backfill and compaction shall conform to the applicable provisions of Section *02275, Trenching, Backfilling, and Compaction of Utilities*. Backfill shall be brought up evenly on both sides of the pipe. Backfill shall be suitable material such as free-draining sands and gravel conforming to ASTM D2321, Class I, II or III (see also Division *02275, Trenching, Backfilling, and Compaction of Utilities*,

paragraph 2.1.1.F for Satisfactory Soils). Lift thickness and compaction requirements for backfill shall conform to the requirement of Section *02275, Trenching, Backfilling, and Compaction of Utilities*, Tables 2275.3 and 2275.4.

D. **Bury Limitations**: Unless otherwise approved by the City Engineer or Stormwater Program Manager, the minimum cover over pipe shall be 24 inches in a quality backfill envelope. Maximum cover over pipe shall be limited to 6 feet. At the discretion of the City Engineer or Stormwater Program Manager, deeper bury may be permitted provided calculations are submitted and sealed by a NC Professional Engineer for the proposed application or, with the approval of the City Engineer or Stormwater Program Manager, the installation guidelines in NCDOT Standard Detail 300.01 for both trench and embankment applications (sheets 2 and 3) are followed.

3.2 MANHOLE CONSTRUCTION FOR PRECAST STANDARD MANHOLES AND DROP INLET BASES

A. **Standard Manholes and Drop Inlet Bases**: Manholes shall be constructed in accordance with the NCDOT Standard Detail 840.52 and the City of Wilson **Standard Detail 732.03** with the following exceptions:

1) Flexible boots and precast concrete inverts will not be required.

2) Joints will be as specified in the product section of this specification.

3) The pipe opening in precast units shall be at least 4 inches but not more than 8 inches larger than the outside diameter of the pipe. Pipe openings shall be formed, drilled, or neatly cut as approved by the Engineer.

4) The Contractor may use brick and masonry block or concrete pipe cutoffs in conjunction with mortar to fill the void between pipe culverts and precast structures. Such materials shall be thoroughly wetted and bonded with mortar. The remaining exterior and interior void shall be filled and sealed/slicked with mortar to the contour of the precast structure.

5) The standard joint shall be sealed on the interior of the structure, after installation, with a non-shrink hydraulic cement mortar.

6) Do not plug weep holes. Place a non-woven Geotextile fabric over weep holes.

7) Pour concrete inverts in all structures. Concrete shall be in compliance with products section for miscellaneous concrete of these specifications. Shape manhole channel with a smooth semicircular bottom matching inside diameter of the connecting pipe/pipes. Change directions of flow with a smooth curve of as large a radius as the manhole size will permit. Change size and grade of channels gradually and evenly. Shape the shelf to provide a slope between 1 and 2 inches per foot towards the invert.

8) Manholes shall be installed plumb.

9) Manholes shall be no less than 4 feet in diameter. Larger diameter manholes needed to accommodate larger pipe shall be sized based on an angle of entry sufficient to accommodate adjacent pipe, with sufficient annular clearance to

permit pipe entry into manhole, while also providing a vertical undisturbed column of reinforced concrete between adjacent pipes of at least 8 inches in thickness for manholes up to 12 feet in depth.

10) Place #57 stone around pipe penetrations into manhole base. All penetrations in manhole bases shall be inspected prior to backfilling structure with stone around pipe. See **Standard Detail 639.01** for detail of treatment around pipe.

11) NCDOT Standard Detail 840.53 may only be used if approved by the City Engineer or Stormwater Program Manager prior to its proposed use.

12) Manholes shall be fabricated in such a way as to minimize the potential of the pipe landing in a riser joint.

B. **Adjustments**: The Contractor shall exercise care in the ordering of structures so that the use of brick for leveling and adjustments can be minimized. Where adjustment of a manhole is required, grade rings shall not be used unless otherwise approved by the City Engineer or Stormwater Program Manager. Where adjustment of the inlet is required, the use of bricks is approved, provided that the entire void between the flat-top and inlet is also filled with brick and mortar to uniformly distribute loading of the inlet. The depth of bricks shall not exceed 12 inches before removal of the cone or flat-top is necessary for adjustment (see **Standard Detail C06.03**).

On all storm manholes, a mastic joint material shall be placed between the frame and cover and the cone or grade ring.

When applicable, during the installation of manholes, if frame and cover is near or within wheel path in roadway, turn cone to place the frame out of wheel path.

C. **Replacement/Rehabilitation of Existing Manholes**: When a new manhole is necessary, the old manhole must be completely removed and a new precast manhole set in its place. Where the old manhole is of satisfactory quality, the Contractor will make connection thereto as directed by the City Engineer or Stormwater Program Manager at no additional cost even if it is necessary to modify the bottom of the manhole to meet the new grade. Such extras are considered incidental to the manhole connection cost.

3.3 PRECAST REINFORCED CONCRETE STORM DRAINAGE BOX STRUCTURES (Flush Wall, Waffle and Knockout Panel Type):

A. **Design Requirements**: See paragraph 2.2.14, Precast Underground Concrete Utility Structures
   1) **Formed Inverts**: All boxes shall have formed inverts. Invert forming is to be performed after the pipe penetrations have been made, the annular space around the pipe grouted and the pipe sawn flush with the interior face of the structure.
   2) Seal joints with a flexible butyl rubber.

B. **Box Size**: The outside pipe diameter plus 2” or the opening required for frame and grate is the minimum structure size whichever is greater.

C. **Maximum Depth** (manhole junction boxes and catch basins): Limit maximum depth to top of bottom slab for waffle wall structure to 10'-0"; limit solid wall structure to 15'-0" unless approved otherwise by the City Engineer or Stormwater Program Manager.

D. **Grade Adjustment**: Precast storm drainage boxes with knockout panels shall be set to the prescribed grade designated on the construction drawings. Boxes shall be placed on a stone bed of a minimum of 6 inches of #57 stone. Boxes shall be adjusted to final grade by the addition of either precast reinforced concrete grade rings or solid clay brick or concrete masonry with type M mortar. Boxes may not be saw cut to lower the grade unless first approved by the City Engineer or Stormwater Program Manager and then by no more than 2 inches. Due to the potential for grade variation in setting the structures, and to avoid cutting the boxes, it is recommended that boxes be ordered slightly short of the depth required to permit final grade adjustment by adding risers. However, the total depth of riser ring or masonry adjustment shall not exceed 8 inches.

E. **Pipe Penetration(s) Into Boxes**:
   1) Cut or form openings for pipe to provide required size and location. Remove knockout panels by saw cutting. Cut to pipe OD plus 2 inches.
   2) Orient waffle wall structures so that pipes enter through the knockout/waffle panels only.
   3) Preformed pipe penetrations may enter through the corners of solid wall precast boxes if a minimum of 6" of wall is provided above the hole.
   4) Patching: The pipe shall be placed in the hole and the annular opening grouted the full 360 degrees of the pipe diameter with concrete. The grouted pipe penetration shall be inspected prior to backfilling. Once the concrete collar has set (4 days minimum), pipe(s) protruding into the box shall be cut flush with the inside face of the box and the annular edge grouted to form a smooth entrance.
   5) See also paragrpah 3.3.I, below.

F. **Manhole Junction Boxes**: Every junction box shall have manhole access. No blind manholes are permitted.

G. Frame and grate height may be adjusted with concrete or brick in accordance with City of Wilson specifications. Use manhole frame and cover as indicated on the plans. Reinforce manhole opening in top as shown on standard details or as designed by NC Professional Engineer for required loading condition.

H. Precast boxes may be used for City of Wilson **Standard Details 633.02, 633.06,** and **634.01**. See also Table 2630.2 for a list of approved NCDOT Standards with precast boxes.

I. To avoid damaging steel reinforcement and weakening box structures (both smooth wall and waffle boxes), unless otherwise designed by the box precaster, maintain a minimum of 6" of clearance at the top and sides of precast boxes/box segments. See **Standard Detail 634.03**.

J. The outside diameter of pipe may not enter a rectangular drainage structure such that the outside diameter is closer than 6 inches from the inside corner of the box. See **Standard Detail 639.01**.

3.4 MASONRY STRUCTURES:

A. **Design Requirements**:
   1) **Invert Forming**: All boxes shall have formed inverts. Invert forming is to be performed after the pipe penetrations have been made, the annular space around the pipe grouted and the pipe sawn flush with the interior face of the structure.

B. Masonry construction shall conform to Section 834, *Block Masonry Construction – General and* Section 840, *Minor Drainage Structures* of the NCDOT *Standard Specifications For Roads and Structures,* latest edition. Clay brick structures are not permitted.

C. Masonry boxes may be used with the City of Wilson **Standard Details 633.02** and **634.01**. See also Table 2630.2 for a list of approved NCDOT Standards with brick boxes.

D. **Maximum Depth/Wall Thickness**: See **Standard Detail 634.02**, *Drainage Structure Notes*.

   Top and bottom slabs to be designed by NC Professional Engineers and approved by City Engineer or Stormwater Program Manager for H20 loading condition.

E. **Maximum Wall Span**: The maximum horizontal span of an 8-inch thick wall shall not exceed 8 feet for boxes 8 feet or less in depth and 10 feet for boxes 12 feet or less in depth.

F. **Manhole Junction Boxes**: Every junction box shall have manhole access. No blind manholes are permitted.

G. **Pipe Penetrations**: Inside of boxes shall allow for 6 inches of clearance on both sides of pipe. The dimension shown on the structures in the standard details are minimum box dimensions. For boxes with greater dimensions add a reinforced concrete top slab or lengthen the box by adding additional grates and frames (see paragraph I, below regarding corbelling). Once pipe has been set and mortared in place, pipe projections shall be cut flush with interior face of the box.

F. **Steps**: For structures over 4'-0" in depth, provide steps. Steps are to be located on a non-pipe wall. Steps to meet OSHA requirements.

H. **Grade Adjustment**: Frame and grate height may be adjusted with concrete or brick. Use manhole frame and cover as indicated on the plans. Reinforce manhole opening in top as shown on standard details or as designed by NC Professional Engineer for required loading condition.

I. Corbelling: Not permitted unless approved otherwise by the City Engineer or Stormwater Program Manager.

J. Mortar in masonry structures is to be minimum type M.

K. The outside diameter of pipe may not enter a rectangular drainage structure such that the outside diameter is closer than 6 inches from the inside corner of the box. See **Standard Detail 639.01**.

3.5 NCDOT STANDARD DETAILS

The following NCDOT Standards are approved for use in the City of Wilson:

Table 2630.2

Detail	Sheet Title
840.01	Brick Catch Basin – 12" thru 54"
840.02	Concrete Catch Basin – 12" thru 54"
840.04	Concrete Catch Basin with Single and Multiple Pipes – 12" thru 48" Pipe
840.05	Brick Catch Basin with Single and Multiple Pipes – 12" thru 48" Pipe
840.14	Concrete Drop Inlet – 12" thru 30" Pipe
840.15	Brick Drop Inlet – 12" thru 30" Pipe
840.17	Concrete Median Drop Inlet Type 'A' – 12" thru 72" Pipe
840.18	Concrete Median Drop Inlet Type 'B' – 12" thru 36" Pipe
840.19	Concrete Median Drop Inlet Type 'D' – 12" thru 36" Pipe
840.26	Brick Median Drop Inlet Type 'A' – 12" thru 72" Pipe
840.27	Brick Median Drop Inlet Type 'B' – 12" thru 36" Pipe
840.28	Brick Median Drop Inlet Type 'D' – 12" thru 36" Pipe
840.31	Concrete Junction Box – 12" thru 66" Pipe
840.32	Brick Junction Box – 12" thru 66" Pipe
840.34	Traffic Bearing Junction Box for Pipes 42" and Under, deep boxes
840.41	Spring Box – Concrete or Brick
840.45	Precast Drainage Structure
840.46	Traffic Bearing Precast Drainage Structure (except no corner entry)

3.6 CONSTRUCTION OF MISCELLANEOUS APPURTENANCES

End walls and other miscellaneous storm drainage items shall be constructed in accordance with the latest edition of the NCDOT *Standard Specifications For Roads and Structures* and the applicable NCDOT standard details.

3.7 ABANDONING STORM DRAINAGE LINES & MANHOLES

A. **Storm Lines**: Unless directed otherwise by the City Engineer or Stormwater Program Manager, when an existing storm drainage line is designated to be abandoned in place, the low end of the line is to be plugged and lean concrete grout (flowable fill) pumped into the line until line is completely filled.

B. **Manholes**: When an existing manhole, either partially or wholly, is designated to be abandoned and the storm lines, either entering or exiting the manhole, have been abandoned according to the preceding paragraph, the upper portion of the manhole shall be removed to a minimum of 18 inches below the proposed finished grade, or as determined by the City Engineer or Stormwater Program Manager, NCDOT #57 stone dumped into the manhole, and the stone vibrated to effect consolidation of the stone. The remainder of the fill between the top of the manhole and the finished subgrade is to be backfilled as follows. Where the manhole is located within a roadway right of way, backfill with NCDOT # 57 Stone and consolidate. Outside roadway right of ways, filter fabric shall be placed over

the stone, suitable material of a compactable nature shall be placed over the top of the manhole, and the material tamped.

3.8 SLOPE ANCHORS

All lines on slopes equal to or greater than 20% slope shall have concrete anchors placed around the pipe directly below the bell end of the line. The anchors shall be spaced every other joint unless otherwise shown on the plans and constructed to the dimensions shown on the approved plans.

3.9 EXCAVATION OF DRAINAGE CHANNELS

A. Open storm drainage channels and ditches shall be graded and shaped in accordance with the elevations, slopes, widths, and lengths indicated on the plans except that the side slopes shall be 3:1 or flatter. The outfall elevation of the new channels and ditches shall be graded to match the flow elevations of all existing or natural channels, unless indicated or specified otherwise.

B. The drainage channels shaped with fill materials shall be compacted within the limits and in accordance with the related backfill work specified elsewhere.

C. The drainage channels shall be prepared, seeded, and mulched in accordance with the related work specified elsewhere. Where indicated on the drawings, specified, or otherwise directed by the City Engineer or Stormwater Program Manager, erosions control measures, such as temporary liners, rip rap, concrete liners, etc., shall be provided.

3.10 PLACEMENT OF RIP RAP AND RIP RAP BEDDING

Placement of Rip Rap and fabric shall conform to Section 876 – *Rip Rap* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision.

3.11 SUBSURFACE DRAINAGE

Installation of subsurface drainage systems shall conform to the requirements of Section 815 – *Subsurface Drainage* of the NCDOT *Standard Specifications for Roadways and Structures*, latest revision using non-woven needle-punched fabric.

3.12 INSPECTION

At any time during construction up to and including completion of entire pipe installation, the City Engineer or Stormwater Program Manager may inspect the work in part or as a whole in order to satisfy himself/herself that every portion of the project has been faithfully carried out in accordance with the plans, specifications, and standard details, as applicable.

If, in the opinion of the City Engineer or Stormwater Program Manager, a defect exists in the pipeline or its appurtenances, in some place not accessible except by uncovering, the City Engineer or Stormwater Program Manager may order the line to be uncovered. If it is found that after the pipe has been uncovered at the order of the City Engineer or Stormwater Program Manager, no defect exists or that the defects were not the fault of the Contractor, then the expense so incurred by the Contractor shall be borne by the City.

Inspect the system for conformance with line and grades shown on the plans and provide record drawing measurements on record drawings.

TV Inspection: The Contractor will TV the storm drainage lines using a TV inspection truck and all services inspected using a mini-cam. It is the responsibility of the contractor to flush all sand, dirt, and debris from the lines, manholes and catch basins to ensure there is no sediment or debris in the lines, manholes and catch basins at the time of the TV inspection. The contractor and/or Engineer or their designated representative shall be present during the TV inspection. Contractor to provide a minimum 24 hours' notice to the City's representative prior to TV inspection. Alternatively, when the City Engineer permits, contractors may TV their lines and deliver the TV inspection and log on CD or flash drive to the City for review. Regardless of whether the City's representative is present or not during TV inspection, a CD or flash drive log of the inspection is required to be delivered to the City's representative upon completion of all TV inspections.

Inspection Criteria:

a. The lines will be checked for leaking joints, deformed pipe, cracked pipe, grade problems, excessive infiltration, and overall appearance.

b. TV inspections are required at completion of other required testing and following placement of stone base but prior to placement of pavement.

The Contractor will televise all storm drainage lines for conformance to the project drawings and specifications. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the City; and if unsatisfactory, equipment shall be removed and no payment will be made for an unsatisfactory inspection.

The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the line's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the storm drainage line conditions shall be used to move the camera through the storm drainage line. If, during the inspection operation, the television camera will not pass through the entire manhole or catch basin section, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole or catch basin. If, again, the camera fails to pass through the entire manhole or catch basin section, the inspection shall be considered complete and no additional inspection will be required.

The City will also televise storm drainage lines prior to the expiration of the two-year warranty. If a defective condition is found, it shall be presumed to be caused by defective workmanship or materials. The Contractor shall be notified and shall correct the work in a manner approved by the City.

Laying Tolerance: Place pipe to the grades and alignment shown on the plans

Horizontal Laying Tolerance: 1:500 horizontal (straight runs), unless otherwise directed by the City Engineer or Stormwater Program Manager.

Vertical Laying Tolerance: Unless otherwise directed by the City Engineer or Stormwater Program Manager, the maximum permitted negative grade variation in post-construction pipe grade shall be -10% of the design grade. The computation of the post-construction pipe grade shall be based on a post-construction field survey. The grade shall be computed by taking the actual difference between the invert in and invert out of the pipe run divided by the actual pipe length. Pipe runs laid at less than the approved design grade must be removed and re-laid.

Example:

Design Grade: 0.005 ft//ft or 0.5%

Field Check of Grade:

Surveyed Invert in =	*96.50*		
less Surveyed Invert out =	*96.04*		
Difference =	*0.46*	*ft*	
Actual Pipe Run Length =	*100*	*ft*	*(not measured C-C of Boxes!)*
Slope =	$\frac{0.46}{100}$	=	*.0046 or 0.46%*

Variation Check:

Design Grade	*0.50%*
Actual Grade	*0.46%*
Difference:	*0.04%*

Allowable deviation is 10% of Design Grade = 0.10 x 0.50% = 0.05%

Allowable deviation of 0.05% > 0.04% allowable deviation…VARIATION OK!

3.13 MAINTENANCE

The developer shall maintain all pipe installations in such a condition that they will function continuously from the time the pipe is installed until the development/project is accepted for maintenance by the City. Furthermore, soil erosion and sedimentation control measures shall be installed wherever necessary, including at curb inlets for example, and maintained for the duration of the development until the project is fully stabilized. Once permanent groundcover has been established, temporary erosion control measures shall be removed and the disturbed areas landscaped and seeded.

3.14 MEASUREMENT & PAYMENT

See Section 1.4 of 00950, *Measurement and Payment*.

END OF SECTION 02630

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02632 – SEGMENTAL CONCRETE RETAINING WALL SYSTEM

(Last Revised ~~8/23/13~~ 9/18/19) R3

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION

Work shall consist of furnishing all materials, labor, equipment, and supervision to install a Segmental concrete Retaining Wall (SRW) system to the lines, grades, design and dimensions shown on the plans, or as established by the owner or owner's engineer.

The work includes constructing the (SRW) system and includes, but is not necessarily limited to, the leveling pad, soil reinforcement, unit drainage fill, wall drainage pipe/laterals, reinforced backfill, and incidental materials required for SRW construction in accordance with the construction drawings and installation guidelines/recommendations of the block manufacturer as well as specified herein.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. Section 00825 – Product Substitutions

C. Section 00950 – Measurement and Payment

D. Section 02200 – Earthwork

E. Section 02630 – Storm Drainage

F. City of Wilson List of Approved Manufacturers and Products

G. NCDEQ Division of Energy, Mineral, and Land Resources, Land Quality Section's "Erosion and Sedimentation Control Planning and Design Manual" latest revision

H. NCMA Design Manual for Segmental Retaining Walls.

1.3 REFERENCE STANDARDS

A. **American Society for Testing and Materials (ASTM)**

1) **ASTM C90** Standard Specification for Loadbearing Concrete Masonry Units

2) **ASTM C140** Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

3) **ASTM C1262** Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units

4) **ASTM C1372** Standard Specification for Dry-Cast Segmental Retaining Wall Units

5) **ASTM D422** Standard Test Method for Particle-Size Analysis of Soils

6) **ASTM D698** Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

7) **ASTM D1248** Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

8) **ASTM D1388** Standard Test Method for Stiffness of Fabrics

9) **ASTM D2166** Standard Test Method for Unconfined Compressive Strength of Cohesive Soil

10) **ASTM D2321** Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

11) **ASTM D3034** Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

12) **ASTM D3080** Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions

13) **ASTM D3212** Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

14) **ASTM D3350** Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

15) **ASTM D4318** Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

16) **ASTM D4475** Standard Test Method for Apparent Horizontal Shear Strength of Pultruded Reinforced Plastic Rods By the Short-Beam Method

17) **ASTM D4595** Standard Test Methods for Tensile Properties of

Geotextiles by the Wide-Width Strip Method

18) **ASTM D5262** Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics

19) **ASTM D6638** Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)

20) **ASTM D6916** Standard Test Method for Determining the Shear Strength Between Segmental Concrete Units (Modular Concrete Blocks)

21) **ASTM F477** Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

22) **ASTM F810** Standard Specification for Smoothwall Polyethylene (PE) Pipe for Use in Drainage and Waste Disposal Absorption Fields

23) **ASTM G51** Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing

24) **ASTM G57** Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method

B. **Geosynthetic Research Institute (GRI)**

1) **GRI-GG4** Determination of Long Term Design Strength of Geogrids

2) **GRI-GG5** Determination of Geogrid (soil) Pullout

C. **National Concrete Masonry Association (NCMA)**

1) **NCMA SRWU-1** Test Method for Determining Connection Strength of SRW

2) **NCMA SRWU-2** Test Method for Determining Shear Strength of SRW

D. **American Association of State Highway and Transportation Officials (AASHTO)**

1) **AASHTO M288** Standard Specification for Geotextile Specification For Highway Applications

2) **AASHTO M252** Standard Specification for Corrugated Polyethylene Drainage Pipe

3) AASHTO Standard Specifications for Highway Bridges, Latest Edition

E. Contact "***NC One Call"*** at 811 before you dig.

Know what's **below.** **Call** before you dig.

1.4 DESIGN REQUIREMENTS

A. **Wall Design Engineer**: The wall design shall be performed by a Professional Engineer licensed in the State of North Carolina that prepares and seals the design submittals. For the City of Wilson minimum standard SRW design requirements, see ***Segmental Retaining Wall Design*** in the City of Wilson Design Manual**.**

B. **Design Method**: Design of SRW's using geosynthetic reinforcement shall be in accordance with the NCMA Design Guidelines for Segmental Walls, AASHTO or NCMA utilizing AASHTO earth pressure and stability design criteria. Metallic reinforcement systems shall be designed in accordance with AASHTO *Standard Specification for Highway Bridges*, Section 5.8, using the Coherent Gravity Method. All designs shall conform to the minimum safety factors in this Specification. Design submittals not meeting this design criteria or technical/administrative criteria specified will be rejected in their entirety until complete compliance is achieved.

1.5 SUBMITTALS

Fourteen Days prior to the anticipated start date for the SRW, the SRW contractor shall provide to the City of Wilson a minimum of a submittal package for review including the following:

A. A set of detailed SRW design plans sealed by a registered professional engineer licensed in the state of North Carolina. The SRW plans shall include plan and elevation views of each wall, cross sections and all details, dimensions and quantities necessary to construct the SRW.

B. Detailed design calculations including soil bearing pressure. Calculations shall include assumed design properties for the Geogrid reinforcement such as SRW/soil reinforcement connection and shear, reinforcement strength.

C. Product literature indicating specifically which SRW units and soil reinforcement are proposed for use on the project including color, face style and texture.

D. Documentation for the SRW units and soil reinforcement demonstrating compliance with the requirements of this specification including but not limited to SRW compressive strength and absorption;

E. If requested by the City Engineer, Manufacturer's certification that the SRW units and soil reinforcement meet the requirements of this specification.

F. Contractor's certification that the contractor has 2 years experience or is certified in the construction of the SRW proposed for use on this project. Contact names and telephone numbers shall be listed for similar projects.

1.6 DELIVERY, STORAGE AND HANDLING

The contractor shall inspect all materials upon delivery to assure that the proper type, grade, color, and material certification have been received. Contractor shall protect materials from damage due to jobsite conditions and in accordance with the manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

PART 2 - PRODUCTS

2.1 DEFINITIONS

A. **Base Leveling Pad**: Level compacted gravel or unreinforced concrete pad upon which the first course of segmental concrete facing units is placed.

B. **Foundation Soil**: Compacted, imported or in-situ soil beneath entire wall.

C. **PET**: Polyethylene Terephthalate (polyester): PET, a Geogrid Polymer, is the material from which the majority of Geogrids are manufactured.

D. **Reinforced Backfill**: Compacted soil that is within the reinforced soil volume as shown on the plans.

E. **Retained Soil**: Compacted, imported or in-situ soil behind reinforced zone of the retaining wall.

F. **Segmental Concrete Units:** A modular concrete facing unit machine made from Portland cement, water and mineral aggregates.

G. **Soil Reinforcement**: Geosynthetic or steel reinforcement formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock or earth and function as reinforcement. Soil reinforcement shall be specifically manufactured for soil reinforcement.

H. **Unit Drainage Fill**: Drainage aggregate that is placed within and behind the segmental concrete units.

2.2 SEGMENTAL CONCRETE UNITS SHALL MEET THE FOLLOWING REQUIREMENTS

A. Manufactured in accordance with ASTM C1372 with a minimum 28-day compressive strength of 3,000 psi (4,000 psi for steel reinforced systems) for any one individual unit and 3,500 psi for the average of three units. The 24-hour water absorption rate shall not exceed 8%. SRW units finish and appearance shall be per ASTM C1372. Units may be either solid or hollow as per the manufacturer's standard design.

Freeze-thaw durability testing will be required as described in ASTM C1372 Sections 4.2, 4.2.1 and 7.3. Testing shall be in accordance with ASTM C1262.

Exposed faces shall be free of chips, cracks or other imperfections when viewed from a distance of 20 feet under diffused lighting. All units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength of permanence of the construction.

Unless otherwise identified prior to ordering, color shall be concrete gray and the face finish shall be a sculptured rock face in a flat planar configuration unless shown otherwise on the Plans.

Acceptable Manufacturers are Allan Block, Belgard, Keystone Retaining Wall Systems, Rockwood Retaining Walls, or Versa-Lok.

B. **Shear Pin Units**: Provide shear pins or connection devices to provide a mechanical connection between vertically and horizontally adjacent units so as to provide at a 2 psi normal pressure a minimum inter-unit shear strength of 500 plf per NCMA SRWU-2 and a geosynthetic to SRW unit peak connection strength of 500 lbs/ft per NCMA SRWU-1. Shear devices shall protrude at least 1 inch into receiving openings of the SRW units. At least one shear connector is required per linear foot of wall for each course. The shear connector must fit within an aperture of the soil reinforcement and be capable of holding the reinforcement in the proper position during tensioning and backfilling. Connectors shall result in a design wall batter of 1º to 10º.

2.3 SOIL REINFORCEMENT

A. **Geosynthetic Reinforcement**: The type, strength, and placement location of the reinforcing Geogrid reinforcement shall be determined by the Wall Design Engineer as shown on the drawings.

Geogrid reinforcement shall be of a type recommended by the block supplier to be compatible with the facing units, with minimum long term design strength (in pounds per foot) as specified by the Wall Design Engineer and shown on the wall plans. The Geogrid shall be a regular grid structure having an aperture geometry and rib and junction cross-sections sufficient to permit significant mechanical interlock with the granular backfill material. The Geogrid shall have high continuity of tensile strength through all ribs and junctions of the grid structure. The Geogrid shall have high resistance to deformation under sustained long term design load while in service and shall also be resistant to ultraviolet degradation, to damage under normal construction practices, and to all forms of biological or chemical degradation normally encountered in the granular backfill material.

B. Geosynthetic reinforcement shall be evaluated in accordance with NCMA Section 3.5 with the following additions and clarifications.

1) The minimum RF_{ID} shall be ≥ 1.05.
2) The minimum RF_{D} shall be ≥ 1.10.
3) The minimum FS_{UNC} shall be ≥ 1.5.
4) Geogrids not providing a minimum junction strength of 40 lbs per foot per GRI: GG2 and all geotextiles shall have a minimum mass of 8 oz/sy and meet the strength requirements of AASHTO M288, Class 1 Geotextile.

5) Geogrids not providing a minimum stiffness (flexural rigidity) of 30,000 mg-cm per ASTM D1388 and all geotextiles shall be staked during placement per Section 3.1.B.
6) PET geosynthetics shall be coated with a suitable coating immutably bonded to the PET bundles. The coating shall contain a minimum of 1% carbon black measured per ASTM D4218 *Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique*. Geogrids not meeting this requirement and all geotextiles shall use a minimum $RF_D = 1.6$.
7) PET geosynthetics shall possess a Molecular Weight $\geq$ 25,000 g/m per GRI: GG8 and a carboxyl end group number $\leq$ 30 per GRI: GG7. PET geosynthetics not meeting this criteria shall use a minimum $RF_D = 2.0$.
8) HDPE geogrids shall have a melt flow index value$\geq$ 0.88. HDPE geogrids not meeting this criteria shall use a minimum $RF_D = 2.0$.
9) Manufacturing Quality Control - The geosynthetic manufacturer shall have a quality control program that includes QC testing no less frequently than each 400,000 sf of production. The testing, as a minimum, shall include Tensile Strength per ASTM D4595 *Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method*.

C. **Steel Reinforcement**: Steel reinforcement shall meet the requirements of and possess the minimum strength and durability at the end of the 75-year design life per the AASHTO Standard Specifications for Highway Bridges. Allowable tensile stress shall not exceed $0.55F_y$ at the end of the design service life.

2.4 UNIT DRAINAGE FILL

Fill of concrete units in place shall be porous backfill and shall consist of clean 1-inch minus crushed stone or crushed gravel meeting the following gradation per ASTM D422 *Standard Test Method for Particle-Size Analysis of Soils*. Geotextile shall not be substituted for unit drainage fill.

Sieve Size	Percent Passing
1 inch	100
¾ inch	75-100
No. 4	0-10
No. 50	0-5

2.5 SUBDRAIN:

Subdrain shall be a minimum of 4 inches in diameter. Pipe shall equal or exceed Hancor perforated co-extruded smoothwall pipe meeting ASTM F810 PVC bell & spigot or Hancor perforated heavy-duty Hi-Q or Sure-Lok pipe meeting AASHTO M252, Type S or SP.

2.6 REINFORCED BACKFILL

The fill soil material in the entire reinforced earth zone shall be granular backfill meeting the following requirements**:**

A. Backfill shall consist of soil with:
   1) Less than 35% passing the No. 200 sieve per ASTM D422 *Standard Test Method for Particle-Size Analysis of Soils* with a maximum size of 3/4 inches (4-inch maximum for steel reinforced systems).
   2) A plasticity index less than 10 per ASTM D4318.
   3) An effective internal angle of friction $\geq$ 30º per ASTM D2166 or D3080 at the compaction standard.
   4) Less than 0.5% organic material.
   5) Material can be site-excavated soils where the above requirements can be met. Unsuitable soils for backfill including ML, CL, MH, CH, OH or PT shall not be used in the backfill or in the reinforced soil mass.

B. Use of an effective friction angle greater than 30º for design shall be verified by appropriate testing submitted to and approved by the City Engineer prior to construction.

C. Backfill reinforced with geosynthetic shall have a pH in the range of 3 to 9 per ASTM G51.

D. Backfill reinforced with steel reinforcement shall have a pH in the range of 5 to 10 per ASTM G51, minimum resistivity of 3000 ohm-cm at 100% saturation per ASTM G57 *Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method* and free of sulfates > 200 ppm or chlorides > 100 ppm. If the resistivity is $\geq$ 5000 ohm-cm, the chloride and sulphate requirements are waived. Subject to approval, the City Engineer may allow slightly wider ranges of pH for higher resistivities.

2.7 BASE LEVELING PAD

Unless otherwise recommended by the supplier/manufacturer, base leveling pad shall be constructed of dense graded crushed stone or crushed gravel. A concrete leveling pad consisting of lean unreinforced concrete (NCDOT Class B Concrete) may be used at the wall contractor's option.

PART 3 - CONSTRUCTION

3.1 GENERAL

Construction and construction tolerances shall be in accordance with NCMA Section 6 and 7 or AASHTO Section 7 of AASHTO's *Standard Specifications for Highway Bridges* with the following additions or clarifications.

A. A minimum of 1 cubic foot of unit drainage fill shall be used for each square foot of wall face and shall be placed within the cores, between and behind the SRW units and shall extend back from the face of the wall a minimum of 2 feet. Geotextile is not an acceptable substitute for unit drainage fill unless the entire reinforced backfill zone meets the requirements of AASHTO *Standard Specifications for Highway Bridges* Section 7.3.6.3 and connection strength requirements can be met without unit drainage fill.

B. Reinforcement not meeting the minimum stiffness requirement of Section 2.3.A (5) or wider than 12 feet shall be staked at the corners and on 12 foot centers along the roll edges to prevent wrinkling or other distortion of the reinforcement during backfill placement.

3.2 FOUNDATION SOIL PREPARATION

Foundation soil shall be excavated as required for base course leveling pad dimensions pad dimensions indicated on the plans and limits of reinforced earth zone as shown on the construction drawings. Contractor shall take precautions to minimize over-excavation. Excavation support, if required, shall be accommodated and improved as directed by the Wall Design Engineer.

Prior to placement of the stone or concrete leveling pad, foundation soil shall be examined by the Engineer to assure that the actual foundation soil strength meets or exceeds the assumed design bearing strength. Soils not meeting the required strengths shall be removed and replaced with soil or stone meeting the design criteria.

The earth foundation shall have a density equal to or greater than 90% of the Maximum Standard Proctor Dry Density. The earth foundation shall be stepped at the required intervals to keep the subgrade at a minimum of 12 inches below the proposed toe side finished grade and no less than that shown on the construction drawings.

3.3 LEVELING PAD

The contractor shall place the leveling pad as shown on the construction drawings but no less than 6 inches thick. The contractor shall construct the leveling pad to ensure complete contact of the retaining wall unit with the leveling pad. Gaps will not be allowed between the retaining wall unit and the leveling pad.

The granular base shall be compacted to 95% of the maximum Standard Proctor density. The base shall be capable of providing a firm level bearing pad on which to place the first course of Segmental Retaining Wall Units.

3.4 UNIT INSTALLATION

The concrete segmental units and Geogrid reinforcement shall be installed in general accordance with the approved submittals. The plans should govern in any conflict between the 2 requirements.

A. Materials shall be installed at the proper elevation and orientation shown on the plans.

B. The retaining wall units shall be installed adjacent to each other along the alignment of the wall.

C. Fill the Retaining Wall Units with drainage aggregate.

D. Extend the drainage aggregate a minimum of 12 inches behind the retaining wall units.

E. Clean the top of the units so that they are free of aggregate.

F. Offset the second course of the units when indicated on the details. Engage/interlock lower unit as required by manufacturer. Repeat the above procedure until the proper height is achieved.

G. Unless otherwise indicated on the plans, terminate the end of the wall by turning the units at a radius into the embankment or tapering the top of wall with the desired slope.

H. Cap Unit Installation:
   1) Place the Cap Unit over the last course of retaining wall units.
   2) Saw cut block as needed.
   3) Use a high strength cap adhesive to bond the cap unit to the wall.

3.5 GEOGRID INSTALLATION

A. Install the geosynthetic reinforcement at the elevations and lengths shown on the construction drawings.

B. The geosynthetic shall be installed by placing the primary strength direction of the product over the Segmental Retaining Wall Unit (extended to the face of the unit), placing the next course of retaining wall units over the geosynthetic and pulling the geosynthetic taut.

C. Geogrid reinforcement should be installed under tension. Apply a nominal tension to the reinforcement by hand and maintain it by pins, staples, or stakes. The tension applied may be released after the Geogrid reinforcement has been covered and held in place with soil fill.

D. Overlap of the Geogrid in the design strength direction shall not be permitted. The design strength direction is that length of Geogrid reinforcement perpendicular to the wall face and shall be one continuous piece of material. Adjacent sections of Geogrid shall be butted in a manner to assure 100% coverage after placement.

3.6 BACKFILL PLACEMENT

A. The backfill shall be placed in maximum loose lift thicknesses of 10 inches, and compacted to 95% of Standard Proctor density (ASTM D 698) at a moisture between 3% under optimum moisture to not more than the optimum moisture content.

B. Backfill shall be placed, spread, and compacted in such a manner that eliminates the development of wrinkles and/or movement of the Geogrid reinforcement.

C. Only hand operated compaction equipment shall be allowed within 3 feet of the front of the wall face.

D. Tracked construction equipment shall not operate directly upon the geosynthetic reinforcement. A minimum backfill thickness of 6 inches is required prior to

operation of tracked vehicles over the geosynthetic reinforcement. Turning of tracked vehicles shall be kept to a minimum to prevent fill and geosynthetic displacement.

E. Rubber tired equipment may pass over the geosynthetic reinforcement at slow speeds less than 10 mph. Sudden braking and turning must be avoided.

F. At the end of the day's operation, slope the backfill away from the wall to direct runoff away from the wall face. The contractor shall not allow surface runoff to enter the wall construction site.

G. The granular backfill shall be compacted in accordance with Specification section **02200 Earthwork**. The granular backfill shall be placed as shown on the construction drawings in maximum 8-inch lift and compacted to a minimum of 95% of the Standard Proctor Maximum Dry Density (ASTM D698).

3.7 DRAINAGE FILL PLACEMENT

A. Drainage Fill shall be installed as shown on the construction drawings to maintain gravity flow of water outside of the reinforced earth zone. The drainage fill shall be placed as directed on the construction plans.

B. Unless otherwise shown on the plans, install a minimum 3-inch diameter perforated or slotted PVC or corrugated HDPE drainage pipe (manufactured in accordance with ASTM D3034 and/or ASTM D1248) behind the base of the wall to collect drainage from the drainage fill. The drainage collection pipe should daylight into a storm sewer manhole or along a slope at an elevation which is at a lower elevation than the lowest point within the aggregate drain SRW reinforced earth zone.

C. Drainage laterals shall be placed at a maximum of 50 feet spacing along the wall face.

3.8 FIELD QUALITY CONTROL AND ASSURANCE

A. **Field Quality Assurance**: The City of Wilson shall engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. As a minimum, quality assurance testing should include foundation soil inspection, inspection for the need for any additional drainage, soil and backfill testing, verification of design parameters, and observation of construction for general compliance with design drawings and specifications. This does not relieve the Contractor from securing the necessary construction quality control testing during construction.

B. **Field Quality Control**: The Contractor's quality control testing and construction inspection services shall only be performed by independent, qualified and experienced technicians and engineers. The Contractor's quality control testing, as a minimum, shall include:

1) Field density testing
   a. Subgrade: One test for every 2500 square feet of subgrade.

b. Reinforced Backfill: One test for every 2500 square feet of lift with a minimum of one test for every other lift.
c. Retained and Foundation Soil: Per Section 02200.

2) Laboratory Moisture Density: Minimum one test per soil type.

3) Gradation Analysis:
a. Unit Fill: One test per 500 CY
b. Backfill: One test per 1000 CY

3.9 CLEANUP AND RESTORATION OF SITE

A. During the progress of the work, the Contractor shall keep the premises and the vicinity of the work clear from unsightly and disorderly piles of debris. Suitable locations shall be specified for the various construction materials and for debris. The materials shall be kept in their storage locations, except as needed for the work and debris shall be promptly and regularly collected and deposited in the specified location.

B. Upon completion of the wall and appurtenances, the Contractor shall fine grade the ground adjacent thereto, removing all surplus excavated material, leaving the area free from surface irregularities. He shall dispose of all surplus material, excess SRW units, fabric, dirt, and rubbish from the site; and shall keep the site free of mud and dust to the satisfaction of the City Engineer.

C. When working on the shoulders of paved roads, the Contractor shall keep the pavement clean of all loose earth, dust, mud, grave, etc., and shall restore road surfaces, shoulders, and ditches as required by either the NCDOT or the right-of-way owner.

D. After all work is completed, the contractor shall remove all tools and other equipment, leaving the site free, clean, landscaped, and in good condition.

END OF SECTION 02632

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02740 – BASE COURSE AND PAVING

(Last revised 7/2/20) R4

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. Section 00825 – Product Substitutions

C. Section 00950 – Measurement and Payment

D. Section 02200 – Earthwork

E. Section 02275 – Trenching, Backfilling, and Compaction of Utilities

F. Section 02400 – Curb & Gutter, Driveways and Sidewalks

G. Section 02920 – Seeding, Sodding, & Groundcover

H. City of Wilson List of Approved Manufacturers and Products

I. Bicycle lanes and paths shall be designed and constructed in accordance with the latest version of the NCDOT *NC Bicycle Facilities Planning and Design Guidelines*, latest revision, NCDOT Office of Bicycle and Pedestrian Transportation.

1.2 SUMMARY

This section includes all equipment, labor, material, and services required for complete installation of aggregate base courses and bituminous concrete pavement structures and specialties for municipal street and greenway systems.

1.3 DEFINITIONS

A. **General**

For the purposes of this specification, the following definitions refer to roadway and street systems that come under the authority of the City of Wilson, North Carolina as specified within this section and other sections of this manual.

1) **Aggregate Base Course**: A layer of graded aggregate materials (ABC unless otherwise specified by the City Engineer) of a specified thickness placed between the subgrade and the paving course.

2) **Base Course**: A layer of bituminous material of a specified thickness placed between the subgrade or aggregate base course and the intermediate or surface bituminous paving course.

3) **Cold Patch**: A layer of temporary asphaltic concrete mixture used for the repair and patching of small pavement areas in asphaltic concrete and Portland cement concrete in cool to cold weather applications.

4) **Bikeway/Greenway**: A facility, and its appurtenances, used for the public conveyance of pedestrians and/or bicyclists that is maintained by the City of Wilson, the North Carolina Department of Transportation, or other entity for the good of the public.

5) **Public Road System**: Roadway, streets, and their appurtenances required for the conveyance of the motoring public that are maintained by either the City of Wilson or the North Carolina Department of Transportation.

6) **Intermediate Course**: A layer of bituminous material of a specified thickness that is placed between the subgrade or base course and the surface bituminous paving course.

7) **Subgrade**: The top surface of a roadbed shaped to conform to the typical section on which the pavement structure and shoulders are constructed.

8) **Subgrade Stabilization**: The modification of roadbed soils by admixing with stabilizing or chemical agents that will increase the load bearing capacity, firmness, and resistance to weathering or displacement.

9) **Suitable Subgrade**: A subgrade that consists of a material type and density that is approved by the City Engineer for placement of a subsequent layer of material.

10) **Surface Course/Wearing Surface**: The top layer of a bituminous or concrete pavement structure which resists skidding, traffic abrasion, and the disintegrating effects of weather.

1.4 SUBMITTALS

A. Submit job-mix formula for each mixture to be supplied within 30 days after contract is awarded.

B. Submit product data and shop drawings for manholes adjustment rings.

C. MSDS sheet on cold patch.

1.5 QUALITY ASSURANCE

A. **Geotechnical Testing Agency Qualifications**: An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing as documented according to ASTM D3740 and ASTM E548.

B. Unless shown otherwise herein, comply with the applicable requirements of the NCDOT Asphalt Quality Management System (QMS) Manual, latest edition.

C. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

D. The Contractor shall comply with North Carolina Department of Environment and Natural Resources, "Erosion and Sedimentation Control Handbook," latest revision.

E. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Society for Testing and Materials

ASTM C33	Standard Specification for Concrete Aggregates
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils (for classification purposes only)
ASTM D476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
ASTM D698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3) (Standard Proctor)
ASTM D1556	Standard Method of Test for Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (Modified Proctor)
ASTM D1883	Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D2049	Withdrawn and replaced by D4253
ASTM D2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
ASTM D2937	Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
ASTM D3740	Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E303	Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E548	Standard Guide for General Criteria Used for Evaluating Laboratory Competence

American Association of State Highway & Transportation Officials

AASHTO M145	Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction
AASHTO T99	The Moisture-Density Relations of Soils using a 5.5-pound Rammer and a 12-inch drop
AASHTO T180	The Moisture Density Relations of Soils using a 10-pound Rammer and an 18-inch drop
AASHTO T191	Density of Soil In-Place by the Sand-Cone Method
AASHTO T204	Density of Soil In-Place by the Drive Cylinder Method – Replaced by ASTM D2937
AASHTO T205	Density of Soil In-Place by the Rubber-Balloon Method – Replaced by ASTM D2167

1.6 STANDARD ABBREVIATIONS

A. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

AASHTO	American Association of State Highway Transportation Officials.
ANSI	American National Standards Institute
AREA	American Railway Engineers Association
ASTM	American Society for Testing and Materials
FS	Federal Specifications
HMA	Hot Mix Asphalt
MSDS	Material Safety Data Sheets
MUTCD	Manual on Uniform Traffic Control Devices
NCDOT	North Carolina Department of Transportation
OSHA	Occupational Safety and Health Administration
RAP	Recycled Asphalt Pavement

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Plant operations shall be in accordance with the applicable sections of Section 610, *Asphalt Concrete Plant Mix Pavements* of the NCDOT *Standard Specifications for Roads and Structures,* latest revision.

B. Limitation for producing and placing ashpalt mixtures shall comply with Section 610-4, *Weather, Temperature, and Seasonal Limitations For Producing and Placing Asphalt Mixutures*, of the NCDOT *Standard Specifications for Roads and Structures,* latest revision.

C. Storage shall be in accordance with Section 610-6, *Hot Mix Storage Systems* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

D. Hauling and Spreading shall be in accordance with Section 610-7, *Hauling of Asphalt Mixture* and Section 610-8*, Spreading and Finishing* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

E. Delivery:

1) Hauling equipment shall be loaded in a manner to minimize segregation of the mix.

2) Haul trucks must park in a designated area to minimize tracking of tack coats.

3) Once loaded, haul trucks shall proceed immediately to the job site.

1.8 COORDINATION

A. Coordinate manhole and valve box adjusting with the City Engineer or City Engineer's representative as it relates to resurfacing.

B. Coordinate tie-in to municipal roadways with the City Engineer.

C. All new paved areas shall have positive drainage to eliminate ponding. Where new paved areas join existing, measures shall be taken to incorporate positive drainage to eliminate ponding.

D. Repair of pavement markings: When cuts are made through any paved surface and the cuts extend through the pavement markings, the replaced pavement shall be marked to match the existing.

PART 2 – PRODUCTS

2.1 AGGREGATE BASE COURSE

Aggregate Base Course material shall be designated as ABC in accordance with Section 520, *Aggregate Base Course*, and Table 1005-1 *Aggregate Gradation, Coarse Aggregate* of the NCDOT *Standard Specifications for Roads and Structures,* latest revision.

2.2 ASPHALT SURFACE TREATMENT

Asphalt Surface Treatment shall be in accordance with Section 660 *Asphalt Surface Treatment* of the NCDOT *Standard Specifications for Roads and Structures,* latest revision.

2.3 ASPHALT TACK COAT

Asphalt Tack Coat shall be in accordance with Section 605 *Asphalt Tack Coat* of the NCDOT *Standard Specifications for Roads and Structures,* latest revision.

2.4 BITUMINOUS CONCRETE PAVEMENTS

Bituminous Concrete Pavements shall be in accordance with Section 610-3 *Composition of Mixtures (Mix Design and Job Mix Formula)* of the NCDOT *Standard Specifications for Roads and Structures,* latest revision.

2.5 CEMENT TREATED BASE COURSE

Cement Treated Base Course shall be in accordance with Section 540, *Cement Treated Base Course* of the NCDOT *Standard Specifications for Roads and Structures,* latest revision or as specified by the City Engineer.

2.6 COLD PATCH

Cold Patch mixture shall have good workability and be capable of being placed at temperatures of 20º F to 140º F without the addition of heat. The mixture shall have good adhesion to wet surfaces and be resistant to damage by water, salt, and deicing products. It shall consist primarily of crushed stone, cut-back asphalt and additives. The mixture must be uniform and not require any mixing prior to use. It shall be capable of being removed from the container without significant adherence to the container. Application of the mixture must be able to be accomplished by hand labor. Traffic must be able to travel

over the mix with little to no compaction immediately after installation without pick-up of the mix by vehicle tires. The mixture shall cure and harden with continued vehicle use. Provide MSDS sheets with product.

Approved products include the following:

Product	Manufacturer
QPR	Lafarage North America, Norcross, GA
E-Z Street	S. T. Wooten Corporation

2.7 LIME-TREATED SOIL

Lime-Treated Soil shall be in accordance with Section 501 *Lime-Treated Soil* of the NCDOT *Standard Specifications for Roads and Structures,* latest revision or as specified by the City Engineer.

2.8 PRIME COAT

Prime Coat shall be in accordance with Section 600 *Prime Coat* of the NCDOT *Standard Specifications for Roads and Structures,* latest revision or as specified by the City Engineer.

PART 3 – EXECUTION

3.1 GENERAL

Construction and testing shall conform to the applicable sections of Division 6 – *Asphalt Pavements* of the NCDOT *Standard Specifications for Roads and Structures,* latest revision. Other requirements for base course and pavement are also set out on the drawings and on the Standard Details shown in the City of Wilson standard street details.

3.2 PAVEMENT, PATCHES, REPAIR AND REPLACEMENT

A. **General**: This work shall consist of replacing subbase stone, and bituminous material in the street in areas where it becomes necessary to remove the original pavement such as for sewer trenches, water main trenches, storm drainage pipe ditches, etc. Pavement repair shall be the type to match the existing street pavement as shown on **Standard Detail C01.03** or as determined by the City Engineer**.**

B. **Cutting Pavement**

Where a utility line is proposed to be placed in an existing paved area, the edges of the pavement for the utility line shall be cut in a straight line, parallel to the pipe on each side (see **Standard Detail C01.02** for the width of the pavement). Perform cutting operations prior to installation of line to avoid excessive removal of pavement. Care shall also be taken during installation of pipe to avoid damage to adjoining paved surfaces. Additional cutting may be required to provide a straightedge.

C. **Surface Tolerances**

The bituminous patched surface will be tested using a 10-foot straightedge. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall not exceed ¼-inch allowing for the contours of the existing pavement. All humps or depressions exceeding the specified tolerance shall be corrected or the defective work removed and replaced with new material. Any deviation from this standard will be at the discretion of the City Engineer.

3.2.1 PERMANENT PAVEMENT REPAIR

Excavation: Excavation of the existing pavement and subbase shall be made to the depth shown on the construction drawings or as directed by the City Engineer. Before the placement of any stone, concrete, or bituminous material, a representative of the City Engineer shall inspect the underlying subgrade. The Contractor shall be responsible for correcting any ruts or soft yielding places to the depth necessary to pass a proof roll of the subgrade before placing of the bituminous material.

A. **Bituminous Pavement Repair**

Aggregate Base Stone: The aggregate base shall be placed in accordance with **Standard Detail C01.03** and compacted to 95% of the Standard Proctor maximum dry density based on ASTM D698. A proof roll must be passed prior to the placement of any subsequent course. For subgrade compaction requirements, see *Table 2200.2A* of *Section 02200 Earthwork*.

Bituminous Concrete Pavement: Placing of the bituminous concrete pavement shall be placed in accordance with **Standard Detail C01.03**. Compact all mixes shown inr paragraph 3.6.3, I, Placement Limitations, (reference: Table 610-7 of the NCDOT *Standard Specifications for Roads and Structures, latest revision)*to 92% based on AASHTO T209.

1) **Bituminous Base Course**: Before placing any bituminous material, all sides of the existing pavement and subbase shall be thoroughly tacked at the rate of 0.3 Gal/SY.

2) **Bituminous Surface Course**: The finished surface shall abut the existing pavement with no overlap allowed. Care shall be taken to ensure a uniform grade between the existing pavement and the new surface.

3) **Rideability**: Finished pavement surface shall be free of defects, irregularities, undulations, ridges, etc., whether transverse or longitudinal, that, in the opinion and discretion of the City Engineer, would negatively impact rideability.

B. **Concrete Pavement Repair**

Aggregate Base Stone: The aggregate base shall be placed to a depth as shown on the drawings or as directed by the City Engineer and compacted to 95% of the Standard Proctor maximum dry density based on ASTM D698. A proof roll must be passed prior to the placement of any subsequent course.

Concrete Pavement: Placing of the concrete pavement shall be performed in accordance with drawings or as directed by the City Engineer. Concrete shall meet

Section 1000, *Portland Cement Concrete Production and Delivery* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision except that the minimum compressive strength shall NCDOT Class A air-entrained concrete. The City Engineer reserves the right to require that the Contractor pull concrete test cylinders for verifying concrete strength.

3.2.2 TEMPORARY PAVEMENT REPAIR

A. **Bituminous Pavement Repair**

When shown on the plans, during winter months when bituminous concrete asphalt is unavailable or when directed by the City Engineer, temporary pavement patches shall be employed (see paragraph 2.6, Cold Patch). The Contractor shall maintain the temporary repair to the satisfaction of the City Engineer until the permanent pavement repair is made. Before placing any bituminous material, all sides of the existing pavement and subbase shall be thoroughly tacked at the rate of 0.3 gal/SY. The patch shall conform to the section shown on **Standard Detail C01.03**.

Density shall conform to the applicable sections referenced above under permanent pavement repair for each particular product (i.e. aggregate base course, bituminous concrete asphalt).

B. Once hot bituminous mix is available, all temporary patch material shall be replaced at the discretion of the City Engineer.

3.3 AGGREGATE BASE COURSE (ABC)

A. **Weather Limitations**

Stabilized aggregate base courses shall not be constructed unless the atmospheric temperature is at a minimum of 35ºF and rising. Any areas of completed base course that are damaged by freezing shall be reconditioned, reshaped, and recompacted.

B. **Subgrade Approval**

The subgrade upon which the aggregate base course is to be placed shall be prepared in accordance with the requirements Section 02200, *Earthwork*.

Proofrolling the subgrade prior to placement of ABC shall be performed in accordance with paragraph 3.3.2.F *Preparation of subgrade areas to receive curb and gutter, stone base or concrete pavement*. All areas failing initial proofrolling shall be repaired and re-proofrolled prior to placement of stone base to allow time for bridging/consolidation of the subgrade.

Prior to any spreading operations, the subgrade shall be checked and accepted by the City Engineer or his/her representative for adequate compaction and surface tolerances. The surface of the subgrade shall be dry and clean of all foreign substances. The option to re-proofroll the entire subgrade immediately prior to placement of stone base shall be at the discretion of the City Engineer or his/her representative.

C. **Installation of Aggregate Base Course**

The aggregate base course shall be constructed in layers not less than 3 inches or more than 6 inches of compacted thickness. When vibrating with other approved types of special compacting equipment, the compacted depth of a single layer of the aggregate base course may be increased to 8 inches upon approval. The aggregate, as spread, shall be uniform in gradation with no segregation or pockets of fine or course material. Frequent template checks shall be made to ensure that a minimum amount of patching is necessary after complete compaction is secured.

Multiple Lifts: If multiple lifts of ABC are required due to either base thickness or a requirement of either a Geotechnical Engineer or the City Engineer, the City Engineer has the option to request, at his/her discretion, a passing proof roll test of the initial base course lift prior to the placement of any subsequent stone base course lift.

Over wintering: If the stone base is planned to set up over the winter or for an extended period of time, the stone base must be subjected to and pass density testing just prior to asphalt placement. The City Engineer has the option to request, at his/her discretion, a passing proof roll test of the base course just prior to paving.

D. **Compaction Operations and Density Requirements**

After mixing and spreading, the aggregate base course shall be well rolled and machined until thoroughly compacted at optimum moisture within +20% percent of optimum. Rolling shall progress gradually from the sides to the center and shall continue until the entire area of the course has been rolled by the rear wheels. Rolling shall continue until the full depth of the material has been compacted to not less than 95 percent density of the maximum dry density when tested in accordance with ASTM D1556, Standard Method of Test for Density of Soil in Place by the Sand-Cone Method, latest revisions.

Aggregate base course density shall also conform to the applicable requirements of NCDOT *Standard Specifications for Roads and Structures*, Section 1006, *Aggregate Quality Control/Quality Assurance*, latest revision. See paragraph H *Stone Base Testing*, below for testing frequency and desnity requirements.

E. **Grading Tolerances of Final Surface**

After final rolling, the surface shall be inspected and any irregularities in excess of ½ inch shall be corrected. Aggregated base course shall conform to the lines, grades, and typical cross sections shown on the plans, details or as established by the City Engineer within a tolerance of +/- ½ inch. Any irregularities in the surface shall be corrected by scarifying, remixing, reshaping, and recompacting until a smooth surface is obtained.

F. **Maintenance**

If directed by the City Engineer, either the aggregate base shall be opened to public traffic for at least 4 months before being surfaced or, prior to paving, the Contractor/Engineer shall provide to the City Engineer evidence that passing density tests meeting these specifications have been conducted on the subgrade, in trenches, and on the stone base. The minimum density requirements and frequency of tests shall meet the requirements of 02200 *Earthwork* and 02275 *Trenching, Backfilling and Compaction of Utilities*, as applicable. During the time

the base is open to the public, the surface shall be protected against excessive base erosion, rutting, shoulder erosion, and washboarding; regrading as necessary to maintain rideability. However, traffic shall be kept off the base between preparatory final compaction and surfacing.

G. Base Contamination

Should the base become contaminated, a sufficient depth of the base shall be removed, as determined by the City Engineer, replaced with ABC, and the base compacted to the minimum density specified in this specification.

H. Stone Base Testing:
Nuclear density tests conducted in accordance with the requirements of the NCDOT will be required to verify stone base density. Density tests shall be conducted at a frequency of 1 test shot per 50 linear foot of street. A passing test is comprised of group of 5 test shots yielding an average of 98% with no single test shot lower than 95%. If one shot out of the 5 falls below 95% minimum, the whole group is considered a failure.

3.4 CEMENT TREATED STABILIZATION

Cement Treated Stabilization shall be performed in accordance with NCDOT *Standard Specifications for Roads and Structures*, Section 540, latest revision or as specified by the City Engineer.

3.5 LIME-TREATED SOIL

Lime-Treated Soil shall be performed in accordance with NCDOT *Standard Specifications for Roads and Structures*, Section 501, latest revision or as specified by the City Engineer.

3.6 BITUMINOUS CONCRETE PAVEMENT

3.6.1 CONDITIONING EXISTING SURFACES

A. **Adjusting Existing Manholes and Valve boxes prior to final paving:** See paragraph 3.9.C *Surface Casting Adjustments/Preparation* for valve boxes and manholes. Tack coating is to be applied to the exposed edges of the asphalt providing ample time for tack to "break" prior to placement of concrete collar(s).

B. **Tack Coating**:

Procedures and equipment shall be in accordance with Section 605, *Asphalt Tack Coat* of the NCDOT Standard Specifications for Roads and Structures, latest revision.

Contact surfaces of curbing, gutters, manholes, and other structures projecting into or abutting the pavement and cold joints of bituminous concrete asphalt shall be painted with a thick uniform coating of liquid asphalt prior to placement of bituminous concrete asphalt mixture. Application of tack at joints, adjacent to curbs, gutters, or other appurtenances shall be applied with a hand wand at the rate of 0.2 gallons per square yard. At joints, the hand wand applied tack shall be 2 feet in width with 4 to 6 inches protruding beyond the joint for the first pass. Tack

for the adjacent pass shall completely cover the vertical face of the mat edge, so that slight puddling of asphalt occurs at the joint, and extends a minimum of 1 foot into the lane to be paved. Milled faces that are to remain in place shall be tacked as above for the adjacent pass. Use of tack at longitudinal joint vertical faces will not be required when 2 or more pavers are used such that one paver follows the front paver to the rear and side of the front (paving in echelon).

Tack shall be applied in such a manner as to offer the least inconvenience to traffic and to permit a minimum of one-way traffic without pickup or tracking. **Tack coats shall be allowed sufficient time to "break" prior to beginning the paving operation** (which includes hauling and paving equipment access across tack coat).

All asphaltic cement or other materials which discolor the surface of concrete structures and items which are spilled or placed on such surfaces shall be removed at the Contractor's expense. Contractor's inability to remove such foreign and disfiguring stains shall result in the complete removal of the structures so stained or disfigured, and these removed structures or surfaces shall be replaced at his expense. Particular care shall be taken to prevent tack coat from getting into and on gutter areas. Care shall also be taken to prevent spattering of adjacent pavements, drives, trees, and private property. Any spattering will be cleaned up by the Contractor at no cost to the City.

Payment for tack shall be included in bituminous concrete asphalt prices.

C. **Removing Depressions/Irregularities**

Where irregularities in the existing surface would result in a course more than 3 inches in thickness after compaction, the surface shall be brought to a uniform grade by snatching with a thin layer of bituminous concrete asphalt not exceeding the minimum thickness as recommended for that type of mix. Then the material shall be thoroughly compacted until it conforms to the surrounding surface. The mixture used shall be the same as that specified for the surface mix to be placed.

D. **Bicycle/Greenway subgrade – Herbicide Treatment:**

Herbicides shall conform to Section 1060-13, *Herbicides* of the NCDOT *Specifications for Roads and Structures*, latest revision shall be applied to the aggregate base course and/or subgrade no more than 15 minutes prior to paving. The rate of application shall be as recommended by the herbicide manufacturer. Herbicides shall not be used where they may contaminate water used for irrigation and drinking purposes.

3.6.2 PAVEMENT PROFILING - MILLING

The work included under this contract item shall consist of the removal of existing bituminous surfaces of in-place pavements on various streets within the City of Wilson, to produce the desired profile, cross-section, and surface conditions as specified by the City Engineer. All removed material shall become the property of the Contractor.

The Contractor shall plan and prosecute a schedule of operations so that milled roadways will be overlaid with bituminous concrete asphalt as soon as possible, and, in no instance, shall the time lapse exceed 4 days after the milling operations,

unless otherwise specified. The milled areas of the roadway shall be kept free of irregularities and obstructions that may create a hazard or annoyance to traffic in accordance with the requirements of NCDOT *Standard Specifications for Roads and Structures*, Section 607, *Milling Asphalt Pavement*, latest revision.

The Contractor shall plan and prosecute the milling operation to avoid trapping of water on the roadway. At the discretion of the City Engineer, cutting drainage slots in roadway shoulders or inlets may be required, at no additional costs. The Contractor shall also restore the cut drainage slots and any damage due to weather or traffic afterwards at no additional cost to the City.

A. The equipment and manpower furnished for this work shall be:

1) A cold milling machine capable of cutting at least 2 inches and 55 inches wide in flexible pavement while leaving a uniform cut and rideable surface capable of handling traffic prior to placement of a new bituminous overlay. The ground speed of the machine shall be independent of the cutting equipment. The machine shall maintain a sharp cutting edge at all times. The machine shall have a self-contained water system for control of dust and fine particles. The machine shall be capable of working in wet and dry conditions with temperatures down to 32ºF.

2) The width of the machine shall be such to allow for one lane of traffic at all times. The machine shall be capable of cutting within 1 inch of manholes, valve box tops and facedown walks with a minimum radius of 5 feet.

3) If the machine is not self-loading, then a capable loader shall be furnished for placing the material onto trucks.

4) A power broom or equivalent is to be used for cleaning the planed surfaces.

5) The Contractor shall furnish all hose and water.

6) Traffic control and flagman are to be provided by the Contractor.

7) All work associated with the milling operation shall be performed by the Contractor (such as asphalt removal at intersections and around utilities and clean up in yards).

B. The construction methods shall be as follows:

Where bituminous pavement extends into the existing curb and gutter, the Contractor shall be required to plane at different slopes. The first cuts shall remove the material existing above the gutter line (whether by milling, motor grader, or hand shovel). These cuts will be made at the appropriate gutter slope (1/2":1') for both 24 and 30 inch curb and gutter. Any curb and gutter with a different slope will be planed at the existing curb and gutter slope.

The last cuts shall remove the material to a minimum depth of 1" below the gutter line, or to a depth as specified by the City Engineer, with a street cross-section slope of 1/4":1' or to slope of existing street.

Where curb and gutter exists but the pavement is at or below the existing gutter line, the pavement will be cut to a depth of the thickness of overlay below the gutter

line while adjusting street cross-section to 1/4":1' toward the centerline of the street.

Where existing straight curbing has pavement built up to expose less than 6 inches of curbing, the pavement will be planed down on grade of 1/4":1' or whatever the existing grade of the street back to the street centerline until a desired height of curbing is exposed.

Where center of pavement has correct crown but, pavement has rutting or ripples (possibly caused by vehicular braking), the pavement will be planed to the depth necessary to remove all such defects.

If milling encroaches into base, the area shall be patched the same day.

C. **Incidental Milling**: To permit transitioning of the new asphalt to an existing paved street, the existing asphalt pavement shall be milled 1 1/2" inches deep for a maximum length of 15 feet to allow for placement of the final lift of asphalt.

D. Surface Casting Adjustments/Preparation: See paragraph *3.9B, Surface Casting Adjustments*.

3.6.3 PAVING OPERATIONS

A. **Bituminous Concrete Pavement Equipment**

Bituminous concrete pavement equipment shall be in accordance with Section 610 *Asphalt Concrete Plant Mix Pavement* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

B. **Transportation of Bituminous Mixture**

Transportation of bituminous mixture from the paving plant to the site shall be in trucks having tight, clean, and smooth beds. Each load shall be covered with canvas or other suitable material of ample size to protect it from the weather and to prevent the loss of heat. Prior to discharge from the hauling vehicle, the temperature of the mixture shall be within a tolerance of plus 15ºF to minus 25ºF of the specified job mix formula temperature. Any loads wet excessively by rain will be rejected. Hauling over freshly laid material will not be permitted.

C. **Placing and Furnishing**

1) **Pre-Paving Meeting to be Conducted**: Prior to placement of asphalt of on any City project or New Development Project (i.e. Subdivisions, etc.) that will be accepted by the City of Wilson for maintenance, a pre-paving meeting shall be held between the City of Wilson Engineering staff/Inspector, the Prime Contractor, the Paving Contractor, and the Engineer of Record. The party responsible for Project Management shall be responsible for setting up the date and time for the meeting and for coordinating the meeting with the participants. (Rev 7/2/20)

2) Bituminous concrete asphalt shall only be placed when the weather conditions are suitable (see paragraph I, *Placement Limitations*, below).

Bituminous concrete asphalt shall not be placed until surface upon which it is to be placed has been approved by the City Engineer. Prior to delivery of surface course material, the base course shall be completed for receiving the surface course material and shall be kept from traffic, with the exception of the mixture vehicles and those other vehicles necessary for the placement of asphalt.

For strip paved streets, the edge of the pavement shall be marked by means of a continuous line placed and maintained a sufficient distance ahead of the paving operation to provide proper control of the pavement width and horizontal alignment.

Contact surfaces of curb and gutters, manholes, etc., shall be painted with a thin uniform coating of cut-back asphalt just before the surface mixture is placed against them. Immediately adjacent to headers, flush curbing, gutters, liners, and other structures, the surface course mixture shall be spread uniformly high so that after the final compaction it will be approximately 1/8 inch above the edge of the structure.

An approved asphalt paver shall be used to distribute the bituminous mix over the widest pavement width practicable. It is important that the augers carry a consistent amount of mix across the front of the screed so that the pressure (head of material) on the screed is kept as constant as possible. Auger extensions shall be used to provide a proper head of mix in front of the full screed length. When the screed is extended by more than one-foot, the auger on that side of the paver shall be extended by an equivalent amount. The machine shall be capable of laying down 1 layer per lane width unless paving in echelon (i.e. when 2 or more pavers are used such that one paver follows the front paver to the rear and side of the front). Wherever practicable and when the capacity of sustained production and delivery is such that more than one paver can be operated, pavers shall be used in echelon to place the wearing course in adjacent lanes. Crossovers, as well as areas containing manholes or other obstacles that prohibit the practical use of mechanical spreading and finishing equipment, may be constructed using hand tools. However, care shall be taken to obtain the required thickness, jointing, compaction, and surface smoothness.

3) Longitudinal Pulls: To minimize longitudinal joints in pavement, any street that is to be paved or resurfaced shall be limited to a maximum of 2 pulls (i.e. the machine shall be capable of laying down 1 layer per lane width) unless otherwise approved by the City Engineer.

4) The longitudinal joint in one layer shall offset that in the layer immediately below by approximately 6 inches. However, the joint in the wearing surface shall be at the centerline of the pavement if the roadway comprises two traffic lanes or at lane lines if the roadway is more than two lanes in width. Offsetting layers will not be required when adjoining lanes are paved in echelon (when 2 or more pavers are used such that one paver follows the front paver to the rear and side of the front) and the rolling of both lanes occurs within 15 minutes after laydown.

The Contractor shall have a certified Asphalt Concrete Paving Technician present during paving operations. Immediately after placement and screeding, the surface and edges of each layer shall be inspected and

straightedged by the technician and necessary corrections performed prior to compaction. The finished pavement shall be uniform and smooth.

The placement of bituminous concrete shall be as continuous as possible and shall be scheduled such that the interruption occurring at the completion of each day's work will not detrimentally affect the partially completed work. Material that cannot be spread and finished in daylight shall not be dispatched from the plant unless the use of artificial lighting has been approved. When paving is performed at night, sufficient light shall be provided to properly perform and thoroughly inspect every phase of the operation. Such phases include cleaning planed surfaces, tack application, paving, compacting, and testing. Lighting shall be provided and positioned such as to not create a blinding hazard to the traveling public.

The Contractor shall distribute to each residence or business along a road to be paved, a flyer with notification of the work to be done and the dates it will be performed. The contractor's phone number is to be listed first on all notices. Also to be included is a request that all vehicles be removed from the street during this time period. The flyers are to be delivered 2 to 4 days prior to the actual start date of the construction. If work does not commence within the prior 2- to 4-day notice period, Contractor is to renotify residents before starting.

5) **Layer Placement Limitations**: Unless otherwise approved by the City Engineer, to permit chilling and curing of asphalt prior to placement of a second or subsequent layers, only one layer of asphalt may be placed in a single day.

D. **Layer Thickness**

Minimum Layer Thickness: Bituminous concrete SUPERPAVE pavement courses shall be placed in layers not exceeding 4.0 times the nominal maximum size aggregate in the bituminous mixture. The maximum thickness may be reduced if the mixture cannot be adequately placed in a single lift and compacted to required uniform density and smoothness. The minimum thickness for a pavement course shall be no less than 2.5 times the nominal maximum size aggregate in the bituminous mixture. These nominal maximum and minimum lift depths correlate as shown in the table below. If the proposed total depth for a prescribed mix type exceeds the maximum single layer depth shown in the table, the asphalt must be placed in **two lifts;** the first lift having a thickness of not less than the minimum single lift depth shown in the table. Asphalt cores must be taken to confirm thickness and compaction.

Mix Type	Minimum Single Lift[a] Depth (inches)	Maximum Single Lift (inches)	Maximum Layer Depth (inches)
S 9.5B	1	1.5	3
S9.5C, D	1.5	2	3
I19.0C	2.5	4	4
B25.0C[b]	3[b]	5.5	No Restrictions

[a] Approximate Minimum Thickness; lower rates may be used for leveling courses.
[b] For B 25.0C placed on stabilized subgrade, minimum lift thickness is 4.0 inches.

Source: NCDOT 2019 HMA/QMS Manual, Section 3.3.

E. **Joints**

1) **General**: All joints shall present the same texture, density, and smoothness as other section of the course. The joints between old and new pavements or between successive days' work shall be carefully made in such a manner as to ensure a continuous bond between old and new sections of the course. All contact surfaces of previously constructed pavements shall be painted with a thin, uniform coat of hot bituminous material just before the fresh mixture is placed.

   Care shall be exercised when tying into curb and gutter and newly over-laid travel lanes to ensure a uniform grade and joint.

   At tie-ins to existing pavement surfaces, the Contractor shall construct the final riding surface by cutting the existing asphalt for its full width to permit tying to the existing pavement; driveways and ramps included. Joint location to be determined and/or approved by the City Engineer. Suitable guidelines or devices shall be used to ensure cutting of the joint on a true line. The joint shall be thoroughly cleaned and dried prior to being sealed. This work shall be done at no additional cost to the City.

   Method of temporary joints at the end of each workday shall be approved by the City Engineer.

   In addition to the following, both transverse and longitudinal joints shall conform to Section 610-11, *Joints*, paragraphs A and B, respectively of the *NCDOT Standard Specifications for Roads and Structures*, latest revision.

2) **Transverse**: The roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is to be discontinued or when delivery of the mixture is interrupted to the extent that the unrolled material may become cold. Construct a sloped wedge ahead of the end of the full depth pavement to provide for compaction and the protection of the full depth pavement. Place a paper parting strip beneath this wedge to facilitate joint construction unless waved by the City Engineer. Before paving operations are resumed, remove the sloped wedge and cut back into the previously constructed pavement to the point of full pavement depth to expose an even vertical surface for the full thickness of the course as directed by the City Engineer.

3) **Longitudinal**: In all cases, the edges of cold longitudinal joints shall be cut back to expose an even, vertical surface for the full thickness of the course prior to constructing the adjacent pavement.

F. **Compaction**

Immediately after the bituminous mixture is placed and struck off and surface irregularities are corrected, the mixture shall be thoroughly and uniformly compacted by rolling.

During compaction of bituminous concrete asphalt, the roller shall not pass over the end of freshly placed material except when a construction joint is to be formed. Edges shall be finished true and uniform.

The surface shall be rolled when the mixture is in the proper condition. Rolling shall not cause undue displacement, cracking, or shoving.

The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. The sequence of rolling operations and the selection of roller types shall provide the specified pavement density. However, the minimum and maximum combination (smooth drum and tires) roller weight shall be 3 to 5 tons, respectively.

Immediately after the hot mixture is placed, it shall be sealed with rollers. Thereafter, rolling shall be a continuous process, insofar as practicable, and all parts of the pavement shall receive uniform compaction. In the event that the rolling operation is not able to properly keep up with the placement of the mixture, the finishing machine shall be stopped and no mixture shall be laid until the rolling has been caught up.

Rolling shall begin at the sides and proceed longitudinally parallel to the center of the pavement, each trip overlapping at least ½ the roller width, gradually progressing to the crown of the pavement. When abutting a previously placed lane, the longitudinal joint shall be rolled first, followed by the regular rolling procedure. On superelevated curves, rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline.

Displacements occurring as a result of reversing the direction of a roller, or from other causes, shall be corrected at once by the use of rakes or lutes and addition of fresh mixture when required. Care shall be taken in rolling not to displace the line and grade of the edges of the bituminous mixture. The motion of the roller shall be at all times slow enough to avoid displacement of the hot mixture. All roller marks must be eliminated.

To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with a very small quantity of detergent or other approved material. Excess liquid will not be permitted.

Along forms, curbs, headers, walls, and other places not accessible to rollers, the mixture shall be thoroughly compacted with hot hand tampers, smoothing irons, or mechanical tampers. On depressed areas, a trench roller may be used or cleated compression strips may be used under the roller to transmit compression to the depressed area.

Edges of bituminous pavement surfaces shall be true curves or tangents. Irregularities shall be corrected.

The surface of the compacted course shall be protected until the material has cooled sufficiently to support normal traffic without marring.

G. **Density**

Superpave mix density criteria for mixes listed in Table 610-3 of the NCDOT *Standard Specifications for Roads and Structures* shall be minimum 92.0% (based on AASHTO T209) for all mixes shown under paragraph 3.6.3, I, Placement Limitations, below (reference: Table 610-7 of the NCDOT *Standard Specifications for Roads and Structures, latest revision)*.

H. **Pavement Samples**

Bituminous pavement coring sampling and density test reports shall be submitted at completion of project in accordance with the requirements of the NCDOT *Standard Specifications for Roads and Structures* Section 609, *Quality Management System For Ashphalt Pavements*, latest revision.

Provide reports on the results of the corings in accordance with Section 609-5, *Contractor's Quality Control System* of the NCDOT Standard Specifications for Roads and Structures, latest revision.

Suitability of the samples shall be based on the limits of precision specified in Section 609-9, *Quality Assurance* of the NCDOT Standard Specifications for Roads and Structures, latest revision.

I. **Placement Limitations**

Asphalt mixtures that have temperatures of less than 225ºF, when ready to dump into the mechanical spreader, will be rejected. All compaction rolling shall be completed prior to the mat cooling down to 175ºF. Finish rolling may be performed at a lower mat temperature.

Asphalt mixtures shall not be either produced or placed during rainy weather, when the subgrade or base course is frozen, or when the moisture on the surface to be paved would prevent proper bond.

Do not place asphalt material when the air or surface temperatures, measured at the location of the paving operation, in the shade away from the artificial heat, does not meet the following table.

Asphalt Placement – Minimum Temperature Requirements[1]	
Asphalt Concrete Mix Type	**Minimum Surface and Air Temperature**
S9.5B	50°F
S9.5C	40ºF
S9.5D	50°F
I19.0C	35°F
B25.0C	35°F

[1]Source: Table 610-6, NCDOT Standard Specifications for Roads and Structures, except S9.5B which shall be 50ºF.

In addition, surface course material which is to be the final layer of pavement shall not be placed between December 15 and March 15 unless approved otherwise by the City Engineer in writing.

Do not place plant mix base course if the base course will not be covered with either a surface course or an intermediate course within 15 days of placement if the plant mix is placed in January or February.

Other placement limitations, to include but not limited to, mixture temperatures, and cold weather paving shall be in accordance with Section 610, *Asphalt Concrete Plant Mix Pavements* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

J. **Pavement Tolerance**

The surface will be tested by using a 10-foot straightedge. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall not be more than 1/4 inch. Humps and depressions exceeding the specified tolerance shall be corrected, or the defective work shall be removed and replaced with new material.

K. **Rideability:**

Finished pavement surface shall be free of defects, irregularities, undulations, ridges, etc., whether transverse or longitudinal, that, in the opinion and discretion of the City Engineer, would negatively impact rideability.

3.7 TACK COAT

Procedures and equipment shall be in accordance with Section 605, *Asphalt Tack Coat* of the NCDOT Standard Specifications for Roads and Structures, latest revision and Section 3.6 Bituminous Concrete Pavement of these specifications.

All castings, the gutter edge, and other surfaces which pavement rests against shall be painted with asphalt tack coat material by way of a hand brush, or other approved means, prior to the placing of the surface course. All asphaltic cement or other materials which discolor the surface of concrete structures and items which are spilled or placed on such surfaces shall be removed at the Contractor's expense. His inability to remove such foreign and disfiguring stains shall result in the complete removal of the structures so stained or disfigured, and these removed structures or surfaces shall be replaced at his expense. Particular care shall be taken to prevent tack coat from getting into and on gutter areas.

When resurfacing existing pavements, the exiting pavement shall be tacked with RS-1H asphalt at the rate of 0.03 gallon per SY to 0.10 gallon per SY. Application of the tack coat shall be made by an approved asphalt distributor.

Tack coats shall be allowed sufficient time to "break" prior to beginning the resurfacing operation (which includes hauling and paving equipment access across tack coat).

3.8 ASPHALT SURFACE TREATMENT

Section 660, *Asphalt Surface Treatment* of the NCDOT Standard Specifications for Roads and Structures, latest revision.

3.9 PREPARATION OF PAVEMENT FOR RESURFACING

A. **Preparation of Surface**: Prior to beginning paving operations, the existing areas to be resurfaced shall be thoroughly cleaned by the Contractor to the satisfaction of the City Engineer. This cleaning shall include sweeping of the streets with a power operated broom, cutting excess debris with a grader, washing with a water truck, and hand cleaning any debris left over after this operation is complete. Cleaning operations shall commence just prior to the resurfacing of streets. In addition, the Contractor shall expose any existing paved areas, which have been covered by soil, grass, or debris. These areas shall be thoroughly cleaned, herbicide applied, and tacked before resurfacing. Any excess material left over after this operation shall be removed or spread out to the satisfaction of the City Engineer. No additional payment shall be made for this work.

When the surface of the existing pavement or base is irregular, it shall be brought to a uniform grade and cross per paragraph 3.6.1.C; removing depressions and irregularities.

B. **Surface Casting Adjustments/Preparation**

Any surface casting, such as valve boxes, manholes, air release valve structures, grates, cleanouts, etc., shall be set to grade prior to beginning of paving operation. However, adjustments to valve boxes and manholes (water, sewer and storm drainage) shall be made in accordance with the following.

1) Iron Riser Ring Grade Extensions:

Elevation adjustments to both valve boxes and manholes are to be made with using iron riser rings with set screws. The iron riser rings, ordered for the corresponding depth increase in asphalt, shall be set and the street paved. Such castings shall be adjusted within a tolerance of 1/8 inch below or flush with the asphalt finished elevation. After the street has been paved, the contractor shall saw cut a square of asphalt around the valve box or manhole and construction a reinforced concrete collar per details C06.04 and C06.05.

2) Other Utility manhole, valves, cleanout boxes: All other public utility manholes, valve and cleanout boxes are to be adjusted by the utility companies or Contractor if approved by the City Engineer. If adjustments have to be made, make adjustments a minimum of 2 days and a maximum of 4 days prior to resurfacing. Installation of riser rings to be coordinated with inspector.

3.10 PROTECTION OF ASPHALTIC SURFACE COURSE

Sections of newly placed and compacted asphalt surface course shall be barricaded and protected from all defects for a period of at least 8 hours until they have become properly hardened by cooling. **Protect asphalt from petroleum products during and following placement of surface course**. When directed by the City Engineer, Certain resurfaced areas may require cooling of asphalt prior to opening to traffic.

If patching is required to make repairs, the base material in place shall be removed to a minimum depth of 4 inches, replaced with bituminous concrete base course (type B25.0C) and surfaced with 2 inches of S9.5B bituminous asphalt concrete.

3.11 PAVEMENT MARKINGS

A. **General**

1) **Applicable Design Standards**: Marking layout, dimensions, colors, etc. shall be subject to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) and the applicable details of the NCDOT *Standard Roadway Drawings*, latest revision. Unless otherwise noted below, pavement marking materials and preparation shall be of a thermoplastic material, and shall comply with Section 1087, *Pavement Markings* and Section 1205, *Pavement Marking General Requirements* of the NCDOT Standard Specifications for Roads and Structures, latest revision.

   Prior to marking, all pavements are to be free of grease, oil, mud, dust, dirt, grass, loose gravel, and other deleterious material.

B. **Thermoplastic Striping**:

1) All thermoplastic striping shall be a NCDOT approved mix that minimizes the slipperiness of the marking surface.

2) Thermoplastic traffic line paint shall be a reflectorized thermoplastic pavement striping material applied to the road surface in a molten state by mechanical means. It shall have surface application of glass beads which, upon cooling to normal pavement temperature, will produce an adherent reflectorized stripe of the specified thickness and width.

3) The markings must be capable of conforming to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures. The markings shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastic when heated with a torch.

4) The markings must be able to be applied in temperatures down to 32°F, without any special storage, preheating, or treatment of the material before application.

5) Thermoplastic paint shall comply with NCDOT *Standard Specifications for Roads and Structures*, Section 1087-2(C), *Thermoplastic Composition*, latest revision. The material shall contain at least 30 percent by weight of graded premixed glass beads. It must contain a minimum of 10% titanium dioxide pigment (ASTM D476 Type 2) to ensure a color similar to Federal Highway White, Color No. 17886, as per Federal Standard 595.

6) The surface must have a minimum skid resistance value of 55 BPN when tested according to ASTM E303, *Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester,* latest revision.

7) The material, when applied at a temperature range of 400°F to 440°F and shall set to bear traffic in not more than 2 minutes when the air temperature is 50°F. Minimum thickness shall be 90 mils for arrows, edge lines, diagonals, and gore lines; 120 mils for centerlines, skip lines, mini-skip lines, characters, and crosswalk lines.

8) The material must be resistant to deterioration due to exposure to sunlight, water, oil, gasoline, salt or adverse weather conditions.

9) When applied to Portland concrete surfaces, the application notes above still apply, except that a compatible surface primer/sealer shall be applied prior to the application of the Thermoplastic material to assure proper adhesion.

10) Do not apply thermoplastic pavement markings between December 15 and the following March 16.

11) Provide drainage openings at intervals of 250 feet in edge lines placed on the inside of curves and in edge lines on the low side of tangents. Provide openings that are a maximum of 12 inches and a minimum of 6 inches in length.

C. Existing Pavement Markings:

1) Prior to the installation of paint or thermoplastic pavement marking lines and symbols, the surface of existing pavement markings shall be cleaned by a method which does not materially damage the existing pavement surfaces.

2) Materials deposited on the pavement and adjacent surfaces as a result of the removal of pavement markings shall be removed as the work progresses.

3) When a blast removal method is used, care must be taken to protect adjacent surfaces and structures from flying debris.

4) Painting over or black out painting of existing pavement markings with black paint or bituminous solutions shall not be allowed.

END OF SECTION 02740

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02920 – SEEDING, SODDING AND GROUNDCOVER

(Last Revised ~~4/20/12~~, 9/18/19) R2

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.

B. Section 00825 – Product Substitutions

C. Section 00950 – Measurement and Payment

D. Section 02200 – Earthwork

E. Section 02275 – Trenching, Backfilling, & Compaction of Utilities

F. Section 02510 – Water Distribution

G. Section 02530 – Sanitary Sewer

H. Section 02630 – Storm Drainage

I. City of Wilson List of Approved Manufacturers and Products

J. NCDEQ Division of Energy, Mineral, and Land Resources, Land Quality Section's Erosion and Sedimentation Control Planning and Design Manual, latest revision.

1.2 SUMMARY

A. This section includes preparation of surfaces and application for seeding and sodding of areas proposed to be stabilized and landscaped in utility easements, on sites, along roadways and other applicable areas disturbed by construction.

B. This specification covers seeding, sodding and groundcover but excludes trees, shrubs, plants, edgings, planters and irrigation.

1.3 DEFINITIONS

A. **GENERAL**: For the purposes of this specification, the following definitions refer to landscaping items that come under the authority of the City of Wilson as specified within this section and other sections of this manual.

1) **Finish Grade**: In terms of landscaping, the surface that has been established, graded, raked, and prepared to receive groundcover, fertilizer, seed, and mulch; the finished surface of planting soil.

2) **Groundcover**: The material placed on a prepared surface and used to stabilize the soil from erosion.

3) **Sod**: An existing established matt of grass that has been removed from one area by a mechanical harvester and transferred to a prepared subgrade at another location; used to render a finished appearance and/or provide immediate resistance to erosion.

4) **Subgrad**e: Surface or elevation remaining after completing the excavation before placement of topsoil.

5) **Topsoil**: A native, imported, or modified soil which is primarily organic in nature, free of rocks, clumps of clayey soils and otherwise friable in texture.

1.4 SUBMITTALS

A. Submit product data and shop drawings for the following:

1) **Seed certification**: All seed shall be labeled to show it meets North Carolina Seed Law requirements. All seed must have been tested within 6 months of planting.

2) A seed bag tag shall be submitted with final payment request from each type or mixture of seed used.

3) Topsoil analysis, if requested by City Engineer. Soil testing shall state percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil. Report is to state suitability of topsoil for lawn growth and recommend quantities of nitrogen, phosphorus, potash nutrients and soil amendments to be added to produce satisfactory topsoil.

1.5 QUALITY ASSURANCE

A. Materials and operations shall comply with the latest revision of all applicable Codes and Standards.

1.6 NCDEQ NCG01

1.7 QUALITY STANDARDS

A. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American National Standards Institute

ANSI Z60.1 American Standard for Nursery Stock

American Society for Testing and Materials

ASTM C602 Specification for Agricultural Liming Materials

ASTM D5268 Specification for Topsoil Used for Landscaping purposes

1.8 STANDARD ABBREVIATIONS

AASHTO American Association of State Highway Transportation Officials.

ANLA American Nursery & Landscaping Association

ANSI American National Standards Institute

ASTM American Society for Testing and Materials

FS Federal Specifications

MSDS Material Safety Data Sheets

NCDOT North Carolina Department of Transportation

NCSPA North Carolina Sod Producers Association

USDA United States Department of Agriculture

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

A. **Handling/Storage**:

1) See Part 3 - EXECUTION of these specifications for handling of sod materials during placement.

2) Observe Nursery's directions for delivery and storage of seed and sod materials.

3) Store and protect fertilizer and lime until item is applied.

1.10 PROJECT CONDITIONS

A. The Contractor is responsible for obtaining all applicable permits (encroachment, grading, etc.), making application, and paying permit fees.

B. Seed mixture shall be chosen to ensure the development of plants during the season of planting, and to ensure future growth and permanence.

C. Protect structures, utilities, sidewalks, pavements, and other facilities, along with lawns and existing exterior plants from damage caused by planting operations.

D. **Temporary Seeding**: Denuded areas to be graded during the construction phases that are not to be brought to final grade shall receive temporary seeding and mulching. Temporary seeding shall also be used to stabilize finished grade areas if the time of year is outside the specified permanent seeding periods. All disturbed areas are to be stabilized with either temporary or permanent vegetation in accordance with Table 2920.1, Stabilization Timeframes, below.

E. **Environmental - Wetlands**: Before crossing or entering into any jurisdictional wetlands, Contractor shall verify whether or not a wetlands permit has been obtained for the encroachment and whether special restrictions have been imposed. Care shall be taken not to disrupt drainage, alter, or destroy non-permitted wetlands unless a permit has been obtained. Restore areas noted on the project drawings, the contract documents, and/or in the permit. All encroachments shall be subject to US COE and NCDENR Division of Water Quality approval and permitting conditions.

F. **Safety**: The Contractor shall keep the surface in a safe and satisfactory condition during the progress of the work.

G. After seeding and mulching, care shall be taken to prevent future runoff destruction of seeded areas.

1.11 SERVICE INTERRUPTION

Contact the City of Wilson to coordinate interruption of service, operation of valves, line cut-ins, or placement of a tapping sleeve and valve. If interruption is necessary, the interruption shall be arranged to occur at such a time to cause the least disruption and minimize loss of service. At the direction of City Engineer, temporary service may be required to be provided. Provide a minimum of 72 hours notice of the proposed utility interruption or necessary operation of valves.

1.12 LOCATING SERVICES

Contact ***"NC One Call"*** 811 before digging.

811 Know what's below. Call before you dig.

1.13 COORDINATION

A. Coordinate placement of groundcover with other Contractors and with the City Engineer.

B. Proceed with planting only when existing and forecasted weather conditions permit.

C. Protect undisturbed lawns, shrubs and trees and promptly repair damages caused by seeding, sodding, and groundcover operation.

1.14 WARRANTY

Warranty period for groundcover: 12 months from date of substantial completion if not designated as temporary cover.

PART 2 – PRODUCTS

2.1 MISCELLANEOUS

2.1.1 TOPSOIL

A. **Topsoil**: Comply with ASTM D 5268, *Standard Specification for Topsoil Used for Landscaping Purposes,* pH range of 5.5 to 7, a minimum of 4% organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.

1) On-site Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth. Provide erosion control measures to prevent erosion, and off-site deposition of topsoil.

a. Contractor may supplement on-site source with imported or manufactured topsoil when quantities are insufficient. Obtain topsoil from naturally well-drained sites where topsoil occurs at least 4 inches in depth. Do not obtain from swamps or marshes.

2) Off-site Topsoil Source: Obtain topsoil from naturally well-drained sites where topsoil occurs at least 4 inches in depth. Do not obtain from swamps or marshes.

2.1.2 FERTILIZER

A. **Commercial Fertilizer**: Commercial-grade complete fertilizer of neutral character, consisting of fast and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the composition as shown on **Standard Detail 350.01**.

B. **Slow-Release Fertilizer**: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the composition as shown on **Standard Detail 350.01**.

2.1.3 LIME

A. **Lime**: ASTM C602, *Standard Specification for Agricultural Liming Materials*, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, Class O, with a minimum 95 percent passing through No. 8 sieve and a minimum 55 percent passing through No. 60 sieve.

If ordered by the City Engineer, a pelted form of limestone with a water-soluble binder may be required to speed breakdown of limestone.

PART 3 – EXECUTION

3.1 CONSTRUCTION OF SUBGRADE

A. **EXCAVATION, GRADING AND SUBGRADE PREPARATION FOR SEEDING/SODDING**: Excavation, grading and subgrade preparation for seeding and/or sodding shall be in strict compliance with Division 02200, *Earthwork* and Division 02275, *Trenching, Backfilling, and Compaction of Utlities*, and this specification section, as applicable. The subgrade upon which this work is to be placed shall be smoothly shaped and compacted to a firm, even surface conforming to the elevation and cross-sections shown on the plans, the standard

drawings, or as directed by the City Engineer. All soft, frozen, and unsuitable material shall be removed and replaced with approved material.

B. **FINE GRADING (Trimming)**: Fine grading shall be the responsibility of the Contractor to ensure that the finished grade conforms to the proposed finished grades as shown on the plans and the applicable standard details.

3.2 SEEDING, SODDING, AND GROUNDCOVER

3.2.1 GENERAL

Seeding and groundcover includes seedbed preparation, liming, fertilizing, seeding, and mulching of all disturbed areas. Areas inside or outside the limits of construction that are disturbed by the Contractor's operation and activity shall be seeded and mulched.

A. Unless called for otherwise on the Erosion and Sedimentation Control Plan, in areas where natural sod or vegetation has been disturbed, the area shall be fertilized, limed, seeded, and mulched in accordance with **Standard Detail 350.01**.

If a utility line is installed through a landscaped lawn, the seeding shall be modified to restore ground cover comparable to the existing lawn.

B. Seeding shall be carried out as soon as practical after the construction in any one area, and shall be maintained against erosion through the completion of the project. Seeding shall be accomplished as work progresses.

The Contractor shall be responsible for proper care of the seeded area during the period that vegetation is being established. In the event of an erosive rain before an adequate stand of vegetation has been established, damaged areas shall be repaired, fertilized, seeded, and mulched at the Contractor's expense.

C. Seeding on rights of way of NCDOT maintained roads shall be in accordance with NCDOT specifications and the requirements of the approved encroachment permit.

D. **Stockpile Area**: The Contractor is responsible for securing a material lay down and stockpile storage area. As such, the Contractor is responsible for the necessary erosion control measures, including but not necessarily limited to, a construction entrance, silt fence, protection of streams/buffers, clean up and restoration of site to the satisfaction of the City and the NCDENR, Department of Water Quality, Land Quality Section. Stockpile and/or waste areas must be maintained within the limits of the areas protected by the proposed measures and otherwise temporarily seeded if to be left stockpiled over 30 days.

E. **Stabilization Time Frames**:

Table 2920.1 Stabilization Timeframes[a]		
Site Area Description	**Stabilization**	**Timeframe Exceptions**
Perimeter dikes, swales, Ditches, and perimeter slopes	7 days	None
High Quality Water (HQW) Zones	7 days	None
Slopes steeper than 3:1	7 days	If slopes are 10 feet or less in length and are not steeper than 2:1, 14 days are allowed
Slopes 3:1 to 4:1	14 days	-7 days for slopes greater than 50 feet in length and with slopes steeper than 4:1 -7 days for perimeter dikes, swales, ditches, perimeter slopes and HQW Zones
Areas with slopes flatter than 4:1	14 days	-7 days for perimeter dikes, swales, ditches, perimeter slopes and HQW Zones

[a]Effective April 1, 2019. Source: NCDEQ/Division of Energy, Minerals, and Land Resources; Land Quality

Note: After the permanent cessation of construction activities, any areas with temporary ground stabilization shall be converted to permanent ground stabilization as soon as practicable but in no case longer than 90 calendar days after the last land disturbing activity. Temporary ground stabilization shall be maintained in a manner to render the surface stable against accelerated erosion until permanent ground stabilization is achieved.

3.2.2 SODDING/SEEDING

A. GENERAL

The goal of sodding/seeding, where specified, is to return the disturbed area to its original vegetative condition, and to return the area to an aesthetically pleasing environment. Thus, all sodding/seeding shall meet the following requirements:

In most instances the areas requiring sod restoration versus seed restoration should be readily determinable by the Contractor based on preconstruction conditions. In general, where streets have roadside ditches, the area from the edge of pavement to the centerline of the ditch will be reseeded or sodded, depending on the existing condition of the grass. Installation in areas where there are no roadside ditches and traffic does not generally frequent, and has an existing good thick uniform stand of grass, shall be resodded.

Any questionable areas shall be restored in the manner (sodded or seeded) determined on site by the City Engineer.

Vegetative restoration (sodding or seeding) shall be done as the work progresses. Areas to be protected by a vegetative cover include, but are not limited to, any areas disturbed during construction that are not otherwise

stabilized by gravel, concrete, or asphaltic paving, or other impervious built-upon surface.

Any area disturbed without owner authorization will be restored by the Contractor at his own expense. In all cases the Contractor will guarantee a stand of grass over the entire area.

The work to be done to acquire the necessary vegetative cover shall include but is not specifically restricted to appropriate tilling of the area, the application of fertilizer and lime for areas to be seeded, placement of sod, or sowing of seed and placing of a straw mulch to hold the seed and soil in place until germination and growth occur.

After bringing the area to be sodded or seeded to proper grade, the entire area shall be tilled to a minimum depth of 4 inches by discing, harrowing, or other approved means. Following tilling, all large debris and stones shall be removed to the satisfaction of the City Engineer and the surface leveled.

3.2.3 MAINTENANCE OF SEEDED/SODDED AREAS:

Contractor shall provide a suitable backflow prevention devise for filling of water tank trucks or trailers (see **Standard Detail 519.01**). Contractor shall water sodded/seeded areas as necessary for providing for growth of sod/seed.

The Contractor shall provide general care for the restored areas as soon as the sod has been laid (or seeded and mulched), and such care shall continue until final inspection and acceptance of the work. All restored areas shall be protected against traffic or other use by warning signs or barricades approved by the City.

The Contractor shall mow the sodded and/or seeded areas with approved mowing equipment, depending upon climatic and growth conditions and the need for mowing specific areas. In the event that weeds or other undesirable vegetation are permitted to grow to such an extent that, either cut or uncut, they threaten to smother the species, they shall be mowed and the clippings raked and removed from the area. When the surface has been damaged during the period covered by this contract, the affected areas shall be repaired to re-establish the grade and the condition of the soil, as directed by the City Engineer, and shall then be sodded, or seeded, as specified.

3.2.4 SODDING

All existing ornamental grass stands (commercial or private lawns) may be carefully taken up, protected and replaced to their original condition or the Contractor may elect to install new sod of the same grass type. Sod furnished by the Contractor shall have a good cover of living or growing grass. This shall be interpreted to include grass that is seasonally dormant during the cold or dry seasons and capable of renewing growth after the dormant period. All sod shall be obtained from areas where the soil is reasonably fertile and contains a high percentage of loamy topsoil. Sod shall be cut or stripped from living, thickly matted turf relatively free of weeds or other undesirable foreign plants, large stones, roots, or other materials, which might be detrimental to the development of the sod or to future maintenance. At least 70% of the plants in the cut sod

shall be composed of the existing lawn species, and any vegetation more than 6 inches in height, shall be mowed to a height of 3 inches or less before sod is lifted. Sod, including the soil containing the roots and the plant growth showing above, shall be cut uniformly to a thickness not less than 2 inches.

After inspection and approval of the source of sod by the City Engineer, the sod shall be cut with approved sod cutters to such a thickness that after it has been compacted, it shall have a uniform thickness of not less than 2 inches. Sod sections or strips shall be cut in uniform widths, not less than 10 inches, and in lengths of not less than 18 inches, but of such length as may be readily lifted without breaking, tearing, or loss of soil. Where strips are required, the sod must be rolled without damage with the grass folded inside. The Contractor may be required to mow high grass before cutting sod.

The sod shall be transplanted within 24 hours from the time it is stripped, unless circumstances beyond the Contractor's control make storing necessary. In such cases, sod shall be stored in an unrolled condition, irrigated, and protected from exposure to air drafts and sun and shall be kept from freezing. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected. Where the soil is too dry, permission to cut sod may be granted only after it has been watered sufficiently to moisten the soil to the depth the sod is to be cut.

Sodding shall be performed only during the seasons when satisfactory results can be expected. Frozen sod shall not be used and sod shall not be placed upon frozen soil. Sod may be transplanted during periods of drought with the approval of the City Engineer, provided the sod bed is watered to moisten the soil to a depth of at least 4 inches immediately prior to laying the sod.

The sod shall be moist and shall be placed on a moist earth bed. Pitchforks shall not be used to handle sod, and dumping from vehicles shall not be permitted. The sod shall be carefully placed by hand, edge to edge and with staggered joints, in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface, and ensure knitting without displacement of the sod or deformation of the surfaces of sodded areas. Where the sod may be displaced during sodding operations, the workmen when replacing it shall work from ladders or treated planks to prevent further displacement. Screened soil of good quality shall be used to fill all cracks between sod sections. The quantity of the fill soil shall not cause smothering of the grass. Where the grades are such that the flow of water will be from paved surfaces across sodded areas, the surface of the soil in the sod after compaction shall be set approximately 1 inch below the pavement edge. Where the flow will be over the sodded areas and onto the paved surfaced around manholes and inlets, the surface of the soil in the sod after compaction shall be placed flush with pavement edges.

Adequate water and watering equipment must be on hand before sodding begins, and sod shall be kept moist until it has become established and its continued growth assured. Contractor shall water sodded areas a minimum of 1 inch of water, twice per week until re-established and once per week thereafter

until work is accepted. In all cases, watering shall be done in a manner, which will avoid erosion from the application of excessive quantities and will avoid damage to the finished surface.

3.2.5 SEEDING

Following surface preparation as described in paragraph 3.1A, *Excavation, Grading and Subgrade Preparation for Seeding/Sodding*, above, unless no soil test results are available, areas to be seeded shall be given an initial application of agricultural lime at a rate of at least 4,000 pounds per acre as well as fertilize and phosphate as shown on **Standard Detail 350.01**, all of which shall be thoroughly mixed with the soil. Dense or compacted soil areas and cut grade soil areas shall be ripped at greater than 6 inches of depth with a spring toothed ripper or similar equipment after finish grade but before tillage. Severely compacted surfaces shall be ripped to at least 12-inches of depth. No compaction soils shall be covered with soil fill until ripped. Finish grades on slopes shall be roughened parallel to contours to maximize surface storage and minimize runoff.

Upon completion of ground and soil preparation work, a grass seed mixture applied in accordance with **Standard Detail 350.01** shall be sown. When permitted to be placed, Bermuda grass seed shall be in an unhulled condition from September 1 to April 1 and be in a hulled condition at all other times. Centipede grass seed is permitted to be planted from April 1 through July 15. Target pH at 5.5 for centipede grass. Substitutions for “Rebel” fescue will be considered acceptable only if the substituted fescue variety has no ratings less than “5” as determined by the USDA 1983 Tall Fescue Trails or more recent USDA trail data. No rye grass or other ground cover species shall be included in the seeding mixture. This shall be followed by placing a suitable cover of clean straw or approved equivalent mulch at the rate specified in **Standard Detail 350.01**. If straw is used as a temporary cover only, these rates shall be doubled or tripled depending upon average slope conditions.

All straw shall be stabilized by the application of an asphalt emulsion or other approved binding materials. Alternative methods such as hydro-seeding or hydro-mulching may be considered on an individual basis.

A stand of grass shall be considered acceptable when area cover is at least 95%. The Contractor shall overseed, and otherwise maintain the grassed areas until the stand of grass has reached a uniform height of 3 to 4 inches and a state of uniform species maturity. The Contractor shall then top-dress the stand of grass with a minimum of 300 pounds per acre of 12-4-8 (4-1-2 or 3-1-2 ratio) fertilizer (or equivalent). Supply at least 1 lb. of nitrogen. Annual weed grasses and grain weeds shall not be considered part of the area cover, and seeding stands shall not be considered acceptable until the stand reaches a state of uniform post-seeding maturity for the specified species.

If straw mulching results in competing stands of grain, maintenance shall include mowing of the grain weed stand to a height of 4 inches prior to reaching a height of 10 inches. Grain weed stands shall not be considered part of the minimum 95% area cover. Unacceptable grass stands shall be overseeded, after aeration

by spiker, at half the original rate, as many times as necessary to establish an acceptable stand.

3.3 CLEANUP

A. Disposal: Remove surplus soil and waste material, unsuitable soil, trash, and debris and legally dispose of off-site.

END OF DIVISION 02920

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INTRODUCTION TO DESIGN AIDS

The design section of this manual is intended as an aid for use in water and sewer design, flexible pavement design, and hydrologic and hydraulic analysis. While it is presumed that the user of this manual is basically familiar with the methods of analysis presented herein; in many cases, the manual provides examples and detailed instructions for their development. An exception to this rule is the case where another source document is referenced that expounds upon the method in greater detail. In that case, the designer is directed to the source document.

The City of Wilson recognizes the difficulty in accurately defining or predicting the dynamic properties of nature. There are numerous methods of analysis available and it is recommended that as many methods as may be appropriate be employed in the solution of a problem. Furthermore, in hydraulic design, the designer must give consideration towards economic, aesthetic, and environmental aspects of the given design.

To the best of their ability, the authors have tried to ensure that the information presented here is correct and that the procedures are reliable. The execution of an engineering design; however, involves the judgment of the designer and only he or she can ascertain whether a technique or item of information can be applied to a given situation.

Therefore, neither Appian Consulting Engineers, the City of Wilson, nor any contributor accepts responsibility for any real or alleged error, loss, damage or injury resulting from the use of material contained herein.