

# 20-YEAR WATER AND SEWER INFRASTRUCTURE

## CAPITAL IMPROVEMENT PLAN

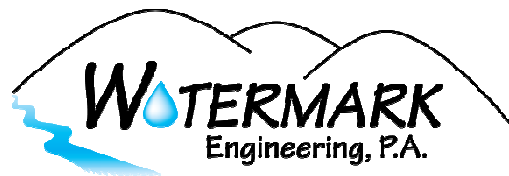
PREPARED FOR:

TOWN OF TRYON

APRIL, 2012



PREPARED BY:



170 TIMBERLAKE DRIVE

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## OVERVIEW

The purpose of this Capital Improvement Plan (CIP) is to provide a twenty-year schedule for capital improvement needs within the Town of Tryon. The CIP will act as a guidance document for use each budget year and will assist during long range planning efforts. The CIP must be updated annually to reflect the changing needs within the town and to modify revenue and expense projections as necessary. Capital Improvements for water and sewer infrastructure will be outlined in this plan.

The Town of Tryon has both water and sewer systems. These systems include distribution and collection lines as well as treatment works for both water and sewer. The sewage system is comprised of approximately 100,000 linear feet of vitrified clay pipe, polyvinyl chloride pipe, and ductile iron pipe ranging in size from 4 inch to 18 inches in diameter. A large majority of the collection system is constructed of vitrified clay pipe with unsealed joints. This old collection system presents problems with infiltration and inflow (I/I) that can negatively impact a wastewater treatment facility. The average daily flow into the facility is 0.374 MGD and the average peak daily flow is 0.58 MGD. However, during rainfalls, the maximum peak daily flow can reach 2.5 MGD, demonstrating the severity of infiltration and inflow into the system. Presently, the Town treats all of the wastewater generated by the Town's 930 wastewater customers at a single wastewater treatment facility. The facility is located northeast of the center of the Town of Tryon and the facility discharges into Vaughn Creek, a tributary to the Pacolet River. The facility has a National Pollutant Discharge Elimination (NPDES) number NC0021601 and NPDES Permit Number NC 0086525 with a permitted discharge rate of 1.5 million gallons per day (MGD). The original facility was constructed in 1966 and upgraded in 1989.

Regarding water, the Town produces potable water for domestic use at its existing water purification plant from raw water extracted from Lake Lanier as well as mountain

creek sources. The facility has a Public Water Supply ID number NC002160101-75-010 with a permitted production rate of 2.0 million gallons per day (MGD). The original facility was designed in 1985 and completed and put into operation in November, 1988. Recent upgrades were completed in 2011 to update the facilities and allow use of the mountain creek water as a water supply source. The Town's water purification plant supplies approximately 1,900 residential and commercial users, and serves as an emergency supply for the Town of Columbus. The water system is comprised of approximately 342,000 linear feet of various types of pipe, ranging in size from 1 inch to 16 inches in diameter. Recent historical data indicates that the average monthly volume of water produced by the Town's water purification facilities is 7,200,000 gallons per month with a peak month production of 10,372,000 gallons. The following section contains a detailed review of how the water demands were developed.

## WATER DEMAND

Existing water demand for Tryon has been developed from the water system's usage records. Plant flow data and metered data have been collected to establish a base flow of water demand. The demand shown is actual water sold per month for the years 2009-2011.

<b>Average Water Usage</b>		
<b>YR</b>	<b>MONTH</b>	<b>TOTAL</b>
<b>2009</b>	<b>JAN</b>	258,983
	<b>FEB</b>	211,373
	<b>MAR</b>	202,863
	<b>APR</b>	215,200
	<b>MAY</b>	233,757
	<b>JUN</b>	282,510
	<b>JUL</b>	252,690
	<b>AUG</b>	255,990
	<b>SEP</b>	236,713
	<b>OCT</b>	247,140
	<b>NOV</b>	222,640
	<b>DEC</b>	232,907
	<b>AVG</b>	237,731
<b>2010</b>	<b>JAN</b>	248,707
	<b>FEB</b>	206,133
	<b>MAR</b>	188,730
	<b>APR</b>	244,420
	<b>MAY</b>	205,090
	<b>JUN</b>	240,023
	<b>JUL</b>	220,203
	<b>AUG</b>	345,753
	<b>SEP</b>	264,083
	<b>OCT</b>	273,970
	<b>NOV</b>	237,260
	<b>DEC</b>	230,397
	<b>AVG</b>	242,064
<b>2011</b>	<b>JAN</b>	244,840
	<b>FEB</b>	221,713
	<b>MAR</b>	185,133
	<b>APR</b>	223,473
	<b>MAY</b>	221,680
	<b>JUN</b>	313,150
	<b>JUL</b>	274,743
	<b>AUG</b>	230,265
	<b>SEP</b>	293,547
	<b>OCT</b>	223,163
	<b>NOV</b>	236,343
	<b>DEC</b>	198,437
	<b>AVG</b>	238,874

Average day demand is the total water delivered during a given month divided by the number of days in that month. Total water delivered is equal to the total water produced less water used in the water filtration facilities and includes total metered customer consumption and unaccounted for water. Unaccounted for water includes lost water (leakage and unauthorized use), under registration of meters, and water used for such things as fire fighting, flushing of mains and sewers, and street cleaning. Table II Summarizes the total delivered finished water for the public water distribution systems in the Town for the year 2011. Ideally, a Town needs to keep water loss at or around 20%.

Year	Water Loss %
2007	27.43%
2008	24.34%
2009	33.39%
2010	39.45%
2011	25.95%

### Residential/Commercial Users

To develop an average daily demand for residential users, the average daily water delivered minus the industrial use was calculated. The result was then divided by the total number of residential and minor commercial connections. The resulting amount, 3,300 gallons per month over the past three years, is the average daily demand per residential connection.

### Projected Water Demand

The estimated population increase for Polk County from the year 2010 to 2030 is negligible (North Carolina Demographics). Typically, Town population grows faster than the County due to access to public water and sewer, annexation, etc., etc. However,

due to recent patterns in the Town and County reflecting little difference in growth the County population projection numbers will also be applied to the Town. Thus, we don't anticipate any significant increase in population for the Town of Tryon.

Regarding flows, they typically increase at a rate higher than the population growth rate. However, we have instead seen a significant decline in water usage within the Town of Tryon over the past 10 years. In fact, the average daily flows are roughly ½ of what they were in the original CIP document in 2002. A portion of this is attributed to the loss of wet industry, but perhaps an even more significant factor is the result of reduced consumer usage.

In the mid 2000's North Carolina went through a period of severe drought, and the Town's water supply was strained. As a result, mandatory conservation measures were enforced. Due to the length of these measures many people became accustomed to conserving water. When the restrictions were lifted, water usage did not return to its previous state. Currently, the average residential usage is 3,300 gallons per month; approximately 1000 gallons per month less than the last report in 2002. Due to anticipated patterns of growth, no changes in water demand are expected.

### SEWER USAGE

At present, the average daily flow to the wastewater treatment facility is 0.169 MGD and the average peak daily flow is 0.234 MGD. However, during severe rainfall, the maximum peak daily flow can reach 2.5 MGD due to excessive infiltration and inflow (I/I).

Due to the significant I&I, a study was recently completed to determine areas of inflow and infiltration. The resulting information shows numerous areas with small leaks as opposed to a few large contributing leaks. The smaller leaks are due to the age of the system and type of pipe that is predominant in the system (4' lengths of



vitriified clay pipe without seals). A map of leak results will be included in the appendix of this report, and many of the collection projects target these areas.

Due to the extent of the leaks within the system, it is not feasible to repair each and every leak in a short period of time. Instead, the Town needs to implement a plan to replace various sections of pipe annually, initially targeting those with the most leaks per line length.

## COLLECTION AND DISTRIBUTION SYSTEM UPGRADES

A list of new projects and needed upgrades over the next twenty (20) years was compiled to guide the Town in planning expenditures over this period of time. A summary of each project is listed below, and cost estimates of each project can be found following the summaries. The projects are listed in order of priority, and scheduling of these projects, along with all necessary upgrades of the treatment/distribution facilities, can be found at the end of this report.

## SEWER PROJECTS

### 1. Sewer Trunk Line Replacement

The first among several sewer line replacement projects, this line has caused over 1 million gallons of sewer to spill during significant rain events.

This project will consist of approximately \$2,900 LF of 24-inch sewer line, 18 manholes and all associated appurtenances. The estimated cost of this project is \$634,450.

### 2. Sewer Line Replacement along CYP Basin

This project will replace an existing 12-inch sewer line that is sagging and thus reducing hydraulic capacity within the area.

This project will consist of approximately 1,000 LF of 12-inch sewer line, 10 manholes and all associated appurtenances. The estimated cost of this project is \$129,500.

### 3. Sewer Line Replacement Barnette Southern

This project will replace an existing section of 8" sewer line that is in severe disrepair.

This project will consist of approximately 1,000 LF of 8-inch sewer line, 5 manholes and all associated appurtenances. The estimated cost of this project is \$80,050.

### 4. Sewer Line Replacement along Markham Road

This project will replace nearly 3,000 feet of sewer line that travels down into a swale. The pipe is old and has numerous leaks.

This project will consist of approximately 3,000 LF of 8-inch sewer line, 10 manholes and all associated appurtenances. The estimated cost of this project is \$209,350.

### 5. Sewer Line Replacement along Spanish Court

This line is comprised of the old, 4" vitrified clay pipe, and viewing the line by remote camera shows that it is infiltrated in numerous places by Japanese Maple root systems.

This project will consist of approximately 1,000 LF of 8-inch sewer line, 5 manholes and all associated appurtenances. The estimated cost of this project is \$80,050.

6. *Sewer Line Replacement along Galax Circle*

This project is to replace a small section of old, failing sewer line.

This project will consist of approximately 500 LF of 8-inch sewer line, 3 manholes and all associated appurtenances. The estimated cost of this project is \$43,800.

7. *Sewer Line Replacement along Depot Street*

This project will replace nearly 2,000 feet of old, 4" vitrified clay line that has significant leaks.

This project will consist of approximately 2,000 LF of 8-inch sewer line, 10 manholes and all associated appurtenances. The estimated cost of this project is \$156,650.

8. *Sewer Line Replacement along Broadway and Whitney*

One of the larger sewer projects, this one will replace 4,000 feet of existing 8" sewer that is consistently an issue for Town maintenance. Additionally, another 1,000 LF of sewer line will be run to tie into new areas.

This project will consist of approximately 5,000 LF of 8-inch sewer line, 25 manholes and all associated appurtenances. The estimated cost of this project is \$388,850.

9. *Glenqarnock Road Sewer Line Extension*

This project will extend sewer into a densely populated area in need of public sewer access. In order for this project to be feasible, project #2 (listed above) must be completed.

This project will consist of approximately 1800 LF of 8-inch sewer line, 7 manholes and all associated appurtenances. The estimated cost of this project is \$132,000.

10. *Hidden Hill Road Sewer Line Replacement*

The sewer line at this location is undersized. The minimum line size for a public sewer line as required by the state is 8-inches, and the existing line is 4 inches in

diameter. This project will replace the entire length of the undersized line and install necessary appurtenances, as well.

This project will consist of approximately 1100 LF of 8-inch sewer line, 4 manholes and all associated appurtenances. The estimated cost of this project is \$80,700.

## WATER PROJECTS

### 1. Lennox Road Water Line Replacement

This project will replace a water line that is too shallow, causing erosion issues within the area.

This project will consist of approximately 1,000 LF of 4-inch water line, and all associated appurtenances. The estimated cost of this project is \$36,700.

### 2. Country Club Road Water Line

This project will extend a new water line to remove citizens that were errantly tied into a raw water line.

This project will consist of approximately 10,000 LF of 4-inch water line, a booster pump station and all associated appurtenances. The estimated cost of this project is \$528,100.

### 3. Lynn Court Water Line Replacement

This project will also replace undersized water lines. Numerous complaints have been filed due to instances of low pressure, and a larger water line size will also be beneficial due to fire protection benefits.

This project will consist of approximately 600 LF of 6-inch water line, and all associated appurtenances. The estimated cost of this project is \$34,950.

### 4. Chestnut Street Water Line Replacement

This project will also replace undersized water lines near the same area and for the same reasons as project #2. This project will close the loop between lines along Hideaway Lane and Chestnut Street, as well as increase existing line sizes along Chestnut Street.

This project will consist of approximately 800 LF of 6-inch water line, and all associated appurtenances. The estimated cost of this project is \$43,550.

5. Well's Lane Water Line Replacement

This project will replace an existing galvanized water line that has corroded causing numerous leaks in the area.

This project will consist of approximately 1,500 LF of 3-inch water line, and all associated appurtenances. The estimated cost of this project is \$52,250.

6. Lakata Lane Water Line Replacement

This project will replace an existing galvanized water line that has corroded causing numerous leaks in the area.

This project will consist of approximately 2,000 LF of 3-inch water line, and all associated appurtenances. The estimated cost of this project is \$68,150.

7. Rippy Road Water Line Extension

This project will run water service to Rippy Road. Water already exists at the beginning of the road, but consists of a 2-inch water line that is already vastly undersized. For this reason, it is recommended that a 3-inch line be run back to the 12-inch line on 108 and continue until it intersects a new 2-inch line on Rippy Road.

This project will consist of approximately 1300 LF of 3-inch water line, 1000 LF of 2-inch water line, and all associated appurtenances. The estimated cost of this project is \$57,800.

8. Pacolet Valley Water Line Extension

This project proposes to replace a significant length of 2" galvanized line with 6" water line and hydrants for fire protection.

This project will consist of approximately 3,200 LF of 6-inch water line, 6 fire hydrants and all associated appurtenances. The estimated cost of this project is \$169,300.

9. New Market Road Water Line Extension

This project proposes to extend water service along New Market Road approximately 3000 feet outside Town Limits. The line will originate from a 12-inch line along Vaughn Street and will tie into the 8-inch existing line near Hunting Country Road.

This project will consist of approximately 5000 LF of 6-inch water line, and all associated appurtenances. The estimated cost of this project is \$243,600.

10. Hunting Country Road Water Line Extension

This project proposes to extend water along Hunting Country Road from the intersection of Ridgetop Road to the intersection of South River Road. Currently an 8-inch water line exists at the proposed beginning of the project, and due to the nature of the service area it is recommended that an 8-inch line be used in the proposed extension.

This project will consist of approximately 3500 LF of 8-inch water line, and all associated appurtenances. The estimated cost of this project is \$222,450.

11. Oak Street Water Line Extension

This project will close a loop between Maple and Trade Streets, and provide water service along Oak Street. The loop will consist of tying into 6-inch water lines at both locations.

This project will consist of approximately 550 LF of 6-inch water line, and all associated appurtenances. The estimated cost of this project is \$29,130.



SEWER PROJECT COST ESTIMATES

Sewer Trunk Line Replacement

**Sewer Trunk Line Replacement**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	24" DIP Sewer Line	LF	2900	\$120.00	\$348,000.00
2	Sanitary Sewer Manhole	EA	15	\$3,500.00	\$52,500.00
3	Tie to Existing Sewer	LS	3	\$10,000.00	\$30,000.00
4	Rock Excavation	CY	50	\$100.00	\$5,000.00
5	WWTP Headwork Modifications	LS	1	\$45,000.00	\$45,000.00
<b>SUBTOTAL</b>					<b>\$480,500.00</b>
Contingencies (10%)					\$48,050.00
Design Engineering					\$68,800.00
Construction Administration/Inspection					\$26,500.00
Surveying (pre and post)					\$10,600.00
<b>TOTAL PROJECT COST</b>					<b>\$634,450.00</b>

*Sewer Line Replacement along CYP Basin*

**Sewer Line Replacement Along CYP Basin**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	12" DIP Sewer Line	LF	1000	\$60.00	\$60,000.00
2	Sanitary Sewer Manhole	EA	10	\$3,500.00	\$35,000.00
3	Tie to Existing Sewer	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	10	\$100.00	\$1,000.00
<b>SUBTOTAL</b>					<b>\$98,000.00</b>
Contingencies (10%)					\$9,800.00
Design Engineering					\$14,100.00
Construction Administration/Inspection					\$5,400.00
Surveying (pre and post)					\$2,200.00
<b>TOTAL PROJECT COST</b>					<b>\$129,500.00</b>

Sewer Line Replacement Barnette Southern

**Sewer Line Replacement Barnette Southern**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	8" DIP Sewer Line	LF	1000	\$40.00	\$40,000.00
2	Sanitary Sewer Manhole	EA	5	\$3,500.00	\$17,500.00
3	Tie to Existing Sewer	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	10	\$100.00	\$1,000.00
<b>SUBTOTAL</b>					<b>\$60,500.00</b>
Contingencies (10%)					\$6,050.00
Design Engineering					\$8,700.00
Construction Administration/Inspection					\$3,400.00
Surveying (pre and post)					\$1,400.00
<b>TOTAL PROJECT COST</b>					<b>\$80,050.00</b>

Sewer Line Replacement along Markham Road



**Sewer Line Replacement Along Markham Road**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	8" DIP Sewer Line	LF	3000	\$40.00	\$120,000.00
2	Sanitary Sewer Manhole	EA	10	\$3,500.00	\$35,000.00
3	Tie to Existing Sewer	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	15	\$100.00	\$1,500.00
<b>SUBTOTAL</b>					<b>\$158,500.00</b>
Contingencies (10%)					\$15,850.00
Design Engineering					\$22,700.00
Construction Administration/Inspection					\$8,800.00
Surveying (pre and post)					\$3,500.00
<b>TOTAL PROJECT COST</b>					<b>\$209,350.00</b>

*Sewer Line Replacement along Spanish Court*

**Sewer Line Replacement Along Spanish Court**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	24" DIP Sewer Line	LF	1000	\$40.00	\$40,000.00
2	Sanitary Sewer Manhole	EA	5	\$3,500.00	\$17,500.00
3	Tie to Existing Sewer	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	10	\$100.00	\$1,000.00
<b>SUBTOTAL</b>					<b>\$60,500.00</b>
Contingencies (10%)					\$6,050.00
Design Engineering					\$8,700.00
Construction Administration/Inspection					\$3,400.00
Surveying (pre and post)					\$1,400.00
<b>TOTAL PROJECT COST</b>					<b>\$80,050.00</b>

Sewer Line Replacement along Galax Circle

**Sewer Line Replacement Along Galax Circle**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	8" DIP Sewer Line	LF	500	\$40.00	\$20,000.00
2	Sanitary Sewer Manhole	EA	3	\$3,500.00	\$10,500.00
3	Tie to Existing Sewer	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	5	\$100.00	\$500.00
<b>SUBTOTAL</b>					<b>\$33,000.00</b>
Contingencies (10%)					\$3,300.00
Design Engineering					\$4,800.00
Construction Administration/Inspection					\$1,900.00
Surveying (pre and post)					\$800.00
<b>TOTAL PROJECT COST</b>					<b>\$43,800.00</b>

*Sewer Line Replacement along Depot Street*

**Sewer Line Replacement Along Depot Street**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	8" DIP Sewer Line	LF	2000	\$40.00	\$80,000.00
2	Sanitary Sewer Manhole	EA	10	\$3,500.00	\$35,000.00
3	Tie to Existing Sewer	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	15	\$100.00	\$1,500.00
<b>SUBTOTAL</b>					<b>\$118,500.00</b>
Contingencies (10%)					\$11,850.00
Design Engineering					\$17,000.00
Construction Administration/Inspection					\$6,600.00
Surveying (pre and post)					\$2,700.00
<b>TOTAL PROJECT COST</b>					<b>\$156,650.00</b>

*Sewer Line Replacement along Broadway and Whitney*



**Sewer Line Replacement Along Broadway and Whitney**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	8" DIP Sewer Line	LF	5000	\$40.00	\$200,000.00
2	Sanitary Sewer Manhole	EA	25	\$3,500.00	\$87,500.00
3	Tie to Existing Sewer	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	50	\$100.00	\$5,000.00
<b>SUBTOTAL</b>					<b>\$294,500.00</b>
Contingencies (10%)					\$29,450.00
Design Engineering					\$42,200.00
Construction Administration/Inspection					\$16,200.00
Surveying (pre and post)					\$6,500.00
<b>TOTAL PROJECT COST</b>					<b>\$388,850.00</b>

*Glenqarnock Road Sewer Line Extension*

**Glengarnock Road Sewer Line Replacement**  
**Tryon, North Carolina**  
**June, 2012**

	<b>ITEM</b>	<b>UNITS</b>	<b>QUANTITY</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
1	8" DIP Sewer Line	LF	1800	\$40.00	\$72,000.00
2	Sanitary Sewer Manhole	EA	7	\$3,500.00	\$24,500.00
3	Tie to Existing Sewer	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	15	\$100.00	\$1,500.00
<b>SUBTOTAL</b>					<b>\$100,000.00</b>
Contingencies (10%)					\$10,000.00
Design Engineering					\$14,300.00
Construction Administration/Inspection					\$5,500.00
Surveying (pre and post)					\$2,200.00
<b>TOTAL PROJECT COST</b>					<b>\$132,000.00</b>

*Hidden Hill Sewer Line Replacement*

**Hidden Hill Road Sewer Line Replacement**  
**Tryon, North Carolina**  
**June, 2012**

	<b>ITEM</b>	<b>UNITS</b>	<b>QUANTITY</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
<b>1</b>	8" DIP Sewer Line	LF	1100	\$40.00	\$44,000.00
<b>2</b>	Sanitary Sewer Manhole	EA	4	\$3,500.00	\$14,000.00
<b>3</b>	Tie to Existing Sewer	LS	1	\$2,000.00	\$2,000.00
<b>4</b>	Rock Excavation	CY	10	\$100.00	\$1,000.00
<b>SUBTOTAL</b>					<b>\$61,000.00</b>
Contingencies (10%)					\$6,100.00
Design Engineering					\$8,800.00
Construction Administration/Inspection					\$3,400.00
Surveying (pre and post)					\$1,400.00
<b>TOTAL PROJECT COST</b>					<b>\$80,700.00</b>

WATER PROJECT COST ESTIMATES

Lennox Road Water Line Replacement

**Lennox Road Water Line Replacement**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	4" DIP Water Line	LF	1000	\$25.00	\$25,000.00
2	Tie to Existing Water	LS	1	\$2,000.00	\$2,000.00
3	Rock Excavation	CY	10	\$100.00	\$1,000.00
<b>SUBTOTAL</b>					<b>\$28,000.00</b>
Contingencies (10%)					\$2,800.00
Design Engineering					\$3,400.00
Construction Administration/Inspection					\$2,000.00
Surveying (pre and post)					\$500.00
<b>TOTAL PROJECT COST</b>					<b>\$36,700.00</b>



Country Club Road Water Line

**Country Club Water Line**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	6" DIP Water Line	LF	10000	\$35.00	\$350,000.00
2	Fire Hydrant	EA	6	\$2,500.00	\$15,000.00
3	Booster Pump Station	LS	1	\$35,000.00	\$35,000.00
4	Tie to Existing Water	LS	1	\$2,000.00	\$2,000.00
5	Rock Excavation	CY	100	\$100.00	\$10,000.00
<b>SUBTOTAL</b>					<b>\$412,000.00</b>
Contingencies (10%)					\$41,200.00
Design Engineering					\$49,900.00
Construction Administration/Inspection					\$18,200.00
Surveying (pre and post)					\$6,800.00
<b>TOTAL PROJECT COST</b>					<b>\$528,100.00</b>

Lynn Court Water Line Replacement

**Lynn Court Water Line Replacement**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	6" DIP Water Line	LF	600	\$35.00	\$21,000.00
2	Fire Hydrant	EA	1	\$2,500.00	\$2,500.00
3	Tie to Existing Water	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	10	\$100.00	\$1,000.00
<b>SUBTOTAL</b>					<b>\$26,500.00</b>
Contingencies (10%)					\$2,650.00
Design Engineering					\$3,300.00
Construction Administration/Inspection					\$2,000.00
Surveying (pre and post)					\$500.00
<b>TOTAL PROJECT COST</b>					<b>\$34,950.00</b>

Chestnut Street Water Line Replacement

**Chestnut Street Water Line Replacement**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	6" DIP Water Line	LF	800	\$35.00	\$28,000.00
2	Fire Hydrant	EA	1	\$2,500.00	\$2,500.00
3	Tie to Existing Water	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	10	\$100.00	\$1,000.00
<b>SUBTOTAL</b>					<b>\$33,500.00</b>
Contingencies (10%)					\$3,350.00
Design Engineering					\$4,100.00
Construction Administration/Inspection					\$2,000.00
Surveying (pre and post)					\$600.00
<b>TOTAL PROJECT COST</b>					<b>\$43,550.00</b>

Well's Lane Water Line Replacement

**Well's Lane Water Line Replacement**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	4" DIP Water Line	LF	1500	\$25.00	\$37,500.00
2	Tie to Existing Water	LS	1	\$2,000.00	\$2,000.00
3	Rock Excavation	CY	10	\$100.00	\$1,000.00
<b>SUBTOTAL</b>					<b>\$40,500.00</b>
Contingencies (10%)					\$4,050.00
Design Engineering					\$5,000.00
Construction Administration/Inspection					\$2,000.00
Surveying (pre and post)					\$700.00
<b>TOTAL PROJECT COST</b>					<b>\$52,250.00</b>



Lakata Lane Water Line Replacement

**Lakata Lane Water Line Replacement**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	4" DIP Water Line	LF	2000	\$25.00	\$50,000.00
2	Tie to Existing Water	LS	1	\$2,000.00	\$2,000.00
3	Rock Excavation	CY	10	\$100.00	\$1,000.00
<b>SUBTOTAL</b>					<b>\$53,000.00</b>
Contingencies (10%)					\$5,300.00
Design Engineering					\$6,500.00
Construction Administration/Inspection					\$2,400.00
Surveying (pre and post)					\$900.00
<b>TOTAL PROJECT COST</b>					<b>\$68,100.00</b>

Rippy Road Water Line Extension

**Rippy Road Water Line Extension**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	3" PVC Water Line	LF	1300	\$20.00	\$26,000.00
2	2" PVC Water Line	LF	1000	\$15.00	\$15,000.00
3	Tie to Existing Water	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	20	\$100.00	\$2,000.00
<b>SUBTOTAL</b>					<b>\$45,000.00</b>
Contingencies (10%)					\$4,500.00
Design Engineering					\$5,500.00
Construction Administration/Inspection					\$2,000.00
Surveying (pre and post)					\$800.00
<b>TOTAL PROJECT COST</b>					<b>\$57,800.00</b>

Pacolet Valley Water Line Extension

**Pacolet Valley Water Line Extension**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	6" DIP Water Line	LF	3200	\$35.00	\$112,000.00
2	Fire Hydrant	EA	6	\$2,500.00	\$15,000.00
3	Tie to Existing Water	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	30	\$100.00	\$3,000.00
<b>SUBTOTAL</b>					<b>\$132,000.00</b>
Contingencies (10%)					\$13,200.00
Design Engineering					\$16,000.00
Construction Administration/Inspection					\$5,900.00
Surveying (pre and post)					\$2,200.00
<b>TOTAL PROJECT COST</b>					<b>\$169,300.00</b>

*New Market Road Water Line Extension*

**New Market Road Water Line Extension**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	6" DIP Water Line	LF	5000	\$35.00	\$175,000.00
2	Fire Hydrant	EA	5	\$2,500.00	\$12,500.00
3	Tie to Existing Water	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	5	\$100.00	\$500.00
<b>SUBTOTAL</b>					<b>\$190,000.00</b>
Contingencies (10%)					\$19,000.00
Design Engineering					\$23,000.00
Construction Administration/Inspection					\$8,400.00
Surveying (pre and post)					\$3,200.00
<b>TOTAL PROJECT COST</b>					<b>\$243,600.00</b>



Hunting Country Road Water Line Extension

**Hunting Country Road Water Line Extension**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	8" DIP Water Line	LF	3500	\$45.00	\$157,500.00
2	Fire Hydrant	EA	4	\$2,500.00	\$10,000.00
3	Tie to Existing Water	LS	1	\$2,000.00	\$2,000.00
4	Rock Excavation	CY	40	\$100.00	\$4,000.00
<b>SUBTOTAL</b>					<b>\$173,500.00</b>
Contingencies (10%)					\$17,350.00
Design Engineering					\$21,000.00
Construction Administration/Inspection					\$7,700.00
Surveying (pre and post)					\$2,900.00
<b>TOTAL PROJECT COST</b>					<b>\$222,450.00</b>

Oak Street Water Line Extension

**Oak Street Water Line Extension**  
**Tryon, North Carolina**  
**June, 2012**

	ITEM	UNITS	QUANTITY	UNIT PRICE	TOTAL COST
1	6" DIP Water Line	LF	550	\$35.00	\$19,250.00
2	Tie to Existing Water	LS	1	\$2,000.00	\$2,000.00
3	Rock Excavation	CY	5	\$100.00	\$500.00
<b>SUBTOTAL</b>					<b>\$21,750.00</b>
Contingencies (10%)					\$2,180.00
Design Engineering					\$2,700.00
Construction Administration/Inspection					\$2,000.00
Surveying (pre and post)					\$500.00
<b>TOTAL PROJECT COST</b>					<b>\$29,130.00</b>

## RATE STUDY SUMMARY

Separate from this report, a rate study was completed and will be used to determine the feasibility of funding the above-listed projects. The initial phase of this study required an accurate modeling of the current rate structure which includes billing types, billing structure, current billing rates, number and type of users, and so-on. For this information, a list of rates and structures was acquired from the Town, as well as the past three years of billings including the user types and their respective usage. The types of user classifications and their definitions are listed at the end of this report.

The Town of Tryon is presently within the guidelines of 1.5% MHI (median household income) for water and sewer rates, as well as the increasing block rate structure. Both of these items are requirements to be eligible for grant funding through numerous agencies, and care must be taken to ensure this category is still applicable in the future.

The Town of Tryon currently uses an increasing block rate structure (mentioned above) consisting of a minimum charge for the first 1000 gallons. The Town is also considering an increase based on the rate study that was completed, primarily to fund some much-needed infrastructure projects as well as to cover current budget shortfalls. The recommended increase will come as a result of reducing the “included” 1000 gallons that are included in the base fee eventually down to zero. Additionally, an overall increase of rates by 1% per year will be implemented along with the reduction in gallonage included with the base fee.

As a result, it is recommended the rate schedule on the following pages be initiated immediately.

## Recommended Water Rates FY 2012-2013

	Inside Water Rates (per 1000)	Outside Water Rates (per 1000)
Base Rate (inc. 750 Gallons)	\$14.86	\$32.62
3,000 to 5,000	\$3.96	\$11.88
5,000 to 100,000	\$4.10	\$12.30
100,000 to 500,000	\$4.23	\$12.70
500,000 and above	\$4.37	\$13.12

## Recommended Sewer Rates FY 2012-2013

	Inside Sewer Rates (per 1000)	Outside Sewer Rates (per 1000)
Base Rate (inc. 750 Gallons)	\$22.29	\$32.30
3,000 to 5,000	\$5.94	\$17.82
5,000 to 100,000	\$6.15	\$18.45
100,000 to 500,000	\$6.35	\$19.04
500,000 and above	\$6.56	\$19.68

## Recommended Water Rates FY 2013-2014

	Inside Water Rates (per 1000)	Outside Water Rates (per 1000)
Base Rate (inc. 500 Gallons)	\$15.00	\$32.95
3,000 to 5,000	\$4.00	\$12.00
5,000 to 100,000	\$4.14	\$12.42
100,000 to 500,000	\$4.27	\$12.82
500,000 and above	\$4.42	\$13.25

## Recommended Sewer Rates FY 2013-2014

	Inside Sewer Rates (per 1000)	Outside Sewer Rates (per 1000)
Base Rate (inc. 500 Gallons)	\$22.51	\$32.95
3,000 to 5,000	\$6.00	\$17.99
5,000 to 100,000	\$6.21	\$18.64
100,000 to 500,000	\$6.41	\$19.23
500,000 and above	\$6.62	\$19.87

## Recommended Water Rates FY 2014-2015

	Inside Water Rates (per 1000)	Outside Water Rates (per 1000)
Base Rate (inc. 250 Gallons)	\$15.15	\$33.27
3,000 to 5,000	\$4.04	\$12.11
5,000 to 100,000	\$4.18	\$12.55
100,000 to 500,000	\$4.32	\$12.95
500,000 and above	\$4.46	\$13.38

## Recommended Sewer Rates FY 2015-2016

	Inside Sewer Rates (per 1000)	Outside Sewer Rates (per 1000)
Base Rate (inc. 250 Gallons)	\$22.73	\$33.27
3,000 to 5,000	\$6.06	\$18.17
5,000 to 100,000	\$6.27	\$18.82
100,000 to 500,000	\$6.47	\$19.42
500,000 and above	\$6.69	\$20.07

## Recommended Water Rates FY 2015-2016

	Inside Water Rates (per 1000)	Outside Water Rates (per 1000)
Base Rate (inc. 0 Gallons)	\$15.30	\$33.59
3,000 to 5,000	\$4.08	\$12.23
5,000 to 100,000	\$4.22	\$12.67
100,000 to 500,000	\$4.36	\$13.07
500,000 and above	\$4.50	\$13.51

## Recommended Sewer Rates FY 2015-2016

	Inside Sewer Rates (per 1000)	Outside Sewer Rates (per 1000)
Base Rate (inc. 0 Gallons)	\$22.95	\$33.59
3,000 to 5,000	\$6.12	\$18.35
5,000 to 100,000	\$6.33	\$19.00
100,000 to 500,000	\$6.54	\$19.61
500,000 and above	\$6.75	\$20.26

Using these rates, the average household water and sewer use of 3,300 gallons per month would yield an inside water and sewer bill of \$28.76 and \$43.94, respectively. These numbers yield an approximate increase in revenue in 2015 of 22.6% (\$1,818,887 versus the current 1,541,443) over the existing water and sewer rates.

For reference, one-hundred thousand dollars annually is sufficient to finance a \$1.6 million, 20-year term loan at 2.5% interest, putting the Town in position to fund all of the projects listed in the CIP.



*Appendix A: Town of Tryon General Specifications*

## SECTION 02110

## SITE CLEARING

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Removal of surface debris.
- B. Removal of paving, curbs, and structures
- C. Removal of trees, shrubs, and other plant life.
- D. Removal of underground storage tanks.
- E. Topsoil excavation.

## 1.2 RELATED SECTIONS

- A. Section 02211 - Rough Grading.
- B. Section 02229 - Rock Removal.

## 1.3 REGULATORY REQUIREMENTS

- A. Conform to Town of Tryon, Polk County, Department of Transportation, local fire department, and any other applicable codes for environmental requirements, disposal of debris, burning debris on site, and use of herbicides.
- B. Coordinate clearing Work with applicable utility companies.

## PART 2 PRODUCTS

## 2.1 MATERIALS

- A. Herbicide: as indicated on plans.

## PART 3 EXECUTION

## 3.1 PREPARATION

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- A. Verify that existing plant life designated to remain is tagged or identified.
- B. Identify a waste area for placing removed materials.

### 3.2 PROTECTION

- A. Locate, identify, and protect utilities that remain from damage.
- B. Protect trees, plant growth, and features designated to remain as final landscaping.
- C. Protect bench marks, and survey control points, and existing remaining structures from damage or displacement.

### 3.3 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees and shrubs as indicated on plans. Remove stumps and root systems to an adequate depth. Remove surface rocks and other debris.
- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Apply herbicide to remaining stumps to inhibit growth.

### 3.4 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Remove demolished pavement and curb and other debris from site.
- C. Excavate and remove underground storage tanks, restraining straps, associated plumbing, and other debris.

### 3.5 TOPSOIL EXCAVATION

- A. Excavate topsoil from marked areas in accordance with the plans without mixing with foreign materials.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on the plans to depth not exceeding 8 feet and

protect from erosion.

- D. Remove topsoil not intended for reuse from site to an appropriate and permitted site.

END OF SECTION

## SECTION 02205

## SOIL MATERIALS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Subsoil materials.
- B. Topsoil materials.

## 1.2 RELATED SECTIONS

- A. Section 02207 - Aggregate Materials.
- B. Section 02223 - Backfilling.
- C. Section 02225 - Trenching.
- D. Section 02275 - Riprap.
- E. Section 02936 - Seeding.

## 1.3 QUALITY ASSURANCE

- A. Perform work in accordance with all references, Town requirements, and applicable state agency requirements.

## 1.4 REFERENCES

- A. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. Rammer and 18 inch Drop.
- B. ASTM D2487 - Classification of Soils for Engineering Purposes.

## 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of North Carolina, Town of Tryon and the NCDOT. Maintain one copy of all approved permits on site during construction.

## PART 2 PRODUCTS

### 2.1 SUBSOIL MATERIALS

- A. Subsoil Type S1: Conforming to North Carolina Department of Transportation requirements.
- B. Subsoil Type S2:
  - 1. Excavated and re-used material, imported borrow, or select or local borrow.
  - 2. Graded.
  - 3. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
  - 4. Relatively free of organic material.
  - 5. Conforming to ASTM D2487 Group Symbol CL.

### 2.2 TOPSOIL MATERIALS

- A. Topsoil Type S3: Conforming to North Carolina Department of Transportation requirements.
- B. Topsoil Type S4:
  - 1. Excavated and reused material.
  - 2. Graded.
  - 3. Free of roots, rocks larger than ½ inch, subsoil, debris, large weeds and foreign matter.
  - 4. Containing organic materials.
  - 5. Conforming to ASTM D2487 Group Symbol OH.
- C. Topsoil Type S5:
  - 1. Imported borrow.
  - 2. Friable loam.
  - 3. Reasonably free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds, and foreign matter.
  - 4. Acidity range (pH) of 5.5 to 7.5.
  - 5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
  - 6. Conforming to ASTM D2487 Group Symbol PT.

### 2.3 SOURCE QUALITY CONTROL

- A. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM

D1557.

- B. If tests indicate materials do not meet specified requirements, change material and retest.
- C. Provide materials of each type from same source throughout the Work.

### PART 3 EXECUTION

#### 3.1 SOIL REMOVAL

- A. Excavate subsoil and topsoil from areas designated.
- B. Remove lumped soil, boulders, and rock.
- C. Either stockpile or removal soil as required by design plans.
- D. Separate differing materials with dividers or stockpile apart to prevent mixing.
- E. Prevent intermixing of soil types or contamination.
- F. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

#### 3.2 STOCKPILE CLEANUP

- A. As specified on design plans either direct surface water away from stockpile site to prevent erosion or deterioration of materials or leave unused materials in a neat, compact stockpile.
- B. If a borrow area is indicated, leave area in a clean and neat condition. Grade site surface to prevent freestanding surface water.

END OF SECTION

## SECTION 02207

## AGGREGATE MATERIALS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Aggregate materials.

## 1.2 RELATED SECTIONS

- A. Geotechnical Report (if provided); bore hole locations and findings of subsurface materials.
- B. Section 02205 - Soil Materials.
- C. Section 02225 - Trenching.
- D. Section 02275 - Riprap.
- E. Section 02667 - Site Water Lines.
- F. Section 02732 - Site Sanitary Sewerage Systems.

## 1.3 REFERENCES

- A. AASHTO - M147 - Materials for Aggregate and Soil-Aggregate.
- B. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. Rammer and 18 inch Drop.
- D. ASTM D2487 - Classification of Soils for Engineering Purposes.
- E. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

## 1.4 QUALITY ASSURANCE

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- A. Perform work in accordance with all references, Town requirements, and applicable state agency requirements.

## PART 2 PRODUCTS

### 2.1 COARSE AGGREGATE MATERIALS

- A. Coarse Aggregate Type A1: Aggregate Base Course (ABC) conforming North Carolina Department of Transportation Standard.
- B. Coarse Aggregate Type A2 (Gravel): AASHTO M147, 35% or less passing the No. 200.
- C. Coarse Aggregate Type A3 (Gravel): Washed stone; free of shale, clay, friable material and debris; graded in accordance with ASTM C136, ASTM D2487 Group Symbol GP.
- D. Aggregate Type A4 (Pea Gravel): Natural stone; washed, free of clay, shale, organic matter; graded in accordance with ASTM C136, ASTM D2487 Group Symbol GM.

### 2.2 FINE AGGREGATE MATERIALS

- A. Fine Aggregate Type A5: Conforming to North Carolina Department of Transportation standard.
- B. Fine Aggregate Type A6 (Sand): Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded in accordance with ASTM C136, ASTM D2487 Group Symbol SP.

### 2.3 SOURCE QUALITY CONTROL

- A. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with ASTM D1557.
- B. Fine Aggregate Material - Testing and Analysis: Perform in accordance with ASTM D1557.
- C. If tests indicate materials do not meet specified requirements, change material or material source and retest.
- D. Provide materials of each type from same source throughout the Work.

## PART 3 EXECUTION

### 3.1 STOCKPILING

- A. Stockpile materials on site at locations designated by Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Direct surface water away from stockpile site so as to prevent erosion or deterioration of materials.

### 3.2 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.
- B. If a borrow area is indicated, leave area in a clean and neat condition. Grade site surface to prevent freestanding surface water.

END OF SECTION

## SECTION 02211

## ROUGH GRADING

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Removal of topsoil and subsoil.
- B. Cutting, grading, filling, rough contouring, and compacting the site for site structures, building pads, and other required grading.

## 1.2 RELATED SECTIONS

- A. Section 02110 - Site Clearing.
- B. Section 02205 - Soil Materials.
- C. Section 02207 - Aggregate Materials.
- D. Section 02229 - Rock Removal.
- E. Section 02222 - Excavating.
- F. Section 02223 - Backfilling.
- G. Section 02225 - Trenching.
- H. Section 02923 - Landscape Grading.

## 1.3 REFERENCES

- A. ASTM C136 - Method For Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- C. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- D. ASTM D2419 - Test Method For Sand Equivalent Value of Soils and Fine

Aggregate.

- E. ASTM D2434 - Test Method For Permeability of Granular Soils (Constant Head).
- F. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

#### 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C136, ASTM D2419, ASTM D2434, and any other applicable local standards. Maintain one copy of all required permits on site.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Topsoil: Type S3, S4 or S5 as specified in Section 02205.
- B. Subsoil Fill: Type S1 or S2 as specified in Section 02205.
- C. Structural Fill: Type S1 or S2 as specified in Section 02205.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify site conditions conform to site plans.
- B. Verify that survey bench mark and intended elevations for the Work are as indicated.

#### 3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.

- C. Locate, identify, and protect utilities that remain, from damage.
- D. Notify applicable utility company to remove and relocate utilities.
- E. Protect above and below grade utilities that remain.
- F. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
- G. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

### 3.3 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, relandscaped, or regraded.
- B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.
- C. When excavating through roots, perform work by hand and cut roots with sharp axe.
- D. Remove subsoil from site or stockpile in area designated on site to depth not exceeding eight feet and protect from erosion. Remove from site, subsoil not being reused.
- E. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key placed fill material to slope to provide firm bearing.
- F. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

### 3.4 FILLING

- A. Install Work in accordance with applicable local standards.
- B. Fill areas to contours and elevations with unfrozen materials.
- C. Place fill material on continuous layers and compact.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum 1.5:100 unless noted otherwise.

- F. Make grade changes gradual. Blend slope into level areas.
- G. Remove surplus fill materials from site.

3.5 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.6 FIELD QUALITY CONTROL

- A. Testing: In accordance with ASTM D1557.
  - B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- i. Frequency of Tests: Perform tests as required by Town and/or Engineer.

END OF SECTION

## SECTION 02222

## EXCAVATING

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Excavating for site structures.

## 1.2 RELATED SECTIONS

- A. Section 02110 - Site Clearing.
- B. Section 02223 - Backfilling.
- C. Section 02225 - Trenching.
- D. Section 02229 - Rock Removal.
- E. Section 02607: Manholes and Covers.
- F. Section 02667 - Site Water Lines.

## 1.3 FIELD MEASUREMENTS

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

## PART 2 PRODUCTS

Not Used.

## PART 3 EXECUTION

## 3.1 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain from damage.
- C. Notify utility company to remove and relocate utilities.
- D. Protect plant life, lawns, rock outcroppings and other features remaining as a



portion of final landscaping.

- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

### 3.2 EXCAVATING

- A. Excavate subsoil to accommodate building foundations, slabs-on-grade paving and site structures.
- B. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 02223 and 02225.
- C. Grade top perimeter of excavating to prevent surface water from draining into excavation.
- D. Hand trim excavation. Remove loose matter.
- E. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume. Larger material will be removed under Section 02229.
- F. Notify Town of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- G. Correct areas over excavated in accordance with Section 02223.
- H. Stockpile excavated material in area designated on site in accordance with Section 02205.

### 3.3 FIELD QUALITY CONTROL

- A. Provide for visual inspection of bearing surfaces.

### 3.4 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION

## SECTION 02223

## BACKFILLING

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Building perimeter and site structure backfilling to subgrade elevations.
- B. Site filling and backfilling.
- C. Fill under slabs-on-grade and paving.
- D. Fill for over-excavation.
- E. Consolidation and compaction as scheduled.

## 1.2 RELATED SECTIONS.

- A. Section 02222 - Excavating.
- B. Section 02225 - Trenching.
- C. Section 02229 - Rock Removal.
- D. Section 02275 - Riprap.
- E. Section 2607: Manholes and Covers.
- F. Section 02667 - Site Water Lines.
- G. Section 02923 - Landscape Grading.

## 1.3 REFERENCES

- A. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb Rammer and 18 inch Drop.

## PART 2 PRODUCTS

## 2.1 FILL MATERIALS

- A. Fill Type: As specified in Section 02205.

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## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- B. Verify underground tanks and manholes are anchored to their own foundations to avoid flotation after backfilling.
- C. Verify structural ability of unsupported walls to support imposed loads by the fill.

### 3.2 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Type A3 fill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Scarify and proof roll subgrade surface to identify soft spots. Fill and compact to density equal to or greater than requirements for subsequent fill material.

### 3.3 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Employ a placement method that does not disturb or damage other work.
- D. Place geotextile fabric over Type A2 fill prior to placing next lift of fill.
- E. Granular Fill Type A3: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.
- F. Soil Fill Type S2: Place and compact material in equal continuous layers not exceeding 12 inches compacted depth.
- G. Maintain optimum moisture content of backfill materials to attain required compaction density.

- H. Remove surplus backfill materials from site.
- I. Leave fill material stockpile areas free of excess fill materials.

#### 3.4 TOLERANCES

- A. Top Surface of Backfilling Under Paved Areas: Plus or minus 0.5 inches from required elevations.
- B. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

#### 3.5 FIELD QUALITY CONTROL

- A. Compaction testing will be performed in accordance with ASTM D1557.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- C. Proof roll compacted fill surfaces under slabs-on-grade and paving.

#### 3.6 PROTECTION OF FINISHED WORK

- A. Protect finished Work.
- B. Reshape and re-compact fills subjected to vehicular traffic.

#### 3.7 SCHEDULE

- A. All fill and compaction to comply with approved design plans.

END OF SECTION

## SECTION 02225

## TRENCHING

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Excavating trenches for utilities from clean out outside building to municipal utilities.
- B. Compacted fill from top of utility bedding to subgrade elevations.
- C. Backfilling and compaction.

## 1.2 RELATED SECTIONS

- A. Section 02110 - Site Clearing.
- B. Section 02205 - Soil Materials.
- C. Section 02222 - Excavating.
- D. Section 02223 - Backfilling.
- E. Section 02229 - Rock Removal.
- F. Section 02275 - Riprap.
- G. Section 02667 - Site Water Lines.
- H. Section 02732 - Site Sanitary Sewerage Systems.
- I. Section 02923 - Landscape Grading.

## 1.3 REFERENCES

- A. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

## 1.4 DEFINITIONS

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- A. Utility: Any buried pipe, duct, conduit, or cable.

## 1.5 FIELD MEASUREMENTS

- A. Verify that survey bench mark, control point, and intended elevations for the work are as shown on drawings.

## 1.6 COORDINATION

- A. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.

## PART 2 PRODUCTS

### 2.1 FILL MATERIALS

- A. Fill Type S2: As specified in Section 02205.

### 2.2 ACCESSORIES

- A. Geotextile Fabric: Non-biodegradable fabric in accordance with plans.
- B. Filter Fabric: Non-biodegradable fabric in accordance with plans.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.
- C. Protect bench marks, existing structures, paving, and curbs from excavating equipment and vehicular traffic.
- D. Maintain and protect above and below grade utilities that are to remain.
- E. Cut out soft areas of subgrade not capable of compaction in place. Backfill and compact to density equal to or greater than requirements for subsequent backfill material.

### 3.2 EXCAVATING

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- A. Excavate subsoil required for municipal utilities.
- B. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. In trenches where water is present or where dewatering is required, the trench bottom shall be undercut and stabilized with No. 67 stone, having a minimum depth of 8 inches.
- E. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- F. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd, measured by volume. Larger material will be removed under Section 02229.
- G. Stockpile excavated material in area designated on site and remove excess material not being used, from site.

### 3.3 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place geotextile fabric over Fill Type A2 prior to placing next lift of fill.
- D. Granular Fill Type A6: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.
- E. Soil Fill Type S2: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.
- F. Employ a placement method that does not disturb or damage foundation perimeter drainage, utilities in trench, or any other existing structures.
- G. Maintain optimum moisture content of fill materials to attain required compaction density.
- H. Remove surplus fill materials from site.
- I. Leave fill material stockpile areas completely free of excess fill materials.

### 3.4 TOLERANCES

- A. Top Surface of Backfilling Under Paved Areas: Plus or minus 0.5 inches from required elevations.
- B. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

### 3.5 FIELD QUALITY CONTROL

- A. Compaction testing will be performed in accordance with ASTM D1557.
- B. If tests indicate Work does not meet specified requirements, [remove Work, replace, compact, and retest.
- C. Frequency of Tests: Compaction tests will be conducted as required by the Town's Engineering Representative.

### 3.6 PROTECTION OF FINISHED WORK

- A. Protect finished Work.
- B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION



## SECTION 02229

## ROCK REMOVAL

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Removal of discovered rock during excavation.
- B. Explosives to assist rock removal.

## 1.2 RELATED SECTIONS

- A. Section 02225 - Trenching: Trenching and backfilling for utilities.
- B. Section 02275 - Riprap.

## 1.3 REFERENCES

- A. NFPA 495 - Code for Manufacture, Transportation, Storage, and Use of Explosive Materials.

## 1.4 DEFINITIONS

- A. Rock: Solid mineral material with a volume in excess of 1/6 cu yd or solid material that cannot be removed with a 3/4 cu yd capacity power shovel without drilling or blasting.

## 1.5 SUBMITTALS FOR REVIEW

- A. Shop Drawings: Indicate the proposed method of blasting, delay pattern, explosive types, type of blasting mat or cover, and intended rock removal method. Town's Engineering Representative must approve prior to any blasting.

## 1.6 QUALITY ASSURANCE

- A. Seismic Survey Firm: Company specializing in seismic surveys with five years experience or approval by Town's Engineering Representative.
- B. Explosives Firm: Company specializing in explosives for disintegration of rock, with five years documented experience or approval by Town's Engineering Representative.

## 1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable safety codes for explosive disintegration of rock and to NFPA 495 for handling explosive materials.
- B. Blasting Procedures shall conform to all applicable local, state, and Federal laws and ordinances. The Contractor shall take all necessary precautions to protect life and property, including the use of an approved blasting mat where there exists the danger of throwing rock or overburden.
- C. Obtain permits from authorities having jurisdiction before explosives are brought to site or drilling is started.

## 1.8 PROJECT CONDITIONS

- A. The Contractor shall keep explosive materials that are needed on the job site in specially constructed boxes provided with locks. These boxes shall be painted red and plainly identified as to their contents. After working hours, the boxes containing explosive materials shall be removed from the job site. Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made.
- B. Conduct survey and document conditions of buildings near locations of rock removal, prior to blasting, and photograph existing conditions identifying existing irregularities.
- C. Advise owners of adjacent buildings or structures in writing, prior to executing seismographic survey. Explain planned blasting and seismic operations.
- D. Where blasting takes place within 500 feet of a utility, structure, or property which could be damaged by vibration, concussion, or falling rock, the Contractor shall be required to keep a blasting log containing the following information for each and every shot:
  - 1. Date of shot.
  - 2. Time of shot.
  - 3. Foreman's name.
  - 4. Number and depth of holes.
  - 5. Approximate depth of overburden.
  - 6. Amount and type of explosive used in each hole.
  - 7. Type of caps used (instant or delay).
  - 8. The weather.

- E. Blasting log shall be made available to the Town's Engineering Representative upon request and shall be kept in an orderly manner. Compliance by the Contractor with these specifications does in no way relieve him of legal liabilities relative to blasting operations.
- F. Obtain a seismic survey prior to rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties or other work.
- G. No blasting shall be allowed unless a galvanometer is employed to check cap circuits.
- H. The Town reserves the right to require removal of rock by means other than blasting where any utility, residence, structure, etc. is either too close to, or so situated with respect to the blasting as to make blasting hazardous.

## 1.9 SCHEDULING

- A. Schedule Work to avoid disruption to occupied buildings nearby.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Explosives: Type recommended by explosive firm following seismic survey and required by authorities having jurisdiction.
- B. Delay Device: Type recommended by explosives firm.
- C. Blast Mat Materials: Type recommended by explosives firm.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify site conditions and note subsurface irregularities affecting work of this section.

### 3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.

### 3.3 ROCK REMOVAL BY A MECHANICAL METHOD

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- A. Excavate and remove rock by the mechanical method.
- B. Drill holes and utilize wedges or mechanical disintegration compound to fracture rock.
- C. Cut away rock at bottom of excavation to form level bearing.
- D. In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.
- E. Remove excavated materials from site or reuse for site landscaping.
- F. Correct unauthorized rock removal to directions of Town's Engineering Representative.

#### 3.4 ROCK REMOVAL BY EXPLOSIVE METHODS

- A. If rock is uncovered requiring the explosives method for rock disintegration, notify the Town.
- B. Provide seismographic monitoring during progress of blasting operations.
- C. Drill blasting holes within 12 feet of finished slope.
- D. Disintegrate rock and remove from excavation.
- E. Remove rock at excavation bottom to form level bearing.
- F. In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.
- G. Remove excavated material from site or reuse for site landscaping.
- H. Correct unauthorized rock removal to directions of Town's Engineering Representative.

#### 3.5 FIELD QUALITY CONTROL

- A. Provide for visual inspection of foundation bearing surfaces and cavities formed by removed rock.

END OF SECTION

## SECTION 02231

## AGGREGATE BASE COURSE

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Aggregate base course.

## 1.2 RELATED SECTIONS

- A. Section 02207 - Aggregate Materials.
- B. Section 02225 - Trenching.
- C. Section 02275 - Riprap.
- D. Section 02510 - Asphaltic Concrete Paving.
- E. Section 02520 - Portland Cement Concrete Paving.
- F. Section 02607 - Manholes and Covers.
- G. Section 02923 - Landscape Grading.

## 1.3 REFERENCES

- A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb. Rammer and an 18-in. Drop.
- B. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. Rammer and an 18 inch Drop.

## PART 2 PRODUCTS

## 2.1 MATERIALS

- A. Coarse Aggregate Fill Type A1: As specified in Section 02207.

## PART 3 EXECUTION

## 3.1 EXAMINATION

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- A. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

### 3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place fill on soft, muddy, or frozen surfaces.

### 3.3 AGGREGATE PLACEMENT

- A. Spread aggregate over prepared substrate to a total compacted thickness as indicated on design plans and in accordance with North Carolina Department of Transportation. Requirements.
- B. Place aggregate in maximum 6 inch layers and roller compact to specified density.
- C. Level and contour surfaces to elevations and gradients indicated.
- D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

### 3.4 TOLERANCES

- A. Flatness: Maximum variation of 1/2 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation From Design Elevation: Within 1/2 inch.

### 3.5 FIELD QUALITY CONTROL

- A. Compaction testing will be performed in accordance with AASHTO T180.
- B. If tests indicate Work does not meet specified requirements, remove Work,

replace and retest.

3.6 SCHEDULES

A. Under Asphalt Pavement:

1. Compact placed aggregate materials to achieve compaction of 95 percent.

B. Under Concrete Pavement:

1. Compact placed aggregate materials to achieve compaction of 95 percent.

END OF SECTION

## SECTION 02275

## RIPRAP

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Riprap.

## 1.2 RELATED SECTIONS

- A. Section 02225 – Trenching.

## PART 2 PRODUCTS

## 2.1 MATERIALS

- A. Riprap: Sized in accordance with design plans.
- B. Geotextile fabric.

## PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Do not place riprap over frozen or spongy subgrade surfaces.

## 3.2 PLACEMENT

- A. Place geotextile fabric over substrate, lap edges and ends.
- B. Place riprap at culvert pipe ends and other locations as indicated on design plans.
- C. Place riprap into position. Key into grade so that top of riprap is at same grade as surrounding ground.
- D. Install to indicated thickness.
- E. Place rock evenly and carefully to minimize voids, do not tear fabric, and place in one consistent operation to preclude disturbance or displacement of substrate.



- F. After placement, spray with water to moisten the bagged mix. Maintain moist for 24 hours.

END OF SECTION

## SECTION 02510

## ASPHALTIC CONCRETE PAVING

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Asphaltic concrete paving, wearing binder or base course.
- B. Surface sealer.
- C. Aggregate base course.

## 1.2 RELATED SECTIONS

- A. Section 02231 - Aggregate Base Course.
- B. Section 02607 - Manholes and Covers.

## 1.3 REFERENCES

- A. ASTM D946 - Penetration-Graded Asphalt Cement for Use in Pavement Construction.
- B. TAI - (The Asphalt Institute) - MS-2 Mix Design Methods for Asphalt Concrete and Other Hot Mix Types.

## 1.4 PERFORMANCE REQUIREMENTS

- A. Paving: Designed in accordance with Town Requirements and/or North Carolina Department of Transportation.
- B. Patching: Designed in accordance with approved design plans. Patching in Town streets or DOT roads must meet appropriate requirements.

## 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with Town and/or North Carolina Department of Transportation standard.
- B. Mixing Plant: Conform to Town and/or North Carolina Department of Transportation standard.

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- C. Obtain materials from same source throughout.

## 1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for paving work on public property.

## 1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F or surface is wet or frozen.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Asphalt Cement: ASTM D946. In accordance with North Carolina Department of Transportation standards.
- B. Aggregate for Base Course Mix: In accordance with Section 02207 Type A1.
- C. Aggregate for Binder Course Mix: In accordance with North Carolina Department of Transportation standards.
- D. Aggregate for Wearing Course Mix: In accordance with North Carolina Department of Transportation standards.
- E. Fine Aggregate: In accordance with Section 02207 Type A5.
- F. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.
- G. Primer: In accordance with North Carolina Department of Transportation standards.
- H. Tack Coat: In accordance with North Carolina Department of Transportation standards.
- I. Seal Coat: In accordance with North Carolina Department of Transportation standards.

### 2.2 ASPHALT PAVING MIX

- A. Use dry material to avoid foaming. Mix uniformly.

- B. Base Course: 3.0 to 6.0 percent of asphalt cement by weight in mixture in accordance with North Carolina Department of Transportation standards.
- C. Binder Course: 4.5 to 6.0 percent of asphalt cement by weight in mixture in accordance with North Carolina Department of Transportation standards.
- D. Wearing Course: 5.0 to 7.0 percent of asphalt cement by weight in mixture in accordance with North Carolina Department of Transportation standards.]

### 2.3 SOURCE QUALITY CONTROL AND TESTS

- A. Submit proposed mix design of each class of mix for review prior to beginning of work.
- B. Test samples in accordance with TAI MS-2.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify base conditions satisfactory.
- B. Verify that compacted granular base is dry and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.

### 3.2 SUBBASE

- A. Section 02231 - Aggregate Base Course forms the base construction for work of this section.

### 3.3 PREPARATION - PRIMER

- A. Apply primer in accordance with North Carolina Department of Transportation standards

### 3.4 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with North Carolina Department of Transportation standards

### 3.5 PLACING ASPHALT PAVEMENT - SINGLE COURSE

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- A. Install Work in accordance with North Carolina Department of Transportation standards
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Place asphalt to thickness shown on approved design plans.
- D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

### 3.6 SEAL COAT

- A. Apply seal coat to surface course in accordance with North Carolina Department of Transportation standards.

### 3.7 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch .
- C. Variation from True Elevation: Within 1/2 inch .

### 3.8 FIELD QUALITY CONTROL

- A. Take samples and perform tests in accordance with TAI MS-2.

### 3.9 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury until surface temperature is less than 140 degrees F.

END OF SECTION

## SECTION 02520

## PORTLAND CEMENT CONCRETE PAVING

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Concrete sidewalks and driveways.
- B. Aggregate base course.

## 1.2 RELATED SECTIONS

- A. Section 02231 - Aggregate Base Course
- B. Section 02510 - Asphaltic Concrete Paving.
- C. Section 02607 - Manholes and Covers.
- D. Section 02923 - Landscape Grading.

## 1.3 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- C. ASTM C33 - Concrete Aggregates.
- D. ASTM C94 - Ready Mix Concrete.
- E. ASTM C150 - Portland Cement
- F. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
- G. ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

## 1.4 QUALITY ASSURANCE

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- A. Perform work in accordance with ACI 301.
- B. Obtain cementitious materials from same source throughout.

#### 1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete when base surface temperature is less than 40 degrees F or surface is wet or frozen.

### PART 2 PRODUCTS

#### 2.1 FORM MATERIALS

- A. Form Materials: Conform to ACI 301.

#### 2.2 REINFORCEMENT

#### 2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150 Portland type, white color.
- B. Fine and Coarse Mix Aggregates: ASTM C33.
- C. Water: Potable, not detrimental to concrete.

#### 2.4 ACCESSORIES

- A. Curing Compound: ASTM C309.
- B. Liquid Surface Sealer.
- C. Surface Retarder.
- D. Joint Sealers.

#### 2.5 CONCRETE MIX - BY PERFORMANCE CRITERIA

- A. Mix and deliver concrete in accordance with ASTM C94, Alternative No. 2.
- B. Select proportions for normal weight concrete in accordance with ACI 301 Method 1.
- C. Provide concrete to the specifications given on the approved design plans.

- D. Use accelerating admixtures in cold weather only when approved by Town. Use of admixtures will not relax cold weather placement requirements.
- E. Use calcium chloride only when approved by Town.
- F. Use set retarding admixtures during hot weather only when approved by Town.

## 2.6 SOURCE QUALITY CONTROL AND TESTS

- A. Submit proposed mix design to Town for review prior to commencement of work.
- B. Tests on cement and aggregates will be performed to ensure conformance with specified requirements.
- C. Test samples in accordance with ACI 301.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify compacted stabilized soil is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

### 3.2 SUBBASE

- A. Section 02231 - Aggregate Base Course forms the base construction for work of this Section.

### 3.3 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole or catch basin (if applicable) frames with oil to prevent bond with concrete pavement.
- C. Notify Town minimum 24 hours prior to commencement of concreting operations.

### 3.4 FORMING



- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

### 3.5 REINFORCEMENT

- A. Place reinforcement as indicated.
- B. Interrupt reinforcement at expansion joints.
- C. Place reinforcement to achieve pavement and curb alignment as detailed.

### 3.6 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301.

### 3.7 JOINTS

- A. Place expansion joints at 20 foot intervals. Align curb, gutter, and sidewalk joints.
- B. Place joint filler between paving components and building or other appurtenances.
- C. Provide sawn joints at 3 foot intervals, between sidewalks and curbs, and between curbs and pavement.
- D. Provide keyed joints as indicated.

### 3.8 EXPOSED AGGREGATE

- A. Wash exposed aggregate surface with clean water and scrub with stiff bristle brush to match sample panel.

### 3.9 FINISHING

- A. Finish as stated on design plans or to match existing surfaces.

### 3.10 JOINT SEALING

02520 - 4

*Town of Tryon Specifications  
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- A. Separate pavement from vertical surfaces with 1/4 inch thick joint filler.
- B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- C. Extend joint filler from bottom of pavement to within 1/4 inch of finished surface.

### 3.11 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/2 inch in 10 ft.
- B. Maximum Variation From True Position: 1/2 inch.

### 3.12 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian or vehicular traffic over pavement for 3 days minimum after finishing.

END OF SECTION

## SECTION 02607

## MANHOLES AND COVERS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Modular precast concrete manhole sections with tongue-and-groove joints with masonry transition to lid frame, covers, anchorage, and accessories.

## 1.2 RELATED SECTIONS

- A. Section 02205 - Soil Materials.
- B. Section 02222 - Excavating.
- C. Section 02223 - Backfilling.

## 1.3 REFERENCES

- A. ASTM A48 - Gray Iron Castings.
- B. ASTM C62 - Building Brick (Solid Masonry Units Made From Clay or Shale).
- C. ASTM C443
- D. ASTM C478 - Precast Reinforced Concrete Manhole Sections.
- E. ASTM C923 - Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.

## PART 2 PRODUCTS

## 2.1 MATERIALS

- A. Manhole Sections: Reinforced precast concrete manufactured in accordance with ASTM C478 with gaskets in accordance with ASTM C923. Manhole walls shall be a minimum of five inches thick and base slab shall have a minimum thickness of six inches. All manhole components shall be designed to withstand a H-20 loading. All manholes installed in DOT right of ways shall be approved by the DOT.

- B. All pipe penetrations in manholes shall be equipped with a flexible watertight connection and sealing system in accordance with ASTM C923.
- C. Manhole sections shall have a standard tongue and groove joint with a rubber "O"-ring, conforming to ASTM C443.
- D. Mortar: Mortar used in manhole invert construction shall consist of one part Portland Cement and two parts sand (Fine Aggregate Type A6). Portland Cement shall meet the requirements of ASTM C150. Mortar shall be mixed in a clean, tight mortar box or in an approved mechanical mixer and shall be used within 45 minutes after mixing.

## 2.2 COMPONENTS

- A. Lid and Frame: ASTM A48, Class 30B Cast iron construction, machined flat bearing surface, removable lid design; live load rating of H-20; sealing gasket; lid molded with words "SANITARY SEWER" manufactured in the U.S. Cover shall be perforated with two one inch diameter holes. Manholes within pavement shall have Dewey Brothers rings and covers, MH-RCR-2001 EC or equal to facilitate raising of manhole lid for future paving. All other rings and covers shall be Dewey Brothers MH-RCR-2001 or equal. Where deemed necessary, in low areas, solid manhole covers may be required. Additionally, sealed covers may be required in 100-year flood zones.
- B. Manhole Steps: Fiber reinforced plastic in accordance with ASTM D3753. Steps shall be constructed of a slip resistant reinforced molded polypropylene plastic shell. Reinforcing shall be of a single 3/8" steel bar, ASTM A615, grade 60. The steps shall be a "PS-1" step manufactured by M.A. Industries, Inc., equivalent product by Oliver Tire & Rubber, or Town approved equal. Steps are to be placed 16" horizontally apart.
- C. Flexible Sealing System for Joining Pipes to Precast Manholes: Each connection to a manhole shall be sealed water tight by means of a flexible sleeve or gasket type sealing system. The flexible sleeve type system, if used, shall be equal to Flexible Manhole Sleeve as manufactured by the Interpace Corporation. The gasket type system if used, shall be equal to the PSX system as manufactured by the Press Seal Gasket Corporation. The sealing system shall be furnished by the manhole manufacturer.

## 2.3 CONFIGURATION

- A. Shaft Construction: Concentric or eccentric in accordance with plans, with

concentric cone top section; lipped male/female joints; sleeved to receive pipe.

- B. Shape: Cylindrical.
- C. Clear Inside Dimensions: 48 inches diameter minimum.
- D. Design Depth: As indicated on design plans.
- E. Clear Lid Opening: 26 inches diameter minimum.
- F. Pipe Entry: Provide openings as indicated on plans.
- G. Steps: 12 inches wide, 16 inches on center vertically, set into manhole wall.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes is correct.

#### 3.2 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

#### 3.3 PLACING MANHOLE SECTIONS

- A. Precast concrete manholes shall be set true to the alignment and elevations indicated on the design plans.
- B. The monolithic base section shall be set on an 8" thick, No. 67 stone base.
- C. Place base pad, trowel top surface level.
- D. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.
- E. Cut and fit for pipe. Inlet and outlet piping shall be connected using the gasket

seal system as previously specified, in strict accordance with the manufacturer's recommendation.

- F. The inverts from intercepted cross lines shall be tied into the main flow line wherever possible, so as to provide a smooth transition. Wherever such cross lines tie-in at a substantially higher elevation than that of the downstream invert, the connecting line shall extend into the manhole a sufficient distance to enable the flow to spill into the flow line rather than onto the invert bench.
- G. On dead end manholes receiving service connections, the invert must be constructed and the invert flow line shall extend through the manhole so that all flow entering the manhole shall be readily conveyed downstream
- H. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required. The inverts shall be shaped to form a smooth and regular surface free from sharp and jagged edges.
- I. Set cover frames and covers level without tipping, to correct elevations. The manhole rings shall be set in full mortar beds. The rings with covers shall be set to the final grade indicated on the plans or as directed by the Town's Engineering Representative. The Contractor shall adjust any rings and covers not conforming to the correct grade.
- J. Coordinate with other sections of work to provide correct size, shape, and location.
- K. The exterior surface of all manholes shall be thoroughly cleaned of all grease, dirt, etc. All lifting lugs shall be removed and holes patched thoroughly with non-shrink mortar, color to match that of the manhole where such patches are exposed.
- L. Backfill around manholes shall be placed uniformly in shallow layers and thoroughly compacted with mechanical tampers and with care taken to ensure against displacement of the structure.
- M. Where drop manholes are noted on the drawings, they shall be constructed in accordance with the Standard Details. Drop pipe and fittings shall be ductile iron. The sewer pipe entering the drop tee shall consist of one joint of ductile iron pipe.

END OF SECTION

## SECTION 02667

## SITE WATER LINES

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Pipe, fittings, and thrust restraint for site water lines.
- B. Valves, blowoffs, and fire hydrants
- C. Pressure and leakage tests.

## 1.2 RELATED SECTIONS

- A. Section 02207 - Aggregate Materials.
- B. Section 02222 - Excavating.
- C. Section 02223 - Backfilling.
- D. Section 02225 - Trenching.
- E. Section 02607 - Manholes and Covers.
- F. Section 02675 - Disinfection of Water Distribution Systems.

## 1.3 REFERENCES

- A. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb. Rammer and 18 inch Drop.
- B. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
- C. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- D. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.
- E. ASTM D3035 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.
- F. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

- G. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
- H. AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.
- I. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- J. AWWA C500 - Gate Valves, 3 inch through 48 inch NPS, for Water and Sewage Systems.
- K. AWWA C502 - Dry Barrel Fire Hydrants.
- L. AWWA C504 - Rubber Seated Butterfly Valves.
- M. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 inch through 24 inch NPS.
- N. AWWA C509 - Resilient Seated Gate Valves 3 inch through 12 inch NPS, for Water and Sewage Systems.
- O. AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.
- P. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
- Q. AWWA C606 - Grooved and Shouldered Type Joints.
- R. AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water.
- S. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 1/2 inch through 3 inch, for Water.
- T. UL 246 - Hydrants for Fire - Protection Service.

#### 1.4 QUALITY ASSURANCE

- A. Perform work in accordance with Town's requirements.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

#### 1.5 DELIVERY, STORAGE, AND HANDLING



- A. The unloading and loading of pipe, fittings, valves and related accessories shall be performed with care so as to avoid any damage to these materials. All such materials should not be stored directly on the ground, but shall be on pallets, or other suitable supports, so as to prevent the entry of mud and debris into the pipe or other materials. Contractors shall also endeavor to store these materials in accordance with any special practices as may be recommended by the manufacturer.
- B. Deliver and store valves in shipping containers with labeling in place.

## PART 2 PRODUCTS

### 2.1 WATER PIPE

#### A. Ductile Iron Pipe:

All ductile iron pipes shall be manufactured in accordance with the requirements of AWWA C151. Pipe thickness shall be in accordance with AWWA C150 and be based on laying conditions and internal pressure as specified by the project plans.

Pipe joints shall be of the push-on type as per AWWA Standard C111. Pipe lining shall be cement mortar with a seal coat of bituminous material, all in accordance with AWWA Standard C104. Fittings shall be ductile iron and in accordance with AWWA C153 and AWWA C110. Mechanical joints shall conform to AWWA C111.

Ductile iron pipe shall be as manufactured by Griffin, U.S. Pipe, American, or Clow, and shall be furnished in 18 or 20 foot lengths.

#### B. PVC Pipe:

All PVC pipes four inches or larger shall meet the requirements of AWWA C900. Pipe shall be Class 150, DR-18, integral bell, iron pipe O.D., 20-foot length, with an elastomeric gasketed compression joint PVC pipe shall be as furnished by Jones-Manville, Clow, Robin-Tech, or equal as may be approved the Town's Engineering Representative.

Two-inch pipe shall be SDR-13.5 meeting the requirements of ASTM D2241. All PVC pipe shall bear the National Sanitation Foundation (NSF) potable water logo.

- NOTES:
1. Lubricants that will support microbiological growth shall not be used for slip-on joints. Vegetable shortening shall not be used to lubricate joints.

2. Natural rubber or other material which will support microbiological growth may not be used for any gaskets, O-rings, and other products which will expose the material to the water.
3. All pipe material, solder and flux shall be lead free (less than 0.2% lead in solder and flux and less than 8.0% lead in pipes and fittings).
4. All materials/products that contact potable water must be third party certified as meeting the specifications of ANSI/NSF.

## 2.2 HYDRANTS:

Fire hydrants shall be of the compression type meeting AWWA Standard C502, designed for a minimum working pressure of 150 psi and a hydrostatic pressure of 300 psi with the valve in both the open and closed positions.

All hydrants shall be equipped with two 2 ½-inch nozzles and one 5 1/4-inch pumper nozzle.

Each nozzle shall be bronze with cast iron caps secured thereto with a suitable steel chain. Nozzles shall have National Standard threads.

The hydrants shall be open-left and equipped with a pentagon-type operating nut (National Standard) measuring 1-½ inches from point to flat. Hydrants shall be of the "dry top" type with the upper rod threads completely enclosed in a sealed grease or oil chamber, equipped with "O" ring seals and a Teflon thrust bearing.

The hydrant valve opening shall be of sufficient size to insure such flows and corresponding minimum losses as set forth by the American Water Works Association. The minimum valve opening shall be 5 1/4 inches

The hydrants shall have a six inch shoe or boot, mechanical joint. Hydrants shall have bronze-to-bronze threads provided between the hydrant seat or seat ring and the seat attaching assembly. The hydrant shall be of the "safety" type so that, if the upper barrel is broken off, the hydrant valve will remain closed and reasonable tight. All hydrants shall be furnished with barrel and stem extensions as required by the final field location to provide a nominal minimum bury of three feet, six inches (3'-6"), or greater if indicated on the drawings.

Hydrants shall be Mueller Company Super Centurion 200 No. 421 or American Darling Mark 73-1.

## 2.3 GATE VALVES - UP TO 3 INCHES

Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, IPS ends, with

control rod, extension box and valve key.

#### 2.4 GATE VALVES - 3 INCHES AND OVER

Resilient wedge type manufactured in accordance with AWWA C509. They shall be designed for a working pressure of 200 psi and shall be hydrostatically shop tested to 400 psi. They shall be open-left, non-rising stem, cast or ductile iron body, double disc, parallel seat, fully bronze, mounted and equipped with O-ring seals and a standard 2-inch square operating nut. Valve fittings shall be mechanical joint.

#### 2.5 BALL VALVES - UP TO 2 INCHES

Brass body, Teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, IPS inlet end, IPS outlet, with control rod, extension box and valve key.

#### 2.6 SWING CHECK VALVES - FROM 2 INCHES TO 24 INCHES

AWWA C508, iron body, bronze trim, 45-degree swing disc, renewable disc and seat, flanged ends.

#### 2.7 BUTTERFLY VALVES - FROM 2 INCHES TO 24 INCHES

AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, infinite position lever handle.

#### 2.8 TAPPING VALVES

All tapping valves shall conform to the Standard Specification for gate valves as noted above, except that the inlet end shall be flanged, faced and drilled per ANSI B16.1 for 125 lb. Standard. The outlet end shall be of the mechanical joint type capable of receiving a standard tapping machine.

#### 2.9 BEDDING AND COVER MATERIALS

##### A. Bedding:

The barrel of the pipe shall bear uniformly upon the supporting trench bottom at all times. Bedding type will be specified on the Detail Drawings and in accordance with Section 02222 Excavating.

##### B. Cover:

All water mains shall be backfilled in accordance with the Standard Details and Section 02223 Backfilling as applicable.

## 2.10 ACCESSORIES

- A. Concrete for Thrust Restraints: Utilize 3000 psi batched concrete approved the Engineer. As an alternate, the concrete may be job mixed, subject to approval by the Engineer.
- B. Backflow Preventer: See Water Line Details in Plans.
- C. Meter: See Water Line Details in Plans.
- D. Manhole and Cover: Refer to Section 02607 and Water Line Details in Plans.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that all existing utilities are as specified on Plans. Contractor to verify location of all utilities prior to construction. Any damaged existing utilities will be the responsibility of the contractor to repair.

### 3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
- B. Remove scale and dirt on inside and outside of pipe before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

### 3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 02225 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Provide thrust restraint bearing as indicated on Water Line Details in Plans. Install restrain joint pipe or form and place concrete for pipe thrust restraints at any change of pipe direction. Place concrete to permit full access to pipe and pipe accessories.
- C. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth; compact to 95 percent.
- D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact to 95 percent.
- E. Maintain optimum moisture content of bedding material to attain required

compaction density.

### 3.4 INSTALLATION – PIPE

- A. Parallel Installation - Water mains shall be laid at least 10 feet horizontally from any sanitary sewer, storm sewer, or sewer manhole, whenever possible; the distance shall be measured from the outside diameters of the pipes.
- B. Crossings - Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.
- C. Sewer manholes - No water pipe shall pass through or come into contact with any part of a sewer or sewer manhole.
- D. Install ductile iron piping and fittings to AWWA C600. Care should be used not to exceed the maximum joint deflection in accordance with manufacturer's requirements.
- E. Install AWWA C900 pipe in accordance with AWWA C605. The maximum horizontal deflection for PVC pipe shall be in accordance with the manufacturer's recommendations.
- F. Open ends of the pipe shall be plugged at all times that pipe laying is not in progress.
- G. Water main trenches shall be excavated to such depth that the pipe will have a minimum cover of three feet. Where water mains are installed in new subdivision streets, the depth of cover shall be measured from the finished subgrade. If three feet of cover cannot be maintained, ductile iron pipe must be used.
- H. Trench width shall be a minimum of 16 inches plus the outside diameter of the pipe and a maximum of 24 inches plus the outside diameter of the pipe, unless the Town's Engineering Representative grants approval for deviation from this requirement.
- I. Where water main trench excavation is in rock, the rock shall be excavated to a minimum depth of 6 inches below the bottom of the pipe. This space shall be filled with No. 67 stone or other material approved by the Town's Engineering Representative.
- J. In trenches where water is present or where dewatering is required, the trench

bottom shall be stabilized with No. 67 stone. When material of poor supporting value (i.e. "muck") is encountered in the trench, it shall be removed and replaced with No. 67 stone or other material approved by the Town's Engineering Representative.

- K. All water main trenched shall be protected from the entrance of surface water. Any water observed in the trench shall be promptly removed by pumping, provided that water pumped from trenches is directed to suitable erosion control devices to prevent deposition of sediment into nearby streams, ponds, etc. The Contractor shall use all means necessary to prevent the entrance of water, including the construction of temporary berms or dikes.
- L. All water main pipes shall be clean before installation. Any dirty pipe shall be thoroughly swabbed by the Contractor. Pipe showing evidence of oil or grease contamination shall not be used.
- M. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- N. Install access fittings to permit disinfection of water system performed under Section 02675.
- O. Slope water pipe and position drains at low points.
- P. All PVC pipe shall be installed with a metallic detector wire in accordance with the Standard Detail.
- Q. Backfill trench in accordance with Section 02225.
- R. In backfilling PVC water mains, care shall be taken to ensure that the material in the "haunching" zone (up to the spring-line of the pipe) is carefully placed and compacted so that the pipe is properly supported in accordance with the pipe manufacturer's recommendations.
- S. Should any water line trench exhibit settlement, the Contractor shall correct the deficiency to the complete satisfaction of the Town.
- T. Where a water line crosses existing NCDOT roads or other publicly maintained roads, the backfill shall be compacted to at least 95% standard density as measured by AASHTO Method T-99. Where deemed necessary, the Town may require compaction tests to be performed (at the Contractor's expense) on backfill placed in trenches across such roads.

### 3.5 INSTALLATION - VALVES AND HYDRANTS

- A. Valves shall be set at locations shown on the plans with care being taken to support the valve properly and to accurately position the valve box over the operating nut of the valve.
- B. All valves used on PVC pipe shall be set on a solid concrete block. The blocks shall be 4-inch thick; width shall be the nominal pipe size, plus 4 inches. Length shall be the length of the valve, plus 4 inches. Minimum block size shall be 8" x 16" x 4".
- C. Where pavement exists, the box shall be adjusted to finished street grade.
- D. When valves are located in street right-of-way, but out of pavement, the boxes shall be adjusted to finish grade and a concrete collar 2 feet square and 6 inches thick shall be poured around the box ½ inch from the top of the casting. In lieu of the poured in place concrete, a pre-cast concrete collar may be used such as manufactured by Brooks, Inc. or Buckhorn Products or Town approved equal.
- E. When valves are located outside of street right-of-way, the boxes shall be adjusted 6 inches above the finished grade, and a concrete collar 2 feet square and 6 inches thick shall be poured around the casting.
- F. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.
- G. Set hydrants to grade, with nozzle height as indicated on Standard Details.
- H. Locate control valve 4 inches away from hydrant.
- I. Paint hydrants in accordance with Town's requirements.

### 3.6 INSTALLATION – FITTINGS

- A. Fittings shall be installed at the location indicated on the drawings with care taken to insure that joints are fully homed and that the fittings are fully and properly supported.

### 3.7 INSTALLATION – REACTION BLOCKING

- A. All bends, tees and plugs shall be blocked with 4000 psi concrete to undisturbed ground to the dimensions shown on the plans. The concrete shall be cured for 24 hours before being backfilled.
- B. If the existing ground is soft, the Town may require restrained joint fittings.
- C. Restrained joint fittings will be required on all 16 inch ductile iron pipe and larger.

### 3.8 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Flush and disinfect system in accordance with Section 02675

### 3.9 SERVICE CONNECTIONS

- A. Provide water service as indicated.

### 3.10 PRESSURE AND LEAKAGE TESTS

- A. No valve in the existing system shall be operated without giving a minimum of 4 hours notice to the Town.
- B. After the pipe has been laid and backfilled or partially backfilled, each valved section of pipeline shall be subjected to hydrostatic and leakage tests in accordance with the applicable requirements of AWWA C600 for ductile-iron pipe and AWWA C605 for PVC pipe.
- C. Before applying the test, all air shall be expelled from the pipe. Each valved section of the pipe shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a satisfactory manner. The Town's Engineering Representative shall witness all tests.
- D. Test pressure for the pipeline shall be 200 psi as measured at the lowest elevation, if the material used is ductile iron pipe. For pipelines constructed of PVC pipe or a mixture of PVC pipe and ductile iron pipe, the test pressure for the pipelines shall be 160 psi. In neither case shall the test pressure be less than 1.5 times the working pressure within the system. Test pressures shall be applied for a minimum duration of 2 hours.
- E. The pressure gauge used in the hydrostatic test shall be calibrated in increments of 10 psi or less.
- F. At the end of the test period, the leakage shall be measured with an accurate water meter.
- G. The formula to be used for calculating the maximum allowable leakage per hour shall be:

Ductile Iron:  

$$L = [S * D(P)^{0.5}] / 133,200$$

PVC:  

$$L = [N * D(P)^{0.5}] / 7,400$$

S = length of pipeline tested (ft)

N = # of joints in pipe being tested



L = allowable leakage (gallons per hour)

D = pipe diameter (ft)

P = average test pressure (psi)

- H. No pipe installation shall be accepted if leakage is greater than that determined for mechanical and push-on joint pipe in AWWA C600, Section 4.1.6. Defective pipe, joints, fittings, valves, accessories, or workmanship shall be removed or corrected. Tests shall be repeated until satisfactory to the Engineer.

### 3.11 FIELD QUALITY CONTROL

- A. If tests indicate work does not meet specified requirements, remove, replace, and retest.

### 3.12 FINAL CLEANUP

- A. After completion of the installation the contractor shall remove all refuse and debris from the site. The site will be cleaned to the satisfaction of the Town. The Contractor shall remove all surplus materials, tools, vehicles, equipment, and temporary structures from the site.
- B. Site will be landscaped and seeded to Town's satisfaction prior to final site approval.

END OF SECTION

## SECTION 02669

## WATER SERVICE CONNECTIONS

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Water services.

## 1.2 RELATED SECTIONS

- A. Section 02222 - Excavating.
- B. Section 02223 - Backfilling.
- C. Section 02225 - Trenching.
- D. Section 02667 - Site Water Lines.

## PART 2 MATERIALS

## 2.1 SERVICE PIPES

- A. Copper Tubing: ASTM Standard B88, "K" copper.
- B. Polybutylene Tubing: AWWA C902, rated for 250 psi.
- C. PVC: Shall be of the size dimension ratio (SDR) noted on plans. AWWA C900 or ASTM D2241 standards.

## 2.2 WATER METERS

- A. Residential: Shall be 5/8" by 3/4" and conform to AWWA Standard C700. Meters used must be approved by Town prior to installation and must conform to Standard Details.
- B. Commercial: Shall be approved by Town on a case by case basis.

## 2.3 METER BOXES

- A. Shall be designed to provide adequate space for installation and removal of the meter and backflow preventer as a unit inside the box. Will also contain an inlet control valve and expansion connection.

- B. Unit Base: To be cast iron sized in accordance with Standard Details.
- C. Inlet Control Valve: Teflon coated ball valve.
- D. Backflow Preventer: Dual check valve, straight line design, in accordance with AWWA C506. Maximum allowable head loss of six psi at 20 gpm.
- E. Expansion Connection: Shall be of a three piece design (handwheel, barrel, and thimble) and have a beveled expansion connection gasket and a meter washer. Shall permit easy installation or removal of meter/backflow unit.
- F. Unit Upper Housing: Cast iron, fixed to base with stainless screws and nuts.
- G. Unit Cover: Cast iron with easy off pick up bar, non skid surface, and "WATER METER" cast in one inch letters on the upper side.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Installed at locations shown on plans. Meters should be located at edge of right of way outside of vehicular traffic areas if possible in easily accessible locations.
- B. Taps: Sized in accordance with plans. A tapping sleeve shall be used on all plastic pipes. A corporation stop and service pipe adaptor shall be installed in the tap.
- C. Service pipe: Install in accordance with plans.
- D. Backfill: Backfill in accordance with Section 02223. Clean and landscape to the requirements and approval of Town.

END OF SECTION

## SECTION 02675

## DISINFECTION OF WATER DISTRIBUTION SYSTEM

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Disinfection of potable water distribution system.
- B. Testing and reporting results.

## 1.2 RELATED SECTIONS

- A. Section 02667 - Site Water Lines.

## 1.3 REFERENCES

- A. AWWA B300 - Hypochlorites.
- B. AWWA B301 - Liquid Chlorine.
- C. AWWA B302 - Ammonium Sulfate.
- D. AWWA B303 - Sodium Chlorite.
- E. AWWA C651 - Disinfecting Water Mains.

## 1.4 SUBMITTALS FOR INFORMATION

- A. Test Reports: Indicate results comparative to specified requirements.
- B. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.

## 1.5 PROJECT RECORD DOCUMENTS

- A. Disinfection report:
  - 1. Type and form of disinfectant used.
  - 2. Date and time of disinfectant injection start and time of completion.
  - 3. Test locations.
  - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
  - 5. Date and time of flushing start and completion.

6. Disinfectant residual after flushing in ppm for each outlet tested.
- B. Bacteriological report:
1. Date issued, project name, and testing laboratory name, address, and telephone number.
  2. Time and date of water sample collection.
  3. Name of person collecting samples.
  4. Test locations.
  5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
  6. Coliform bacteria test results for each outlet tested.
  7. Certification that water conforms, or fails to conform, to bacterial standards of NCDENR.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AWWA C651.
- B. Testing Firm: Company specializing in testing potable water systems, certified by the State of North Carolina.
- C. Submit bacteriologist's signature and authority associated with testing.

#### 1.7 REGULATORY REQUIREMENTS

- A. Before being placed in service and after the hydrostatic tests are completed, all pipe and fittings shall be sterilized.
- B. Conform to applicable code or regulation for performing the work of this Section.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of water system.

### PART 2 PRODUCTS

#### 2.1 DISINFECTION CHEMICALS

- A. Chemicals: AWWA B300, Hypochlorite, AWWA B301 and Liquid Chlorine, AWWA B302.

### PART 3 EXECUTION

#### 3.1 EXAMINATION AND PREPARATION

- A. Verify that piping system has been thoroughly flushed, inspected, and pressure tested. Each valved section of newly laid pipe shall be flushed independently.
- B. Preliminary Flushing: Prior to chlorination the main shall be filled to eliminate air pockets and flushed to remove particulates. The minimum flushing velocity in the main shall be 2.5 feet per second unless the Design Engineer determines that conditions do not permit the required flow to be discharged to waste. The following table gives approximate velocities in gallons per minute to maintain 2.5 ft/s.

Pipe Diameter (in.)	Flow Required in gpm (approx.)
4	100
6	200
8	400
10	600
12	900
16	1600

Note that flushing is not a substitute for maintaining pipe interior cleanliness during construction. Every effort will be made to ensure contaminants do not entire the pipe.

- C. Perform scheduling and disinfecting activity with start-up, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

### 3.2 EXECUTION

- A. Disinfection of all new mains shall be conducted in accordance with AWWA C651-86 Section 5.2 before being placed into service.
- B. Chlorination must take place under the supervision of a Town's Representative.
- C. The Contractor performing the chlorination of the main shall be responsible for any health or environmental damage that might occur as a result of his operations.
- D. A chlorine gas-water mixture shall be applied by means of a solution-fed chlorinating device, or the gas may be fed directly from a chlorine cylinder equipped with proper devices for regulating the rate of flow and the effective diffusion of gas within the pipe. (Chlorination with the gas-water mixture is preferred to direct feed.)

- E. Introduce treatment into piping system. The rate of chlorine gas-water mixture flow shall be in such proportion to the rate of water flowing through the pipe that the treated water entering the newly laid pipe shall have a concentration of residual chlorine of at least 50 milligrams per liter (or ppm).
- F. Solution shall be circulated in the main by opening the control valve and systematically manipulating hydrants and taps at the line extremities.
- G. Samples will be required at various locations using appropriate chlorine test kits to ensure the required dosage of 50 mg/l (or ppm) is obtained.
- H. Maintain disinfectant in system for no less than 24 hours, but longer than 24 hours if so directed by the Town's Engineering Representative.
- I. At the end of the 24 hour period, the treated water in all portions of the main must have a residual of not less than 10 ppm free chlorine or the Town will require that the lines be rechlorinated.
- J. The highly chlorinated water should remain in the line until the residual chlorine drops below 10 ppm, or a minimum of 96 hours, whichever is first. After this period, the remaining water will be wasted by pumping it into the air to dissipate the residual chlorine. Pumping rate shall not exceed 25 gpm. Pressure and nozzle size shall be such as to produce an 8 foot vertical spray. In lieu of spraying, if the line is located near a sewer manhole, chlorinated water maybe pumped into it.
- K. The lines should then be flushed with potable water until only normal chlorine levels are obtained. Chlorine levels must be below 10 ppm and the Town's Engineering Representative must approve it.
- L. Within 24 hours after flushing is complete, the Contractor shall collect samples for bacteriological analysis under direct observation of the Town's Engineering Representative. Sampling shall be taken every 5,000 feet of line and include all dead-end lines. At each site, a minimum of two satisfactory bacteriological samples taken at least 24 hours apart shall be obtained. Also at each site, minimum chlorine residual at time of sampling must be measured and reported. If the membrane filter method of coliform analysis is used, non-coliform growth must also be reported. Contractor is responsible for the delivery of the sample to the Town's Engineering Representative or a testing laboratory certified by the North Carolina Department of Health and Human Services, Division of Public Health, State Laboratory of Public Health, Environmental Sciences Branch. The Contractor shall furnish the Engineer with a copy of the results.
- M. In the event that three successive bacteriological test fail, that section of the main shall be rechlorinated by the Contractor and new tests performed prior to

moving to the next section of the main.

N. Replace permanent system devices removed for disinfection.

O. Pressure test system to 150 psi. Repair leaks and re-test.

### 3.3 FIELD QUALITY CONTROL

A. Test samples in accordance with AWWA C651.

END OF SECTION



## SECTION 02732

## SITE SANITARY SEWERAGE SYSTEM

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Sanitary sewerage drainage piping, fittings, accessories and bedding.
- B. Bored casings.
- C. Service laterals.
- D. Pressure tests.
- E. Infiltration tests.
- F. Deflection tests.

## 1.2 RELATED SECTIONS

- A. Section 02205 - Soil Materials.
- B. Section 02207 - Aggregate Material.
- C. Section 02222 - Excavating.
- D. Section 02223 - Backfilling.
- E. Section 02225 - Trenching.
- F. Section 02229 - Rock Removal.
- G. Section 02231 - Aggregate Base Course.
- H. Section 02607 - Manholes and Covers.

## 1.3 REFERENCES

- A. ANSI/AWWA C104/A21.4 - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

- B. ANSI/AWWA C110/A21.10 - Standard for Ductile-Iron and Gray-Iron Fittings, 3 In.-48 In., for Water.
- C. ANSI/AWWA C111/A21.11: Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- D. ANSI/AWWA C150/A21.50 - Standard for Thickness Design of Ductile-Iron Pipe.
- E. ANSI/AWWA C151/A21.51 - Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
- F. ANSI/AWWA C153/A21.53 - Standard for Ductile-Iron Compact Fittings for Water Service.
- G. ASTM A139 - Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).
- H. ASTM A746 - Ductile Iron Gravity Sewer Pipe.
- I. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- J. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb. Rammer and 18 inch Drop.
- K. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- L. ASTM D1785 - Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- M. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.
- N. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- O. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
- P. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
- Q. ASTM D3034 - Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- R. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using

### Flexible Elastomeric Seals

- S. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- T. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

## 1.4 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

## 1.5 SUBMITTALS

- A. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

## 1.6 PROJECT RECORD DOCUMENTS

- A. Record location of pipe runs, connections, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

## 1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable NCDENR requirements for materials and installation of the Work of this section.

## 1.8 FIELD MEASUREMENTS

- A. Verify that field measurements and elevations are as indicated.

## 1.9 COORDINATION

- A. Coordinate the Work with termination of sanitary sewer connection outside building, connection to municipal sewer utility service, and trenching.

## PART 2 PRODUCTS

## 2.1 GRAVITY SEWER PIPE MATERIALS (8 INCH TO 16 INCH)

- A. Ductile Iron Pipe: Unless noted otherwise on the drawings, the pipe thickness class shall be Class 350 and shall be manufactured in accordance with ANSI/AWWA C151/A21.51. Pipe shall have cement mortar lining and seal coating in accordance with ANSI/AWWA C104/A21.4. Joints for ductile iron pipe shall be mechanical or of the “push-on” type conforming to the requirements of ANSI/AWWA C111/A21.11.
- B. PVC Sewer Pipe - SDR 35: Sewer pipe for gravity flow installations shall be manufactured in accordance with all requirements of ASTM Standard D3034. PVC gravity sewer pipe shall be furnished in nominal laying lengths of 13 feet or 20 feet and installed in accordance with ASTM. PVC sewer pipe (SDR-35) and fittings shall be of PVC material having a cell classification of 12454-B, as defined in ASTM D1784. PVC of other cell classifications will not be accepted. This pipe shall be appropriately marked. The manufacturer of non-pressure PVC Sewer Pipe shall furnish a notarized affidavit certifying as to compliance with the foregoing ASTM Specifications and with the foregoing ASTM Specifications and with the PVC cell classification as specified. Pipe joints shall be of the bell and spigot type and conform to ASTM D3212. Gaskets shall be in accordance with ASTM F477.

## 2.2 SEWER FORCE MAIN PIPE MATERIALS

- A. Ductile Iron Pipe: AWWA C151 with a minimum pressure class of 350. Pipe shall have cement mortar lining in accordance with AWWA C104 and have push on joints in accordance with AWWA C111.
- B. PVC Pipe: Pipe is either AWWA C900 with DR of 18 or thicker or ASTM D2241 with a minimum DR of 26 or thicker. Pipe thickness should be designed in accordance. Joints shall be by elastomeric gasket joints only conforming to ASTM D3139.
- C. Fittings: All fitting shall be ductile iron for pipes four inch and larger. Smaller than four inch pipe shall be solvent weld PVC.
  - 1. Ductile Iron Fittings: Pressure Class 250 mechanical joints in accordance with AWWA C110 or Pressure Class 350 compact fittings in accordance with AWWA C153. Fittings shall have cement mortar lining in accordance with AWWA C104.
  - 2. PVC Fittings: Schedule 80 in accordance with ASTM D2467 with solvent weld joints in accordance with ASTM D2855.
- D. Valves: All valves on force mains to be open left plug or ball valves.

1. Plug valves: Non-lubricated specifically recommended by the manufacturer for use in pressure sewer systems. Stainless steel upper and lower plug stem bearings and nickel valve seats. Port opening of no less than 81% of full pipe area. Valves shall be manufactured by Dezurik Corporation, Milliken Valve Company, Keystone Valve or approved equal. Valves 4 inches and larger will have mechanical joints while smaller valves will have Schedule 80 threaded ends. 2" operating nuts in adjustable valve boxes conforming to ASTM A48. To be Tyler 462A or equal.
2. Thermoplastic ball valves: Used at all service connections. Teflon seats and true union ends. Manufactured by Hayward, Inc. or equal.
3. Thermoplastic ball check valves: Used at all service connections. Elastomeric seats and true union threaded ends. Manufactured by Haywood, Inc. or equal.
4. Sewage Air and Vacuum Valves: Specifically designed for use with sewage. Valve body height shall not be less than 15 inches. Materials shall include cast iron body and cover, bronze float stem and guide, rubber seat and stainless steel float. Valves shall have provisions for backflushing and designed for a working pressure of 150 psi.
5. Sewage Air Release Valves: Specifically designed for use with sewage. Materials shall include cast iron body and cover, rubber seat and stainless steel float stem and internal linkages. Valves shall be sized according to the drawings and designed for a working pressure of 150 psi.
6. Service Boxes and Lids: All service connections and clean outs will be placed in an appropriately sized box. Manufactured by Brooks Products Company (36 Series) or approved equal. Service connection boxes shall be made of green plastic manufactured by Brooks Products Company (Series 1730). Lids shall have "snap locks" and imprinted with the words "{Pressure Sewer" on the lid.

### 2.3 BORED CASINGS

- A. Steel Encasement pipe shall be welded or seamless, consisting of grade "B" steel with a minimum yield strength of 35,000 psi and manufactured in accordance with ASTM A139. The pipe thickness shall be as specified on the North Carolina Department of Transportation encroachment agreement and/or approved plans, and the ends shall be beveled and prepared for field welding of the circumferential joints.
- B. Metal fabricated "spiders" shall be used for support of the carrier pipe within the bored casing.

### 2.4 SERVICE LATERAL MATERIALS

- A. PVC Service Pipe & Fittings: PVC pipe and fittings for sewer laterals shall conform to ASTM D2665 "PVC" Plastic Drain, Waste & Vent Piping and shall be Schedule 40 and NSF approved except for laterals or sections of laterals with less than 12 inches of cover. Ductile Iron Pipe shall be used if cover is less than 12". Laying lengths may be 10 or 20 feet. Joints shall be of the solvent weld type.
- B. Service Saddles on DIP Sewers: Service saddles for connection of laterals to DIP sewers shall be cast iron, 45-degree deflection, equipped with a single stainless steel clamp. The saddle shall be furnished with adapters as required to properly receive the service pipe to be used.
- C. Saddles for PVC Sewer Pipe: Saddles for PVC sewer pipe shall be of PVC material, 45 degree deflection, conforming to the requirements of ASTM D3034. The saddle shall be equipped with two (2) stainless steel clamps and all adapters as required to properly receive the service pipe to be used. The saddle service branch shall stub slightly into the sewer main so that when installed, the saddle shall not slip or rotate

## 2.5 BEDDING MATERIALS

- A. Soils Classification for Bedding and Backfill of sewer pipe: Soils for pipe bedding and backfill shall be classified as ML (low plasticity silt) or better by the Unified Soil Classification System (USCS). For purposes of these specifications, soils are grouped into the following five categories:
  1. Class I Soil: Angular, 6 to 40 mm (1/4 to 1 1/2 in.), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
  2. Class II Soil: Course sands and gravels with maximum particle size of 40 mm (1 1/2 in.), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW, and SP are included in this class.
  3. Class III Soil: Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM, and SC are included in this class.
  4. Class IV Soil: Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH, and CL are included in this class.
  5. Class V Soil: Include the organic soils - types OL, OH, and PT, as well as soils containing frozen earth, debris, rocks larger than 1 1/2" diameter, and other foreign materials.

Classes I, II, III and Class IV ML are suitable for bedding, haunching, and backfill of PVC sewer pipes. All fill material shall have a plasticity index of less than 20 and

a Standard Proctor at optimum moisture of greater than 90 lbs per cubic foot. The remaining Class IV Soils (CL, MH, CH) and all Class V soils may be used as backfill.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that trench cut excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

### 3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.
- B. Remove large stones or other hard matter that could damage pipe or impede consistent backfilling or compaction.
- C. The unloading and loading of all pipe, fittings, and other accessories shall be in accordance with the manufacturer's recommended practices and shall at all times be performed with care to avoid any damage to the material. Once on the job site, all materials shall be stored in accordance with the manufacturer's recommended practices, and within the limits of the Project site.

### 3.3 BEDDING

- A. Pipe Bedding Classes Definition: For these specifications, pipe bedding classes shall be those classes as defined below:
  - 1. Class "D" Bedding: That condition existing when the ditch is excavated slightly above grade and cut to finish grade by hand. Bell holes are dug, and the pipe bears uniformly upon the trench bottom. Soil is tamped to 90% of maximum Proctor Density (ASTM D1557) around the pipe and to a point one foot above the pipe; the remainder of the soil to ground surface is compacted to specified density.
  - 2. Class "C" Bedding: That condition existing when the trench bottom is undercut a minimum of 4 inches below the pipe bell and filled to pipe grade with No. 67 stone in such a manner that the pipe will be bedded in stone to a vertical height of one-sixth the outside diameter of the pipe barrel. The remainder of the soil to ground surface is compacted to specified density.
  - 3. Class "B" Bedding: That condition existing when the trench bottom is undercut a minimum of 4 inches and No. 67 stone is placed in the trench

in such a manner that the pipe is bedded to the pipe spring line in stone. Soil of a granular nature is placed to the top of the pipe and compacted to 90% of maximum Proctor Density (ASTM D1557). Soil is then compacted to specified density to ground surface.

4. Class "A" Bedding: That condition existing when the trench bottom is undercut a minimum of 4 inches and the pipe bedded in No. 67 stone to the spring line. The top half of the pipe is then covered with a monolithic arch or reinforced, 2,000 psi concrete, extending to a point at least 4 inches above top of pipe barrel. Backfill is compacted to a specified density to ground surface.
- B. Pipe Bedding Requirements: The trench bedding for ductile iron pipe material shall be Class "D". The trench bedding for PVC SDR-21 pipe materials shall be Class "B", i.e. No. 67 Stone from 4 inches beneath pipe and thinner to the springline. All other bedding types must be approved by the Town's Engineering Representative prior to construction.
  - C. Excavate pipe trench in accordance with Section 02225 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
  - D. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth, compact to 95 percent.
  - E. Maintain optimum moisture content of bedding material to attain required compaction density.

#### 3.4 INSTALLATION - GRAVITY PIPE

- A. Install pipe, fittings, and accessories in accordance with ASTM D2321 and manufacturer's instructions. Seal joints watertight.
- B. Lay pipe to slope gradients noted on drawings unless the Town and the Design Engineer approve deviation.
- C. The Contractor shall use laser equipment for maintaining proper alignment.
- D. Installation shall begin at the down stream end of a sewer segment and progress upstream.
- E. Install bedding in accordance to detail drawings. Drawing should comply with one on the "Bedding Classes" previously listed.
- F. Refer to Section 02225 for trenching requirements. Do not displace or damage pipe when compacting.



- G. Install gravity sewer pipe and service laterals so as to have a full and uniform load bearing throughout its entire length.
- H. Pipe shall be carefully handled and in no case shall pipe be dumped or dropped into the trench. Any damaged pipe shall be rejected and replaced.
- I. The pipe interior shall be kept clean throughout the pipe laying operation. Pipe ends shall be plugged at the end of each workday. Plugs shall be watertight to prevent the entrance of foreign matter into the pipe.
- J. Where a sewer line crosses an existing or proposed water line or water service line, the sewer shall always be installed beneath the water line, with a minimum separation of 18 inches between the outside diameters of the two pipes. The Contractor shall locate the conflicting water main or service sufficiently far in advance to ensure that the sewer can be laid at the proper gradient and meet the 18 inch separation requirement. If this separation cannot be attained, then both the water line and the sewer line shall be constructed of ductile iron pipe, with joints equivalent to water main standards, for a distance of not less than 10 feet on each side of the crossing.
- K. Refer to Section 02607 for manhole requirements.

### 3.5 INSTALLATION - FORCE MAINS

- A. All pipe shall be laid in accordance to manufacturers requirements.
- B. Keep all pipe clean and free of dirt.
- C. In trenches with rock or water, place a washed stone bedding from four inches below pipe to springline. For all other trenches hand shape trench bottom to evenly distribute the load.
- D. All bends, tees, and plugs shall be blocked with 3000 psi concrete in accordance with plans.
- E. All PVC force mains will require utility line marking tape with the word "SEWER" on it.

### 3.6 BACKFILLING

- A. Backfilling shall be completed as soon as possible, so as to minimize the length of time that the trench, or any part thereof, is left open. Material classification for backfill materials as may be noted hereinafter shall conform to the allowable soil classifications as defined in Section 2.2 hereof.

- B. Backfilling - Ductile Iron Pipe: Backfill with suitable native materials. The initial backfill, to a point 12 inches above top of the pipe, shall be placed in shallow, 6 inch layers, individually compacted. See last paragraph of this section for the final backfill requirements.
- C. Backfilling - PVC Sewer Pipe - SDR 35: Backfill shall be Class I, Class II, Class III, or Class IV ML soils placed in 6-inch layers to a point 12 inches above the top of the pipe. All soils must have a plasticity index of less than 20 and a Standard Proctor at optimum moisture of greater than 90 pounds per cubic foot. The initial backfill placed directly over the top of the pipe should receive very little tamping to avoid disturbing the embedded pipe. This initial backfill zone shall extend to a point 12 inches above the top of the pipe. If there is a question as to soils classification, the Contractor shall have representative samples of the soil(s) classified by an approved testing laboratory to ensure that unapproved materials have been excluded from the initial backfill zone. See last paragraph of this section for final backfill requirements.
- D. Final Backfill - All Pipe: Final backfill shall be suitable native material, placed and compacted in layers not to exceed 12 inches. No rocks, boulders, or stones shall be included in the backfill material for at least two (2) feet above the top of the pipe. In traffic areas the final backfill shall be placed and compacted in 6 inch layers. Backfill shall be of such density as to ensure no settlement of the trench. Should any sewer trench exhibit settlement, the Contractor shall correct the deficiency to the complete satisfaction of the Town. Where the sewer pipe is placed in public roads the backfill shall be compacted to at least 95% standard density as measured by AASTHO Method T-99. Where deemed necessary, the Town may require compaction tests on backfill placed under State roads or other public roads. The cost for such tests shall be borne by the Contractor or Developer.

### 3.7 INSTALLATION - SEWER SERVICE LATERALS

- A. Connection to the sewer main shall be made by means of a special saddle and 1/8 bend as previously specified and shown on the detail and specifically designed to fit the sewer pipe selected. The inlet connection shall include any required adapters to accommodate the selected service pipe material.
- B. The saddle shall be installed in strict accordance with the manufacturer's recommendations and shall be properly bedded and backfilled so as to prevent slippage or rotation on the sewer main.
- C. The service lateral shall terminate with a combination wye and 1/8 bend. A vertical riser shall extend and project slightly above grade (6 inches nominal).

The riser shall terminate with a removable plug.

- D. All specifications previously presented relative to bedding and backfill shall apply. Four-inch service pipe shall be laid on a gradient of not less than 1/8 inch per foot. Minimum gradient for 6-inch pipe shall be 0.6 percent.
- E. Where service laterals connect to a manhole, an invert shall be constructed wherever possible to provide a smooth flow line.
- F. Where the drop is 30 inches or greater, a service drop connection with cleanout shall be provided in accordance with the standard detail.

### 3.8 INSTALLATION - STEEL CASING PIPES BY BORING AND JACKING

- A. Steel casing pipe to be installed by simultaneous boring and jacking shall be constructed to the required standards of the NCDOT as applicable. Approval for crossing DOT road shall be obtained prior to construction.
- B. For railroad crossings, the construction requirements shall conform to the requirements of the affected railway company. Approval for crossing railroad shall be obtained prior to construction.
- C. The project drawings shall show a plan and profile for each casing pipe to be installed.
- D. The plan shall clearly note the casing pipe wall thickness and length.
- E. For railroad crossings, the Contractor shall be certain that a proper license agreement has been obtained and that any special insurance requirements are complied with.

### 3.9 CUTTING AND AND REPLACING EXISTING PAVEMENT

- A. Open-cut of existing bituminous pavement may be permitted on Town streets and/or designated State maintained roads. Where bituminous pavements are open-cut, the pavement shall be restored with pavement replacement conforming to the detail shown on the approved drawings.
- B. Prior to open cutting of the roadway, approval by the Town and/or NCDOT must be obtained in writing.
- C. Open-cut of concrete pavement may also be permitted where required at existing private driveways.

- D. Concrete pavement shall be restored with pavement replacement conforming to the standard detail and to the complete satisfaction of the affected property owner.
- E. The pavement shall be cut to true neat lines, with cutting equipment as may be approved by the Town's Engineering Representative, and in such a manner as not to damage the pavement outside the cutting line. The cut pavement shall be broken up as necessary and removed from site before trench excavation is begun to prevent its being mixed with the excavated material to be used for backfill. The edge of the pavement cut shall be at least 12 inches beyond the edge of the trench line.
- F. Specifications previously presented relative to excavation, bedding, and backfilling shall apply with special care taken to ensure that backfill material is of select quality, and is placed and compacted in shallow 6-inch lifts.
- G. After completion of the trenching and pipe laying operations, the backfill shall be brought to the required subgrade depth, from which point the remaining depth (8" - 12") shall be backfilled with Aggregate Base Course (A1), compacted in two lifts. The base course shall remain for a minimum of four (4) days prior to placement of paving, so as to allow for further natural settlement that may result from normal traffic.
- H. When final settlement is obtained, a portion of the ABC shall be removed as required to accommodate the final pavement section.
- I. All materials and pavement placement methods shall be in a strict accordance with the requirement of the NC DOT - Standard Specifications for Roads & Structures, latest edition.
- J. Black base - type HB shall be used in lieu of ABC, if required by the NC DOT.

### 3.10 FIELD QUALITY CONTROL

- A. Contractor to request Town's inspection prior to and immediately after placing bedding.
- B. Compaction testing will be performed in accordance with ASTM D1557.
- C. Visual Inspection of Pipeline Interior: upon completion of any designated portion of the sewer line, the Design Engineer and Town, in the presence of the Contractor, shall conduct a visual inspection of the pipeline interior. The test shall be conducted by flashing a light between manholes, by use of mirrors, or by

such other devices as will allow an adequate inspection of the line to detect misalignment or structural defects. Any portion of the line which does not exhibit a true alignment and uniform grade, or which shows any defect, shall be corrected to the complete satisfaction of the Design Engineer and the Town.

- D. The Town may re-inspect the line at any time prior to final acceptance if any damage or displacement is suspected to have occurred subsequent to the initial inspection.
- E. Pressure Test - Gravity Sewer: Portions of the sewer lines that do not exhibit a ground water problem shall be subjected to a low pressure air test. The portions of the line to be so tested shall be determined by the Design Engineer and/or the Town’s Engineering Representative.
  - 1. Prior to testing, the sewer line shall be clear of debris and flushed with water as necessary. The line shall be plugged and the plugs shall be securely braced to prevent slippage.
  - 2. Pressurize the line with air to 5 psi and allowed to stabilize for a period of two (2) minutes.
  - 3. To simplify the ASTM procedure, the following table shall be used to determine the test time. If there are multiple sizes, add the various times together.

Normal Pipe Size (inches)	Time (t) - Minutes/100 ft.
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0
42	7.3

- 4. If the pressure stays at 5 psi for the required test time length as noted above, the pipe is acceptable.
- 5. Should the section of pipe being tested fail to meet these requirements, the source of leakage shall be determined and repaired. The section shall

then be retested until it is deemed to be acceptable.

6. The Contractor shall furnish all plugs, compressors, hose, gauges, etc., as required to conduct the low pressure air test.

F. Hydrostatic Test - Force Mains:

1. General: Furnish all materials, labor, equipment, and laboratory testing. Notify Town 48 hours prior to performing any tests.
2. Hydrostatic Test: Provide pressure gauge calibrated in increments of 10 psi or less. Fill section of line to be test slowly with water. Measure leakage with accurate meter. Leakage acceptable if less than limits below.

Pipe Size (inches)	Allowable Leakage (gal/hr/1000 feet of pipe)
2"	0.21
3"	0.32
4"	0.42
6"	0.64
8"	0.85
12"	1.27

G. Infiltration Test - Gravity Sewer: Portions of the sewer lines installed in areas with a higher ground water table be tested for infiltration. The portions of the line to be infiltration tested shall be determined by the Design Engineer and/or the Town's Engineering Representative.

1. Install a V-notch weir or other suitable measuring device in the downstream end of the pipe to be tested.
2. When a steady flow occurs over the weir, the rate of flow (infiltration) shall be measured.
3. The rate measured shall not exceed 100 gallons per 24 hours per inch of sewer pipe diameter per mile of pipe.
4. The Contractor shall furnish weirs and other equipment required for infiltration tests.
5. The tests shall be performed in the presence of the Design Engineer and the Town.

H. Deflection Testing of PVC Gravity Sewer Pipe: A deflection test shall be conducted on all PVC pipe.

1. Pipes shall be mandreled with a rigid device sized to ensure that the final long term deflection or deformation of the pipe barrel has not exceeded five percent for PVC sewer pipes.
2. The mandrel (Go/No-Go) device shall be cylindrical in shape and constructed with nine or ten evenly spaced arms or prongs. Mandrels

- with fewer arms will be rejected as not sufficiently accurate.
3. The outside diameter of the 9-arm mandrel shall be as shown below for 8-inch PVC Pipe. The mandrel diameter shall have a tolerance of + or - 0.01". Contact length shall not be less than 2 inches.

MANDREL DIMENSIONS

<u>Main Size</u>	<u>Mandrel Diameter</u>
8"	7.28"
10"	9.08"
12"	10.79"
15"	13.20"

4. The contact length of the mandrel shall be at least 2 inches.
5. Allowances for pipe wall thickness tolerances or ovality shall not be deducted from the Mandrel diameter but shall be counted in as a part of the deflection allowance.
6. The mandrel shall be hand pulled by the Contractor through all PVC sewer lines.
7. Any sections of sewer not passing the mandrel shall be uncovered and the Contractor shall reround or replace the sewer to the satisfaction of the Design Engineer and the Town. These repaired sections shall be retested.

I.If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner or Town.

3.11 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

## SECTION 02733

## SEWAGE SUBMERSIBLE PUMPING STATION

## PART 1 GENERAL

## 1.1 REQUIREMENTS:

Furnish and install submersible non-clog sewage pumps. Each pump shall be equipped as shown in the details of the project. The power cable shall be sized according to NEC and ICEA standards and have P-MSHA Approval. Each pump shall be fitted with 20 feet of stainless steel lifting chain. The working load of the lifting system shall be 50% greater than the pump unit weight.

## PART 2 MATERIALS

## 2.1 PUMP DESIGN

The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. No portion of the pump shall bear directly on the sump floor.

## 2.2 PUMP CONSTRUCTION

Major pump components shall be of grey cast iron, ASTM A-48, Class 30, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel, shall be protected by a factory applied spray coating of alkyd primer with a chlorinated rubber paint finish on the exterior of the pump.

Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.

Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

## 2.3 COOLING SYSTEM



Motors are sufficiently cooled by the surrounding environment or pumped media. A water jacket is not required.

#### 2.4 CABLE ENTRY SEAL

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a terminal board, which shall isolate the interior from foreign material gaining access through the pump top.

#### 2.5 MOTOR

The pump motor shall be induction type with a squirrel-cage rotor, shell type design, housed in an air-filled, watertight chamber, NEMA B type. The stator windings and stator leads shall be insulated with moisture resistant Class F insulation rated for 155°C (311°F). The stator shall be dipped and baked three times in Class F varnish and shall be heat-shrink fitted into the stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board, shall be hermetically sealed from the motor by an elastomer o-ring seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. Wire nuts or crimping type connection devices are not acceptable. The motor and pump shall be designed and assembled by the same manufacturer.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of

the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

## 2.6 BEARINGS

The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

## 2.7 MECHANICAL SEAL

Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in an oil reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the oil chamber, shall contain one stationary and one positively driven rotating tungsten-carbide ring. The upper, secondary seal unit, located between the oil chamber and the motor housing, shall contain one stationary tungsten-carbide seal ring and one positively driven rotating carbon seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.

The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. Cartridge type systems will not be acceptable. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to prevent overfilling and to provide oil expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

## 2.8 PUMP SHAFT

Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be AISI type 420 stainless steel.

If a shaft material of lower quality than 420 stainless steel is used, a shaft sleeve of 420 stainless steel is used to protect the shaft material. However, shaft sleeves only protect the shaft around

the lower mechanical seal. No protection is provided in the oil housing and above. Therefore, the use of stainless steel sleeves will not be considered equal to stainless steel shafts.

## 2.9 IMPELLER

The impeller(s) shall be of gray cast iron, Class 30, and shall be dynamically balanced. The impeller(s) shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater. Mass moment of inertia calculations shall be provided by the pump manufacturer upon request. Impeller(s) shall be keyed to the shaft, retained with an allen head bolt and shall be capable of passing a minimum 3 inch diameter solid. All impellers shall be coated with alkyd resin primer.

## 2.10 VOLUTE

Pump volute(s) shall be single-piece grey cast iron, Class 30, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

## PART 3 EXECUTION

### 3.1 PROTECTION

All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 125°C (260°F) the thermal switches shall open, stop the motor and activate an alarm.

A leakage sensor shall be installed to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and send an alarm both local and/or remote. USE OF VOLTAGE SENSITIVE SOLID STATE SENSORS AND TRIP TEMPERATURE ABOVE 125°C (260°F) SHALL NOT BE ALLOWED.

### 3.2 PUMP STATION TESTING

- A. Watertightness Testing
  1. Wet wells and other wastewater-containing structures at the pump station shall be inspected and tested for watertightness.
  2. The watertightness test for the wet well and other wastewater-containing structures at the pump station shall be completed separately and independently of the leakage test performed on the force main.
  3. The watertightness test shall be performed in the presence of the Owner, the PE, or other authorized representative.

- B. Procedure:
1. Unless the pump station wet well is constructed of cast-in-place concrete, testing shall not commence until the structure being tested has been fully assembled and backfilling complete.
  2. All inlets and outlets shall be temporarily plugged and braced.
  3. Fill wet well with water. Ensure plugs remain watertight and there are no obvious leaks.
  4. Leave wet well full for a minimum of three days prior to starting the test.
  5. Measure the location of the water surface at four points 90 degrees apart and cover the wet well.
  6. Record location of water surface at 24 hour periods.
  7. Duration of the test will continue for a period of time sufficient to produce at least a one-half inch drop in the water surface over at the maximum allowed leakage rate. The maximum allowed leakage rate for unlined structures with a maximum depth of 25 feet is 0.1% per day. Confer with engineer for lined and deeper wet wells. Use the following formula to compute the length of test (in days):
 
$$\frac{0.5 \text{ in.}}{0.001 \text{ in./in./day} * \text{depth (ft)} * 12 \text{ in./ft.}}$$
  8. Record measurements at the end of the test period. Wet wells that fail the test requirements shall be inspected, made watertight, and retested until the test is passed.
  9. The results of all watertightness testing shall be maintained by the Owner as part of the construction record documentation.

### 3.3 PUMP TESTING

- A. Factory Testing
1. All pumps shall be tested by the manufacturer in accordance with the appropriate HI standard prior to shipment for installation.
  2. The results of all factory testing shall be maintained by the Owner as part of the construction record documentation.
- B. Drawdown Testing
1. Following installation, each pump in the pump station shall be subjected to a drawdown test or other similar testing procedure to confirm that the pump is operating at or near the required design operating point(s).
  2. The drawdown test shall be performed in the presence of the Owner, the PE, or other authorized representative.
  3. The results of all drawdown testing shall be maintained by the Owner as part of the construction record documentation.

END OF SECTION

## SECTION 02734

## DUPLEX CONTROL PANEL SPECIFICATION

## PART 1 GENERAL

## 1.1 REQUIREMENTS

Electrical systems for pump stations shall be designed and installed in strict conformance with NFPA 70 "National Electric Code," ANSI, as well as all applicable federal, state, and local codes. Enclosures for electrical and control components for the pump station shall be located outside of the wet well and in a location such that they are readily accessible, ensure maximum electrical and personnel safety, and are protected from damage due to vehicular traffic and flooding. The main power feed to all pump stations shall be equipped with an above-grade, fused disconnect switch.

## PART 2 MATERIALS

## 2.1 Panel Enclosure:

Provide a NEMA 4X enclosure constructed of painted steel with deadfront-type cover and padlocked. Provide removable back panel of 12 gauge steel, attached to enclosure on collar studs and of adequate size to accommodate all basic and optional components. Mount components to back panel securely utilizing screws and lockwashers. Tap panel to accept mounting screws. Do not use any self-tapping screws. Paint back panel to be with two coats of white epoxy enamel. Provide engraved nameplates on door mounted hardware.

## 2.2 Motor starters:

Provide for each motor a NEMA rated magnetic motor starter as manufactured by Square D or equal. Equip with undervoltage release and overload protection on all three phases. Furnish motor starter contacts which can be easily replaced without removing the motor's starter from its mounted position. Use manual reset overload relays and do not provide means for converting to automatic reset.

## 2.3 Components:

Provide "Hands-Off-Auto" switches for each motor. Provide UL rated, heavy duty, 600 VAC, oil-tight switches. "Hand" position not to override motor overload shutdown. Provide the following components with the panel:

- A. Pilot run light for each motor.
- B. Lockable enclosure.

- C. Pump run timer for each pump.
- D. Condensation heater.
- E. Phase protection.
- F. High level alarm indication light.
- G. Alarm horn silence.
- H. GFI 20A duplex receptacle with stainless steel cover.
- I. Control relays.
- J. Remote alarm terminals.
- K. "Seal failure" indicator lamp.
- L. "High temperature" indicator lamp.

#### 2.4 Pump alternator relay:

Provide relay of electronic design with three position toggle switch to override automatic and provide manual selection of either Pump No. 1 or No. 2 as the "LEAD" pump.

#### 2.5 High temperature shutdown:

Provide high temperature shutdown for each motor utilizing the temperature switches embedded in the motor windings. Under high temperature conditions switch shall open, de-energizing the motor starter and stopping the pump motor.

#### 2.6 Moisture detector control:

Provide for each pump a moisture sensor which will detect moisture in the stator chamber. Detection of moisture by the sensor shall disrupt the motor starting circuit of the pump involved. Motor shall remain inoperative until problem is corrected and the control circuit is manually reset. Provide the following components and mount on the back plate:

- A. Provide a 115V control circuit transformer (open core and coil type) with primary fuses and secondary circuit breaker for control.
- B. Provide power terminals and control terminals.

2.7 Design control sequence so that panel is functioning automatically again after a power failure and manual reset is not necessary.

2.8 Provide a terminal board for connection of line, pump leads and level sensors.

2.9 Provide elapsed time meter wired to each motor starter, six digit, non-resettable, to indicate total running time in hours and tenths.

2.10 Provide high water alarm activated by mercury float switch.

- A. Include front panel mounted silence switch.

- B. Provide 115 volt AC, 40 watt, vapor tight, alarm light with red globe, guard and mounting hardware.
  - 1. Mount on side of panel.
- C. Provide 115 volt AC, single projection, vibrating type horn with weatherproof housing, including mounting lugs and conduit tap.
- D. Horn and light to operate simultaneously under alarm conditions.
- E. Horn and light to be on at high level.

2.11 Relays:

- A. Provide plug in type.
- B. Provide Idec, Allen Bradley, Potter and Brunefield, Diversified Electronics, or Square D relays and sockets.
- C. Provide silver cadmium oxide contacts.

2.12 Electrical Schematic:

- A. Provide a laminated electrical schematic diagram of the pump controls including terminal board connections.
- B. Permanently mount on the inside of the enclosure door.

2.13 All attachment screws are to be stainless steel.

2.14 Manufacturer:

- A. All control components, starters, relays, contacts, etc. shall be manufactured in the United States.

2.15 Wiring:

- A. Unit to be completely factory wired except for power supply, motor connections and mercury float switches.
  - 1. Company with applicable standards of National Electric Code.
  - 2. Color code and number as indicated on factory wiring diagram.
  - 3. Control wire to be MTW 900C #14 AWG.
- B. Electrically ground all components to a common ground screw mounted on the removable back panel.
- C. Neatly group all wiring in plastic wire troughs except wiring from the backplate shall be done in separate bundled harnesses for control circuits.
- D. The panel shall bear a UL508 label.

2.16 Level control and motor power cable: Provide cable of adequate length to terminate in

control panel without splicing.

2.17 General:

- A. The control panel shall be furnished by the pump supplier.

END OF SECTION



## SECTION 02923

## LANDSCAPE GRADING

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Final grade topsoil for finish landscaping.

## 1.2 RELATED SECTIONS

- A. Section 02205 - Soil Materials.
- B. Section 02211 - Rough Grading.
- C. Section 02223 - Backfilling.
- D. Section 02225 - Trenching.
- E. Section 02936 - Seeding.

## PART 2 PRODUCTS

## 2.1 MATERIAL

- A. Topsoil: Fill Type S3, S4 or S5 as specified in Section 02205.

## PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Verify building and trench backfilling have been inspected.
- B. Verify substrate base has been contoured and compacted.

## 3.2 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, stones, in excess of 1 inch in size. Remove subsoil contaminated with petroleum products.
- C. Scarify surface to depth of 3 inches where topsoil is scheduled. Scarify in areas

where equipment used for hauling and spreading topsoil has compacted subsoil.

### 3.3 PLACING TOPSOIL

- A. Place topsoil in areas where seeding is required. Place topsoil during dry weather.
- B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
- C. Remove roots, weeds, rocks, and foreign material while spreading.
- D. Manually spread topsoil close to plant life, buildings, and other structures to prevent damage.
- E. Lightly compact placed topsoil.
- F. Remove surplus subsoil and topsoil from site.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping.

### 3.4 TOLERANCES

- A. Top of Topsoil: Plus or minus 1/2 inch.

### 3.5 PROTECTION

- A. Protect landscaping and other features remaining as final work.
- B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

END OF SECTION

## SECTION 02936

## SEEDING

## PART 1 GENERAL

## 1.1 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Placing topsoil.
- C. Seeding, Hydroseeding, mulching and fertilizer.
- D. Maintenance.

## 1.2 RELATED SECTIONS

- A. Section 02205 - Soil Materials: Topsoil material.
- B. Section 02223 - Backfilling: Rough grading of site.
- C. Section 02225 - Trenching: Rough grading over cut.

## 1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Grassed Areas:
  - 1. Basis of Measurement: By the acre.
  - 2. Basis of Payment: Includes preparation of topsoil, and seeding, and maintenance until full growth achieved.

## 1.4 REFERENCES

- A. FS O-F-241 - Fertilizers, Mixed, Commercial.

## 1.5 DEFINITIONS

- A. Weeds: Include Dandelion, Jimsonweed, Quack grass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambs quarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

## 1.6 MAINTENANCE DATA

- A. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

## 1.7 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

## 1.8 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and] herbicide composition.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- B. Deliver fertilized in waterproof bags showing weight, chemical analysis, and name of manufacturer.

## 1.10 COORDINATION

- A. Coordinate with installation of underground sprinkler system piping and watering heads.

## 1.11 MAINTENANCE SERVICE

- A. Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition cuttings.

## PART 2 PRODUCTS

### 2.1 SEED REQUIREMENTS

- A. Tall Fescue: 200 lbs/acre.
- B. Kentucky Blue Grass: 20 lbs/acre.
- C. Rye: 40 lbs/acre.

### 2.2 SOIL MATERIALS

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- A. Topsoil: Excavated from site and free of weeds.

### 2.3 ACCESSORIES

- A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable. Use 400 lbs/acre.
- B. Fertilizer: Recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil. Use 1200 lbs/acre.
- C. Lime: Use 4000 lbs/acre.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this Section.

### 3.2 PREPARATION OF SUBSOIL

- A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.
- C. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

### 3.3 PLACING TOPSOIL

- A. Spread topsoil to a minimum depth of 8 inches over area to be seeded. Rake until smooth.
- B. Place topsoil during dry weather and on dry unfrozen subgrade.
- C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.
- D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive

drainage.

- E. Install edging at periphery of seeded areas in straight lines to consistent depth.

### 3.4 FERTILIZING

- A. Apply fertilizer at a rate of 4000 lbs/acre.
- B. Apply after smooth raking of topsoil and prior to roller compaction.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

### 3.5 SEEDING

- A. Apply seed, at the rates identified in Part 2.2 of this section, in two intersecting directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- D. Roll seeded area with roller not exceeding 112 lbs.
- E. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.
- F. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

### 3.6 HYDROSEEDING

- A. Apply seeded slurry with a hydraulic seeder at a rate to be approved by Engineer evenly in two intersecting directions.
- B. Do not hydroseed area in excess of that which can be mulched on same day.
- C. Immediately following seeding, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.

- D. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

### 3.7 SEED PROTECTION

- A. Identify seeded areas with stakes and string around area periphery. Set string height to 6 inches.
- B. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.
- C. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Provide 12 inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.
- D. Secure outside edges and overlaps at 36 inch intervals with stakes.
- E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- F. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

### 3.8 MAINTENANCE

- A. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.
- B. Neatly trim edges and hand clip where necessary.
- C. Immediately remove clippings after mowing and trimming.
- D. Water to prevent grass and soil from drying out.
- E. Roll surface to remove minor depressions or irregularities.
- F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- G. Immediately reseed areas which show bare spots.
- H. Protect seeded areas with warning signs during maintenance period.

END OF SECTION

*Apendix B: 20-Year Project Monetary Needs*





*Apendix C: Sewer System Leakage Map*