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ENGINEERING INTEGRATION

October 13, 2016

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OCT 14 2016

TN DEPT. OF ENVIRONMENT  
AND CONSERVATION  
DIVISION OF WATER RESOURCES

Mr. Mahendra Upadhyaya  
Tennessee Department of Environment & Conservation  
Division of Water Resources  
William R. Snodgrass Tennessee Tower  
312 Rosa Parks Avenue, 11<sup>th</sup> Floor  
Nashville, TN 37243

**RE: SANITARY SEWER COLLECTION SYSTEM  
THE VILLAGES AT WHITE OAKS P.D., PHASE 1B  
ARLINGTON, TENNESSEE**

# 780 91 / 25  
# 1055 / 200

Dear Mahendra:

Enclosed please find four (4) sets of signed construction plans for Phase 1B, The Villages at White Oak Planned Development in Arlington, Tennessee, along with specifications, sanitary sewer calculations and a check in the amount of \$225.00 for the required processing fee. This project includes the installation of 2,185 linear feet of 8" public, gravity sanitary sewer collection line. This collection system will be owned and maintained by the Town of Arlington.

Please let me know if you need any additional information. Thank you.

Sincerely,

**Fisher Arnold**

**Michael Rogers, PE, RLS, LEED AP BD+C, CPESC**

UPN10-0860

Attachments

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Memphis, TN 38125

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The Villages at White Oaks Phase 1B  
Sanitary Sewer Calculations

October 12, 2016

Upstream Structure			Downstream Structure			# Equiv	Qd (cfs)	Qc (cfs)	Vel (ft/s)	
Code	Invert	Code	Invert	Size (Inches)	Length (LF)					Slope (%)
STUB 1A (N)	352.17	SMH #1A	351.60	8	114	0.50%	35	0.06	1.11	3.19
STUB 1A (E)	352.10	SMH #1A	351.60	8	100	0.50%	28	0.05	1.11	3.19
SMH #1A	351.50	SMH #1	350.23	8	255	0.50%	68	0.12	1.11	3.18
SMH #1	350.12	SMH #2	349.32	8	161	0.50%	70	0.13	1.11	3.18
SMH #2	349.22	SMH #3	348.57	8	130	0.50%	72	0.13	1.11	3.19
SMH #3	348.47	SMH #10	347.95	8	105	0.50%	75	0.14	1.11	3.18
SMH #10	347.85	SMH #11	346.75	8	219	0.50%	78	0.14	1.12	3.20
SMH #11	343.43	EXISTING SMH #2	342.88	8	110	0.50%	79	0.14	1.11	3.19
SMH #5	359.50	SMH #6	358.20	8	129	1.01%	4	0.01	1.58	4.53
SMH #6	358.10	SMH #7	355.85	8	219	1.03%	6	0.01	1.60	4.57
SMH #4	366.00	SMH #7	355.85	8	251	4.04%	6	0.01	3.17	9.07
SMH #7	355.75	SMH #8	353.20	8	170	1.50%	12	0.02	1.93	5.53
SMH #8	353.10	SMH #9	351.41	8	112	1.51%	14	0.03	1.93	5.54
SMH #9	345.55	EXISTING SMH #1	345.00	8	110	0.50%	15	0.03	1.11	3.19
Total L.F.						2,185				

**SECTION 02722  
SEWERAGE SYSTEMS**

**PART 1 - GENERAL**

**1.01 WORK INCLUDED**

- A. Installation of sanitary sewerage system.

**1.02 RELATED WORK**

- A. Section 02221: Trenching, Backfilling and Compaction
- B. Section 02605: Separation of Piped Utilities

**PART 2 - PRODUCTS**

**2.01 DUCTILE IRON PIPE AND FITTINGS**

**A. Pipe:**

1. Manufactured in accordance with ANSI A-21.50 (AWWA C- 151) and ANSI A-21.10 (AWWA C-110).
2. A cement lining meeting the requirements of ANSI 21.4 (AWWA C-104).
3. A minimum of 1 mil thick bituminous coating on the outside surface.
4. Clearly mark with manufacturer's name, D.I. or Ductile, weight, class or nominal thickness, and casting period.
5. Unless otherwise specified or shown on the plans, ductile iron pipe shall be Class 350 for 200 psi working pressure.
6. Ductile iron pipe shall be used in all diameters.

**B. Fittings:**

1. Fittings 4"-24": Pressure rated at 350 psi.
2. Fittings 30"-36": Pressure rated at 250 psi.
3. Joints meeting the requirements of ANSI A-21.11 (AWWA C-111).

**2.02 POLYVINYL CHLORIDE PIPE AND FITTINGS**

- A. Manufactured from virgin, National Sanitation Foundation (NSF) approved resin conforming to ASTM D-1784.
- B. Unless otherwise specified, all PVC pipe and fittings shall conform to ASTM D-3034 and have a Standard Dimension Ratio (SDR) of 26.
- C. The gaskets used for joining PVC sewer pipe shall conform to ASTM F-477.

- D. All PVC gravity sewer pipe shall be clearly marked with the manufacturer's name, nominal diameter, SDR, ASTM D- 3034, and NSF approval seal.
- E. PVC pipe shall be used only up to 18" unless otherwise shown on the plans or directed by the Engineer.

#### 2.03 CONCRETE MATERIALS

- A. Class A in all cases with a minimum strength of 4,000 psi.

#### 2.04 CASTINGS FOR FRAME AND COVERS

- A. Gray iron, Class 30 unless otherwise specified, meeting AASHTO M-108.
- B. Cleaned and coated with bituminous paint that will produce an acceptable finish that is not affected by exposure to hot or cold weather.
- C. Rings and covers for use on watertight manholes shall be machined to smooth uniform bearing that will provide a watertight seal.

#### 2.05 PRE-CAST MANHOLES

- A. AASHTO M-199 SR or ASTM C-478.
- B. Manholes shall be coated with a bitumastic waterproofing sealant.
- C. Use pre-molded rubber or approved bitumastic gaskets at all joints between sections in sanitary sewer manholes.

#### 2.06 MANHOLE STEPS

- A. Plastic manhole steps on 16" centers.

#### 2.07 MANHOLE BASES

- A. Manhole bases shall be poured in place using Class A, 4000 psi concrete only if the pre-cast bases do not comply with section 02722, sub-section 3.06, Item E, Nos. 1-4, and then only when pre-approved by the Engineer.
- B. Base section heights shall be determined by the supplier.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Prior to laying pipe, prepare a suitable bedding according to Section 02221.
- B. Before placing pipe in the trench, field inspect for cracks or other defects; remove defective pipe from the construction site.

- C. Swab the interior of the pipe to remove all undesirable material.
- D. Prepare the bell end and remove undesirable material from the gasket and gasket recess.

### 3.02 INSTALLING GRAVITY SANITARY SEWERS

- A. Lay pipe true to the lines and grades from the grade and alignment stakes, or equally usable references.
  - 1. Where laser equipment is used, provide offset hubs at every break in the line of sight and at every major break in grade.
  - 2. Where batter boards are used, furnish stakes at intervals of 50 feet along the route of the pipeline.
  - 3. Set stakes at such distance from centerline of excavation as is suitable for the excavating method and machinery used.
  - 4. Provide and use accurately set batter boards at each 50 foot interval in establishing the bottom invert of each pipe laid.
- B. Accurately establish the centerline of each pipe using a string stretched between targets and a plumb line extended to the centerline of the pipe.
- C. Carefully inspect all pipe and each fitting prior to its placement in the trench, and reject and remove any defective pipe or fitting from the job site.
- D. Lay pipe progressively up grade, with bell upstream, in such manner as to form close, concentric joints with smooth bottom inverts. Joining of all pipe shall be in accordance with manufacturer's specifications.
- E. Bed each pipe section in accordance with Section 02221.
- F. Unless otherwise specified, provide all gravity sewer lines with a minimum of 4 feet of cover in roadways and 2- 1/2 feet of cover in open areas, unless ductile iron pipe or concrete encasement is used.
- G. Do not allow walking on completed pipelines until backfill has been placed to a depth of at least 6 inches above the crown of the pipe.
- H. Keep the interior of the pipe free of all unneeded material, and upon completion of a section between any two manholes it shall be possible to view a complete circle of light when looking through the pipe.
- I. When laying pipe ceases, close the open ends of the pipe with a suitable plug for preventing the entrance of foreign materials.
- J. Couplings and adapters used for joining dissimilar gravity pipe materials, for repairing and rejoining sections of gravity sewer, and for connecting the first full joint of pipe to a short stub through a manhole wall shall meet the requirements of ASTM C-425.

- K. All couplings and adapters for gravity sewer pipe shall be of rubber, plastic and metallic materials that will not be attacked by municipal wastewaters or aggressive elements in the soil and conform to ASTM C-425, Section 5.

### 3.03 INITIAL PROOF TESTING OF SANITARY SEWERS

- A. It is the intent to specify a "test as you go" procedure in order to establish confidence in the installation and avoid the unnecessary delay of final acceptance.
- B. Before a reach of pipeline is approved for payment, successfully proof test that reach for grade, alignment, cleanliness, and leakage.
- C. In the event that four or more reaches fail to satisfactorily pass proof testing procedures, cease pipe laying until deficiencies are identified and corrected.
- D. The basis for grade, alignment and cleanliness testing will be a visual inspection. Leakage testing will be by means of low pressure air or exfiltration or infiltration as deemed by the Project Engineer.
- E. Proof test flexible pipeline installation for deflection by pulling a "go-no go" test mandrel through the line after the initial backfill is complete to avoid unnecessary dig-ups.

### 3.04 FINAL TESTING

- A. Before the job is accepted and before any existing services are connected, a final testing procedure is to be followed.
- B. Perform a visual inspection when groundwater levels are above the pipeline if possible. All visible leaks shall be repaired. It shall be the Contractor's responsibility to show proof that the groundwater is above the pipe without additional compensation.
- C. If there is evidence of infiltration, make measurement with suitable pipe weirs:
  - 1. If the flow through the lower most manhole of a continuous section of sewer does not exceed 25 gallons/day/inch/mile of pipeline and the groundwater level is representative of the highest annual level, the entire continuous section shall be approved for leakage.
  - 2. The leakage test will be conducted with all lines connected (including service lines).
  - 3. If the apparent infiltration rate exceeds 25 gallons/day/inch/mile, then take additional weir measurements to isolate those sections leaking.
  - 4. Any single reach of pipeline which exhibits an apparent infiltration rate in excess of 200 gallons/day/inch/mile will not be accepted and all leaks will be located and corrected.
- D. If it is not practical to wait for groundwater levels that are representative of the highest annual level, the Contractor may request approval on the basis of a low pressure air exfiltration (or other approved exfiltration) test.
  - 1. Such tests, if approved by the Project Engineer, will be conducted in accordance with ASTM C-828 or latest revision.

2. When an exfiltration test is used as a substitute for infiltration testing, correct all conditions that are potential sources of infiltration.
- E. If flexible pipe is used, pull an approved go-no go deflection mandrel of 95/100 pipe diameter through all reaches of gravity sewer main. This test shall be conducted no sooner than 30 days after completion of backfilling of the tested reach. No sections will be accepted that exhibit a deflection of more than 5%.

3.05 LOW PRESSURE AIR EXFILTRATION TEST

- A. Calculate the pressure drop as the number of minutes for the air pressure to drop from a stabilized pressure of 3- 1/2 to 2-1/2 PSIG.
- B. Times for mixed pipe sizes of varying lengths should be calculated as described in ASTM, C828-76T using formula  $t = k d/q$  ( $q = .0020$ ).
- C. Lengths of section under test shall not exceed 500 linear feet.
- D. The following times are for one pipe size only:

MINIMUM TEST TIME FOR VARIOUS PIPE SIZES  
(BASED UPON ASTM C828-80)

<u>Nominal Pipe Size, In.</u>	<u>T (Time) Sec/100</u>	<u>Nominal Pipe Size, In.</u>	<u>T (Time) Sec/100 ft.</u>
3	128	21	892
4	170	24	1020
6	255	27	1147
8	340	30	1275
10	425	33	1402
12	510	36	1530
15	637	42	1785
18	765	48	2040

3.06 SEWER MANHOLES - GENERAL

- A. Unless otherwise specified, all manhole risers shall have an inside diameter of not less than 4 feet and a vertical wall height of not less than 2.5 feet. All base sections shall have a diameter as shown on the plans.
- B. The clear opening in the manhole shall be not less than 2.0 feet.
- C. Manhole types shall be as designated on the construction plans.
- D. Depth of the manhole shall be the vertical distance from the lowest invert in the manhole to the base of the ring.
- E. A flexible pipe-to-manhole connector shall be employed in the connection of the sanitary

sewer pipe to the precast manhole base section.

1. The connector shall be the sole element relied upon to assure a flexible watertight seal of the pipe to the manhole. No adhesives or lubricants shall be employed in the installation of the connector into the manhole. The rubber for the connector shall comply with ASTM C433 and ASTM C923 and consist of EPDM and elastomers designed to be resistant to ozone, weather elements, chemicals, including acids, alkalies, animal and vegetable fats, oils and petroleum products from spills.
  2. All stainless steel elements of the connector shall be totally non-magnetic Series 304 Stainless, excluding the worm screw for tightening the steel band around the pipe which shall be Series 305 Stainless. The worm screw shall be torqued by a break-away torque wrench available from the precast manhole supplier, and set for 60-70 inch-pounds.
  3. The connector shall be installed in the manhole wall by activating the expanding mechanism in strict accordance with the recommendation of the connector manufacturer.
  4. The connector shall be of a size specifically designed for the pipe material and size being utilized on the project.
- F. Apply two applications of a bituminous waterproofing sealant to the outside of each manhole section prior to backfilling.
- G. Backfill manholes with the same material used for pipeline.
- H. The base of the manhole shall be precast, 8 inch thick, with room for a minimum 4 inch invert to be poured and shaped. The invert shall not be less than 0.7 x diameter of pipe in depth.
- I. Manholes shall be bedded with a minimum of 1 foot of crushed limestone.

### 3.07 VACUUM TESTING OF MANHOLES

- A. All manholes, either cast-in-place or pre-cast, shall be vacuum tested as follows:
1. All lift holes shall be plugged with an approved non-shrink grout.
  2. All pipes entering the manhole shall be plugged, taking care to securely brace the plug from being drawn into the manhole.
  3. The test head shall be placed at the inside of the top of the cone section and the seal inflated in accordance with the manufacturer's recommendations.
  4. A vacuum of ten (10) inches of mercury shall be drawn and the vacuum pump shut-off. With the valves closed, the time shall be measured for the vacuum to drop to nine (9) inches. The manhole shall pass if the time is greater than sixty (60) seconds for 48" diameter, seventy-five (75) seconds for 60" diameter, and ninety (90) seconds for 72" diameter manholes.
  5. If the manhole fails the initial test, necessary repairs shall be made while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained.

### 3.08 STANDARD PRE-CAST CONCRETE MANHOLES

- A. Pre-cast manhole bases and sections shall comply with AASHTO M-199 SR or ASTM C-478.



- B. The base of the manhole shall be precast, 8 inch thick, with room for a minimum 4 inch invert to be poured and shaped. The invert shall not be less than 0.7 x diameter of pipe in depth.
- C. Shape manhole inverts from Class A concrete to be smooth, accurately shaped, and in accordance with the plans.
- D. Inlets and outlets from each manhole shall be finished smooth and flush with the sides of manholes walls so as not to obstruct the flow of liquid through the manhole.
- E. Provide a subbase with a minimum of 12" of crushed limestone, well compacted with mechanical tamping equipment.

### 3.09 MANHOLE STEPS

- A. Manholes shall have plastic steps at intervals of 16 inches along the wall of the manhole.
- B. The treads of the steps shall be free from mortar or other material when the manhole is completed.
- C. In pre-cast manholes, the holes left to receive the steps shall be mortared smooth following placement of the steps.

### 3.10 MANHOLE RINGS AND COVERS

- A. Grout manhole rings and covers in place with cement mortars.
- B. The bearing surfaces between cast rings and covers shall be machined, fitted together, and match marked to prevent rocking.
- C. All castings shall be of the types, dimensions, and weights as shown on the plans and shall be free of faults, cracks, blow-holes, or other defects.

### 3.11 TIE-INS

- A. Existing lines shall remain in place and in working order until the exact planned time of tie-ins is required.
- B. Should existing lines become damaged during construction at any time prior to time of tie-in, the Contractor shall assume full responsibility for repairing and returning to normal operation.
- C. Tie-ins shall be made in full coordination with the Project Engineer upon completion of and testing of all new sewer lines.

### 3.12 SEWER SERVICE ASSEMBLIES

- A. Where shown on the plans or located in the field, install fittings for individual service assemblies.
  1. The standard collector tap shall consist of a tee connected with a 6 inch diameter branch.
  2. Use vertical risers when the depth of the collector line is greater than 8 feet or when

- their use will facilitate connection of individual services.
3. Plug the ends of tee branches not to be used immediately with stoppers of the same material and joints used on the collector lines.
- B. Where shown on the plans or located in the field, install collector saddles by attaching to the sewer main by stainless steel bands secured by 2 bronze or stainless steel bolts, with a minimum diameter of 3/8".
- C. Service pipe shall be a minimum 6" diameter and shall be installed as shown on the plans.
1. Plug the ends of service pipe and cover the same as for collectors and interceptors (where possible.)
  2. The minimum grade on service pipes shall be 1% or 1/8" per foot.

END OF SECTION 02722