DIVISION 19

VACUUM SEWER SYSTEM

19.01 GENERAL:

Provide vacuum sewer service for new development in accordance with the City's Sewer Master Plan, Rules and Policies Governing Vacuum Sewer, and these standards and specifications. Vacuum sewer may include, but not necessarily be limited to, vacuum collection mains, vacuum service laterals, vacuum valve pits, vacuum buffer tanks, division valves, vacuum pump stations and force mains.

19.02 APPROVED MANUFACTURER:

All vacuum sewer equipment shall be manufactured by AIRVAC, Inc. of Rochester, Indiana.

19.03 DESIGN:

Design of the vacuum sewer system will be completed as follows:

A. Vacuum Sewer Collection System: The vacuum sewer collection system will be designed by the developer's engineer with technical assistance from the City Engineer and the City's Sewer Manager. Detailed design criteria are available in AIRVAC 2005 Design Manual which can be obtained from the City. The design, including calculations, must be approved by the City Engineer before Final Plat approval by the City Council.

B. Vacuum Pump Station: The vacuum pump stations will be designed by the City Engineer or the City's designated representative – no exceptions.

19.04 WORK COORDINATION BETWEEN CITY AND CONTRACTOR:

The Contractor will purchase all valve pits from a local AIRVAC distributor. The City will purchase vacuum valves directly from AIRVAC and include the cost of the valves in the Developer's Agreement. Vacuum valves will be installed in the valve pits by the City when the customer has received an Occupancy Permit from the City.

The City has purchased a trailer-mounted vacuum field test pump, which will be used by the Contractor for testing the vacuum sewer piping. Use of the pump shall be coordinated with the Sewer Manager. Any damage to the unit shall be repaired at the Contractor's expense.

19.05 SUBMITTALS:

A. Certificate: Provide a certificate from the pipe manufacturer by the manufacturer stating the pipe has been tested at 22 in. hg. vacuum with no leakage in accordance with ASTM 3139, and is guaranteed for such use.

B. Division Valve: Submit division valve manufacturer's certificate that valve will not leak when subject to a vacuum of 22 inches mercury for one (1) hour in both open and closed position.

19.06 WARRANTY:

Provide two (2) year warranty. Warranty shall cover materials and workmanship of products supplied, along with installation of vacuum valve pits. Warranty shall commence on the date of conditional acceptance.

19.07 MATERIALS:

A. Vacuum Sewer Piping: All buried vacuum mainlines, branch lines and service laterals to be SDR21 rated PVC pipe.

B. Conformance:

1.. Pipe: ASTM D-2241, ASTM D-1784 Cell Classification 12454-B.

2. Joint: ASTM D-3139 Using elastmeric seals. This pipe must be certified by the manufacturer that pipe and seal will operate at 22 inches of mercury vacuum and withstand a vacuum test at 22 inches of mercury vacuum with no leakage after 1 hour with joints deflected as per ASTM D3139.6.1.1

3. Fittings: All PVC Schedule 40 pipe fittings (for solvent cement joints) shall be as produced by Spears Manufacturing Company (or approved equal) from a PVC compound having a cell classification of 12454 conforming to ASTM D-1784. All PVC Schedule 40 fittings shall be injection molded in accordance with ASTM D-2466 with the exception of wye fittings. These wye fittings may be fabricated on the condition that fitting dimensions shall not deviate significantly from fitting dimensions shown on the standard details. Wye fitting sockets shall be made in accordance with ASTM D-2466. A written certification is required from the manufacturer that these fittings are suitable for operation in a vacuum of 22 inches of mercury and that the fittings have been tested at a minimum of 22 inches of mercury vacuum.

4. Fittings (Alternate): Gasketed PVC fittings using Rieber (or approved equal) gaskets may be used. Such fittings shall be as manufactured by Specified Fittings of Bellingham, Washington or approved equal. Gasketed fittings shall be made from the same material described in Paragraph C as a minimum. Written certification from the manufacturer that the fittings are suitable for use in a vacuum shall be required as outlined in Paragraph C above. Gasket material shall be EPDM or SBR unless otherwise specified.

5.. Solvent Cement: ASTM 2564, primer and cement shall not be of same color.

6.. Wye Fittings: 45° Ells shall be used through out. A 3" 90° Ell may be used at the entering side of 3" vacuum valve and at the wye connection to the vacuum main. Tee fittings and vent type ells are prohibited exclusively.

C. AIRVAC 3” Flexible Pipe (Optional) General Description: This product is fabricated by AIRVAC with an overall length of 8’-2”. One end of this product is a plain piece of 3” SDR 21 PVC pipe joined to the specially manufactured flexible pipe with a 3” Sch. 40 coupling. The specially manufactured flexible pipe has the proper outside diameter for solvent welding into PVC fittings.

D. Vacuum Line Division Valves:

1. Valves shall conform to AWWA C509087, Standard for Resilient Seated Gate Valves, as manufactured by Waterous Company or approved equal.

2. Wedge shall be constructed of ductile iron, fully encapsulated in synthetic rubber except for guide and wedge nut areas.

3. Wedge rubber shall be molded in place and bonded to the ductile iron portion, and shall not be mechanically attached with screws, rivets, or similar fasteners.

4. Wedge shall seat against seating surfaces arranged symmetrically about the centerline of the operating stem, so that seating is equally effective regardless of direction of pressure unbalance across the wedge.

5. All seating surfaces in body shall be inclined to the vertical at a minimum angle of 32° (when stem is in a vertical position) to eliminate abrasive wear of rubber sealing surfaces.

6. Stem shall be sealed by at least two (2) O-Rings; all stem seals shall be replaceable with valve wide open and while subjected to full rated pressure.

7. Waterway shall be smooth and shall have no depressions or cavities in seat area where foreign material can lodge and prevent closure or sealing.

8. Valve body and bonnet shall be coated, inside and out, with fusion-bonded epoxy. Coating shall conform to AWWA C550-81, Standard for Protective Interior Coating for Valves and Hydrants.

9. Mechanical joint connections with transition to PVC gaskets shall be provided.

10. Buried valves shall be provided with valve boxes and the operating nut shall be extended to within 9", plus or minus 6", of the finished grade. The valve box cover shall have the words "SEWER" and "OPEN" with a directional arrow cast on it.

11. Full ten (10) year money back warranty.

E. Underground Pipe Markers:

1. For all vacuum sewer main pipe, install green magnetic detectable warning tape imprinted with "SEWER" directly over pipe and at outside edges of underground structures, or approved equal.

19.08 TRENCHING:

See Division 2.

19.09 DEWATERING:

A. Preparation

1. Furnish, install and operate all necessary machinery, appliances and equipment to maintain all excavations and trenches free from water during construction.

B. Dewatering

1. Dispose of water in such a manner that it does not cause injury to public or private property, or cause a nuisance or a menace to the general public.

2. Comply with State of Utah, Water Quality Standards, latest edition, for discharge of water to surface water.

3. The Contractor shall be fully responsible for complying with the permitting performance requirements. Contractor may devise dewatering system to achieve such requirements. It is anticipated that well point methods, stilling basins, geotextile dams, straw bails, silt fences, or siltation channels will be

required to meet performance stipulations of the reference permits. Such temporary facilities can be constructed on-site, and will be required to be removed after completion.

4. Draw static water level to at least one foot (1') below the bottom of the excavation prior to excavation to maintain the undisturbed state of the foundation soils and allow placement of bedding material and backfill to the required density.

5. Compact native soil prior to placing bedding according to Division 2 of these specifications.

6. Prevent softening of the bottom of excavations and the formation of "quick" conditions or "boils" during excavation.

7. Control surface runoff to prevent entry or collection of water in excavations.

8. Install and operate the dewatering system so that adjacent structures or property are not endangered by the reduction in the groundwater level.

19.10 INSTALLATION:

A. All vacuum sewers shall be laid to the line and grade with the use of construction laser beam equipment. All pipe which has been designed to slope downward, shall be installed to slope continuously downward. There shall be no abrupt sags or bellies in the line. The maximum deviation from planned elevations shall not exceed 0.05 feet in any 100 feet of length. This is a plus or minus tolerance and applies to all pipe sizes.

B. Use proper tools and appliances for handling and laying of pipe and fittings.

C. Prevent entrance of dirt or foreign matter or damage to pipe lining or coating. Plug the pipe any time work is stopped.

D. No defective pieces are permitted. Defective pieces discovered after use will be removed and replaced with a sound piece.

E. Fully bare pipe along its entire length.

F. Lay and join pipe in accordance with manufacturer's instructions to insure pipe thermal expansion and contraction. Lay pipe with spigot end down stream.

G. Place compacted fill in entire space between the fitting and the trench walls.

H. Use temporary plugs in end of pipes when work is not in progress.

I. Provide pipe through casing with support skids to hold pipe to center of casing. Alternate support methods acceptable contingent upon Sewer Manager's review.

J. Bed pipe as specified in section describing trenching.

K. Verify pipe grade and elevation at each change in grade and record in notebook in a manner acceptable to the Sewer Manager.

19.11 DIVISION VALVE AND GAGE TAP INSTALLATION:

A. Division valves shall be resilient wedge gate valves.

B. Furnish and install valves under provisions in a separate section.

C. Install gage tap adjacent to division valve where shown in accordance with standard detail.

D. Provide concrete collar around each division valve and gage tap.

19.12 VALVE PIT INSTALLATION:

A. Install complete valve pits in accordance with manufacturer's instruction. Installation training will be provided by the Sewer Manager.

B. The 2" sensor line shall be factory tested for leaks prior to installation in the valve pit bottom. Prior to fitting the valve pit bottom, the flanges and mating surfaces shall be clean and dry.

C. Lay "O" ring sealing gasket in pre-formed groove in sump, fit and tighten bolts and nuts.

D. PVC caps shall be solvent bonded to the stub-outs for the gravity line inlets to the holding tank. A stop shall be solvent bonded around the gravity line 4" from the end that is inserted into the holding tank.

19.13 AIRVAC SUMP TESTING

A. At the Construction Site:

1. Following proper assembly, prior to installation, the collection sump shall be tested as follows:

   First make a 3" test plug using a 3" PVC cap glued onto a 6" length of 3" pipe. Tap a 1/8" tubing connection and an air valve fitting into the 3" PVC cap and using a 3" no-hub coupling, attach to the installed 3" suction pipe. Fabricate a 2" test plug using a 2" PVC cap glued onto a 6" length of 2" PVC pipe and insert into the 2" sump vent grommet. Insert the tested sensor tube into its 4" grommet in pit bottom. Using a length of 3/8" AIRVAC tubing, attach one end to the spigot end of sensor tube and the other to a 0-50" Magnehelic gauge. Connect an air supply to the air valve fitting. Bring to 40" water gauge and watch for leaks. Leakage must be under 1" water gage in one (1) minute.

B. In the Field:

1. Following initial testing, excavate and prepare bedding for holding sump as shown on construction plans or as field instructed. Check to insure adequate slope exists between the home and the holding tank.

   As an example: For 30" sump installations, the gravity lines will enter the sump at a minimum depth of 4.65 ft. If the gravity line leaves the home at a depth of approximately 2 ft., and slope of gravity sewer is 2%, the home must be no farther than 130 ft. from the sump. If insufficient fall exists, contact Engineer immediately.

   a. Mark and cut the 5" holes in the holding sump at the appropriate locations for gravity lines. There are four (4) raised surfaces suitable for gravity connections. Install 4" grommets into openings and lubricate as before.

   b. Lower the assembled holding sump into the excavation taking care that no material is allowed to enter the sump.

c. Install the prefabricated 4" gravity stubs into their grommets with stop coupling firmly against the grommet.

2. Re-test complete assembly in place as outlined above in 19.13 A. 1.

3. After testing, installation may now proceed in accordance with installation instruction manual. Installation may include but is not limited to:

a. Placement of buoyancy collar as directed.
b. Proper use of correct backfill material
c. Pouring concrete collar around cast iron manhole frame as needed in paved traffic areas

19.14 BACKFILLING:

See Division 2

19.15 FIELD QUALITY CONTROL:

A. Provide daily testing of all sewer mains and lateral connections laid: Plug all open connection with rubber stoppers or temporary caps, fitted to the pipe by "no-hub" couplings. Apply a vacuum to 22 inches Hg to the pipes and allow the pressure to stabilize for 15 minutes. There shall be no loss of vacuum in excess of 1% per hour for a two-hour test period. There shall be absolutely no water allowed to be admitted into the piping network during this test. As pipe is laid the new section shall be tested in addition to the previously laid pipe on that main.

The Contractor should leave uncovered the sewer main pipe joints until after the daily vacuum test is complete so that any leaks can be easily located and repaired.

B. Two (2) Hour Vacuum Line Test Modification Provision: If the Contractor succeeds in meeting the daily 2-hour test for seven (7) consecutive working days or two thousand feet of pipe, he may alter the procedure to allow the trench to be covered as work progresses rather than the trench being kept open all day as is the norm with the daily 2-hour test. Should a line fail the vacuum test while utilizing this test modification, the Contractor shall take whatever action necessary at his cost to pass the test including the re-excavation of the trench, leak detection and line repair, and additional cleanup as required by the Sewer Manager. After the failure, the contractor must "re-qualify" as specified above. Note this test modification is optional, and as such, the Contractor assumes all liability in its use.

C. Required Final Acceptance Testing on complete system: Subject the entire sewerage system to a vacuum of 22 inches Hg, allow to stabilize for 15 minutes. There shall be no loss greater than 1% per hour over a four (4) hour test period. There shall be absolutely no water allowed to enter the piping system or the vacuum station during this test.

Contractor to provide 48 hours notice to Sewer Manager prior to test.

Contractor to assure all division valves are open prior to beginning of Final Acceptance Test.

Final Acceptance Test shall be recorded on approved vacuum chart recorder. This chart will not be considered valid unless witnessed by Sewer Manager on test equipment at beginning and the end of vacuum test period.

Sewer Manager will sign and date chart to verify witness of test. This signature does not indicate acceptance of the system.

19.16 LINE FLUSHING:

After acceptance testing, flush lines to remove debris and foreign materials that accumulated in the lines during construction.

Suggested procedure (In the absence of special test apparatus, this procedure will require the use of vacuum valves, which must be installed by the City. Coordination is therefore required.):

A. Place system under vacuum

B. Add water and air in controlled amounts to valve pits at extreme ends of system

C. Utilize system vacuum to transport water and debris to collection point.

D. Continue procedure until water entering at collection point is free of contamination or debris. If vacuum collection tank is used as collection point, monitor volume of liquid in tank and pump out as necessary. Use system sewage pumps only after verifying that no debris is present in collection tank. If debris is present, use other methods to empty collection tank. At completion of flushing, clean collection tank of all collected debris.

E. Seal system and make ready to place into operation.

Alternate flushing procedure subject to Sewer Manager's review.

19.17 SEWER LATERAL CONNECTIONS FOR VACUUM SEWER SYSTEMS:

All sewer lateral connections onto new vacuum sewer mains shall be made through preformed wye fittings installed in the main line at the time of main line installation.

Connections onto existing sewer mains shall only be made under the direction of the City's Sewer Manager.

19.18 SEWER SERVICE LATERALS FOR VACUUM SEWER SYSTEMS

New service laterals for vacuum sewer systems shall be constructed with materials and procedures as specified herein and shown in the Standard Drawings.

All laterals shall be four-inch (4") in diameter unless required otherwise.

Sub-section A. Extent of Laterals and Location of Laterals:

New sewer laterals in the vacuum sewer system shall be installed in a location and direction to correspond to the location of the vacuum valve pit as shown on the Plans or as directed by the City's Sewer Manager. Valve pits will typically be installed at the edge of the City's right-of-way and be shared by two adjacent buildings. Minimum slope shall be one-quarter-inch (1/4") per foot.

Sub-section B. Excavation and Backfill:

Trench excavation and backfill shall conform to the applicable paragraphs of Division 2 and the bedding requirements of this Division.

Sub-section C. Pipe:

Pipe used for new service laterals in the vacuum sewer system shall be Schedule 40 or SDR21 rated PVC Pipe. Fittings shall be Schedule 40.

Sub-section D. Connection to Main:

Connections to the main shall be made as specified in Section 19.17 above.

Sub-section E. Backflow Preventor:

All sewer laterals shall be equipped with a 4-inch (or line size) backflow prevention device which shall be installed upstream of the air vent connection.

Sub-section F. Sewer Clean Outs:

At least one clean out shall be installed in each sewer lateral. The air vent riser may be used as a clean out (do not glue the elbows at the top of the air vent). There shall be a maximum distance of one hundred (100) feet between cleanouts and a there shall be a clean out when a combination of bends is ninety degree (90^{o}) or greater.

Sub-section G. Damage and Repairs of Sewers and Appurtenances:

The Developer/Contractor shall be responsible for the protection of existing improvements, and any damage resulting from its operations shall be its sole responsibility.

Damage to the sewers, laterals, or appurtenances shall be repaired by acceptable and approved methods.

- END OF SECTION -