

**Wastewater Specifications
Section 400**

410 Design Criteria for Wastewater Collection

411 General Information

These design criteria are minimum requirements to be used in the design of wastewater collection systems within the jurisdiction of the City of Burnet. The jurisdiction of the City of Burnet is defined as the area bound by the ETJ of the City of Burnet. In all cases, the Texas Commission on Environmental Quality Design Criteria for Sewerage Systems shall be enforced as the minimum design criteria for use in the City of Burnet. The following design criteria shall be supplemented by the TCEQ design criteria. Engineered plans must be submitted to the City Engineer for review, comment and approval with regards to compliance with the Standard Specifications and applicable TCEQ Rules.

412 Design Criteria, Mains

412.01 Gravity Mains

- A. Size: the minimum main size shall be eight (8) inches, except that six inch (6") will be permitted only at the direction of the City Engineer or his designated appointee (in low flow situations, in standard length cul-de-sacs or lines less than 200 feet in length which will not be extended in the future).
- B. Sanitary Sewer mains in new subdivisions shall be placed to produce a minimum velocity of 2 feet per second (based on the calculated flows) and in no case be flatter or steeper than the grades as set forth below:

<u>Size (in)</u>	<u>Grade (ft/ft)</u>	<u>Grade (%)</u>	<u>Max. Grade(%)</u>
6"	0.0050	0.50%	12.35%
8"	0.0040	0.40%	8.40%
10"	0.0035	0.35%	6.23%
12"	0.0030	0.30%	4.88%
15"	0.0015	0.15%	3.62%
18"	0.0011	0.11%	2.83%
24"	0.0008	0.08%	1.93%

The grades shown in the above are based on Manning's formula with an assumed "n factor" or 0.013 and constitute minimum acceptable slopes. The minimum acceptable "n" for design and construction shall be 0.013. The "n" used takes into consideration the slime, grit and grease layers that will affect hydraulics or hinder flow as the pipe matures.

- C. The maximum design velocity should not be greater than ten (10) fps at peak flow. However, a velocity in excess of ten (10) fps will be approved with proper consideration of pipe material, abrasive characteristics of the wastewater, turbulence, and thrust blocks at changes in direction. A minimum design velocity shall not be less than two (2) fps.
- D. Where the pipe grade exceeds 12.5%, concrete retards shall be used at intervals not exceeding 50 feet.
- E. All sanitary sewer mains shall be designed for a 50-year life.
- F. Wastewater piping and appurtenances shall conform to Section 420 of these specifications.
- G. Minimum depth of cover shall be 3.5 feet measured from the top of pipe while the maximum cover shall be 14 feet, variances from this shall be as approved by the City Engineer. Backfill must be compacted in 4-6" lifts with a hand operated tamper, 6-8" lifts with a remote compactor or sheepsfoot roller mounted to a backhoe, max 12" lift with a sheepsfoot roller mounted to a minimum 5 ton excavator; compaction to 95% Standard Proctor (ASTM D-698) for cover of 10

feet or less, 95% Modified Proctor (ASTM D-1557) for more than 10 feet of cover. Density tests shall be taken in the presence of a city inspector horizontally every 100 linear feet and vertically at the following depths (depending on depth of sewer main): 2 ft, 5 ft, 7.5 ft, 10 ft, and 12.5 ft.

- H. The average daily flow for single family residences shall be taken to be ⁷⁰~~100~~ gal/capita-day. Peaking factors range from 2 – 6 depending on the population served. The following formula shall be used to determine the peaking factor, M,

$$M = 1 + 14 / (4 + P^{0.5})$$

Where, M = the ratio of peak-to-average and average-to-minimum rates of flow; and

P = the population served, thousands

- I. Sewers shall be laid in straight alignment with uniform grade between manholes unless slight deviations from straight alignment and uniform grade are justified to the satisfaction of the City Engineer. Deviations from uniform grade (i.e., grade breaks or vertical curves) will not be allowed.
- J. Gravity sewers with horizontal curvature shall be sloped at least 3% greater than the minimum allowable slope for the same diameter pipe. For example, an 8" diameter gravity pipe (with horizontal curvature) minimum slope shall be 0.40% X 1.03 = 0.412%. The maximum allowable manhole spacing for sewers with horizontal curvature shall be 300 feet. All reaches of sewer, which includes horizontal curvature, shall be tested with a rigid mandrel and shall be hydrostatically tested using a maximum allowed exfiltration of 10 gallons per inch diameter per mile of pipe.
- K. Construction methods which utilize flexure of the pipe joint are prohibited. The engineer shall provide the calculations for horizontal pipe curvature in the final engineering design report and detail the proposed curvature on the plans. The maximum allowable joint deflection shall be the lesser of the following three alternatives:
- (A) equal to 5°;
 - (B) 80% of the manufacturer's recommended maximum deflection; or,
 - (C) 80% of the appropriate ASTM, AWWA, ANSI or nationally-established standard for joint deflection.
- L. Separation Distances: Separation distances shall comply with Section 700 of the City of Burnet Standard Specifications. Waterline/Wastewater lines must conform to the TCEQ requirement for spacing as a minimum.

412.02 Force Mains

- A. General: Pipe material and fittings shall be PVC meeting ASTM D2241 SDR-26 specifications with a minimum pressure rating of 160 psi or C-900 PVC DR-14. Pipe shall be designed and installed according to TCEQ rules and regulations. A detector tape shall be laid, in the same trench, above and parallel to the forced main. The tape shall state in a minimum of 6-inch tall letters "Pressurized Wastewater" continuously along the tape.
- B. Installation shall be in accordance with Section 600 of these specifications. Contractor shall provide submittals on pipe and fittings prior to ordering materials.
- C. Minimum depth of cover shall be 3 feet while maximum shall be 5 feet.
- D. Testing: Systems will be tested in accordance with Section 800 of these specifications.

413 Design Criteria, Manholes

413.01 Manholes

Shall be placed and located to facilitate their use for inspection and maintenance of the sewer main. They will be placed at:

- A. Intersections of mains
- B. Horizontal alignment changes
- C. Vertical grade changes
- D. Change of pipe size
- E. Six inch and above service laterals (because of large volume, etc)
- F. At the end of all sewer mains except where a Wastewater Access Device is used.
- G. Maximum spacing shall be 500 feet for mains between 6 and 15" diameters. For mains over 15 inches, maximum spacing shall be 600 feet. Maximum spacing for sewer mains with horizontal curves shall be 300 feet regardless of the size of pipe.
- H. When sewer mains have horizontal curvature (generally where they follow curvature of a street); manholes shall be located at the P.C. and P.T. of the curve and the minimum radius of curvature shall be 250 feet.
- I. Venting. Where gasketed manhole covers are required for more than three manholes in sequence, an alternate means of venting shall be provided at less than 1,500 foot intervals. Vents shall be designed to minimize inflow. Vents shall be 1 foot above the B.F.E. for the 100-year flood elevation.

413.02 Manhole Inverts

The bottom of the manhole shall be provided with a "U" shaped channel that is a smooth continuation of the inlet and outlet pipes. For manholes connected to pipes less than 15 inches in diameter, the channel depth shall be at least half the largest pipe diameter. For manholes connected to pipes 15 to 24 inches in diameter, the channel depth shall be at least three fourths the largest pipe diameter. For manholes connected to pipes greater than 24 inches in diameter, the channel depth shall be at least equal to the largest pipe diameter. In manholes with pipes of different sizes, the tops of the pipes shall be placed at the same elevation and flow channels in the invert sloped on an even slope from pipe to pipe. The bench provided above the channel shall be sloped at a minimum of 0.5 inch per foot. Where sewer lines enter the manhole up to 24 inches above the manhole invert, the invert shall be filleted to prevent solids deposition. A drop pipe shall be provided for a sewer entering a manhole more than 24 inches above the invert. The minimum change in elevation from invert in and invert out is 0.1' measured at the flow line.

414 Design Criteria, Sewer Services

RESIDENTIAL - As a minimum, 4" SCH-40 sewer service complete with a double cleanout placed at the property line will be required for each platted lot. Each service will be required to have at least 30" of cover between the curb and the service. Services shall be located near the center of each lot with a minimum of 9-foot separation between the water and the sewer services.

COMMERCIAL - In accordance with the City of Burnet adopted 2009 Edition of the International Building Code and the International Plumbing Code.

415 Design Criteria, Lift Stations

Lift Stations shall be designed in accordance with Section 430 and Section 440 of the City of Burnet Standard Specifications. Lift stations shall not be used where a gravity main can be installed to provide the necessary service.

416 Construction Plans

- A. Construction plans shall be drawn to one of the following scales:

<u>Horizontal</u>	<u>Vertical</u>
1" = 20'	1" = 2 ft
1" = 40'	1" = 4 ft

- B. Elevations shall be provided at all manhole rims and flowlines. The pipe gradient between manholes shall be clearly shown on the plans. The ground profile shall be shown.
- C. Benchmarks shall be shown on the plans at distances no greater than 1000 feet.
- D. The location and stationing of all services shall be shown on the construction plans.
- E. Sequence of construction (for sewer line and for all other construction in conformance with Section 101).

NOTE: A professional engineer may submit a request to modify design criteria, upon presentation of sufficient data to justify the variation, based upon unique and known circumstances.

420 Materials For Construction

All sewer mains shall have **metallic location tape** placed in the last 2 feet of fill of the trench (i.e. 2 feet deep from the final grade). See details.

421 General Information

421.01 Description: This item shall consist of furnishing all necessary labor, equipment, materials, and performing all work required to install sanitary sewer pipe and appurtenances of the class, size, and dimensions specified at the locations and to the lines and grades shown on the plans, all in strict compliance with these specifications.

422 Materials

422.01 PVC Pipe and Fittings: Pipe material, fittings, and services shall be cement lined Ductile Iron Class 50 or PVC meeting ASTM D3034-SDR26 specifications. Pipe shall be designed and installed according to City of Burnet Subdivision Specifications and the Rules and Regulations for Sewage Collection Systems as adopted by the TCEQ.

Joints shall be locked in rubber sealing ring to provide water tight, flexible seal, and shall meet the requirements of ASTM D3212.

Permanent marking on the pipe shall include the following at intervals of not more than 5 feet:

Manufacturer's name and/or trademark.

Nominal pipe size.

PVC cell classification per ASTM D 1784.

Fittings shall be clearly marked as follows:

Manufacturer's name or trademark,

Nominal size,

The material designation

422.02 Manholes

- A. General: Manholes shall be 48" diameter fiberglass material, larger diameter manholes will be necessary as indicated in the details section of this specification book. Brick manholes will not be allowed, nor shall brick be used to adjust manhole covers to grade. All manholes (whether in pavement or not) shall have a 4-ft x 4-ft x 6-inch thick slab of concrete placed around the ring and cover and reinforced with #6, 6" x 6" wire mesh. Where the manhole is in pavement it shall be rotated so that the sides of the square are at a 45° angle with the curb as shown in the details section. Manholes shall be tested using the Vacuum Test as specified in Section 800 of these specifications.

- B. **Grade Rings:** Grade rings shall be HDPE Recycled Plastic Manhole Adjusting Rings. Manholes shall be designed and constructed with a maximum allowable grade adjustment (using grade rings) of no more than 8-inches. Existing manholes receiving rehabilitation may have a maximum allowable grade adjustment of no more than 20-inches including existing grade rings. Concrete grade rings will not be permitted and must be replaced with HDPE grade rings on existing manholes receiving rehabilitation.
- C. **Ring and Cover:** The ring and cover shall be ductile iron, REXEL manufactured by SAINT-GOBAIN PAM or East Jordan Iron Works #1033Z or 1034Z or an approved equal with a minimum nominal opening of 36 inches. Manholes which lie within the 100 year floodplain shall have the covers be sealed and gasketed to protect against inflow. Where gasketed manhole covers are required for more than three manholes in sequence, an alternate means of venting shall be provided at less than 1,500 foot intervals. Vents should be designed to minimize inflow and be place a minimum of 1' above the Base Flood Elevation. Impervious material should be utilized for manhole construction in these areas in order to minimize infiltration.

423 Testing

423.01 **Requirements:** All testing shall be in accordance with Section 800 of the City of Burnet Standard Specifications.

424.02 **Manholes:** Standard Manholes: Payment for manholes shall be in accordance with the unit bid price bid regardless of depth, which price shall be full compensation for ductile iron ring and cover, wall construction, sheeting, shoring, special joint treatment to prevent infiltration testing, and all other incidentals necessary to complete the work in accordance with the Bid documents.

430 Lift Stations

431 Description

431.01 **General:** The contractor shall furnish all labor, materials, and equipment required to provide the duplex pumping system specified herein. The control system shall be as specified by the City of Burnet Director of Public Works.

431.02 **Extent of Work:** System shall consist of two (2) submersible pumps, reinforced concrete wet well and valve vault with flood proof access hatches and coal tar epoxy interior coating, wet well level control switches, submersible pump cable, discharge plumbing with hydraulically seated discharge flange, pump mounting plates with bottom rail supports, upper rail supports, lifting chain, all pressure piping and valves within the lift station site, manual transfer switch and enclosure, Data Flow Model PCU001 pump control unit, control transformer and enclosure, electrical service pole, stainless steel Unistrut mounting assembly with concrete base, mobile generator receptacle, all electrical wiring, conduits, fasteners, and all NEMA 4X weather proof enclosures shown on plans and provided in specifications necessary to produce a properly functioning lift station site.

432 Quality Assurance

432.01 **General:** Three submittals shall be sent to the City Engineer for review. One approved copy shall be returned to the Contractor.

432.02 **Submittals Required:**

- A. Certified dimension prints showing complete dimensions of all components.
- B. Materials list showing material specifications for all components.
- C. Performance curves for each pump unit showing capacity, head, and efficiency over the entire range of the pump.
- D. Controls: Control schematic, field wiring diagram, manufacturer's catalog data

on all components, panel and arrangement details.

- E. Warranty: Manufacturer's standard published warranty certified on supplied equipment.

433 Component Construction

433.01 Submersible Pumps: The pump shall be Fairbanks Morse or as approved by the City Director of Public Works. The pumps shall be capable of handling screened raw wastewater. The discharge connection elbow shall be permanently installed in the wetwell along with the discharge piping. The pumps shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service along with guide rails. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. All hardware associated with the pump guide, pipe supports, lifting chain, and hardware shall be 304 stainless steel. The entire weight of the pump unit shall be guided by no less than two guide bars and pressed tightly against the discharge connection elbow with metal to metal contact.

Sealing of the discharge interface by means of a diaphragm, O-ring, or other device will not be acceptable. No portion of the pump shall bear directly on the floor of the sump.

Hydraulic Components:

- A. The pump casing shall be of gray iron with a gray iron or ductile iron slide rail guide shoe attached to the discharge flange as an integral assembly. Casing shall be easily removable from the motor for full inspection of impeller.
- B. The pump openings and passages shall be of adequate size to pass 3" diameter spheres and any trash or stringy material which may pass through a wastewater collection system. The back of the impeller shall incorporate straight auxiliary vanes to hydraulically reduce pressure on the primary seal, and force debris away from the impeller clearance. No wearing rings or adjustments of the backside clearance will be required.
- C. The impeller shall be of semi-axial flow design, incorporating one or two sweeping vanes with wide flow channels. It shall be gray iron 30 or ductile iron Class 80-56-06 with designed counter mass for dynamic balancing to eliminate vibration. Balancing shall not deform or weaken the impeller.
- D. The suction clearance between the impeller and pump casing shall be in the axial direction only. This clearance must be fully adjustable to maintain peak operating efficiency of the pump.

433.02 Pump Motor Description:

- A. The submersible pump motor shall operate in accordance with the electrical power indicated on the drawings. The motor and pump must be connected to form an integral unit. Motor shall be a squirrel-cage, induction type in an air-filled water tight enclosure. The motor shall conform to NEMA design class B, and incorporate Class F insulation materials to withstand a continuous operating temperature of 155 degrees C (311 deg F). The pump and motor shall be capable of handling liquids with a maximum temperature of 40 deg C (104 deg F). Oil filled motors are not acceptable.
- B. Motor shall be capable of sustaining a minimum of 10 starts per hour. The motor shall operate while only partially submerged and not require a cooling jacket or any other means of auxiliary cooling during normal continuous operation.
- C. Motor housing shall be cast iron. The stator shall consist of copper windings with copper connectors applied to high-grade electrical steel laminations. The stator shall be held securely in place by a heat-shrink fit into the motor housing. Any other means of securing the stator which would require penetration of the motor housing shall not be considered acceptable.

- D. Rotor shall be solid cast and dynamically balanced for vibration-free operation. Rotor end bars and short circuit rings shall be of aluminum. The pump shaft shall be stainless steel. The shaft shall be machined with shoulders or snap ring grooves for positive placement of bearings. The upper and lower bearing shall be of heavy duty design, capable of supporting the shaft and rotor while under maximum radial and thrust loads. The bearings shall be permanently grease lubricated at the time of installation.

433.03 Sump Level Controls: Float switches shall be supplied to control sump level and alarm signals. The switches shall be sealed in a solid polypropylene float for corrosion and shock resistance. The support cable shall be stainless steel. A weight shall be attached to the cable above the float to hold switch in place. A quantity of four (4) floats shall be provided.

433.04 Check Valve and Pipe: The discharge piping shall include exterior lever air cushioned check valves and wheel actuated gate valves located in a concrete valve pit on each discharge main.

433.05 Concrete or Fiberglass (FRP) Wetwell: Concrete wetwell shall contain either a pre-cast or cast in place reinforced concrete foundation, pre-cast 10' diameter walls, and reinforced concrete top with flood proof access hatch. Exterior of concrete wetwell shall be coated with 6 mils of coal tar epoxy (pre-cast only). Interior of concrete wetwell shall be coated with PolyBrid 705 to 80 mils per manufacturer's recommendations.

The bottom of the wet well shall have a minimum slope of 10% to the pump intakes and shall have a smooth finish. The wet well shall be sized to provide adequate storage volumes.

Glass-Fiber Reinforced Polyester (FRP) wetwells shall be a one-piece monolithic designed unit constructed of glass-fiber reinforced, supplier certified, unsaturated commercial grade polyester resin containing chemically enhanced silica to improve corrosion resistance, strength and overall performance. FRP wetwells shall be manufactured in strict accordance with ASTM D-3753 "Standard Specification for Glass-Fiber Reinforced Polyester Manholes and Wetwells", as manufactured by Containment Solutions, Inc., Conroe, Texas, "Flowtite" Fiberglass wetwells, or Engineer Pre-Approved Equal.

433.06 Wetwell Access Hatch: The wetwell access hatch shall consist of two Halladay Series FIR access doors, each containing 36" X 60" openings, each centered directly over each pump and guiderail. The flood tight access doors shall be certified to be watertight when under 2' of water. Alternates to the Halladay access hatch shall be submitted to the City Engineer for review.

433.07 Guide Rail: The guide rail assembly shall be permanently attached to the sump basin. The entire rail system shall be constructed of stainless steel. The guide rail assembly shall consist of a bottom plate which shall be bolted to the bottom of the basin, a minimum of two guide rails per pump to insure correct placement of the pumps and provide easy installation and removal of pumps, and rail braces as required.

The lifting cable shall consist of a stainless steel braided wire cable attached to the pump lifting bail of sufficient length to connect directly to the hoist for single lift operation. An eyelet shall be provided at the upper end of this cable for attaching to the wet well access frame.

433.08 Discharge Piping Assembly: The discharge piping assembly shall include be as shown on the construction plans. All interior piping within the wetwell shall be ductile iron or stainless steel. Any interior couplings shall be stainless steel. Piping within the valve vault shall be ductile iron. Check valves shall be external lever air cushioned swing check valves. Gate valves shall have flanged joints complete with wheel actuator.

433.09 Vent: The lift station vent shall be placed in order to vent the wet well and additionally protect the lift station from the 100 year flood event. The vent shall be installed a minimum of 1' above the Base Flood Elevation. Vent material shall be PVC schedule 40 pipe w/stainless steel screen.

433.10 Valve Vault: Valve vault shall be precast or cast in place reinforced concrete, outer dimensions 10' X 6', a minimum of 5' in depth, with a bottom backfilled with a minimum of 12" of washed 1.5" rock to allow the bottom to drain. The valve vault shall contain a Halladay Series WS27248 access hatch, or approved equal to allow operators to easily access the valve vault for maintenance.

433.11 **Electric:** The control system shall include circuit breakers, motor starters, transformers, hand-off-automatic switches, automatic pump alternator, wetwell level sensing devices, cycle timers, and accessories required to provide a complete and functional system.

All wiring within the wetwell and outside the control cabinet shall be run in PVC conduit except for wiring to motors which shall be in accordance to manufacturer recommendations. All wiring shall be in accordance with current National Electric Code and applicable local code revisions. It shall be the responsibility of the contractor to furnish and install correctly sized service wires and obtain service for installation. No splice shall be permitted in any wiring. It shall also be the responsibility of the Contractor to furnish and install all required exterior disconnects, switching mechanisms, alarm or control conduit and wiring.

433.12 **Pump Control Center:** A complete pump control center shall be mounted adjacent to the wet well on a Unistrut support anchored into a concrete pad, as shown on the construction plans. The panel, all its components, and the wiring shall be in accordance with the latest NEC Code. The panel shall be NEMA 4X construction with doors hinged to swing horizontally and utilize acceptable stainless steel clasp devices. For operator safety, one panel shall house the breakers, contactors, and current transformer while a separate panel shall house the pump control unit and phase monitors. All circuit breaker operators, selector switches and gauges shall be accessible from the front panel without opening the doors. Internal panel wiring shall be color coded and any wiring leaving the panel shall pass through properly numbered or coded terminal strips. Every switch, control relay, circuit breaker and other components, either inside or out shall be visibly and permanently identified.

The pump station control panel shall be as specified in the construction drawings. The contractor shall be responsible for providing compartmentalization of control transformer and control panel to prevent unauthorized access.

The service meter for lift station will be fastened to a service pole provided by contractor. Contractor will be responsible for placing electrical service line underground from the starters to the junction box located at the lift station wetwell. The work required will include the trenching, PVC conduit, and the construction of the junction box and control panel mounting structure.

434 ***SAMPLE Pump Performance and Design Requirements** (This is a sample only, refer to the approved construction plans for site specific requirements).

TYPE:	Fairbanks Morse, 4" Type 5432 Non Clog Submersible
RATED CAPACITY:	600 gpm at 80'
MIN SHUT OFF HEAD:	114'
OPERATING SPEED:	1765 rpm
MIN. PUMP EFFICIENCY AT DESIGN POINT:	65%
MIN. MOTOR HORSEPOWER:	20 HP
MOTOR SERVICE FACTOR	1.15
ELECTRIC SERVICE	480 Volt, 3 Phase, 60 Hz

435 **Operation of System**

On sump level rise, lower switch shall first be energized, then upper switch shall next energize and start lead pump. With lead pump operating, sump level shall lower to low switch turn off setting and pump shall stop. Alternating relay shall index on stopping of pump so that lag pump will start first on next operation and become lead pump. If sump level continues to rise when lead pump is operating, override switch shall energize and start lag pump. Both lead and lag pump shall operate together until low level switch turns off both pumps. If level continues to rise when both pumps are operating, alarm switch shall energize and signal the alarm. If one pump should fail for any reason, the second pump shall operate on the override control and

if the level rises above the override control, the alarm shall signal. All level switches shall be adjustable for level setting from the surface.

436 Execution

The Contractor shall leave the entire packaged lift station installed under this contract in proper working order. Upon completion of the installation, an acceptance test run shall be run in the presence of the City Engineer or his representative for a period of six (6) hours to ascertain that the system is operating correctly as required for the overall operation of the facility.

437 Operations and Maintenance Manuals

437.01 **Requirements:** The operations and maintenance manuals for each type of equipment furnished by the Contractor shall be a separate document meeting the following specific requirements:

A. Format and Organization

1. Use drawings and photographs to illustrate the printed text as necessary to fully present the required information.
2. Where information covers similar items of equipment, identify the applicable portions by heavy weighted arrows, boxes, or circles, or strike out the inapplicable information. Nonconforming data is not acceptable and will be returned for rework and resubmittal.

B. Contents

1. Table of Contents and Index
2. Description of each system and components
3. Complete starting and stopping procedures
4. Emergency stopping procedures
5. Operating instructions, including special operating instructions.
6. Routine maintenance procedures
7. Lubrication requirements
8. Manufacturer's printed operating and maintenance instructions, parts lists, illustrations, and exploded view diagrams.
9. Complete copy of approved shop drawing, including cross sections.
10. Complete procedure for installation, alignment, adjusting, and checking.
11. List of spare parts, recommended spare parts, and recommended quantity.
12. Name, address, and phone number of supplier's headquarters.
13. Safety instructions and requirements.
14. Electrical schematic diagram.
15. Control wiring diagram.
16. Copy of warranty or bond.
17. **Performance curves, engineering data and start-up test results, including start-up amperages, running amperages, and line voltages.**

C. Materials

1. Loose leaf on 30 pound punched paper, protected to repel oil and moisture and be wear resistant.
2. Printed on one side only.
3. Of original quality, reproducible by dry copy method.

D. Final Submittal

1. Four copies of operations and maintenance manual shall be submitted to the City of Burnet prior to final acceptance.

438 Accountability

438.01 Warranty: Manufacturer shall warrant in writing the entire structure to be free from defects in materials and workmanship for a period of 1 year starting from the date of written project acceptance. The manufacturer shall submit in writing, a letter guaranteeing compliance to pump performance data submitted. The approved packaged lift station manufacturer shall provide references of similar lift station installations in Texas if requested by the City Engineer.

440 Remote Terminal Unit (RTU) for Computer Based Supervisory Control and Data Acquisition System

441 General

441.01 Scope of Work: The CONTRACTOR shall furnish all labor, supervision, materials, tools, equipment and services necessary for the complete installation of a Remote Terminal Unit (RTU) for the existing computer based Distributed Supervisory Control and Data Acquisition (SCADA) system. The RTU system shall consist of product manufacturers who have at least five years experience in furnishing similar SCADA equipment and developing SCADA systems. The RTU system shall be placed in service and demonstrated to OWNER when it is complete and ready for operation.

The CONTRACTOR shall install the radio based RTU equipment at the Lift Station site and shall connect all signal, power, and communications wiring, cable, and program, start up, and calibrate the installed system. CONTRACTOR shall furnish all necessary labor and materials for program upgrading and I/O setpoint changes.

The accompanying input/output point list shall describe all of the input and outputs to be controlled by the system.

441.02 Submittals: The submittals for the SCADA system shall include the following:

- A. Manufacturer's product data
- B. Typical system diagrams showing all wiring connections and field wiring.
- C. Narrative description of all software and hardware which will be provided by the CONTRACTOR.
- D. Manufacturer's manuals for each component or unit which lists performance capabilities.
- E. Manufacturer's recommended spare part list.
- F. Warranty documents describing coverages and limits.
- G. Wiring diagrams to show the complete point to point connections.
- H. Manufacturer's recommended spare part list.

441.03 Acceptable Manufacturers:

- A. Autocon Industries
- B. Hydro-Con Industries
- C. Siemens Energy and Automation
- D. Engineer approved equal

442 Products

442.01 General: The SCADA system is currently used for data acquisition. However, the SCADA system shall have all the control capabilities for controlling pumps, valves, and other equipment used.

The RTU for the SCADA system shall perform the following:

- A. Monitor the lift station, pumps, and wetwell alarms
- B. Transmit current status information to the SCADA system at the WWTP over a radio telemetry unit.

442.02 Manuals: Three complete sets of laminated manuals shall be provided at the time the RTU is delivered to the site.

The manuals shall include the following information:

- A. General System Description
- B. Equipment Reference Manuals
- C. Software Documentation
- D. Hardware Documentation
- E. Installation Guidelines
- F. Operation Procedures
- G. Maintenance Procedures

442.03 Quality Assurance:

- A. The RTU and radio system shall be furnished with all equipment and accessories specified herein. All components shall be the products of companies normally engaged in the manufacture of such equipment.
- B. The vendor shall perform all system engineering and assume responsibility for successful and functional operation of this equipment in accordance with the system requirements set forth in these specifications. The vendor shall be responsible for providing the complete verbal and written operating and configuration procedures and instructions to OWNER designated operations personnel.
- C. The vendor of the RTU system equipment must be approved by the engineer/owner and shall be required to show experience in the design, installation, and maintenance of radio based RTU systems.
- D. The vendor must provide local service and inventory of replacement parts so that any system failure can be corrected within 24 hours.

442.04 Warranty: The vendor shall provide a warranty for parts and labor for a minimum period of one (1) year.

442.05 Functional Requirements:

- A. The existing SCADA system shall be programmed to automatically interrogate each RTU for status information (analog, discrete, and accumulative data).
- B. The existing SCADA system shall receive status information from the RTU.
- C. The system shall be capable of communicating over the radio system furnished with the RTU system.
- D. All system components shall be solid state design and modular construction shall be utilized throughout.

442.06 SCADA Software:

- A. The existing SCADA system utilizes Windows NT operating system and operates Wonderware software.
- B. The SCADA system shall store operating parameters (flowrates, levels, equipment run time, etc) taken every 3 minutes, and alarms as they occur on the hard disk storage device.

- C. Software licenses shall be provided for remote site locations.

442.07 Remote Terminal Unit (RTU):

- A. The RTU shall have the capability for the functions required. Refer to the input/output point list contained within this specification.
- B. The RTU shall have the following capabilities:
1. Accept, directly, analog inputs such as thermocouple RTD and voltage ranging from 10.8 millivolts full scale to ± 5.4 volts without need for amplification or characterization.
 2. Accept 4-20 ma dc primary 2 wire instrument inputs.
 3. Accept, directly, rate signal inputs as well as performing pulse totalizations.
 4. Provide outputs as required for external devices and/or control elements.
 5. All software control programs in PROM memory or alterable data in battery backed RAM so there shall be no loss of configuration and parameter data regardless of the length of power failure. The battery shall be the socketed type and have a minimum life span of three years.
 6. Include a power fail/auto restart routine which permits selection of restart in manual or automatic, based on the time interval of power failure.
 7. Perform on line diagnostics.
 8. Operate from power of 120 volts AC, +10%, -15% ; 60 Hz, ± 5 Hz.
 9. Provide power to field transmitters as required.
 10. All input circuits to have electrical noise immunity which, at a minimum, meets the IEEE 472-1974 standard for surge withstand capability.
 11. Input/output lines shall withstand application of 250 volts AC rms for a period of one (1) minute without equipment damage.
- C. Each RTU shall be located as indicated on the plans. All circuitry shall be on plug in cards which are field replaceable. The terminals for input and output connections shall be physically separated to avoid installation and maintenance damage. The terminals shall be a rugged type suitable for standard #16 AWG wire.
- D. The remote RTU shall be Autocon Industries MICROCAT Class 9701 or approved equal.
- E. RTU enclosures shall be NEMA 4X corrosion resistant fiberglass or stainless steel boxes complete with closed cell neoprene gasketing and a white or natural metal finish.

443 **Radio Telemetry Equipment**

443.01 Transceivers: Radio transceivers will meet the needs of the system and the FCC. The RTU shall have a radio transceiver meeting the requirements of FCC Part 90 that can be tuned, aligned, and repaired at any competent two-way radio service center. The RTU shall be capable of using any data radios that are commercially available for use on the Owner designated frequencies. The radio shall have a type-acceptance under FCC Part 90 for operation in the appropriate bandwidth (either narrow or wide band). All electrical connections to the radio shall be plug-in for ease of repair.

443.02 Antennas: Radio antennas shall be Omni or Yagi type units with gain as required by the site field surveys. The antennas shall be rated for 80 miles per hour wind speed. Antennas shall be connected to radios with RG/8U low loss coaxial cable. Each antenna shall be mounted at a height above ground as determined

by the site surveys and comply with FCC regulations. Coaxial connection to the remote unit enclosure shall be by means of a coaxial type bulkhead lightning arrester rated at 1 kilowatt with a minimum of 500 V and a maximum of 2000 V breakdown voltage. Antenna masts, if required, shall be free standing, un-guyed, galvanized steel or aluminum.

443.03 Modems: Radio modems will be provided as an interface between transceivers and the System Control Computer or RTU's. Radio modems shall be consistent with the system design and telemetry strategy.

443.04 Repeaters: Radio repeaters shall be furnished selectively to insure reliability of the telemetry network where such factors as terrain features or effective radiated power of the system does not provide a reliable communications path.

- A. The RTU will be capable of being a Store and Forward Repeater and include the option of a route repeating strategy.
- B. Two frequency repeaters will operate on one frequency with the base station radio on a separate non-interfering frequency with the system RTU's.

444 **Base System Radio Control Hardware and Software**

444.01 System Base Radio Modem: The system base radio modem shall link the base radio and the system control computer and be contained within a NEMA 4 wall mounted standard Hoffman enclosure suitable for office appearance. The system shall be battery backed for short term operation during power outages. The base radio modem and all other functions shall operate on battery voltage.

The base radio modem shall be capable of printed circuit board level additions of synthesized voice telephone or radio dialers and also be capable of serving as a terminal unit link to the control site as if the control site was another remote site on the system with full data and control processing.

444.02 System Reporting Software: The system reporting software is coordinated with the system files to provide automatic and operator reports of the system variables. Automatic period reports are generated for year, month, and day. Operator periods reports are generated for year to last month, month to last day, and day to last hour poll. Period reports express the system variables in form of accumulated count or averages for the period. Operator instantaneous values reports are implemented by polling the system to update the system status, then generating the report. The report presents the system variables in the form of instantaneous status on/off, fail, alarm, rate value, or level value.

445 **Execution**

445.01 General Installation: The SCADA system vendor shall attach field wiring to termination strips in RTU enclosures. The vendor shall install SCADA software and install all communications hardware. The vendor shall test all communication links to ensure proper communications between Central Station Unit (CSU) and RTU.

RTU Inputs/Outputs: The input/output requirements are described in the Input/Output point list sheet for this project.

445.02 Software Configuration: The RTU System vendor and user assigned operation personnel, shall configure or modify the CSU SCADA system so as to provide monitoring of the RTU at the SCADA system owned by the City of Burnet.

The configuration shall include:

- A. Creation of data base of I/O points
- B. Inclusion of calculated values in data base
- C. Creation of graphic displays
- D. Creation of daily wastewater report, including pump run times, all alarms and changes of status,

and lift station level status changes and time of day of occurrences.

E. Creation of monthly wastewater run time reports.

F. Creation of CSU control setpoints and strategies.

445.03 Acceptance Testing: The system shall be completely assembled, configured, and tested to insure the operation of each command and acquisition point. A hard copy of the database shall be submitted to the City for their review, comment, and approval one week prior to the acceptance testing.

445.04 Start Up: The manufacturer shall furnish a competent technical representative to check out field adjust and start up the system and operate the system for a period of five consecutive days.

445.05 Spare Parts: CONTRACTOR shall furnish one set of plug-in card used in the RTU system and five of each type fuse required by the system as spare parts.

445.06 Service and Support: During and after the warranty period, the vendor shall provide service on all RTU System equipment for a period up to five years from the acceptance date.

450 Effluent Reuse – Type I Reclaimed Water

All effluent reuse mains shall have **metallic location tape** placed in the last 2 feet of fill of the trench (i.e. 2 feet deep from the final grade). See details.

451 General

451.01 Description: This item shall consist of furnishing all necessary labor, equipment, and materials and performing all work required to install reclaimed water pressure mains and appurtenances of the class, size, and dimensions specified at the locations and to the lines and grades shown on the plans, all in strict compliance with these specifications.

452 Design Criteria

452.01 Hose bibs and Faucets: All hose bibs and faucets shall be painted purple and designed to prevent connection to a standard water hose. Hose bibs shall be located in locked, below grade vaults which shall be clearly labeled as being of non-potable quality. As an alternate to the use of locked, below grade vaults with standard hose bibs services, hose bibs may be placed in a non-lockable service box which can only be operated by a special tool so long as the hose bib is clearly labeled as non-potable water and complies with one of the following requirements:

A. Signs having a minimum size of eight inches by eight inches, as shown in Figure 1, shall be posted at all storage areas and on all hose bibs and faucets reading, in both English and Spanish, "Reclaimed Water, Do Not Drink" or similar warning.

A. The area shall be secured to prevent access by the public.

452.02 Separation Requirements: Separation distances shall comply with Section 700 of the City of Burnet Standard Specifications. Reclaimed water lines must conform to the TCEQ requirement for spacing as a minimum.

452.03 Pressure Mains: Reclaimed water lines which transport reclaimed water under pressure shall be sized according to acceptable engineering practices for the needs of the reclaimed water users. The designer shall consider methods to prevent or maintain lines to mitigate the effect of the deposition of solids in such lines. Pipe specified for reclaimed water force mains shall be of a type having an expected life at least as long as that of the lift station and shall be suitable for the reclaimed water being pumped and operating pressure to which it will be subjected. All pipes and fittings shall have a minimum working pressure rating of 150 pounds per square inch.

452.03 Gravity Mains: Gravity flow reclaimed water lines shall meet the requirements of Section 412 of these specifications. The designer shall consider methods maintain line fluid velocity to migrate the effects of the depositions of silt in the gravity conveyance.

452.04 Marking of Pipe: All exposed piping and piping within a building shall be either purple pipe or painted purple. All buried piping shall be manufactured in purple color. All exposed piping shall be stenciled in white with a warning reading "NON-POTABLE WATER". All exposed or buried reclaimed water piping constructed at a wastewater treatment facility is exempt from the color coding requirements of this section.

452.05 Isolation Valves. In-line isolation valves for reuse pipes shall open clockwise to distinguish them from potable water isolation valves. Valve casings for underground isolation valves shall have cast into the cast iron lid "reuse" or "NPW".

452.06 Storage: All effluent ground level and elevated storage tanks shall be designed, installed, and constructed in accordance with current AWWA standards with reference to materials to be used and construction practices to be followed, except for health-based standards strictly related to potable water storage and contact practices, where less restrictive standards may be applied. All storage facilities shall be stenciled in white with a warning reading "NON-POTABLE WATER".

470 Standard Products List

471 470.01, Piping

<u>PIPING</u>		
<u>TYPE</u>	<u>Manufacturer</u>	<u>Size</u>
Ductile Iron	U.S. Pipe, Tyler Pipe, Griffin Pipe, American Ductile Iron Pipe, McWane, or approved equal	3" and up
The above shall apply to lift station piping suction and discharge always flanged.		
PVC SDR 26 Sewer	J-M Pipe, Certainteed, North American Pipe, Can-Tex, or approved equal	4" and up
The above shall apply to gravity sewer in uninterfered trench (not crossing water mains, through creeks etc.)		
ASTM D-2241 SDR-26 Sewer Pressure Pipe	J-M Pipe, Certainteed, North American Pipe, Can-Tex, or approved equal	4" and up
C-900 PVC DR-14 Only		

The above shall apply to lift station force mains, interfered trenches, special circumstance gravity lines as deemed necessary by City Engineer and or Water/Wastewater Manager

304 Stainless Steel

Merit Brass or approved equal

1/4 " up to 3"

The above shall apply to Wastewater Plant, lift station and air relief piping, pump rails, any and all nipples for gauges, sample cocks etc.

472
~~470.02~~ Valves

<u>VALVES</u>		
<u>TYPE</u>	<u>Manufacturer</u>	<u>Size</u>
External Lever and Weight Check Valves	Mueller A-2606-01 or approved equal	2 1/2" to 16"
Ball Check Valves	Apollo or approved equal	1 1/4" to 2"
Gate Valves	Mueller 2360 & 2361 Series or Clow F-6102	2 1/2' through 24"
Small Brass Ball and Gate Valves	Hammond or equal gate valves Red&White ball valves or approved equal	1/4" through 2"

473 ~~470.03~~ Sewage Air Release Valves

<u>Sewage Air Release Valves</u>		
<u>TYPE</u>	<u>Manufacturer</u>	<u>Size</u>
Air Release Vacuum Breaker	A.R.I. Model D-025 or approved equivalent	2" and 3"

474 470.04 Manholes

<u>Manholes and Wetwells</u>		
<u>TYPE</u>	<u>Manufacturer</u>	<u>Size</u>
Fiberglas Heavy Wall Manholes (minimum wall thickness 0.480 inches)	Flowtite ASTM D 3753 or approved equivalent	42", 48", 54", 60", 66", 72", and 92"
H-20 Minimum rating		
Fiberglas Heavy Wall Wetwells (minimum wall thickness 0.480 inches)	Flowtite ASTM D 3753 or approved equivalent	36" to 240" diameter 6ft. To 35 ft. height
H-20 Minimum rating		

475 470.05 Ring & Cover

<u>Ring and Covers</u>		
<u>TYPE</u>	<u>Manufacturer</u>	<u>Size</u>
Ductile Iron Ring and Cover	Saint Gobain RE62M4RD or East Jordan Iron Works #1033Z or #1034Z or approved equivalent must be ductile iron self latching	24"
H-20 Rating		
Ductile Iron Ring and Cover	Saint Gobain RE60R8FD or approved equivalent must be ductile iron with latching mechanism for inflow prevention	24" or 32"
H-20 Rating		

476 470.06 Covers

<u>Covers</u>		
<u>TYPE</u>	<u>Manufacturer</u>	<u>Size</u>
Aluminum Wetwell Covers and hatches	Halliday W1S, W2S, S1S, S2S, W1R, W2R, S1R, S2R, H1W, 2W, H1R, H2R or approved equal	As Per Specifications depending on pump size and wetwell configuration
Cleanout boot for drop manholes	East Jordan Iron Works model #1565, Cast Iron	As per manufacturer's specifications

Miscellaneous/Fasteners		
TYPE	Manufacturer	Size
?	?	?
<p>Note: Any and all fasteners, nuts, bolts, washers, chains, wire rope, clasps, rails, hasps, brackets, or hangers at or around wastewater wetwells shall be a minimum construction material of 304 stainless steel and 316 or greater stainless steel if deemed necessary by the City Engineer or Water/Wastewater Manager.</p>		
<p>Note: Any and all fasteners, nut and bolt combinations not required to have thread locking compound shall be dressed with an anti-seize thread compound so as to allow for disassembly in future. Anti-seize compound shall be installed before final assembly.</p>		
<p>Note: Any device, piping assembly, bracketry, hatch or any other item secured to concrete on or around a wastewater plant or lift station shall be approved by the City Engineer, Water/Wastewater Manager or designated City of Burnet Inspector before installation.</p>		