Lewis & Clark Caverns Upper Visitor Center Septic Replacement (FWP #7136345)
SPECIFICATIONS LIST

Special Provisions:

1. Site Access & Contractor's Access Plan
2. Existing Septage Removal & Disposal
3. Construction Survey by Contractor
4. Water Pollutions & Sediment Control
5. Sanitary Facilities
6. System Testing & Demonstration
7. Permitting
8. Measurement & Payment
9. Exploratory Excavations
10. Excavations at or Through Existing Drainfield Sites
11. Air Quality Compliance
12. Historical and Archaeological Sites
13. Electrical Power
14. Noxious Weed Deterrence
15. Wildfire Awareness
16. Camping
17. Soils Information

Technical Specifications:

01610 General Equipment Stipulations

02050 Demolition & Clearing
02210 Excavation & Backfill
02600 Pipelines & Appurtenances
02910 Seeding

03300 Concrete

06672 Buried F.R.P. Tanks & Accessories
06675 Plastic Manholes, Handholes & Vaults
06678 Infiltration Chambers

09900 Painting

10400 Signs

11228 Submersible Sewage Pumps

13400 Process Instrumentation & Control

15101 Valves

16005 Electrical
16483 Variable Frequency Drives

SPECIAL PROVISIONS:

1. SITE ACCESS & CONTRACTOR'S ACCESS PLAN

The Contractor is advised that access to all portions of the Work site is difficult – including steep terrain, absence of access and haul roads, and unavailability of water and electrical power service – and may require specialized methods and equipment. Work is also being conducted in a State Park environment, requiring minimized equipment intrusion and temporary construction for access routes.

The Contractor shall assess site access in the field for his/her intended construction methods prior to bidding and determine and execute means suitable for successful conduct of the work. Specialized means and methods for access and construction at the site shall be as elected by the Contractor and shall be considered incidental to the Work and the Contract Price. No additional cost or adjustment to the Contract Time or Contract Price will be allowed for special access and construction methods at the site.

1.1 Septic and Dosing Tank Sites

Septic and dosing tank sites lie at the foot of an extended steep slope from the Upper Facilities parking lot, without any established equipment routes to the sites. Crane rigging for equipment setting, pumping of concrete, and conveying systems for aggregate all may be allowed at the Contractor's option, subject to approval Submittal review of the Access Plan described below.

Excavating equipment can possibly be brought to the tank site by a temporary equipment ramp constructed from the Upper Parking Lot, subject to review and approval of the Contractor's Access Plan. Any temporary equipment ramps or routes shall be fully removed and reclaimed in the same manner as pipe and tank excavations – including topsoil salvage, reseeding and erosion mat coverage, Excavations for new buried tanks shall be adequately shored and braced to avoid sloughing or erosion to upslope fill for the Upper Parking Lot.

All equipment and materials staging in the Upper Parking Lot shall be conducted with full protection of existing pavement, curbs and rock walls, signs, benches, and other Park improvements. Any existing Park facilities damaged by the Contractor shall be fully repaired and restored or replaced in timely fashion at his/her sole expense.

1.2 Pipeline and Drainfield Sites

New effluent delivery pipelines and the new drainfield lie on steep terrain, with ground slope ranging from 20% to in excess of 25%. Specialized construction equipment, such as self-leveling excavators, may be necessary at the Contractor's option.

An optional access route to the pipeline and drainfield sites may use the existing unimproved "two tracks" and hiking trail from Highway 2 up the bottom of Lower Cave Gulch, but the Contractor is cautioned that this route is partly obstructed and not currently passable for trucks

and most construction equipment. The Contractor may conduct limited temporary improvements to the upper "Hiking Trail" portion of this route for his/her site access as indicated on the Drawings, subject to the requirements for Submittal review of the Access Plan described below. Contingent on Access Plan submittal approval, any such improvements to this route will require restoration to "trail-like" conditions as shown on the Drawings. Any portions of the Lower Cave Gulch used for construction access shall be left in well-graded, clean condition with positive drainage and broadcast-seeded. This route is also part of the Park's hiking/bicycling trail system which is used year around, and any proposed use for construction must include a Safety and Signage Plan to protect recreationists as part of the Contractor's Site Access Plan submittal for approval. Based on the Contractor's Access Plan, the State Park will post "Trail Closure" signs at trailheads at the Upper Parking Lot and the Lower Campground; all other construction and safety signage is the Contractor's responsibility. Materials transport and delivery to the pipeline and drainfield sites may also utilize aircraft at the option of the Contractor, subject to Submittal review of the Access Plan described below.

Due to the steep terrain, the Contractor shall make effective provisions to prevent spillage, or "roll away" of all materials and equipment used on the site.

1.3 Concession Building Electrical Extension and Plumbing

New electrical conductor/conduit extension from the Concession Building existing power panel and plumbing improvements (pressure-vacuum breaker on hose bib) shall be addressed in the Contractor's Construction Schedule submittal. These activities will require coordination with Park staff for access. Work cannot be conducted when the Concession Building is operating (see Calendar Limitations, below).

1.4 Site Access and Construction Calendar Limitations

Construction at all points upstream of the existing 1969 Drainfield (new piping Sta. 10+00 approx.) and access for same are not allowed from the Upper Parking Lot while Lewis & Clark Caverns cave tours and Concession Building operation is occurring – specifically from May 1st through September 30th. The existing septic system and drainfield(s) must remain fully operable during this period. Delivery and staging of construction equipment and materials, and other construction staging activities are likewise not allowed during that period at or from the Upper Parking Lot.

Construction, access improvements, and materials delivery and storage below the existing 1969 Drainfield will be allowed after July 8th , subject to all requirements for submittal review including the Contractor's Site Access Plan.

Construction surveying and staking by the Contractor year around will also be allowed.

The Contractor is reminded that Park's potable water system for the Upper Facilities is drained from September 30th until May 1st. The Park cannot provide water supply for potable or testing purposes during construction, and the Contractor must make his/her own provisions for all water

needed during construction and startup.The Contractor is responsible for all snow removal on the Upper Facilities access road, beyond the main Park entry gate, from October 1st to April 30th.

1.5 Access Plan Submittal

At least 30 days prior to any construction mobilization or activity at the site, the Contractor shall submit a detailed Access Plan conforming to the requirements for Submittal review. His/her Access Plan shall include:

A. Drawings of proposed access routes to all portions of the work;
B. Dates and times of use for proposed access routes;
C. Written descriptions of all access and construction means and methods showing conformance to the requirements above;
D. Models, dimensions, weights, wheel loading, and operating characteristics of all construction and access or materials delivery equipment proposed;
E. Materials types and volumes to be delivered by each means proposed;
F. Safety and Signage Plan for protection of Park users;
G. Protective measures proposed for Park features, facilities, signs and benches, etc., during construction;
H. Written description of all post-construction removal or restoration activities for access routes, including specifications for any remedial materials proposed.

The Contractor is reminded that his/her Access Plan will be subject to the Engineer's review as a submittal, and the Engineer will consult with the Owner and Park staff if/as necessary to assure access provisions are appropriate for the Park. The Owner and Park staff reserve the right to disallow any access or construction means or methods they deem detrimental to the Park environment and require Contractor modifications to his/her proposal accordingly. The Contractor is strongly encouraged to consult with Park staff prior to bidding and ahead of preparing his/her Access Plan.

2. EXISTING SEPTAGE REMOVAL & DISPOSAL

The Park partially pumps out its existing septic tank around September 30th at the end of each season. The Contractor shall be responsible for the pumped removal and legal disposal of all remaining septage in the existing 6,500+ gallon concrete septic tank, prior to demolition and backfilling the tank.

3. CONSTRUCTION SURVEY BY CONTRACTOR

Benchmarks for the work are limited to three control points placed during engineering design, as shown on the Drawings. The Contractor shall provide with his/her own equipment, tools, material and labor, all other horizontal and vertical control necessary to install the work within

the tolerances shown and specified. The Contractor shall be responsible for all surveying and construction staking for manholes, tanks, piping, and drainfield trenches.

Discrepancies between Drawings, Specifications, and existing conditions shall be referred to the Engineer for adjustment before work is performed. In case any existing control points have been disturbed since placement, the Contractor shall verify their elevations against other control points. Any control points compromised or lost during construction will be replaced at the Contractor's expense.

The Contractor must utilize the services of a Professional Land Surveyor, currently licensed in the State of Montana, for construction staking for this project. The Contractor shall provide his/her own survey equipment to maintain grade control on pipelines, structures, and drainfield trenches.

4. WATER POLLUTION & SEDIMENT CONTROL

The Contractor shall comply with all laws and regulations of MDEQ and the USEPA regarding pollution of the environment. The Contractor shall take necessary precautions to prevent pollution of surface and ground waters with fuels, oils, bitumen, chemicals, or other harmful materials.

The Contractor is advised that MDEQ considers the (dry) coulee directly below the work site as an ephemeral drainage, and as such may be considered State surface water. Since construction disturbance will exceed 1.0 acres, the Contractor shall obtain and comply with the conditions of the 2018 MPDES General Permit for Storm Water Discharges Associated with Construction Activity (see http://deq.mt.gov/Water/WPB/mpdes/2018_stormwaterconstruction).

The Contractor's responsibilities include but are not limited to preparation of a complete Permit application package with Notice of Intent (NOI) and Storm Water Pollution Prevention Plan (SWPPP); determination if a DNRC "Sage Grouse Consultation Letter" is required with the NOI submission due to project location within identified sage grouse habitat, and if so, execution of that process; payment of permit application and ongoing annual fees; implementation and administration of the SWPPP including inspections as required under his/her Permit; materials and water testing as required under his/her Permit; monitoring and maintenance of all pollution control measures; any signs or postings required under his/her Permit; payment of any penalties for Permit non-compliance or violations; and post-project monitoring of vegetation reestablishment and filing of a Permit Notice of Termination (NOT) once a 70% reestablishment threshold is met. The Contractor is cautioned that new SWPPP requirements became effective January 2018, and now require MDEQ-certified SWPP "preparers" and "administrators" – consult with MDEQ or the Montana Contractor's Association for further information. Annual Permit fees will continue to be payable by the Contractor until the NOT is filed, and may span a multi-year period depending on the pace of revegetation success.

A Sage Grouse habitat determination does not appear likely to be required based on project location (see https://sagegrouse.mt.gov/), but the Contractor shall satisfy him/herself that no

such determination is required and nonetheless comply with State of Montana (including DNRC) requirements relative to Sage Grouse habitat.

Sediment control provisions shall be used whenever work is conducted adjacent to drainage ways or water courses to control silt in runoff. Adequate silt barriers or sediment traps shall be used to comply with statutory requirements for all stream-side work. Measures used may include but are not limited to staked straw bales, fiber rolls, sediment ponds, or staked silt fence. The Contractor will be solely responsible for the selections and implementation of sediment and pollution control measures to assure permit and statutory compliance. Sediment control and storm water permitting, and compliance are considered incidental to the Work, and no separate payment for them will be allowed.

5. SANITARY FACILITIES

The Contractor shall furnish, install and maintain sanitary facilities for his/her workers, including an adequate number of enclosed portable toilets. The Park's "pit toilet" at the Upper Parking Lot is not to be used by construction workers, since it must be pumped out by Park staff.

6. SYSTEM TESTING & DEMONSTRATION

Functional and Performance Tests as described below are required for the completed dosing pumps including VFDs and relay control panel, effluent flowmeter, tank level alarm systems, hydraulic flow splitter and drainfield flow distribution piping. System testing, and demonstration requirements are in additional to requirements for Manufacturers Field Services, as specified in individual equipment Specifications.

A. Field Tests:

1. Functional Test:

a. Prior to startup, all equipment shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a field Functional Test.

b. Functional testing may be conducted concurrently with the Manufacturers' Field Services specified in the respective control and pump equipment sections of these Specifications. Manufacturer's Field Services shall nonetheless meet both the topical and time requirements specified therein, excluding any delays caused by Functional Test problems or failures.

c. Prior to the Performance Test, all supporting control, monitoring, alarm, and flow delivery systems shall be in place, tested, and functional. The Functional Test shall be satisfactorily passed to the satisfaction of the Engineer, before proceeding to the Performance Test, below.

2. Performance Test:

a. Ahead of performance testing, the Contractor shall provide a written Performance Testing Plan(s) for each sub-system, indicating methods to be used and step-by-step tests to be conducted, along with the proposed time and date for testing.

b. Field Performance Tests shall be performed individually on each installed pump or set of pumps and include simulated failure of one pump/VFD in order to trigger the backup pump/VFD. The tests shall demonstrate compliance with the specified performance. Data shall be recorded as follows:

i. Flow, as measured by effluent flow meter, and

ii. Discharge pressure simultaneously measured by pressure gage in flowmeter vault.

iii. Continuous recording of dosing tank levels during testing.

c. Performance Test of each pumping system shall be of a minimum duration of 3.0 minutes each over at least (2) full (automatic) pump cycles. VFD-driven pump systems shall also be demonstrated and tested over their full "low to high" flow range. Pump sets with automatic alternation shall also be tested for successfully demonstration of those respective functions. Dosing tank level float switch controls shall also be successfully demonstrated both in "start/enable" and "low level shutdown" modes.

d. "High" alarm functions, and pump "seal failure" alarm functions (by jumpering seal probe contact circuits) shall be successfully tested and demonstrated.

e. Field performance testing shall also include visual checking for residual water pressure at the end of each drainfield lateral during operation. Using the clean-outs provide on each lateral end, install temporary 1½" PVC standpipes 4' long (or temporary caps with 1/8-in reamed orifices) on the end of each lateral. At least 5.0 ft of standpipe water level (or orifice "squirt height") shall be observed above the lateral piping centerline during drainfield dosing. Repeat test for any laterals not meeting this criterion, after changing the lateral orifice and/or adjusting the inlet gate valve as required to achieve this water level/height.

f. The Contractor shall be responsible for delivering water to the new facilities for testing, and for disposal of water after testing.

g. If any Performance Tests fail or do not achieve the operation shown and specified, the Contractor shall correct deficiencies and repeat the Performance Test until successful.

h. After successful performance testing to the satisfaction of the Engineer, the Contractor may proceed with full commissioning of the new system.

B. Testing Certifications:

The following shall be provided:

1. Manufacturer's Certification of "proper installation" and "successful performance testing" for each pump and control system.
2. Field Functional Test reports, including test data.
3. Performance Test reports, including test data.

7. PERMITTING

The Contractor is responsible for acquiring all construction permits necessary for the project. Required permits include, but may not be limited to the following:

- MDEQ MPDES General Permit for Storm Water Discharges Associated with Construction Activity, and a Storm Water Pollution Prevention Plan for construction.
- Electrical and plumbing permits.

The Contractor shall be a "certified septic system installer" in Jefferson County or comparable county entity.

8. MEASUREMENT & PAYMENT

8.1 Scope: This section described the method of measurements and the basis of payment for all work covered by the Contract. For purposes of this Contract, this Measurement & Payment section shall govern and shall take precedence over all other references to measurement and payment referenced in the Specifications.

8.2 Bid Prices:

A. The bid price of each item of the Contract in the Bid Proposal shall cover all work shown on the Drawings and required by the Specifications and other Contract documents. All costs in connection with the work, including furnishing all materials, equipment, supplies and appurtenances; providing all required construction support plans, equipment and tools; constructing and maintaining dewatering and shoring systems; and performing all necessary labor and supervision to fully complete the work, shall be included in the unit and/or lump sum prices bid in the Bid Proposal. The amounts shown on the Bid Proposal shall be the Contract Price, unless otherwise adjusted by Change Order.

B. No item that is required by the Contract Documents for the proper and successful completion of the work will be paid for outside of or in addition to the prices submitted in the Bid Proposal. All work not specifically set forth as a pay item in the

Bid Proposal shall be considered a subsidiary obligation of the Contractor, and all costs in connection therewith shall be included in the prices bid.

8.3 Estimated Quantities:

Any estimated quantities listed in the Bid Proposal or other Contract Documents are approximate and are to be used only as a basis for: 1) estimating the probable cost of the work, and 2) for the purpose of comparing the bids submitted for the work. Actual field-installed quantities as measure in the field will be the basis for Contractor payment, at the Unit Prices contained in the Bid Proposal. The Contractor is advised that his/her Unit Bid Prices shall apply without Change Order or other price adjustment for installed quantities that differ by plus-or-minus 10.0% from the quantities listed on the Bid Proposal.

8.4 Incidentals:

The Drawings and Specifications do not necessarily name all of the incidental items required to complete the work. The cost of all such incidentals shall be included in the various related bid items.

8.5 Method of Measurement and Payment:

A. No measurement of items listed on the Bid Proposal as "Lump Sum", other than interim progress payments made according to increments of completion as identified in the Contractor's Schedule of Values.

B. Measurement of items that are Unit-priced on the Bid Proposal shall be made by the number of units of each installed, both for purposes of interim progress payments and final Contract quantities and payment. Contractor payment(s) shall be for the field- installed quantities of each Unit-priced bid item, as measured in the field, at the unit prices contained in the Bid Proposal.

8.6 Basis of Payment:

Each bid item listed on the Bid Proposal shall include all labor, tools, equipment, materials and incidentals necessary to complete the work as specified. Bid items include the preparation, review and furnishing of material and equipment Submittals, including modification and resubmittal when required. Where excavation is involved, bid items shall include topsoil salvage/replacement, excavation, backfill, and fine-grading.

Where necessary to achieve the quality of work specified, each bid item shall also include any utility locates, surveys, staking and grade control necessary. Where specified, each bid item shall also include all performance testing, and manufacturer-assisted startup and Owner training; re-testing and repairs if/as necessary are also included. Bid items include furnishing spare parts, where specified. Mandatory code inspections and permits shall be incidental to the work.

The basis of payment for each bid item listed on the Bid Proposal shall be as follows: A.

Mobilization, Bonding & Insurance (Not to Exceed 10.00% of Total Bid)

a. Work Included:
   i. Transport and setup of all equipment, materials and other items needed to complete the project.
   ii. All permits, coordination and compliance and code inspections required for the work, including all permitting and inspection costs.
   iii. Preparation, submission, adherence and monitoring, and close-out of a Montana Stormwater Pollution Prevention Plan (SWPPP), and payment of any fees, consultant costs, testing, and fines involved.
   iv. Bonding and insurance.
   v. Preparation, review, and furnishing of the construction Schedule and regular updates, the Schedule of Values (for lump sum bid items), the Site Access Plan, Safety & Signage Plan, including modification and resubmittal when required.
   vi. Traffic and pedestrian control, including construction signage, protective barriers, and all safety provisions necessary to protect the public.
   vii. Site access provisions, including all ramp, road or trail improvements, and aircraft use as elected by the Contractor per his/her Site Access Plan; also including removal of temporary access features and reclaiming and seeding access corridors used.
   viii. Pump out existing septic tank with septage transport off site and regulatory-compliant disposal.
   ix. Site(s) cleanup and de-mobilization.

b. Measurement: Measurement shall be one lump sum bid item, not exceeding 10%
of the total bid.

c. Payment: Payment will be allowed at 50% of the lump sum bid item once the Contractor is fully mobilized on site and bonds and insurance certificates are provided and approved. Full 100% payment will be allowed once temporary access routes are prepared and the SWPPP has been prepared and approved by MDEQ.

B. New 17,000-gal (nominal) FRP Septic Tank with Installation & Appurtenances; ALSO New 6,000-gal (nominal) FRP Dosing Tank with Installation & Appurtenances

a. Work Included:
   i. New FRP tank fabrication, delivery, setting and testing.
   ii. All tank hatchways, risers, pipe penetrations, vents, carbon odor filters, pump support pads, warning signs, fixtures, and accessories shown on the Drawings or deemed necessary by the tank fabricator.
   iii. Tank excavations, including shoring and bracing. iv.
   Excavation dewatering if/as required.
   v. Demolition of existing concrete septic tank, existing flow-splitter manhole, and 1950s existing drainfield (if required) for clearance for new FRP tanks.
   vi. Crane use and rigging as elected by the Contractor for tank handling and

placement.

vii. Tank manufacturer-engineered backfill and bedding materials and placement.

viii. Furnishing and installing deadman concrete anchors and tank anchor straps and structural attachments per the tank manufacturer's recommendations.

ix. Pipe connections and couplings to and from tanks.

x. Surface restoration and fine grading of backfilled tank sites.

b. Measurement: Measurement shall be by the lump sum bid item for each respective size of FRP tank.

c. Payment: Payment will be allowed incrementally on each tank according to completion status, based on the Contractor's Schedule of Values.

C. Extension and Connection of Exist. Building Sewer Service Lines

a. Work Included:

i. Locating and accessing existing building sewer service lines from the Concession Building and the Visitor Center Guides' Lounge.

ii. Determining, furnishing and installing suitable connecting fittings to adapt and attach to existing sewer service lines and the new septic tank pipe penetration.

iii. Providing new Schedule 80 PVC sewer service line extensions, including fittings to join two lines before entry to new septic tank.

iv. Excavating, installing and backfilling new 6" PVC service line extensions from the point of connection on existing lines to the new septic tank.

v. Segregating, screening and placing native material pipe bedding. vi. Surface restoration and fine grading of pipe trenches.

b. Measurement: Measurement shall be by the lineal foot of sewer service line extension installed, as measured through all pipe fittings, from the point of connection to existing lines to the point of connection to new septic tank pipe stubs. No separate payment for pipe connectors and fittings is allowed.

c. Payment: Payment shall be at the unit price bid per lineal foot of sewer service line installed and completed, including backfill.

D. Duplex Submersible Dosing Pumps with Slide-rail Mounts

a. Work Included:

i. Providing and installing (in dosing tank) new dual submersible dosing pumps complete with motors, seals, and power and control cabling with brackets and supports.

ii. Pump slide rails, bases, lifting chains and brackets.

iii. Pump discharge and connecting piping to the point outside of the dosing tank, including fittings and couplings.

iv. Pump manufacturer's testing and certification of completed pump installation.

b. Measurement: Measurement shall be one lump sum bid item per duplex dosing

pump system.

c. Payment: Payment will be allowed incrementally according to completion status, based on the Contractor's Schedule of Values.

E. 240V Power Extension in Exposed Conduit

a. Work Included:

i. Confirming suitable exposed conduit routings.

ii. New conductors and conduit mounted to the Concession Building, including conduit fittings, junction boxes and condulets.

iii. Conduit clamps and fasteners.

iv. Connection to the existing Concession Building 240/120V breaker panel, including new and relocated circuit breakers as shown on the Drawings.

b. Measurement: Measurement shall be by the lineal foot of exposed conduit installed, as measured through all fittings and boxes, and including conductors within. No separate payment for conductors or conduit fittings or boxes is allowed. Exposed conduit shall be measured from the point of connection to the existing Concession Building panel, to the point of transition to underground conduit. Measurement and payment of exposed conduit does not include, and exposed conduit/conductor runs to/from or aboard the Subpanel/VFD/Alarm panel rack – such conduits and conductors shall be included with that lump sum bid item.

c. Payment: Payment shall be at the unit price bid per lineal foot of exposed conduit installed and completed.

F. 240V Power Extension in Buried Conduit

a. Work Included:

i. Confirming suitable buried conduit routings.

ii. New conductors and buried conduit, including conduit, fittings, excavation and backfill.

iii. Electrical warning tape buried atop new buried conduit runs.

iv. Electrical handholes complete with covers, including excavation, bedding, backfill, and conduit sealing.

b. Measurement: Measurement shall be by the lineal foot of buried conduit installed, as measured through all fittings and handholes, and including conductors within. No separate payment for conductors or conduit fittings or boxes is allowed. Buried conduit shall be measured from the point of transition from exposed conduit on the Concession Building, to the point of "daylighting" directly beneath the Subpanel/VFD/Alarm panel rack. Measurement and payment of buried conduit does not include buried conduit/conductor runs between that panel rack and pumps, alarms, or the flowmeter vault – such conduits and conductors shall be included with those lump sums bid items, and as such are not eligible for separate measurement or payment.

c. Payment: Payment shall be at the unit price bid per lineal foot of buried conduit installed and completed.

G. Subpanel, Relay, Alarm, and VFD Panels with Rack and Wiring

a. Work Included:

i. New Variable Frequency Drives (VFDs) for dosing pumps, including drive accessories, harmonic filters, human-machine-interfaces, disconnects and pilot lights, enclosures, and mounting.
ii. New 240/120V electrical subpanel, complete with surge protection devices, breakers, and enclosure.
iii. New dosing pump relay and alarm panel, with float switches for control and alarm, including cabling and conduit.
iv. All power, control and alarm wiring for panels, VFDs, pumps, meters, controls and alarms, including exposed and buries conduit runs as shown on the Drawings.
v. Grounding for all drives, panels, and equipment per NEC requirements, including grounding cables and ground rods.
vi. Sunshades for panels as shown on the Drawings.
vii. Bolted strut rack for panels, complete with concrete foundations.
viii. Warning signs.
ix. VFD manufacturer's field testing and certification of completed drive installations.

b. Measurement: Measurement shall be one lump sum bid item for panels, rack and wiring.

c. Payment: Payment will be allowed incrementally according to completion status, based on the Contractor's Schedule of Values.

H. Dosing Tank Valve Vault & Connecting Piping

a. Work Included:
i. Valve vault structure with cover and fasteners, including excavation, drain gravel, and backfill.
ii. Ductile iron and PVC pipe fittings in and adjacent valve vault, including thrust restraints as shown on the Drawings.
iii. Dual 6" check valves, and dual 6" gate valves with handwheels. iv. Pipe couplings and flanged adapters.
v. Dual Vent & Bleed valves.
vi. Connecting piping and fittings, with excavation and backfill, from the point outside the dosing tank where dosing pump discharge lines exit, to the new Flowmeter Vault.

b. Measurement: Measurement shall be per each for the dosing tank valve vault including connecting piping.

c. Payment: Payment will be allowed incrementally according to completion status, based on the Contractor's Schedule of Values.

I. Flowmeter Vault & Connecting Piping

a. Work Included:
i. Flowmeter vault structure with cover and fasteners, including excavation, meter-support precast pad, drain gravel, and backfill.
ii. PVC pipe and fittings in and adjacent valve vault, including flanged coupling adapters.
iii. Pressure gage with service saddle, isolation valve and diaphragm seal.

iv. Magnetic flowmeter with sensor with grounding rings, remote transmitter (at panel rack), and instrumentation cabling between, including buried conduit with warning tape, junction boxes, and excavation and backfill.
v. Connecting piping and fittings, with excavation and backfill, from the Flowmeter Vault to the point of connection to the new Effluent Manhole.

b. Measurement: Measurement shall be per each for the flowmeter vault including connecting piping.

c. Payment: Payment will be allowed incrementally according to completion status, based on the Contractor's Schedule of Values.

J. New Effluent Manhole with Connecting & Bypass Piping

a. Work Included:

i. New effluent manhole structure with integral floor, including excavation, concrete base pad, and backfill.
ii. New insulated manhole cover with fasteners, carbon filter, and warning signs.
iii. PVC pipe and fittings in and adjacent effluent manhole, including winter drain valve with support and piping.
iv. Six-inch emergency overflow piping from the dosing tank to the new effluent manhole, including excavation, bedding and backfill.
v. Sealed pipe penetrations to/from new effluent manhole. vi.
Pipe connection to start of new 8" outfall sewer.

b. Measurement: Measurement shall be per each for the effluent manhole including bypass and connecting piping.

c. Payment: Payment will be allowed incrementally according to completion status, based on the Contractor's Schedule of Values.

K. New 8" (Replacement) Outfall Sewer; ALSO New 6" PVC Delivery Piping; ALSO New 10: PV Delivery Piping (Head Tanks); ALSO New 4" PVC Delivery Piping

a. Work Included:

i. New self-restrained PVC pipe of the sizes and ratings shown on the Drawings.
ii. All pipe fittings, couplings, adapters, caps, and flanged soil restraints. iii.
Topsoil salvage and replacement.
iv. Pipe excavation, screened native bedding, and backfill, including demolition and disposal of existing piping where conflicting with new pipe.
v. Detectable buried pipe warning tape.
vi. Special soil compaction requirements where identified on the Drawings. vii.
Rip rap removal and replacement where pipe alignment crosses upper Cave Gulch, as shown on the Drawings.
viii. New pipe cleaning and flushing.
ix. TV inspection of completed 6", 8", and 10" PVC delivery piping.

b. Measurement: Measurement shall be by the lineal foot for each individual size and type of PVC delivery pipe contained in the Bid Proposal. Footage measurements shall be through all pipe fittings and vault and manhole structures. Delivery piping shall be measured from the new effluent manhole

to the starting point of each drainfield zone manifold (first drainfield lateral valve handhole in each drainfield zone). Separate measurement and payment for PVC pipe fittings is not allowed.

c. Payment: Payment shall be at the unit price bid per lineal foot of each individual size and type of PVC delivery pipe, installed and completed.

L. New 8" Cleanout; ALSO New 4" Cleanout

a. Work Included:

i. New surface cleanouts using self-restrained PVC pipe of the sizes and ratings shown on the Drawings.

ii. All pipe wyes, elbows, spools, and caps to construct cleanouts as shown on the Drawings.

iii. Pipe excavation, screened native bedding, and backfill. iv. Cleanout marker posts with pipe clamps.

b. Measurement: Measurement shall be per each for individual sizes of cleanouts contained in the Bid Proposal. No separate measurement and payment for PVC pipe footage used to fabricate cleanouts shall be allowed.

c. Payment: Payment shall be at the unit price bid per each for individual sizes of cleanouts installed and completed.

M. New Energy Dissipater Manhole; ALSO New Flow Splitter Manhole

a. Work Included:

i. New manhole structures with integral floor and baffles and/or cleanout and discharge risers, including excavation, concrete base pad, and backfill.

ii. New insulated manhole cover with fasteners and warning signs.

iii. PVC pipe and fittings in and adjacent manholes, including baffle pate (energy dissipater manhole), and inlet cleanout/vent and outlet perforated risers (flow splitter manhole).

iv. Pipe couplings adjacent manholes, where shown on the Drawings. v. Sealed pipe penetrations to/from new manholes.

b. Measurement: Measurement shall be per each for each type of manhole.

c. Payment: Payment will be allowed incrementally for each type of manhole according to completion status, based on the Contractor's Schedule of Values.

N. 2" Air/Vac Valve Vault on Delivery Pipelines

a. Work Included:

i. New air/vac valve vault structure with open floor, including excavation, gravel base pad, and backfill.

ii. New insulated manhole cover with fasteners and warning signs. iii. Vent & Bleed Valve of size and type scheduled on the Drawing.

iv. 2" PVC riser piping of the class shown on the Drawings, including tapping saddle, isolation valve, pipe union, and support brackets.

b. Measurement: Measurement shall be per each for air/vac valve vaults on delivery pipelines.

c. Payment: Payment shall be at the unit price bid per each for air/vac valve vaults installed and completed.

O. 4" PVC Manifold Piping in Drainfield

a. Work Included:

i. New 4" self-restrained PVC pipe manifolds for each of the two drainfield zones.

ii. All pipe fittings, couplings, adapters, and caps on manifolds. iii. Topsoil salvage and replacement.

iv. Pipe excavation, screened native bedding, and backfill. v. Detectable buried pipe warning tape.

vi. New manifold pipe cleaning and flushing.

b. Measurement: Measurement shall be by the lineal foot for 4" PVC manifold piping in drainfield. Footage measurements shall be through all pipe fittings and valve handhole structures. Separate measurement and payment for PVC pipe fittings is not allowed.

c. Payment: Payment shall be at the unit price bid per lineal foot 4" manifold piping in drainfield, installed and completed.

P. Drainfield Lateral Valve Handhole on Manifold

a. Work Included:

i. Drainfield lateral valve handhole structure with cover and fasteners, including excavation and backfill.

ii. Service saddle on 4" drainfield manifold, and PVC pipe and fittings connecting manifold to laterals, including valves and pipe unions as shown on the Drawings.

iii. Dual 1½"throttling gate valves for lateral connections each direction.

iv. Lateral flow-control orifice plates installed in pipe unions, as scheduled in the Drawings.

v. Completed drainfield end-of-lateral residual pressure (water level or "squirt height") testing, and subsequent adjustment of gate valves and/or orifice change-out if/as required.

b. Measurement: Measurement shall be per each for drainfield lateral valve handholes.

c. Payment: Payment shall be at the unit price bid per each for drainfield lateral valve handholes, installed and completed.

Q. Drainfield Manifold Winter Drain

a. Work Included:

i. Manifold taps, drain valves, fittings, and perforated tubing to empty drainfield manifolds over winter, as shown on the Drawings.

ii. Excavation and backfill.

iii. Drain line cleaning and flushing.

b. Measurement: Measurement shall be per each for drainfield manifold winter drains.

c. Payment: Payment shall be at the unit price bid per each for drainfield manifold winter drains, installed and completed.

R. 36" Wide Drainfield Trench with Infiltration Chamber & 1½" Perforated PVC Lateral Piping

a. Work Included:

i. Topsoil salvage and replacement.

ii. Re-routing or alteration of drainfield trench alignments to circumvent unfavorable soil (or rock) conditions.

iii. 36" wide drainfield trench excavation, including rock removal.

iv. Leveling of trench floors, and hand-scarification of trench floor and walls. v. 34" wide polyethylene infiltration chambers including end caps and section connectors assembled and installed.

vi. 1½" perforated PVC lateral piping supported inside infiltration chambers, including orifice shields as shown on the Drawings.

vii. Screening and place of select screened native backfill atop infiltration chambers in trenches.

viii. Detectable buried pipe warning tape.

ix. Special soil compaction requirements and equipment limitations as identified on the Drawings.

x. New pipe cleaning and flushing.

b. Measurement: Measurement shall be by the lineal foot for drainfield trench, complete with infiltration chambers and lateral piping. Footage measurements shall be through all pipe fittings and handhole structures.

c. Payment: Payment shall be at the unit price bid per lineal foot for drainfield trench with infiltration chambers and lateral piping, installed and completed.

S. Drainfield Lateral End Cleanout & Handhole

a. Work Included:

i. Drainfield lateral end cleanout handhole structure with cover and fasteners, including excavation and backfill.

ii. PVC pipe, elbows and permanent end plugs for end-of-lateral cleanouts. iii. Temporary end-of-lateral 1½" PVC end plugs w/ 0.125" reamed orifices for "squirt height" testing of completed drainfield; replacement of temporary perforated plugs with permanent unperforated plugs after testing.

b. Measurement: Measurement shall be per each for drainfield lateral end cleanouts with handholes.

c. Payment: Payment shall be at the unit price bid per each for drainfield lateral end cleanouts with handholes, installed and completed.

T. Drainfield Surface Runoff Diversion Berm

a. Work Included

i. Surveyed layout and slope-staking of diversion berm.

ii. Re-routing or alteration of berm alignment to conform to final drainfield lateral installation and/or circumvent unfavorable soil (or rock) conditions.

iii. Topsoil salvage and

replacement. iv. Berm cut and fill earthwork.

v. Transport and placement of surplus fill from other work locations to armor upslope of berm embankment.

vi. Collection, transport and placement of salvage rock (of sizes shown on the Drawings) to armor upper slope of berm.

vii. Fine grading of completed diversion berm.

b. Measurement: Measurement shall be by the lineal foot of diversion berm constructed, as measured along the berm centerline (excluding berm end slopes).

c. Payment: Payment shall be by the lineal foot of diversion berm completed.

U. Broadcast Seeding with Erosion Mat

a. Work Included

i. Fine-grading and seedbed preparation of areas to be reseeded.

ii. Obtain certified weed-free seed meeting seed mix specifications. iii. Broadcast seeding, with any fertilizer inclusions specified.

iv. Erosion mat placement and anchorage, including anchor trenches and stapling installed per mat manufacturer's requirements.

b. Measurement: Measurement shall be by the square yard of broadcast seeding with erosion mat installed, excluding all mat "overlap" area and mat area buried in anchor trenches. Measurement shall be at the finished surface area exposed. Measurement of seeding with erosion mat for payment purposes shall be limited to the following:

i. Between points 4'-0" each side of pipe centerline for all outfall and delivery pipe trenches, or between points 4'-0" beyond each pipe when parallel lines are laid within 8' of each other;

ii. 80' x 80' for new tank and vault work area below Upper Parking Lot, including buried electrical power runs and sewer service line extensions;

iii. 6'-6" each side of drainfield trench centerlines (times trench lengths);

iv. 30' total width for drainfield surface runoff diversion berm (times berm centerline length); and

v. All other disturbed areas for pipeline, drainfield, tank and structure installations (including any temporary access ramps constructed from the Upper Parking Lot) shall be excluded from measurement for broadcast seeding with erosion mat, but nonetheless shall require such treatment at the Contractor's sole expense.

c. Payment: Payment shall be by the square yard of broadcast seeding with erosion mat completed.

9. EXPLORATORY EXCAVATIONS

The Contractor shall conduct exploratory excavations as necessary to determine existing/new tank locations, and piping connection points including but not necessarily limited to – the

existing sewer services lines from buildings; the existing 6" outfall line for routing the new 8" Outfall Sewer; and the existing drainfield(s). Exploratory excavation shall also be performed to located existing buried utilities that may lie in proximity to the work, including buried propane service and water/sewer lines and building connections, and in the event rock intrusions are encountered in areas to be excavated. The Contractor is advised that existing utilities and pipelines shown on the Drawings are conceptual only and are not represented to be complete or accurate in size and location. The Contractor shall conduct all exploratory excavations determined in his/her judgement to be necessary for the conduct of the Work, for the protection of existing infrastructure, and for safety purposes. This does not mitigate or replace the need for One Call utility locates as required under the General Conditions.

All exploratory excavations are considered incidental to the Work, and no separate payment for them will be allowed.

10. EXCAVATIONS AT OR THROUGH EXISTING DRAINFIELD SITES

As shown on the Drawings, new effluent pipelines will be installed through the existing 1969 drainfield, once abandoned. At new septic/dosing tank and control panel sites, the 1950s drainfield may also be encountered. The Contractor shall remove and properly dispose of any saturated, biosolids, or unsuitable fill from excavations at these locations, and replace it with clean fill from elsewhere on the work site. Existing pipe pieces or shards generated at these excavation sites shall be removed or buried at least 36" in a manner not to interfere with backfill compaction or new pipes and structures. No existing pipe debris or biosolids shall be left exposed at the ground surface.

Excavation at or through existing drainfield sites are considered incidental to the Work, and no separate payment for them will be allowed.

11. AIR QUALITY COMPLIANCE

Best Management Practices shall be observed by the Contractor to mitigate release of airborne particulates from fugitive dust and vehicle/equipment emissions.

12. HISTORICAL AND ARCHAEOLOGICAL SITES

No known historical or archaeological sites are anticipated to be encountered in the construction area(s). In the event that cultural, historical or archaeological materials are inadvertently encountered during the conduct of the Work, the Contractor shall prevent further disturbance to such items and immediately notify the Owner and the Engineer, who will contact the Montana State Historic Preservation Office for investigation.

13. ELECTRICAL POWER

The Contractor shall furnish, install and maintain his/her own electrical power as necessary for

construction activity, and will not be allowed to use Park outlets or power feeds. Portable generators or temporary power drop (from Northwestern Energy) are allowable, but at the Contractor's sole cost. Once new dosing pumps and controls are placed, wired and ready for testing, Park power will be provided without cost to the Contractor only for pump and instrumentation startup, testing, troubleshooting, and system demonstration purposes.

14. NOXIOUS WEED DETERRENCE

The Contractor shall be solely responsible for effective noxious weed deterrence during the course of construction. The Contractor shall thoroughly power-wash all delivery and construction equipment and vehicles prior to their entry or re-entry onto the work site(s). Materials to be brought onto the site shall be cleaned and handled in a manner to avoid introduction of weed remnants or seeds.

15. WILDFIRE AWARENESS

The Contractor is cautioned to conduct all operations on the work site(s) and within the Park with fire safety and wildfire prevention in mind. No open burning is allowed, and all vehicles and equipment (including chainsaws) shall have effective, operable spark arrestors. Adequate fire extinguishers shall be on-board all equipment, and water tanks shall be maintained in proximity to the work site(s). The Contractor must comply with any Fire Restrictions promulgated by the Park, Jefferson County, of the State of Montana during the course of construction.

16. CAMPING

Camping by construction personnel is only allowed in State Park-designated campsites, and must comply with all Park regulations. Camping or overnight parking are not allowed at the Upper Parking Lot(s) or anywhere beyond the main Park entry gate.

17. SOILS INFORMATION

Soils information for the project consists of (5) soil test pits, excavated by Davis Excavating in April 2017, and field logged by the Engineer. Soil test pit locations are shown on the Drawings. The Engineer also prepared an 05Nov17 Soils Report of the test pit excavations, solely for the basis of soil absorption drainfield design and which is not be construed as a geotechnical investigation for construction purposes. The Contractor is advised to conduct additional geotechnical investigation as necessary for his/her bidding and construction purposes. On-site excavation, sub-surface probing, or test holes by the Contractor will require written concurrence from the Park Manager.

For information purposes, the 05Nov17 Soils Report with field soils logs appears on the following pages.

Montana Fish, Wildlife & Parks
Lewis & Clark Caverns State Park
Upper Visitor Center Septic Replacement Project (FWP #6839)

SOILS REPORT

revised 05Nov17

Background and Purpose

The Upper Facilities at Lewis & Clark Caverns State Park include a Visitor Center, restrooms, ticket sales, and (non-cooking) food concessionaire, and are served by a conventional septic tank and drainfield system for treatment of wastewater. The original 1950s system included a small drainfield near the 5,000-gal (assumed size) concrete septic tank. A septic effluent flow splitter manhole, 6-inch outfall pipe, and much larger second drainfield were added in 1969, approximately 1,000 ft downgradient and to the west (see Figure 1, next page).

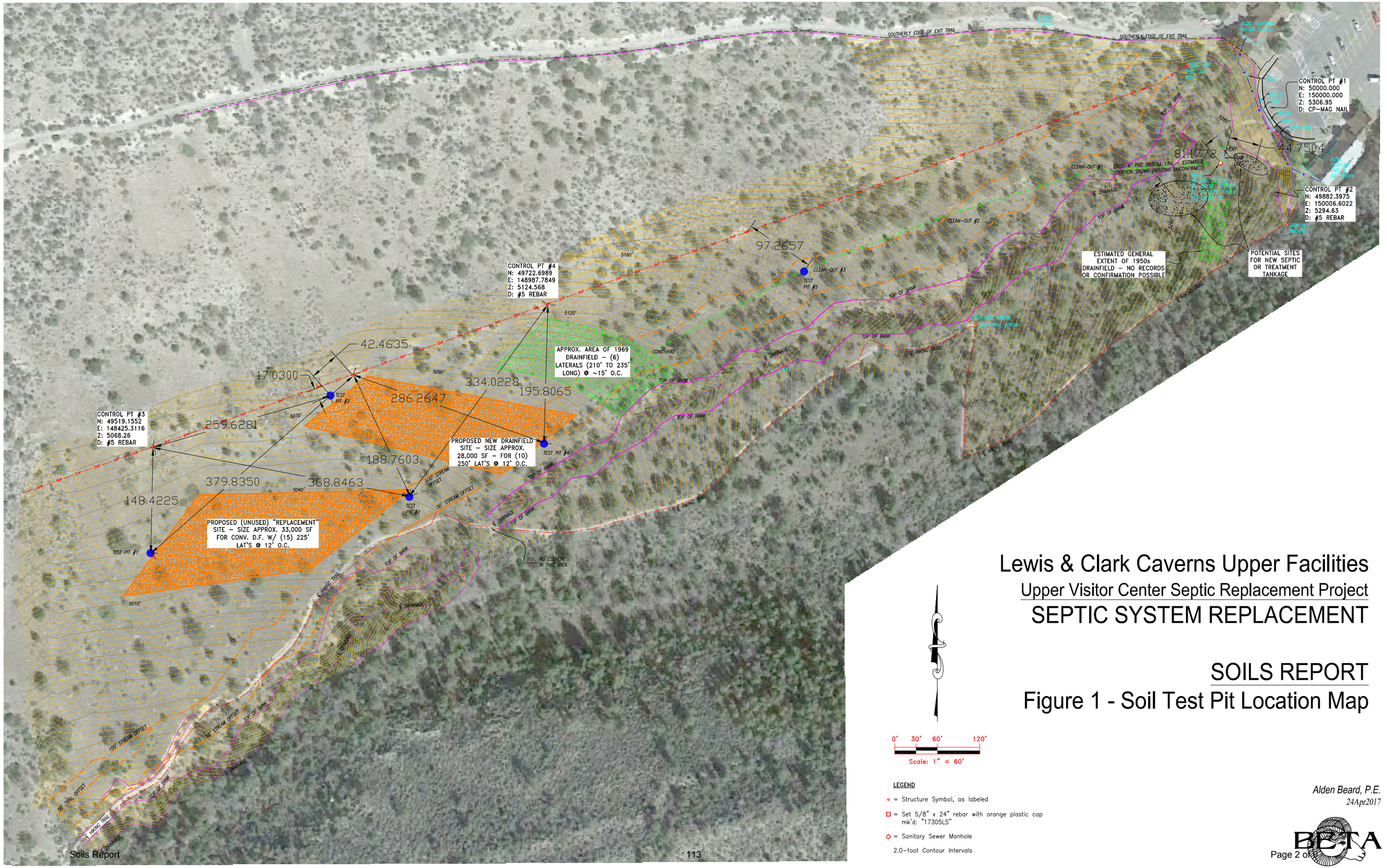
The 1969 as-built drawings show 1,350 ft. of gravel-lined drainfield trenches with 4-inch perforated pipe, laid in six parallel gravity-fed laterals. Replacement of the existing septic tank and soil absorption system (drainfield) at the Upper Facilities is the focus of this project.

A 26Apr17 Technical Memorandum on Septic System Replacement Alternatives established that the recommended option for a replacement system is a 6,000 gpd conventional septic system with a pressure-dosed, infiltration chamber drainfield (Alternative 2). The new drainfield is proposed west and further downslope from the 1969 field.

Circular DEQ4 is the governing MDEQ design standard for public subsurface wastewater treatment systems. Therein a soils investigation is required as part of the siting evaluation for the replacement drainfield. This report addresses those soils considerations in accordance with Sections 2.1.3 and 2.1.4 of DEQ4. The goal of the soils evaluation is to confirm that soil characteristics are conducive to effective treatment, that bedrock and groundwater intrusions do not pose interferences, and that a suitable septic effluent application rate can be rationally determined. Application rates based on soil type and texture are prescribed in Table 2.1-1 of Circular DEQ4, as shown below:

TABLE 2.1-1
Soil Texture Descriptions are found in Appendix B

Texture	Percolation Rate (minutes per inch)	Application rate (gpd/ft^2) (a) (b)
Gravel, gravelly sand, or very coarse sand (c)	<3	0.8
Loamy sand, coarse sand (d)	3-<6	0.8
Medium sand, sandy loam	6- <10	0.6
Fine sandy loam, loam	10- <16	0.5
Very fine sand, sandy clay loam, silt loam	16-<31	0.4
Clay loam, silty clay loam	31-<51	0.3
Sandy clay	51-<121	0.2
Clays, silts, silty clays (e)	121- <240	0.15
Clays, silts, silty clays (f)	>240	Additional Soil Information Required



Lewis & Clark Caverns Upper Facilities

Upper Visitor Center Septic Replacement Project

SEPTIC SYSTEM REPLACEMENT

SOILS REPORT

Figure 1 - Soil Test Pit Location Map

0' 30' 60' 120'

Scale: 1" = 60'

LEGEND

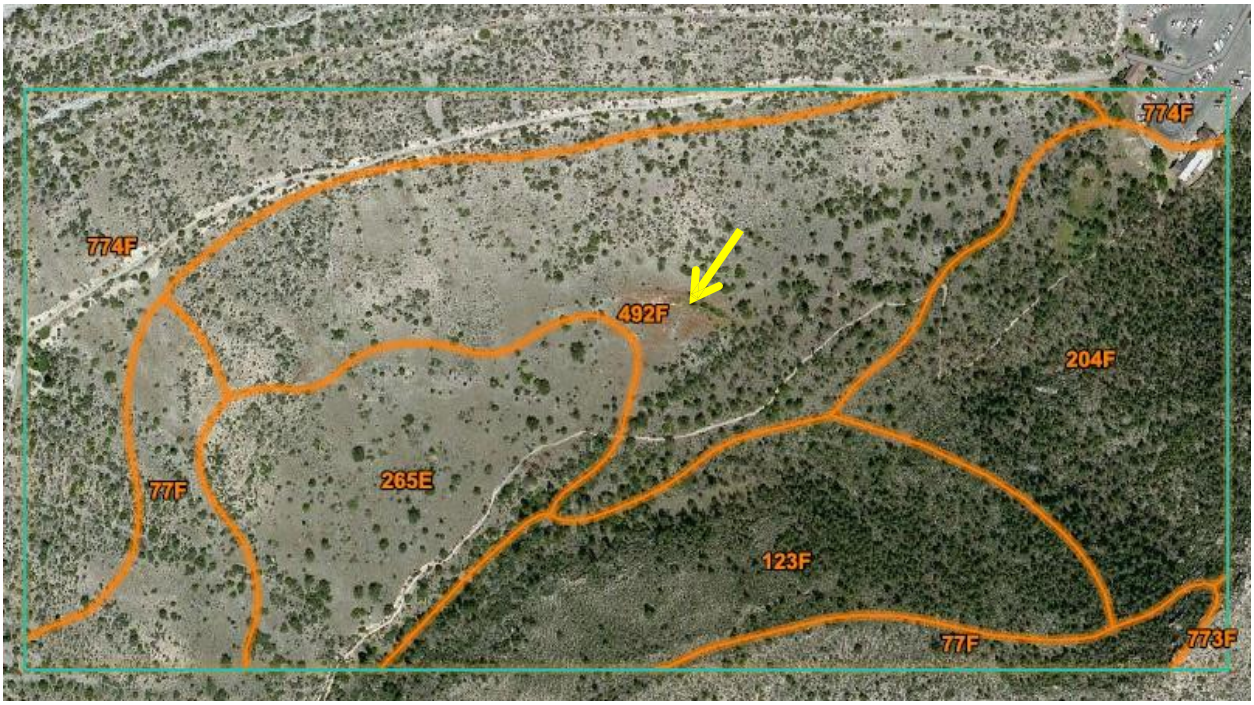
- ∘ = Structure Symbol, as labeled
- □ = Set 5/8" x 24" rebar with orange plastic cap mk'd: "17305LS"
- ○ = Sanitary Sewer Manhole
- 2.0-foot Contour Intervals

Alden Beard, P.E.
24Apr2017

BCTA

A U.S.D.A. NRCS Soils Report was generated 08Oct16 as part of the schematic design phase of the project, and used as a tool to initially assess feasibility of siting a new drainfield(s) west of the existing field. New (and "replacement area") drainfield locations appear to fall in NRCS Soils Unit 265E, a "Crago Very Cobbly Loam, Very Stony" – see NRCS Soils map (below), and characterization for 265E (next page).

NRCS characterizes 265E as "very limited" for septic tank absorption fields, primarily due to "slope." Up-gradient where the 1969 drainfield is located in Soil Unit 492F, that unit is also rated as "very limited" for a combination of "slope" and "depth to bedrock" which seems reasonable given its closer proximity to steep coulee walls. The 1969 drainfield (yellow arrow on map, below) has nonetheless performed satisfactorily for over 40 years.



[Soils Map above from 08Oct16 NRCS Custom Soil Resource Report for project area; requested and downloaded by A. Beard, BETA, from NRCS website.]

265E—Crago very cobbly loam, 15 to 45 percent slopes, very stony

Map Unit Setting

National map unit symbol: 5230
Elevation: 3,800 to 5,500 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 37 to 45 degrees F
Frost-free period: 90 to 115 days
Farmland classification: Not prime farmland

Map Unit Composition

Crago, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Crago, Very Stony

Setting

Landform: Alluvial fans, escarpments, hillsides, plains

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous gravelly slope alluvium derived from limestone, unspecified

Typical profile

A - 0 to 4 inches: very cobbly loam
Bk1 - 4 to 20 inches: very gravelly loam
Bk2 - 20 to 50 inches: very gravelly loam
2C - 50 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 15 to 45 percent
Percent of area covered with surface fragments: 1.5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 70 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Ecological site: Silty-Droughty-Steep (SiDrStp) 9-14" p.z. (R044XS340MT)
Hydric soil rating: No

[Soils Characterization above from 08Oct16 NRCS Custom Soil Resource Report for project area; requested and downloaded by A. Beard, BETA, from NRCS website.]

Conduct of Soils Investigation

Based on the proposed new drainfield location and a companion "replacement area" as required by DEQ4-6.6.2.3, pairs of soil test pits were located to bracket both drainfield areas. Pits TP-3 and TP-4 bracket the proposed new drainfield area, and TP-1 and TP-2 bracket the "replacement area" (see Figure 1). These four test pits and the proposed drainfield area(s) lie in approximately a 20%+ ground slope regime, similar to the 1969 field, but were located to avoid adjacent even steeper slope areas and a potential ephemeral drainage to the south of the site. TP-1 through TP-4 were each excavated to a depth of 9.0 feet.

Pit locations remained flexible during the excavations, depending on conditions encountered, but were located just outside the actual drainfield areas per DEQ4-2.1.4 (to avoid creating a percolation conduit between soil strata). The option was retained of adding test pits if significant variations in lithology were encountered in the field.

Reuse of the existing 6-inch PVC outfall line from the Flow Splitter Manhole to the 1969 drainfield could save almost 900 ft of new piping, assuming the new drainfield is located beyond (down-gradient of) the existing field. Circular DEQ4 requires Schedule 40 or Class 200 PVC pipe, but 1969 plans do not identify the pipe other than as "6-inch PVC." If the existing line is not Schedule 40 pipe, an MDEQ Deviation will be necessary to reuse it, assuming it remains serviceable. As part of the soils investigation a fifth pit (TP-5) was excavated to expose the line at a single location and determine the pipe dimensions (i.e., rating). This pit was not logged for soil characteristics since it was up-gradient of the existing drainfield (see Figure 1).

Alden Beard of BETA field-located and staked the test pits per Figure 1 on April 18th, immediately before excavation began. BETA hired Davis Excavation, LLC, of Whitehall, MT, as its excavating subcontractor, and Joe Davis and a helper dug the five pits on 18Apr17 using a Case 580 4WD rubber-tired backhoe with an extendable boom. Due to access constraints from above (Upper Parking Lot), the excavator accessed the site from an old "two-track" following the coulee bottom from state secondary Highway 2. Alden Beard was on site fulltime during the excavations, and field-characterized, logged, sampled and photographed the soil strata in each test pit. Soil samples were taken in gallon-sized heavy zip-lock baggies and kept in sealed polyethylene pails to preserve their in situ moisture condition.

Later at BETA's office, Beard physically reviewed the soil samples from strata in each test pit, including "dry" and "wet" (i.e., water added) manipulations on a white cutting board. Goals of this "bench-scale" analysis were to further characterize sand, silt and clay presence and proportions. Slight adjustments to original field characterizations of some strata were made based on the bench evaluation of soil samples.

After preparing preliminary soils logs for TP-1 through TP-4, Beard also met with Jefferson County Sanitarian, Megan Bullock, at her office in Boulder, MT, on May 3rd. Originally Sanitarian Bullock had hoped to be on site for the test pit excavations, but had a schedule conflict. Beard reviewed soils samples and preliminary logs with the Sanitarian, and solicited her opinions and input on the appropriateness of the soils characterizations. A couple further slight adjustments to BETA's initial soil characterizations resulted from their meeting.

Soils Results and Interpretation

Based on characterizations of soil strata and samples, final test pit logs were developed for TP-1 through TP-4, as shown in Figure 2 (next page). [See Figure 1, previous for test pit locations.] Interpretations are as follows. Of particular interest relative to new drainfield (infiltration chamber) trenches are characteristics of soils lying 3 to 6 feet BGS, since infiltration chamber trenches will likely be 3 feet deep. Strata at and within 1 to 2 feet of the trench floors (i.e., the infiltrative surface) are the most critical from the standpoint of percolation characteristics.

- No bedrock conditions were encountered in the any of the 9.0-foot excavations.

- No groundwater or evidence of seasonal groundwater intrusion (e.g., soil mottling) was encountered in any of the 9.0-foot excavations. Most soil strata appeared moist, but no "free water", glistening, or evidence of saturation was observed.

- The four test pits showed generally consistent lithology (cobbly or gravelly loams of tan, brown or yellow-brown color with fine-to-medium sand often present), and supplemental test pits were not deemed necessary.

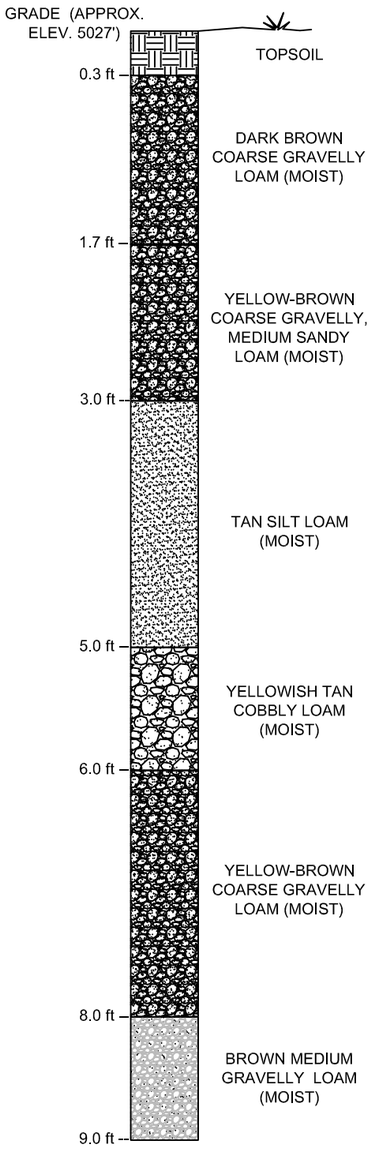
- Noticeable "medium sand" and "fine sand" fractions were observed in multiple loam strata. Visual estimation of the sand fractions appeared to be less than the 30% threshold to classify these materials fully as "sandy loams" (per USDA Soil Survey Manual 13), other than in TP-3 from 3.0 to 6.3 ft BGS (below ground surface).

- Soil characteristics appeared to be moderately consistent with the NRCS characterization for Soil Unit 265 E – "Crago Very Cobbly Loam, Very Stony" although stoniness (10" to 24" fragments) was generally absent. Other characteristics cited by NRCS for Unit 265E that were consistent with the test pits included:
    - Gravelly loam character;
    - Non-hydric soil, and greater than 80 inches to groundwater; and
    - Greater than 80 inches to bedrock.

- In TP-4 a gray "silty clay loam" was encountered between 4.0 and 5.6 ft BGS. This represents a potentially reduced percolation rate stratum, compared to pure "loam" in Circular DEQ4 Table 2.1-1 (previous). Avoidance of this stratum should be considered, if possibly by shifting the location of the new drainfield away from TP-4.

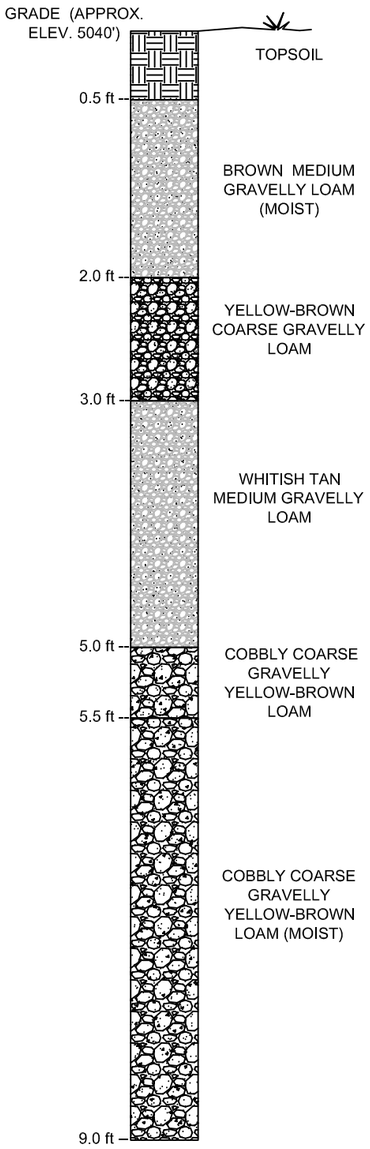
- In TP-1 "silt loam" was observed between 3.0 and 5.0 ft BGS, although the silt fraction is difficult to visually quantify. The two-foot strata observed there was overlain by gravelly/sandy loam, and underlain by cobbly/gravelly loam. Silt characteristics were less conspicuous in other test pits and strata, other than in conjunction with the "silty clay loam" at 4.0 to 5.6 ft BGS in TP-4.

- Other than the localized exceptions noted above, soil strata from the four test pits appear to generally fit "loam" characteristics with moderate "gravelly" or "cobbly" components, and usually some sand present. This supports moderate percolation rates as shown in Circular DEQ4 Table 2.1-1.



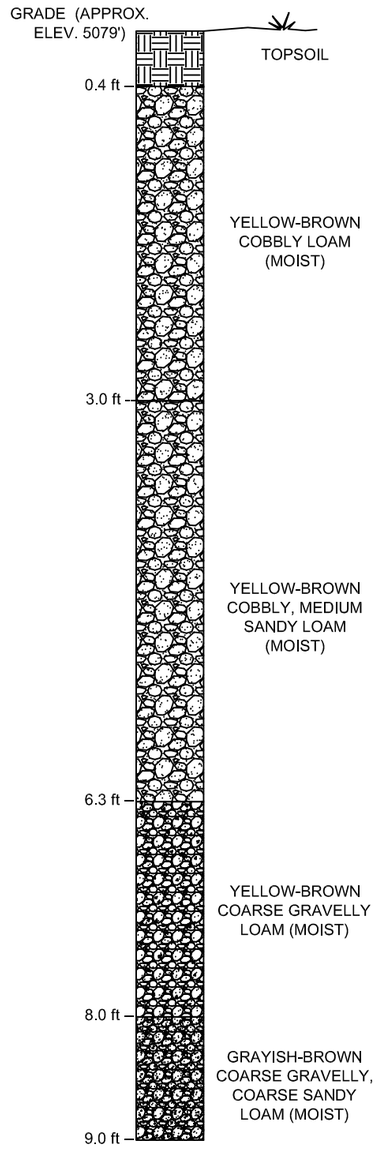
Test Pit TP-1 Log

(no scale)



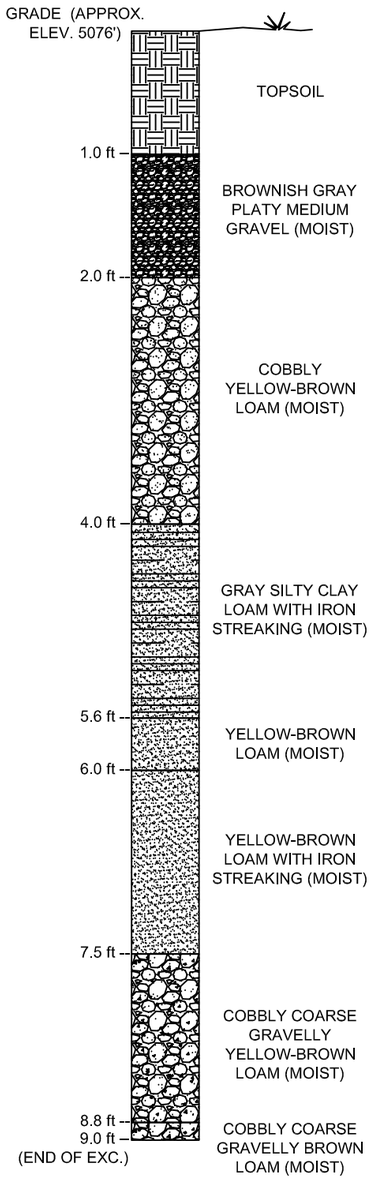
Test Pit TP-2 Log

(no scale)



Test Pit TP-3 Log

(no scale)



Test Pit TP-4 Log

(no scale)

NOTES: A. No static water level or saturated soils were observed in any test pits; no evidence of seasonal groundwater intrusion observed.

B. Excavations done by Davis Excavation, LLC, Whitehall, MT, using Case 580 4WD backhoe with extendable boom on April 18, 2017.

C. Materials observed to be relatively dry, unless noted as "Moist" above.

D. Pit TP-5 was excavated to approx. 3½' depth to locate & inspect exist. 6" PVC outfall pipe to exist. drainfield, but was not logged (in disturbed soil).

sheet 1 of 1

logged: Alden G. Beard, P.E.
date: April 18, 2017 (logged)
drawn: April 24, 2017
revised: May 10, 2017

Lewis & Clark Caverns State Park
Upper Visitor Center Septic Replacement
Figure 2 - SOIL TEST PIT LOGS

Existing 6-inch Outfall Pipe Results

To determine the suitability for reuse of the existing approximately 900-foot, 6-inch PVC outfall sewer ferrying septic effluent to the 1969 drainfield, it was exposed at the TP-5 location (see Figure 1, previous). The excavated location was directly downstream of an existing "cleanout" – built using a 6-inch wye, angled riser, and brass plug per 1969 drawings.

The pipe is shown in the photo below, and the following observations were made:

- Pipe circumference measured 19.72" (using a soft "pipe O.D." measuring tape), equaling a 6.28" O.D. This corresponds to the industry standard of 6.275" O.D. for Schedule 35 PVC sewer pipe.
- Pipe was very well bedded in what appeared to be screened native material. Bedding was rock-free and generously placed for about a foot around all sides of the pipe.
- Pipe exterior appeared in excellent condition, with no visible deterioration.
- Pipe cover at the location measured 31 inches, slightly less than the 4'-0" minimum cover called out on the 1969 drawings.
- While a pipe joint was not exposed, it is presumed that the pipe is glue-joint, based on an old methyl ethyl ketone (solvent) can found buried adjacent the pipe. Solvent is used to clean pipe ends before gluing. The 1969 drawings do not indicate joint type.

Conclusions and Recommendations

The following conclusions and recommendations are derived by the author from this soils investigation:

1. Since "Medium Sand" or "Sandy Loam" strata were not observed consistently throughout test pits TP-1 through TP-4, the initial assumption of a 0.6 gpd/sf effluent application rate per Circular DEQ4 Table 2.1-1 (previous) may be unrealistic. That assumption was used in the 26Apr17 Tech Memo on Septic Alternatives and associated drainfield sizing and cost estimates. It was based on the NRCS characterizations for Soil Unit 265E as "well drained" with "gravelly loamy sand" beginning at 50 inches BGS (see previous NRCS Soils Characterization).

   Based on soil test pit results, generalized soil characteristics appear to better fit the "Loam" categories in DEQ4 Table 2.1-1 (previous). This classification represents a design effluent application rate of 0.5 gpd/sf per Table 2.1-1, rather than the 0.6 gpd/sf originally assumed. While some localized "Silt Loam" was encountered (TP-1), it was

not pervasive enough to warrant dropping to a 0.4 gpd/sf application rate, particularly with the prevalent gravel and sand fractions encountered.

A 0.5 gpd/sf design application rate increases the required size of the new drainfield by 20% with a proportional impact to drainfield cost estimates, compared to sizing and costs presented in the 26Apr17 Tech Memo on Septic Alternatives. BETA recommends that drainfield size and design proceed on this basis. This will require an expansion of the proposed new and replacement drainfield areas shown in Figure 1 during design of the new facilities. Potentially, the new drainfield area could be extended further west (downslope) to encompass additional area.

2. The occurrence of a "silty clay loam" strata in TP-4 at 4.0 to 5.6 ft BGS is a potential further restriction to percolation rate (0.3 gpd/sf per Circular DEQ4 Table 2.1-1), although it is apparently localized and does not appear in TP-2 or TP-3. The boundary of the new drainfield site as shown in Figure 1 could potentially move 50 ft or more, further away from TP-4 to minimize the chance of encountering this clayey loam. A new drainfield site may nonetheless fall within 100 ft of the potential ephemeral drainage (State "surface waters") in the coulee. Usable ground with less than 25% slope is limited, and may require the drainfield to extend to 50 ft from the drainage, which was anticipated but requires an MDEQ Deviation.

3. The existing 6-inch PVC outfall pipe to the 1969 drainfield appears to be in suitable condition for reuse based on visual inspection at a single location. However SDR 35 PVC sewer pipe does not meet the requirements of Circular DEQ4. Section 4.3.2.2 therein requires pressure water pipe of either Schedule 40 or Class 200 (200 psi) for PVC "transport pipe" to effluent distribution systems. Either of these PVC pipe ratings has a 6.625" O.D., significantly larger than the 6.28" O.D. measured for the existing pipe. SDR 35 PVC sewer pipe is not pressure-rated by manufacturers, since it is typically used for gravity sewers. However in the PVC industry, SDR 35 does correspond to a pressure rating of 118 psi, although gasketed jointing systems are often manufacturer-tested at 50 psi or less. While an MDEQ Deviation may not be required to reuse the pipe provided it meets "current design standards," verification of its condition by TV-inspection is proposed to verify pipe serviceability and condition. This is slated for Spring 2018.

Based on this soils investigation, some re-evaluation of size and configuration of new drainfield site(s) will be necessary based on soil characteristics observed. This will be accomplished as part of ongoing conceptual design, with results incorporated into final design criteria and facilities locations for the project. Drainfield-related costs as presented in the 26Apr17 Technical Memorandum on Septic System Replacement Alternatives are also likely to increase.

prepared by: Alden Beard, P.E.

BETA

SECTION 01610

GENERAL EQUIPMENT STIPULATIONS

PART 1: GENERAL

1.1 Section Includes

A. All equipment furnished and installed under this Contract shall conform to the general stipulations set forth in this section except as otherwise specified in other sections.

1.2 General

A. Manufacturer's Experience: Unless specifically named in the Specifications, a manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past five years.

B. Coordination: Contractor shall coordinate all details of the equipment with other related parts of the Work, including verification that the structures, piping, wiring and equipment components are compatible. Contractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

C. Workmanship and Materials

1. Supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

2. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

3. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or

vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4-inch thick.

D. Value Engineering

1. Manufacturer may submit for review and approval proposed modifications to the design, materials or arrangements specified. Request shall clearly state the advantages, cost savings or other reasons for the proposed change. Acceptance of any proposed changes will be the sole discretion of the Engineer as proscribed under the "or equal" and "substitute item" clauses of the General Conditions.

E. Seismic Loading Design Provisions

1. Machinery, equipment, and components such as tanks, piping, and electrical panels, including their supports and anchorages, designed by manufacturers or suppliers, shall be designed in accordance with the provisions of the latest edition of the International Building Code to withstand seismic loads for the project area in addition to other loads. Design shall be performed by a licensed professional engineer familiar with seismic design. Submittals shall be certified, by the Design Engineer, that equipment designs conform to all applicable IBC requirements including provisions to withstand seismic loads.

F. Elevation

1. The elevation of the site ranges between approximately 5010 and 5280 feet above MSL. All equipment furnished shall be designed to meet stipulated conditions and to operate satisfactorily at this elevation.

G. Manufacturers' Reference

1. The use of a manufacturer's name, model or catalog number is intended to establish a standard of quality and the general configuration required, subject to the requirements for Submittal review.

H. Single Source

1. Like items of equipment shall be the end product of one manufacturer in order to achieve standardization. Note that a single manufacturer is required to supply and warranty specific

duplex dosing pump equipment, and the septic and dosing tanks to be supplied on this Project.

I. Manufacturer's Representative

1. Manufacturer shall provide a Manufacturer's Representative as required to assist in the installation, adjustment, startup, certification and operating training.

2. Manufacturer's Representative shall be an employee or certified sales representative of the manufacturer who is factory trained and knowledgeable in the technical aspects of the products and systems.

3. When the services of the representative are specifically required for a listed time period, "days" shall represent 8-hour full days, exclusive of Saturdays, Sundays and holidays. Travel time is considered incidental to the work and will not apply to the required listed time.

4. The Contractor shall make clear and audible video recordings of the full duration all "Operator Training" portions of the manufacturer's representatives' on-site services. Duplicate copies of these video recordings in a commonly readable electronic format shall be provided to the Engineer on previously unused USB flash drives.

4. If listed time is not required by or is modified by determination of the Owner after Contract award, an appropriate adjustment in payment shall be made.

5. If the provided Manufacturer's Representative is found deficient in training or experience by the Owner or Engineer, the manufacturer shall furnish another acceptable representative.

1.3 Submittals

A. General

1. Submittals and shop drawings for review and approval shall be submitted electronically to the Engineer at beta97@blackfoot.net. All electronically provided submittals must be in no larger than 11x17 paper-size format and must bear signature or other notation indicating the Contractor's own review and approval prior to submission. The governing Technical Specification section(s) for each submittal shall also be indicated therein by the Contractor.

2. The submittals shall include satisfactory identification of items, units, and assemblies in relation to the Specification section number, and the system or equipment identification or tag number shown on the Drawings, or as provided in the applicable specification section.

3. Should the Contractor propose any item on his/her shop drawings, or incorporate an item into the work, and that item should subsequently prove to be defective or otherwise unsatisfactory, (regardless of the Engineer's preliminary review), the Contractor shall, at his/her own expense, replace the item with another item that will perform satisfactorily.

4. See also Submittal requirements of Article 3.12 of General Conditions.

B. Shop Drawings

1. The Supplier shall submit, as applicable, the following for all prefabricated or manufactured structural, mechanical, electrical, plumbing, process systems, and equipment

2. Shop drawings or equipment drawings, including dimensions, size and location of connections to other work, and weight of equipment.

3. Catalog information and cuts

4. Installation or placing drawings for equipment, drives, and bases

5. Supporting calculations for equipment and associated supports specified to be designed by equipment manufacturers or suppliers.

6. Wiring and control diagrams of systems and equipment.

7. Complete manufacturer's specifications, including materials description and painting system.

8. List of special motor features being provided (i.e., space heaters, altitude corrections, thermal protectors, etc.).

9. Complete motor rating for all motors, including inverter-duty, motor no-load, starting, and full-load current at rated voltage; full-load speed and full-load current at 110 percent voltage; motor efficiency and power factor at 1/2, 3/4, and full load at rated voltage.

10. Performance data and pump curves, including pump head-capacity at reduced speeds by 100 rpm increments for all pumps called for VFD operation.

11. List of spare parts to be furnished under the Contract.

12. List of any additional manufacturer-recommended spare parts with current price information.

13. List of special tools required for checking, testing, parts replacement, and maintenance (Special tools are those which have been specially designed or adapted for use on parts of the equipment, and which are not customarily and routinely carried by maintenance mechanics).

14. List of special tools furnished with the equipment.

15. List of materials and supplies required for the equipment prior to, and during startup.

16. List of lubricants and supplies furnished with the equipment.

17. Samples of finish colors for selection, if/as applicable.

18. Special handling instructions.

19. Requirements for storage and protection prior to installation.

20. Requirements for installation and recommended installation procedures.

21. Requirements for routine maintenance required prior to equipment startup.

22. List of all requested exceptions to the Contract Documents.

C. Submittals Required for Foreign-Manufactured Items

1. In addition to the submittal requirements stated above, suppliers of foreign-manufactured items shall submit the names and addresses of companies within the United States that maintain technical service representatives and a complete inventory of spare parts and accessories for each foreign-made item proposed for incorporation into the work. Failure to prove the foregoing capabilities shall be just cause for rejection of the foreign-manufactured items.

D. Interface Information (Connection and Relationship with Other Work)

1. Where called for in the Specifications, and as determined to be necessary by the Engineer, interface information shall be submitted as specified. This interface information shall be accurate and contain all information necessary to allow the completion of detail design and construction of the interfacing or connecting work.

E. Certification of Compliance

1. Where specified, furnish certification of compliance for products specified to a recognized standard or code prior to the use of such products in the work.

2. Certifications shall be signed by the manufacturer of the product; state that the components involved comply in all respects with the requirements of the Specifications.

3. Products used on the basis of a certification of compliance may be sampled and tested at any time. The fact that a product is used on the basis of a certification of compliance shall not relieve Contractor of responsibility for incorporating products in the work which conforms to requirements of the Contract. Products not conforming to such requirements will be subject to rejection whether in-place or not.

4. Engineer reserves the right to refuse permission for use of products on the basis of a certification of compliance.

F. Manufacturer's Certification of Proper Installation

1. When manufacturer's certification is required in the Specifications, the manufacturer shall provide certification stating the following:
   a. The product or system has been installed in accordance with the manufacturer's recommendations.
   b. The product or system has been inspected by a manufacturer's authorized representative.
   c. The product or system has been serviced with the proper lubricants.
   d. Applicable safety equipment has been properly installed.
   e. Proper electrical and mechanical connections have been made.
   f. Proper adjustments have been made and the product or system is ready for functional testing, plant startup, and operation.

G. Functional Test Certification

1. Where a certification of functional testing is specified for certain equipment, Contractor (as applicable to the equipment furnished) shall state in writing that:
   a. Necessary hydraulic structures, pumps, valves, etc., and have been successfully tested.
   b. Necessary equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate they are operational.
   c. Adjustments and calibrations have been made.
   d. The systems and subsystems are capable of performing their intended functions.
   e. The facilities are ready for performance testing, or for startup and intended operation, as applicable.

H. Performance Test Reports

1. Prepare and submit performance test reports where specified for equipment and systems.

I. Shop Drawing Submittal Procedures

1. Procedures

   a. Combine submittals specified in each Specification section into a single package. Partial packages will not be reviewed until all submittals required for the section have been received.

   b. Sequentially number the transmittal forms; resubmittals to have original number with a decimal numeric suffix – for example, original Submittal No. 1.0, second (or resubmittal) Submittal No. 1.1, etc.

   c. Revise and resubmit submittals as required; identify all changes made since previous submittal.

J. Accessories

1. All equipment shall be provided with the following accessories as applicable.

2. Safety Guards:
   a. All belt or chain drives, fan blades, couplings, and other

moving or rotating parts shall be covered on all sides by a safety guard in complete accordance with the requirements of OSHA. Safety guards shall be fabricated from 16 USS gauge or heavier galvanized or aluminum-clad sheet steel or 1/2-inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

3. Anchor Bolts:

   a. Equipment manufacturers shall provide anchor bolt size, location and loads, including seismic loading. Anchor bolts will be provided by others, unless noted to be supplied by the equipment manufacturer in the Equipment Specifications.

4. Lifting Lugs:

   a. Equipment weighing over 100 pounds shall be provided with lifting lugs.

5. Identification Plates:

   a. A 16-gauge stainless steel identification plate shall be securely mounted on each piece of equipment in a readily visible location. The plate shall bear the 1/4-inch die-stamped equipment identification number indicated in this Specification and/or shown on the Drawings.

6. Special Tools:

   a. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

7. Spare Parts:

   a. Furnish all spare parts specified or purchased prior to requesting the issuance of a Certificate of Completion and/or operation of the equipment by the Owner.

b. Spare parts and special tools shall be properly packaged to avoid damage, in their original cartons insofar as possible, and shall be stored in a location as determined by the Engineer. Any spare parts found to be damaged or otherwise inoperable at the time of delivery shall be replaced or, if approved by the Engineer, satisfactorily repaired.

c. Spare parts and special tools shall be labeled with a minimum 3-inch by 6-inch manila spare parts tag with such information as the part description, the manufacturer's part number, the applicable equipment description and manufacturer, the quantity of parts delivered in each package, the applicable specification section, and the Contractor's and Project's name. This tag shall be firmly affixed to, and prominently displayed on the outside of each package.

K. Miscellaneous

1. Lubrication

a. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

b. Lubricants of the type recommended by the equipment manufacturer shall be provided in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

c. Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

2. Shop Painting

a. All steel and iron surfaces shall be protected by suitable paint or coatings applied in the shop meeting the

requirements of TS 09900. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be coated with a high-grade, oil-resistant enamel. Coatings shall be suitable for the environment where the equipment is installed. Color shall be the manufacturer's standard, unless stated otherwise in the Technical Specifications.

L. Preparation for Shipment

1. Preparation

a. All equipment shall be suitably packaged to facilitate handling and protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.

b. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

c. Grease and lubricating oil shall be applied to all bearings and similar items.

d. Each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

M. Operation and Maintenance (O&M) Manuals

1. The Contractor shall furnish four hard (4) copies of a complete manufacturer's manual for installation, operation, and maintenance of each item of mechanical and electrical equipment or system. Each O&M manual furnished shall be clearly labeled to designate the system or equipment to which it applies, including reference to the governing Technical Specification section(s).

2. The manuals shall be furnished at least 21 calendar days prior to the scheduled start-up of the equipment item completion of the work; but in no case shall submission of the manuals be delayed beyond 75 percent completion point of the Work. Submission of the manuals shall precede payment for all work completed in excess of the 75 percent completion level on the particular equipment and systems for which the manuals are due. Any deficiencies found by the Engineer to exist in the manuals submitted shall be corrected within 30 calendar days following notification of the deficiencies.

3. Each instruction manual shall include, but not be limited to the following:

    a. Diagrams and illustrations.
    b. Detailed description of the function of each principal component of the system.
    c. Performance and nameplate data.
    d. Installation instructions.
    e. Procedure for starting.
    f. Proper adjustment.
    g. Test procedures.
    h. Procedure for operating.
    i. Shutdown instructions.
    j. Emergency operating instruction and troubleshooting guide.
    k. Safety precautions.
    l. Maintenance and overhaul instruction which shall include detailed assembly drawings with part numbers, parts list, instructions for ordering spare parts, and complete preventive maintenance instructions required to ensure satisfactory performance and longevity of the equipment.
    m. Lubrication instructions, which shall list points to be greased or oiled, shall recommend type, grade, and temperature range of lubricants, and shall recommend frequency of lubrication.
    n. List of electrical relay settings and control and alarm contact settings.
    o. Electrical interconnection wiring diagram for equipment furnished, including all control and lighting systems.
    p. Troubleshooting guide.

4. Manuals shall be complete in all respects for all equipment, controls, accessories, and associated appurtenances.

5. Manuals shall be assembled in one or more binders, each with title

page typed table of contents, and heavy section dividers with numbered plastic index tabs. Each manual shall be divided into sections paralleling the Equipment Specifications. Binders shall be three-ring, hard-back type. All data shall be punched for binding and composition and printing shall be arranged so that punching does not obliterate any data. The project title, division designation, and manual title printed thereon shall be as furnished by the Engineer.

6. When more than one binder is required, they shall be labeled "Vol. 1," "Vol. 2," and so on. The table of contents for the entire set, identified by volume number, shall appear in each binder. Submit manual organization and format to the Engineer for approval prior to manual preparation.

7. Each O&M Manual shall be transmitted to the Engineer prior to installation of the equipment and all equipment shall be serviced in accordance with the manufacturer's recommendations prior to operation. A service record shall be maintained on each item of equipment and shall be delivered to the Engineer prior to final acceptance of the project.

N. Maintenance Summary Form

1. Each equipment manufacturer shall furnish a completed Maintenance Summary Form for each piece of mechanical equipment supplied. A blank form shall also be included for the Owner’s future use. The completed Maintenance Summary Form shall be included with the Shop Drawing submitted for each piece of equipment.

2. Maintenance tasks included on the Maintenance Summary Form shall include all routine operations required to ensure the satisfactory performance and longevity of the equipment. Examples include lubrication, belt tensioning, adjustment of pump packing glands, clearance adjustments, and other routine adjustments.

O. Warranty

1. A manufacturer's warranty is required for each piece of equipment as defined in Article 3.5 of the Contract General Conditions.

2. The One-Year Contractor Warranty Period shall begin at the time of Owner acceptance of the installed system or equipment.

SECTION 02050

DEMOLITION & CLEARING

PART 1: GENERAL

1.1 Description

A. This section includes all labor and materials necessary for the work associated with the demolition of miscellaneous facilities as shown on the Drawings and specified herein. This section also covers clearing of trees, brush and vegetation as required for new installations.

1.2 Submittals

A. The following submittals for construction shall be made in accordance with the project submittal requirements as described in the Supplementary Conditions. Demolition and Clearing Plans will be subject to review and approval by the Montana Department of Fish, Wildlife & Parks, in addition to the Engineer's review.

1. Demolition Plan, including all scheduling, sequencing and demolition methods to be used.

2. Clearing Plan, including extent, scheduling, sequencing, access, and equipment methods to be used for clearing, and disposal method and location.

1.3 Site Conditions

A. The Contractor shall satisfy himself/herself as to the conditions that exist at the site both prior to bidding and prior to construction.

B. The Contractor shall confine his operation to within the Construction Limits as indicated on the Drawings.

PART 2: MATERIALS

(not applicable)

PART 3: EXECUTION

3.1 Safety Requirements

A. All work shall be done in conformance with the rules and regulations pertaining to safety established by the State of Montana, OSHA, local authorities, and as specified elsewhere in these specifications.

3.2 Utilities

A. The Contractor shall be responsible for locating all utilities within the demolition area before any demolition is started. The Contractor shall not disconnect or cause interruption of service to any electrical, gas, or water or wastewater conveyance or treatment system without prior approval of the Owner and Engineer.

3.3 General Demolition

A. The Drawings are based on the best available information and may not contain all items requiring removal. The Contractor shall be responsible for determining the work required by inspecting the site.

B. Any non-vegetative debris generated by demolition shall be hauled off-site and disposed of by the Contractor in a legally permissible manner, other than broken pieces no longer than 12" of existing PVC or other pipe (6" diameter and less). Such pipe shards may be buried in new piping trenches outside the pipe bedding zone, but at least one foot below natural grade.

C. Native vegetative debris, including trees, limbs, brush, and other vegetation can be cut to 4' maximum lengths and slashed/scattered uniformly along the pipeline corridors. Slashing and scattering of vegetative debris is not allowed in the tanksite or drainfield areas, or on the surface diversion berm above the drainfield.

D. The Contractor shall be solely responsible for de-energizing and locking out all electrical power to equipment being removed or modified, prior to removal or modification.

3.4 Clearing

A. Trees, brush, and vegetative cover cleared for the conduct of the work and installation of new facilities shall be removed to full depth of vegetative roots, or 4' below grade, whichever is less. Voids left by root removal shall be filled with clean native soil, compacted to a density equal to in situ conditions.

B. Rock removal necessary for the conduct of the work and installation of new facilities shall be removed to 5' below grade. Blasting for rock removal shall not be allowed. Voids left by rock removal shall be filled with clean native soil, compacted to a density equal to in situ conditions.

C. Vegetative clearing or rock removal at the site of the new drainfield shall be done with minimal equipment intrusion and soil compaction, in order to maintain soil suitability for drainfield percolation. Clearing (or backfilling) equipment operated atop the new drainfield area shall have high-flotation tracks or wheels, imparting a soil load no greater than 400 pounds per square foot. The Contractor shall furnish proposed equipment load ratings as part of his/her Clearing Plan.

D. Vegetative clearing for new pipelines outside the drainfield area shall be confined to a corridor no wider than 6' each side of piping centerlines, in order to minimize disruption to the Park environment.

E. Burning or burial on site of cleared vegetative material will not be permitted. Rock material salvaged from excavations that fits with the size range shown on the Drawings shall be transported to the drainfield surface runoff diversion berm and used for armor on its uphill face. Burial of larger removed rock materials could potentially be allowed on site, but only with the express written permission of the Engineer.

3.5 Demolished and Cleared Material

A. Any material which is called on the Drawings to be salvaged to the Owner shall be delivered and placed at a location selected by the Owner.

B. All other material, rock, and vegetative debris shall be the responsibility of the Contractor for removal and legal disposal and shall be accomplished at no additional cost to the Owner.

C. Demolished or cleared material shall not be allowed to obstruct free access and shall be promptly removed from Park property.

SECTION 02210

EXCAVATION & BACKFILL

1. GENERAL

1.1 DESCRIPTION

A. This section covers the work necessary to excavate and backfill for new buried sewer lines, valves, manholes, drainfield manifolds, drainfield infiltration chambers, tanks and appurtenances, and underground electrical, as shown on the Drawings.

B. See also Buried FRP Tanks Specification for additional septic and dosing tank excavation backfilling requirements.

2. MATERIALS

2.1. GENERAL

A. The following referenced specifications shall apply to all excavations and backfill placement:

Montana Public Works Standard Specifications (MPWSS) – 6th Edition (April 2010)

Section 02221 – Trench Excavation and Backfill for Pipelines and Appurtenant Structures

3. MODIFICATIONS

3.1 GENERAL

A. Measurement and Payment Section does not apply.

B. Due to inaccessibility of the site, "Type 1 Pipe Bedding" and "Select Type 1 Bedding" per MPWSS 02221-2.1A and B are not required for new pipelines provided screened non-cohesive native soil is used to bed new pipes. For use as pipe bedding, native soil must be non-clayey (won't hand-roll into a ribbon) and screened to exclude particles larger than 1" diameter. Soil used for pipe bedding must extend 4" beneath pipes, be "haunched" beneath the pipe, and extend alongside and to 12" above the pipe. Native soil used for pipe bedding below, along and above piping

must be placed in lifts not to exceed 6 inches in thickness and compacted to at least
85% of AASHTO T99 maximum dry density.

C. Detectable Warning Tape is required in new pipe trenches per MPWSS 02221-2.4, including manifold and lateral piping within the new drainfield area.

D. Blasting provisions per MPWSS 02221-3.3.D do not apply. Blasting will not be allowed on the site.

3.2 BACKFILL CLASSIFICATIONS AND USES:

A. Pipe trench backfill except at structures and appurtenances per the Drawings, the drainage way crossing, or as otherwise specified below shall be "Type C Trench Backfill" as defined in MPWSS 02221-3.6.C, with 12 inches of mounding above grade as measured at the pipe centerline. Discontinue mounding 25 lf upslope (upstream) of where new piping passes beneath surface diversion berms around drainfield.

B. In the drainfield area only, Type C Trench Backfill shall not be mounded.

1. In the drainfield area only, Type C Trench Backfill shall be hand compacted to only match (not exceed) the adjacent soil in situ density.

2. Type C Trench Backfill shall be screened to 1"-minus size, and placed full depth in drainfield trenches, including alongside and atop infiltration chambers and extending up to natural grade.

C. Pipe trench backfill upstream of Sta. 1+25, including at the Upper Cave Gulch drainage way crossing (Sta. 0+85 to 1+05 approx.) shall be "Type B Trench Backfill" as defined in MPWSS 02221-3.6.C.

D. Backfill around new manholes and Flanged (pipe joint) Soil Restraints shall be "Type B Trench Backfill" as defined in MPWSS 02221-3.6.C and shown on the Drawings.

1. Subgrade for new manholes before (upstream of) Sta. 0+50 shall consist of a
12" thickness of 1"-minus clean washed gravel.

2. Subgrade for new manholes beyond (downstream) of Sta. 0+50 shall consist of 12" of non-cohesive, screened (<2½") native soil, compacted to "Type B Trench Backfill" requirements.

3. Open-bottom valve, meter, and air/vac vaults shall have floor (drainage) layers of 1”-minus clean washed gravel, of the thicknesses shown on the Drawings.

E. Excavation, bedding, and backfill for new buried FRP tanks shall be per the tank manufacturer’s requirements and the Buried FRP Tank & Accessories Specification.

F. Backfill for new buried electrical conduit, including pull boxes, shall be “Type B Trench Backfill” as defined in MPWSS 02221-3.6.C.

3.3 PREPARATIONS AND EXECUTION

A. Contractor shall remove, segregate, and stockpile all native topsoil to its full depth prior to pipeline trench excavations. After backfilling, stockpiled topsoil shall be replaced in the upper excavation and compacted to 80 percent of maximum dry density as determined by AASHTO T99.

B. Equipment operated atop the new drainfield area shall have high-flotation tracks or wheels, imparting a soil load no greater than 400 pounds per square foot. The Contractor shall furnish proposed equipment load ratings as part of his/her Submittals.

C. Contractors are cautioned that much of the work area lies at ≥20% ground slope, including the new drainfield area. To maintain consistence in drainfield lateral trench elevations, “self-leveling” excavator equipment may be necessary at the Contractor’s discretion.

D. Contractor shall take care to fully protect new FRP tanks, new manholes and vaults, existing Park piping (water, sewer and propane) and electrical wiring, and other Park facilities and structures during excavation and backfill. Existing power distribution and lighting wiring, and other buried utilities routings are not known, and must be field-verified by the Contractor. Contractor shall be responsible to repair any damage to buried utilities or Park facilities and replace same if damaged to the pre-project condition and the full satisfaction of the Owner.

E. Testing requirements for fill materials may be waived at the option of the Engineer.

3.4 FINAL GRADING AND CLEANUP

A. All exposed fill surfaces shall be fine-graded to ± 1.0 inches as measured across a five-foot span and shall be suitable to receive seeding.

B. The Contractor shall maintain a clean and non-hazardous work site to thesatisfaction of the Owners. The Engineers, Montana FWP representatives, and Park staff are not trained in construction safety, and work site safety is the sole responsibility of the Contractor, including protection of his/her personnel, the public, area residents and property, and all other property.

C. The Contractor shall promptly clean up and properly dispose of all debris, litter, and leftover materials following completion of the Work and leave the site in conditions meeting the Owners' approval.

D. Surplus excavated fill, as generated from pipe and drainfield trenches, shall be transported to and incorporated into the construction of the drainfield surface runoff diversion berm to the configuration shown on the Drawings.

1. The drainfield runoff diversion berm is configured in an attempt to roughly balance surplus fill generated from the drainfield trenches and delivery piping corridors with the berm embankment requirements. Transport of all surplus fill from these locations to the berm site shall be required, up to the point the full berm section and length has been constructed as shown on the Drawings.

2. If further surplus fill is generated after drainfield diversion berm embankment requirements are met, additional fill may be added to the downslope face of the berm with the approval of the Engineer, provided berm slopes are maintained as shown on the Drawings.

3. Surplus fill generated by the new septic and dosing tank installations may at the Contractor's option be also transported to the drainfield diversion berm location or be hauled and disposed of off-site at his/her option.

SECTION 02600

PIPELINES & APPURTENANCES

1. GENERAL

A. DESCRIPTION

1. This section covers the work necessary to install new buried and exposed pipelines, fittings, and saddles for conveyance of wastewater and septic effluent, and drainfield distribution piping, as shown on the Drawings.

2. New pipelines will perform as a combination of gravity and pressure piping, as lines fill and drain during drainfield dosing cycles. Other than lines connecting to the inlet of the new septic tank, all pipelines will transport filtered septic effluent – to/from the new dosing tank and to the new drainfield.

2. MATERIALS

A. GENERAL

1. All new pipelines shall be PVC, of the Class (SDR) or Schedule as indicated on the Drawings. A combination of PVC and ductile iron fittings are used, as shown on the Drawings.

2. The following referenced specifications shall apply to all pipelines for wastewater service, including fittings, and the installation thereof, unless specifically modified below:

Montana Public Works Standard Specifications (MPWSS) – 6th Edition (April 2010)

Section 02221 – Trench Excavation and Backfill for Pipelines and Appurtenance Structures

Section 02660 – Water Distribution (applies to pressure pipelines)

Section 02730 -- Sanitary Sewer Collection Systems (applies to gravity pipelines)

3. MODIFICATIONS

A. GENERAL

1. Measurement and Payment Section does not apply.

2. Gate Valves specifications per MPWSS 02660-2.8.A do not apply. See project Specification 15101 – Valves for gate valve requirements.

3. Ductile iron fittings per MPWSS 02660-2.2.B shall be flanged as shown on the Drawings, rather than push-on or mechanical joint.

4. Concrete thrust block requirements per MPWSS Standard Drawing 02660-1 are <u>not</u> required with self-restrained PVC pipe fittings, except where specifically shown or called on the Drawings.

5. Specifications for PVC Pressure Pipe per MPWSS 02660-2.2.C are replaced per the following section.

6. Specifications for Service Clamps (Saddles) per MPWSS 02660-2.5 are replaced per the following section.

7. See Excavation & Backfill Specification for pipe bedding requirements.

B. PVC PIPELINES AND FITTINGS

1. <u>Uses</u>: PVC pipe types included, as shown on the Drawings, include – Class 150, 200 and 250 self-restrained PVC and fittings; Schedule 40 and Schedule 80 glued PVC and fittings (stubs to septic tank inlet and septic-to-dosing tank connections); and Class 200 glued PVC and fittings (drainfield laterals).

2. <u>Self-restrained PVC Pipe and Fittings</u>:

a. Self-restrained (thrust-restrained) PVC pipe and fittings shall be IPS of the Classes and sizes as called on the Drawings. All self-restrained PVC pipe and fittings shall be the product of a single manufacturer.

b. Pipe shall have a gasketed joint system with flexible elastomeric gasket in a fitted recess in pipe ends and couplings. Pipe restraint shall have a companion retention spline, fitting in a second recess in pipe ends and couplings. Pipe and fittings shall connect with splined, gasketed female couplings. Similarly splined and gasketed integral pipe bells shall be allowed for connections on direct-bury pipe runs between Sta. 8+58 and Sta. 14+00, except where separate couplings are shown on the Drawings.

c. Where self-restrained pipe lengths must be field cut to meet installation requirements, pipe ends shall be prepared and grooved in exact accordance with the pipe manufacturer's requirements.

d. General:

i. Products delivered under this specification shall be manufactured water distribution pipe and couplings conforming to ASTM D2241. The restrained joint pipe system shall also meet all short- and long-term pressure test requirements of ASTM D2241. Pipe, couplings, and locking splines shall be completely non-metallic to eliminate corrosion problems.

e. Materials:

i. Pipe and couplings shall be made from unplasticized PVC compounds having a minimum cell classification of 12454, as defined in ASTM D1784. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4°F, in accordance with the requirements of ASTM D2837.

f. Approvals:

i. Restrained joint PVC pipe products shall have been tested and approved by NSF International. All 4" through 10" PVC pipe and coupling systems up to Class 250 shall be listed in NSF14. Copies of agency approval reports or product listings shall be provided per the requirements for Submittal review.

g. Dimensions:

i. Nominal outside diameters and wall thicknesses of self-restrained pipe shall conform to the requirements of ASTM D2241. Self-restrained pipe and fittings shall be furnished in 4", 6" 8", and 10 sizes with pressure ratings as called on the Drawings. Pipe shall be furnished in standard lengths of 20 feet.

h. Joints:

i. Pipe shall be joined using non-metallic couplings to form an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic splines shall be inserted into mating, precision-machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading.

ii. Couplings shall be designed for use at or above the rated pressures of the pipe with which they are utilized and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage test requirements of ASTM D3139.

i. Workmanship:

i. Pipe and couplings shall be homogeneous throughout and free from voids, cracks, inclusions and other defects, and shall be as uniform as commercially practicable in color, density and other physical characteristics.

j. Marking:

i. Pipe and couplings shall be legibly and permanently marked in ink with the following minimum information:

a) Nominal size.
b) Outside Diameter System (I.P.S.).
c) PVC.
d) Standard Dimension Ratio (SDR) and pressure rating.
e) ASTM designation D2241-05 (or latest edition).
f) Manufacturer's name or trademark and production record code.
g) Seal (mark) of the testing agency verifying the suitability of the pipe material for potable water service.

k. Manufacture's Reference:

1. Certa-Lok Yelomine restrained joint-pipe from CertainTeed Corporation, or equal, subject to the requirements for Submittal review. Glue-joint PVC will not be considered an equal to the self-restrained PVC pipe specified.

3. Glued PVC Pipe and Fittings:

a. Pipe and fitting shall be IPS, and shall conform to ASTM D1784 and D1785.

b. Joints shall be socket-weld (glued) except where connecting to threaded saddles. Fittings shall conform to ASTM D2467 socket-type standards.

c. Where shown on the Drawings, PVC Van Stone socket-style 150# PVC

flanges shall be provided. Van Stone flanges shall be Spears model 854-060, or equal.

i. Flange gaskets shall be full-faced, 1/8" thick, fabricated from ethylene propylene rubber. Where a mating flange has a raised face, use flat ring gasket and provide filler gasket between the OD of the raised face and flange OD to protect the PVC flange from bolting moment.

ii. Flange bolting shall be Type 316 stainless steel meeting ASTM A193, grade B8M hex, with nuts and washers of like material.

d. Solvent cement shall conform to ASTM D2564, with preparatory use of compatible pipe cleaner solvent.

e. Threaded PVC joints shall be sealed with Teflon tape.

f. Schedule 40 and Schedule 80 PVC glued pipe and fittings shall be used where shown on the Drawings for pipe stubs adjacent septic and dosing tank connections, air/vac valves, and drainfield lateral connections.

g. Drainfield Laterals: Class 200 PVC glued pipe and fittings shall be used for drainfield laterals.

i. Lateral piping shall be plain-end type, with female socket glued couplings.

ii. Lateral perforations shall be sized and spaced as called on the Drawings. Perforations shall be drilled using jig and drill press equipment and machine reamed to the exact I.D. shown, removing all burrs and edge-of-hole irregularities to enhance hydraulic performance.

iii. Orifice Plates for uniform flow distribution shall be installed at the inlet to each 1½" drainfield lateral, according to the sizes and locations listed on the Drawings. Orifices shall be factory-manufactured PVC orifice plates suitable for installation inside union couplings and provided with union flow-assembly bodies. Orifice plates shall be available in 1/64" increments. Field or Contractor fabrication of orifices plates is not allowed. Orifice plates shall be Orenco Systems Inc., series FCA125, or equal. [See Spare Parts in this Specification for spare orifice plates to be provided under Contract.]

iv. Orifice Shields shall be installed on distribution lateral orifices

where shown on the Drawings. Orifice shields shall be molded plastic to snap onto 1½" PVC lateral piping, and shall be Orenco Systems, Inc., model OS150, or equal.

4. PVC Installation:

   a. All PVC pipe shall be cut and installed per the pipe manufacturer's recommendations. Buried PVC pipe shall be laid by snaking the pipe side-to-side within the trench if/as recommended by the manufacturer for the maximum temperature variation between time of assembly and during operation.

   b. Only strap wrenches shall be used to tighten threaded plastic joints, and fittings shall not be over-tightened. Pipe shall not be laid when the temperature is below 40-deg F, or when above 90-deg F if exposed to direct sunlight.

   c. Where necessary to achieve vertical (including slope) or horizontal alignments required for the installation, pipe joint deflection can be used up to the pipe manufacturer's recommended allowances. Angulation exceeding the manufacturer's allowances must be achieved by adding bend fittings to the pipe alignment, and if required shall be provided by the Contractor at no additional cost to the Owner.

   d. All delivery piping, head tanks, drainfield manifolds, and drainfield laterals shall be thoroughly flushed with clean water by the Contractor after installation. Prior to flushing all construction debris, materials cuttings, and other foreign materials shall be completely removed in a manner so as not to impinge or plug valves, orifices, and appurtenances. Throughout pipe assembly and flushing, the Contractor shall take positive preventative measures to keep any gravel, solids, foreign objects, or washed-out debris from entering downstream delivery or drainfield piping. All open pipe ends shall be temporarily capped overnight or when not part of active work. When flushing completed piping, end caps, valves and orifice plates shall be removed during initial flushing to allow unobstructed purging of any foreign materials remaining in piping.

5. Pressure Testing: For pressure testing per MPWSS 02660-3.4, the Contractor shall provide suitable temporary closures at pipe ends during testing.

   a. The replacement Outfall Sewer does not require pressure testing.

   b. Drainfield distribution (perforated) laterals must be thoroughly flushed with clean water by the Contractor after installation, but do not require

pressure testing; end-of-lateral residual pressure testing is required as described in the Special Provisions.

c. Drainfield header (manifold) piping does require pressure testing, and may be tested in conjunction with upstream delivery pipelines. For manifold testing, isolation valves to drainfield laterals can be temporarily closed.

d. At the Contractor's option, piping requiring tests can be pressure tested prior to or after backfilling, the obligation for any leakage repairs notwithstanding.

6. T.V. Inspection: The TV Inspection requirements of MPWSS 02730-3.4.H do apply for all new installed 6-, 8-, and 10-inch delivery piping, including the (replacement) gravity Outfall Sewer. Four-inch and smaller piping, and service line extensions and septic/dosing tank piping upstream of the new Effluent Manhole are exempt from TV inspection requirements. New piping shall be thoroughly flushed with clean water before TV inspection, taking positive preventative measures to keep any washed-out debris, gravel, and solids from entering downstream delivery or drainfield piping. The TV inspection video record shall include date and location stamping and/or audio identification of same. Three duplicate video records shall be provided to the Engineer in a commonly readable electronic format on previously unused USB flash drives.

C. SERVICE SADDLES

1. Service saddles for drainfield distribution header connections to drainfield laterals, and appurtenance connections to pipelines shall be stainless steel double- strap or band-type with plastic- or epoxy-coated body sized for IPS PVC.
Double-strap saddles shall be exactly formed for the PVC pipe O.D. per UniBell and AWWA standards.

a. FIPT outlets shall be sized as shown on the Drawings for the appurtenances to be connected.

b. Saddles shall have EPDM baskets, and Type 304 stainless steel bands, threaded studs and nuts.

c. Saddles shall be 200 psi rated, and shall be JCM model 406; or Ford model FC(D)-202; or equal.

D. SPARE PARTS

1. The following spare parts shall be provided by the Contractor under this contract: A. (4) splines each for self-restrained PVC pipe joints of each size (pipe-diameter) used on the project.

B. (4) pipe gaskets each for self-restrained PVC pipe joints of each size (pipe diameter) used on the project.

C. (66) spare Orenco Systems, Inc., model FCDD-150 orifice plates (flow control discs) – two each in 1/64" increments from 1/8" through 5/8", suitable for use in 1½" unions.

SECTION 02910

SEEDING

1. GENERAL

A. DESCRIPTION

1. This section covers the work necessary for seeding and fertilizing all un-paved Park areas disturbed by construction, plus erosion-mat protection of select areas.

2. The Contractor is reminded that specific limitations apply on areas of seed/fertilizer and erosion mat application that are eligible for payment. Payable width limits apply relative to pipeline corridors and other work areas, and similar reclamation is required on any disturbed areas beyond those limits but at the Contractor's sole cost – see Measurement & Payment descriptions in Special Provisions. Broadcast seeding and fertilizing is also required at the Contractor's sole cost to reclaim the Optional Lower Cave Gulch Access Route, if used.

2. MATERIALS

A. GENERAL

1. The following referenced specifications shall apply to all seeding, fertilizing and related activities, unless specifically modified below:

Montana Public Works Standard Specifications (MPWSS) – 6th Edition (April 2010)

Section 02910 – Seeding

3. MODIFICATIONS

A. GENERAL

1. Measurement and Payment Section does not apply.

B. SEED MIX & APPLICATION

1. Seed mix for reseeding disturbed areas shall consist of blended portions of the following species at the application rates indicated (based on "Pure Live Seed"):

a. Green Needlegrass 3 lb PLS/ac

b.	Western Wheatgrass	4 lb PLS/ac
c.	Snake River Wheatgrass	3 lb PLS/ac
d.	Slender Wheatgrass	4 lb PLS/ac
e.	Thickspike Wheatgrass	4 lb PLS/ac
f.	Mountain Brome	4 lb PLS/ac
g.	Blue Flax	2 lb PLS/ac
h.	TOTAL:	24 lb PLS/ac

2. Seed shall be sourced from indigenous stocks grown north of 41 degrees N latitude.

C. FERTILIZING

1. Fertilizer shall be inorganic dry chemical fertilizer with the following characteristics and application rates:

a.	Nitrogen (elemental)	40 lb/ac
b.	Phosphorous (P_2O_5)	60 lb/ac
c.	Potassium (K_2O)	30 lb/ac

2. Fertilizer shall be used on all seeded areas.

3. Fertilizer application shall be uniform and protected from runoff or ponded water dissolution or concentration.

D. EROSION MAT

1. Erosion mat shall be provided and installed to completely cover the following areas:
   a. Temporary access ramp (once removed, if used) from Upper Parking Lot.
   b. Tank (existing septic, new septic, and new dosing tank) sites.
   c. Buried electrical conduit and all pipe routes connecting to tanks and flow structures.
   d. New outfall and delivery pipe corridors.
   e. New drainfield, including manifolds, and lateral trenches and intervening areas between laterals.
   f. New drainfield diversion berm, except rock armored areas.

   Note that erosion mat is not required for restoration of the Lower Cave Gulch access two-track and hiking trail, if used by the Contractor for optional site access.

2. Mat characteristics shall be per the following:
   a. 100% coconut fiber matrix in biodegradable double polypropylene netting (with up to 36-month net life), sewn together on 1½“ centers.

b. Minimum mat weight of 0.50 lb/sy.
c. Maximum permissible shear stress of 2.25 lb/sf.
d. Minimum mat thickness of 0.26".
e. Meeting requirements established in FHWA FP-03 as a Type 4 erosion control blanket for use on slopes not exceeding 1:1.
f. Minimum mat overall dimensions of 8' wide by 100' long; larger mat rolls are allowed.
g. Minimum mat water absorption of 230% by ASTM D1117.
h. Minimum tensile strength of 19.9 lb/in in main direction and 14.3 lb/in in transverse direction, per ASTM D6818.
i. Seed germination improvement of 415% minimum, per ASTM D7322.

3. Erosion mat installation shall be exactly per mat manufacturer's recommendations, including specialized methods for steeply sloped areas. Mat installation shall use a combination of (upslope) anchor trenches, mat overlaps, and stapling per manufacturer's requirements.
   a. Erosion mat staples shall be 8" long, round-top, preformed steel of 13 ga. minimum.

4. Erosion Mat Manufacturer's Reference: Erosion mat shall be model C32BD blanket as manufactured by ECB/Verdyol (Riverton, Manitoba); or AEC Premier Coconut blanket as manufactured by American Excelsior Company (Arlington, Texas); or equal, subject to requirements for Submittal review.

E. SEEDING AND FERTILIZING METHODS AND CARE

1. Hydraulic Seeding per MPWSS 02920 is not allowed.

2. Over-winter Protection: Seeding, fertilizing, and erosion mat placement shall be done on all completed project areas prior to December 1st, excluding areas disturbed after that date, in order to provide soil protection over winter. Areas disturbed after that date shall be seeded, fertilized and matted the following spring. The Contractor is encouraged to fully complete individual project areas before the onset of winter and is required to promptly conduct full reclamation of same.

3. Seedbed Preparation: All areas to be reseeded shall be fine-graded and raked or scarified to a nominal depth of 1½ inches before seed or fertilizer application.

4. Seed and fertilizer application to all areas shall be by broadcast methods, uniformly at the rates specified.
   a. Seed and fertilizer can be broadcast separately, or in combination provided the respective application rates can be calibrated and maintained.
   b. Seed and fertilizer application rates shall be demonstrated in the presence

of the Engineer by applying over a 100 sf (minimum) area tarp, then collecting and weighing the seed (or fertilizer) collected. The Contractor shall provide tarp and suitable scale and perform this calibration before any application. The Engineer reserves the right to require periodic additional demonstration calibrations during the course of reseeding.

c. Any grading or seed/fertilizer application equipment operated atop the new drainfield areas shall have high flotation tracks or wheels imparting a soil load no greater than 400 lb/sf.

F. AREAS NOT REQUIRING EROSION MAT

1. Erosion mat is not required for restoration of the Lower Cave Gulch access two-track and hiking trail, if used by the Contractor for optional site access.

2. Reclamation of the Lower Cave Gulch access two-track (road) and hiking trail shall be by broadcast seeding and fertilizer application, after hiking trail restorative earthwork.

3. The Contractor is reminded that all broadcast seeding and fertilizing to reclaim the Lower Cave Gulch access two-track (road) and hiking trail are not separately payable under Measurement & Payment in the Special Provisions.

SECTION 03300

CONCRETE

1. GENERAL

A. DESCRIPTION

1. This section covers new cast-in-place concrete and reinforcing steel for structure bases, valve/fitting thrust blocks, and deadmen (flotation anchors) for buried FRP septic and dosing tanks.

2. MATERIALS

A. GENERAL

1. The following referenced specifications shall apply to all concrete and reinforcing steel, unless specifically modified below:

Montana Public Works Standard Specifications (MPWSS) – 6th Edition (April 2010)

Section 03210 – Reinforcing Steel
Section 03310 – Structural Concrete

3. MODIFICATIONS

A. GENERAL

1. Measurement and Payment Section does not apply.

2. All reinforcing steel shall be Grade 60.

3. MPWSS "Class M-3000" concrete shall be used for all applications, other than "field-mixed" applications so indicated on the Drawings.

B. "FIELD-MIXED" CONCRETE

1. Where difficult access precludes the use of ready-mixed concrete, "field-mixed" concrete is called for on the Drawings (generally beyond pipeline Sta. 8+48), subject to Submittal requirements.

2. Field-mixed concrete shall be bagged, dry pre-mix complete with cement and

aggregate, with a 28-day compressive strength of 4,000 psi minimum. Field-mixed concrete shall be mixed with clean water, and prepared and placed per the manufacturer's recommendations.

3. Field-mixed concrete shall be Sakrete High-strength Concrete Mix, or equal.

C. PUMPED CONCRETE

1. At the Contractor's option, concrete pumping may be used to reach portions of the work site. Where pumped concrete is used, mix formulation shall include plasticizer or other admixtures to enhance pumping characteristics, subject to the requirements for Submittal review.

D. CONCRETE MIX DESIGN AND TESTING

1. Where total quantities of cast-in-place concrete for the work do not exceed 10 cy, MPWSS 03310 requirements for a Mix Design and for Concrete Testing may be waived at the discretion of the Engineer. If Mix Design and/or Testing requirements are waived, the Contractor and his/her concrete supplier will be required to furnish past documentation for similar mix designs and concrete test results.

2. For concrete deadman anchors for new FRP tanks, concrete mix design, placement and testing shall comply with all requirements of the tank manufacturer (see Buried FRP Tanks & Accessories Specifications).

SECTION 06672

BURIED F.R.P. TANKS & ACCESSORIES

PART 1. GENERAL

1.1 DESCRIPTION

A. This section covers underground F.R.P. (fiberglass) septic and storage tanks and accessories as Drawings. Tanks shall be single-wall fiberglass rated by the manufacturer for septic service and must be installed according to manufacturer's current installation instructions.

1. This section also addresses the septic tank effluent filter system installed in that tank.
2. This section also addresses carbon filter vents for odor control on the septic tank.
3. See also Plastic Manholes, Handholes & Vaults Specification for tank riser and riser lid requirements.
4. See Valves Specification for dosing tank ventilating valve requirements.

1.2 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Fiberglass Structures, Inc., Laurel, MT; Containment Solutions, Inc., Conroe, TX; Xerxes, Minneapolis, MN; or approved equal.
2. Both the septic tank and dosing tank must be products of the same manufacturer.

B. Governing Standards, as applicable:

i. Tank manufacturer shall be in the business of manufacturing tanks to Underwriters Laboratories (UL) Standard 1316.

ii. Tank manufacturer shall be in the business of manufacturing tanks with materials conforming to the requirements of ANSI/AWWA – D120 (Thermosetting Fiberglass-Reinforced Plastic Tanks).

iii. Tank must be built to International Association of Plumbing and Mechanical Officials (IAPMO)/ANSI Z1000 Standard - Prefabricated Septic Tanks.

1.3 SUBMITTALS

A. The following submittals for construction shall be made in accordance with the project submittal requirements as described in the General Equipment Stipulations. Submit to the Engineer shop drawings, copies of manufacturer's literature and details of construction and erection for each tank as follows:

1. Dimensions of tank, fittings and attachments, with bolt and gasket material.
2. Locations of fittings and attachments and size of man way openings.
3. Drawing, specifications, and structural criteria for pump support platform installed in Dosing Tank, based on Dosing (submersible) Pump manufacturer's requirements.
4. Resin used, and a complete manufacturer specification of the resin used.
5. Weight of tank.
6. Statement that fabrication is in accordance with these specifications.
7. Certificate of compliance from the tank manufacturer stating:
   a. That material and resin used are suitable for intended service.
   b. That tank and tank appurtenances are structurally designed by tank manufacturer to meet installation and service requirements.
8. Details of preparation for and method of shipment.
9. Instructions for handling, storage and installation of tanks.
10. Certified gradations for all tank backfill materials; placement diagrams including dimensions for all select backfill materials recommended by tank manufacturer; and tank manufacturer's backfill compaction and testing requirements.
11. Dimensioned diagrams, specifications and materials of construction, and detailed placement and anchorage instructions for all deadman anchors and anchor straps for tanks, as recommended by tank manufacturer. Also submit concrete deadman anchor sourcing – i.e., provided by tank manufacturer, precast by Contractor, or field-poured. If other than manufacturer-provided deadman anchors are to be used, provide tank manufacturer's deadman casting recommendations, including concrete mix design, reinforcing steel drawings and required 7- and 28-day concrete strength. Take concrete test cylinders (one set per 3 cy of concrete used).
12. Manufacturer's specifications for any geotextile filter fabric used in tank backfill.
13. Detailed description and equipment and support ratings for any crane rigging or suspended support to be used for unloading and placement of tanks.

PART 2. MATERIALS

2.1 DESCRIPTION

A. This section covers underground F.R.P. (fiberglass) septic and storage tanks and accessories as Drawings. Tanks shall be single-wall fiberglass rated by the manufacturer for septic service and must be installed according to manufacturer's current installation instructions.

B. Single-Wall Fiberglass Underground Tanks:

1. Product-Storage Requirements:

   a. All primary tanks must be vented. Tanks are designed for operation at atmospheric pressure only.

   b. Tanks shall be capable of storing sewage not to exceed 140°F at the tank interior surface.

2. Loading Conditions - Tanks shall meet the following design criteria:

   a. External hydrostatic pressure: Buried in ground with 7' of over burden over the top of the tank, the hole fully flooded and a safety factor of 5:1 against general buckling.

   b. Surface Loads: When installed according to manufacturer's current installation instructions and at the bury depth shown on the Drawings, tanks will withstand (ground) surface loading of 100 psf.

   c. Internal Load: Tanks shall withstand a 5 psig air pressure test with 5:1 safety factor.

   d. Tanks shall be designed to support accessory equipment such as submersible pumps, pump bases and slide-rails, hatchways and manways, and inlet/outlet pipe penetrations and connections when installed according to manufacturer's recommendations and limitations.

3. Fabrication:

   a. The tank shall be manufactured as a matrix of premium resin, glass fibers and (optional) silane-treated silica for a composite matrix affording corrosion protection.

   b. Tank inner wall shall be fabricated against a mold to produce a non-air inhibited and high gloss laminate to provide fully cured inner surface without the need of wax coats, a low coefficient of friction and a natural resistance to the build-up of algae or other contamination on the surface. Wax and wax resin coatings cannot

be used to achieve full surface cure on tank shells and endcaps.

4. Tank Dimensions and Capacity:

   a. Tank Dimensions and Capacity:

      i. Septic Tank: 10’-0” dia. X 31’-0”± OAL (28’-6”± straight shell length) 17,652-gal capacity (15,012-gal with 26 3/8” freeboard)

      ii. Dosing Tank: 8’-0” dia. X 17’-6”± OAL (15’-0”± straight shell length) 6,256-gal capacity

   b. Tank Color: Natural

5. Accessories:

   a. Anchor Straps:

      i. Straps shall be standard as supplied by tank manufacturer.

      ii. Provide corrosion-proof anchor straps for each tank shown.

      iii. Number and location of straps shall be as specified by manufacturer.

   b. Bouyancy Prevention and Deadmen:

      i. Tanks shall be installed with precast or cast-in-place concrete anchorage (deadmen) as recommended by the tank manufacturer. Deadman dimensions and weight shall be determined by the tank manufacturer using engineered calculations and installed by the Contractor per the manufacturer’s requirements.

      ii. For buoyancy calculations, maximum groundwater surcharge shall be assumed to be 3’-0” BGS with an empty tank condition.

   c. Access Risers:

      i. Access risers shall be 24” and 30” diameter per the Drawings, at heights and locations as shown.

      ii. Riser tubes and covers (lids) shall be as specified in the Plastic Manholes, Handholes & Vaults Specification.

      iii. All access collars will be furnished complete with exterior adhesive channel.

      iv. Manufacturer supplied epoxy adhesive kit (Orenco model Kit-AD, or equal) shall be used for watertight collar/riser connection.

d. Septic Tank Effluent Filter:

i. A unitized, removable fabric filter system shall be installed for effluent leaving the septic tank, as shown on the Drawings. The filter system shall include a stationary PVC vault with support bracket(s) and outlet pipe coupling, and a removable polypropylene and polyethylene fabric filter cartridge with PVC lifting handle and slide rail support system. Filter unit shall also include a float switch bracket for use with a tank high-level alarm float (see Process Instrumentation and Control Specification).

ii. Filter unit shall be 15" nominal diameter, with a 36" tall cleanable filter. Housing height shall be 66".

iii. Filter cartridge shall have 1/16" (1.6 mm) mesh openings.

iv. Septic tank effluent filter system shall be Orenco y Systems, Inc., model FTP1566-36R, or equal.

v. FRP septic tank manufacturer shall provide molded, integral FRP support tabs, flanges, and/or other fixtures as required inside the tank by the filter manufacturer to support the filter unit. Tank manufacturer shall verify support and fixture requirements for the effluent filter system provided. Additional supports within the tank's PVC manway above the filter shall be provided if/as required by the filter manufacturer.

e. Septic Tank Baffle:

i. An FRP perforated baffle, configured as shown on the Drawings, shall be molded into the septic tank, and shall be supplied by the tank manufacturer. The tank manufacturer shall verify and incorporate loading and support requirements for the baffle.

ii. FRP baffle shall include Sch. 40 PVC sanitary tee fittings with PVC spool extensions, as shown on the Drawings. PVC fittings installed in the baffle shall be wrapped and sealed watertight with FRP by the tank manufacturer.

f. Dosing Tank FRP Pump Access Hatchway:

i. The pump access hatchway shall be of the size, height and location as shown on the Drawings for installation and maintenance of duplex slide-rail submersible dosing pumps.

ii. Pump hatchway shall be fabricated from FRP and molded to the dosing tank. Pump hatchway shall include a hinged

FRP lid with overhanging lip and neoprene gasket. Hinges shall be stainless steel. Lid shall include a safety hold-open device, and a lockable stainless-steel hasp.

iii. Pump hatchway shall include an FRP beam spanning the upper opening, sized and positioned per the submersible pump manufacturer's requirements for upper slide-rail support bracket anchorage. The tank manufacturer shall verify loading and support requirements with the pump manufacturer.

iv. All fixtures on the inside of the access hatchway shall be attached with stainless steel bolts, nuts, and over-sized washers on each side of the FRP to distribute stress.

g. Dosing Tank Pump Platform:

i. A molded-in support platform shall be molded in the Dosing Tank for the duplex submersible Dosing Pumps and bases.

ii. Pump platform shall be stainless steel plate, fully encased in FRP and molded to the tank walls. Pump platform shall include stainless tell anchor bolts sized and patterned to match pump bases.

iii. Pump platform shall be designed and installed by the tank manufacturer to meet the structural requirements of the pump manufacturer. Tank manufacturer shall coordinate with pump manufacturer to assure that all structural criteria for pumps are addressed in tank and platform fabrication.

iv. Platform support shall be suitable for the duplex submersible pumps, pump bases, base elbows and discharge piping.

v. The tank manufacturer shall also account for all loading, support, and attachment criteria for Dosing Pump manufacturer's slide-rail system for pump removal.

h. Pipe Inlet/Outlet Penetrations and Fittings:

i. All tank inlet/outlet pipe penetrations, including tank vents, shall be located and sized as shown on the Drawings.

ii. All inlet/outlet penetrations shall have Schedule 80 PVC or FRP stub-outs molded to the tanks, as shown on the Drawings.

a) Stub-outs shall have plain ends, unless otherwise

b) shown on the Drawings. Stub-outs shall have adequate interior and exterior length to permit effective coupling of connecting pipes shown on the Drawings.

b) PVC pipe stubs shall be wrapped and sealed watertight with FRP by the tank manufacturer.

c) FRP stub-outs, where shown, shall be adequately smoothed on their exterior to permit watertight connection of Fernco-style couplings.

iii. Flexible connectors must be used where shown on the Drawings for piping connections. Flexible connectors shall be elastomeric PVC with stainless steel band clamps, and shall be Fernco 1001 Series, or equal.

i. Septic Tank Carbon Filter Vents

i. The septic tank shall be equipped with pipe risers, coupled to carbon filter vents sized and mounted as shown on the Drawings.

ii. Carbon filter vents shall have a UV-resistant PVC housing, 6 inches in diameter, with polyethylene screen plate and perforated ABS or FRP weather cap.

iii. Carbon filter vents shall house granular activated, impregnated carbon for odor control. Carbon media shall be replaceable using a self-contained packet; bulk carbon replenishment systems are not allowed. [See Spare Parts in this Specification for additional carbon recharge packets required.]

iv. Carbon filter vents shall be rated for 0.8 cfs (inlet and outlet) air flow.

v. Carbon filter vents shall be Orenco model CF6, or equal.

6. Select Fill Around Tanks:

a. Fill around tanks shall be aggregate of the characteristics and placement method recommended by the tank manufacturer.

b. Material shall be clean, free-flowing, and free of dirt, sand, large rocks, roots, organic materials, debris, ice and snow. Backfill material shall not be frozen or contain lumps of frozen material.

c. Fill shall be round gravel conforming to ASTM C33, size numbers

6, 67, or 7, and shall be sized between 1/8" and ¾" (100% passing 1" sieve); or fill shall be crushed gravel conforming to ASTM C33, size numbers 7 or 8, and shall be sized between 1/8" and ½" (100% passing ¾" sieve). Neither type of gravel shall contain more than 5% by weight passing a #8 sieve. Gravel backfill shall have a minimum dry density of 95.0 pcf.

PART 3. EXECUTION

3.1 INSTALLATION AND BACKFILL

A. Floors of tank excavations must be leveled and compacted to 90% of ASSHTO maximum density before any tank bedding (backfill) placement.

B. Any crane rigging, or suspended support used for tank unloading or placement shall meet all recommendations of the tank manufacturer, including pick points, padding, and cabling.

C. Select gravel backfill material shall be used for a minimum of 12" beneath, on all sides, and above all tanks, placed and tamped to provide uniform placement without bridging or voids.

1. Care shall be taken to fully fill the areas under the haunches of the tanks.

2. Select gravel shall be placed in uniform lifts not to exceed 12" in thickness.

D. Only from a point 12" above the tops of tanks to the ground surface, can select earth fill be used. If select earth fill is used, it must be underlain by geotextile filter fabric to prevent fines migration into the underlying gravel backfill. Earth fill must be screened to exclude any particles larger than 1" size, and shall be free of large rocks, roots, organic materials, debris, ice, snow and lumps of frozen material. Earth fill shall be compacted to 85% of AASHTO maximum density, using non-mechanized tampers. Construction equipment and motorized compaction equipment and "whackers" are not allowed to operate above tanks in place.

E. Tank excavations, placement, and fill material must meet all requirements of the tank manufacturer. All tank bedding and backfill materials shall be placed, tested, and compacted in full accordance with the tank manufacturer's requirements, including any compaction testing required during backfilling. Compaction testing shall be by a certified material engineer or laboratory, and at the Contractor's expense.

3.2 CLEANING

A. Once placed and backfilled, tanks shall be thoroughly flushed with clean water by the Contractor. Prior to flushing all construction debris, materials cuttings, and other foreign materials shall be completely removed in a manner so as not to foul dosing pumps or be transferred to any downstream facilities.

3.3 TESTING

A. Field Testing:

1. After installation but before connecting external piping, each tank shall be field tested by filling with water. The tank and fittings shall hold water without loss, or evidence of weeping or capillary action for a period of 24 hours prior to acceptance.

2. After installation but before connecting external piping, each tank shall also be field tested with air in accordance with MDEQ Circular DEQ4 Section
5.1.7.2 for "public systems." Air testing shall include charging the tank with 5 psi pressure, and observation for pressure loss over a 60-minute period. For the test, the Contractor or tank manufacturer's representative shall provide air-charging equipment and a new pressure gage rated for 2% accuracy with gradations reading to 0.1 psi.

3. For factory and field testing, the tank manufacturer shall provide and install suitable sealed plates and closures at all pipe connections, manways and hatchways to sustain pressure and leakage testing. After successful testing, closures shall be removed and only then can final piping connections to the tanks be made.

4. A representative of the tank manufacturer shall also field-inspect each tank after placement for defects, damage, and conformance with these specifications.

5. In the event of failed tests, the tank manufacturer shall diagnose the cause of leakage causing the test failure and remedy and suitably repair the cause(s). Thereafter testing must be repeated until successful test passage can be achieved.

B. Tank(s) Warranty:

1. The tank manufacturer shall warrant the tank(s) for a period of 1 year after the time of delivery for any defects in materials or workmanship.

C. Installation/Startup Assistance:

1. The tank manufacturer shall provide an on-site representative to advise the Contractor during tank installation and inspect the completed tank installations. A minimum of 6 hours of manufacturer's field representative time on site for installation is required.

2. The tank manufacturer shall also provide an on-site representative to train the Owner in operation and maintenance of the tanks, after installation. A minimum of 2 hour of manufacturer's field representative time on site for Owner training is required.

3. The tank manufacturer shall furnish a written instruction manual (3 copies required) to the Owner and Engineer, documented recommended operation, maintenance and repair instructions for the tanks.

D. Spare Parts:

1. The following spare parts are required to be provided under the Contract:

   a. (1) removable 15" diameter septic tank effluent filter cartridge with 1/16" openings, fitting filter housing specified above.

   b. (4) replacement carbon filter recharge packets (Orenco CFR12, or equal) for septic tank carbon filter vents.

SECTION 06675

PLASTIC MANHOLES, HANDHOLES & VAULTS

PART 1: GENERAL

1.1 Description

A. This section covers the fabrication and installation of pre-fabricated plastic (PVC and FRP) manholes and appurtenances, air/vac valve vaults, and FRP or polymer concrete handholes and vaults.

1. The requirements of this section also apply to risers with lids for the new FRP septic and dosing tanks (see also Buried FRP Tanks Specification).

2. The requirements of this section also apply to electrical power and instrumentation cable handholes (see also Electrical Specification).

1.2 Submittals

A. Complete submittals, including materials specifications, and dimensional drawings portraying the assembled structure(s) shall be provided in accordance with the requirements of Section 01610 – General Equipment Stipulations.

PART 2: MATERIALS

2.1. Plastic Manholes, Risers, and Lid Materials

A. Manholes, tank risers, and circular (air/vac) valve vaults shall be of the sizes and overall heights shown on the Drawings. Exposed (above grade) portions of manholes and lids shall be green or brown in color.

B. Manholes and Tank Risers:

1. Manholes shall be 30” diameter per the Drawings, at heights and locations as shown. Piping penetrations shall be sized per the Drawings.

2. Manholes shall be furnished as prefabricated basins with ribbed PVC one-piece risers, water-tight FRP base and bolted FRP lid. Bases shall be epoxy cemented to risers.

3. Manhole Pipe Penetrations: Pipe penetrations to manholes shall be sized

equal in diameter to connecting pipes and shall be watertight with the manhole structure. Pipe penetrations shall include adequate exposed spool lengths exterior to the manhole wall to meet installation requirements for connecting pipe couplings shown on the Drawings. Pipe penetration seals shall be full-circumferential and may use one of the following methods, subject to requirements for Submittal review and hydrostatic testing:

a Pipe penetration utilizing closed-cell foam, water tight sealing grommets with adhesive sealant – Orenco G6L pipe grommets with ADH100 adhesive sealant, or equal.

b. Synthetic rubber "manhole boots" mechanically attached and adhesive sealed by the manhole manufacturer to the manhole wall – Press-Seal Corp. PSX boot, or equal.

c. Sch. 80 PVC pipe spools PVC-welded or fiberglass-wrap-sealed by the manhole manufacturer into the manhole wall.

Pipe penetrations must provide for a constant elevation between the manhole floor and exiting pipe invert, as shown on the Drawings, without any vertical transition or "step."

4. Manholes and risers shall be double-wall, ribbed PVC. Tank risers shall be Orenco Kor-Flo RR series, or equal. Manholes shall be Orenco PB30 basins, or equal.

C. Lids shall be encapsulated foam-core FRP (fiberglass) with overhanging lip, and shall have the following features:

1. Full circumference neoprene gasket, and stainless steel "vandal-resistant" or "penta-head" bolting (all lids).

2. Eight-inch diameter perforated vent cap with stainless steel basket strainer (all lids).

3. Four-inch thick foam insulation (all lids).

4. Replaceable carbon filter assembly (all lids except air/vac valve vaults). [See Spare Parts in this Specification for additional carbon recharge packets required.]

5. Insulated lids with carbon filters shall be Orenco FLF30GVCF14, or equal.

6. Insulated lids without carbon filters shall be Orenco FLF30G, or equal.

D. Discharge Manhole and Energy Dissipater Manhole:

1. Energy Dissipater Manhole shall have an installed energy-dissipating baffle as shown on the Drawings, constructed of FRP or stainless steel. Baffle shall structurally designed by the manhole manufacturer for 600 gpm inlet flow arriving at up to 15 fps. Baffle shall be PVC-welded, or epoxy cemented and stainless steel-bolted in place, and sealed water-tight.

E. New Flow Splitter Manhole:

1. Manhole shall have two 6" diameter (removable) outlet standpipes with staggered flow control orifices, sized by the manufacturer to equally split 300 gpm to each outlet.

2. Flow splitter shall be Orenco Systems Inc., 30-inch "Flow Splitter Basin" (NDW-TD-PB-4), or equal.

F. Air/Vac Valve Vaults:

1. Valve vaults shall be 30" diameter per the Drawings, at heights and locations as shown. Valve vaults do not require bases (floor plates).

2.2 Precast Handholes and Vaults

A. Handholes and vaults for valves, flowmeters, drainfield appurtenances, and electrical pull boxes shall be precast from FRP, polymer concrete, or HDPE, and meet or exceed the nominal sizes indicated on the Drawings. Vaults shall include vertical extension sections where required to achieve the overall height or grade separation shown on the Drawings.

B. Exposed (above grade) portions of handholes and vaults shall be green in color. Handhole, vault, and lid materials shall be UV-stabilized.

C. Handholes and vaults shall be rated "Pedestrian Duty" conforming to ASTM C857, WUC 3.6. Vehicular traffic rating is not required.

D. Handholes and vaults shall include basin and reinforced integral frame at opening,

1. Handholes and vaults for valves, meters and piping appurtenances do not require floor plates (bottoms).

2. Electrical pull boxes shall have a solid bottom.

E. Removable lids shall be FRP, polymer concrete, or HDPE, gasketed and held in place with stainless steel "vandal-resistant" or "penta-head" bolts.

1. Lids shall be provided in one or two (mating) sections. Individual lids or sections cannot exceed 75 lb in weight.

2. Lids shall have a cast-in non-skid "diamond plate" pattern.

i. Electrical pull boxes lids shall have cast-in markings indicating "Power" or "I/C" according to the installation application.

ii. Lids for vaults for drainfield lateral valves shall have cast-in markings indicating "Drainfield".

iii. Lid(s) for the dosing pump valve vault shall have cast-in markings indicating "Pump Valves".

iv. Lid(s) for the dosing pump effluent flowmeter shall have cast-in markings indicating "Flowmeter".

F. Manufacturer's Reference: Handholes and vaults shall be Oldcastle Duravault FRP Series; or Oldcastle/Carson Plastic HDPE series; or Handhole.com FC Series, or equal.

PART 3: EXECUTION

3.1 Structural Fill

A. Structural fill used under manholes shall be a minimum thickness of 12-inches and shall meet the requirements of the Excavation and Backfill Specification.

3.2 Vault and Manhole Installation

A. Vaults and manholes shall be installed plumb and perpendicular to piping runs shown on the Drawings. Pipe penetrations at manholes shall be sealed water-tight with the manhole manufacturer's recommended flexible, elastomeric seal or pipe coupling, subject to the requirements for Submittal review.

B. Lower walls of "dry" (non-water-holding) vaults and manholes shall be precisely contoured to fit atop piping over which they extend. Pipe (partial) cut-outs shall be over-sized enough to avoid pipe contact and not impart any structural load to the piping – annular space shall be closed with slotted closed-cell foam pipe insulation (around edges of cut-out) or Dow GreatStuff spray foam insulation after installation.

C. Manhole bases shall be set in concrete of the dimensions shown on the Drawings (see Concrete Specifications for concrete requirements).

D. Where shown on the Drawings, "open" floors of vaults shall include a layer of washed gravel to the depths shown.

E. After completed installation but before commissioning, all water-holding manholes shall be thoroughly flushed with clean water by the Contractor. Prior to flushing, all construction debris, materials cuttings and other foreign materials shall be completely removed in a manner so as not to be conveyed downstream or plug valves, orifices and appurtenances.

3.3 Manhole Leakage Testing

A. General.

1. Leakage (exfiltration) testing of pre-fabricated manholes is required, once placed and connected to piping.

2. Should a manhole not satisfactorily pass testing, repair and repeat testing until such manhole does test satisfactorily. Repairs and/or replacements and retests are required at no additional expense to the Owner.

3. Prior to testing, clean manholes thoroughly and seal inside of connecting pipes using properly sized plugs.

4. The Contractor may elect to make a test for his/her own purposes prior to backfilling. However, only tests on installed (backfilling complete) manholes will be accepted by the Engineer.

B. Exfiltration Test Procedure: Test in accordance with ASTM C969 and the following testing procedures:

1. Completely fill manhole to the top of the riser with water.

2. Allow water-filled manhole to stand a minimum of 15 minutes prior to testing to allow absorbing into materials.

3. At commencement of test, refill manhole to top riser.

4. During a 1-hour long period, keep an accurate record of the amount of water to be added because of exfiltration. (How much water is added to maintain the water level at the top of the riser).

5. Consider the manhole acceptable when exfiltration rate does not exceed a rate of 0.1 gal/ (ft of diameter) (ft of head) (hr).

3.4 Handholes

A. Handholes shall be set in select soil (non-cohesive and screened to $\leq$ 1" diameter) for 4" on all sides. Units shall be set with frames/lids 2" above grade, unless otherwise shown on the Drawings.

B. Handhole floors through which power or control cables are routed shall be drilled or provided with suitably size knock-outs. Underground (PVC) electrical conduits shall be extended a minimum of 1" above the handhole floor and sealed around their perimeter with silicon sealant.

3.5 Spare Parts

A. The following spare parts shall be provided under the Contract:

1. (4) replacement carbon filter recharge packets (Orenco CFR12, or equal) for manhole lid inserts.

2. (3) vandal-resistant or "Penta-heat" bolt wrenches for each type and size of such fasteners used on manhole and riser lids and handholes.

SECTION 06678

INFILTRATION CHAMBERS

PART 1: GENERAL

1.1 Description

A. This section covers the fabrication and installation of pre-fabricated plastic (HPDE) infiltration chambers for use in the pressure-dosed drainfield trenches. Infiltration chambers shall be placed as shown on the Drawings

1.2 Submittals

A. Complete submittals, including materials specifications, and dimensional drawings portraying the assembled structure(s) shall be provided in accordance with the requirements of Section 01610 – General Equipment Stipulations.

B. Additionally, Installation Guide manuals for the infiltration chambers shall be provided ahead of drainfield construction, as part of Submittals. Installation Guides shall be exactly followed by the Contractor in placement of infiltration chambers.

PART 2: MATERIALS

2.1. General

A. Infiltration chambers shall be the product of a single manufacturer and shall be furnished complete with end caps and accessories compatible with the chambers and sourced from the same manufacturer.

2.2 Dimensions

A. Infiltration chambers shall be 34½" nominal width, suitable for installation in 36" wide drainfield trenches.

B. Chambers shall have an actual length of 63", with an effective length of 60" once joined.

C. Chambers shall have an overall height of 13" and a sidewall height of 7 1/8", provisions for suspending drainfield lateral piping at 6½" (pipe invert to bottom of chamber).

2.3 Materials and Construction

A. Infiltration chambers shall be manufactured from high-density polyethylene with an open bottom, solid top and louvered sidewalls. Sidewall louvers shall be designed to minimize soil intrusion. Chamber shall be manufactured from high-density polyethylene as defined and described in IAPMO PS 63.

B. Each chamber shall interlock with an integral articulating joint. Articulating joints shall have a free range of horizontal rotation of 20 degrees, with a maximum of 10 degrees in either direction. Articulating joint shall be constructed by placing the dome with engaging knuckle of the incoming chamber over the post end of the previously-installed chamber.

C. Crowns of chambers shall have slots for use of zip ties to suspend piping. Each chamber section shall also have one knock-out for insertion of (vertical) vent or clean-out piping.

D. Chamber end caps shall be of similar materials and construction and shall be suitable for snap-in installation with a molded lip in the cap to mate to the corresponding recess in the end of each chamber.

1. End caps shall have knock-outs for insertion of 3" or 4" (distribution lateral) pipe insertion but will require (hole)saw cutting of smaller openings for 1½" pressure distribution lines.

2. End caps shall be furnished with the manufacturer's optional splash plates connecting to the lower end of the cap.

E. Distribution Piping Ties: Ties to support distribution piping inside infiltration chambers shall be removable/adjustable NyLok zip ties rated for 90 lb and shall have a minimum width of 0.250 inches. Ties shall be manufactured with UV-stabilized polymers.

2.4 Functionality

A. Infiltration chambers shall be suitable for placement directly atop the infiltrative (soil) surface, with or without a gravel layer.

B. Chamber shall meet the load rating of H-10 (16,000 lb per axle) with a minimum of 12 inches of cover when tested in accordance with IAPMO PS 63 and installed in accordance with manufacturers installation procedures.

2.5 Manufacturer's Reference

A. Infiltration chambers and accessories shall be Advanced Drainage Systems, Inc. model ARC 36, or equal.

PART 3: EXECUTION

3.1 Trench Preparation

A. Floors of excavated drainfield trenches to receive infiltration chambers shall be leveled to a plus-or-minus 0.05-ft tolerance prior to chamber and piping placement. The Contractor shall provide laser leveling (or comparable) equipment for continuous grade control of drainfield trench floor elevations.

B. Trench floors and sidewalls (to the height of infiltration chambers) shall be scarified to a depth of 1½" using hand rakes immediately prior to chamber placement. Motorized or rolling equipment cannot be operated at any time on trench floors, once excavated.

C. After infiltration chamber (and distribution piping) placement, trenches shall be backfilled per the requirements of the Drawings and the chamber manufacturer's recommendations. The requirements of the Excavation & Backfill Specification also apply.

3.2 Chamber Installation

A. Chamber installation shall be in accordance with the manufacturer's installation procedures, as well as all state and local health department regulations. Backfill materials alongside and atop chambers shall be carefully placed per the manufacturer's recommendations, without creating undue soil compaction or stress to the completed installation.

B. Infiltration chambers and trenches shall be laid to the alignments shown on the Drawings, including horizontal angulation where shown. Chambers (and trenches) shall not exceed the chamber manufacturer's maximum allowable joint articulation. Where horizontal alignments shown on the Drawings exceed maximum allowable joint articulation, drainfield trench layout shall be adjusted to utilize multiple chamber joints in succession to achieve that alignment.

C. Chambers shall be placed and assembled to $\pm$0.05-ft vertical tolerance.

3.3 Lateral Piping

A. Lateral piping for pressure-dosing drainfield trenches shall be 1½" nominal diameter, as shown on the Drawings and specified in the PVC Piping System & Appurtenances Specification.

B. Piping placement shall occur in conjunction with infiltration chamber installation. Zip ties shall be installed at no more than 5'-0" O.C. to support distribution piping.

C. Lateral piping shall be placed at a uniform elevation of ±1/2" to assure uniform distribution and draining. Zip ties supporting piping shall be adjusted to achieve this tolerance.

D. See Pipelines & Appurtenances Specification for lateral piping orifice shield requirements.

E. See Special Provisions for lateral piping Performance Testing requirements.

3.4 Handholes

A. Handholes for terminal clean-outs, and vaults for distribution valving are required on drainfield laterals, as shown on the Drawings. Handhole and vault construction shall interface with and not compromise or interfere with chamber installations. Handholes and vaults shall be per the Plastic Manholes, Handholes & Vaults Specification.

SECTION 09900

PAINTING

PART 1: GENERAL

1.1 Description

A. This section covers surface preparation, furnishing, and application of protective coatings for metals in contact or proximity to soil or wastewater.

1.2 Submittals

A. The following submittals for construction shall be made in accordance with the General Equipment Stipulations:

1. Product Data Sheets. For each paint system, submit manufacturers' technical data sheets, application instructions, and paint colors available for each product used in the paint system, except for products applied by equipment manufacturers. This information shall be submitted for each paint system specified. Also provide copies of paint system submittals to the coating applicator.

1.3 Paint Delivery, Storage and Handling

A. Deliver paint to project site in unopened containers that plainly show at time of use, the designated name, date of manufacture, color, and name of manufacturer.

B. Store paints in a suitable protected area that is heated or cooled as required to maintain temperatures within the range recommended by paint manufacturer.

C. Shipping:
1. Where precoated items are to be shipped to the job site, protect coating from damage.
2. Use nonmetallic or padded slings and straps in handling.
3. Items will be rejected for excessive damage.

PART 2: MATERIALS

2.1 Paint and Coating Manufacturers

A. Below is a list of manufacturers referenced, or that may be able to supply the materials outlined in these Specifications.

1. Tnemec Coatings, Kansas City, MO. (1-800-TNEMEC1)
2. Sherwin Williams, Cleveland, OH.

3. Columbia Paints & Coatings, Spokane, WA.
4. Rustoleum Corp., Evanston, IL.
5. Valspar Corp., Azusa, CA.
6. Benjamin Moore Paints, New York, NY.

2.2 Paint Materials

A. Products shall meet federal, state, and local requirements limiting the emission of volatile organic compounds. Specific information may be secured through the local office of the USEPA. Paint or color additives that contain lead will not be allowed.

B. Each paint system specified herein shall include products (including primer and finish coat) from only one manufacturer.

C. Thinners, cleaners, additives, primers, tie and barrier coats shall be provided as recommended by the coating manufacturer.

D. Paint products specified in the COATING SYSTEMS section of this specification are listed in the following table:

Generic Product Name	Description	Manufacturers & Products
Coal Tar Epoxy	High-build, corrosion resistant polyamide epoxy coal tar coating	1. Tnemec 46H-413 Hi-Build Tneme-Tar 2. Sherwin-Williams Targuard 3. Or equal

PART 3: EXECUTION

SURFACE PREPARATION

3.1 General

A. Protection of materials not to be painted:

1. Remove, mask or otherwise protect hardware; instruments, electrical panels and fixtures; stainless steel, aluminum and plastic surfaces; machined surfaces, couplings, shafts, bearings and nameplates on machinery; and other surfaces not intended to be painted.

2. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

3. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

4. Mask openings in motors to prevent paint and other materials from entering the motors.

B. Workmanship for metal surface preparation as specified shall meet current SSPC Specifications as follows:

1. SP1: Solvent Cleaning
2. SP2: Hand Tool Cleaning
3. SP3: Power Tool Cleaning
4. SP5: White Metal Blast Cleaning
5. SP6: Commercial Blast Cleaning
6. SP7: Brush-Off Blast Cleaning
7. SP8: Pickling
8. SP10: Near-White Metal Blast Cleaning
9. SP11: Power Tool Cleaning to Bare Metal
10. SP12: Surface Preparation by Water Jetting

3.2 Solvent Cleaning

A. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action.

B. Method shall meet SSPC-SP 1.

3.3 Application of Paint

A. Apply coatings in accordance with paint manufacturer's recommendations. Allow sufficient time between coats to assure thorough drying of previously applied paint.

B. Apply paint in accordance with these specifications and the manufacturer's printed directions and recommendations. In the event that these specifications are not in agreement with the manufacturer-s recommendations, the manufacturer's-s recommendations shall govern.

3.4 Tie and Barrier Coats

A. Paint Compatibility: The Contractor, working with his coatings supplier, shall be responsible for verifying compatibility of newly applied coatings with existing paint substrates The Contractor shall conduct such investigations and testing as necessary to assure compatibility between new and existing paint products.

B. Tie Coats: The Contractor, working with his coatings supplier, shall apply a suitable tie coat(s) as recommended by the coating manufacturer, where new coatings will not develop suitable adhesion with existing, in-place coatings.

C. Barrier Coats: The Contractor, working with his coatings supplier, shall apply a suitable barrier coat(s) as recommended by the coating manufacturer, where new coatings are not compatible with existing, in-place coatings.

E. The cost of tie or barrier coats, where used, shall be considered incidental to the Work, and will not be allowed as a basis for a change to the Contract Price. The Contractor shall conduct such investigations as he/she deems necessary prior to proceeding with the Work.

3.4 Manufacturer Applied Paint Systems

A. Repair abraded areas on factory finished items in accordance with the equipment manufacturer's directions, using compatible similar coating materials.

B. Carefully blend repaired areas into original finish.

3.5 Film Thickness

A. Coverage is listed as minimum dry film thickness in mils (MDFT), including per coat requirements as listed.

B. Minimum number of coats shall be as specified, irrespective of coating thickness. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.

C. Maximum film build per coat shall not exceed coating manufacturer's recommendations.

3.9 Coating Systems

A. SYSTEM NO. 1: METAL IN CONTACT OR PROXIMITY WITH SOIL OR WASTEWATER

Surface Prep.	Coating Product	Min. Coats, Cover
Solvent Clean (SP 1)	COAL TAR EPOXY	2 coats, 10 mils MDFT per coat

B. Unless otherwise shown or specified, PVC, FRP, HDPE, stainless steel, copper, brass, bronze, aluminum (other than at points of concrete contact), instruments and transmitters, and electrical conduit are not to be painted.

C. SYSTEM NO. 1: METAL IN CONTACT OR PROXIMITY WITH SOIL OR WASTEWATER: Use on all buried or partially-buried cast and ductile iron or steel, including items contacting placed gravel substrates. Items to be coated with this system include, but are not necessarily limited to, the following:

1. New buried ductile iron pipe fittings (portion in soil or gravel contact).
2. Iron valve bodies (portion in soil contact).
3. Aluminum surfaces in contact with concrete.

SECTION 10400

SIGNS

PART 1 GENERAL

1.1 Work Included

A. This section covers the work necessary to furnish warning signs and their mounting requirements at tank risers and manholes, and the electrical panel rack.

1.2 Submittals

A. In addition to the requirements of Section 01/610 - General Equipment Stipulations, the following documentation shall also be provided for signs, and accompany other required submittals:

1. Scaled drawings and specifications covering materials, mounting fixtures, and locations shall be submitted for each sign in accordance with project submittal requirements.
2. Product samples consisting of a 3" x 3" coupon of sign sheeting complete with proposed lettering shall be provided for each sign style and material to be used.

1.3 Product Delivery, Storage and Handling

A. Materials shall be protected from damage during transit, handling, storage and installation.

B. Fabricated sign panels shall be delivered with protective poly sheeting adhered to the lettered surface to protect from scratching. Any scratched or otherwise damaged signs shall be replaced by the Contractor.

PART 2 MATERIALS

2.1 General

A. Signs shall be provided with stainless steel fasteners suitable for the substrate at the mounting location.

B. The sign manufacturer shall verify all sign graphics before fabrications. Signs with typographical or format errors shall not be installed and replaced.

2.2 Sign Panels

A. Signs Mounted Outdoors: Outdoor sign panels shall be 40-mil thick aluminum in standard "3M Engineer Grade" with reflective face and 10-year warranty from 3M Co. Signs shall have 3M SmartShield POF Laminate overlay atop message side for vandalism and UV resistance. Sign panels shall be MySafetySign.com model S-2250 in 10" x 14" size, or equal.

B. Signs Mounted in Manholes and Tank Risers: Sign panels mounted inside manholes and tank risers shall be 55-mil thick plastic. Sign panels shall be MySafetySign.com model S-0705 in 10" x 14" size, or equal.

C. Panel background color shall be as indicated in the Sign Schedule herein.

D. Sign panels shall be cut to the dimensions shown in the Sign Schedule herein. All panel corners shall be cut to a smooth ¼" radius. Mounting holes shall be neatly drilled and symmetrical with panel geometry. Panel edges, corners, and mounting holes shall be de-burred and smooth.

2.3 Sign Panel Lettering

A. Sign lettering shall be "Arial Black" font, all capital letters, in the sizes indicated in the Sign Schedule herein.

B. Sign lettering shall be permanently adhered, vinyl lettering, suitable for the sign panel material. Lettering and lettering adhesive for outdoor signs shall be UV protected and suitable for outdoor use without peeling or cracking.

2.4 Sign Schedule:

Sign Text	No. Reqd.	Location(s)	Panel Size (H x W)	Letter Height	Color	
					Letters	Background
Manholes and Tank Risers:						
DANGER CONFINED SPACE DO NOT ENTER	1	Septic Tank North Riser (wall-mount w/in 6" of top)	10" x 14"	1.75'" & 1"	white* black	red/black* white
	1	Septic Tank Middle Riser (wall-mount w/in 6" of top)				
	1	Septic Tank South Riser (wall-mount w/in 6" of top)				
	1	Dosing Tank Pump Hatchway (wall-mount w/in 6" of top)				
	1	Dosing Tank South Riser (wall-mount w/in 6" of top)				
	1	New Effluent Manhole (wall-mount w/in 6" of top)				
	1	New Energy Dissipater Manhole (wall-mount w/in 6" of top)				
	1	New Flow-Splitter Manhole (wall-mount w/in 6" of top)				
	6	Each Air/Vac Valve Vault (wall-mount w/in 6" of top)				
Electrical Panel Rack:						
DANGER HIGH VOLTAGE (with "Mr. Ouch" Graphic)	2	Electrical Panel Rack (south/front side; mount to UniStrut toward ea. end of rack)	10" x 14"	1.75'" & 1"	white* black	red/black* white
	2	Electrical Panel Rack (north/back side; mount to UniStrut toward ea. end of rack)				
* White "DANGER" text to be placed on red oval over black rectangle, with white margins separating colors.						

PART 3 EXECUTION

3.1 Mounting

A. Mount all custom-fabricated, lettered signs at 5'-0" A.F.F., unless otherwise noted in Sign Schedule or on the Drawings. Where dual signs are required at same

location, place lower sign 4’-0” A.F.F. and place upper sign directly above, separated by 3”. If specified sign locations conflict with other rack-mounted items, adjust locations to nearest clear space while maintaining high visibility.

B. Mount all signs using stainless steel fasteners and hardware. Signs mounted to Uni-Strut members shall use standard strut clamps or bolt receivers, and signs mounted to PVC riser and manhole walls shall use 3/16” diameter bolts with hex nuts and washers. Use fasteners at all four corners of each sign.

C. Mount signs level, and centered on walls or next to identified objects shown in the Sign Schedule and the Drawings.

D. Where signs are mounted to rounded walls inside manholes and vaults, gently bend sign to match curvature of wall surface when mounting. Confirm lettering remains undamaged by arcing sign.

SECTION 11228

SUBMERSIBLE SEWAGE PUMPS

PART 1: GENERAL

1.1 DESCRIPTION AND SCOPE

A. This section includes the duplex non-clog submersible sewage pumps for effluent dosing, and slide rail mounting and appurtenances, as shown in the Drawings. Pumps will be VFD-driven (see VFD Specification), and will operate individually rather than simultaneously. Pumps are located inside the new 6,000-gal, 8-ft diameter FRP Dosing Tank.

B. The pump manufacturer and the Contractor are reminded that coordination with the Dosing Tank manufacturer for pump installation and fit-up inside the Dosing Tank is required. A pump support platform in the Dosing Tank and slide-rail attachment points shall be designed and installed by the tank manufacturer based on information to be provided by the pump supplier (see Buried FRP Tanks & Accessories Specification).

1.2 SUBMITTALS

A. In addition to the requirements of Section 01610 - General Equipment Stipulations, the following documentation shall also be provided for this equipment and accompany other required submittals:

1. Complete equipment installation and operation manuals including information on field installation requirements for the Contractor during construction, and maintenance information for the Owner during future operations.

2. Assembly drawings showing construction details and materials of all components.

3. Pump discharge quick-disconnect and pipe connection details and dimensions. [information also to be provided to FRP Dosing Tank manufacturer]

4. Mounting drawings showing bolting requirements for pump bases, base elbows, and slide rail system. [information also to be provided to FRP Dosing Tank manufacturer]

5. Mechanical seal materials of construction, installation and service procedure, assembly drawings, pressure and service rating; seal failure alarm protective sensors and circuitry.

6. Electrical ratings and amp-draw; drawings including circuit schematics, interconnection diagrams; and all information necessary for connection of motors and electrical components.

7. Pump performance data showing head-capacity, horsepower draw, amperage, and efficiency over the pump's full operating range. Pump curves shall be provided, including head-capacity curves for reduced speed (VFD) operation in 100-rpm increments. The rated head-capacity conditions shall be specifically indicated. The manufacturer's safe minimum and maximum head-capacities shall also be indicated.

8. Total weight of pump; also, weight of pump bases, including quick-disconnects and base elbows. [information also to be provided to FRP Dosing Tank manufacturer]

PART 2: MATERIALS

2.1 GENERAL

A. Performance of each pump shall be stable and free from cavitation, vibration, and excess noise while operating on submitted pump curve(s), including the anticipated variable speed operating range.

B. Submersible pumps with motors shall be UL-listed and certified to CSA Standard C22.2 No. 108. Pumps, motors and wiring shall also conform to N.E.C. Class 1, Division 2 requirements for hazardous locations, per MDEQ Circular DEQ4 Section 4.2.3.1.

C. Manufacturer-s Reference: Submersible pumps shall be HOMA model AMX446-190, or equal, subject to the requirements for Submittal review.

D. Submersible pumps slide rail system, pump control panel, and float switches shall all be the standard products of a single manufacturer in order to assure operational compatibility.

2.2 SERVICE CONDITIONS

A. The pumps will be used for drainfield dosing, pumping filtered effluent from the dosing tank. Dosing cycles will be of 3 to 5 minutes duration, once to three times per day using a single pump. The second pump is redundant and will operate only in the

event of a lead pump failure. Effluent is filtered (1/16" opening) leaving the septic tank but may contain up to 500 mg/l of Total Suspended Solids primarily of an organic nature.

B. Water Temperature: 30 to 90 deg F.

C. Site Elevation: 5,270 feet MSL.

2.3 PERFORMANCE REQUIREMENTS

Pump total dynamic head (TDH) will vary as the liquid level in the dosing tank is drawn down over repeated pump cycles. Pump flow rate is maintained at the constant rate indicated to maintain a constant drainfield dosing rate. An effluent flowmeter will provide an analog signal to the pump VFD(s) to maintain a constant flow through varying TDH conditions (see Process Instrumentation & Control Specification).

Head-Capacity:	600 gpm at 13.2 ft total dynamic head (max.), to 600 gpm at 4.7 ft total dynamic head (reduced rpm)
Min. Pump Efficiency	70.0%
Pump Speed	1160 rpm (nominal)
Max. Amp Draw (running)	8.2A at 240V, 3-phase
Solids Handling:	4-inch spherical
Discharge Connection	6-inch vertical ANSI 125# flanged
Pump Base Elbow	4" X 6" Reducing Base Elbow (by pump mfr.)
Impeller Type	single-stage, ASTM A48 Class 40 cast iron
NEC Class	Class 1, Division 1, Group C & D

2.4 PUMP MATERIALS AND CONSTRUCTION DETAILS

A. Pump(s) shall be single stage, non-clog centrifugal pump, close-coupled to a squirrel cage induction type electric motor assembled in a single-body, watertight assembly, capable of maintaining its integrity submerged under 80 feet of water. Pumps shall be complete with base, discharge elbow and slide rails for automatic operation in the dosing tank. The discharge flange from the reducing elbow base shall be ANSI Class l25, 6-inch Cast Iron.

B. Major castings -- ASTM A48 Class 40B Cast Iron; Wear Ring -- ASTM Bl44 Bronze; Shaft -- AISI 430F Stainless Steel; Fasteners -- AISI 304 Stainless Steel; O-Rings -- Nitrile Rubber; Shaft Seals -- Silicon Carbide/Silicon Carbide (impeller and motor side); Cable Jacket – Neoprene; Cable Entry -- elastomer grommet, stainless steel washers; Protective Coating -- High Solids Epoxy.

C. Impeller will be cast as one piece and shall be of a single-vane closed (double-shrouded), radial non- clog design statically and dynamically balanced, to assure that vibration amplitudes, measured at the level of the upper bearing while operating in a

vertical position, remain within the limits specified by the Hydraulic Institute Standards.

D. Volute will be cast in one piece, with smooth internal contours and surfaces, providing obstruction-free passageways with low friction losses. A stationary Wear Ring, made of bronze, shall maintain close tolerances between the rotating Impeller and the stationary Volute.

E. Pump shaft must have generous shoulder fillet radii to minimize stress concentration and fatigue. Deflection at the Shaft Seal within the operating range shall not be more than 0.002 inch.

F. Pump shaft shall be supported by anti-friction bearings, designed for minimum 50,000 hours B-l0 Life at the pumps Best Efficiency Point and shall be factory pre-lubricated. The lower impeller-side bearing will be a double-row, deep groove ball bearing, axially retained, to sustain both axial and radial loads. The upper motor-end bearing is a single-row, deep groove ball bearing axially floating, to sustain radial loads only.

G. Cable entry assembly shall contain an elastomer grommet, flanked by two washers, closely fitted to the cable O.D. A watertight seal shall be maintained by screwing a threaded cable entry gland into a cable inlet flange which bolts into the motor cap. The cable entry gland threads down to a positive stop, thereby tightly compressing the grommet around the cable. The gland will provide a strain-relieving, anti-kink feature, functioning independently from the separate sealing action. The cable inlet flange shall contain an O-ring groove on the bottom side of the flange to allow for watertight integrity of the bolt-on cable entry assembly when bolted into the entry holes in the motor cap. Each pump shall be supplied with an adequate unspliced length for the installation requirements of Type H07RN8-F submersible power cable.

H. Seals: Motor compartment shall be isolated from the liquid end by single mechanical shaft seals in tandem arrangement (dual-independent, both oriented to resist pressure from the impeller). The upper motor side seal shall run in an oil chamber, which separates the motor compartment from the liquid end and provides permanent lubrication and cooling. The lower impeller side seal will also get lubrication from the oil chamber. Each seal will have a stationary portion and a positively driven rotary portion. Springs must be protected from the pumped liquid; and under no circumstances can solid particles accumulate on the external spring and hamper its effectiveness. Seals must not require repeated checking or re-adjustment, except periodic inspection of the oil chamber. At the interfaces of major castings, sealing shall by accomplished by resilient Buna-N O-Rings, confined within closely fitted, high surface quality rabbet joints, compressed only to the prescribed dimension by metal-to-metal contact, allowing radial movement and preventing permanent set. Flat gaskets and seal rings, which may be squeezed unevenly or beyond the permanent deformation limit, are not allowed.

I. Seal Probe: A conductive seal probe shall be provided on each pump. Probe shall be mounted into mechanical seal chamber and when interlocked with VFD/control panel. The probe shall indicate the presence of contaminants within mechanical seal chamber, and shall include 120V, 10A-rated NO contacts, and 40 feet of Type SO nitrile-sheathed submersible cable.

2.5 MOTORS

A. Pump motors shall be inverter duty-rated, suitable for VFD operation. Power available at the site is 120/240 single-phase. Pump power will be routed through VFDs, producing 240V, 3-phase power to the pumps. Dedicated VFDs will be provided for each pump (see VFD Specification).

B. Motors shall be NEMA Code J for continuous duty, capable of sustaining 15 starts per hour. The pump and motor shall be produced by one manufacturer and shall be of the air-filled, watertight design. Motors and wiring shall conform to N.E.C. Class 1, Division 1, Groups C and D requirements for hazardous locations.

C. Pump and motor combinations shall be designed to be non-overloading throughout the entire pump curve, including anticipated reduced speed (VFD) operation. The pump motor shall be of the submersible type, oil filled, and hermetically sealed. Motor shall be rated to operate in submerged, partially submerged, or non-submerged conditions. Overload protection shall be integral to the motor and of the automatic-resetting type. The motor shall require no external overload protection.

Motor Horsepower:	2.8 hp (nominal); 3.0 hp maximum
Amp Draw	8.2 A (maximum running)
Speed:	1160 rpm (nominal)
Power:	230V, 3-phase, 60 Hz

D. All stator windings and leads shall be insulated with moisture-resistant Class H Insulation, capable of withstanding l55-deg C maximum temperature, dipped and baked three times. Upon assembly the stator shall be heat-shrink-fitted into the stator housing; the use of bolts, pins or other fastening devices, which would require penetration of the stator housing, shall not be acceptable.

E. In each phase winding there shall be embedded a bi-metallic temperature sensor, wired in series and interlocked with the motor overload protection in the VFD/control panel(s). Any of these thermal sensors shall cut out electric power if the temperature

in its winding exceeds l40-deg C but shall automatically reset when the winding temperature returns to normal. The motor shall be non-overloading through the selected performance curve and have a Service Factor of l.l5.

2.6 PUMP SLIDE RAIL MOUNTING SYSTEM

A. The installed pumps shall be provided with the pump manufacturer's guide rail system. The rail system shall be non-sparking and include epoxy-coated 4" X 6" (reducing) cast iron discharge base elbow and epoxy-coated guide brackets, 1½" Schedule 40 stainless steel guide rails, and stainless-steel upper rail bracket and hardware. Slide rail system shall be of length adequate for the dosing tank depth as shown on the Drawings and provide positive leak-free automatic engagement and disengagement of the pump from the base elbow.

B. A stainless-steel lifting bail shall be provided on the installed pumps, and stainless-steel lifting cable or chain with stainless steel connectors shall be provided, both rated at 800 lb load, in adequate length for the wet well depth.

C. Pump quick-disconnect bases shall use an easily replaceable resilient rubber seal ring as part of the pump assembly, that is axially and evenly compressed upon contact. Metal-to-metal contact faces shall not be allowed. Once seated, the pump shall be entirely supported by the quick-disconnect base, without any reliance on additional supports.

2.7 ACCESSORIES

A. A 6-hook stainless steel wall bracket shall be provided for pump lifting chains and electrical cable(s) support and adjustment and mounted as shown on the Drawings. Wall bracket shall be USA Bluebook item no. 47715, or equal.

PART 3: EXECUTION

3.1 GENERAL

A. Care during storage and procedures for installation, lubrication, and startup of the pumps and motors shall be in strict conformance with the manufacturer-s instructions. In addition, the instructions for installation, operation, and maintenance from the Hydraulic Institute Standards shall be followed.

B. Contractor shall verify all mounting requirements for pumping equipment with the FRP dosing tank manufacturer and obtain written concurrence from the Dosing Tank manufacturer as to his/her intended equipment installation – a copy of same will be provided to the Engineer.

C. Install pumping equipment per the pump manufacturer's and the FRP Dosing Tank manufacturer's pump support platform requirements. An FRP-encapsulated stainless-steel support platform is provided in the Dosing Tank for pump base support, and a hatchway beam is provided for upper slide rail support (see Drawings, and Buried FRP Tank & Accessories Specification).

3.2 PUMP INSTALLATION

A. The pump shall be connected to the discharge line without adding strain to the piping.

B. Pump power and control cables shall be mounted to suspend without interference or tangling and routed to provide protection from abrasion. Cable slack shall be provided and tethered within the tank access hatchway.

C. No field-splicing of the pump manufacturer's power and control cables is allowed.

3.3 SLIDE RAIL INSTALLATION

A. The pump slide rail system shall be installed in the FRP dosing tank to avoid any structural or surficial damage or abnormal stress to the tank. Pump bases and slide rail supports shall be connected to the FRP tank in accordance with the pump manufacturer's and the FRP Dosing Tank manufacturer's recommendations.

B. Slide rails and pump bases shall be set plumb and carefully aligned to the tank hatchway for unhindered pump removal/resetting. The Contractor shall confirm all lateral clearances required with the pump manufacturer, before setting equipment or drilling the FRP pump platform.

3.4 FIELD QUALITY CONTROL – FUNCTIONAL TEST

1. Prior to startup, all equipment shall be inspected for proper alignment, rotation, and proper connections.

2. Manufacturer's On-site Assistance:

1. An authorized representative of the pump manufacturer shall provide on-site assistance to advise the Contractor during pump installation and inspect the completed pump and slide-rail system. A minimum of 4 hours of manufacturer's field representative time on site for installation is required.

2. The pump manufacturer's representative shall also provide on-site training to the Owner in operation and maintenance of the pumps after installation. A minimum of 2 hour of manufacturer's field representative time on site for Owner training is required.

C. Functional tests of installed pumping equipment shall be conducted in accordance with Section 01610 - General Equipment Stipulations. Functional tests shall also include:

1. Individual operating test events of at least 2.0-minute duration for each pump, during which the pump's output will be monitored using the pressure gage and magnetic flowmeter in the Flowmeter Vault. During each operational test event, each pump's operating amp-draw shall also be monitored by the Contractor using amperage testing equipment he/she provides. The Contactor shall be responsible for providing, collecting, and disposing of clean water for these pump tests – pump discharge may not be routed to the new drainfield, unless authorized in writing by the Engineer.

2. Successful removal/resetting of each pump on its slide rail system.

3.5 SPARE PARTS

A. Provide the following spare parts (in the quantities indicated) meeting the specifications of this Section:

1. (2) each, resilient rubber seal rings for pump quick-disconnect bases, by pump manufacturer.

SECTION 13400

PROCESS INSTRUMENTATION & CONTROL

PART 1: GENERAL

1.1 Description

A. This section covers process instruments and controllers to be installed for septic and dosing tank level monitoring, dosing pump control and effluent (dosing) flow metering. Components include magnetic flowmeters, float switches and level alarm and relay panels, pressure gauges, appurtenances.

1. Variable frequency drives (VFDs) dosing pumps are specified in the Variable Speed Drives Specification.

2. Dosing pumps are specified in the Submersible Sewage Pumps Specification.

3. Ball valves for pressure gauge isolation are specified in the Valves Specification.

B. Items specified in this section shall include all materials, equipment, and work required for implementation of completely operable instruments. Instruments shall include primary elements for process variable measurements, analog and discrete outputs, and display and control elements (where specified).

C. The Contractor shall conduct all calibration adjustments, troubleshooting, and startup to assure instruments are properly operating and interfaced with other equipment. (See General Equipment Stipulations for system testing and startup requirements.)

D. Instruments specified in this section are subject to the requirements of Section 01610 - General Equipment Stipulations.

1.2 Submittals

A. In addition to the requirements of Section 01610 - General Equipment Stipulations, the following documentation shall also be provided for this equipment and accompany other required submittals:

1. Electrical drawings including circuit schematics, interconnection diagrams, and all information necessary for connection of electrical power and input/output circuits.

2. Panel elementary diagrams of pre-wired panels, including identification of all switched analog signals and all auxiliary devices such as relays, alarms, fuses, and lights.

3. Interconnecting wiring diagrams to tie instruments to Owner's telemetry system if/as shown on the Drawings, including all component and panel terminal board identification numbers and external wire numbers.

4. Hydraulic characteristics and requirements for all flow- and pressure-related devices.

5. Any special options included for each instrument.

6. Submittal information for each instrument shall bear the component name and Specification sub-section reference number.

7. Manufacturer's ratings for each instrument, including:
   a. Certified accuracy and precision (including repeatability).
   b. Scale range.
   c. Environmental tolerance (temperature, humidity, electrical induction isolation, and chemical resistance).
   d. UL, ANSI, or other ratings.

8. Dimensional drawings and ratings for all instrument panels and enclosures.

9. Specifications, ratings, and power requirements for any heating or ventilating devices installed in instrument enclosures.

1.3 Responsibility for Complete System

A. Unit Responsibility for Process Instruments:
   1. Unit responsibility for the Process Instruments shall be provided by the Contractor.

B. The Contractor shall be responsible for coordination of the work to ensure that:

   1. All components provided under this section are properly installed.

   2. The proper type, size, and number of control wires with their conduits are provided and installed.

   3. Proper electric power and control circuits are provided for all components and systems.

4. Instrumentation cable, power conductors, and conduits, and the installation thereof shall be provided and installed to meet the requirements of the Electrical Specifications.

1.4 Process Control System Descriptions

Specific control loops and/or integrated functionality for control systems are generally described as follows (see also Drawings and VFD Specification):

A. Septic Tank High Alarm: The new Septic Tank is equipped with a float switch-activated "high level" alarm that registers at a stand-alone alarm panel mounted on the panel rack near the tank(s).

B. Dosing Pumps and Dosing Tank:

1. General:

a. As wastewater enters the Septic Tank, a proportional volume of effluent overflows to the Dosing Tank. [Wastewater generation is generally limited to daytime hours when Caverns tours operate between May 1st and Sept. 30th.] Septic effluent is filtered through a cleanable 1/16-inch opening fabric screen cartridge.

b. While wastewater generation is limited to 8 to 10 hours per day, dosing of the new drainfield is intended to be spread out over a 24-hour period. So dosing pumps are timer-controlled for both dosing interval and dose duration (dose volume).

c. The two drainfield zones are dosed together, and a downstream hydraulic flow-splitter equally splits pumped effluent to individual pipelines to each zone. Upstream of the flow-splitter, an existing 6-inch gravity PVC outfall sewer conveys effluent to the splitter. Low head dosing pumps lift effluent from the dosing tank to the upstream end of this existing outfall line.

d. Because of drainfield size, 150 gpm dispensing rates in each of the two zones are maintained and controlled by orifice plates at the entry to each drainfield lateral pipe.

e. Either dosing pump will deliver 600 gpm (split 300 gpm per zone) for an adjustable duration of approximately 3.5 minutes. Pumps operate individually, and not together – the second pump is an automatic backup if one pump (or VFD) fails. Drainfield lateral piping, manifolds and effluent transport lines will fill in approximately 1.5

minutes, after which piping will surcharge into up-gradient oversized 10-inch pipe sections that serve as "head tanks." After 3.5 minutes of pumping, the head tanks and piping will gravity drain for an additional 1.5 minutes, completing the dosing cycle.

f. Dose volume is approximately 2,000 gal. Doses per day can range from only one (during very low weekday sewage flows) to three (during 6,000 gpd peak day design flow). To spread multiple daily doses over a 24-hour period, dosing pump control includes a separately adjustable timer function for dosing interval, to be set at 8± hours between doses.

2. Dosing Pump Control:

a. Three float switches are used in the Dosing Tank:
   i. "Low Level" cutoff for pump protection;
   ii. "Pump Start (Enable)" that signals enough liquid is present in the tank for a full (2,000 gal) dose volume; and
   iii. "High Level Alarm" to activate an alarm beacon/horn at the pump relay control panel.

b. If enabled by the "Pump Start" float switch, a dosing pump will be started by the dosing interval timer (e.g., at the end of 8 hours). That pump will stop when the dosing duration timer setting expires (e.g., 3.5 minutes). Both timing functions are combined in a single electronic timing relay in the pump relay control panel.

c. During pump operation, pump speed is modulated through its VFD to maintain 600 gpm flow as measured by the effluent magnetic flowmeter, through a 4-20 mA analog control loop. The flow analog signal is series-wired through both pump VFDs. Pump flow control is necessary because pump output can vary with the liquid level in the dosing tank, and a constant 600 gpm flow is needed.

d. After a pump cycle, the dosing interval timer prevents another pumping event until the timer setting expires (e.g., after 8 hr). Then another pumping cycle occurs using the alternate pump. Should a pump or its VFD fail, the second pump and VFD are called by the pump relay control panel, which also provides automatic pump alternation.

e. At any time during a pumping event, low liquid level (float switch) in the dosing tank will trigger a "stop" signal through the pump relay control panel to both pump VFDs.

3. Dosing Pump Seal Failure:

a. Each pump includes NO contacts for seal failure (moisture) detection. These are wired separately for each pump using 110 VAC circuits to seal failure relays in the pump relay control panel. These relays interface with 24 VDC circuits to trigger "Auxiliary Faults" on each VFD, shutting down that VFD and pump if seal failure is detected.

b. The 24 VDC for pump seal failure "Auxiliary Fault" circuits are sourced from each VFD for its respective circuit.

c. "Auxiliary Fault" circuits can be manually cleared on the VFD control screens, permitting the system operator to continue to use a pump with seal failure while awaiting repairs.

PART 2: MATERIALS

2.1 General

A. Like items of equipment provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.

2.2 Equipment Specifications

A. Unless superseded by other specifications herein or the manufacturer's standard ratings for a referenced instrument brand and model, all instruments shall be capable of the following minimum accuracy and precision:

1. Accuracy: plus-or-minus 1.0% of full scale
2. Precision: plus-or-minus 0.5% of full scale

B. Environmental Conditions: Unless otherwise noted, equipment shall be suitable for the following environmental conditions:

1.	Temperature	32 ˚to 120˚ F operating (storage to -40^{o} F)
2.	Relative Humidity	10 to 90 percent
3.	Enclosure Rating	NEMA 4X (instruments outside panels)
4.	Classification	Hazardous (Class I, Division 2) required
5.	Process Water Temp.	30˚ to 90˚ F

C. Wiring:

1. All electrical wiring shall be in accordance with the applicable requirements of the Electrical Specifications. Instrumentation cable and power conductors shall meet the requirements stated therein.

2. Wiring for signal circuits and 24VDC shall not be smaller than No. 18 AWG, and be separated at least 18 inches from any 120 VAC power wiring.

3. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks. All wires shall be color coded, and be identified by permanent plastic number tags placed within 2 inches of each termination.

4. Wiring run in panels shall be run in covered wiring duct identified by permanent plastic number tags within two inches of entering and leaving the duct. Wiring duct shall be covered, constructed of plastic and be of a snap-in slot type design.

D. Terminal Blocks:

1. Terminal blocks shall be one-piece molded plastic blocks with screw type terminals and barriers rated for 300 volts. Terminals shall be double sided and supplied with removable covers to prevent accidental contact with live circuits. Terminals shall be numbered and have permanent, legible identification, clearly visible with the protective cover removed.

2. Wires shall be terminated at the terminal blocks of one of the following ways:
   a. Crimp type, pre-insulated, forked-tongue lugs for screw post terminals.
   b. Bared wire ends for clamp-type terminals.

3. Lugs shall be of the appropriate size for the terminal block screws and for the number and size of the wires terminated.

2.3 Instrument Specifications

A. Effluent Magnetic Flow Meter with Remote Transmitter

1. Flowmeter shall be 6-inch (DN 150) nominal size, of full-bore style, and shall be used to measure dosing pump flow. Material to be measured is screened septic tank effluent. Explosion protection for metering components is not required.

a. The effluent flowmeter shall provide an analog 4-20 mA effluent flowmeter output signal to be wired in a series loop to the two dosing pump VFDs as shown on the Drawings.

2. The meter shall be provided with a full-bore metering tube, flanges, amplifier, remote display, and all connecting wiring. Meter tube (sensor) shall be perform at manufacturer's standard rated accuracy with no more than "5 pipe diameters" straight pipe upstream and no more than "2 pipe diameters" straight pipe downstream (at full pipe conditions).

3. The flow meter shall be of the electromagnetic induction type and use coil excitation with high impedance electrodes to produce a DC-pulsed signal directly proportional to and linear with the flow rate of the passing fluid. Within the metering tube there shall be a magnetic field traversing the entire cross section of the flow tube. Complete zero stability shall be inherent in the flow meter.

4. Flow meter shall operate from 120V, 1-phase, 60 Hz power.

5. The metering tube shall be constructed of 316 or 304 stainless steel with (2) 150# carbon steel ANSI flanges (or NPT ends for small diameter meters), and hard rubber liner.

6. Meter electrode shall be 316 stainless steel, and of a conical self-cleaning design.

7. The metering tube and remote display shall both meet NEMA 4X classification standards.

8. The amplifier/signal converter shall provide a 4-20 mA output signal

proportional to the flow rate. Converter shall also provide two discrete output settings. All outputs shall be short circuit proof to 500 volts.

9. Flowmeter transmitter shall be remotely mounted as shown on the Drawings, and be of the single-compartment design with LCD display for operator interface. The meter shall display instantaneous flow rate in U.S. gallons per minute, and totalized flow in gallons. Display housing shall be polycarbonate or epoxy-coated aluminum. Signal cable in adequate length shall be provided to connect the meter to the display location.

    a. Flow Transmitter Auxiliary Enclosure: Flow transmitter shall be installed in a 304 stainless steel, NEMA 4X, "dead-front" enclosure with hinged door with manufacturer's optional "key insert" latch system suitable for locking. Enclosure shall have nominal dimensions of 12"W x 14"H x 8"D, or as otherwise required to hold transmitter equipment. Enclosure shall be furnished with manufacturer's interior panel and DIN-rail mounting strip. Enclosure shall be Pentair Hoffman model LSC353020SS with LP3530 interior panel, or equal.

10. Meter accuracy shall be 0.4% of actual flow for all velocities greater than 1.7 fps. Meter repeatability shall be $\pm$0.05% of flow reading, or $\pm$0.0008 fps, whichever is greater. The meter shall be capable of measuring the flow rate of fluids having a conductivity of 0.5 micromhos per centimeter.

11. Provide two grounding rings at flowmeter sensor per manufacturer's recommendations for sensor installation in non-metallic pipelines. Provide and connect external ground-to-earth for ground plate(s), including copper cable and rod, per meter manufacturer's recommendations.

12. Remote transmitter shall be provided with manufacturer's standard 20m (60 ft) cabling. Cable shall be factory-potted at the sensor, suitable for submersion. Cable shall not be field-cut or field-spliced.

13. Flowmeter and remote transmitter shall be rated for "operating" temperatures of -4^{o} to +140^{o} F, and "storage" temperature down to -40^{o} F. Equipment will be de-energized between October 1st and April 30th (over winter) each year.

14. Magnetic flow meter shall be A.B.B. ProcessMaster FEP321 with FET321 remote transmitter, or equal subject to requirements for submittal review.

B. Level Alarm and Relay Control Panels and Float Switches

1. Float switches and related wiring for septic and dosing tanks and dosing pumps shall conform to N.E.C. Class 1, Division 2 requirements for hazardous locations, per MDEQ Circular DEQ4 Section 4.2.3.1.

2. Level alarm and pump relay control panels shall operate on 120 VAC, other than 24 VDC relay interface circuits from pump VFDs as shown on the Drawings.

3. The septic tank high level alarm panel shall be a self-contained unit, including float switches by the panel manufacturer.

   a. The high-level alarm panel shall have 5A, 120V auxiliary alarm contacts (currently unused).

   b. Unit shall have a two-year limited warranty.

4. Level alarm and relay control panels shall be NEMA 3R non-metallic enclosures with 85 db alarm horn and red alarm beacon, with "test" and "silence" functions.

5. The relay control panel for dosing pump and dosing tank level control shall be UL listed and built to UL 508A. Relays and auxiliary contacts in the panel shall be as shown on the Drawings. Panel features shall include:

   a. NEMA 4X poly enclosure shall have lockable SS latches and aluminum back plate.

   b. Three float switch system for "low level (pump cut-off)", "pump start" and "high water level".

   c. Individual circuit breakers for controls; timing relay; and panel strip heater (to allow operation during winter when controls are shut off).

   d. Six full featured SPDT relays for interface with dosing pump VFDs – including "pump start/run", "pump stop/low level", and "auxiliary fault/pump seal failure" for each pump and VFD (see Process Control System Description in the Specification; also see Drawings). Float switch relays shall be intrinsically safe.

   e. Terminal blocks for incoming 120 VAC power supply, floats, and 110VAC and 24 VDC interfaces with VFDs.

f. IDEC Smart Relay Generation 6 solid state programmable timing relay for independent control of dosing pump "interval" (frequency) and "duration", plus automatic alternation of pumps. Timing relay shall have backlit LCD display and scrolling buttons for menu access and parameter selection.

g. Monitoring circuit to monitor signals from dosing pump VFDs for "VFD fault" or "Pump (seal) Failure".

h. Automatic backup of pumps by calling second pump in event of first pump (or its VFD) failure.

i. Panel shall include an additional pair of auxiliary alarm contacts (for dosing tank "high alarm") – currently unused, that may be wired in the future to the Owner's telemetry system.

j. Thermostatically-controlled 110V, 60W anti-condensation heater.

6. Float switches for alarm panels shall be hermetically sealed, UL-listed heavy-duty mechanical wide-angle floats with water and oil resistant cables and narrow angle NO or NC contacts, as required for the application.

a. Cable lengths shall be manufacturer's standard 30-ft cables.

b. Floats shall be furnished with zinc-plated cast iron cord weights by the float manufacturer.

7. Manufacturer's References:

a. Level alarm and control panel for dosing tank and pumps shall be Septic Products, Inc. (Ashland, OH, 419/282-5933) model 10A500-(2)C3 as factory modified for the functionality shown on the Drawings, or equal.

b. Septic tank high-level alarm panel shall be Septic Products, Inc. model Observer 400 , or equal.

c. Panels shall be provided with Septic Products, Inc. Navigator Plus 30HM float switches, 'C10' cord weights, '1FB' float brackets, and 'G1' cord grips, or equal.

C. Pressure Gauges

1. Pressure gauges shall have a range of 0-15 psi and read in 0.2 psi marked gradations.

2. Shall be Bourdon tube actuated pressure gauges. Gauges shall be metal cased and silicone liquid filled. Gauges shall be stem mounted with minimum 2½-inch dial size, and ¼ -inch MPT connections. Gauge shall be ANSI Grade 2A with accuracy of plus or minus 0.5 percent of span.

3. The sensing element shall be phosphor-bronze, unless otherwise noted.

4. Pressure gauges shall be furnished with diaphragm seals, and pressure gauges with integral diaphragm seals are acceptable. Diaphragm seals are to be compatible with municipal wastewater and have ¼" NPT inlets/outlets. Diaphragm seals shall be Ashcroft capsule type or approved equal.

5. Connecting piping/tubing for pressure gages, diaphragm seals and gauge isolation valves shall be threaded brass or stainless steel.

6. All pressure gauge assemblies shall include a ¼" isolation valve between the pressure gauge (or diaphragm seal) and the carrier pipe. Isolation valves shall be as specified in the Valves Specification.

7. Units shall be Ashcroft Duragauge with Flush Mini Diaphragm Seal, or equal.

PART 3: EXECUTION

3.1 General

A. Coordinate process instrument electrical interface, installation and startup of all process instruments.

B. Follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturers' instructions, and these Contract Documents, follow Engineer's decision, at no additional cost to Owner. Keep copy of manufacturers' instructions on the jobsite available for review at all times.

3.2 Electrical Power and Signal Wiring

A. Control and signal wiring external to the control panels and all power wiring shall conform to the requirements of Electrical Specification.

B. Control and signal wiring in control panels shall be restrained by plastic ties or ducts. Hinge wiring shall be secured at each end so that any bending or twisting will be around the axis of the wire, and the bend area shall be protected with a sleeve.

C. Arrange wiring neatly, cut to proper length, and remove surplus wire. Provide abrasion protection for wire bundles passing through holes or across metal edges.

D. Wiring shall not be spliced or tapped except at device terminals or terminal blocks.

3.3 Special Requirements for Float Switch and Flowmeter Cables

A. Manufacturer's cables for float switches shall be supported and routed as shown on the Drawings, with slack cable provided in handholes or hatchways to facilitate float switch removal and replacement.

B. Cables shall be completely stress relieved. Support points and tie-off's shall be fully cushioned to prevent cable damage, and in full accordance with manufacturer's installation recommendations.

C. Cabling from flowmeter transmitters and displays shall be protected with neoprene grommets where entering conduit ends, sleeves, panels, or any sharp-edged openings in order to protect the cable.

3.4 Manufacturer's Field Services for Flowmeter

A. A manufacturer's representative for the flowmeter equipment specified herein shall be present at the jobsite and/or classroom designated by the Owner for the minimum hours listed for the services as follows, travel time excluded. The startup/training representative's qualifications shall be provided for approval in accordance with the requirements for equipment Submittal Review:

1. (4) hours for installation and startup assistance to the Contractor, inspection, functional and performance testing, and signal interface with the pump VFDs.

2. (2) hours for operator training to the Owner, to include the following:

a. Flowmeter sensor operation, including maintenance requirements.

b. Flow transmitter operation, including on-screen menu manipulation, display options, data retrieval, and any calibration procedures.

c. Seasonal shutdown and over-winter protection of equipment.

3.4 Contractor Testing

A. Calibrate, condition, and test all instruments in accordance with manufacturers' recommendations prior to demonstrating instruments and placing in service.

B. Provide testing and functional demonstration of all monitoring and control functions as described in manufacturers' submittals, the Drawings, these Specifications, and the General Equipment Stipulations.

C. Operating and Maintenance Manuals: Manufacturer's O & M manuals shall be provided for each electrified instrument per the General Equipment Stipulations.

D. Record Drawings: The Contractor shall provide one set of record drawings in both hard copy and electronic format for any field-wired interconnects between instruments or controllers.

3.5 Spares Parts

A. The following spare parts are required under the Contract:

1. (1) uninstalled NO float switches for septic tank high level alarm panel.

2. (1) uninstalled NO float switch for dosing pump relay control panel.

SECTION 15101

VALVES

PART 1: GENERAL

1.1 Work Included

A. This section covers the work necessary for furnishing and installing the various types of valves shown in the Drawings.

1.2 Submittals

A. The following submittal for construction shall be made in accordance with the project Submittal requirements described in the General Equipment Stipulations.

1. Product Data (provide for each type of valve specified)
   i. Complete specifications, dimensions, pressure and temperature ratings, materials data and catalog cuts or drawings shall be submitted for all valves.
   ii. Instructions for adjustment, adjustment range, a cut section view, and narrative description of valve operation for gate, air/vacuum release, and check valves.

PART 2: MATERIALS

2.1 General

A. All valves shall be complete with all necessary operators, actuators, hand wheel, chain wheels, extension stems, floor stands, worm and gear operators, operating nuts, chains, wrenches, and other accessories or appurtenances which are required for the proper completion of the work. Operators, actuators, and other accessories shall be sized and furnished by the valve supplier and factory mounted.

B. Valves shall be suitable for the intended service. Renewable parts including discs, packing, and seats shall be of types recommended by valve manufacturer for intended service, but not of a lower quality than specified herein.

C. Valves and operators shall be suitable for the applicable exposure: buried, interior or exterior. They shall have all safety features required by OSHA.

D. All units shall have the name of the manufacturer and the size of the valve cast on the

body or bonnet or shown on a permanently attached stainless steel or aluminum plate in raised letters.

E. For the purpose of designating the type and grade of valve desired, a manufacturer's name and list or figure number is given in the following specifications. Valves of equal quality by other manufacturers will be considered in accordance with the General Conditions.

2.2 Valve Types and Sizes

A. Valve types and sizes are generally called on the Drawings. Where not shown, valves shall be the same size as the pipe to which connected.

2.3 Design Features

A. Brass and bronze components of valves and appurtenances which have surfaces in contact with the water shall be alloys containing less than 16 percent zinc and 2 percent aluminum.

B. Approved alloys are of the following ASTM designations:

1. B61, B62, B98 (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.

2. Stainless steel Alloy 18-8 may be substituted for bronze at the option of the manufacturer and with the approval of the Engineer.

C. Valve ends shall be as specified, as shown on the Drawings, and to suit the adjacent piping.

2.4 Valve Operators

A. General

1. All valves shall be equipped with operators. The valve operator types, as specified herein, describe only the general characteristics of the operator. The operator shall be compatible with the valve with which it will be used and shall be of the same manufacturer, or a product that is recommended by the valve manufacturer. The operator shall be sized to operate the valve for the full range of pressures and velocities imposed by the service. All valve operators shall be installed such that there is no interference with existing piping or other equipment.

B. Manual Operators

1. Manual hand wheel shall be provided unless otherwise shown or specified. Ferrous hand wheel shall be painted the same color as the valve and associated pipeline. PVC valves shall have plastic hand wheels.

2. Lever operators shall be supplied on quarter-turn ball valves 3 inches and smaller.

3. Operator force shall not exceed 40 pounds under any operating condition, including initial breakaway.

2.5 Valves

A. Gate Valves

1. Gate valves in 1½" IPS size for drainfield lateral isolation and flow control shall be high-pressure, PVC valves with non-rising stems and hand wheel operators. Valves shall be rated for 150 psi at 73-deg F, with Schedule 40 high-impact PVC Type II bodies per ASTM D1785, and polypropylene paddles. Valves shall have socket or FPT ends.

2. Gate valves, 6-inch size, shall be iron-body, bronze-mounted, resilient seat gate valves with non-rising stems with design, construction and pressure rating conforming to AWWA Specification C509, with modifications specified herein. Stem seals shall be double rubber O-rings designed so that the seal above the stem collar can be replaced with the valve under pressure in full open position. Gate valves shall have ANSI 125# flanged ends, and hand wheel operators. Gate valve bodies shall be epoxy- or powder-coated by the manufacturer. All valves shall open counter-clockwise unless indicated otherwise in the Drawings or these Specifications. Valves shall be Mueller Resilient Wedge gate valves or approved equal.

B. Ball Valves

1. Stainless steel ball valves 1-inch and smaller, for general water and air service, shall be two-piece design with Teflon seats and packing and hand lever operators. Valves shall have 316 stainless steel bodies, and be rated for 1,000 psi, with threaded ends unless otherwise shown. Stainless steel ball valves shall be, Nibco T-585-S6-R-66-LL or approved equal.

2. PVC ball valves 4-inch and smaller shall be rated 150 psi at 120˚ F. Valves shall be of true union design, with ends compatible with adjacent piping, with two-way blocking capability. Valves shall have replaceable elastomer seats,

Viton or EPDM O-ring stem seals, and handle for manual operation. Ball valves shall be Asahi/America, Type 21; or approved equal.

i. Stem extension for PVC ball valves shall be provided where shown on the Drawings, and shall be of the lengths shown. Stem extensions shall be of the same manufacturer and rated for the ball valves on which used. Extensions shall include machined PVC upper and lower couplings, and shall be use cut-to-length 1" diameter Sch. 80 PVC pipe for the extension. Upper and lower couplings shall be affixed to the valve body and valve handle with stainless steel set screws. PVC ball valve extensions shall be Asahi/America part numbers 1000205 (1/2") and 1000210 (3/4" and 1"), or equal.

C. Check Valves

1. Check valves for dosing pump discharge lines shall be 6" full-body, flanged type, suitable for cold working pressure of 150 psi in wastewater service. Check valves shall be of the flexible elastomeric disc type. Valve body shall have full flow equal to nominal pipe diameter at all points through the valve. The seating surface shall be on a 45-dgree angle to minimize disc travel. Valves shall have a top access port of full size, allowing removal of the disc without removing the valve from the line.

2. Check valve discs shall be Buna-N (NBR) meeting ASTM D2000-BG. Discs shall be one-piece, precision molded with an integral O-ring sealing surface, and contain steel and nylon reinforcement at the hinge point. Non-slam closing characteristics shall be provided through a short 35-degree disc stroke.

3. Valve bodies shall be ASTM A126 Class B case iron, with alkyd enamel or epoxy coating.

4. Check valves shall be ValMatic Series #500, or equal.

D. Pressure-Vacuum Breaker (Concession Bldg. Hose Bib)

1. Pressure-vacuum breaker for backflow avoidance on the existing Concession Building hose bib shall of the pressure anti-siphon vacuum breaker type.

2. Pressure-vacuum breaker assembly shall have a "lead free" copper/silicon alloy body, with an acetal bonnet with silicone rubber O-ring seal and silicone rubber seat disc. Springs shall be stainless steel, and valve shall have replaceable seats, and inlet and outlet test cocks (also permitting draining). Check assembly shall be guided over its full stroke by vee-notched guides.

3. The assembly shall include an internal relief valve to protect components and the backflow body from freezing. The relief valve shall automatically reseat when pressure within the valve is below the set point of the freeze-relief valve.

4. Pressure-vacuum breaker shall be certified "lead free" by the manufacturer.

5. Unit shall meet the requirements of ANSI/ASSE Standard 120.

6. Pressure-vacuum breaker shall be a Watts Series LF800M4FR, or equal.

E. Stop-and-waste Valve

1. Stop-and-waste valve for winter draining of pressure-vacuum breaker plumbing shall be manufacturer-certified "lead free" and rated for 150 psi.

2. Valve shall have a brass body, rubber seats and stem packing, FIPT ends, and metal hand wheel operator. Drain port shall have a threaded brass cap and rubber packing.

3. Stop-and-waste valve shall be a Watts Series LFST, or equal.

F. Ventilating and Vent-and-Bleed Valves

1. A "ventilating valve" shall be used for vacuum relief on the FRP Dosing Tank during pump-down cycles. The ventilating valve shall have a spring-supported cone, pressed into the profile seat that opens under negative pressure. Spring force shall keep the valve closed in the absence of negative pressure.

2. Combination "vent-and-bleed valves" are used for air-and-vacuum relief on pump discharge lines and septic effluent gravity transport lines, as shown on the Drawings. Vent-and-bleed valves shall have buoyant floats that rise with liquid level, allowing air to exhaust when present, or allowing air to enter when the float is not buoyed and negative pressure exists.

3. Both "ventilating" and "vent-and-bleed" valves shall have PVC-U bodies, with metric solvent (socket) ends and provided with threaded end connectors. Valves shall be rated for 16 bars (230 psi). Valve floats and cones shall be polypropylene and ventilating valve springs shall be Halar-coated Nimonic 90.Valve seats shall be EPDM, and replaceable. Valves shall have a polypropylene protective cap.

4. Valves shall be furnished with spare units and manufacturer's dismantling tools, as specified under Spare Parts in this Specification.

5. Manufacturer's Reference:
   i. "Ventilating Valve" shall be Georg Fischer Piping Systems +GF+ Type 595, or equal.
   ii. "Vent-and-bleed Valves" shall be Georg Fischer Piping Systems +GF+ Type 591 (or U.S. Plastic Corp. item #20824 at www.usplastic.com), or equal.

PART 3: EXECUTION

3.1 General

A. Prior to installing flanged valves, the flange faces shall be thoroughly cleaned. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen or remove the nuts and bolts, reseat or replace the gasket, re-tighten and/or reinstall the nuts and bolts, and retest the joints. Joints shall be watertight at test pressures before acceptance.

B. Thoroughly clean threads of screwed joints by wire brushing, swabbing, or other approved methods. Apply approved joint compound to (metal) threads prior to making joints. Teflon tape shall be used to seal PVC threaded joints. Joints shall be watertight at test pressures before acceptance.

3.2 Placing

A. Generally, unless otherwise indicated on the Drawings, all valves installed in horizontal runs of pipe shall be installed with their operating stems vertical. Valves installed in vertical runs of pipe shall have their operating stems orientated to facilitate the most practicable operation.

3.3 Testing

A. Valves shall be field tested at the same time that the adjacent pipeline is tested. Joints shall show no visible leakage under test. Repair joints that show signs of leakage prior to final acceptance. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. The Contractor will be held responsible for any damage caused by the testing.

B. All valve operators shall be tested under pressure to confirm free operation without binding after connections to piping are completed.

3.4 Spare Parts

A. The following spare parts are required to be furnished under the Contract:

1. Two spare DN50 (2”) Vent-and-bleed Valves.
. Two manufacturer’s dismantling handles for DN50 (2”) Vent-and-bleed Valves.
3. One manufacturer’s dismantling handle for DN80 (3”) Ventilating Valve.

SECTION 16005

ELECTRICAL

PART 1: GENERAL

1.1 DESCRIPTION

A. This section covers all electrical work as indicated on the Drawings.

B. The work, in general, consists of, but is not limited to:

1. Extension of power service from existing power panel at Concession Building to new septic and dosing tank and dosing pump site(s).
2. Electrical feeds to dosing pumps and VFDs, and tank site instrumentation and controls.
3. Instrumentation cable from new flowmeter vault to pump VFDs.
4. Installation of new float switch controls and alarms for new septic and dosing tanks.
5. Conduit and wiring for all equipment shown.

C. See also Submersible Sewage Pump, VFD, and Instrumentation & Control Specifications.

1.2 SUBMITTALS

A. In addition to the requirements of the General Equipment Stipulations, the following documentation shall also be provided and accompany other required submittals for equipment specified herein:

1. Complete manufacturer's descriptive information and shop drawings for all equipment, material, and devices furnished under this Section, including certified outline drawings, arrangement drawings, elementary (schematic) diagrams, panel elevation drawings, interconnection and connection wiring diagrams.

2. Manufacturers' installation instructions and Operation and Maintenance Manuals for electrical equipment and controls as specified herein.

1.3 RESPONSIBILITY

A. The Contractor shall be responsible for:

1. Complete systems in accordance with these Contract Documents.

2. Coordinating the work required under all Sections of this Specification that affect the work covered in this section. This effort is required to assure that the project construction proceeds in an appropriate and timely manner.

3. Furnishing and installing all incidental items not actually shown or specified, but which are required by code or good practice to provide complete functional systems.

1.4 INTENT OF DRAWINGS

A. Electrical plan drawings show only general locations of equipment, devices, and raceway, unless specifically dimensioned. The Contractor shall be responsible for the proper routing of raceways, final sizing of conductors, and location of equipment and connections.

B. The control diagrams for the equipment are schematic and intended to show the desired operation. The Contractor shall install exactly as shown unless this operation will cause failure of the equipment due to unique operating characteristics of the supplied equipment not known to the Engineer.

C. The contractor shall notify the Engineer of such conflicts within 30 days of the Contract award and receive written resolution before proceeding with the Contract work. Any damage to the Contractor-supplied equipment arising due to improper control shall be the responsibility of the Contractor.

1.5 CODES, PERMITS, AND REGULATIONS

A. All work shall be performed in strict accordance with the current edition of the Local Laws and Ordinances, National Electrical Code (NEC), National Electrical Safety Codes (NESC), and the Occupational Safety and Health Act. (OSHA).

B. Wherever the requirements of the Specifications or Drawings exceed those of these codes, the requirements of the Specifications or Drawings shall govern. Code compliance is mandatory. Nothing in the Contract Documents shall be construed as permitting work not in accordance with these laws and codes.

C. Obtain all electrical permits and inspections, and pay all fees required by any governmental agency having jurisdiction over this work. Upon completion of the work, furnish satisfactory evidence to the Engineer that the work is acceptable to the regulatory authorities having jurisdiction.

PART 2: MATERIALS

2.1 GENERAL

A. Unless otherwise indicated, provide all first-quality, new materials and equipment, free from any defects, in first-class condition, and suitable for the space provided. Provide materials and equipment listed by UL wherever standards have been established by that agency. No used equipment shall be allowed.

B. Like items of equipment provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.

2.2 STANDARD PRODUCTS

A. Unless otherwise indicated, provide materials and equipment that are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.

2.3 EQUIPMENT FINISH

A. Provide materials and equipment with manufacturers' standard finish system unless otherwise noted. Provide manufacturers' standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with ANSI NO. 61, light gray color.

2.4 OUTDOOR EQUIPMENT

A. Equipment and devices to be installed outdoors or in unheated enclosures shall be capable of continuous operation within an ambient temperature range of minus 20° F to 104° F.

2.5 CIRCUIT BREAKERS

A. Circuit breakers shall be thermal magnetic type of the ratings shown on the Drawings. Breakers shall be molded case, with visible trip indication showing ON/OFF and TRIPPED positions on the operating handle. Multi-pole circuit breakers shall be designed so that an overload on one pole automatically causes all poles to open. Straps between single-pole breakers are not allowed for multi-pole breaker installations.

B. Circuit breakers shall be CH or CHT type, compatible with panels where installed.

C. Molded case breakers shall conform to NEMA AB-1and UL 489.

2.6 CONDUITS

A. Rigid Galvanized Steel (RGS) or Intermediate Metal Conduit (IMC): Use rigid steel or intermediate metal conduit, including threaded type couplings, elbows, nipples, and other fittings, galvanized by hot dipping, electroplating, or metalizing process and meeting the requirements of ANSI C80, NEMA FB 1, UL 6, and the NEC.

B. Electric Metallic Tubing (EMT): Use electric metallic tubing, zinc-coated and enamel-lined with thread-less couplings, bushings, elbows, nipples, and other fittings meeting the requirements of ANSI C80, NEMA FB 1, UL 797, and the NEC.

C. PVC Conduit: Use rigid PVC Schedule 80 conduit, UL listed for concrete encased, underground direct burial, concealed and direct sunlight exposed use, and UL listed and marked for use with conductors having 90° C insulation. Use conduits, couplings, bushings, elbows, nipples, and other fittings meeting the requirements of NEMA TC 2 and TC 3, Federal Specification W-C-1094, UL 651, NEC, and ASTM specified tests for the intended use.

D. Flexible Metal Conduit, Liquid-tight: Use UL 360 listed for 105 degrees C insulated conductors, conduit consisting of galvanized steel flexible conduit covered with an extruded PVC jacket and terminated with nylon bushings or bushings with steel or malleable iron body and insulated throat and sealing O-ring. Fittings and conduit bodies shall meet the requirements of NEMA FB 1.

E. Flexible Conduit, Non-liquid-tight: Use non-liquid-tight flexible steel conduit tubing, consisting of hot-dipped galvanized or electrogalvanized, inside and outside, made in one continuous length of spirally-wound steel strip with uniform interlocking convolution meeting the requirements of UL-1, or any subsequent revisions. Fittings and conduit bodies shall meet the requirements of NEMA FB 1.

F. Conduit clamps to support conduit on vertical or horizontal surfaces shall match conduit size and shall be galvanized steel strap-type with fasteners on each end. Fasteners shall be suitable for the substrate to which clamps are attached.

2.7 CONDUCTORS

A. All conductors shall be copper. Provide stranded conductors except provide solid conductors where No. 10 AWG and No. 12 AWG are used for branch circuit power wiring in lighting and receptacle circuits.

B. Wire sizes No. 8 AWG and smaller shall have a thermoplastic PVC insulation with

an overall nylon jacket. Stranded wire shall be Class C stranded. The conductor shall be rated THHN/THWN.

C. Wire sizes larger than No. 8 AWG shall be non-organically filled cross-linked polyethylene insulation Type XHHW, or have thermoplastic PVC insulation with an overall nylon jacket rated THHN/THWN.

D. Cords shall be type SEOW, American Insulated Wire Corp., Coleman Cable Co Seoprene 105, or approved equal.

E. Multi-Conductor Cable: Provide cables as specified under the following Type numbers.

1. Type 1 (600 Volt Multi-Conductor Control Cable, Type TC)

a. General: Multi-conductor control circuit interconnection cable with ground. Suitable for installation in open air, in cable trays, conduit, or other approved raceways. Minimum cable temperature rating shall be 90° C dry locations, and 75° C wet locations.

b. Individual conductors: No. 14 AWG, 19 strand copper.

c. Insulation and Jacket: Each conductor shall have 15-mil PVC insulation with THHN-THWN legend. Conductor group shall be color-coded in accordance with ICEA method 1, Table K2, and shall include one full size green grounding conductor. Group shall be bound with a spiral wrap of barrier tape. Jacket shall be flame retardant and sunlight and oil resistant PVC. Provide 5-, 7-, 12-, 25-, conductor cable as required, including a green grounding conductor.

d. Manufacturer and type: Okonite FMR-Okoseal Type TC; Cablec Corp. XLPE Control Cable Type TC; or equal.

2. Type 2 (600 Volt Multi-Conductor Power Cable, Type TC)

a. General: Three or four conductors, with ground and overall jacket. Suitable for installation in open air, in cable trays, conduit, or other approved raceways. Minimum cable temperature rating shall be 90° C dry locations, and 75° C wet locations.

b. Individual Conductors: Class B stranded per ASTM B-8. Size as shown.

c. Insulation and Jacket: Each phase conductor shall be insulated with chemically crosslinked polyethylene, or ethylene propylene, meeting type XHHW, VW-1 requirements of Underwriters Laboratories. Jacket shall

be flame retardant and sunlight and oil resistant Hypalon.

d. Manufacturer and type: Pkonite-FMR Okolon; B/W Cable Systems Inc. Pyronot II; or equal.

3. Type 3 (600 Volt No. 16 AWG Twisted, Shielded Pair Instrumentation Cable, Type TC).

a. General: Single pair instrumentation cable designed for noise rejection for process control, computer, or datalog applications. Suitable for installation in cable trays, conduit, or other approved raceways. Minimum cable temperature rating shall be 90° C dry locations, and 75° C wet locations.

b. Individual Conductors: No. 16 AWG Soft annealed copper, Class B, seven strand concentric per ASTM B 8. Size 20 AWG tinned copper drain wire.

c. Insulation and Jacket: Each conductor shall have 15 mil PVC insulation. Jacket shall be flame retardant and sunlight and oil resistant PVC with 35 mils nominal thickness. Shield shall be 0.35 mil aluminum/mylar overlapped to provide 100 percent coverage.

d. Manufacturer and type: Okonite Okoseal-N P-OS; Belden No. 9342; or equal.

F. Equipment Grounding Conductors: Provide stranded copper conductors with green insulation, size as required by NEC for equipment grounding.

G. Service Grounding Conductors: Provide bare solid or stranded copper, size as required by NEC for service grounding.

H. Ground Rods: Ground rods shall be all-copper, sized and arranged per NEC requirements for the equipment or system(s) protected.

2.8 TERMINAL BLOCKS

A. Provide terminal blocks for termination of all control circuits leaving or entering equipment, panels, or boxes. Terminal blocks shall be UL 1059, compression screw clamp type with current bar providing direct contact with wire and yoke. Yokes and clamping screws shall be zinc-plated hardened steel. Individual terminals shall be rail mounted to create a complete assembly. Units shall be UL approved, CSA certified, and rated for 600V ac and currents as required. Marking system shall permit use of

preprinted or field-marked tags.

2.9 PANELS AND ENCLOSURES

A. Panels, electrical boxes and enclosures above grade shall be NEMA 3R, with lockable dead fronts.

1. Subpanel at Dosing/Septic Tanks: New subpanel for dosing pump VFDs and tank level and flow control shall be a single-phase, 120/240 VAC main lug load center with twin neutral bars, main circuit breaker and 8-slot panel.
   a. Bussing shall be one-piece, silver-flashed copper. Panel shall be rated for 125A, and provided with 60A, single-phase, double-pole main breaker.
   b. Main lugs shall accept up to 1/0 copper conductor.
   c. Panel shall have nominal dimensions of 13”H x 11”W with powder-coated “sandalwood” color finish.
   d. Panel shall have metal tang suitable for padlocking.
   e. Panel shall be Eaton Type CH model CH8L125RP, or equal.

B. Panels and electrical boxes and enclosures below grade shall be NEMA 4X, with bolted front panels.

C. Panel access fasteners shall be stainless steel.

2.10 PANEL SUN SHADES

A. Panels, electrical boxes and enclosures rack-mounted at the new septic/dosing tank site shall be protected with sun shades to deter over-heating, as shown on the Drawings. Sun shades shall be of the nominal sizes indicated on the Drawings.

B. Sunshades shall be molded of ABS plastic with UV resistance. Units shall have backplates, overhangs, and side gussets molded integrally with the shade assembly.

C. Sunshades shall be provided with galvanized steel mounting plates and hardware to support the shades on the UniStrut rack for the panels to be protected. Provide “universal” or “L” brackets with backing plates for bolting sunshades to rack.

D. Sunshades shall be O’Brien/Ametek VIPAK model E2B (23”W x 19½”H x 19½”D) or VIPAK model EB3 (30”W x 19½”H x 19½”D) according to the sizes indicated on the Drawings, or equal.

2.11 HANDHOLES

A. Handholes for buried electrical circuits shall be places as shown on the Drawings, or as otherwise required or elected by the Contractor to facilitate wiring installation.

B. Handholes shall be as specified in the Plastic Manholes, Vaults & Handholes Specification.

2.12 WARNING TAPE

A. Provide heavy gauge, red plastic tape of 3-inch minimum width for use in trenches containing electric conduits for power or control circuits.

B. Tape shall be placed 12 inches vertically above buried conduits.

C. Utilize tape made of material resistant to corrosive soil. Use tape with printed warning that an electric circuit is located below the tape.

D. Manufacturers and types: Klein no. 58003, ITT Blackburn Type RT; Griffolyn Terra Tape; or equal.

2.13 SURGE SUPPRESSION DEVICES (SPDs)

A. Surge suppression shall be provided on the line side of the new dosing pump subpanel, as shown on the Drawings. Line side surge protection shall be Type 1 SPDs rated for 100 kA per phase, and suitable for integration on the panelboard bus. Power characteristics shall be 240V single-phase.

B. Type 1 surge protection devices shall comply with UL 1449 and shall be CSA C22.2 certified.

C. Type 1 surge protection devices shall be Eaton model SPD100 240S 1A, or equal.

PART 3: EXECUTION

3.1 GENERAL

A. Float switches and related wiring for septic and dosing tanks and dosing pumps shall conform to N.E.C. Class 1, Division 2 requirements for hazardous locations per MDEQ Circular DEQ4 Section 4.2.3.1.

B. Coordinate electrical work with the Owner and work of other trades to avoid interruption of services or power to Owner's other facilities.

C. Check the indicated locations of electrical equipment, outlets, and other system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, consult the Engineer, and make any approved modifications and changes required.

3.2 PROTECTION DURING CONSTRUCTION

A. Throughout this Contract, provide protection for materials and equipment against loss or damages in accordance with provisions elsewhere in these Contract Documents. Protect everything from the effects of weather.

B. Items that are subject to corrosion under damp conditions and items containing electrical insulation, such as transformers, conductors, motors, and controls, shall be stored in clean, dry, indoor, heated locations.

C. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. Cap conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed during construction.

D. Protect all conduit, wiring, and connections for Owner's existing equipment, or new equipment specified under other Sections.

3.3 MOTOR ROTATION

A. After final service connections are made, check and correct if necessary the rotation of all motors.

B. Coordinate rotation checks with the Engineer and the Contractor responsible for the driven equipment. Submit a written report to the Engineer for each motor verifying that rotation has been checked and corrected.

3.4 CONDUIT

A. All power and instrumentations conductors shall be installed in conduit in accordance with the following table, unless otherwise indicated in the Drawings:

AREA	CONDUIT
Exterior	Rigid Steel or IMC
Interior exposed	Rigid Steel or IMC
Interior concealed	EMT
Interior lighting and receptacles exposed or concealed	EMT
Underground, earth burial	PVC
Embedded in concrete	PVC

B. Special Locations:

1. Use rigid steel conduit or IMC:
   a. Where conduit changes from underground and/or concrete-embedded to exposed.
   b. Under equipment mounting pads.

C. Conduits entering cabinets, pull boxes or outlet boxes shall be secured with double galvanized locknuts, one inside and outside of box, and bushings.

D. Conduit shall be sized in accordance with the NEC and shall be of such size and so installed that conductors may be drawn in without injury or excessive strain.

E. Make final connection to motors, VFDs, instrumentation, and other equipment to facilitate removal or adjustment of equipment, with 18-inch minimum, 36-inch maximum lengths of liquid-tight, PVC jacketed, flexible steel conduit.

F. All vault and exterior wall penetrations shall be sealed with a waterproof, non-sag sealant.

G. Buried Conduit Backfill:

1. Backfill material for the conduit zone of direct burial conduit trenches may be selected from the excavated material if it is free from roots, foreign material, and oversized particles. Use material with 3/4-inch maximum particle size and suitable gradation for satisfactory compaction. Sort material if necessary to meet these requirements. Carefully tamp around and over conduits with hand tampers.

2. Imported 3/4 inch minus gravel or sand may be used in lieu of material from the excavation.

3. After conduits have been properly installed and bedded, backfill the trench above conduits with material meeting the requirements of the Excavation and Backfill Specification.

4. Final conduit cover shall be 24 inches minimum. Depths of handholes and pull boxes and/or penetrations in same shall accommodate conduit burial depth.

H. Prohibition Against Installing Instrumentation Cable in Conduit with Power Conductors:

1. Instrumentation cable shall be placed in separate conduit runs and may not be installed in the same conduit as power distribution conductors.

2. Instrumentation cable conduit runs in parallel with power distribution conductors and/or conduits must be laid with a minimum of 18 inches of spatial separation.

3. Instrumentation cable shall not be routed through junction boxes, handholes, or pull boxes shared by power distribution conductors.

3.5 GROUNDING

A. All services, load centers, VFDs, panelboard cabinets, equipment and enclosures, and the complete conduit system shall be grounded securely in accordance with pertinent sections of Article 250 of the NEC. Grounds shall be individual or combined, according to equipment manufacturers and NEC requirements. All electrically operated equipment shall be bonded to the grounding conduit system.

3.6 WIRE PULLING

A. No wire shall be drawn into conduit until conduit system is complete. Lubricant shall be approved by wire manufacturer.

3.7 COLOR MARKINGS

A. Where two or more conduits run to a single outlet box, each circuit shall be color coded as a guide in making connections. Colors shall be carried continuously throughout the system if more than one multi-wire branch circuit is carried through a single raceway. All circuit conductors of the same color shall be connected to the same underground feeder conductor throughout the installation.

3.8 CIRCUITS

A. Deviations from conduit runs will be permitted with the Engineer's approval. Combining circuits in single conduit is permitted with proper identification and wire derating, subject to NEC requirements.

3.9 LOAD BALANCE

A. The Drawings indicate circuiting to distribute electrical loads . However, after installation, if necessary, balance electrical load between phases or legs as nearly as possible on power distribution and panel boards.

3.10 TESTS

A. Operations: After the electrical system installation is completed and at such time as the Engineer concurs, conduct an operating test for approval. See Performance Testing requirements in Special Provisions. Demonstrate that the equipment operates in accordance with the requirements of these Specifications and Drawings. Perform the test in the presence of the Engineer. Furnish all instruments and personnel required for the tests. The Owner will furnish the necessary electric power for new equipment testing only; the Contractor is responsible for providing his/her own electrical power system for construction (see Special Provisions).

B. Voltage:

1. When the installation is essentially complete and new electrified equipment is operable, check the voltage at the point of termination of the power company supply system to the project. Check voltage amplitude and balance between phases for loaded and unloaded conditions.

2. At the request of the Engineer, record the supply voltage for 24 hours during a normal working day.

3. If the unbalance (as defined by NEMA) exceeds 1 percent, or if the voltage varies throughout the day and from loaded to unloaded conditions more than plus or minus 4 percent of nominal, make a written request to the power company that the condition be corrected. If corrections are not made, obtain from a responsible power company official a written statement that the voltage variations and/or unbalance are within their normal standards.

4. Equipment Line Current: Check the line current in each phase for each piece of equipment. If the power company makes adjustments to the supply voltage magnitude or balance, make the line current check after the adjustments are made. If any phase current in any piece of equipment is above the rated nameplate current, determine and submit in writing to the Engineer the cause of the problem.

3.11 FIELD DOCUMENTATION

A. In addition to the O&M Manual requirements of the General Equipment Stipulations, the following documentation shall also be provided by the Contractor for electrical systems:

1. As-built electric circuit and equipment drawings.

2. Index of all equipment suppliers listing current names, addresses, and telephone numbers of those who should be contacted for service, information, and assistance.

3. As-built Contract Drawings showing all departures from original Drawings. Show all underground cable, conduit, or duct runs dimensioned from established building lines, and all electrical work revisions. Prepared by Contractor on clean set of Contract Drawings.

4. Documentation of all field test results.

SECTION 16483

VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 Description

A. Variable frequency drives (VFDs) shall be solid state, adjustable frequency devices to provide 240V single- to three-phase power conversion, and speed control and flow modulation for submersible dosing pumps. Dedicated VFDs are provided for each dosing pump, as shown on the Drawings. Harmonics filters, integrated into drive enclosures, are included as specified herein.

B. VFDs shall be furnished in individual manufacturer-engineered enclosures (panels), incorporating harmonic filters and human-interface-modules (HIMs) and other controls as shown and specified.

C. VFDs shall modulate dosing pump flows in response to an effluent flowmeter analog signal (see also Process Instrumentation & Control Specification).

1.2 Certifications and General Operating Conditions

A. The manufacturer shall have minimum 5 years' experience in the design and manufacture of Variable Frequency Drives (VFDs).

B. The VFD and all associated equipment shall be UL Listed according to UL 508C – Power Conversion Equipment. As verification, a UL label shall be attached on the enclosure.

C. Each VFD in conjunction with its associated passive harmonics filter shall achieve IEEE519 compliance for total harmonics, including Total Demand Distortion per Table 10-3 of IEEE-519 and Total Harmonic Voltage Distortion per Table 10-2 of IEEE-519. Total harmonic distortion emanating from each drive-and-filter combination shall not exceed 5.0 percent.

D. The VFD shall be designed, constructed and tested in accordance with UL, CSA, NEMA, and NEC standards.

E. Every power converter shall be tested with an AC induction motor while loaded and temperature cycled within an environment chamber.

F. Wiring for power and control circuits to/from the drives, motors, and external circuits shall meet the requirements of the Electrical Specification.

1.3 Submittals

A. In addition to the requirements of the General Equipment Stipulations, the following documentation shall also be provided for this equipment and accompany other required submittals:

1. Electrical drawings including circuit schematics, interconnection diagrams, and all information necessary for connection of electrical power and input/output circuits.

2. Interconnecting wiring diagrams to tie instruments to Owner's control system where shown on the Drawings, including all component and panel terminal board identification numbers and external wire numbers. This diagram shall include all intermediate terminations between field elements and panels (including disconnect devices, pilot devices, terminal junction boxes, motor control centers, etc.).

3. Power diagram including amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings.

4. Major components list and data sheets for major components, including contactors, circuit breakers and fuse (both power and control), control power transformers, pilot devices, relays and timers, and harmonic filters.

5. Manufacturer's statement relative to IEEE 519 compliance on harmonics.

6. Drive and harmonic filter elevation drawings including dimensional information and conduit routing locations.

7. Active and passive ventilation and heat dissipation features and appliances in each drive or filter, including ratings and electrical characteristics.

8. For separate or manufacturer out-sourced enclosures -- elevation drawings and dimensions; ventilation and/or cooling equipment component list: rating, arrangement and wiring; and NEMA and environmental ratings.

9. Any special options or accessories included for each drive and filter.

10. Test procedures prescribed by the drive and filter manufacturers.

1.4 Closeout Submittals (Operation and Maintenance Manuals)

A. Shop Drawings – Final as shipped

1. Elevation Drawings: Include dimensional information and conduit routing locations.

2. Unit Descriptions: Include amperage ratings, enclosure ratings, fault ratings, nameplate information, etc. as required for approval.

3. Wiring Diagrams:

   a. Power Diagram: Include amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings, etc. as required for approval.
   b. Control Diagram: Include disconnect devices, pilot devices, etc.

4. Major components list.

B. Product Data Sheets

1. VFD and Operator Interface publications.
2. Harmonic filter publications.
3. Data sheets and publications on all major components including but not limited to the following:
   a. Contactors
   b. Circuit breaker and fuse (power and control)
   c. Control power transformers
   d. Pilot devices
   e. Relays/Timers
   f. Harmonic filters

C. Test procedures shall be per the manufacturer's standards.

D. Operation and Maintenance Data

1. Service and Contact information
2. VFD and Operator Interface User Manuals
3. Harmonic Filter User Manuals
4. Troubleshooting / Service Manuals

1.5 Quality Assurance

A. Qualifications:
1. Manufacturers:

   a. The VFD and all associated optional equipment shall be UL listed or recognized.
   b. The VFD shall contain a UL label attached on the inside of the enclosure cabinet.

2. Equipment Scope:

   a. The VFD with harmonic filter shall be factory pre-wired, assembled and tested as a complete package.

1.6 Delivery, Storage, And Handling

A. Contractor shall coordinate the shipping of equipment with the manufacturer.
   1. Contractor shall store the equipment in a clean and dry space at an ambient temperature range with the VFD manufacturer's prescribed tolerances.
   2. The Contractor shall protect the units from dirt, water, construction debris and traffic.

1.7 Warranty

A. The drive manufacturer shall provide their standard parts warranty for eighteen (18) months from the date of shipment or twelve (12) months from the date of being energized, whichever occurs first.

PART 2 PRODUCTS

2.1 Manufacturers Reference

A. The VFDs shall be Powerflex 525 AC Drive Units, provided by Allen-Bradley/Rockwell Automation, or equal, subject to performance equivalency and the requirements for Submittal review.

2.2 Performance Requirements

A. The VFD shall convert the input AC 240V, single-phase, three-wire 60 Hz power supplied from the existing Concession Building 120/240V panel, into an adjustable frequency and 240V, 3-phase wye-connected output voltage. VFDs shall have no greater than a 50% de-rating factor by the manufacturer for output loading when supplied with single-phase power.

B. The VFD shall be listed and labeled as a complete unit and shall include all accessories and requirements as described in this section.

C. VFD enclosures shall be NEMA 3R, and out-door mounted at the location shown on the Drawings.

D. Equipment will be de-energized between October 1st and April 30th (over winter) each year.

E. Environmental Ratings:

   1. Storage ambient temperature range: -40 to 185°F.
   2. Ambient air temperature operating range: -4 to 122°F (without derating).
   3. Relative humidity range: 5% to 95%, non-condensing.
   4. Operating elevation: 5275 ft MSL

5. Shock: 15G peak for 11ms duration.
6. Vibration: 0.152 mm (0.006 inches) displacement, 1G peak.
7. Seismic: The AC drive shall meet the seismic requirements of the 2003 International Building Code as specified by AC156.

F. VFD Loads and Application Data:

1. Each AC drive shall be sized to operate a variable torque (centrifugal pump) load.

2. The speed range shall be from a minimum speed of 1.0 Hz to a maximum speed of 60 Hz.

3. VFD Loads: VFDs shall operate centrifugal pumps manufacturer-rated at 2.8 hp and 8.2 running amps (230V, three-phase) per pump (see Submersible Sewage Pump Specifications). VFDs shall have a 3-phase 240V output load rating of at least 11 amps (with 240V single-phase input), or larger if so recommended by the drive manufacturer for this application. Note that actual pumps provided could vary from those specified, subject to requirements for Submittal review, and the VFD supplier must verify with the Contractor the exact electrical and load characteristics of the pumps being provided.

G. Features:

1. Certifications

   a. Listed to UL508C and CAN/CSA-C22.2 No. 14-05.
   b. In conformity with EMC Directive (2004/108/EC) and Low Voltage Directive (2006/95/EC). Standards applied; EN 61800-3:2004, EN 61800-5-1:2007.
   c. Electric Power Research Institute. Certified compliant with standards SEMI F47 and IEC 61000-4-34Hardware.

2. Characteristics

   a. Utilize diode bridge or SCR bridge on the input rectifier.
   b. Utilize DC bus inductor on all six-pulse VFDs only.
   c. Utilize switching logic power supply operating from the DC bus.
   d. Incorporate phase to phase and phase to ground MOV protection on the AC input line.
   e. Microprocessor based inverter logic shall be isolated from power circuits.
   f. Utilize latest generation IGBT inverter section.
   g. Battery receptacle for Lithium battery power to the Real Time Clock.
   h. Additional DPI port for handheld and remote HIM options.

i. Dedicated Digital Input for hardware enable.
j. Conformal coated printed circuit boards.
k. Optional onboard 24V DC Auxiliary Control Power Supply.

3. Control Logic

a. Ability to operate with motor disconnected.
b. Provide a controlled shut down, when properly protected, with no component failure in the event of an output phase to phase or phase to ground short circuit. Provide annunciation of the fault condition.
c. Provide multiple programmable stop modes including Ramp, Coast, DC-Brake, Ramp-to-Hold, Fast Braking, and Current Limit Stop.
d. Provide multiple acceleration and deceleration rats.
e. Adjustable output frequency up to 650Hz.

4. DeviceLogix Control

a. Ability to control outputs and manage status information locally within the VFD.
b. Ability to function stand-alone or complimentary to supervisory control.
c. Ability to speed reaction time by processing in the VFD.
d. Ability to provide scaling, selector switches, or other data manipulations not already built into the VFD.
e. Ability to read inputs/write outputs and exclusively control the VFD.
f. Ability to provide an option for decision making if communication is lost with main controller.
g. Ability to control other VFDs via a peer-to-peer EtherNet/IP network.
h. Ability to write programs off-line.

5. Motor Control Modes

a. Selectable Sensorless Vector, Flux Vector, V/Hz, and Adjustable Voltage Control modes selectable through programming.
b. The drive shall be supplied with a Start-up and Auto-tune mode.
c. The V/Hz mode shall be programmable for fan curve or full custom patterns.
d. Capable of Open Loop V/Hz.

6. Current Limit

a. Programmable current limit from 20 to 160% of rated output current.
b. Current limit shall be active for all drive states: accelerating, constant speed and decelerating.
c. The drive shall employ PI regulation with an adjustable gain for smooth transition in and out of current limit.

7. Acceleration / Deceleration

    a. Accel/Decel settings shall provide separate adjustments to allow either setting to be adjusted from 0 to 3600 seconds.
    b. A second set of remotely selectable accel/decel settings shall be accessible through digital inputs.

8. Speed Profiles

    a. Programming capability shall allow the user to produce speed profiles with linear acceleration/deceleration or "S Curve" profiles that provide changing accel/decel rates.
    b. S Curve profiles shall be adjustable.

9. Adjustments

    a. A digital interface can be used for all set-up, operation and adjustment settings.
    b. All adjustments shall be stored in nonvolatile memory (EEPROM).
    c. No potentiometer adjustments shall be required.
    d. EEPROM memory for factory default values shall be provided.
    e. Software must be available for trending and diagnostics, as well as online and offline programming functionality.

10. Process PID Control

    a. The drive shall incorporate an internal process PI regulator with proportional and integral gain adjustments as well as error inversion and output clamping functions.
    b. The feedback shall be configurable for normal or square root functions. If the feedback indicates that the process is moving away from the set-point, the regulator shall adjust the drive output until the feedback equals the reference.
    c. Process control shall be capable of being enabled or disabled with a hardwire input. Transitioning in and out of process control shall be capable of being tuned for faster response by preloading the integrator.
    d. Protection shall be provided for a loss of feedback or reference signal.

11. Skip Frequencies

    a. Three adjustable set points that lock out continuous operation at frequencies which may produce mechanical resonance shall be provided.
    b. The set points shall have a bandwidth adjustable from Maximum Reverse Speed to Maximum Forward Speed.

12. Fault Reset / Run

    a. The drive shall provide up to nine automatic fault reset and restarts following a fault condition before locking out and requiring manual restart.
    b. The automatic mode shall not be applicable to a ground fault, shorted output faults and other internal microprocessor faults.
    c. The time between restarts shall be adjustable from 0.5 seconds to 30 seconds.

13. Run on Power Up

    a. A user programmable restart function shall be provided to allow restart of the equipment after restoration of power after long duration power outages. Restart time dependent on presence of incoming signal.

14. Fault Memory

    a. The last 32 fault codes shall be stored, and time stamped in a fault buffer.
    b. Information about the drive's condition at the time of the last fault such as operating frequency, output current, dc bus voltage and twenty-seven other status conditions shall be stored.
    c. A power-up marker shall be provided at each power-up time to aid in analyzing fault data.
    d. The last 32 alarm codes shall be stored, and time stamped for additional troubleshooting reference.

15. Overload Protection

    a. The drive shall provide internal class 10 adjustable overload protection.
    b. Overload protection shall be speed sensitive and adjustable.
    c. A viewable parameter shall store the overload usage.

16. Auto Economizer

    a. An auto economizer feature shall be available to automatically reduce the output voltage when the drive is operating in an idle mode (drive output current less than programmed motor FLA). The voltage shall be reduced to minimize flux current in a lightly loaded motor thus reducing kW usage.
    b. When the load increases, the drive shall automatically return to normal operation.

17. Terminal Blocks

    a. Separate terminal blocks shall be provided for control and power wiring.
    b. I/O terminal blocks shall be removable with wiring in place.

18. Flying Start

    a. The drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to "pick-up" the motor at the rotating speed. This feature is disabled by default.

19. Inputs and Outputs

    a The Input / Output option modules shall consist of both analog and digital I/Os and shall provide interfaces to accomplish all functionality and logic shown and specified. Additional I/O cards or capacity shall be provided in each drive as necessary to meet this requirement.
    b. No jumpers or switches shall be required to configure digital inputs and outputs.
    c. All digital input and output functions shall be fully programmable.
    d. The control terminal blocks shall be rated for 115V AC.
    e. Inputs shall be optically isolated from the drive control logic.
    f. The control interface card shall provide input terminals for access to fixed drive functions that include start, stop, external fault, speed, and enable.
    g. VFDs shall have a minimum of 7 digital inputs, 2 analog inputs, and 2 relay outputs.
    h. Inputs /Outputs shall have the following features:

        i. Analog Inputs:

            a) Quantity two (2) differentially isolated, ±10V (bi-polar), 88k ohm input impedance, 11 bit plus sign.
            b) Analog inputs shall be user programmable for a variety of uses including frequency command and process loop input. Analog inputs shall be user programmable for function scaling (including invert), offset, signal loss detect and square root.

        ii. Digital Inputs:

            a) Quantity of seven (7) digital inputs rated 24V DC/115V AC.
            b) All inputs shall be individually programmable for multiple functions including: Start, Run, Stop, Auxiliary Fault, Speed Select, Jog and Process PI functions.

        iii. Digital Outputs:

            a) At least two (2) relay outputs (N.O. or N.C.).

            b) For 240V AC or 24V DC, N.O. contact output

ratings shall be 2-amp max., general purpose (inductive)/resistive. N.C. contact output ratings shall be 2-amp max., resistive only.

c) Relays shall be programmable to multiple conditions including: Fault, Alarm, At Speed, Drive Ready and PI Excess Error.

d) Timers shall be available for each output to control the amount of time, after the occurring event, that the output relay actually changes state.

e) Output contacts shall be rated 3.0 amp max, Resistive, at 24 VDC, 120 or 240 VAC.

i. Reference Signals

i. The drive shall be capable of using the following input reference signals:

a) Analog inputs
b) Preset speeds
c) Remote potentiometer
d) Digital MOP
e) Human Interface Module
f) Communication modules
g) Loss of Reference

ii. The drive shall be capable of sensing reference loss conditions.

iii. In the event of loss of the reference signal, the drive shall be user programmable to the following:

a) Fault the drive and coast to stop.
b) Issue a minor fault - allows the drive to continue running while some types of faults are present.
c) Alarm and maintain last reference.

iv. When using a communications network to control the drive, the communications adapter shall have these configurable responses to network disruptions and controller idle (fault or program) conditions:

a) Fault
b) Stop
c) Zero Data
d) Hold Last State
e) Send Fault Configuration

j. At a minimum, the following parameters shall be accessible through the Human Interface Module:

i. Output Current in Amps
ii. Output Voltage in Volts
iii. Output Power in kW
iv. Elapsed MWh
v. DC Bus Voltage
vi. Frequency
vii. Heatsink Temperature
viii. Last eight (32) faults
ix. Elapsed Run Time
x. IGBT Temperature

20. Faults

a. At a minimum, the following faults shall be accessible through the Human Interface Module:

i. Power Loss
ii. Undervoltage
iii. Overvoltage
iv. Motor Overload
v. Heat Sink Over-temperature
vi. Maximum Retries
vii. Phase to Phase and Phase to Ground Faults

21. Predictive Diagnostics

a. At a minimum, the following predictive diagnostic features shall be provided:

i. Relay Output Life Cycles based on load type and amps.
ii. Hours of Fan Life based on load and ambient temperature.
iii. Motor Bearing life based on expected hours of use.
iv. Motor Lubrication schedule based on hours of use.
v. Machine Bearing life based on expected hours of use.

22. Real-Time Clock

a. Shall be capable of providing time stamped events.
b. Shall have the ability to be set locally or via a remote controller.
c. Shall provide the ability to be programmable for month, day, year and local time zones in HH:MM:SS.

H. VFD Packaged System:

1. Voltage
    a. Capable of accepting nominal supplied power of 240V, single-phase AC at 60Hz.
    b. The supply input voltage tolerance shall be ± 10% of nominal line voltage.

2. Displacement Power Factor

    a. VFDs shall be six-pulse and shall be capable of maintaining a minimum true power factor (Displacement P.F. X Distortion P.F.) of 0.95 or better at rated load and nominal line voltage, over the entire speed range.

3. Efficiency

    a. A minimum of 96.5% (+/- 1%) at 100% speed and 100% motor load at nominal line voltage.
    b. Control power supplies, control circuits, and cooling fans shall be included in all loss calculations.

4. Sizing and Duty Rating

    a. Add drives shall be sized and manufacturer-rated at "Standard Duty."
    b. Operating ambient temperature range without derating: 0 °C to 40 °C (-4 °F to 122 °F)
    c. Operating relative humidity range shall be 5% to 95% non-condensing.
    d. Operating elevation shall be up to 1000 Meters (3,300 ft) without derating.

5. Auto Reset/Run

    a. For faults other than those caused by a loss of power or any other non-critical fault, the drive system shall provide a means to automatically clear the fault and resume operation.

6. Ride-Through

    a. The VFD system shall attempt to ride through power dips up to 20% of nominal. The duration of ride-through shall be inversely proportional to load. For outages greater than 20%, the drive shall stop the motor and issue a power loss alarm signal to a process controller, which may be forwarded to an external alarm signaling device.

7. Run on Power Up
    a. The VFD system shall provide circuitry to allow for remote restart of equipment after a power outage. Unless indicated in the contact drawings, faults due to power outages shall be remotely resettable. The VFD system shall indicate a loss of power to a process controller, which may be forwarded to an external alarm signaling device. Upon indication of power restoration, the process controller will attempt to clear any faults and issue a run command, if desired.

8. Communications

    a. VFD shall be capable of communicating on multiple networks.
    b. VFD shall be capable of supporting the EtherNet I/P network communications. Additional communications protocol (optional) cards are not required.

9. Enclosure Door-mounted Human Interface Module (HIM)

    a. VFD shall provide a HIM with integral LCD display. The HIM shall be NEMA-rated the same as the VFD (see VFD Schedule).
    b. The HIM shall have the following features:

        i. A seven (7) line by twenty-one (21) character backlit LCD display with graphics capability.
        ii. Shall indicate drive operating conditions, adjustments and fault indications.
        iii. Shall be configured to display in the following three distinct zones:

            a) The top zone shall display the status of direction, drive condition, fault /alarm conditions and Auto/Manual mode.
            b) The middle zone shall display drive output frequency.
            c) The bottom zone shall be configurable as a display for either programming menus / information or as a two-line user display for two additional values utilizing scaled units.

    c. Shall provide digital speed control.
    d. The keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), and numeric keys for direct entry.
    e. HIM module shall be provided with lockable protective cover.

10. The drive system nameplate shall be marked with system Short Circuit Current Rating (SCCR).

11. Enclosure

    a. Shall be rated NEMA 3R-rated, with gasketed, hinged door.

b. Shall be white powder-coated 14 or 16 ga. steel.
c. Shall provide entry and exit locations for power cables.
d. Shall have door-mounted hand-off-auto selector switch, "Fault" pilot light, and HIM module.
e. Shall contain a label for UL508.
f. Enclosure size shall not exceed 35"H x 24"W x 12"D.
g. Enclosure Forced Air Ventilation: Enclosure shall include suitably size forced air ventilation system for heat dissipation from VFD and harmonic filter. Ventilation system shall include 115V, 160 cfm thermostatically-controlled fan with cleanable, expanded metal inlet air filter. [See Spare Parts in this Specification for spare air filters required.]
h. If in the opinion of the VFD and/or harmonics filter manufacturer a winter ("storage") temperature must be maintained in the enclosure above ambient outdoor conditions, the enclosure shall also include a 200W, thermostatically-controlled heater. If provided, heater shall be switched separately from VFD operation.
i. Enclosure shall be Hoffman WeatherFlo model WR10LP with A30P24 panel, or equal.

12. Drive Enclosure Input Disconnect

a. Provide an enclosure door interlocked input circuit breaker disconnect (MCP style).
b. Operator Handles

i. Provide externally operated main disconnect handle.
ii. Handles shall be lockable with up to three lockout / tagout padlock positions.

13. Branch Circuit Protection

a. Input fusing shall be provided

14. Drive Bypass Option – not required.

15. Control Power Transformer

a. Provide a 24 VDC control power transformer with fused primary/secondary, and mounted and wired inside of the drive system enclosure.
b. The transformer shall be rated for the VFD control requirements. Control power transformer shall be of adequate capacity and impedance to source 24 vdc control circuits and I/Os shown and specified.

16. Harmonic Mitigation Requirements

a. Each drive system shall be compliant with IEEE519-2014 standards at the input power connection terminals based upon the input power phase imbalance within 0.5% of nominal line voltage and under full VFD output current ratings.

b. Passive harmonics filters shall be mounted within the drive enclosure.

c. All harmonics filters shall meet the following requirements:
   i. Filters shall treat all characteristic low frequency harmonics generated by a single-phase full wave inverter load. Characteristic harmonics shall be suppressed without need for individual tuning or the requirement to phase shaft against other harmonic sources.
   ii. Units shall be an adaptive passive series connected low pass filter consisting of an inductor capacitor network. Filter shall meet the harmonic performance specification with a 3 percent phase voltage unbalance as defined in ANSI C-84, 1-1995.
   ii. Filters shall have all copper wiring. An integrated series and shunt reactor shall be used in the construction of the harmonics filter.
   iv. Full load efficiency of the harmonics filter shall be greater than 97 percent.
   v. When fed from a power distribution system operating at the normal distribution voltage, the harmonic filter output voltage at full load shall not be less than the nominal RMS utilization voltage. At no load, the output voltage shall not be more than 4.6 percent of nominal RMS and peak distribution voltage.
   vi. Total Harmonic Input Current Distortion shall be less than 5% at full local.
   vi. Harmonics filters shall be MTE ONE single-phase filters, as manufactured by MTE Corporation, or equal. Filters shall be UL and cUL listed to UL508 Type Mx and CSA-C22.2 No. 14-95 and shall be rated by the manufacturer for use with the associated variable frequency drive equipment.

d. All harmonics filters in combination with the associated variable frequency drives shall be provided with unit responsibility by the drive manufacturer for performance and harmonics mitigation.

e. At the drive manufacturer's option, a drive input line reactor mounted within the drive system enclosure may be used in addition to passive harmonics filters. If used, input line reactors shall meet the following:

i. The construction shall be iron core with an impedance of (3 or 5) percent
ii. The winding shall be copper or aluminum wound.
iii. The insulation shall be Class H with a 115 °C rise over 50 °C ambient.
iv. The unit shall be rated for system voltage, ampacity, and frequency.

17. Auxiliary Relays

a. VFDs shall include one NO auxiliary output relay, and one NOC auxiliary output relay.
b. Relay contacts shall be rated for 115V AC/30V DC, 5.0 amp resistive, 2.5 amp inductive.

18. Control Interface

a. The control terminals shall be rated for 115V AC.
b. The control interface shall provide input terminals for access to VFD functions that include start, stop, external fault, speed select, and enable, as required.

19. Hand/Off/Auto Selector Switch

a. Provide a "Hand/Off/Auto" selector switch with lockable mechanism, mounted on the enclosure door.
b. The "Hand/Off/Auto" selector switch shall start the drive in the "Hand" mode and stop the drive in the "Off" mode.
c. In the "Auto" mode the drive shall be started and stopped from a remote "RUN" contact.
d. In all modes, Auxiliary and Enable inputs to the drive control interface board must be present before the drive will start.
e. When a HIM is present, the stop function shall always be available to stop the drive regardless of the selected mode ("Hand" or "Auto"). The HIM will be non-functional (except for the display and programming) when the switch is in "Off" mode. The HIM shall stop the drive if the switch is in the "Auto" mode with the remote start contact initiated.
f. The drive speed reference shall be controlled from the HIM, unless a separate door-mounted potentiometer is provided, when in "Hand" mode (factory default setting).
g. The drive speed reference shall be controlled by a remote 4…20 mA input when in "Auto" mode.
h. the device shall be a 22 or 30mm, NEMA Type 4/13, mounted on the drive system enclosure door.

20. Pilot Lights

a. Provide LED pilot lights, mounted on the enclosure door, for indication of the following status:

i. Drive Fault

b. The device shall be 22 or 30 mm, NEMA Type 4/13, mounted on the drive system enclosure door. [See Spare Parts in this Specification for spare light bulb and lens requirements.]

PART 3 EXECUTION

3.1 Installation

A. Installation shall be in compliance with manufacturer's instructions, drawings and recommendations.

B. Provide individual ground circuits for each VFD in full accordance with N.E.C. and the drive manufacturer's requirements.

3.2 Start-up

A. Certified factory start-up shall be provided for each VFD provided.

1. At a minimum, the start-up service shall include:

a. Perform pre-Power Check
b. Megger Motor Resistances: Phase-to-Phase and Phase-to-Ground c. Verify system grounding per manufacturer's specifications
d. Verify power and signal grounds e. Check connections
f. Check environment

2. Drive Power-up and Commissioning:

a. Measure Incoming Power Phase-to-Phase and Phase-to-Ground b. Measure DC Bus Voltage
c. Measure AC Current Unloaded and Loaded
d. Measure Output Voltage Phase-to-Phase and Phase-to-Ground e. Verify input reference signal

3. All measurements shall be recorded.

4. Drive shall be tuned for system operation.

5. A written record of drive parameter listing shall be provided.

B. Service engineers shall be employed by the manufacturer or a manufacturer- certified distributor and provide start-up services including physical inspection of drive and connected wiring and final adjustments to meet specified performance requirements.

C. Field Services

1. A manufacturer's representative for the equipment specified herein shall be present at the jobsite and/or classroom designated by the Owner for the minimum hours listed for the services as follows, travel time excluded. The startup/training representative's qualifications shall be provided for approval in accordance with the requirements for equipment Submittal Review:

a. (4) hours for installation and startup assistance to the Contractor, inspection, functional and performance testing, and certification of the installation.

b. (4) hours for operator training to the Owner, to include the following:

i. The basis of the training shall be the variable frequency drive, the engineered drawings and the user manual. At a minimum, the training shall:

ii. Review the engineered drawings identifying the components shown on the drawings.

iii. Review starting / stopping and speed control options for the controller.

iv. Review operation of the Human Interface Module for programming and monitoring of the variable frequency drive.

v. Review the maintenance requirements of the variable frequency drive.

vi. Review safety concerns with operating the variable frequency drive.

2. Startup services and training of Owner's personnel shall be at such times as requested by the Owner and may be at a later date than equipment installation and startup. The manufacturer's representative may be expected to make two separate trips to the jobsite without additional compensation.

D. Product Support

1. Factory-trained application engineering and service personnel that are familiar with the VFD products offered shall be available within the state of Montana.

2. A 24-hour, 365-day technical support line shall be available.

E. Spare Parts

1. The following spare parts shall be provided under the Contract:
   a. (2) VFD enclosure spare air intake filters.
   b. (1) spare red “Fault” pilot light lens.
   c. (1) spare red “Fault” pilot light bulb.