SECTION 33 40 00 – SEWER MONITORING EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Sewer Wastewater Monitoring Equipment including flow meters, samplers, monitoring manholes, pre-engineering enclosures, and accessories.
2. Refer to Appendix A for Summary of Equipment required for each individual site.

B. Related Requirements:
1. Section 33 31 00 – Sanitary Utility Sewerage Piping
2. Section 033000 – Cast-in-Place Concrete
3. Division 16: Electrical Connections

1.2 REFERENCE STANDARDS

1. ASTM C 581 – Practice for Determining Chemical Resistance of Chemical Thermosetting Resins Used in Glass-Fiber Reinforced Structures Intended for Liquid Service.
2. ASTM D 638 – Standard Test Method for Tensile Properties of Plastics.
3. ASTM D 695 – Standard Test Methods for Compressive Properties of Rigid Plastics.
4. ASTM D 790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
5. ASTM D 2583 – Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
6. ASTM D 2584 – Standard Test Method for Ignition Loss of Cured Reinforced Resins.
7. ASTM D 3753 – Standard Specification for Glass-Fiber Reinforced Polyester Manholes.
8. AASHTO H-20 – Axial Loading.
9. ASTM C 518 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
10. ASTM D 256 – Standard Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
11. ASTM D 618 – Standard Practice for Conditioning Plastics for Testing.
12. ASTM D 638 – Standard Test Method for Tensile Properties of Plastics.
13. ASTM D 732 – Standard Test Method for Shear Strength Plastics by Punch Tool.
14. ASTM D 790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
15. ASTM D 792 – Standard Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement.
16. ASTM D 1622 – Standard Test Method for Apparent Density of Rigid Cellular Plastics.
17. ASTM D 2583 – Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:
1. Submit cover and frame construction, features, configuration, and dimensions.
2. Certified independent test results of representative wall laminate.
3. Test results of representative fiberglass reinforced plass laminate for metering manholes.

C. Shop Drawings:
1. Show:
a. Critical dimensions, jointing and connections, fasteners and anchors.
b. Materials of construction.
c. Sizes, spacing, and location of structural members, connections, attachments, openings, and fasteners.
d. Color

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer’s original packaging and inspect for damage.

C. Unload, store, and handle monitoring equipment according to manufacturer instructions.
1. For metering manhole:
a. Store manhole vertically on a smooth surface free of sharp objects.
b. Nylon or fabric slings should be used in conjunction with a spreader bar to lift or move the manhole. Under no circumstances should cables or chains be used.

PART 2 PRODUCTS

2.1 FLOW METER

A. Manufacturers:
1. Teledyne Isco or approved equal.
2. Substitutions: See Section 01 25 00 – Substitution Procedures.

B. Functional Design:

1. Primary flow measurement technology shall be bubbler or area velocity as per plans.
2. The flow meter shall be able to utilize multiple flow and parameter sensing technologies simultaneously, using proprietary Teledyne Isco connectivity.
    a. Additional Isco TIENet™ device options for flow measurement technology will include downward looking ultrasonic level measurement, non-contact laser area velocity, and submerged Doppler ultrasonic area velocity.
    b. Isco TIENet options for parameter sensing will include a pH/temperature device.
    c. The flow meter shall be capable of running up to 9 connected TIENet devices simultaneously.
3. The flow meter shall be capable of interfacing with an optional Isco wastewater sampler by means of an optional Isco TIENet device.Via the interface device, the flow meter shall be capable of enabling and pacing the sampler based on multiple preprogrammed conditions, as well as receiving sampling data from the sampler.
4. The flow meter shall accept SDI-12 device data from up to two connected devices.
5. The flow meter shall be able to record and transmit data from connected monitoring equipment.
6. The flow meter shall be able to track event data that cannot be altered, in order to ensure that data integrity has not been compromised.
7. The flow meter shall have optional 4-20mA output capability by means of field-installable Isco TIENet card(s).
8. The flow meter shall be capable of providing, at the Owner's approval, field-installable cellular communication for remote communication without physically visiting the monitoring site, for alarm notification, and for transmission of data to a central server.
    a. The flow meter shall be capable of remote configuration and data transmission via a dedicated web browser that duplicates flow meter menu and keypad operation.

C. Description:
1. Flow Meter Construction
    a. The flow meter electronics and connections shall be housed in a PPO Polyphenylene Oxide, NEMA4X/IP66, lockable enclosure suitable for conduit connection.
    b. Basic construction shall consist of a two-piece electronics enclosure, front panel, and door.
    c. The enclosure door shall have a clear polycarbonate window for viewing the LCD, optional mechanical totalizer, and LED indicator without opening the door.
    d. The interior of the enclosure, bubbler air supply, and air reference shall be protected from humidity by an indicating, reusable silica gel desiccant contained within a detachable chamber. Humidity values in the chamber, bubbler supply line, and air reference line shall be viewable on the display screen.
    e. Connections shall be accessible for addition and removal of optional devices by unlatching the door and then opening the front panel on the enclosure.
    f. The flow meter shall include a stainless steel bracket for wall mounting, and shall also be suitable for mounting on a rack or inside a console enclosure.
    g. Operating and storage temperature shall be -20 to 60°C (-4 to 140°F).

h. The flow meter's primary user interface shall include a tactile keypad with audible feedback, and 4-inch, 320x240, backlit liquid crystal display with graphing functionality.
i. The flow meter shall have a two-color LED indicator next to the display to indicate activated alarms/events.
j. Input power shall be nominal 12VDC.
    1) The flow meter's internal mains power supply shall operate on 100VAC,50/60Hz or 240VAC,50/60Hz line power.
    2) The flow meter shall have the provision to be powered by an external 12VDC source.
    3) The flow meter shall have the option for external, uninterrupted battery backup power lasting a minimum of 4 hours.
    4) The power circuit shall include trickle charge for a connected rechargeable lead acid battery.
k. TIENet device connection(s) shall be performed by wiring to easily accessible terminal strips and following simple instructions printed on the circuit board assembly.
    1) The flow meter shall provide nominal 12VDC output power to connected TIENet devices.

2. Flow Meter Functionality
    a. Communication and User Interface
        1) Primary programming shall be directly through the tactile keypad and programming menus on the front panel of the flow meter.
        2) Teledyne Isco Flowlink® software shall be used to connect to the flow meter, either directly or remotely, and display secure web server pages with an internal browser for configuration and programming. The displayed pages shall duplicate the flow meter keys and menus in appearance and function. Flowlink shall also provide a one-step control for downloading site and event data to a database.
        3) An optional internal GSM or CDMA cellular modem or Ethernet modem shall provide remote communication for configuration and programming, data access, and alarm notifications.
        4) Alarm status/events shall be indicated by the LED next to the display. Detailed information about the alarm/event(s) indicated will be accessed by pressing a key on the keypad.
        5) Flowlink software shall be able to retrieve stored data from the flow meter, and generate graphs and reports from stored data.
        6) Direct serial connection to a computer or USB flash drive shall be through a micro A/B USB port located on the front panel of the flow meter.
            a) Updates to the flow meter and optional TIENet device software will be performed by connecting a USB flash drive to the flow meter.
            b) The flow meter's program can be downloaded onto the connected flash drive. The saved program can then be duplicated onto other Signature flow meters via the flash drive.

c) Data shall be exported from the flow meter in .ddp format to a USB flash drive.
d) Verifiable text reports shall be exported from the flow meter to a USB flash drive.
e) The flow meter shall include an adaptor for connecting a USB flash drive.
f) The flow meter shall include an optional adaptor cable for connecting to the USB port on a computer.

7) Direct I.P. interface for local area network access will be through an internal Ethernet connection.

b. Outputs
1) The flow meter shall be able to activate an optional connected sampler based on multiple user-selected trigger conditions.
2) The flow meter shall optionally provide industry standard 4-20 mA analog output via a factory- or field-installed internal card, and shall accept up to three such cards, allowing for up to six outputs.
a) Output range shall be from 4 to 20 mA.
b) Isolation will be monolithic air core transformer technology.
c) Maximum load shall be 500Ω.
3) The flow meter shall act as a slave for Modbus interfacing via RS-485 terminal strip connection, using ASCII or RTU transmission coding.

c. Inputs
1) The following data shall be received by the flow meter from an optional connected sampler:
a) Sample event
b) Bottle number
c) Sampler voltage
2) The flow meter shall record flow and parameter data from optional connected TIENet devices.
3) The flow meter shall record parameter data from up to two optional connected SDI-12 devices.
4) The flow meter shall be capable of separate, simultaneous interfacing with multiple connected devices of the same type, i.e., one or more sampler interfaces, one or more pH/Temperature devices, etc.
5) The flow meter shall be capable of accepting inputs from multiple external TIENet devices via optional expansion box(es). For every expansion box, three more devices can be added to the system.

d. Data Storage
1) The flow meter shall store recorded data and program settings on a recoverable, flash-based, secure, non-volatile digital memory card with standard 8MB capacity (180 days with 5 parameters logged at 1-minute intervals and reports at 24-hour intervals).
2) The program memory shall be capable of being updated via the USB port on the flow meter without opening the enclosure.

e. Data Integrity
1) Program Report - Tracks configuration changes to the flow meter.

2) Two programmable Summary Reports - Tracks measurement summaries.
3) Diagnostic Report - Tracks occurrences and results from diagnostic tests.
4) History Report - Tracks user events (such as calibration, etc.).

f. Submerged Bubble Line Flow Measurement Technology
1) A pressure transducer in the flow meter shall measure the liquid level. An internal air compressor shall provide a continuous supply of air to the bubble tube. The bubble line shall be based on the plans:
1/8 " ID, 50 ft. long or 1/8 " ID, 100 ft. long.
A stainless steel bubble tube shall be supplied for installation in the flow stream.
2) The flow meter shall maintain the bubble rate, adjusting the required pressure automatically for any changes in stream conditions.
3) The flow meter shall include automatic bubble line purge with adjustable frequency to minimize plugging of the bubble tube.
4) The level measurement range of the bubbler shall be from 0.003 to 3.05 m (0.01 to 10 feet).
5) The level measurement accuracy of the bubbler shall be ±0.002m at 22 °C (0.007ft at 72 °F).
6) The compensated temperature range shall be 0 to 60 °C (32 to 140 °F).
7) The temperature coefficient shall be ±0.0003 x Level (m) x temperature deviation from 22 °C (±0.00017 x Level (ft) x temperature deviation from 72 °F).
8) The flow meter shall include automatic drift and temperature compensation to periodically reference both sides of the pressure transducer to atmospheric pressure, and automatically compensate for errors due to temperature change, warm-up, and long-term drift.

g. Additional Flow Measurement Sensors
1) Area Velocity: Submerged Doppler Ultrasonic Sensor

h. Level-to-Flow Calculation
1) Measured liquid level readings shall be converted into corresponding flow rate readings using internal conversion algorithms. The flow meter shall contain conversions for V-notch, rectangular and Cipolletti weirs, and Parshall, Palmer-Bowlus, trapezoidal, and H flumes. The flow meter shall accept up to 4 sets of level-flow rate points, with up to 50 pairs of points in each set. The flow meter shall accept a user-defined, one- or two-term, level-flow rate polynomial equation.

i. Level-to-Area Calculation
1) Measured liquid level readings shall be converted into the area of the flow using internal conversion algorithms. The flow meter shall contain conversion information for round, U-shaped, rectangular trapezoidal and elliptical channels. The flow meter shall accept a silt level measurement and adjust the area of the flow appropriately. The flow meter shall also accept up to 50 pairs of level-area points.

2.2 FLOW METER – AREA VELOCITY FLOW MODULE

A. Manufacturers:
1. Teledyne Isco or approved equal.
2. Substitutions: See Section 01 25 00 – Substitution Procedures.

B. Description
1. Instrument
a. The module shall be an open-channel flow module suitable for multi-site monitoring. An area/velocity sensor shall be used to measure flow rate. A battery module shall provide power to operate the flow module. It shall be possible to stack and/or interconnect multiple flow modules in the field for simultaneous monitoring of multiple flow streams and/or for obtaining redundant measurements.
2. Area Velocity Sensor
a. The sensor shall directly measure average liquid velocity using the ultrasonic Doppler method. The sensor shall not require a multiplying factor based on flow depth to convert a point velocity to the average liquid velocity. The sensor shall not require velocity profiling and calibration at the measurement site. The sensor shall not contain electrical contacts exposed to the liquid to measure velocity. The sensor shall contain an automatic gain control amplifier that shall automatically adjust its gain based on the strength of the received Doppler signal.
1) The Doppler velocity measurement frequency shall be 500 kHz with a transmission angle of 20 degrees. The velocity measurement range of the sensor shall be from -5 to +20 feet per second (-1.5 to +6.1 meters per second). The velocity in water with a uniform velocity profile and a speed of sound of 4,850 feet per second (1,480 meters per second) shall be measured with a maximum error of ±0.1 feet per second (±0.03 meters per second) over a range of -5 to +5 feet per second (-1.5 to +1.5 meters per second), and ±2% of reading over a range of 5 to 20 feet per second (1.5 to 6.1 meters per second). The typical minimum depth for velocity measurement shall be 0.08 feet (0.025 m).
b. The sensor shall contain a differential integrated circuit pressure transducer to measure the hydrostatic pressure of the liquid to determine the liquid depth.
1) The level measurement range of the sensor shall be from 0.033 to 10.0 feet (0.010 to 3.05 m). The level shall be measured with a maximum error of ± 0.008 feet per foot (± 0.008 m per m) over a range of 0.033 to 5.0 feet (0.010 to 1.52 m), and ± 0.012 feet per foot (± 0.0012 m per m) for levels greater than 5.0 feet (1.52 m). The temperature coefficient shall be ± 0.0035 feet per degree F (± 0.0019 m per degree C) over the compensated temperature range of 32° to 122° F (0° to 50° C).

2) The pressure transducer in the sensor shall be factory calibrated, with the calibration data stored as digital values in a microcontroller in the sensor. The sensor shall not contain potentiometers to calibrate the pressure transducer. It shall not be necessary to

recalibrate the flow module, other than programming the current flow stream level, if the sensor is interchanged with another sensor. The analog output of the pressure transducer shall be converted to a digital value in the sensor, and the sensor shall transmit to the flow module a digital signal corresponding to the current level measurement. The sensor shall not transmit to the flow module an analog signal corresponding to the current level measurement. The flow module shall store the date and time that the level measurement was last adjusted.

c. The sensor shall be 0.75 inches (1.9 cm) in height and 1.31 inches (3.3 cm) in width. The sensor cable shall be 15' long. The cable shall terminate in a push-on, quick-connect connector so that the sensor can be easily removed and replaced in the field. The connect cable for the sensor shall include a vent tube that shall reference one side of the pressure transducer to atmospheric pressure. The flow module shall include an internal desiccant cartridge with a replaceable hydrophobic filter to protect the atmospheric reference from moisture. Sensor materials exposed to the flow stream shall be epoxy, stainless steel, polyvinyl chloride (PVC), and chlorinated polyvinyl chloride (CPVC).

3. Flow Module

a. The flow module shall be a field-interchangeable measurement and data storage system. It shall be possible to stack and interlock a flow module and a battery module in the field to build a compact, integrated system. It shall also be possible to stack and interlock any combination of up to four 2150 area velocity and/or 2110 ultrasonic flow modules and one or more battery modules in the field to monitor multiple flow streams at the same time and/or to obtain redundant measurements. It shall also be possible to unstack flow modules to use them at separate sites with separate battery modules. The flow module shall also be capable of being located up to 3300 ft. (1000 m) from other flow modules, with all of the flow modules connected with a twisted pair cable for communication. Each flow module shall contain its own microprocessor, so that a failure in one flow module shall not affect the operation of any other stacked and/or interconnected flow modules.

b. The flow module shall be capable of accepting up to 2 flow rate conversions, each of which can be either a level-to-area conversion or a level-to-flow rate conversion, allowing comparison of flow rates calculated using, for example, the continuity equation and the Manning formula. The flow module shall be capable of calculating 2 total flows, each of which shall be capable of being based on either flow rate conversion. Each total flow calculation shall accumulate either net, positive, or negative total flow with user-selectable resolution.

1) For level-to-area conversions, the flow module shall convert measured liquid level readings into the area of the flow using internal conversion algorithms. The flow module shall contain conversion information for round, U-shaped, rectangular trapezoidal and elliptical channels. The flow module shall accept a silt level measurement and adjust the area of the flow appropriately. The flow module shall also accept up to 50 level-area points.

2) For level-to-flow rate conversions, measured liquid level readings shall be converted into corresponding flow rate readings using internal conversion algorithms. The flow module shall accept conversion information for V-notch weirs, rectangular weirs with and without end contractions, Cipolletti weirs, Isco Flow Metering Inserts, and Thel-Mar Weirs, and Parshall, Palmer-Bowlus, Leopold-Lagco, trapezoidal, H, HS, and HL flumes. For monitoring in applications using the Manning formula in round, U-shaped, rectangular, and trapezoidal channels, the flow module shall accept information for channel configuration and size, and slope and roughness coefficient. The flow module shall accept up to 50 level-flow rate data points. The flow module shall accept a two-term, level-flow rate polynomial equation.

c. The flow module shall be capable of pacing an Isco wastewater sampler.

d. The internal data storage memory in the flow module shall have a capacity of 395,000 bytes, equal to up to 79,000 readings, equal to over 270 days of level and velocity readings at 15 minute intervals plus total flow and input voltage readings at 24 hour intervals. The flow module shall store data in rollover mode. The flow module shall be capable of storing level, velocity, flow rate, flow rate 2, total flow, total flow 2, and input voltage data. The data storage interval for each type of data shall be individually selectable from OFF, 15 or 30 seconds, 1, 2, 5, 15, or 30 minutes, or 1, 2, 4, 12, or 24 hours. The flow module shall be capable of variable-rate data storage, with the data storage interval changing based on level, velocity, flow rate, flow rate 2, total flow, total flow 2, or input voltage. It shall be possible to change the data storage setup for any data type at any time without disrupting the data storage of any other data types. It shall be possible to delete all data stored in the data storage memory. When reset, the flow module shall automatically revert to default settings, with level, velocity, and flow rate stored at 15 minute intervals, and total flow and input voltage stored at 24 hour intervals. The flow module shall store signal strength and spectrum strength diagnostics from the last 10 valid and the last 10 invalid velocity measurements.

e. The flow module shall be programmed using a software program that shall operate on an IBM PC or compatible computer. The software shall also retrieve stored data from the flow module, and generate graphs and reports from stored data. The computer shall communicate with the flow module using a direct RS-232 connection at 38,400 baud. Connection to the flow module shall be made with a cable with a push-on, quick-connect connector that can be easily connected and removed in the field. If multiple flow modules are stacked and/or interconnected, a single connection between the computer and any one of the flow modules shall be capable of programming and retrieving stored data from all of the flow modules.

f. The flow module shall contain 2 non-volatile, programmable Flash memories, one for the program memory and one for the user program and the stored data. The program memory shall be capable of being updated via the serial port on the flow module without opening the enclosure. The flow module shall retain the user program and all stored data during program memory updates.

g. The flow module shall be equipped with modbus communications capabilities, independent of Flowlink, enabling the data to be linked to monitoring and/or process control systems and software.
h. The flow module shall be capable of being configured identically to the configuration of a module it is replacing in the field.
i. The flow module shall be powered by 12 VDC supplied by one or more stacked and/or interconnected battery modules. Typical battery life for one flow module with 15 minute reading intervals and one battery module with two 6 volt alkaline lantern batteries shall be 15 months. The flow module shall have the capability of measuring and storing the input voltage from the battery module.
j. The flow module shall be housed in a rugged, permanently sealed, submersible, watertight, dust-tight, corrosion resistant (self-certified NEMA 4X, 6P, and IP68) enclosure. All electrical connections within the flow module shall be soldered, or shall be pin-and-socket connections that are held in place by the flow module enclosure itself. The flow module shall not contain wiring harnesses that can be removed without a soldering iron. The flow module shall include a carrying handle that shall be held between the flow module and the battery module, or between two flow modules. The carrying handle shall include a suspension strap that can be looped around a manhole rung or other attachment point while the user retains hold of the carrying handle. The flow module shall include an LED that is visible from outside the flow module. The LED shall allow individual modules to be identified when multiple flow modules are stacked and/or interconnected. The LED shall also flash every 15 seconds for 5 minutes after a computer is disconnected from the flow module. The flow module shall be CE marked.

4. BATTERY MODULE
   a. The battery module shall include two battery holders, each of which shall hold a rechargeable 6 volt lead-acid lantern battery.The contacts in the battery holders with which the batteries make contact shall be field-replaceable. The flow module shall have the capability of measuring and storing the battery voltage.
   b. It shall be possible to stack and/or interconnect multiple battery modules in the field to increase battery capacity and resultant battery life.
   c. The battery module shall be housed in a rugged, submersible, watertight, dust-tight, corrosion resistant (self-certified NEMA 4X, 6P, and IP68) enclosure. The battery module shall have 2 quarter-turn doors with gaskets that are self-cleaned when the doors are opened and closed to maintain the seal on the battery module. Two internal bags of rechargeable desiccant shall keep the battery module free of moisture. Two humidity indicators shall indicate the humidity level inside the battery module.
5. HANGER
   a. Provide a hanger kit for the area velocity flow module to be suspended from the ring of a 24 inch manhole. The hanger kit shall meet the area velocity flow module manufacturer’s recommendations.

2.3 SAMPLER

A. Manufacturers:
   1. Teledyne Isco or approved equal

2. Substitutions: See Section 01 25 00 – Substitution Procedures.

B. Description

1. Instrument
   a. There shall be furnished a refrigerated sampler for permanent site or portable sampling applications.
   b. The instrument shall be capable of collecting samples from a variety of liquid sources.
   c. The instrument shall route samples to storage containers for collection and off-site analysis.
   d. The instrument shall be suited to collect priority pollutant or general purpose samples in a single bottle.
   e. The unit shall be powered by either a DC source or line voltage.
2. Refrigerator
   a. The sampler shall be 25 inches tall, 15 inches wide and 24 inches long.
   b. The weight of the sampler without the mobility cart shall not exceed 60 pounds.
   c. The controller shall be mounted outside the refrigerator but will be an integral component of the system.
   d. The collected sample shall be stored in a refrigerated enclosure capable of maintaining a sample temperature of 3º ± 1º C in ambient temperatures from 14º F to 105º F while samples are being collected and maintain the collected sample temperature at 3º ± 1º C at ambient temperatures of 32º F to 105º F after the samples have been collected).
   e. The sampler shall have an active cooling and temperature monitoring system to allow for precise temperature control of the directly measured collected sample.
   f. The exterior of the refrigerator shall be constructed of powder-coated steel and embossed polystyrene plastic.
   g. The interior of the refrigerator shall be epoxy-coated or food-grade ABS plastic for easy cleaning and to inhibit bacterial growth.
   h. The copper refrigeration lines and the condenser coil shall be enamel-coated to resist corrosion.
   i. The evaporator plate shall be powder-coated with a food-grade epoxy to resist corrosion.
   j. The refrigerator shall include 30 mm of rigid foamed-in-place polyurethane foam insulation.
3. Sampler Controller
   a. The sampling control components shall be housed in a single enclosure.
   b. The control box shall be constructed of 1/4" thick Noryl® plastic.
   c. There shall be no external electrical or control components for the sample collection controller.
   d. The controller shall use a 2-line 40-character display to show sampler status and program information.
   e. An 18 position keypad shall be used for all program entries, manual control of the sampler, and data transfer functions
   f. The sampler shall provide battery-backed memory with a typical life of five years. This memory shall maintain the sampler's program settings, any stored programs, and the results of the last sampling sequence when the sampler is turned off or in the event of an external power interruption.

g. A user-initiated diagnostics routine shall determine the operational status of the sampler. The controller shall continually run internal diagnostics checks to ensure proper operation of electrical components. Any error conditions detected by the diagnostic routines shall be displayed to the user.
h. A software program lock shall be offered to prevent unauthorized tampering or accidental changing of the sampler control settings.

4. Sampler Programming
   a. The sampler can be programmed to collect composite samples at user-definable intervals. A delay to first sample collection shall be programmable in minutes from 0 to 9,999 or by the real-time clock.
      1) The sampler shall use an internal real-time clock to provide both time and date information.
      2) Uniform time-paced samples shall be collected at regular time intervals from 1 minute to 9,999 minutes.
      3) The sampler shall accept a 12V DC flow proportional pulse or isolated dry contact closure for flow pacing. The pulse or contact closure must be at least 25 ms in duration. The user will select the number of pulses as the flow interval for each sample collection.
5. Sampler Data Storing
   a. The sampler shall be capable of storing key information for each sampling routine. This information shall be accessible at any time during or after a sampling routine on the sampler's display.
   b. The sampler shall also create a report that will have the minimum, maximum, and average sample temperature for the most current sampling sequence. This report shall be available as a display on the controller display or downloadable report using Teledyne Isco Samplink software.
6. Sample Delivery
   a. Samples shall be collected using a peristaltic pump typically producing a line velocity of 2.5 feet (0.76 m) per second in a 3/8 inch (0.95 cm) ID suction line at 3 feet (1 m) of head and capable of producing 26 feet (8 m) of lift.
   b. The body of the peristaltic pump shall be made of high strength plastic for corrosion resistance and extended pump tubing life. Before and after each sample is collected, the pump shall air purge the suction line. Pre-purges and post-purges shall be automatically controlled, and no pre-calibration adjustments are required.
   c. The sample stream shall be a direct tubing path from sample source to sample bottle. Samples that pass through valves, metering chambers, or non-flexible routing tubing are not acceptable.
   d. The sampler shall deliver repeatable sample volumes accurate to +/-10 ml or 10% whichever is greater.
   e. The user can select sample volumes from 10 to 9990 ml in 1 ml increments, dependent on the size of collection container used for the program.
   f. In addition to sample size determination, the delivery system monitors anomalies in the sample collection process.
   g. The sampler shall utilize a non-wetted, non-conductive detector to sense the presence of the liquid.

h. The sensor shall not be dependent on, or affected by, any compositional, chemical, or physical property of the liquid and require no routine maintenance or cleaning.
i. The liquid detection system shall minimize the effects of changing head, intermittent flow in the suction line, or variable battery conditions on sample volume.
j. After initial detection of liquid, the sensor monitors for the presence of liquid during the sample collection sequence.
1) The pump revolution counter shall count actual pump revolutions to determine sample volume delivery to the storage containers. If liquid flow is interrupted during the sample collection sequence, the detector shall inhibit the pump revolution counter from incrementing the counter until liquid flow is restored.

7. Suction Lines and Strainers
a. The sampler shall require a suction line and strainer. The suction line shall be made of 3/8" ID vinyl with a length as per the plans.
b. The suction line shall have a factory-installed standard 3/8" stainless steel low flow strainer.

8. Sample Bottles
a. The sampler shall be capable of collecting discrete samples in a single sample bottle. The sampler shall be provided with 2.5 gallon polyethylene sample container.

2.4 AREA VELOCITY SENSOR

A. Manufacturers:
1. Teledyne Isco or approved equal.
2. Substitutions: See Section 01 25 00 – Substitution Procedures.

B. Functional Design
1. The TIENet 350 Area Velocity Sensor shall directly measure average liquid velocity using submerged ultrasonic continuous wave Doppler technology.
a. The sensor shall not require a multiplying factor based on flow depth to convert a point velocity to the average liquid velocity.
2. The sensor shall directly measure liquid level using a submerged differential linear integrated circuit pressure transducer.
3. The sensor shall transmit flow stream velocity and level data to a Teledyne Isco Signature Series Flow Meter using Teledyne Isco proprietary protocol.
4. Maximum cabling length from the Signature Series Flow Meter to the sensor shall be 1,000 ft, typical.
5. The velocity measurement range of the sensor shall be from -5 to +20 feet per second.
6. The sensor shall be capable of measuring forward and reverse flows.
7. The typical minimum depth for velocity measurement shall be 0.08 feet.
Velocity Accuracy - the velocity in water with a uniform velocity profile and a speed of sound of 4,850 feet per second will be measured with a maximum error of ±0.1 feet per second over a range of -5 to +5 feet per second, and ±2% of reading over a range of 5 to 20 feet per second.
8. The level measurement range of the sensor shall be from 0.033 to 10 ft.

9. Level Accuracy - Maximum non-linearity, hysteresis, and temperature error from actual liquid level shall be ±0.10% full scale over a compensated temperature range of 32 to 158°F.
10. The pressure transducer shall be factory calibrated, with the calibration data stored as digital values in a microcontroller in the sensor.
11. Typical long-term level stability shall be ±0.023 ft/yr.
    a. Temperature range shall be 32 to 158°F, operating and storage.
12. Power Input
    a. Input voltage range will be 7 to 14VDC.
    b. Measurement current @ nominal 12VDC will 100 mA.
13. Standard unterminated sensor cable length shall be 16.4, 32.8, or 75.5 ft.
14. Sensor weight shall be .95 lb, 3.70 lb, 6.84 lb, depending on cable length.

C. Description:
1. Sensor Construction
    a. The sensor probe body shall be 1.9 cm (0.75 inches) in height and 3.3 cm (1.31 inches) in width. The cable diameter is 0.9 cm (0.37 in).
    b. Sensor materials exposed to the flow stream shall be epoxy, stainless steel, Polycarbonate (PC), and UV-rated polyvinyl chloride (PVC).
    c. The sensor cable shall include a vent tube that will reference one side of the pressure transducer to atmospheric pressure.
2. Sensor Operation
    a. The sensor shall measure flow stream velocity using submerged continuous wave Doppler technology.
        1) Ultrasonic transducers inside the probe transmit ultrasonic sound waves at 500kHz, at an angle of 20° from horizontal, into the flow stream. The transducers then receive the reflected sound waves. The increase or decrease in the frequency of the reflected wave indicates forward or reverse flow. A shift in frequency is proportional to flow stream velocity.
        2) The sensor shall contain an automatic gain control amplifier that will adjust its gain based on the strength of the received Doppler signal.
    b. The sensor shall measure the hydrostatic pressure of the liquid depth using a submerged differential linear pressure transducer.
        1) The sensor shall have automatic level correction over the full operating temperature range by way of integral digital compensation coefficients.
        2) The analog output of the pressure transducer shall be converted to a digital value in the sensor, and the sensor will transmit to the flow meter a digital signal corresponding to the current level measurement.
        3) The pressure transducer shall be rated at 5 psi, with a maximum submersible depth of 34.6 ft.

2.5 FLOW METER TO SAMPLER INTERFACE DEVICE

A. Manufacturers:
1. Teledyne Isco or approved equal.

2. Substitutions: See Section 01 25 00 – Substitution Procedures.

B. Functional Design
1. The model 306 interface device connects a Teledyne Isco Signature Series flow meter to a Teledyne Isco sampler using Teledyne Isco proprietary protocol.
2. The interface shall facilitate sampler enabling/disabling triggered by user-programmed condition(s).
3. The interface shall facilitate flow-proportional sampler pacing by the flow meter.
4. The interface shall facilitate input signals to the flow meter from the sampler indicating when a sample is collected, and into which bottle it is placed.
5. The device shall be powered by the Signature flow meter.

C. Description
1. Construction
a. The device cable shall be PVC jacketed, and shall be 16.5, 32.8, or 72.5ft standard length as per the plan lengths.
b. The interface enclosure shall be 3 x 2 in., self-certified NEMA 4X, 6P IP68.
c. Operating temperature shall be -4 to 122°F. Storage temperature shall be -40 to 140°F.
d. The device shall connect to the sampler with a standard 6-pin female, sealed plug connector.
2. Operation
a. The flow-proportional pulse transmitted from flow meter to sampler shall have an output of 5V and width of 50ms.
b. The presence of a connected, powered-on sampler shall be indicated by the presence of 12VDC on pin A of the sampler connector.

2.6 PH AND TEMPERATURE SENSOR

A. Manufacturers:
1. Teledyne Isco or approved equal.
2. Substitutions: See Section 01 25 00 – Substitution Procedures.

B. Functional Design
1. The device shall transmit flow stream pH and temperature data to a Teledyne Isco Signature Series flow meter using Teledyne Isco proprietary protocol.
2. The probe can be mounted horizontally or vertically in the stream.
3. The probe shall have an operational range from 0 to 14 pH units, with a measurement accuracy of +/-0.1 (with new probe, freshly calibrated within range).

C. Description
1. 301 Device
a. Cable from the flow meter to the analog to digital converter box shall be PVC jacketed, and shall be 32.8 or 72.5ft standard length as per the plan lengths.
b. The converter box shall be 4 x 2.125in, with two flanges for wall mounting.
c. Ambient operating temperature shall be -4 to 122°F.
d. Temperature compensation shall be performed by the 301 device.
2. Sensor Construction

a. The probe shall be constructed of 316 stainless steel. The probe cable shall be constructed of polyvinyl chloride.
b. The probe body shall be 6 in. long and 1.12 in. in diameter. The probe cable length shall be 25 ft, ending in a standard, 4-pin, male M/S connector.
c. The double porous liquid junction probe shall be resistant to fouling and coating. The probe shall include an exposed temperature sensor for both pH adjustments and independent temperature recording.
d. The probe shall include a steam-sterilized glass hemi-bulb for long-term stability.
e. Temperature measurement range shall be 32 to 176 °F.

3. Sensor Operation
a. The sensor and amplifier assembly shall measure the acidity or alkalinity of an aqueous solution by determining the relative quantity of dissociated hydrogen ions present in the solution.
b. The sensor shall have built-in reduction of electrical noise and high impedance.

2.7 PACKAGED METERING MANHOLES WITH H20 COVER

A. Manufacturer's:
1. Virtual Polymer Compounds, LLC (VPC) 14103
2. TRACOM, Inc.
3. Open Channel Flow
4. Requests for substitution must be made in writing and received by the engineer's office a minimum of ten (10) business days before bid opening.
5. Substitutions: See Section 01 25 00 - Substitution Procedures. Manufacturers not pre-approved shall not be allowed.
6. Fiberglass tanks modified for flume installation shall not be allowed.
7. Warranty: Manholes shall be warranted to be free of defects in workmanship and materials for a period of (2) two years from shipment.

B. General Information
1. 48" diameter fiberglass reinforced polyester composite metering manhole system that meets the following specifications and the standards established by ASTM D3753-81.
2. The Manhole will include a top lid reduction from 48" to 24" (ID) for installation of H-20 type cover.
a. The manway reducer is to be concentric with respect to the larger portion of the manhole.
b. The manhole shall provide an area for which a typical ring and over plate can be supported without damage to the manhole.
3. The Metering Manhole System will include a large 60° trapezoidal flume. The Flume will include an integral converging section adapter terminating with a pipe size according to the plans ID fiberglass pipe stub. The Flume will include a diverging section end adapters that will terminate with a pipe size according to the plans ID fiberglass pipe stub. Sections of the Flume and end adapters that extend beyond the Manhole will be covered with a core composite laminate that will meet the same load requirements as the manhole structure itself. Flumes must be integral to the manhole floor and body.

4. Fiberglass pipe stubs will be fitted with neoprene rubber slip over couplers. Couplers will be secured in place with stainless steel clamping rings.
5. The Manhole will be fitted with an 18” wide fiberglass ladder. The ladder will extend from the manway reducer to the top flange of the integral flume. The ladder will be attached to a fiberglass mounting bracket that is integral to the manhole. No penetration to the Manhole body will be required for ladder installation.
   a. The fiberglass ladder will meet all current OSHA requirements for ladders of this nature.
6. The Manhole will be fabricated with an integral fiberglass floor. The floor will be 1/2” thick laminate. The floor will extend beyond the manhole body to form a continuous base mounting flange. Where the Flume extends beyond the manhole, the flume will include a 1/2” thick by 2” wide integral mounting flange.
7. The wall laminate is 1/2” thick. The glass reinforcing content of the laminate is a nominal 30%.
8. The entire Manhole body laminate will be pigmented white. The interior surface of the manhole will be a smooth, resin rich finish.
9. A Confined Space Entry Warning Sign will be mounted to a removable secondary cover. This will provide warning and removal demonstrates acknowledgment prior to entry.
10. The surface of the Flume will be finished high grade polyester chemical resistant gel coat. The color will be beige.
11. The Flume is to include the following options:
    a. Fabricate with integral Staff Gauge graduated feet and tenth of a foot.
    b. Provide fixed Stainless Steel Bubble Tub
    c. Provide fixed Stainless Steel Sampler Tube
    d. Fabricate with integral pH Probe Mounting Cavity
12. The Manhole will be fabricated with (2) two inch diameter integral fiberglass NPT coupling to be used as cable passes. The location of this coupling will be per the Plans.

C. Materials

1. All interior surfaces of the Manhole will be smooth and free of surface defects.
2. Fiberglass laminate will include high grade polyester resin and multiple layers of 1.5 ounce chopped strand mat.
3. Manhole ladder will be fabricated by Manhole manufacturer and integral to the manhole.
4. The neoprene pipe coupling will be manufactured by Fernco Company or approved equal.
   a. Coupler will accept a maximum of 5% deflection.
   b. The couplings will meet the following standards:

Tensile	ASTM D 412	1200psi 300% elongation
Hardness	ASTM D2240	Shore A 55min. 65 max.
Compression	ASTM D 395	25% deflection
Tear Strength	ASTM D 624	125 lb./inc.

5. Structural Load rating of the manhole is to have a minimum dynamic-load rating of 16,000lbf when tested according to part 8.4.1 and 8.4.1.1 of ASTM 3753. The complete manhole will not leak, crack, or suffer other damage when loaded to

40,000lbf. The unit will not deflect downward more than 0.25 inches when point loaded at 24,000lbf.

a. Sections of the Flume may extend beyond the manhole body. These sections of the flume will be covered and sealed with a core composite fiberglass cover. These covers will meet equivalent load ratings as those of the manhole body. They will be completely leak free and will deflect less than 0.125 inches at full load.
b. Typical flume cover laminate will include a 1/2” internal fiberglass skin (tension skin), a 2” thick – 8lb density foam core and a 1/2" external skin (compression skin).

6. The circular cylinder of the manhole will meet stiffness standards as defined by ASTM D 2412 with a value of 2.01 for a manhole length 3 to 20 feet.
7. All metallic hardware will be 18-8 Grade Stainless Steel.
8. The fiberglass laminate used for fabrication will have been tested and exhibit following properties at 1/8” laminate thickness.
   a. Specific Gravity 1.2
   b. Percent of Glass 30%
   c. Flexural Strength (ASTM D790) 11,300 psi
   d. Flexural Modulus (ASTM D638) 0.88
   e. Tensile Strength (ASTM D638) 9,700 psi
   f. Barcol Hardness (ASTM D25832) 40
   g. Heat Distortion Tem. (ASTM D648) 148°F
9. The Metering Manhole Structures will be fabricated according to ANSI/ASTM D-3753.
10. The Flume will meet the design standards for this type of flume as published in US Department of Commerce publication PB-250 371 (Nov. 1975) and/or as established by industry standards and submitted herein.

D. Manhole Frames and Covers – Traffic Rated:
   1. Ductile Iron Castings: Comply with ASTM A536.
   2. Contact Surfaces: Machined and matched.
   3. Cast cover “SEWER” inscription per WSDOT Standard Plan B-30.70-04.

E. Base Pad
   1. Cast-in-place concrete as specified in Section 03 30 00 – Cast-in-Place Concrete.
   2. Concrete Reinforcing as specified in Section 03 20 00 – Concrete Reinforcing.
   3. Provide anchorage to concrete base per manufacturer’s installation instructions.

F. Bedding Fill Type
   1. Fine Aggregate Materials as specified in Section 31 05 16 - Aggregates for Earthwork.

2.8 EQUIPMENT ENCLOSURE

A. Maunfacturer’s:
   1. Virtual Polymer Compounds, LLC (VPC) 14103
   2. TRACOM, Inc.
   3. Open Channel Flow

4. Requests for substitution must be made in writing and received by the engineer's office a minimum of ten (10) business days before bid opening. Substitutions shall be made in accordance with the provisions of Section 01 25 00.
5. Substitutions: Manufacturers not pre-approved shall not be allowed.
6. Warranty: Enclosures shall be warranted to be free of defects in workmanship and materials for a period of two years from date of shipment.

B. Functional Design:
1. Size: provide one-piece molded construction FRP enclosures of the following type:
   a. Minimum Size:
      1) 3 FEET W X 2 FEET 4 INCHES D X 3 FEET 0 INCHES H
   b. Construction:
      1) One-piece construction.
      2) Paneled construction shall not be acceptable.

C. MATERIALS
1. Molded Composite Construction:
   a. Laminate: Isophthalic polyester resin with high performance, chopped, commercial grade glass strand fiber reinforcement with a suitable coupling agent.
      1) Minimum glass content: 30%.
      2) Exterior surface: 15 mil (minimum) gel coat with U.V. inhibitors and a satin finish lightly textured and free from fiber pattern, roughness, or other irregularities.
      3) Exterior laminate: 1/8-inch-thick (minimum); chemically bonded to the surface gel coat and encapsulating the foam core.
      4) Foam core (2.2.A.2)
      5) Interior laminate: 1/8-inch-thick (minimum); chemically bonded to the interior gel coat and encapsulating the foam core.
      6) Interior surface: 15 mil (minimum) gel coat with U.V. inhibitors and a textured finish, free from exposed glass or other irregularities.
      7) Laminate properties:
         a) Tensile strength (ASTM D 638): 14,000 PSI.
         b) Flexural strength (ASTM D 790): 25,000 PSI.
         c) Shear strength (ASTM D 732): 12,000 PSI.
         d) Barcol hardness (ASTM D 2583): 40.
         e) Density/specific gravity (ASTM D 792): 93.6 PCF/1.5.
   b. Core:
      1) Rigid closed cell, self-extinguishing, polyisocyanurate foam with a minimum density of 1.9 pounds per cubic foot. Foam shall be P250 Elfoam without exception.
      2) 1 inch thick with a minimum core insulating value of R~7.
      3) Core properties:
         a) Thermal conductivity (ASTM C 518): 0.145 BTU inch/hr./SF/°F
         b) Density/specific gravity (ASTM D 1622): 2.3 PCF
         c) Shear Strength (ASTM C 273): 25 lb/in2
         d) Tensile Strength (ASTM D 1623): 45 lb/in2
         e) Compressive Strength (7% deflection/yield)

(ASTM D 1621): 35

c. Coupons prepared in accordance with ASTM D 618.

2. The manufacturer shall maintain a continuous quality control program and upon request shall furnish to the engineer certified test results of the physical properties.

D. 2.3 COMPONENTS

1. Door:
   a. Fully opening gullwing front/top access door with self-locking door support arm(s).
   b. Construction:
      1) One-piece molded fiberglass construction.
      2) Mount door with stainless steel continuous piano hinge.
      3) Provide stainless steel lockable hasp (for user supplied pad lock) for each door.
      4) Neoprene strip gasket with flexible lock to retain permanent grip.
      5) Provide cushioned door lift handle identical to enclosure lift handles.
2. Floor:
   a. Integral reinforced insulated floor with rigid closed cell, self-extinguishing, polyisocyanurate foam with a density of 2.5 pounds per cubic foot. The foam core shall be 1-inch thick P250 Elfoam without exception, with a minimum insulating value of R~7.
3. Lift Handles:
   a. Provide (4) cushioned lift handles (2 – per enclosure end).
4. Mounting Shelf(s)/Tray(s):
   a. Flow meter mounting shelf: 14 inches wide x 19 inches long.
   b. 2” NPT coupling

E. 2.4 FINISHES

1. Color: Dark Green (Owner to approve color prior to manufacture)

PART 3 EXECUTION

3.1 MONITORING EQUIPMENT INCLUDING FLOW METER, SAMPLER AND ACCESSORIES

A. Examination

1. Section 01 60 00 – Product Requirements.
2. Verify the installation location is clear and free from clutter.
3. Verify the conduit lines are laid from shelter to manhole.

B. Preparation

1. Verify the appropriate monitoring equipment for each monitoring site is provided and inspected prior to installing.
2. Arrange for manufacturer’s service technician to install all monitoring equipment. Estimated installation time for manufacturer’s service technician is 5 days.

C. Installation

1. Manufacturer's service technician to install all equipment as per manufacturer's procedures.

D. Commissioning
1. Section 01 65 00 – Commissioning and Start-up.

3.2 PACKAGED METERING MANHOLES

A. Examination
1. Verify that the excavation base is ready to receive manhole and that dimensions and elevations are as indicated on Drawings.

B. Preparation
1. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.
2. Correct over-excavation with coarse aggregate.
3. Remove large stones or other hard matter impeding consistent backfilling or compaction.
4. Protect manhole from damage or displacement while backfilling operation is in progress.

C. Handling
1. Great care must be taken during unloading and installation to make sure the Metering Manhole is not dropped or impacted.
2. Unload the metering manhole with either a crane or forklift, at least two 3" nylon straps, nylon rope, and a spread bar. Follow the manufacturer's recommendations for handling.

D. Installation
1. Install products in accordance with plans, specifications, local codes, and in a manner consistent with the installation instruction and recommendations of the manufacturer.
2. Excavation and Backfill:
   a. Excavate manholes as specified in Section 31 23 17 - Trenching in location and to indicated depth. All OSHA regulations for below grade construction must be followed.
   b. Provide clearance around sidewalls of structure for construction operations.
   c. When groundwater is encountered, prevent accumulation of water in excavations; place manholes in dry trench.
   d. Anchor structure to avoid flotation.
3. Prep Base Pad:
   a. Place and compact 6" of crushed surfacing top course to 90% MDD.
   b. Pour a concrete pad (width and length per plan) to support all of the manhole, the flume, and the connecting piping. The thickness of the pad shall be minimum 6" with reinforcing steel per the plans and shall be sized to ensure that proper loading is observed and that the manhole will not float.
   c. Trowel top surface level. The surface of the pad shall be level to within 1/8 inch.
      1) If the pad is not level, use non-shrink grout to level it.
4. Installing the manhole on the slab per the manufacturer's instructions:

a. Clean the concrete pad of all sharp objects and debris before laying 1" thick EPS board over the slab and be positioned so the Manhole will rest directly on the board.
b. Attach the flexible boots to the pipe stub connections on the manhole if not installed.
c. Move and position the manhole using a fabric sling and spreader bar. Refer to manufacturer's handling recommendations.
d. Verify the direction of flow through the flume. DO NOT RELY SOLELY ON THE FLOW ARROW.
e. Layout the anchor bolt pattern. The bottom flange of the Metering Manhole is pre-drilled with anchoring to the concrete pad. Drill through the Styrofoam pad and into the concrete slab in accordance with the anchor bolt manufacturer's recommendations for diameter and depth. Hilti Chemical Anchors or Rawl Red Head Anchors are recommended and shall be 304 stainless steel.
f. Secure the anchor bolts. Do not tighten completely. CHECK THE LEVEL OF THE FLUME AND ADJUST THE ANCHOR BOLTS AND SHIMMING, AS NECESSARY.
g. Secure the sewer pipe with flexible couplings. Sewer pipe size as per the plans. Do not lubricate the PVC boots.
h. Grout the area outside the manhole barrel between the flume and the concrete pad if there is a gap and to fully support the flume.
i. Grout the inside of the Metering Manhole filling any voids between the manhole wall, floor and flue with non-shrink grout to the top of the Flume flange.
    1) The interior wall of the Flume shall be supported with reshoring to ensure that the Flume does not deform during grouting.
    2) Design flume wall shoring to handle full hydrostatic head on the outside wall.
    3) Grouting shall be done in lifts of 6" and allowed to set prior to install the next lift.

5. Ensure the product is installed plumb and true, free of twist or warp, within the tolerances specified by the manufacturer.
6. Backfill excavations for manholes as specified in Section 31 23 17 – Trenching.
    a. Verify the level of the flume one last time prior to backfilling and throughout backfilling operations.
    b. Never allow water run off to accumulate in the excavated area.
7. Set cover frames and covers level without tipping and to correct elevations.
8. Coordinate with other Sections of Work to provide correct size, shape, and location.
9. Adjust and clean
    a. Clean surfaces in accordance with the manufacturer's instructions.
    b. Remove trash and debris and leave the site in a clean condition.

3.3 EQUIPMENT ENCLOSURE

A. Examination

1. Verify that the Equipment Enclosure dimensions are correct and that the site conditions are suitable for installing the unit – in particular that there is enough height to fully open the front access door.

B. Preparation

1. Verify the conduit has been installed per the civil and electrical plans.
2. Mark the location of the conduits on the shelter base and drill or cut out where the conduit will penetrate the shelter's base.

C. Installation

1. Concrete Foundation Slab
   a. Provide a concrete foundation slab on which to mount / secure the Equipment Enclosure. The slab should extend a minimum of 6-inches on all sides beyond the Equipment Enclosure.
   b. The thickness of the slab should be a minimum of 6-inches with reinforcement as per Section 03 30 00.
   c. The slab must have a smooth, troweled surface to provide uniform support over the entire base structure. The slab must be level in both directions to within 1/8-inch and free from exposed aggregate and debris.
2. Lifting the Equipment Enclosure
   a. Inspect the installation location and surrounding areas for any obstacles (including overhead) that may cause difficulties or present a hazard – addressing them as necessary before proceeding.
   b. Using proper rigging techniques to move the Equipment Enclosure to the desired installation location.
3. Securing the Equipment Shelter
   a. Install products in accordance with engineer's instructions, plans, blueprints, etc., local codes, and in a manner consistent with the installation instruction and recommendation of the manufacturer.
   b. Move and position the shelter into the appropriate position.
   c. Drill a 3/8" hole through the center of the flange every 18" around the perimeter of the shelter. Continue drilling into the concrete for 3" with a masonry drill bit.
   d. Clean out the hole and insert a 3/8" stainless steel wedge anchor into the hole.
      1) Flat head bolts should be used wherever the sweep of the door crosses the mounting flange so as not to impede the opening or closing of the door.
   e. With a nut and washer on the anchor, tap the anchor with a hammer until the washer rests on the top of the flange.
   f. Tighten the nut with a wrench approximately 3 to 4 turns.
      FAILURE to VERIFY the operation of the door BEFORE the remaining anchor bolts are set MAY RESULT in the BINDING of the door against the door frame.
   g. Seal the flange with sealant, urethane caulk, or grout to ensure a watertight installation.
   h. Install (as necessary) and test the enclosure accessories in accordance with the manufacturers' instructions.
4. Adjust and Clean
   a. Verify that the complete installation meets the criteria above.
   b. Clean surfaces in accordance with the manufacturer's instructions.
   c. Remove all trash and debris, leaving the site in a clean condition.

END OF SECTION 33 40 00

Appendix A – MONITORING EQUIPMENT SUMMARY PER INDIVIDUAL SITE

Notes:

1. Lengths listed below are minimum lengths to order. Contractor shall verify total length required at each site based on where the final location of flow meter is installed and cut lengths to fit.

Rozell (SM-B1):

Flow meter and sampler to be installed inside Rozell.

1. Signature Bubbler Flow Meter with pH, temperature and flow monitoring
2. 1/8” x 85ft vinyl bubble line
3. 85' cables
4. 85' Suction Line
5. 8ft power cord
6. Battery Backup Kit
7. 301 pH and Temperature sensor interface w/ 35ft cable
8. 306 Sampler Interface Cable w/ 32’ long Cable
9. 3/8 inch low flow strainer
10. 3/8” Tubing coupler
11. 3/8” Vinyl suction line (85ft)
12. 48” Packaged Metering Manhole with large 60 degree trapezoidal flume sized for 8” pipe
13. Glacier Sampler

URC (SM-B2)

Flow meter and sampler to be installed inside URC.

1. Signature Area Velocity Flow Meter with temperature and flow monitoring
2. 120ft AV Sensor Cable
3. 120ft Suction Line
4. 8” mounting ring
5. 8ft power cord
6. Battery Backup Kit
7. 306 Sampler Interface Cable w/ 32’ long Cable
8. 3/8 inch low flow strainer
9. 3/8” Tubing coupler
10. 3/8” Vinyl suction line (120ft)
11. SPA 2046 Temperature Sensor w/ 120ft cable
12. Glacier Sampler

Existing PUB (west side) (SM-B3)

Existing equipment to be upgraded to Signature Bubbler flow meter.

1. Signature Bubbler Flow Meter with temperature and flow monitoring
2. 1/8” x 150ft Bubble Line
3. 8ft power cord

4. Battery Backup Kit
5. 306 Sampler Interface Cable w/ 32’ long Cable
6. 3/8 inch low flow strainer
7. 3/8” Tubing coupler
8. 3/8” Vinyl suction line (150ft)
9. SPA 2046 Temperature Sensor w/ 150ft cable
10. Glacier Sampler

PUB (East side) (SM-B4)
Flow meter and sampler to be installed inside a shelter.

1. Signature Area Velocity Flow Meter with temperature and flow monitoring
2. Equipment Shelter
3. 45ft AV sensor cable
4. 8” mounting ring
5. 8ft power cord
6. Battery Backup Kit
7. 306 Sampler Interface Cable w/ 32’ long Cable
8. 3/8 inch low flow strainer
9. 3/8” Tubing coupler
10. 3/8” Vinyl suction line (45ft)
11. SPA 2046 Temperature Sensor w/ 45ft cable
12. Glacier Sampler

Science - East (SM-B5)
Flow meter and sampler to be installed inside a shelter.

1. Signature Area Velocity Flow Meter with temperature and flow monitoring
2. Equipment Shelter
3. 50ft cables
4. 50ft Suction Line
5. Signature desiccator assembly w/ hydrophobic filter
6. 8ft power cord
7. Battery Backup Kit
8. 306 Sampler Interface Cable w/ 32’ long Cable
9. (2) 6” Street Level Installation tool and mounting ring
10. Sensor carrier for AV sensor
11. 3/8 inch low flow strainer
12. 3/8” Tubing coupler
13. 3/8” Vinyl suction line (50ft)
14. Glacier Sampler

Science - South (SM-B6)
Flow meter and sampler to be installed inside a shelter.

1. Signature Area Velocity Flow Meter with temperature and flow monitoring

2. Equipment Shelter
3. 50ft cables
4. 50ft Suction Line
5. 6" mounting ring
6. Signature desiccator assembly w/ hydrophobic filter
7. 8ft power cord
8. Battery Backup Kit
9. 306 Sampler Interface Cable w/ 32’ long Cable
10. Sensor carrier for AV sensor
11. 3/8 inch low flow strainer
12. 3/8” Tubing coupler
13. 3/8” Vinyl suction line (50ft)
14. Glacier Sampler

Existing Tawanka (SM-B7)

Existing equipment to be upgraded to Signature Bubbler flow meter.

1. Signature Bubbler Flow Meter with temperature and flow monitoring
2. 1/8” x 60ft Bubble Line
3. 8ft power cord
4. Battery Backup Kit
5. 306 Sampler Interface Cable w/ 32’ long Cable
6. SPA 2046 Temperature Sensor w/ 60ft cable
7. Glacier Sampler