ADS ENVIRONMENTAL SERVICES®

Flow and Rainfall Monitoring

ADS Process and Specifications

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Exhibit A

1. ADS Qualifications

A. Quality Management System

i. ADS is an ISO 9001 certified manufacturer. In addition, ADS uses certified procedures for the installation, data analysis, operation and maintenance of the flow monitoring products. A copy of the current certificate can be provided.

ii. ADS Certification includes all of the following:

1) Manufacturer – ADS is the manufacturer of the equipment and can provide evidence of the manufacturer's current certification for quality manufacturing processes.

2) Equipment Installation and Maintenance Procedures – ADS can provide evidence that we maintain and enforce quality processes and safety standards for all field service work.

3) Data Analysis Procedures – ADS can provide evidence that we maintain and enforce a quality process for ensuring data integrity in all data analysis.

4) Software Development Process –ADS can provide evidence that we maintain and enforce a quality process for customer requirements, software design, testing, deployment, and support for all software provided.

5) Customer Service / Support – ADS can provide evidence that we maintain and enforce a quality process for handling customer service, problem resolution and feedback.

2. Field Services

A. Site Selection, Investigation and Installation

i. ADS can work with the Owner to select sites for the installation of all equipment.

ii. Each site is inspected to determine hydraulic suitability. This requires a full manhole descent to ensure an adequate inspection. A topside inspection alone is not satisfactory.

iii. ADS installs equipment in optimum locations for best accuracy and reliability. A Site Report for each installed location can be provided for approval.

iv. The Site Report includes, but not limited to the following:

1) The initials of the person who performed the inspection

2) The city and project name

3) The model of flow monitor recommended

4) A placeholder for the serial number of flow monitor

5) The City's numerical designation for the manhole

6) The type of collection system - Sanitary/Storm/Combined

7) House address or a short description of the site location indicating the map page number and grid number, if available

8) The measured height and width of the pipe to be monitored

9) A copy of an electronic, small-scale, detailed map with street names and house numbers (if possible) of the immediate area where you will locate the monitor

10) A road or landmark from the access map and upstream and downstream manholes with the sewer line and flow direction

11) The date and time the site inspection was performed

12) A topside inspection of each up and downstream manhole location with any hydraulic inconsistencies recorded on the inspection form

13) Recorded depth of flow, velocity and silt at time of inspection

14) The depth from the manhole rim to the invert

15) The type of manhole material indicating whether loose bricks, broken rungs, cracked rim or cover, or slippery walls exist on the invert or apron

16) The presence of all drop or side connections

17) The type of pipe material

18) Digital photos is taken of each selected site and alternate sites. One photo is taken of the area where the manhole is located. One photo is a planar view of the manhole invert showing the flow through the manhole from a north orientation. In addition, in-line photos are taken of all contiguous lines.

v. At times we will recommend that a designated monitoring location be changed to take advantage of more favorable hydraulics at upstream or downstream locations.

vi. Site inspections include the accurate measurement of the pipe or channel geometry, silt, and the recommended location for the installed equipment for use in flow calculations. We do not rely on as-built drawings for the determination of pipe geometry.

B. Wireless Access

i. A method for remote (wireless) access to the flow monitors is always provided.

ii. Wireless service in included as a part of all projects.

iii. Software to communicate with the equipment is always provided.

C. Confirmation of Data Accuracy

i. Manual depth and velocity measurements (Confirmations) at each site are performed at least 3 times for long term monitoring and 2 times for short term temporary metering in order to confirm that the sensors are accurately recording depths and velocities.

ii. A valid confirmation is where the field accuracy of a given depth measurement and average velocity is within two standard deviations of the final data set.

iii. 2-3 valid confirmations are maintained at all times at each site during the term of the project.

iv. As a minimum requirement, confirmation of sensor accuracy is measured in the Owner's sewers at least three times; upon installation, during the study and prior to removal or as prescribed by the approved site workplan.

v. Method of confirmation:

1) Initial confirmation of the flow monitors involves a minimum of three (3) in-manhole measurements taken on different days. These initial confirmations are obtained within three months of monitor installation and are compared with manual readings to sensor readings for all depth and velocity sensors. Attempts are made to have these measurements done at flow levels that span typical dry daily flows.

2) The confirmation checks are summarized in depth-to-discharge format on tables. Each confirmation consists of an instantaneous depth of flow and velocity measurement. This is compared to the real-time monitor reading and recorded.

a) The instantaneous depth of flow measurement is taken from the bottom of the pipe to the top of the flow as well as from the crown of the pipe to the top of the flow and both results are recorded.

b) A velocity profile or a direct flow measurement is attempted at all flow sites. These measurements are recorded on the confirmation report.

c) There is a manual depth reading for silt which is recorded on the confirmation report.

D. Operation and Maintenance Services

i. ADS notifies the Owner upon completion of the initial installations. The Owner then has 5 days to notify in writing of acceptance of installations which will provide a start date of the maintenance section of the project.

ii. Spare parts are provided as part of equipment maintenance.

E. Monitoring System Uptime

i. System-wide uptime of 95% or greater is a typical standard. Uptime is defined as number of valid 15-minute flow data points divided by total number of 15-minute intervals in the month. If 5 minute or any other intervals are measured the calculation is adjusted to reflect the actual collection rate.

F. Data Analysis

i. Backup copies of electronic raw data are maintained and delivered to the Owner for the duration of the contract.

ii. Initial data editing is performed by an analyst with a minimum of two (2) years of direct experience. Final flow monitoring data is reviewed and confirmed by an analyst with a minimum of 10 years' experience.

iii. Twice-weekly Data Review is performed to ensure that the equipment is operational and properly logging data. ADS is responsible for issuing maintenance work orders based on this review.

iv. Finalization of data is completed according to the specification for Information Deliverables in Section 6.

3. Detailed Equipment Specifications

A. Triton+ Flow Monitor Minimum Requirements

i. Intrinsically Safe: All monitoring equipment to be installed in the manhole is certified as Intrinsically Safe for installation in hazardous areas. The monitor is certified for installation in Class I, Division 1, Group C & D/Zone 0 atmospheres.

ii. Enclosures NEMA6P/IP68 standards.

iii. Power: The monitor has internal and external power options:

1) Internal Power: Powered by a replaceable 12-volt internal alkaline battery pack which provides greater than 12 months of battery life when monitor is configured on a 15-minute sample rate, recording at least two depth and one velocity measurement each reading and collected using wireless telemetry once per week. Battery life will decrease with increased sample rate or increased wireless telemetry uploads.

a) When the monitor is configured with an Average Velocity Combination sensor (see Section 4.1.21) the 12-volt internal alkaline battery pack provides a minimum of 8 months of battery life on a 15-minute sample rate.

2) External Power: The monitor can optionally support an external DC power source through an External Modem Unit (EMU) which houses a GPRS wireless modem, antenna and an IS communications barrier or an External Multiplexer (EMUX), a communications interface box through which the monitor receives external power and communicates serially to a SCADA RTU and wirelessly to the hosted web-based software and PC-based software packages. An external power supply providing 12V DC at 1.2A is available.

iv. Memory: The flow monitor installed at the sewer manhole location has enough memory to ensure that more than 150 days of 15-minute data can be stored. The no. days of storage will decrease with increased sampling rate. The memory supports a circular buffer with the oldest data only being written over once the memory is filled.

v. Connectors are the equal to U.S. MIL-C-26482, Series 1 connectors made of hard anodized aluminum with interfacial seals and gold-plated contacts.

vi. Inputs: The monitor supports a minimum of two configurable sensor input ports and one communication port. Sensor input ports is interchangeable.

vii. Pipe Channels: The flow monitor model supplied supports single or dual pipe flow measurements with the same electronics and data logger for ease of installation.

viii. Mounting: There are two methods for mounting the monitor within the manhole:

1) An integral two-hole mounting flange is provided on the side of canister to mount to the manhole wall or rim; or

2) A mounting hook to loop over a manhole rung can be provided. The hook has a closure mechanism to prevent the monitor from dislodging during a surcharge event.

ix. Data Recording Interval: Data recording rates are provided at standard intervals of 2, 5, 15 and 30 minutes or 1, 2, 12 or 24 hours.

x. Dual Data Rate: The configuration of the data logger supports automatically switching into a faster data sampling and recording interval once a user-defined depth trigger has been exceeded. The data recording interval will return to normal at such time as the depth trigger, minus a dead band, is no longer exceeded.

xi. Firmware Upgrades: The monitor is capable of receiving firmware upgrades via remote communications or locally via serial connection.

xii. Temperature Range: The unit functions within specifications between -20 and 40° C (-4 and 104° F).

xiii. Clock: Unit employs a battery backed crystal controlled real-time clock/calendar.

xiv. Diagnostic Checking: The monitor performs self-checks of internal systems and battery voltages. Any values that are outside normal levels are annunciated via web-based software (if enabled), or via notifications in collected data logs in desktop monitor configuration, data collection and analysis software.

xv. Cross-Checking: The cross-checking of depth sensors and velocity sensors during every monitor wakeup uses Owner-defined thresholds. Differences between like entities; i.e. depth and velocity, are monitored and an event is recorded when a weighted average of these differences exceeds the defined threshold. The event is able to be elevated to an alarm level and notify the client through the web-based software.

xvi. Pressure Cross-Reference: The flow monitoring equipment includes the ability to cross-reference pressure sensor readings with ultrasonic sensor readings to ensure pressure sensor accuracy. The equipment is also able to provide a composite depth during surcharged conditions.

xvii. Velocity Verification: The flow monitoring equipment includes the ability to establish a depth to velocity relationship against which to reference all velocity readings. Data points that do not match the established depth to velocity relationship are not logged in memory until a second or third re-firing of the sensors confirms the legitimacy of the data point.

xviii. Embedded Software Quality Procedures: All embedded software in the equipment is developed by ADS with certified ISO 9001 quality procedures for software development and testing.

xix. Communication

1) Each monitor is delivered with one standard serial port for local on-site communication with a personal computer. For remote access each monitor is fitted with a worldwide wireless modem that can use virtually any carrier.

   a) The wireless modem is certified to mount in Class I, Div 1, Group C & D/Zone 0 atmospheres. It is mountable to the manhole wall and/or looped over the monitor handle.

2) Modem Diagnostics: The wireless modem supports both on-site and remote diagnostics.

   a) On-Site: The modem has a visible LED display allowing for on-site troubleshooting. A field crew is able to initiate diagnostics by holding a magnet to the outside of the modem enclosure for a few seconds. Upon removal a diagnostics sequence displays, including as a minimum, the monitor's IP address, the wireless signal strength and monitor battery voltage.

3) The wireless modem unit self-monitors wireless connection quality and performs connection refreshes as required to be ready to service incoming connection requests.

4) The wireless modem is connected continuously to the wireless network unless programmed for a battery conservation mode; allowing the modem to be turned off during user-specified time-periods while still allowing the monitor to cry out alarms and upload data when necessary.

5) Antenna: For wireless configurations, a selection of antenna types are available depending on installation requirements. The selection shall include direct burial road surface antennas, stub type enclosure antennas, whip type roof mount antennas and high gain unidirectional elements.

6) SCADA Interface: The monitor can provide real-time data using Modbus protocol via a wireless or serial connection to a customer-provided and configured RTU.

   a) The monitor supports simultaneous SCADA interface and wireless communications to hosted web-based and PC-based software packages.

   b) Supports optional Analog and Digital I/O with ADS XIO: two 4-20 mA inputs and outputs, two switch inputs and two relay outputs

xx. Sensors: The monitor is capable of supporting two sensors at one time. The monitor supports a minimum of four different sensors as described below. The sensors do not require any additional barriers or components to meet IS requirements.

1) Combination Peak Velocity Sensor

   a) Intrinsically Safe: The Combination Peak Velocity Sensor is approved for installation in hazardous, Class I, Division 1, Group C & D/Zone 0 areas.

   b) Connector: The sensor is provided with a temporarily attached connector suitable for continuous immersion and fitted with U.S. Mil spec gold plated contacts.

   c) Housing: The housing is a hydrodynamic ABS plastic shell not to exceed 7” in length by 1.5” wide and 1.0” tall.

   d) Mounting: The sensor is mounted to a ring such that the bottom of the sensor is flush with the underside of the ring to minimize installed flow disturbance.

   e) Cable Length: A standard cable length of 35 feet is used and an extended cable length up to 300 feet is available.

   f) Supported Sensor Technologies: The Combination Peak Velocity Sensor supports up to four independent sensor technologies; peak velocity, uplooking ultrasonic depth, pressure depth and temperature. Requirements for each are described below:

      i) Peak Velocity

         (1) The Peak Velocity sensor is of the ultrasonic Doppler type. The sensor transmits ultrasonic signals throughout the entire flow cross-section

         (2) Range: -30 to 30 feet per second

         (3) Deadband: Measure velocities in depths greater than or equal to 1.5”

(4) Accuracy: A minimum +/- 0.2 fps or 4% of actual peak velocity; whichever is greater in flow velocities between -5 and 20 fps.

(5) Resolution: 0.01 fps

(6) Flow Direction: The peak velocity sensor measures flow in both forward and reverse directions.

(7) Flow Type: The peak velocity sensor supports up to three flow types: Typical, Usually Dry and Wet/Stagnant to facilitate better analysis of monitored conditions.

ii) Uplooking Ultrasonic Depth:

(1) The Uplooking Ultrasonic Depth sends ultrasonic signals upward that reflect off the surface water-air boundary. The travel time from the sensor to the flow surface and back is converted to distance. The ultrasonic signals is compensated for the temperature of the water.

(2) Range: 1.5 inches to 60 inches of flow depth

(3) Deadband: Measures flow depths greater than or equal to 1.5”

(4) Accuracy: Is accurate to 0.125” or 0.5% of reading; whichever is greater.

(5) Resolution: 0.01”

(6) Drift: 0.00”

iii) Pressure Depth

(1) Range: Supports 0 to 5 PSI (up to 11.5 feet), 0 to 15 PSI (up to 34.5 feet) and 0 to 30 PSI (up to 69 feet) pressure sensors.

(2) Accuracy: 1% of full-scale reading

(3) Self-Checks: During free-flow conditions, the pressure sensor is configured to automatically check itself against the Uplooking Ultrasonic Depth sensor. These self-checks shall occur at least once daily.

iv) Temperature

(1) Water Temperature: Is read to within +/- one degree Centigrade of the actual water temperature.

(2) Optional Data Logging: Ability to log and collect water temperature at the designated monitor sample rate.

2) Combination Surface Velocity Sensor

a) Measures both depth and flow velocity and requires no underwater sensor installation to disrupt flow hydraulics.

b) Intrinsically Safe: The Combination Surface Velocity Sensor is approved for installation in

hazardous, Class I, Division 1, Group C & D/Zone 0 areas.

c) Housing: Sensor is constructed of marine grade aluminum/epoxy and has integral flanges for attaching to brackets or to rings using slide-mounts. The sensor is fully sealed and capable of withstanding continuous submersion.

d) Dimensions: 10” in length by 4.5” wide and 2.5” tall

e) Mounting: Sensor is capable of installation in the pipe. Sensor is supported by a mounting mechanism that allows for the replacement of the sensor without the removal of the in-pipe installation ring.

f) Cable Length: A standard cable length of 30 feet is provided and an extended cable length up to 300 feet is available.

g) Supported Sensor Technologies: The Surface Velocity Combo supports up to five independent sensors; surface velocity, surcharge peak velocity, ultrasonic depth, pressure depth and temperature. Requirements for each are described below:

i) Surface Velocity

(1) The sensor measures the velocity of the surface of the water by sending signals to and receiving signals reflected off the flow surface. The measured surface velocity is converted to average velocity using a surface-to-average multiplier derived from field confirmations. The Surface Velocity Combination Sensor meets the following specifications:

(2) Velocity Range: 0.75 to 15 fps

(3) Depth Range: Is able to measure surface velocity between 3” and 48” of the crown of the pipe

(4) Accuracy: +/- 0.25 fps or 5% of actual surface velocity; whichever is greater

(5) Resolution: 0.01” fps

(6) Flow Direction: It is acceptable for the Surface Velocity Combination Sensor to only measure forward velocities.

ii) Surcharge Peak Velocity

(1) The Surcharge Peak Velocity sensor is an integral part of the Surface Velocity Combination Sensor and is used to measure peak velocity during surcharge conditions when surface velocities can no longer be measured. It is of the ultrasonic Doppler type, transmitting ultrasonic signals throughout the entire flow cross-section.

(2) Range: -30 to 30 fps; when flow depths are in surcharge conditions

(3) Accuracy: +/- 0.2 fps or 4% of actual peak velocity; whichever is greater

(4) Resolution: 0.01 fps

iii) Downlooking Ultrasonic Depth (Range)

(1) Range: 0.5 inch to 10 feet from the face of the sensor

(2) Resolution: 0.01” increments

(3) Accuracy: 0.125”

(4) Dead Band: 0.5” or 5% of the maximum range; whichever is greater

(5) Drift: None (0.00”)

(6) Temperature Compensation: Range readings is compensated for changes of the speed of sound in air.

iv) Pressure Depth

(1) Pressure sensor is an integral part of the Surface Velocity Combo sensor and begins reading when the sensor becomes submerged.

(2) Range: Is able to support both 0 to 5 PSI (up to 11.5 feet) and 0 to 15 PSI (up to 34.5 feet) pressure sensors.

(3) Accuracy: 1% of full-scale reading

v) Temperature

(1) Air Temperature (Water Temperature when surcharged): air temperature at the sensor installation point to within +/- one degree Centigrade

(2) Optional Data Logging: air temperature at the designated monitor sample rate.

3) AV/Gated

a) Gated velocity sensors work by measuring flow velocity at multiple discrete points, allowing the sensor to better characterize the velocity distribution and best measure average velocity. The AV/Gated combines pressure depth, up looking ultrasonic depth with the gated velocity to provide area velocity flow measurements.

b) Housing – solid molded polycarbonate providing high impact and high abrasion resistance

c) Operating Range

i) Ultrasonic Depth: 1 in. to 72 in. (2.54 cm-182.88 cm)

ii) Pressure Depth (standard) : 0 in. to 240 in. (0 cm to 609.60 cm) (10 psi)

iii) Velocity: -20 ft/s to +20 ft/s; minimum depth for velocity = 5 in. (12.70 cm)

d) Accuracy

i) Ultrasonic Depth: +/-0.125 in or +/-0.5% of flow depth, whichever is greater

ii) Pressure Depth: +/- 1% of full range

iii) Velocity: +/-0.2% ft/s or +/-4% of average velocity, whichever is greater

e) Resolution

i) Ultrasonic Depth: 0.01 in (0.03 cm)]

ii) Pressure Depth: 0.01 in (0.03 cm)

iii) Velocity: 0.01 ft/s (0.003 m/s)

4) Long Range Depth (LRD)

a) The LRD Sensor measures depth of flow in surcharge up to and including full manhole conditions, while minimizing the amount of effort and number of tools required for installation.

b) The LRD sensor contains an ultrasonic transducer housed within a parabolic reflector that work in tandem to measure the depth of flow in the manhole. The separate integral submersion sensor magnetically attaches to the manhole frame to detect when depths are near the manhole lid. The sensor is mounted near the top of the manhole and can measure depths within the manhole structure at a range of up to 20 feet. It can be installed in minutes and requires no manhole entry

c) Minimum Dead Band: 0.0 in (0.0 mm) from the bottom of sensor housing: Maximum Operating Range: 240 in (6.1 m)

d) Beam Angle: +/- 3 degrees

e) Resolution: 0.01 in (0.24 mm)

f) Accuracy: +/- 0.25% of sensor range measurement or 0.13 in (3.2 mm) whichever is greater, in a homogeneous temperature air column

g) Drift: 0.0 in (0.0 mm)

h) Temperature Compensation: Additional compensation for variable temperature air column supported

i) Submersion: Separate Submersion Sensor detects submersion when fully covered with liquid

B. ECHO Level Monitors

i. Intrinsically Safe: All monitoring equipment installed in the manhole is certified as Intrinsically Safe for installation in hazardous areas. The monitor is certified for installation in Class I, Division 1, Group C and D, Zone 0 atmospheres.

ii. Enclosure: NEMA6P/IP68 standard

iii. Power: Internal power:

1) Internal Power: Is powered by a replaceable 9-volt internal alkaline battery pack which provides at least two years of battery life when monitor is configured on a 5-minute sample rate and collected using wireless telemetry once per hour.

iv. Memory: The level monitor installed at the sewer manhole location has enough memory to ensure that more than 18 months of 5-minute data can be stored. The memory supports a circular buffer with the oldest data only being written over once the memory is filled.

v. Mounting: The level monitor is capable of being installed from the top of the manhole.

1) A removable and adjustable mounting bar; or

2) A mount secured to the wall for permanent installation.

vi. The level monitor is capable of surviving immersion in sewage water for at least four hours.

vii. Data Recording Interval: Supports data recording rates at standard intervals of 2, 5, 15 and 30 minutes or 1, 2, 12 or 24 hours.

viii. Dual Data Rate: The configuration of the data logger automatically switches into a faster data sampling and recording interval once a user-defined depth trigger has been exceeded. The data recording interval returns to normal at such time as the depth trigger is no longer exceeded.

ix. Firmware Upgrades: The monitor is capable of receiving firmware upgrades via remote communications.

x. Temperature Range: The unit functions within specifications between -20 and 60° C (-4 and 140° F).

xi. Clock: A battery backed crystal controlled real-time clock/calendar is synchronized to the nearest cellular tower.

xii. Diagnostic Checking: The monitor performs self-checks of internal systems and battery voltages. Any values that are outside normal levels is annunciated via FSP's web-based software (if enabled), or via notifications in collected data logs in FSP's desktop monitor configuration, data collection and analysis software.

xiii. Embedded Software Quality Procedures: All embedded software in the equipment is developed with ISO 9001 quality procedures for software development and testing.

xiv. Communication

1) Each monitor is accessible via a Bluetooth connection for local on-site communication with a personal computer. For remote access each monitor is fitted with a wireless modem. The web hosted software is able to access the monitor via local or wireless connection.

a) The wireless modem is certified to mount in Class I, Division 1, Group C and D, Zone 0 atmospheres.

2) Modem Diagnostics: The wireless modem supports both on-site and remote diagnostics.

a) On-Site: The modem has a visible LED display allowing for on-site troubleshooting. A field crew is able to initiate diagnostics by holding a magnet to the outside of the modem enclosure for a few seconds. Upon removal a diagnostics sequence displays, including as a minimum the monitor's IP address, the wireless signal strength and monitor battery voltage.

b) Remote: The user is able to connect to the monitor via cellular communications and obtain wireless signal strength, monitor battery voltage and alarm cry out address, at a minimum.

3) The wireless modem unit also self-monitors wireless connection quality and perform connection refreshes as required to be ready to service incoming connection requests.

4) The wireless modem is connected continuously to the wireless network unless programmed for a battery conservation mode; allowing the modem to be turned off during user-specified time-periods while still allowing the monitor to cry out alarms and upload data when necessary.

5) Antenna: For wireless configurations, a selection of antenna types is available depending on installation requirements. The selection includes direct burial road surface antennas, stub type enclosure antennas, whip type roof mount antennas and high gain unidirectional elements. Connection type is SMA.

6) SCADA Interface: The monitor is able to provide real-time data using Modbus protocol via a wireless connection to a customer-provided and configured RTU.

   a) The monitor is able to support simultaneous SCADA interface and wireless communications to a FSP provided web-based and PC-based software packages.

xv. Sensors: The ECHO monitor is capable of supporting a minimum of two different sensors as described below. The sensors do not require any additional barriers or components to meet IS requirements.

1) Long Range Ultrasonic Depth

   a) The Long Range sensor is of the ultrasonic Doppler type.

   b) The Long Range sensor has a range from 0 inches to 240 inches

   c) The Long Range sensor reads into the pipe invert

   d) The Long Range sensor does not have a dead band (0.0 inches)

   e) The Long Range sensor has resolution no greater than 0.01 inches

   f) The Long Range sensor does not have drift

   g) The Long Range sensor uses actual temperature and the seasonal manhole temperatures to obtain accurate depth by compensating for changes of the speed of sound in air

   h) The Long Range sensor reads into channels with a minimum of 0.5 inch of flow depth

2) Sealed Gauge Pressure

   a) The Sealed Gauge Pressure sensor has a range from 0 inches to 100 inches above the Long Range sensor

   b) The Sealed Gauge Pressure sensor does not have a dead band (0.0 inches)

   c) The Sealed Gauge Pressure sensor has resolution of 0.01 inches

   d) The Sealed Gauge Pressure sensor does not have drift

   e) The Sealed Gauge Pressure sensor measures depth when flow depths submerge the Long Range sensor

C. Rain Gauges

i. Equipment General

1) The equipment consists of a wireless data logger equipped to connect to any industry standard tipping bucket type rain gauge. Equipment is developed and manufactured with ISO9001 certification process. The data logger (and tipping bucket) is installed at suitable (secure) locations and conforms to the following minimum specifications:

2) Housing: Waterproof, NEMA 4X/6P fiberglass reinforced polyester enclosure with stainless steel hardware. The unit is lockable with padlock. Dimensions do not exceed 12.0”H x 10.0”W x 5.0”D. Weight does not exceed 22 pounds.

3) Connectors: U.S. MIL-C-26482 Series 1 type hard anodized aluminum with interfacial seals to afford maximum corrosion protection and life expectancy

4) Mounting: Unit supports an integral mounting flange on the top and bottom of housing, each with two holes to attach to a wall. Heavy duty mounting plate and sunshield is available for ground or roof mounted locations.

5) Power Supply: Rain gauge operates with a replaceable alkaline battery pack and consumes less than 6ma under normal (standby) operation. Battery life is a minimum of 24-months under continuous operation when recording up to 12-readings /hour.

6) Communications: Each unit is delivered with one standard RS232 serial port for local on-site communication and configuration with QStart. For remote (telemetered) access, each unit is fitted with a wireless modem. Web hosted software may also be used for configuring and data collection. To reduce battery use, the unit supports a power saving mode whereby the equipment can be programmed to shutdown the wireless modem during user-defined hours of the day. During the power saving mode, the unit ignores incoming connect requests, however it continues to perform all measurement and alarming functions.

7) Remote (Telemetered) Data Access: The unit is continuously on-line and available to answer in-coming requests (unless power savings are implemented). Units fitted with wireless modems remain connected to the wireless network and self-monitor their connection and perform connection refreshes as required to be ready to service incoming connection requests.

8) Antenna: Units is delivered with an internal quad-band slot type antenna. The unit is also capable of field retrofit to accommodate an external antenna using a normal polarity SMA connection.

9) Memory: 2 MB non-volatile memory for program, configuration and data storage is provided. Data storage is minimum 250 days when recording up to 12 sensor readings per hour. Memory supports a circular buffer with the oldest data only being written over once the memory is filled.

10) Clock: Unit employs a battery backed crystal controlled real-time clock/calendar.

11) Data recording: Supports data recording rates at standard intervals of 1, 2, 5, 15 and 30 minutes or 1, 2 12 or 24 hours. Minimum resolution is 0.01 inch (per tip of tipping bucket) and maximum 10 tips per second.

12) Alarming: Supports user definable rainfall intensity thresholds for the purpose of remote alarming. Minimum alarm threshold is 0.01 inch per 5 minutes. Unit automatically generates and notifies up to a

minimum of 3 different addresses via SMS text message and/or email immediately upon exceeding alarm threshold and upon Return to Normal.

13) Status Checks: Wireless units is capable of automatically sending in daily status messages as well as annunciating low battery and other diagnostic information. Status and tipping bucket diagnostics can also be performed by contacting the monitor using FSP provided software.

14) Firmware Upgrades: All upgrades can be done remotely, either via wireless or land line. Upgrades can also be done locally using serial connection.

15) Temperature range: Functions within specifications between 0 and 60° C (0 and 140° F).

4. PRISM Web Hosted Software

A. General

i. All software required for equipment operation and cellular data transmission is provided.

ii. The software is developed under the ISO9001 certified process.

iii. The software operates on version 72 or higher of the EDGE browser.

B. Web-Based Data Management

i. The web-based software system meets the following minimum specifications:

1) A software system that is accessible using Microsoft® Internet Explorer version 8.0 or greater and available to any personnel requiring access.

2) All data is hosted in the secured Microsoft Azure cloud environment.

ii. User Security

1) The software system has unique password security for each user. Each user is permitted to perform only authorized functions as allowed by the System Administrator.

2) Functions that can be restricted by permissions shall include, at a minimum, alarm acknowledgement, reporting, viewing specific data sets and viewing user credentials.

iii. Data Viewing

1) The software system has the ability, at a minimum, to display data for each site in the following formats:

a) Hydrograph – a time series graph of multiple data types with the ability to segment data based on intervals (e.g. “weekly”) over the user specified time period;

b) Scattergraph – a depth to velocity graph for the specified time period with the ability to select a data point to see the actual value for that data point;

c) Tabular – both tables for viewing and a CSV or Excel format for download is available.

iv. Telecommunications

1) The PRISM software system allows authorized users to collect data directly from telemetered monitors via the Internet. The software automatically collects data from all telemetered sites at a minimum each day and whenever an alarm occurs.

2) The software has the ability to issue a data collection command in order to obtain data in near real time.

v. Multiple Data Type Support

1) Final and Original Data: The software system allows for the upload of final edited data and maintains a copy of both the final and the original data after upload.

vi. User Viewing Permissions

1) The software system has the ability to configure users to only view authorized data sets.

vii. Automated Data Verification and Correction

1) The software system can detect and mark or repair data anomalies (also called "automated editing" or "data scrubbing") that are common to sewer flow data. Automatically edited data does not replace or delete any original data.

2) The software system has the ability to configure users to view data and information only from individual monitoring sites.

viii. Data Exports

1) The software system allows the user to export data to an Excel/CSV format.

2) One or multiple monitoring locations can be selected.

3) The user can select the data averaging type and define whether to include time stamps for missing data.

a) The user can have the missing time stamp data exported as a blank or a user-defined value.

b) Duration of time that threshold was exceeded and the volume of the excess flow on a per monitor basis is provided;

c) Capacity trend reports indicating the average and maximum capacity used for each monitoring location for the last 24-hours, compared with a user specified time range, as a percentage of the theoretical capacity for each site;

d) Surcharge trend reports indicating the percentage of time that each site was in a surcharge condition (depth greater than full pipe) over the last 24 hours, past 30 days or past 90 days, compared with a user specified time range; and

e) Percentage-full trend reports indicating percentage of full pipe trending over the last 24 hours, 30 days or past 90 days, compared with a user specified time range.

ix. Reporting Data Types

1) Reports shall use final data for any calculations; if final data is not available then the system uses automatically edited data on the report to minimize possible reporting gaps.

x. Stored Report Preferences

1) The system allows users with authorization to save report preferences by name for future use.

2) The system allows a user to modify the report parameters of a named report they created. Viewing of reports is restricted by security permissions.

3) Users authorized to view reports can view but not modify the named reports of another user.

4) Named reports are available for automatic email generation at a user specified interval.

xi. Alarming and Alarm Types

1) At a minimum, the system provides alarming for the following types of common flow conditions:

a) High depth

b) High-High depth

c) Loss of Flow

d) Rain Exceeding Threshold

e) Wet Weather Overflow

f) Dry Weather Overflow

2) Alarm Acknowledgement

a) The system allows authorized users to acknowledge an alarm condition.

b) The acknowledgement time is recorded along with the user who acknowledged the alarm and any comments by the user.

c) Acknowledged alarms is distinguished from normal conditions as well as from active alarms.

3) Alarm Notification and Escalation

a) The system has an audible notification when new alarms occur.

b) Each user is able to mute the audible notification without affecting other users.

c) The software provides a method for escalating alarms to pagers and email if an alarm is not acknowledged after a specified period of time.

d) The software allows a user to receive alarm escalation messages for each alarm type from each site.

e) The software allows escalation of alarm messages based on individual worker shifts.

4) Logs and Reports

a) The software logs any diagnostic events, such as sensor related events or battery warnings, which are reported by the hardware.

b) Logs has features allowing for queries based on type of event or alarm, time span, and location.

c) The system is able to email configured event, alarm or trend reports based on the description in the Stored Report Preferences section of this document (above).

xii. Dynamic Geographic Information Display

1) The system uses GIS information supplied by the Subscriber for the purpose of providing a map display of all monitoring locations.

2) The map indicates the alarming condition of each alarm configured in the system. The map has the ability to zoom in and out to view additional details in the supplied GIS information.

3) The flow monitor site icon on the map provides a direct link to flow monitor data for that site.

xiii. Attachments

1) The software allows for files (such as images and documents) to attach to monitoring locations.

2) Files can either be private (restricted to authorized users) or publicly available to all users.

xiv. Training and Support

1) ADS provides training on the use of the software to the Owner.

2) ADS provides telephone support to the Owner using personnel experienced in troubleshooting problems with the specified software.

5. Flow Information Deliverables

A. Dry and Wet Weather Performance Report

i. An engineering report is available that characterizes the dry weather and wet weather performance of each sewer shed being monitored. The report includes key operating parameters the Owner uses to guide maintenance, rehabilitation programs and post- rehabilitation evaluation.

B. Dry Day Analysis

i. Dry days used for this analysis are days that are not affected by recent rainfall. Selected dry days is grouped into Weekdays and Weekend and analyzed separately.

ii. Dry days is further grouped into at least two seasons to include the period of time that vegetation is growing and the period of time that vegetation is dormant.

iii. For each day group and season the report includes the Average Dry Day Flow (ADDF), an estimation of the Waste Water Production (WWP) and the Base Infiltration (BI). Each value is normalized by the length of sewer in each basin to allow the Owner to determine the basins with the greatest rates of infiltration.

iv. The ADDF flow is separated into components of WWP and BI using the Stevens-Schutzbach equation as published by WEFTEC and the WEF Water Practice Journal.

v. Each report includes a 24-hour hydrograph of the ADDF for both weekday and weekend days.

C. Rainfall Analysis

i. Rainfall data is reported in tabular form with the depth of rain for each storm. A storm consists of any event in which half the rain gauges in the network record at least 0.5 inches of rainfall.

ii. A Depth Duration Frequency (DDF) analysis is conducted for each storm and each rain gauge to report the maximum return frequency and duration for each storm and rain gauge.

iii. Rainfall on each monitored sewer shed is determined by using the Inverse Distance Squared method for distributing rain gauge data. Assigning a single gauge to each basin is not acceptable.

D. Wet Weather Analysis

i. Rainfall Dependent Infiltration and Inflow (RDII) is calculated for each monitor and every qualifying storm for the period. The objective is to quantify both the peak rate and volume of RDII. If there are upstream monitors, the peak and volume of Net RDII is also to be determined.

ii. RDII is determined after the dry day hydrograph is adjusted either higher or lower to match the actual flow rate immediately prior to the storm. It is intended to compensate for periods of high ground water causing the dry weather flow to be temporarily higher that the average dry weather

iii. RDII values are be normalized by dividing the net RDII by both the area (acres) of the basin and the LF of sewers in the basin. RDII values normalized by area will be presented as a Capture Coefficient or the percentage of rainfall by volume that enters the sewer. A ranking of the basins is based on normalized values of RDII.

iv. Q vs i diagrams in two forms are generated for each monitored sewershed. A volume-to-volume diagram plots the volume of measured RDII versus the depth of rain in the sewershed. A volume-to-peak diagram plots the peak rate of RDII versus the rainfall prior to the time of peak RDII. Linear regression lines and regression statistics are provided for each plot.

v. RDII projections are conducted for selected design storms by applying the design rainfall to the regression line.

vi. Q vs i diagrams are generated for each season (growing and dormant).

vii. As rehabilitation projects are completed, each report compares Q vs i diagrams for the pre-rehabilitation data and the post-rehabilitation data. A change in the slope of the regression line indicates that RDII has been reduced.

E. Hydraulic Capacity Analysis

i. Depth and velocity data is plotted in a scattergraph format with Iso-Q lines and Iso-Froude lines included. The Manning Pipe Curve is based on manual depth/velocity confirmations taken at the site. Iso-Q lines are lines of constant flow rate and Iso-Froude lines show the Critical Velocity at all depths.

ii. The report includes an evaluation of silt or blockages present at each site. The report also includes a determination of both the Theoretical and the Operational Capacity of the sewer at each monitor. Theoretical Capacity is the full pipe flow rate predicted by the Manning Pipe Curve and Operational Capacity is the full pipe flow rate.

iii. The report includes a statistical evaluation of hydraulic performance indicators for each monitoring point; evaluations of depth capacity, flow capacity, backwater, surcharge, velocity and silt.