Stormwater and Instream (Storm Only) Monitoring Standard Operating Procedures

Prepared by: City Salem Public Works Department
Stormwater Services
Last revised: July 2012

Table of Contents

List of Tables

1.0 Purpose

This document provides detailed sampling procedures for the Stormwater and Instream Storm monitoring elements presented in the Surface Water and Stormwater Monitoring Plan. This plan was finalized in 2011 to satisfy the environmental monitoring requirements associated with the December 30, 2010 renewal of the City of Salem's NPDES MS4 Phase I permit.

2.0 Monitoring Equipment

All field parameters (pH, temperature, dissolved oxygen, and specific conductivity) will be collected using the **In-Situ Troll 9500 Multi-Parameter Datasonde** (pH, specific conductivity, temperature) and **YSI Pro ODO** (temperature and dissolved oxygen). As an alternate, the **YSI Model 60** (pH) and **YSI Model 85** (specific conductivity) can be used in place of the In-Situ datasonde.

Flow-weighted stormwater composite samples will be collected using **ISCO 6712 Portable Samplers**, **750 Area Velocity Modules**, and **ISCO Low Profile Area Velocity Sensors**. Instream storm composite samples will be collected using **ISCO 3700 Portable Samplers**. A description of these instruments and list of required accessories is provided in Table 1.

Table 1. Monitoring Equipment

Instrument	Specifications	Accessories
In-Situ Troll 9500 Multi-Parameter Datasonde	<u>pH</u> Accuracy: +/- 0.09 pH units Resolution: 0.01 pH units Range: 0-12 pH units <u>Specific Conductivity</u> Accuracy: Low Range Sensor +/- 0.5% or 2 µS/cm (whichever is >) between 5 & 20,000 µS/cm Resolution: Range-dependent Range: Low Range Sensor = 3 µS/cm - 50,000 µS/cm <u>Temperature</u> Accuracy: +/- 0.1 degrees C Resolution: 0.01 degrees C Range: -5 to 50 degrees C	▪ 2 D batteries ▪ Blue Rugged Reader w/Comm Link ▪ pH 4, 7, and 10 standards, 6.86 check ▪ 1000 µS/cm conductivity standard and 84 µS/cm check solution
YSI Pro ODO	<u>Dissolved Oxygen</u> Accuracy: ±0.1 mg/l (0 to 20 mg/l) Resolution: .01 mg/l Range: 0-50 mg/l <u>Temperature</u> Accuracy: ±.2 ° C Resolution: 0.1 ° C <u>Barometer</u> Accuracy: ±1.5mmHg from 0 to 50°C Resolution:0.1 mmHg	▪ 2 C batteries ▪ protective/calibration sleeve

YSI 60	<u>pH</u>
	Accuracy: ± 0.1
	Resolution: 0.01 unit
	
	<u>Temperature</u>
	  Accuracy: ± 0.1 °C
	  Resolution: 0.1 °C
	  Range: -5 to 75 °C
		▪ 6 AA batteries
		▪ pH 4 & 7 buffers
		▪ graduated cylinder, 100 ml

YSI 85	<u>Specific Conductivity</u> Accuracy: ± 0.5% Resolution: 0.1 µS/cm Range: 0 to 499.9 µS/cm <u>Temperature</u> Temp. Accuracy: +/- 0.1 C Temp. Resolution: 0.1 C	▪ 6 AA batteries ▪ Replacement Membranes ▪ Conductivity Standard ▪ KCl Solution
ISCO 6712	<u>Volume</u> Accuracy: ± 10% or 10 ml <u>Suction Lift</u> 28′ Maximum Suction Head	▪ 6712 Pump tubing ▪ 3/8″ vinyl suction line ▪ 3/8″ CPVC strainer ▪ Model 934 Nickel-Cadmium rechargeable battery ▪ (1) 2.5 gallon nalgene composite bottle with tube guide ▪ Medical grade silicon rubber pump tubing ▪ Rapid Transfer Device (RTD) 581.
750 Module w/ Low Profile Area Velocity (AV) Sensor	<u>Level</u> Accuracy: .033 to 5 ft: ±.008 ft/ft Range: 0.033 to 10 ft Module Resolution: .002 ft <u>Velocity</u> Accuracy: : -5 to 5 ft/s: ± 0.1 ft/s 5 to 20 ft/s: 2% of reading Range: : -5 to 20 ft/s Module Resolution: 0.024 ft/s Minimum Depth: 0.8 ft	▪ Multi-section Pole ▪ 15″ Diameter Street Level Mounting Ring (Electric) ▪ Scissor Ring (Hilfiker and Salem Industrial)
ISCO 3700	<u>Volume</u> Accuracy: ± 10% or 20 ml <u>Suction Lift</u> 26′ Maximum Lift	▪ Medical grade silicon rubber pump tubing ▪ 3/8″ vinyl suction line ▪ (1) 2.5 gallon nalgene composite bottle ▪ Model 934 Nickel-Cadmium rechargeable battery (CLK1 only)

2.1.1 Handheld Instrument Calibration

<u>In-Situ Troll 9500 Multi-parameter Datasonde</u>
See In-Situ the "Mulit-Parameter Troll 9500 Instrument Manual" (http://www.in-situ.com/force_download.php?file_id=365) for calibration instructions.

YSI Model 60 Calibration (pH)

If the pH sensor has been sitting in the storage solution always acclimate it first by placing it in pH 7 for 30 minutes prior to calibration.

3 Point Office pH Calibration (7, 4, 10 pH buffer)

Note: Always calibrate pH 7 first

- Turn instrument on and press the **MODE** key until pH is displayed on the screen.
- Rinse the probe with DI water followed with a rinse of pH 7 buffer.
- Rinse a clean 100 mL graduated cylinder with pH 7 buffer
- Pour 35 mL of pH 7 buffer solution in the 100 mL graduated cylinder.
- Immerse the probe in the pH 7 buffer, making sure that the entire gray area on the probe is covered with solution. Allow time for the temperature and pH readings to stabilize.
- To begin calibration, press the **UP ARROW** and **DOWN ARROW** at the same time. **CAL** will display at the bottom of the screen and the word **STAND** will be flashing.
- Press **ENTER**. The word **STAND** will stop flashing but the decimal point in the middle of the calibration value should be flashing.
- Once the reading has stabilized the decimal point will stop flashing. Press and hold **ENTER**. **SAVE OFS** will flash across the screen.
- **SLOPE** will now appear and start flashing. Rinse the probe and graduated cylinder with DI water followed by a rinse of pH 4 buffer.
- Pour 35 mL of pH 4 buffer solution in the 100 mL graduated cylinder.
- Immerse the probe in the pH 4 buffer, making sure that the entire gray area on the probe is covered with solution. Allow time for the temperature and pH readings to stabilize.
- Press **ENTER**. **CAL** will show at the bottom of the screen, the word **SLOPE** will stop flashing, and the pH calibration value will display with the first decimal flashing.
- Once the reading has stabilized the decimal point will stop flashing. Press and hold **ENTER**. **SAVE** and **SLP** will flash across the screen. **SLOPE** will start to flash.
- Rinse the probe and graduated cylinder with DI water followed by a rinse of pH 10 buffer. Pour 35 mL of pH 10 buffer into 100 mL graduated cylinder.
- Immerse the probe in the pH 10 buffer, making sure that the entire gray area is covered with solution. Allow time for temperature and pH to stabilize.
- Press **ENTER**. **CAL** will show at the bottom of the screen, the word **SLOPE** will stop flashing, and the pH calibration value will display with the first decimal flashing.
- Once the reading has stabilized the decimal point will stop flashing. Press and hold **ENTER**. **SAVE** and **SLP** will flash across the screen. **SLOPE** will start to flash.
- The instrument is now calibrated. Press **MODE** to exit calibration.

1 Point Field Accuracy Check

To perform a field accuracy check on the pH sensor use 7 pH buffer solution and follow the first 5 bullets from above. If the meter is reading within ± .2 of the check solution then another calibration is not necessary and the meter is ready to use. If the meter is reading outside of this range then it will be necessary to perform the calibration process again, followed by another accuracy check. If the sensor is still reading outside of the ± .2 data quality objective, a grab sample will need to be collected and tested at Willow Lake Laboratory.

1 Point Specific Conductivity Check-YSI 85

Conductivity sensor will be checked prior to each sampling event.

- Turn instrument on and allow it to complete its self test procedure.
- Rinse probe and beaker with 84 µS/cm standard solution
- Place at least 3" of solution in beaker (or enough to cover probe completely).
- Read sensor (for specific conductivity verify that the **°C** is flashing!) making sure that instrument is within 7% of standard solution. If sensor is reading outside of 7% of standard solution perform calibration below.

Specific Conductivity Calibration

Before calibration remember to rinse probe with de-ionized water.
- Turn instrument on and allow it to complete its self test procedure.
- Rinse probe and beaker with 1000 µS/cm standard solution
- Place at least 3" of solution in beaker (or enough to cover probe completely).
- Press the **MODE** button until instrument displays conductivity. Make sure the instrument is reading Specific Conductivity by verifying that the **°C** symbol is flashing.
- Insert probe until completely covered. Do not set probe on the bottom of container - keep it suspended at least 1/4".
- Allow the temperature readings to stabilize for 60 seconds then swish probe to remove any air bubbles.
- Press and release the **UP ARROW** and **DOWN ARROW** at the same time. The **CAL** symbol will appear at the bottom left of the display, indicating that the instrument is now in Calibration mode.
- Use the **UP ARROW** or **DOWN ARROW** button to adjust the reading on the display to the value of the solution in use then press **ENTER**. **SAVE** will flash across the display to indicate that the calibration has been accepted.
- Rinse probe and beaker with de-ionized water
- Rinse probe and beaker with 84 µS/cm standard solution
- Place at least 3" of solution in beaker (or enough to cover probe completely).
- Read sensor (for specific conductivity verify that the **°C** is flashing!) making sure that instrument is within 7% of standard solution
- If sensor is not reading within 7% of standard solution repeat calibration process or perform check process on spare sensor.

Notes:
- There is no need to re-calibrate the conductivity after turning power off or changing batteries.
- The degree Celsius symbol flashes <u>only</u> when the instrument is in specific conductivity mode.
- It is very important to keep the conductivity cell clean. Always rinse w/ DI water after each use.

<u>YSI Pro ODO</u> Calibration Checks-(Dissolved Oxygen).
- Moisten sponge in gray storage sleeve with a small amount of clean water.
- Make sure there are no water droplets on the DO sensor cap or temperature sensor, then slide the sensor into the storage sleeve (making sure sensor is not immersed in water).
- Wait 5 to 10 minutes for the storage sleeve to become completely saturated and to allow the temperature and dissolved oxygen sensors to stabilize.
- On the handheld reader press "Calibration".
- Select **DO** and press enter.
- Highlight **DO %** and press enter to confirm.
- The internal barometer value used for calibration will be displayed at the top of the window. Highlight the barometer and press enter to adjust if needed. If the barometer reading is incorrect, it is recommended that you calibrate it (See manual for help or description of "true" barometric pressure).
- Wait for temperature and DO% values under "Actual Readings" to stabilize, then use the table to check your DO reading is within .2 mg/L based on temperature and barometric pressure.
- If it is in range, highlight **Accept Calibration** and press enter.
- Be sure to do a final check using the table after calibration to make sure it calibrated correctly and is within range.

Notes:
- Always calibrate indoors in a stable temperature environment.
- Even though calibrations can last for months, check DO each time to make sure it is still within .10 range.
- During sampling event, rinse DO sensor with DI water before putting back into sleeve to keep the storage sleeve as clean and uncontaminated as possible.

3.0 Stormwater Sampling

3.1.1 Storm Criteria

The following guidelines will be used in selecting wet-weather events to conduct stormwater sampling:

- Storm event must be greater than 0.1 inch of rainfall

- When possible, samples must be collected after an antecedent dry period of a minimum of 24 hours

The following guidelines will be used to determine the Flow Interval Quantity (FIQ)

- Predicted rainfall total depth up to the first 6 hour predicted dry period or 24 hours, whichever comes first

3.1.2 Stormwater Sampling Locations and Parameters

Three stormwater locations will be sampled three times per year (or 15 times within the permit cycle) under the established storm criteria listed above. Table 2 provides a summary of each monitoring location. For further information on site locations refer to the City of Salem storm grid maps. Table 3 provides a list of the stormwater parameters that will be analyzed.

Table 2. Summary of Stormwater Monitoring Sites

Location Identifier	Electric Ave. SE	Salem Industrial NE New sample site	Hilfiker Ln SE New sample site
Dominant Land Use	Residential	Industrial	Commercial
Watershed	Pringle	Upper Claggett	Pringle
Receiving Stream	Clark Creek	Claggett Creek	West Fork Pringle Creek
Number of Monitoring Events	3/year or 15/permit cycle	3/year or 15/permit cycle	3/year or 15/permit cycle
Manhole Number	D42466227	D51488226	D42456234
Catchment Area	101.23 acres	~54 acres	~18 acres
	4,409,578.8 ft²	~2,352,240 ft²	~784,080 ft²
Runoff Coefficient	0.524	~0.6	~0.75
Diameter of Pipe	15″ = 1.25′	24″ = 2′	18″ = 1.5′
Suction Line Length	12 ft	12 ft	6 ft
Closest Rain gauge	RG12	RG4	RG10

Table 3. Stormwater Parameters

Pollutant Parameter	Collection Method
TSS	Composite
Biochemical Oxygen Demand$_{5-day}$	Composite
Total Phosphorus	Composite
Nitrate+Nitrite as Nitrogen	Composite

Pollutant Parameter	Collection Method
Ammonia Nitrogen	Composite
Copper (Total & Dissolved)	Composite
Lead (Total & Dissolved)	Composite
Zinc (Total & Dissolved)	Composite
Hardness	Composite
Sp. Conductivity	Composite & Field
Temperature	Field
Dissolved Oxygen	Field
pH	Field
E. coli	Grab

3.2 Stormwater Sampling Preparation

The Stormwater Monitoring Analysts are responsible for reviewing weather forecasts and rainfall predictions on a daily basis throughout the sampling season. Once it has been determined that the above storm criteria will be achieved they will notify additional stormwater staff and personnel at the Willow Lake laboratory of a possible sampling event. This notification needs to occur at least 1-3 days prior to the actual wet-weather event to ensure ample preparation time.

3.2.1 List of Needed Materials

Available staff will then be responsible for placing pre-programmed automated samplers (with ice packs and bottle) in the sampling manholes, calibrating field meters, locating chain of custody sheets, and organizing the required sampling supplies as follows:

General/Safety
- Proxy Card (Active)
- Raingear
- Safety vests or jackets
- Sampling Gloves
- Safety Goggles/glasses
- Headlight / Flashlight
- Nextel phone
- Manhole puller
- Traffic Cones & Signs

Automated Samplers
- Ice packs
- ISCO 6712
- Nickel cadmium batteries for each sampler (fully charged >13.5 v)
- Acid washed 2.5 gallon naglene composite bottle(1 for each)
- ISCO 750 Flow Modules
- Low flow (AV) sensors (already installed in pipe at each location)
- Acid washed tubing (pump and suction line) and acid washed CPVC strainers

<u>Field Sampling Supplies</u>
- Calibrated meters (In-Situ Troll 9500, YSI ProODO)
- Calibration cup for In-Situ datasonde
- 100 mL graduated cylinder
- pH buffer solutions (4,7, and 10)
- 1000 µS/cm Specific Conductivity standard
- Spare AA batteries (12), C batteries (2), and D batteries (2)
- DI water

<u>Grab Sample Cooler</u>
- Rope (20ft)
- Sterilized stainless steel sampling buckets (3)
- Three 250 ml glass bottles (E.coli)
- Duplicate 250 ml glass bottle (E.coli)

<u>Paperwork</u>
- Chain of custody forms
- Field data sheets

Notes:
- All acid washing and sterilizing of bottles, stainless steel buckets, tubing, and strainers will be done at Willow Lake Laboratory

3.2.2 Estimating Volume and finding the FIQ

With the ISCO 750 Area Velocity Module and ISCO Low Profile Area Velocity (AV) Sensor attached to the ISCO 6712, the automated sampling unit can be programmed to collect a sample after a specified volume of water has passed the AV Sensor in the storm pipe. The volume of water that triggers a sample will be dependent upon the projected rainfall of each storm event. Therefore, an estimated total volume of runoff

total volume (ft³) = Area * Rainfall * runoff coefficient

must be calculated prior to each sampling effort. This estimated runoff volume will then be used to determine Flow Interval Quantity (FIQ).

The procedure for calculating Total Runoff Volume and the FIQ for each wet- weather event and sampling location is presented below:
- Convert predicted total rainfall (in) to **(ft)** by ÷ 12
- Locate values for each MS4 **catchment area (ft²)** and **Runoff Coefficient (RC)** in Table2.
- Calculate Total Runoff Volume using: **(ft³) = Area * Rainfall * RC**
  - *Ex: Runoff Volume = 348480 ft² * .02 ft * .90*
  - *Runoff Volume = 6,272.64 ft³*

- Estimate the total volume of pre-storm base flow during the predicted storm event by multiplying the current site cfs by 3600 (sec/hr) and the length of the predicted storm (hrs).
    - *Ex: 2.6 ft³/sec (pre-storm cfs)*
    - *pre-storm base flow = 2.6 ft³/sec * 3600 sec/hr * 12hr (est. length of storm in hrs.)*
    - *pre-storm base flow = 112,320 ft³*
- Add the Total Storm Runoff Volume (V) to the pre-storm base flow (Q) and calculate the Flow Interval Quantity (FIQ) using: **FIQ = (runoff volume + pre-storm base flow) ÷ 24**
    - *Ex: FIQ = (6,272.64 ft³ + 112,320 ft³) ÷ 24*
    - *FIQ = 4,941.36 ft³*

    Note: 24 = **24** samples (375ml each) into the 10L composite bottle

A simple spreadsheet model has been produced for each location. They can be found at: *S:\SHARED\Storm Drain\PROJECTS\Stream Monitoring Stations\Sampling\sampling 3rd permit\runoff calculations\FIQ*

3.2.3 ISCO 6712 Sampler Setup
- Install the acid washed pump tubing (2 pieces).
- Plug in a fully charged Nickel -Cadmium battery into the programming unit (for programming and calibration of sampler).
- Calibrate sampler:
    1. From the main menu select **OTHER FUNCTIONS**
    2. Select **MANUAL FUNCTIONS**
    3. Select **CALIBRATE VOLUME**
    4. Enter desired volume (375 mL)
    5. Perch top half of sampler on edge of a table so pump tubing hangs free. Put end of suction line into a gallon of DI water. Hold container under pump tubing without touching. Press the enter key when you are ready.
    6. Sampler will purge suction line, pump the set volume of water, and then purge suction line
    7. Using the 100 mL graduated cylinder, measure out the volume delivered and enter that number in the next screen
        - If the volume you entered was more than twice, or less than half, the programmed volume it will ask: "Are you sure?"
            - Select **YES** when the volume delivered was entered correctly
            - Select **NO** to enter the volume entered

- Place the 2.5 gallon nalgene composite bottle (acid washed) in the center of the 6712 sampler base. While the lid is still on, place ice packs around the bottle to

hold it in place and keep samples chilled. Remove lid, place in the stormwater cooler.
- Replace the upper half of the sampler unit while guiding the tube guide and pump tubing into the top of the bottle.
- Remove red desiccant cap from 750 Module.

3.2.4 ISCO 6712 Sampler Programming Instructions

Note: If base flow exists, use standard programming to find out the CFS of the base flow by following the steps below.

<u>**Standard Programming**</u> If in Extended Programming enter 6712.1 at the main menu to return to Standard Programming. If a Program is running, **STOP** the program by pressing the STOP key and selecting **STOP PROGRAM** before entering 6712.1.

1.   Select **PROGRAM** and hit enter key (see page 30 for a table of keypad functions). Verify that the **SITE DESCRIPTION** matches your location. If no changes are necessary, select **NO** to continue.
2.   In the next four screens confirm units selected:
- Flow Rate = **cfs**,
- Flow Volume = **cf**,
- Velocity = **fps**.
3.   **PROGRAM MODULE** select **YES**.
- **MODE OF OPERATION** = **FLOWMETER**,
- **FLOW CALCULATION** = **AREA*VELOCITY**,
- **LEVEL TO AREA** = **CHANNEL SHAPE – ROUND PIPE**. Check Table 2 (page 9) to verify the diameter of the pipe (ft) displayed in the next screen.
4.   Next, the **current level** reading from the AV Sensor will be displayed, as well as an option to adjust this reading. Make sure the sensor is reading the correct level and adjust if necessary. Measure the depth of flow in the pipe upstream of the AV Sensor if doing a confined space entry, or estimate the depth of flow if not doing a confined space entry.
5.   **Zero offset level**-If the AV Sensor has been installed anywhere but directly on the bottom of the pipe an offset level will need to be determined and entered in the next screen. The offset is equal to the vertical (not circumferential) distance of the sensor from the bottom of the pipe.
6.   **Minimum depth for velocity measurement=2″**
7.   Enter (**1**) for the # of bottles and **10 Liters** for the bottle volume. The sampler will then ask for the suction line length. Refer to Table 2 (page 10) for the length at each MS4 location.
8.   Select **FLOW PACED** sampling and enter **1,000 cf**
9.   **Run continuously=NO**
- **Take 24 samples**
- Sample volume = **375 ml**
- **NO delay to start**.

- **Maximum run time** = 24 hrs
- **YES** to run the program.

10. Once the program in running a display will show the current **fps, cfs, level and signal strength, and total accumulated cf.**

11. Once you are confident in the current **cfs** use that number and follow the steps in 3.2.2 to determine final FIQ

12. "Standard Programming" is now complete. Stop the program, and proceed to "Extended Programming".

Extended Programming- Enter 6712.2 at the main menu to enter Extended Programming. The display should read **MODULE INSERTED — DOWNLOAD DATA…** select **Done** by pressing **ENTER** to continue to the main program menu.

1. Select **PROGRAM**.

2. Enter name of extended program (e.g. Hilfiker1) and site description (site name and sample date, e.g. Hilfiker 12-02-10).

3. Confirm Units Selected:
   - Length = **ft**,
   - Flow Rate = **cfs**,
   - Flow Volume = **cf**, and
   - Velocity = **fps**.

4. **AREA-VEL MODULE** set up:
   - **NOTE:** For setup, use the right arrow to move over and select screen so that it is flashing. Then hit enter to go into the setup and make changes. From the **AREA-VEL MODULE** screen: **"MODE OF OPERATION"** = **FLOWMETER**
   - **"FLOW CALCULATION"**= **AREA*VELOCITY**
   - **"LEVEL TO AREA"** = **CHANNEL SHAPE** then choose **ROUND PIPE**
   - **"ROUND PIPE" =** enter the pipe diameter detailed in Table 2

   NOTE: This will bring you back to menu screen and show all the settings for AREA-VEL MODULE

5. **Current Level** = confirm reading is correct by measuring the depth of flow in the pipe upstream of the AV Sensor if doing a confined space entry or estimate the depth of flow if not doing a confined space entry.

6. **ZERO OFFSET LEVEL**= If the AV Sensor has been installed anywhere but directly on the bottom of the pipe an offset level will need to be determined and entered in the next screen. The offset is equal to the vertical (not circumferential) distance of the sensor from the bottom of the pipe.

7. **Minimum Depth for Velocity Measurement = 2"**

8. The **Data Interval** and **Data Storage Interval** = 5 (always the same number)

9. **Number of Bottles = 1**
   - **Bottle Size = 10 lit**
   - **suction line length** found in Table 2 (page 10),
   - **AUTO SUCTION HEAD** = **YES**,
   - **rinses** = **1**, and
   - **retries** =**1**.

10. Select **One-Part Program**.
11. **PACING set up**:
    - Use arrows to enter pacing submenus
    - **FLOW PACED**
    - **"PACED BY" = FLOW MODULE VOLUME**
    - **FIQ =** enter in cubic feet (see section 3.2.2)
    - "**SAMPLE AT START" = YES**

12. **Composite = 24 samples**
    - Use arrows to enter submenus
    - **Run Continously = NO**
    - **Take 24 samples**
    - **Vol. of samples = 375 ml**
13. *ENABLE FUNCTIONS (NOTE: There are 4 different menu screens with submenus for "Enable Functions"*
    - Use arrows to enter submenu
    - **"ENABLE" = LEVEL**
    - **"ENABLE: LEVEL" = DONE**
    - "**LEVEL" CONDITION = SET POINT**
    - "**LEVEL" SET POINT = _____** (enter in the desired level set point (at least 0.05') above the base flow level)
    - **"ENABLE WHEN" = ABOVE SET POINT**.
14. *SECOND ENABLE FUNCTIONS*
    - Use arrows to enter submenu
    - **"ONCE ENABLED" = NO for STAY ENABLED**
    - **"ENABLE" NO** for **SAMPLE AT DISABLE**
    - **"ENABLE" YES** for **SAMPLE AT ENABLE**
15. *THIRD ENABLE FUNCTIONS*
    - Use arrows to enter submenu
    - **RESET SAMPLE INTERVAL AT ENABLE = YES**
16. *FOURTH ENABLE FUNCTIONS*
    - In the first **"ENABLE"** screen make sure line reads **"0 PAUSE & RESUMES"**
    - If the pauses and resumes are anything other than **0,** enter submenu for **PAUSE & RESUMES**
    - **"PAUSE/RESUME"** screen**:** in this screen select **CLEAR**
17. **NO DELAY TO START**
18. **MAXIMUM RUN TIME = 24 HOURS**
19. Run Program = **YES**

    For other functions see Apendix 1.

3.3 Collecting Flow-Weighted Stormwater Samples

Site Setup and Installation

15

The area velocity (AV) sensor is already installed in the sampling manholes in the upstream flow.

The portable sampler setup procedures require a team of two people. Once the team has arrived at the sampling location traffic cones and all of the required equipment should be placed around the manhole before the lid is removed. The list of required equipment includes:

- ISCO 6712 Sampler with ISCO 750 Flow Module attached, fully charged (>13.5 v) battery, 2.5 gallon nalgene composite bottle and ice packs, acid washed suction line tubing and pump tubing, and CPVC strainers.
- Stormwater Field Data Sheet

Once the site has been secured and all of the equipment is assembled the instructions below should be followed to complete the installation process.

- Attach the AV cable to the 750 Module on the sampling unit.
- Connect the suction line to the tubing coupler. Acid washed vinyl suction line tubing will be used for all sampling. Route the suction tube so that it runs continuously downhill from the sampler to the liquid source, without coils. This helps drain the line during pre-sample and post-sample rinses/purges and ensures the sampler delivers accurate sample volumes to the sample bottles.
- Turn the sampling unit on and verify that the programming is complete and ready to collect flow based samples.
- If base flow exists follow the steps in standard programming (see 3.2.4) to determine the current base flow cfs and calculate the total volume for the expected duration of the storm. Next, add this to the calculated expected runoff volume and ÷ the sum by 24 (see section 3.2.2). Take this new number and make the necessary change in the **FLOW MODULE VOLUME** screen in the extended programming mode.
- Replace the sampler cover and lower it into the manhole using the sampler insertion tool.
- Before you leave the location be sure to fill out the appropriate fields on Stormwater Field Information sheet.
- Replace manhole lid and proceed to the next sampling location.

Post Sampling
At the end of the sampling event a team of two will be responsible for removing the sampling unit. The following equipment will be needed:
- Chain of Custody Forms (COC)
- Stormwater Field Data Sheet
- Cooler for bottles and bottle lids
- Tubing cooler
- Modified sampler insertion tool

Carefully pull the sampler from the manhole using sampler insertion tool, trying to keep it as level as possible so as not to spill any sample. Put the lid on the composite bottle and put in cooler (with several ice packs) to be taken to Willow Lake. Screw cap onto AV cable and secure in manhole. Remove all tubing (suction line and pump tubing), put in plastic bag and put it in tubing cooler to be acid washed at lab, and load sampler into van. Check to ensure all necessary fields have been filled out on the Stormwater Field Information Sheets. When you are done with all three sites, the composite samples will need to be transported immediately to the lab in the stormwater cooler with the appropriate COC sheets.

3.4 Stormwater Field and Grab Sampling Procedures

Grab samples and field measurements will be collected at the beginning of each wet-weather event from the same three stormwater manholes that house the automated samplers. Field measurements will document temperature, specific conductivity, DO, and pH. An E. coli grab sample will be collected for analysis at the lab.

General Grab Procedures
1. Fill in Date/Time on the appropriate Chain of Custody form.
2. Label the glass BACTERIOLOGICAL bottle with date, time, location, and sampler name.
3. Tie rope to the stainless steel sampling bucket and with gloved hands peel the protective foil covering off. Rinse sampling bucket three times with stormwater from the manhole then take a sample directly from manhole.
4. Fill the labeled glass BACTERIOLOGICAL bottle only to the shoulder, replace the foil covered cap, and return to the sample cooler.

Field Measured Temperature, Specific Conductivity, DO & pH
1. Pour small amount of sample into clean calibration cup and screw cup onto the In-Situ Troll 9500 datasonde and shake to rinse. Repeat this process 3 times.
2. Pour sample up to blue dashed line in calibration cup and screw on to the In-Situ Troll 9500 datasonde.
3. Turn the datasonde on and go to Profiler (see "Mulit-Parameter Troll 9500 Instrument Manual" for directions) and allow the sensors to stabilize (up to 5 minutes for pH).
4. Write down the readings for pH, specifc conductivity, and temperature on the chain of custody form and Stormwater Field Data Sheet.
5. Fill the stainless steel beaker with water and place the YSI ProODO sensor in it. Wait until the temperature and DO readings have stabilized and then take your reading and record this information on the Stormwater Field Data Sheet.

Note:
- The temperature sensors are high up on the YSI probes, so when taking a reading make sure the entire probe is submerged.

3.5 Flowlink Software

Once the portable samplers are back in Building 36, the internal data from the sampler will need to be downloaded using the ISCO 581 Rapid Transfer Device. These data will then be imported into the flowlink software client. A storm report for each site will need to be produced. This report will include a chart of level, velocity, cfs, and cf for the entire length of the storm. In addition, the sample events will need to be placed in the cf chart. A sample of the final output is below. Refer to the Flowlink manual for further detail on producing the report.
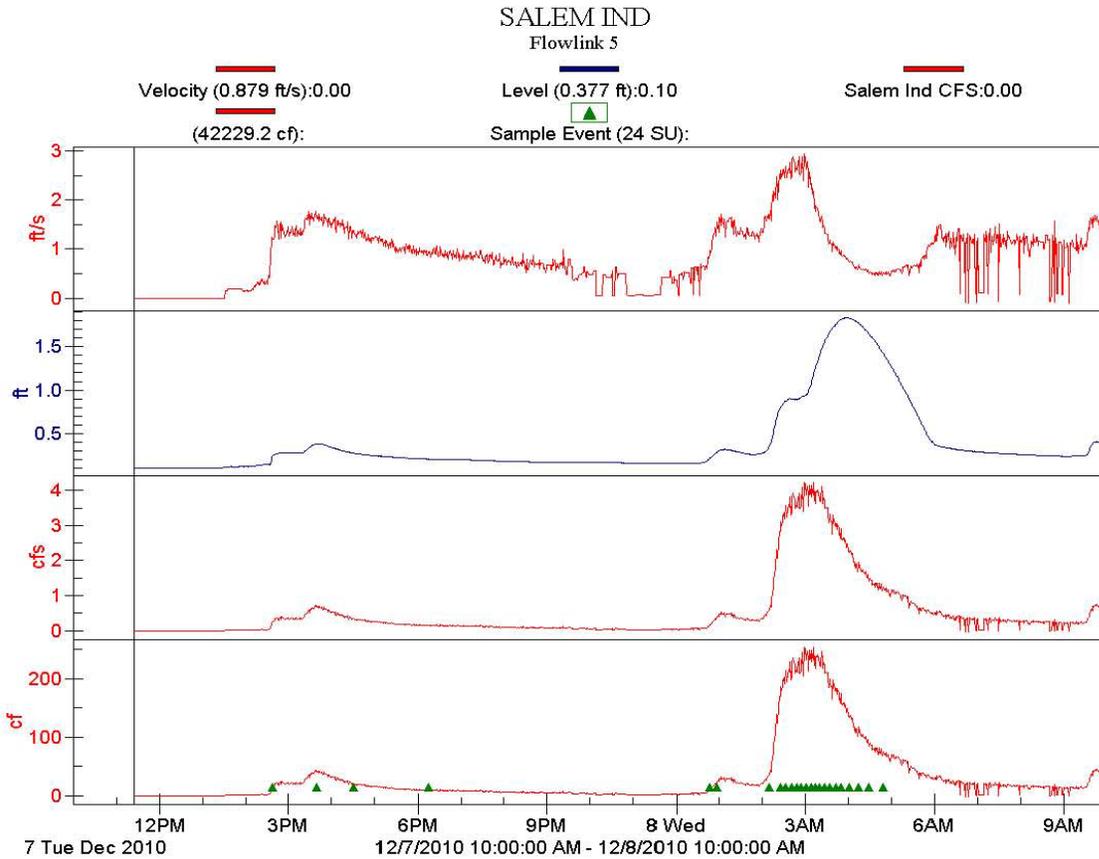
4.0 Instream Storm Sampling

4.1.1 Storm Criteria

The storm criteria for instream storm sampling are detailed below:
- A storm event must be greater than 0.1 inches of rainfall
- Minimum of 50 percent of sample events must be collected between October 1 and April 30.
- Sample events must occur at a minimum of 14 days apart

4.1.2 Instream Storm Locations and Parameters

Instream storm sampling will be performed at the lower Clark Creek Continuous Monitoring Station **(CLK1)** as well as at the upper and lower Monitoring Stations on Pringle Creek **(PRI3 & PRI12)**. These three sites will be sampled at least five times every year for a total of 25 times within the permit cycle.

Table 4. Summary of Instream Monitoring Locations

Monitoring Locations	Monitored Stream	Monitoring Events	Suction Line Length
PRI3	Lower Pringle	5/year or 25/permit cycle	32 ft
PRI12	Upper Pringle	5/year or 25/permit cycle	19.5 ft
CLK1	Lower Clark	5/year or 25/permit cycle	24 ft

Table 5. Instream Parameters

Pollutant Parameter	Collection Method
TSS	Composite
Biochemical Oxygen Demand ('stream')	Composite
Total Phosphorus	Composite
Nitrate+Nitrite as Nitrogen	Composite
Ammonia Nitrogen	Composite
Copper (Total & Dissolved)	Composite
Lead (Total & Dissolved)	Composite
Zinc (Total & Dissolved)	Composite
Hardness	Composite
Sp. Conductivity	Composite & Field
Temperature	Field
pH	Field
Dissolved Oxygen	Field
E. coli	Grab

4.2 Targeted Instream Sampling Preparation

Same as 3.2

4.2.1 List of Needed Materials

Same as 3.2.1, with the following exceptions:
- Use 3700 sampler instead of a 6712 sampler
- One Nickel Cadmium battery for CLK1 site (fully charged >13.5 v)
- Grab cooler will contain one bottle for DO and fixing agents for Winkler Titration.

4.2.2 Estimating Volume and finding the FIQ

To determining the estimated volume during the storm and subsequent FIQ, a flow volume calculator template has been developed for each station. They can be found at:

S:\SHARED\Storm Drain\PROJECTS\Stream Monitoring Stations\Sampling\sampling 3rd permit\runoff calculations\FIQ\volume instream.xlsx
Note: The same basic premise applies to instream storm estimates of total volume and finding the FIQ as applied to the stormwater estimating volume and finding FIQ covered under 3.2.2.

4.2.3 ISCO 3700 Sampler Setup

- Install the acid washed pump tubing
- Plug in a fully charged Nickel -Cadmium battery into the programming unit (for programming and calibration of sampler).
- Calibrate sampler:
    8. Push Enter/Program key
    9. Select **PROGRAM**
    10. Step thru the program until you get to **CALIBRATE SAMPLER?** Select **YES**
    11. Perch top half of sampler on edge of a table so pump tubing hangs free. Put end of suction line into a gallon of DI water. Hold container under pump tubing without touching.
    12. Press the Manual Sample key (on keypad) when you are ready.
    13. Sampler will purge suction line, pump the set volume of water, and then purge suction line
    14. Using the 100 mL graduated cylinder, measure out the volume delivered and enter that number in the next screen
    15. If the volume received was off, press **YES** to calibrate again. When you are satisified with the amount select **NO**

- Place the 2.5 gallon nalgene composite bottle (acid washed) in the base of the 3700 sampler, off to one side so that it lines up with where the pump tubing comes down into the base and into the composite bottle. While the lid is still on, place ice packs around the bottle to hold it in place and keep samples chilled. Remove lid, place in the instream cooler.
- Replace the upper half of the sampler unit while guiding the pump tubing into the top of the bottle.

4.2.4 ISCO 3700 Sampler Programming Instructions

Configuration

The configure settings will remain constant as long as the designated sampler for the given site remains the same. However, it is critical to check that the following set up is correct.

- Turn on sampler and press "Enter/Program" key
- Use right arrow to move and select "Configure"
- 1st Screen: Make sure the clock is set correctly
- 2nd Screen: Bottles and sizes
    - sub screen: "Portable"
    - sub screen: "1 bottle"
    - sub screen: "10,000 mls"
- 3rd Screen: Suction line
    - sub screen "3/8 inch"
    - sub screen "vinyl"
    - suction line length
        - PRI12   19.5 ft
        - PRI3   32 ft
        - CLK1   24 ft
- 4th Screen: Liquid Detector
    - sub screen "enable"
- 5th Screen: Rinse Cycles "1"
- 6th Screen: Enter Head Manually "NO"
- 7th Screen: Retry up to "1" times
- 8th Screen: Programming Mode
    - sub screen: "Basic"
- 9th Screen: Calibrate sampler
    - sub screen: "disable"
- 10th Screen: Start time delay
    - sub screen: select "0 minute delay to start"
- 11th Screen: Enable pin
    - sub screen: master slave mode? "NO"
    - sub screen: sample upon disable? "NO"
    - sub screen: sample upon enable? "NO"
    - sub screen: reset sample interval? "NO"
    - sub screen: inhibit countdown? "NO"
- 12th Screen: Event mark
    - sub screen: select "pulse"
    - sub screen: At the beginning of: "purge"
- 13th Screen: ___purge counts
    - sub screen: pre sample counts (at least 150 for all sites)
    - sub screen: _____ post sample counts
        - Unit calculates this value based on diameter and length of suction line. However, you can check the accuracy by pumping water up the line (pump forward button) to the pump and then back out the

line (pump reverse button). Once bubbling occurs at the end of the suction line push the STOP button and a "counts" number will be displayed. Compare this number with the default number on this screen. If needed change the post sample purge to this number.

- 14th Screen: Tubing life
    - sub screen: make sure counts < 500,000 (if past 500,00 0 replace pump tubing)
    - sub screen: Reset pump counter "NO" (UNLESS the pump tubing was just replaced)
    - sub screen: 500,000 pump counts to warning
- 15th Screen: Program Lock "Disable"
- 16th Screen: Sampler ID
    - sub screen: skip this and move to next
- 17th Screen: Run Diagnostics press "ENTER" and sampler will run through test
- 18th Screen: Test Distributor Arm: NO
- 19th Screen: Reinitialize = "NO"
- Exit Configuration

Program

The program will need to be set up for each sampling event

- Turn on sampler, push Enter/Program key and select "Program"
- 1st Screen: select "Flow"
- 2nd Screen: sample every "1" pulse
- 3rd Screen: 24 composite samples
- 4th Screen: sample volumes of "375 mls"
- 5th Screen: enter start time "NO"
- Program is now complete. To start program hit the "Start Sampling" button, the screen should read "Sample 1 of 24 after 1 pulse"

4.3 Collecting Flow-Weighted Instream Samples

Site Setup and Installation

Before installing the programmed ISCO 3700 sampler, make sure that the FIQ for each station is reading "NAN" on the RTMC station status screen. The FIQ number will need to be entered into the RTMC station status screen for each station at the start of the storm.

Composite sampler setup procedures require a team of two people. The list of required equipment includes:

- Pre-programmed ISCO 3700 Sampler with fully charged (>13.5 v) battery (for CLK1 only), acid washed 2.5 gallon composite bottle, acid washed pump tubing and acid washed vinyl suction line tubing
- Instream (Storm Only) Field Data Sheet

Once all of the equipment is assembled the instructions below should be followed to complete the installation process.

- Connect the suction line to the tubing coupler
- Turn the sampling unit on and verify that the programming is complete and ready to collect flow based samples.
- Replace the sampler cover and lower it into the vault.
- At the station Measurement and Control Unit (MCU) and make sure that the fuses are all closed and sampling switches are set to **FLOW**, **ENABLE**, and, if applicable, power is **ON**.
- Fill out appropriate fields in the Instream (Storm Only) Field Data Sheet
- Close vault lid and proceed to the next sampling location.

AT THE START OF THE STORM

Once the rainfall has started, the predetermined FIQ will need to be entered on the RTMC station status screen for each site. The samplers will begin the program once the FIQ number has been entered.

Note: The Continuous Monitoring Stations have been configured to communicate with the ISCO 3700 Portable Sampling Units via a 4-20 amp pulse. This pulse is generated within the Monitoring Station MCU when a pre-determined threshold (FIQ) has been breached. This pulse is then sent directly to the portable sampling unit to trigger sample collection.

Post Sampling

At the end of the sampling event a team of two will be responsible for removing the sampling unit by reversing the procedures listed above. The following equipment will be needed:

- Chain of Custody Forms
- Instream (with lids inside) and tubing coolers
- Instream (Storm Only) Field Information Sheets

Once all of the equipment has been removed and field sheets filled out, the composite samples should be transported to the lab with the appropriate COC sheets. In addition, pump tubing and suction line tubing needs to be left at Willow Lake for acid washing.

Once the samplers are in Building 36 the date and time of each collected sample will need to be transcribed from the report.
- Select Display Status on Keypad
- Use arrows to select review
- Use arrows to select results
- Use arrows and enter/program key to scroll thru results
In addition, any errors that may have occurred during the event will be recorded.

4.4 Instream Storm Field and Grab Sampling Procedures

Field measurements and grab samples will be collected at each of the targeted instream monitoring locations. Field measurements will be taken of Temperature, pH, Specific Conductivity, and Dissolved Oxygen. Additionally, an E. coli grab sample will be collected for analysis at the lab.

Note:
- Procedures are the same as the stormwater field and grab sampling procedures see section 3.4. In addition, from one site grab a sample in the DO bottle and follow the instructions included in the kit for fixing the sample. This sample will be taken to Willow Lake with the grab samples and a Winkler Titration will be performed.

5.0 Instrument Maintenance

5.1 Field Meters

All field meters need to be rinsed with DI water before calibration checks, sample readings, and prior to storage. Once sampling is complete, remove the In-Situ Troll 9500 pH sensor and place in pH 7 buffer. If using YSI 60 or 85 in place of the sonde, the YSI 60 pH probe should be placed in the storage solution if the interval between use is greater than one week. The YSI 85 can be stored in the instrument storage chamber indefinitely. The YSI Pro ODO can be left in the gray storage sleeve with a moist sponge for up to a month. If you are going to leave it longer use the red cap it was shipped in with a moist sponge.

The field meters are relatively maintenance free as long as they are kept clean. The Operations Manuals for the In-Situ Troll 9500 Multi-Parameter Datasonde, YSI 60, YSI 85, and YSI Pro ODO can be referenced for a detailed discussion of routine maintenance checks or troubleshooting measures.

5.2 Portable Sampling Equipment

The portable sampling units should be rinsed out and wiped down after each sampling event.

Sampler bottles, pump tubing and new suction line tubing will need to be left at Willow Lake for acid washing after each event.

Check internal desiccants on samplers – if 301 area is pink or white, replace. Check desiccants on 750 flow module, if pink coloration is observed, replace desiccants.

6.0   Data and Records Management

Chain of Custody forms will be completed for each sampling location during each storm event. Sampling personnel will be responsible for photocopying any chain of custody forms handed over to the Willow Lake Laboratory.

Field data sheets will be completed for each sampling location during each storm event. It will be up to the Project Manager to ensure that all appropriate fields are completed on this sheet.

All sampling reports generated by the portable sampling units, water quality results from the Willow Lake Laboratory, and QA/QC documentation will be stored online under S:\SHARED\Storm Drain\PROJECTS\Stream Monitoring Stations\Sampling\sampling 3rd permit and in hard copy. All information will be grouped and organized by location and by the date of the sampling event. It is the responsibility of the Project Manager to ensure that this information is in order and easily accessible.

7.0   Quality Assurance/Quality Control

7.1 Field QA/QC Procedures

Calibration checks will be completed on all field meters prior to each sampling event to ensure instrument accuracy. Instrument precision will be checked prior to each sampling event by documenting five consecutive measurements in tap water, pH buffer, or conductivity solution.

Equipment blanks will be completed on a portable sampling unit at the beginning of each sampling season. These blanks will be taken at Willow Lake Laboratory where they will be analyzed for the entire suite of stormwater and instream pollutant parameters.

Hard copies of all QA/QC records will be organized by sampling season and kept on file for a minimum of 3 years.

Table 6 below lists the data quality objectives established by the DEQ for "A" and "B" level data as presented in the DEQ Data Quality Matrix. Grade "A" data quality level is the target for all field parameters.

Table 6. Field Parameter Data Quality Objectives

Parameter	Accuracy	Precision	Data Quality Level
Temperature	$\leq \pm$ 0.5 ºC	$\leq \pm$ 0.5 ºC	A
pH	$\leq \pm$ 0.2 S.U	$\leq \pm$ 0.3 S.U	A
Specific Conductivity	$\leq \pm$ 7%	$\leq \pm$ 10%	A
Dissolved Oxygen	$\leq \pm$ 0.2 mg/L	$\leq \pm$ 0.3 mg/L	A

7.2 Laboratory QA/QC Procedures

The Willow Lake Water Pollution Control Facility Laboratory is accredited by the National Environmental Laboratory Accreditation Program. All chemical analysis will be performed following EPA approved methods identified in 40 CFR 136. For more information on laboratory procedures please reference "Willow Lake Laboratory Quality Manual (2010)". A list of methods and handling requirements for each parameter is provided in Table 7.

Table 7. Analytical Parameters for Stormwater and Instream Monitoring

Parameter	Volume	Container	Holding Time	Analytical Method	Reporting Limit (LOQ)[3]
Biochemical Oxygen Demand	1000 ml	plastic	6 hr	SM5210-B	2 mg/l
TSS	1000 ml	Plastic	7 days	SM2540-D	1 mg/l
Hardness	100 ml	Plastic	6 mo	SM2340-C	5 mg/l
Cu (Total & Dissolved)	1 liter	**plastic (acid rinsed)**	6 mo	EPA 200.7	.0025 mg/l
Pb (Total & Dissolved)				SM3113-B	.0005 mg/l
Zn (Total & Dissolved)				EPA 200.7	.0025 mg/l
Ammonia Nitrogen (NH_3-N)	500 ml	Plastic	7 days	SM4500 NH3-F	0.1 mg/l
Nitrate-Nitrite Nitrogen (NO_3-NO_2-N)	100 ml	Plastic	48 hrs (28 days acidified)	SM4500 NO3-F	0.05 mg/l
Total Phosphorus (TP)	500 ml	Plastic	28 days	SM4500 PO4-B,E	0.01 mg/l
Dissolved Ortho-Phosphorus (O-PO4-P)	500 ml	Plastic	48 hrs	SM4500 PO4-E	0.01 mg/l
E. coli	250 ml	Glass, sterile	6 hrs	SM9223B	1 E.coli/100ml

NOTE: All parameters (except E. Coli) will be collected using four one gallon acid washed glass jars in a composite sampler, brought to the lab, composited, and then placed into the corresponding containers above.

Apendix 1

Portable Sampler Tech Notes

When you press the STOP key while a program is running the sampler records a "Manual Pause" in the sample event log. In the Manual Paused state the Manual Paused Screen shows **STOP PROGRAM**, **RESUME PROGRAM**, **VIEW DATA**, and **GRAB SAMPLE** options. Selecting **STOP PROGRAM** records program stopped as the last event in memory. Selecting **RESUME PROGRAM** exits the manual paused state, returns the sampler to normal program operation, and records a manual resume event in the sample event log. While in manual paused state, the sampling program continues to operate as normal, with the exception of taking samples. After stopping a program using **STOP** PROGRAM be sure to collect sampling data before running the program again since all stored sampling data will be erased.

As soon as you select one of the report options from the View menu, the sampler advances automatically through the report. Stop the automatic displays by pressing the Stop key once. Then, use the arrow keys to move manually through the report. Return to the main menu by pressing Stop twice. At the end of the report, the last item is displayed until you press an arrow key, Stop key to return to the main menu, or Enter to start the automatic displays again.

Calibrate sample volumes when a new pump tube is installed. Run the pump for five minutes before calibrating and use a graduated cylinder for Vol. measurements. Following calibration, the previous calibration settings are replaced when the sampler is reinitialized.

Always reset the pump tube counter after replacing a pump tube. Check the current pump tube count using **OTHER FUNCTIONS** from the main menu then select **MAINTENANCE** > **PUMP TUBE ALARM**.

ISCO Reports

As soon as you select one of the report options from the View menu, the sampler advances automatically through the report. Stop the automatic displays by pressing the Stop key once. Then, use the arrow keys to move manually through the report. Return to the main menu by pressing Stop twice. At the end of the report, the last item is displayed until you press an arrow key, Stop key to return to the main menu, or Enter to start the automatic displays again.

The Configure Report Option allows you to specify which of the Sampling Reports will be included in any output request. SAMPLINK REPORT provides sampling reports only. FLOWLINK REPORT provides sampling reports and detailed partition data. CUSTOM REPORT allows you to specify which reports and data are available as an output. ALL REPORTS provides every available report and detailed partition data.

ISCO 6712 Programming-Other Functions

MAINTENANCE (Available in STANDARD and EXTENDED programming)
Be sure internal clock and time are set correctly in **MAINTENANCE** > **SET CLOCK**.

SOFTWARE OPTIONS (Only available in EXTENDED programming)

1. Confirm that **LIQUID DETECT** = **ON**
2. **DATA MEASUREMENT INTERVAL** is then set. Available Data Measurement Intervals are: 5 Sec., 15 Sec., 30 Sec., 1 Min., 2 Min., 5 Min., or Data Storage Interval. Set to the **STORAGE INTERVAL**.
3. **DUAL SAMPLER** = **OFF**
4. **BTL FULL DETECT** = **OFF**
5. Confirm that **TIMED BACKLIGHT** is selected.
6. Confirm that **EVENT MARK SENT DURING PUMP CYCLE** is selected and that Event Marks are sent for **EVERY SAMPLE** at a duration = **WHILE PUMPING** and **DURING: ENTIRE PUMP CYCLE**.
7. **PUMP COUNTS FOR EACH PURGE CYCLE**: Set **PRE-SAMPLE** purging between 10 – 9999, depending on what it takes to fully purge the suction line. Test by using the Pump Reverse key or Pump Forward keys on the keypad or by selecting **OTHER FUNCTIONS** > **MANUAL FUNCTIONS** > **OPERATE PUMP** then **PUMP FORWARD** and **PUMP REVERSE.** The number of pump cycles performed will be displayed when the Stop key is pressed allowing you to determine the minimum number of pump cycles to fill and purge the line. Set post sample purge to **AUTO POST-SAMPLE**, **DEPENDENT ON HEAD**.
8. Select **NO PERIODIC SERIAL OUTPUT**
9. Select **INTERROGATOR CONNECTOR POWER ALWAYS ON**.

Table 3-1 About the Keypad

Key	Name	Function
⏻	Standby	Turns sampler on or off.
⬡	Stop	Stops the pump or distributor. Pauses a running sampling program. In programming screens, returns to a previous screen.
←	Enter	Accepts a menu choice or number entry and goes to next screen.
?	Help	In programming screens, displays a brief help message.
▸▸	Down-Right Arrow	Selects the menu option right or below the current choice.
◂▴	Up-Left Arrow	Selects the menu option left or above the current choice.
0	Numbers	Types a number.
.	Decimal Point	Types a decimal point.
1	Pump Reverse	Press when at the main menu to run the pump in reverse.
3	Pump Forward	Press when at the main menu to run the pump forward.