

Porewater Sampling Protocol

1 Objective

The objective of this work is to examine the vertical and spatial heterogeneity of porewater conductivity and temperature in areas surrounding the Turkey Point Plant (TPP) including areas such as the Model Land Marsh and the subtidal areas of Biscayne Bay, to determine if there is any Cooling Canal System (CCS) impact on the flora and fauna around the area. This porewater survey is a screening process to determine if there is any warm hypersaline water observed in the areas surrounding the TPP, and to identify areas for CCS tracer suite analyses. Results from these surveys will identify potential zones of CCS water connectivity with surface sediments and soils via seepage and groundwater pathways, providing information on potential influence of the CCS on the surrounding biota.

2 Methods and Materials

Specific conductance and temperature profiles (at 20 cm intervals to 60 cm or refusal) will be measured in-situ, using field meter and probes at 104 points in the wetlands, both freshwater and saline, and at 100 points in Biscayne Bay and Card Sound. The boundaries of the surveyed wetlands shall be as far west as Tallahassee Road and Card Sound Road, as far north as the Florida City Canal and south to Card Point, and east to the estuarine shoreline. The boundaries of estuarine porewater surveys shall be as far east as 4 km offshore from the Biscayne Bay and Card Sound shoreline between the Mowry Canal and Card Sound Road (Figure 1).

The survey will be conducted in the marsh, mangrove and Biscayne Bay areas during the dry season, but only in Biscayne Bay during the wet season. The sites are approximately evenly distributed (i.e., grid) across the landscape, but will also focus on areas of ecological interest (i.e., landscape features such as tree islands, remnant creeks, areas where groundwater input is suspected, etc.) (Figure 1).

2.1 Proposed Locations

For this initial porewater survey effort, a total of 204 sampling points are proposed: 104 locations in the marsh and mangroves, and 100 locations in Biscayne Bay (Figure 1, Table 1). The proposed locations for the grid effort are shown in Figure 2 and Table 2 while areas of ecological interest are shown in Figure 3 and Table 3.

The porewater grid locations were selected based on property maps (i.e., locations had to be located on Florida Power and Light Company [FPL], South Florida Water Management District [SFWMD], or Miami-Dade County Department of Environmental Resources Management

[DERM] property) and where possible, were located in the center of the grid cells. The points will be labeled based on cell location (e.g., A2, B3, etc.); in Biscayne Bay where the density of sampling points is higher nearshore, points on the gridlines will be named with two grid cell letters (e.g., GH1, HI1, IJ3, etc.) (Figure 2). The areas of ecological interest are labeled based on their habitats, i.e., W = marsh, BB = Biscayne Bay, and M = mangrove (Figure 3).

Table 1. Breakdown of the distribution of proposed survey points in the terrestrial (marsh and mangrove) and Biscayne Bay subtidal habitats.

Sampling Distribution	Marsh & Mangrove	Biscayne Bay
Grid points (1 site/point)	68	82
Areas of ecological interest (2 sites/point)	18 sites x 2	9 sites x 2
Total	104	100

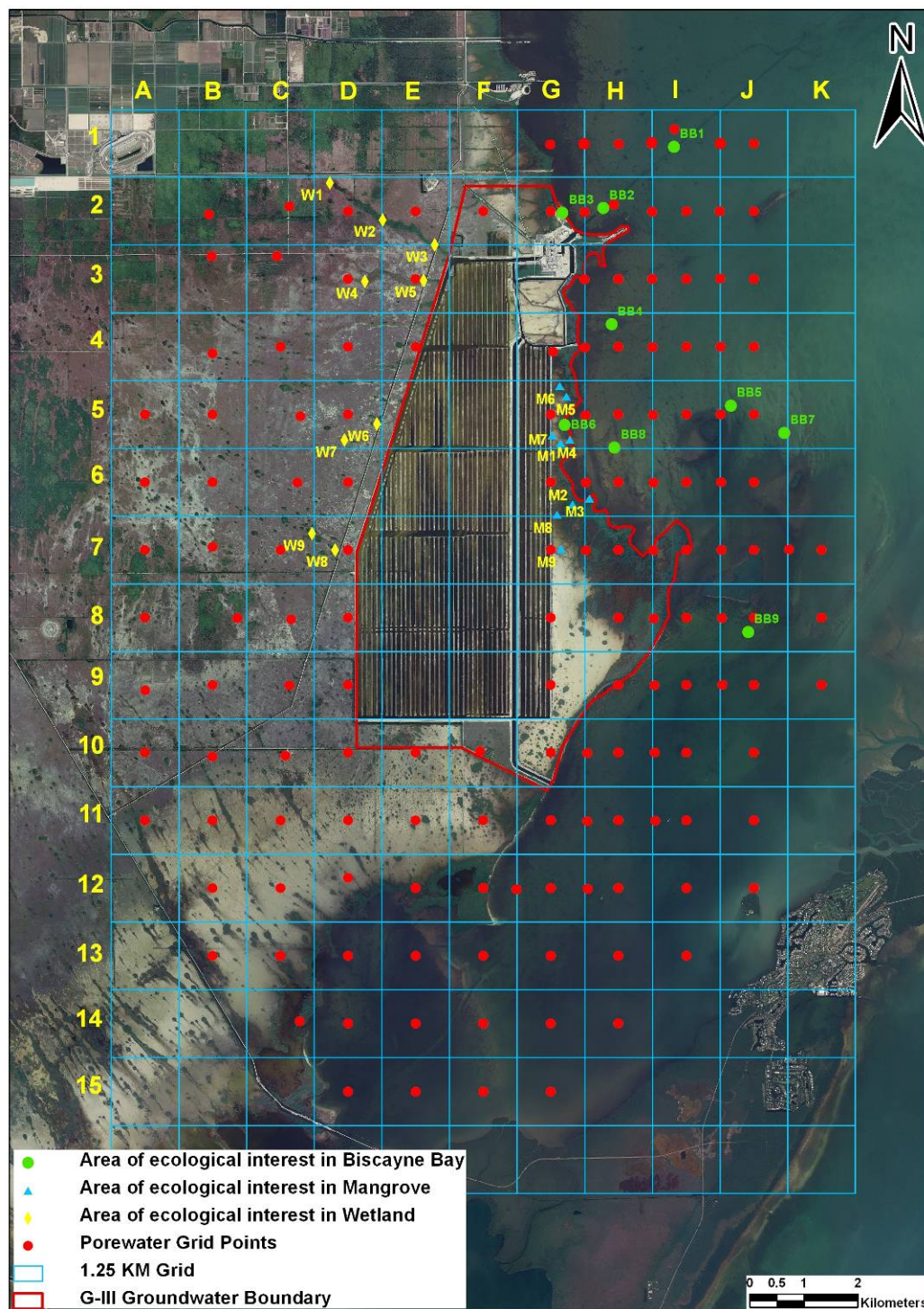


Figure 1. Proposed sampling sites for the porewater grid points and areas of ecological interest.
The red line surrounding the CCS is the FPL G-III boundary.

Table 2. Coordinate locations of all porewater grid survey sites (in decimal degree units). The letters correspond to the column headers in Figure 2 while the numbers correspond to the rows. Locations in *italics* are of low priority and may be substituted for features of interest if any are observed during sampling.

Location Name	Latitude	Longitude
A5	25.40817	-80.40585
A6	25.39688	-80.40591
A7	25.38560	-80.40596
A8	25.37431	-80.40602
A9	25.36214	-80.40605
A10	25.35175	-80.40613
A11	25.34046	-80.40618
B2	25.44144	-80.39396
B3	25.43445	-80.39348
B4	25.41827	-80.39339
B5	25.40811	-80.39343
B6	25.39683	-80.39349
B7	25.38610	-80.39357
B8	25.37419	-80.38905
B9	25.36298	-80.39365
B10	25.35102	-80.39371
B11	25.34041	-80.39377
B12	25.32913	-80.39382
B13	25.31784	-80.39388
C2	25.44270	-80.37914
C3	25.43442	-80.38147
C4	25.41935	-80.38095
C5	25.40775	-80.37728
C6	25.39667	-80.37795
C7	25.38550	-80.38112
C8	25.37392	-80.37918
C9	25.36283	-80.37953
C10	25.35112	-80.38033
C11	25.34036	-80.38135
C12	25.32908	-80.38141
C13	25.31779	-80.38146
C14	25.30687	-80.37800
D2	25.44186	-80.36841
D3	25.43058	-80.36846
D4	25.41929	-80.36852
D5	25.40801	-80.36858
D6	25.39673	-80.36864
D7	25.38544	-80.36870
D8	25.37416	-80.36876
D9	25.36288	-80.36882

Location Name	Latitude	Longitude
D10	25.35159	-80.36887
D11	25.34031	-80.36893
D12	25.33076	-80.36896
D13	25.31774	-80.36905
D14	25.30646	-80.36911
D15	25.29517	-80.36917
E2	25.44181	-80.35598
E3	25.43052	-80.35604
E4	25.41924	-80.35610
E10	25.35154	-80.35646
E11	25.34025	-80.35652
E12	25.32897	-80.35658
E13	25.31769	-80.35664
E14	25.30640	-80.35670
E15	25.29512	-80.35676
F2	25.44175	-80.34355
F10	25.35173	-80.34458
F11	25.34020	-80.34410
F12	25.32892	-80.34416
F13	25.31763	-80.34422
F14	25.30635	-80.34428
F15	25.29506	-80.34434
<i>FG12</i>	<i>25.32869</i>	<i>-80.33807</i>
G1	25.45278	-80.33113
G2	25.44170	-80.33112
G4	25.41827	-80.33087
G5	25.40785	-80.33131
G6	25.39656	-80.33137
G7	25.38528	-80.33144
G8	25.37399	-80.33150
G9	25.36271	-80.33156
G10	25.35143	-80.33162
G11	25.34014	-80.33168
G12	25.32886	-80.33175
G13	25.31758	-80.33181
G14	25.30629	-80.33187
G15	25.29501	-80.33193
GH1	25.45278	-80.32499
GH2	25.44152	-80.32497
GH3	25.43030	-80.32497

Table 2. Continued.

Location Name	Latitude	Longitude
GH4	25.41895	-80.32497
GH5	25.40767	-80.32497
GH6	25.39645	-80.32497
GH7	25.38516	-80.32497
GH10	25.35131	-80.32497
GH11	25.33997	-80.32497
GH12	25.32869	-80.32497
H1	25.45278	-80.31858
H2	25.44272	-80.31950
H3	25.43035	-80.31876
H4	25.41907	-80.31882
H5	25.40779	-80.31889
H6	25.39650	-80.31895
H7	25.38522	-80.31901
H8	25.37394	-80.31908
H9	25.36265	-80.31914
H10	25.35137	-80.31920
H11	25.34009	-80.31927
H12	25.32880	-80.31933
H13	25.31752	-80.31939
H14	25.30624	-80.31946
HI1	25.45278	-80.31253
HI2	25.44152	-80.31256
HI3	25.43030	-80.31256
HI4	25.41895	-80.31256
HI5	25.40767	-80.31256
HI6	25.39645	-80.31256
HI7	25.38516	-80.31256
HI8	25.37382	-80.31256
HI9	25.36254	-80.31256
HI10	25.35131	-80.31256
HI11	25.33997	-80.31256
I1	25.45523	-80.30835
I2	25.44158	-80.30627
I3	25.43030	-80.30634
I4	25.41901	-80.30640
I5	25.40773	-80.30646

Location Name	Latitude	Longitude
I6	25.39645	-80.30653
I7	25.38516	-80.30659
I8	25.37388	-80.30666
I9	25.36260	-80.30672
I10	25.35131	-80.30679
I11	25.34003	-80.30685
I12	25.32875	-80.30692
I13	25.31746	-80.30698
IJ1	25.45278	-80.29988
IJ2	25.44152	-80.30011
IJ3	25.43030	-80.30011
IJ4	25.41895	-80.30011
IJ5	25.40767	-80.30011
IJ6	25.39645	-80.30011
IJ7	25.38516	-80.30011
IJ8	25.37382	-80.30011
IJ9	25.36254	-80.30011
J1	25.45278	-80.29375
J2	25.44152	-80.29384
J3	25.43024	-80.29391
J4	25.41895	-80.29398
J5	25.40767	-80.29404
J6	25.39639	-80.29411
J7	25.38510	-80.29417
J8	25.37382	-80.29424
J9	25.36254	-80.29430
J10	25.35125	-80.29437
J11	25.33997	-80.29443
J12	25.32869	-80.29450
JK7	25.38516	-80.28767
K7	25.38504	-80.28175
K8	25.37376	-80.28182
K9	25.36248	-80.28188



Figure 2. Proposed porewater grid locations. The sites are labeled based on their column and row (i.e. A5, IJ1, etc.) locations within the grid. The red line surrounding the CCS is the FPL G-III boundary.

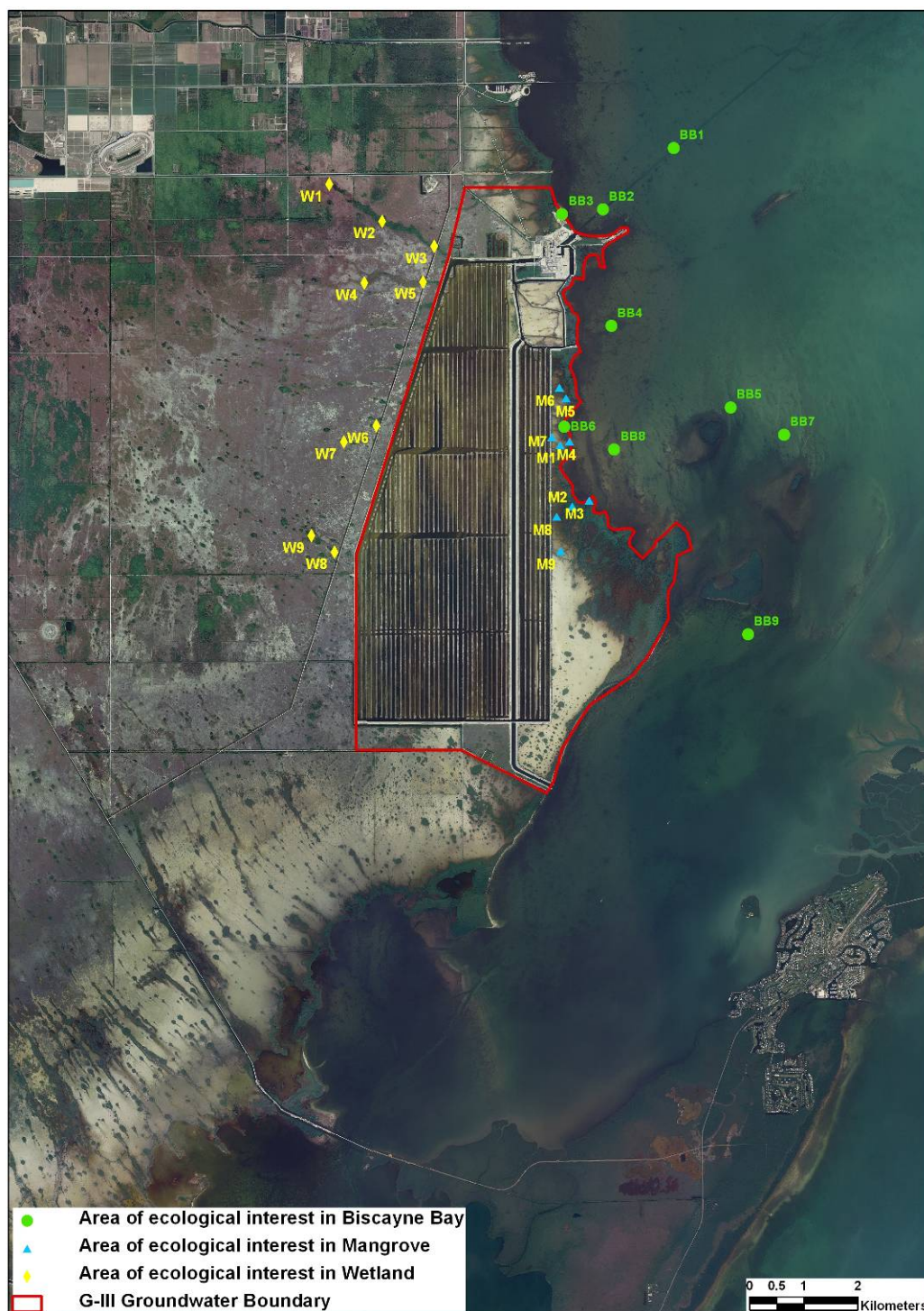


Figure 3. Areas of ecological interest selected for sampling. Freshwater wetland sites (W) are shown in yellow diamonds, mangrove sites (M) are indicated in blue triangles and Biscayne Bay (BB) sites are shown in green circles. The red line surrounding the CCS is the FPL G-III boundary.

Table 3. Coordinate locations of all proposed areas of ecological interest (in decimal degree units). Location names are based on their locations i.e., W = marsh, M = mangrove, and BB = Biscayne Bay.

Location Name	Latitude	Longitude
W1	25.44659	-80.37166
W2	25.44041	-80.36199
W3	25.43618	-80.35248
W4	25.43013	-80.36531
W5	25.43030	-80.35452
W6	25.40639	-80.36326
W7	25.40377	-80.36923
W8	25.38549	-80.37101
W9	25.38821	-80.37526
M1	25.40305	-80.32953
M2	25.39281	-80.32744
M3	25.39378	-80.32433
M4	25.40358	-80.32788
M5	25.41080	-80.32842
M6	25.41260	-80.32965
M7	25.40436	-80.33107
M8	25.39112	-80.33028
M9	25.38541	-80.32960

Location Name	Latitude	Longitude
BB1	25.45225	-80.30847
BB2	25.44212	-80.32148
BB3	25.44138	-80.32900
BB4	25.42275	-80.32005
BB5	25.40912	-80.29824
BB6	25.40606	-80.32877
BB7	25.40453	-80.28849
BB8	25.40226	-80.31966
BB9	25.37144	-80.29527

2.2. Survey Procedures

Sampling sites in the terrestrial areas will be identified using a global positioning system (GPS) unit set to North American Datum 1983 (NAD83) datum with < 3 meters (m) accuracy, while the marine locations will be identified with a GPS of submeter accuracy (e.g., Trimble GeoXT). Data will be recorded in decimal degrees.

2.2.1 Sampling design

One site will be sampled at each grid location while two sites will be sampled in each area of ecological interest.

2.2.1.1 Grid sampling locations

Each grid location site will be as close to the point shown in Table 2, allowing for safety and access constraints. Sediment depth to 60 centimeters (cm) will be probed with a stainless steel metal rod. In the event that initial sediment depth measurements are taken and the depth rod is

rejected at less than 60 cm depth, two additional attempts to find a location with a minimum depth of 60 cm will be made within a 5 m radius of the original survey coordinate location. If a new site is found, the coordinate locations will be recorded and porewater survey data will be collected as described in Figure 4.

If after three attempts, a depth of 60 cm cannot be reached, then readings at 20 cm and/or at 40 cm depths will be obtained if conditions allow. If the site conditions do not allow for readings of any depth of 20 cm, 40 cm, and 60 cm, and three attempts have been made to find a location, then site conditions and coordinate location will be recorded. The field team will then move on to the next site to continue the porewater survey. In the event that site conditions do not allow for readings of any depth of 20 cm, 40 cm, and 60 cm, but there are fractures/fissures present, samples shall be collected from these features at the specified depths to the degree physically possible. Field notes and the tables shall include notes of this sampling method when employed.

	Time: _____		Surveyor: _____ Date/Time: _____
Arrival	_____		
Departure	_____		
Site/Grid: _____	Original selected site: <u>Yes/No</u>	Equipment serial number: _____	
GPS cords: _____			
Water depth (m): _____	Tidal condition	Rising/falling; hours to high/low	
Air temp (°C): _____	Water temp (°C): _____		
For Bay Samples:	Bottom temp (°C): _____	Bottom spec. Cond. _____	
	Aqua TROLL 100		
Depth (cm)	Spec. Cond.	Temperature (°C)	Temp measured in-situ (°C):
20	_____	_____	_____
40	_____	_____	_____
60	_____	_____	_____
Notes: _____			
Ecological observations of note: _____			

Figure 4. Proposed layout of datasheet for porewater survey at each site. Information to be added is underline/marked in red. Standing surface water temperature will also be recorded where applicable. Daily information such as calibration information, probe type, probe serial number, problems encountered with instrumentation, and overall climate (i.e. rainfall, heat index, etc.) will be recorded separately prior to field sampling day.

2.2.1.2 Areas of Ecological Interest

At each area of ecological interest, two sites will be surveyed. The first site will be located at the coordinates identified (Table 3). If the sampling location has < 60 cm of sediment, a similar protocol as the grid sampling method described above will be implemented. The second site at the area of interest will be 2 m away from the first site measured, within the feature of interest.

In the area of ecological interest, if sediment depth of <60 cm is encountered at the second site, a similar methodology will be applied as in the protocol described for grid sampling, but away from the direction of the first sampling site.

At each survey site, porewater specific conductance and temperature will be measured at 20 cm, 40 cm and 60 cm (or until rejection). Specific conductance and temperature will be recorded with an In-Situ Aqua TROLL 100 (In-Situ Inc., Fort Collins, CO) while air temperature will be recorded with a National Institute of Standards & Technology (US) NIST-calibrated thermometer.

The three depths may be sampled using three probes if the sampling is within a one-meter radius. Otherwise, if sampling using a single rod/probe is used for one single insertion process (i.e., to form just one continuous hole for sampling of three depths), sampling should start from the 20 cm depth and progress downwards to minimize contamination. Porewater sampling will be conducted using one of the two methods outlined below.

2.2.2 Porewater Survey Instrumentation

Two sampling methodologies are proposed below. The first and primary method, is a porewater sipper approach that extracts porewater using a hollow rod attached to a syringe. This method would utilize either a PushPoint sampler (EPA SEDPROC-513-R0) or a conventional polyethylene Sipper. The second proposed method is the Porewater Sampler, a new method that allows for in-situ sampling of porewater conductivity and temperature using the Aqua TROLL 100. As the second method is still novel, this sampler will be field-tested for data repeatability. If the Porewater Sampler method yields repeatable data from the Aqua TROLL, and the sampler is found to be easy to use and clean, this method might be selected over the porewater sipper. However, once a sampling protocol has been selected, this method will be maintained for that regional habitat (marsh, mangrove, Biscayne Bay) during a survey event. For both options, an Aqua Troll 100 and associated Rugged Reader will be used to measure the specific conductance and temperature.

2.2.2.1. Option 1/Primary Method: Pore water “Sipper” or PushPoint Sampler Method

Needed materials/equipment

- PushPoint sampler with guard rod or stiff clear polyethylene porewater Sipper

- Flange/sampling platform (flat metal disk ~25 cm in diameter)
- Screen Sok or equivalent mesh filter
- Flexible tubing
- Plastic syringes (50 or 60 milliliters [ml])
- 50-100 ml open measurement container

Before obtaining a sample, the biologist is to carefully approach the sampling location to avoid disturbance of the sampling area. Porewater collection will be done in accordance with Lewis (2007).

1. Insert porewater PushPoint or Sipper sampler into the ground 20-30 cm from where the sampler is standing to reduce negative effects of the sampler on the integrity of the porewater to be obtained (Figure 6A).
2. In a highly turbid area, to avoid surface water intrusion, place the sampling platform on top of the soil/sediment to stabilize the location to be sampled (Figure 6B).
3. Insert the PushPoint/Sipper through the central hole in the sampling platform. Alternately, the PushPoint sampler can be attached to the sampling platform prior to this whole assembly being pushed into the ground.
4. Push the Pushpoint, guard rod or Sipper, carefully down to the appropriate depth (either 20, 40 or 60 cm) using the marked measurements or attached sampling platform as a guide. A Screen-Sok may be placed over the PushPoint to limit the amount of sediment being trapped within the sampler during the insertion process.
5. If using the PushPoint, after deployment, carefully remove the guard rod and attach the flexible tubing (Figure 6C). The Sipper can be pre-attached to the tubing prior to insertion to depth.



Figure 6A. Inserting the porewater sampler into sediment (courtesy: MHE products).



Figure 6B. Sampling platform (courtesy: MHE products).



Figure 6C. Extracting porewater via syringe and tubing (courtesy: MHE products).

6. Attach the other end of the flexible tubing to the syringe.

7. Before collecting a porewater sample, pull on syringe to withdraw enough porewater to purge all air and surface water from the Sipper or PushPoint. Purge at least one tubing and Sipper/Pushpoint volume of water and discard.
8. The second aliquot of water (~50 ml depending on tubing length) should be used to briefly wash the Aqua Troll sensor (~10 ml) and the remainder placed into the open measurement container (30 - 40 ml).
9. Insert the Aqua TROLL 100 into the container to obtain readings.
10. Log data into the Rugged Reader as well as in field notebook.

2.2.1.2. Option 2: Porewater Sampler

This method is proposed as a test methodology. If this method works effectively and reliably, this method might be selected over the porewater sipper. Otherwise, the primary method, the Porewater Sipper, will be used.

Needed materials/equipment

- Porewater sampler: porewater chamber and stainless steel extender rods (90 cm lengths), stainless 12 cm handle, braided fishing line (65 pounds [lbs])
- In-Situ Aqua TROLL with cables (two 5 m lengths) and Rugged Reader
- Non-reactive lubricant (e.g., Silicone or Teflon)
- Bottle of rinsate (analyte-free water)
- Paper towels

Porewater Sampler Preparation:

1. Assemble the porewater sampler as shown in Figure 7A.
2. Lubricate the interior surface of the porewater chamber sliding door with the non-reactive lubricant.
3. Ensure the O-rings around the door in contact with the rod and the O-rings inside in contact with the Aqua TROLL are not chipped/cracked. Replace chipped/cracked rings.

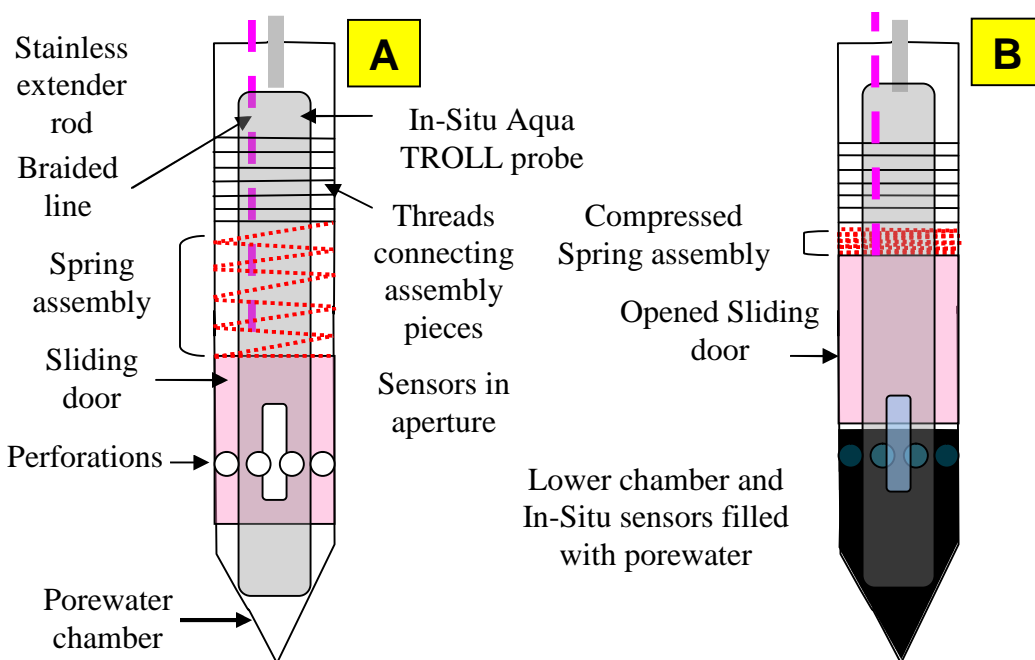


Figure 7. Schematic cross-section of the Porewater Sampler showing the porewater

chamber when the spring-loaded sliding door is closed (A) and when it is opened by pulling on the braided line attached to a stainless steel handle (B), allowing entry of porewater when the probe is placed at the appropriate depth.


4. Thread the braided line attached to the sliding door (via holes at top of piece) up the length of the rod and additional stainless pieces to length desired (i.e., sufficient to keep the exposed end of the sampler above water level.
5. Connect the In-Situ Aqua TROLL 100 to the data cable.
6. Thread the Aqua TROLL and data cable into the appropriate number of extender poles (connect the appropriate number of extender poles and Aqua TROLL cabling as needed).
7. Attach the end of the braided line to the stainless steel handle
8. Connect the end of the In-Situ cable to the Rugged Reader data logger and power on.
9. Holding the porewater sampler upright, and holding on to the PVC lengths to ensure the Aqua TROLL does not move, use the hand held handle with the braided line attached to pull upwards and open the pore space within the porewater chamber (Figure 7B).
10. Hold open for a minimum of one minute, wait for readings to stabilize, and record Aqua TROLL temperature and conductivity readings as provided on the Rugged Reader (record in fieldbook and save data in Rugged Reader).
11. After readings have been recorded and saved, release tension on the hand-held pull system and remove the porewater survey sampler.
12. Disconnect the bottom two pieces (the porewater chamber and porewater chamber connector).
13. Remove the Aqua TROLL and rinse thoroughly with rinsate (analyte-free water) and dry with paper towel.
14. Re-assemble for next measurement.

2.2.2.3. Aqua TROLL 100 and Rugged Reader

Needed materials/equipment

- Aqua TROLL 100
- In-Situ Rugged Reader
- RS-232 cable to Aqua TROLL attachment

The Aqua TROLL will be set up for 1-second readings that are averaged and reported at 10-second intervals. To set the system up and conduct daily checks, follow the procedures below:

1. Press and hold the Power button until the small green light to the right of the Enter key turns on.
2. To launch the software and connect to the Aqua TROLL, start Win-Situ Mobile by tapping the start menu at the top left corner of the touch screen and selecting Win-Situ Mobile from the pull down menu. Win-Situ Mobile launches and displays the Data area (“Data tab”), shown below (Figure 8A). If there is no shortcut for Win Situ Mobile in the drop down menu, go to Programs and tap Win Situ Mobile.
3. Assuming the Aqua TROLL is connected to the Rugged Reader, tap the “Connect” button (Figure 8A) on the bottom left side of the touch screen. The device is connected when the two plugs come together (e.g. ).

Adding a Data Site/File

1. Add a data site by tapping File → Site, and then tapping the New button on the screen.
2. Type in a site name or File by touching the Keyboard icon (Figure 8B) in the center of the very bottom of the screen.
3. Enter the Filename for the habitat (i.e., BBay, Marsh, Mangrove) and day (in month-day-year format) e.g., “BBay_022710” or “Mangrove_030310”. Several filenames should be created in a day if working across habitats during that day.
4. When done typing, press the Keyboard icon again to remove the touch pad from the screen.
5. Set the update rate at 10 seconds and press the right “Next” arrow (Figure 8B) to move to the following screen.
6. If the Rugged Reader is not connected to the add-on GPS extension, choose to not include the coordinates and touch the Check mark icon.
7. On the next screen, make sure that the site you just created is highlighted and press the Check mark. Now that the site is established you must create a data log.

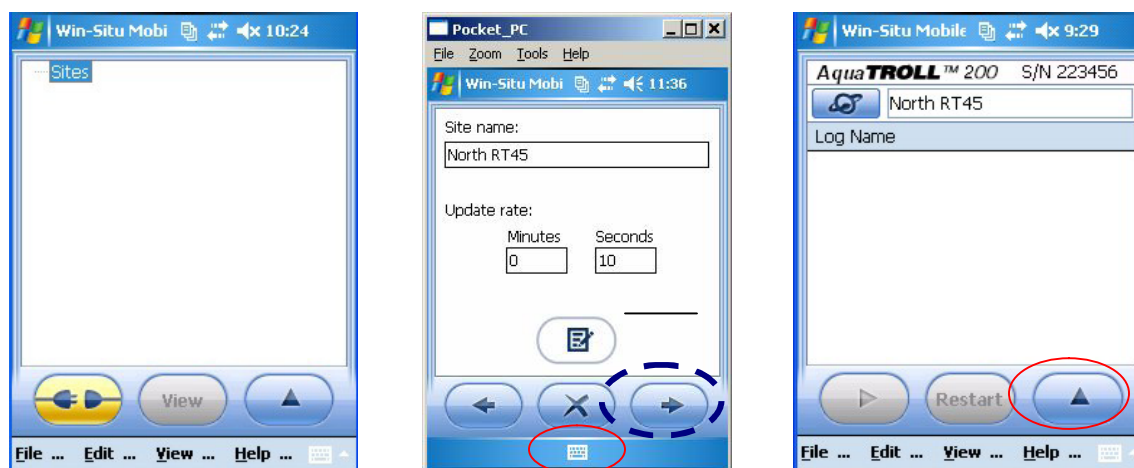


Figure 8A. Win-Situ Mobile with “Connect” button on left highlighted.

Figure 8B. Entering a filename. Hit the “Keyboard” icon (in red) to bring up a keypad for entry. Hit the “Next” arrow (blue dotted line) when done.

Figure 8C. After entering a “Log Name”, hit the “Expander” button (in red) to select “New”.

Creating a Data Log

1. Tap the “View” menu at the bottom of the screen (Figure 8C) and select “Logging”.
2. Tap the “Expander” button (Figure 8C) and then select “New”.
3. Type in a data log name using the “Keyboard” icon. When done, click the “Next” arrow.
Note: Only one log can be actively running at a time.
4. Select all parameters and click the “Next” arrow.
5. Accept default units and click the “Next” arrow.
6. Choose “Event Logging” and click the “Next” arrow.
7. Select “Specific Conductivity” as your primary parameter.
8. *Important:* Select to record primary values every 10 seconds, and secondary parameters every 10 measurements. Click the “Next” arrow.
9. Choose to log data when an event parameter is greater than zero.
10. Select Manual Start. Click the “Next” arrow.
11. Check over the summary page to ensure proper setup. Tap the check mark.

Data Logging

1. When you are ready to take a reading, insert the probe into the sample, then press the “Play” button at the bottom left side of the screen.
2. After you have collected your reading (collected after at least a minute of stabilization), press the “Pause” button.
3. To download the log data, make sure the log is highlighted and: Tap the expander button → Download → Download All → and click the check mark.
4. To view the data at this point you can select “Yes” when asked.
5. Select the parameter that you would like to view from the top drop down menu.
6. To stop logging, go to View → Logging → Expander Key → Stop.

Exit Program

1. To exit Win-Situ Mobile, go to the File Menu → Exit.
2. Turn unit off.

3. Calibration Procedures

3.1 In-Situ Aqua TROLL 100

The Aqua TROLL 100 probe will be calibrated on a daily basis according to manufacturer's instructions as described below. Calibration accuracy will be checked once at noon and again in the evening. Values will be recorded and checked for drift. If at noon, it is found that calibration is needed, a field calibration for conductivity will be performed.

3.1.1 Aqua TROLL Manual Conductivity Calibration (In-Situ Inc., 2008)

To perform a conductivity calibration of the Aqua TROLL 100, the equipment needed includes:

- In-Situ Cal Cup
- Calibration standard solution supplied, or other solution of known specific conductivity in the range 100 to 60,000 $\mu\text{S}/\text{cm}$

Three factors are essential to a successful conductivity calibration:

1. The calibration solution is not diluted or contaminated
2. The probe and the solution are at the same temperature
3. The sensing cell is completely filled with solution—no air bubbles on the sensor

The following preparation steps can help to ensure a successful calibration and avoid erroneous field data. Below is the description for setting up the probe for calibration.

1. Remove the nose cone at the tip of the Aqua TROLL. Water trapped here can dilute the calibration solution. Air bubbles may also come from this area.
2. If the device is wet from previous use, dry the body and shake to clear any liquid inside the conductivity sensor.
3. Before opening the solution bottle, invert it a few times to redistribute any water condensation.
4. Remove the Cal Cup cap and fill the cup to the "Rinse" line with calibration solution.
5. Insert the Aqua TROLL through the grommet in the cap.
6. Attach the cap to the Cal Cup. The Aqua TROLL should rest on or near the bottom.
7. Shake vigorously to rinse the sensing cell (Figure 9A).
8. To allow for temperature equalization, invert the Cal Cup multiple times for at least 30 seconds—longer if the probe and solution are at different temperatures.
9. To dispel air bubbles from the sensor, hold the Aqua TROLL horizontally, and firmly tap the Cal Cup against a convenient surface (for example, your other hand) (Figure

9B). Rotate the Aqua TROLL on its axis about 45 degrees and tap again. If needed, rotate another quarter turn and tap again (Figure 9B).

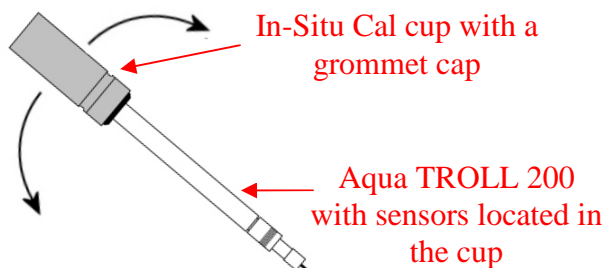


Figure 9A. Calibrating the AquaTroll. Ensure that the probe tip is near/on the bottom of the bottle and shake bottle vigorously.

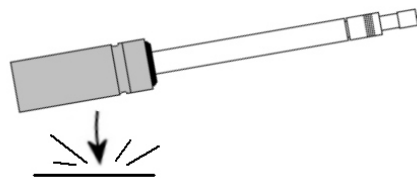


Figure 9B. Dispelling air bubbles from the sensor head. Rotate 45 degrees and tap firmly against a convenient surface (e.g. one's hand).

10. Loosen the cap, remove the Aqua TROLL (no need to pull it out of the cap), and discard the solution.
11. For best results, rinse again using the same procedure.
12. Proceed to initiating calibration.
13. In the event that saline water ($>30,000$ uS/cm) is anticipated to be encountered in the sampling, the calibration described above will be augmented to include a high and low range calibration standard solution check.

The Aqua TROLL uses a single point calibration set-up

1. If you have not already done so, attach cable to the Aqua TROLL and to the computer, launch Win-Situ, and connect to the device.
2. Go to the "Sensors" tab and select the sensor (i.e., Aqua TROLL 100).
3. Click the "Calibrate" button (Figure 10).
4. In the next screen, select the Conductivity parameter and click "Calibrate" (Figure 10).
5. After a review of the preparation steps just performed, a screen like this will be shown:

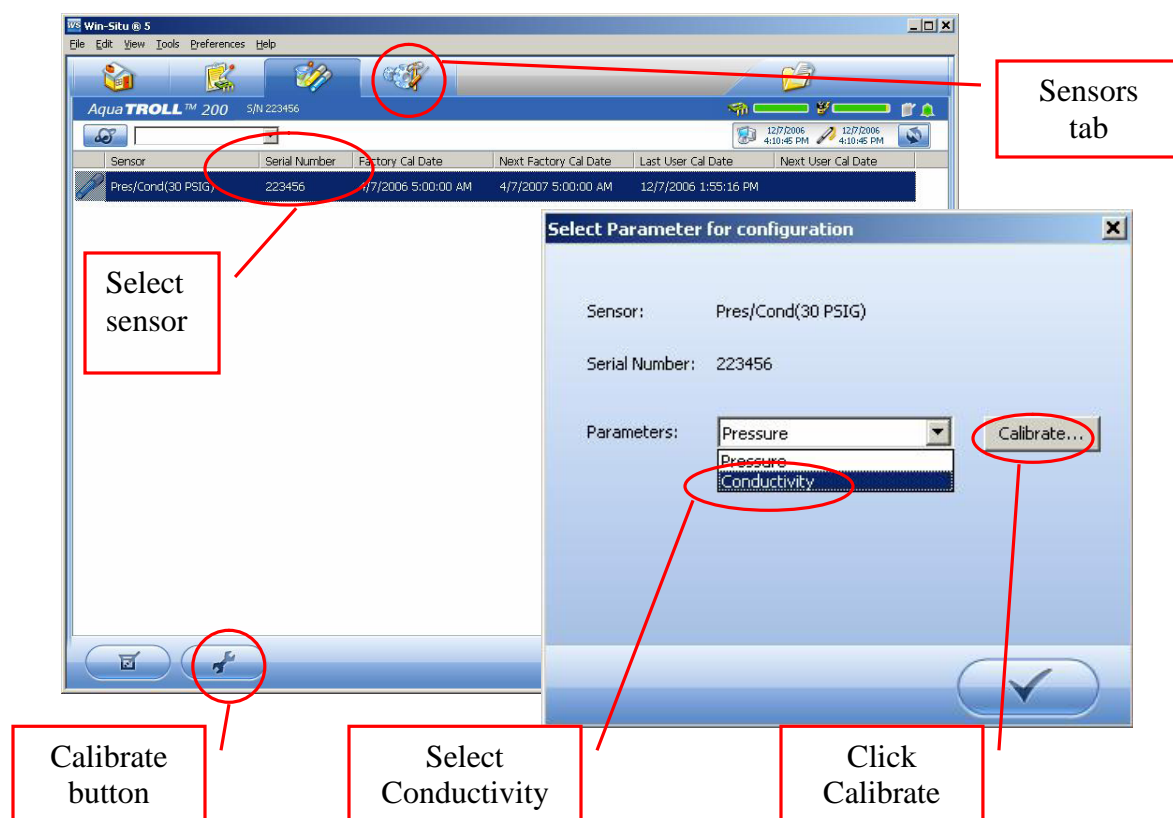
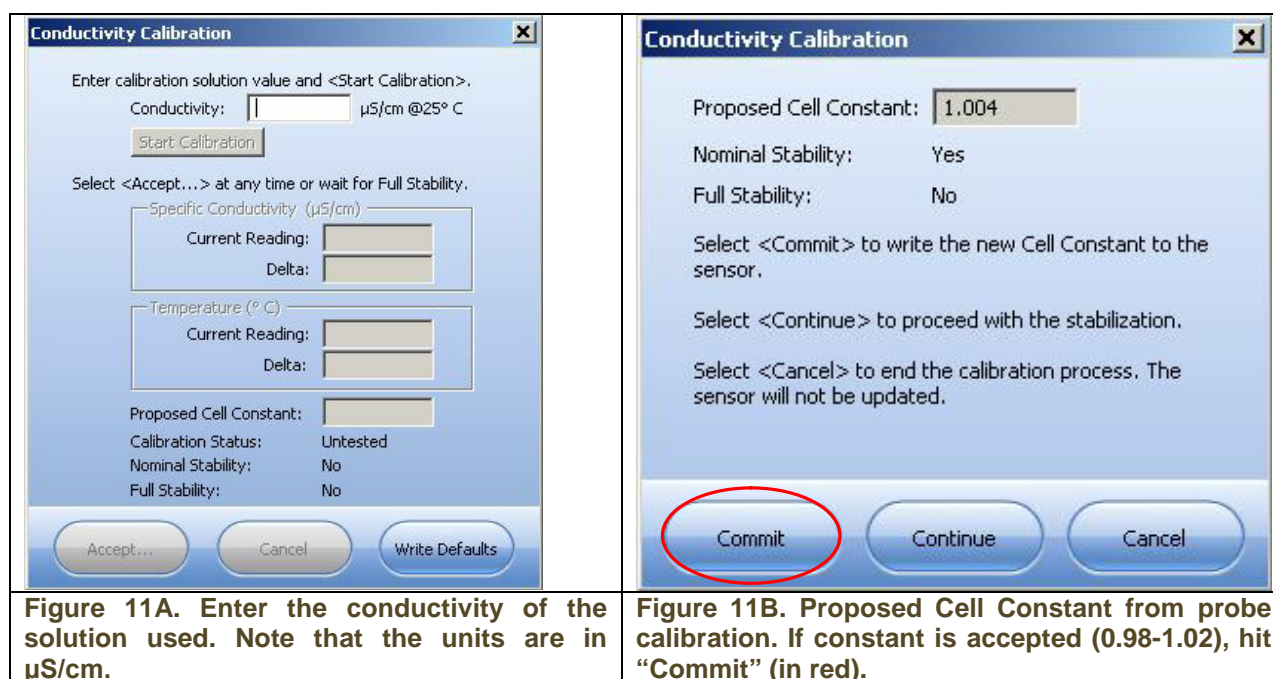


Figure 10. Conducting the single-point calibration setup.

6. Enter the Specific Conductivity of the calibration solution in $\mu\text{S}/\text{cm}$ (Figure 11A).
7. Click “Accept” followed by “Start Calibration”.
8. The software will monitor the conductivity and temperature readings, calculate the cell constant (sometimes called the “Kcell”), and inform you when the response meets the criteria for Nominal Stability.



9. You can click Accept at any time to continue. For best results, wait until Full Stability is reached. At that time, the next screen is displayed automatically.
10. Look at the Proposed Cell Constant before you commit it to the sensor. It should be in the range 0.98 to 1.02 (Figure 11B).
11. If the cell constant is suspect, the cause could be an air bubble, incomplete rinsing, sensor fouling, or other factors.
12. Repeat the preparation and calibration with fresh calibration solution.
13. When you are satisfied with the proposed cell constant, click "Commit" to write the calculated cell constant to the sensor.
14. If the Aqua TROLL will be deployed immediately, remove it from the Cal Cup, rinse it, discard the calibration solution, and reinstall the nose cone.

3.1.2 Care and Maintenance of Conductivity Sensor

Fouling from mineral and biological sources can alter the sensor's response.

- Always begin with a rinse under running water to remove loose material.
- Always finish with a rinse in clean water.
- After cleaning, always check the calibration before redeployment, and recalibrate the sensor when necessary.

Acceptable cleaning processes fall into the following categories:

Process 1: Light scrubbing with a soft swab (or pipe cleaner) and mild soap such as a dilute solution of dish detergent. Be careful not to damage the plastic material of the conductivity cell.

Process 2: Light scrubbing with a foam swab and an aggressive soap such as Alconox® detergent can be used for more stubborn deposits.

Process 3: Dilute (10:1) acetic acid, or consumer-packaged white vinegar, can be used to pre-soften calcium deposits. Follow this with Process 1 or Process 2, depending on the degree of residual contamination. The Aqua TROLL can soak for any length of time in dilute acetic acid. If this does not completely remove the material, try Process 4.

Process 4: Dilute phosphoric acid (< 27%) or the consumer product Lime-A-Way® can be topically applied with a soft swab to remove iron or calcium deposits that remain after using Process 3. Do not soak for more than 10 minutes. Rinse well with water. If contamination cannot be removed using the recommendations above, please contact In-Situ Inc. as described on page 10.

3.2. Temperature Calibration

Temperature will be measured using a National Institute of Standards and Technology (NIST) traceable, certified, Celsius thermometer with a resolution of 0.1 degrees Celsius (°C) and a range of 0 – 100 °C. Temperature calibrations will be conducted once per day.

1. The In-Situ Aqua TROLL 100, and the NIST thermometer will be calibrated at three temperature points.
2. The Aqua TROLL 100 and the NIST thermometer will be placed in cold water at temperatures of < 5°C until the temperature stabilizes, and readings recorded.
3. The probe and the NIST thermometer will then be placed in water at room temperature between 20 - 25°C
4. When the temperature readings stabilize, the temperature will be recorded.
5. The probe and NIST thermometer will then be placed in warm water and >30°C until the temperature readings stabilize.
6. Temperature readings of both the NIST thermometer and Aqua TROLL will be recorded.

3.3 Verification of Calibration

The Aqua TROLL 100 will be checked for conductivity calibration at noon and at the end of the field day with a standard solution and the reading obtained will be recorded and compared to the morning calibrations recorded. If drift of readings is observed to be greater than 10%, the Aqua TROLL 100 will be field calibrated as described in Calibration Procedures described above.

4 Trouble-Shooting

Some of the more commonly encountered problems related to the instrumentation are listed below.

4.1 Porewater “Sipper” or PushPoint Sampler

Problem: No extraction possible

Probable Cause: Sampler/tubing is clogged along length.

Suggested Remedy: Remove syringe and raise barrel to 50 ml. Reconnect syringe to tubing and eject into sampler to purge blockage. If that fails, remove sampler and tubing setup and rinse. Clean blocked portions as needed with 18-gauge wire or pipe cleaner.

Problem: Highly turbid sample

Probable Cause: High silt/sediment content entering probe/sipper.

Suggested Remedy: Replace Screen-Sok or mesh filter and try to re-extract. Alternatively, after measuring temperature, collect the sample and store in a vial on a flat surface to allow settling of particles. Measure conductivity after at least an hour of sample settling.

4.2 Porewater Sampler

Problem: No reading

Probable Cause: Sampler/tubing is clogged with silt/sediment.

Suggested Remedy: Remove assembly and clean. Find a different location to conduct measurements.

Problem: Incorrect reading

Probable Cause: Air bubble within sensor chamber.

Suggested Remedy: Place a small amount of cotton (e.g. from cotton tips) in sensor chamber to create a wicking mechanism and create contact across all Aqua TROLL sensors.

4.3 Aqua TROLL 100 and Rugged Reader

In the event that the Aqua TROLL 100 is not providing readings or accuracy is in question the following steps will be conducted as suggested by the In-Situ Operating Manual (2008):

1. The data cable will be checked for secure connection from the probe to the data logger, and the ports will be checked for proper connection.
2. The communication settings in Win-Situ and in the Aqua TROLL will be checked to ensure they match. To reset the device communication settings to the serial defaults, click “Reset all Devices” in the Comm Settings dialog (Preferences menu > Comm Settings).
3. The internal battery will be checked to ensure it has voltage remaining. If not the battery will be replaced or external power supplied.
4. The Aqua TROLL 100 will be checked for air bubbles in the sensors and agitated to remove them if they are present.
5. If problematic readings are still noted, the Aqua TROLL 100 will be checked with a standard solution. If readings are found to have drifted greater than 10%, the probe will be recalibrated.
6. If after field calibration, the probe continues to produce problematic readings, the probe will be flagged and replaced with a second Aqua TROLL 100 unit.
7. The new Aqua TROLL 100 unit will be calibrated and used to continue porewater survey data collection.

Problem: Aqua TROLL 100 probe is in the wrong units

Probable Cause: Default units are being used.

Suggested Remedy: Click the Sensors tab, select the sensor, click the “Configure” button, and select the desired units for each parameter in the Sensor Setup window. Click OK. Be sure to stop “polling” in the Home screen before selecting units.

In the event the Rugged Reader is not recording data:

Problem: Cannot add a new log

Probable Cause 1: Only one “active” log can reside in the device at a time—an “active” log is a log that is Ready, Pending, Running, or Suspended as shown in the Status column of the Logging Tab

Suggested Remedy: Stop or delete the log if possible. Alternatively, configure the new log after the active log is completed.

Probable Cause 2: The device has its maximum number of logs already stored—although this is not a likely cause for the Aqua TROLL 100, which has a capacity of 50 logs.

Suggested Remedy: Download, and then delete a log you are through with. This will make room for an additional log on the device.

Problem: New log exceeds available memory (message from software).

Probable Cause: The log as configured would exceed the device memory.

Suggested Remedy: Edit the log and try the following procedures:

- Select a longer sampling interval.
- If available, select the “Wrap data” option (later data will overwrite earlier data when the memory is full).
- For a log with a scheduled start, select “None” as the stop condition, or select a stop time that is closer to the start time. You may intend to stop the log before the scheduled end date arrives, but the software doesn’t know that.

In the event that the In-Situ Rugged Reader fails or freezes (power failure):

1. Remove battery and turn the unit on again
2. Check the battery with a multimeter.
3. If the unit will not power on, a replacement battery will be installed.
4. If power does not return to the unit, the Rugged Reader will be replaced with a back up unit. If a back up unit is not available, the field day will be canceled until a replacement unit is provided.

5 Reporting

Maps of the distribution of specific conductance and temperature from the all sampling locations will be provided within two weeks of completion of the survey. All data collected (field notes and information logged in the In-Situ Rugged Reader) will be provided in a MSExcel spreadsheet. General parameters such as start and end times for each day, tidal conditions during collection, and instrumentation calibration information will be included. Specific parameters reported will include instrument serial number, time of recording, specific conductance, temperature, total dissolved solids (TDS), surface water level, water and air temperature, as well as any ecological observations of note. A list of sites recommended for follow-up CCS tracer suite sampling will also be provided for agencies review and approval prior to initiating the follow-up CCS tracer suite sampling. The list of recommended sites will include those sites identified in the initial broad-scale survey as being influenced by the CCS and will also consider those sites where initial survey attempts were unsuccessful but adjacent sites indicate potential influence of the CCS. In these cases, proposals for successful sampling will be provided for approval including alternative sample collection methods such as coring/drilling or alternative representative sample locations.

6 References:

- In-Situ, Inc., 2008. Aqua TROLL Operator's Manual: Aqua TROLL 100 and Aqua TROLL 200.
- Lewis, B. 2007. Pore Water Sampling Operating Procedure, United States Environmental Protection Agency. SESDPROC-513-R0.
- Rohlf, F.J. and Sokal R.R. 1996. Statistical Tables: collection of tables to accompany Biometry (3rd ed.). 199 pp.