STANDARD OPERATING PROCEDURE FOR THE RECORDING OF PHYSICAL/CHEMICAL PARAMETERS USING A MULTIPARAMETER INSTRUMENT IN LAKES

1.0 General Information

A multiparameter instrument (sonde) is used to collect and store information for some of the physical/chemical parameters of the lake or reservoir being studied. Parameters measured by these sondes include water temperature, barometric pressure, dissolved oxygen (D.O.), dissolved oxygen % saturation, pH, specific conductivity, salinity, depth, oxidation-reduction potential (redox), total dissolved solids, and resistivity. In lakes we currently use two different sonde models, either the Y.S.I. ® 6-series sonde or the EXO^2 sonde. There are many similarities in operating both types of sondes. Some instructions on operating both sondes are provided in this document, but specific training on the operation of each sonde will be provided by the supervising F.T.E. The important thing to remember is to always use the same type of sonde, and ensure that it is one designated for lakes use throughout particular study so that data collected is comparable.
(For further information please refer to the corresponding manual cited at end of document)

2.0 Definitions/Terms

3.0 Safety

Upon reaching the sampling location, site safety determinations should be made before proceeding. Please refer to the OWRB safety manual for information on boat safety, trailering and working from boats.

4.0 Quality of the Measurement

When sampling for all programs, Quality Assurance/Quality Control (QA/QC) samples will be routinely collected to assure that environmental samples meet the Data Quality Objectives (DQO's) that are outlined in the controlling Quality Assurance Project Plan (QAPP). QA/QC sampling is designed to control each step of the sampling process. Known standards for each parameter should be routinely measured. Protocols for these calibrations are listed in Section 5.12 of this document

5.0 Personnel and Equipment

Principle investigators for the OWRB are required to have degrees and/or experience with biological or other applicable sciences. Principle investigators are defined as crew leaders, and this designation may be made upon the leader of a multi- or a one-person crew. Training is required for all SOPs dealing with water quality and quantity collections and measurements as well as habitat assessments and biological collections. In-house training will be conducted

for the use of all meters and digital titrators used for water quality or quantity measurements. Investigators must be familiar with all OWRB SOP documents as all training will follow the methods outlined in these documents. Extra training will be provided when new SOPs are developed. Training of field crews will be done through dry run exercises in the laboratory to familiarize field crews with sample collection, sample preservation, instrument operation, calibration, and maintenance. In addition, when new personnel are hired or new methods developed, qualified staff will train on sample collection, measurement, and field analysis methods through side-by-side field trips. These trips will familiarize staff with SOP requirements. When training is considered adequate, a qualified staff member will check field staff for adherence to SOPs.

5.1 EXO^2 and 6-Series Sondes and Handhelds

Check calibration and maintenance logs before leaving office to ensure that the pre-trip calibration has occurred. If calibration has not occurred, perform the pre-trip calibrations (a supervising F.T.E. will demonstrate calibration techniques and the unit's operations manual can be consulted for calibration techniques). **ALL CALIBRATIONS AND MAINTENANCE MUST BE RECORDED IN THE UNIT'S FILE.**

5.11 Maintenance

When not in use, the sonde units should be in kept in their carrying case. The instrument should be kept dry and clean both inside and out. After each measurement, the probes should be rinsed twice with tap water and stored in the storage cap in tap water. Instruments should never be stored in temperatures below freezing or in extremely hot temperatures. Handheld stored data should be recorded and deleted on a weekly schedule. Failure to do so may result in the loss of valuable field data.

Specific pre-trip and in field maintenance should occur for the sonde as follows

- **Sonde casing.** Check the sonde casing periodically for cracks or looseness of sensor connections. Connections may need to be tightened or re-siliconed periodically (only after the approval of a supervisor or senior staff member). All O-rings should be periodically checked and re-siliconed to ensure they are working properly.
- **Bulkhead.** Periodically check the bulkhead connection for bent pins or looseness.
- **Dissolved Oxygen Sensor (ODO).** Check the sensor for any cracks or other abnormalities, and change sensor if necessary (only after the approval of a supervisor or senior staff member).
- **PH/ORP Sensor.** Check the sensor bulbs for cracks, dirt, scum, or other abnormalities, and change or clean probe if necessary (only after the approval of a supervisor or senior staff member). Clean with warm soapy water and Q-tip.
- **Conductivity/Temperature Sensor.** Check the probe for cracks, dirt, scum, or other abnormalities, and change or clean probe if necessary (only after the approval of a supervisor or senior staff member). Clean with warm soapy water and Q-tip.
- **Depth and Level Sensor.** Check the depth ports and ensure that they are clear of obstructions. Clean using a syringe with clean water, gently forcing the water into one of the ports until clean water flows from the other port.

5.12 Pre-trip Calibration

Specific weekly pre-trip calibrations should occur for each parameter as follows. **All calibration standard solutions should be fresh weekly and have the most current date written on the lid.**

- **Dissolved Oxygen Percent Saturation.** Perform an "air" calibration with tap water using the barometric pressure (BP) of the laboratory. The lab and field barometers give BP in units of "inches of Hg", and the unit can only accept BP in units of "mmHg". A conversion chart is provided in the laboratory and in each field notebook (the conversion is 'inHg x 25.4 = mmHg').
- **PH:** In order to maximize accuracy of our pH readings between reservoirs we use a 3-point pH calibration procedure. The three point calibration uses pH 7, 10, and 4 standard solutions. The order of calibration should be 7, 10, and 4. Ensure that the pH mV readings are within the appropriate ranges for the standard solution being used. Refer to the calibration sheet for these ranges.
- **Specific Conductance (SpCond):** The manufacturer recommends using standards greater than 1 mS/cm (1000 µS/cm) at room temperature for greatest stability. A one point calibration should be performed using the recommended standards. Ensure the readings have stabilized before accepting the calibration.
- **Oxidation/Reduction Potential (ORP/Eh):** Should be calibrated weekly using a Zobell solution. The potential of the Zobell solution vs. the Ag/AgCl reference electrode using 4 M KCl is + 229 mV. This ORP value needs to be converted to Eh, to do this simply calibrate to +429 mV. This should give a out of range warning. Ensure that the probe is reading correctly before accepting the calibration out of range (refer to the YSI paper "Measuring OPR on YSI 6-Series Sondes: Tips, Cautions and Limitations", for more information on ORP vs. Eh calibration).

5.13 Site Specific Calibrations or Checks

The following in-field calibrations and checks should occur as follows:

- **Depth (m)/Pressure-Abs:** Depth should be calibrated at the first site of each reservoir. Calibrate at the surface with the sonde out of the water and enter 0.00 for the depth, this will zero out the sensor with regards to the current barometric pressure.
- **Dissolved Oxygen Percent Saturation (D.O.):** Dissolved oxygen percent saturation should be calibrated at the first site daily, when the BP change is greater than 0.5 inches of Hg in comparison to the previous calibration, when the reading is below the screening, or when the reading is outside the norm for a particular station (refer to the description of lab calibration). When calibrating in the field the BP for calculating percent saturation will be provided by the handheld. There should be approximately 1/8 inch of water in the calibration cup and the threads should be loose. Wait 10-15 minutes before accepting calibration to ensure the temperature and oxygen pressure have equalized.

6.0 Measurement of *in-situ* Parameters Using Multiparameter Instruments

No matter which sonde is used, similar techniques are used to collect data. At the first sampling site on each lake, a file should be created on the Handheld labeled with the appropriate lake name. The 6-Series sondes allow you to pre create separate files for each site per lake, on the Exo's you will need to annotate the lake file at each site as data is collected. These files help keep the information in order so that it can be downloaded and stored appropriately in an Excel spreadsheet at the OWRB office. After lowering the sonde into the water, allow the unit to equilibrate. Equilibration should take no more than 1 to 2 minutes. The key is to allow all the parameter readings to stabilize before storing the information. At each lake site, data is collected at every meter starting at the lake surface (0.5m below the surface) and working down to the bottom (1m, 2m, etc); this technique is called "profiling". The final reading will be taken .2 meters off the bottom, this allows for a clean reading w/o sediment interference. The supervising F.T.E. will instruct you on how to operate and store data in the logger unit and also how to extract data from the surveyor unit for downloading in into the appropriate location on the OWRB network.

6.1 6-Series

6.11 Creation of Lake File

Each trip will require files be made for each lake and these files will contain each corresponding site. This will create one file per lake and separate each profile to its corresponding site.

- Sequence: I/O ➔ Logging setup ➔ Edit site list ➔ Enter file name (on first available line) ➔ Enter site number for as many sites as needed on following lines ➔ Repeat for all lakes needed ➔ Escape to main screen.
- File names should be written as the Lake or Reservoir name. If using abbreviations make sure they are easily recognized.

6.2 Exo Sonde

6.21 Creation of Lake File

Each trip will require a file be made for every lake site. These files will contain only the profiles from that specific site. This will need to be repeated for before taking readings at every site.

- Sequence: I/O ➔ Run Settings ➔ File Prefix➔ Enter lake name followed by site number ➔ Apply ➔ OK➔ Escape to main menu.
- File names should be Lake name(or recongnizable abbreviation) followed by the site number (examples: Arcadia01, Arcadia02)
- This step must be repeated for every site.

6.3 Connecting the Sonde to the handheld

- The handheld is connected to the cable at the connector on the bottom of the unit. Ensure that pins are fully aligned before inserting the male pins into the female connector and tightening the retaining collar. Do not force or over-tighten.

- The sonde is connected to the cable in the same manner as the handheld. Ensure that the sonde pins are aligned with the connector by matching the male pins to the female connector. Insert the pins into the connector and tighten the retaining collar. Ensure that the sonde bail does no cross the field cable to prevent strain on the connection.
- Attach the cable's strain relief to the sondes' bail with the provided carabineer.
- **BEFORE PROCEEDING, ENSURE THAT ALL CONNECTIONS BETWEEN SONDE /CABLE/HANDHELD ARE SECURED.**

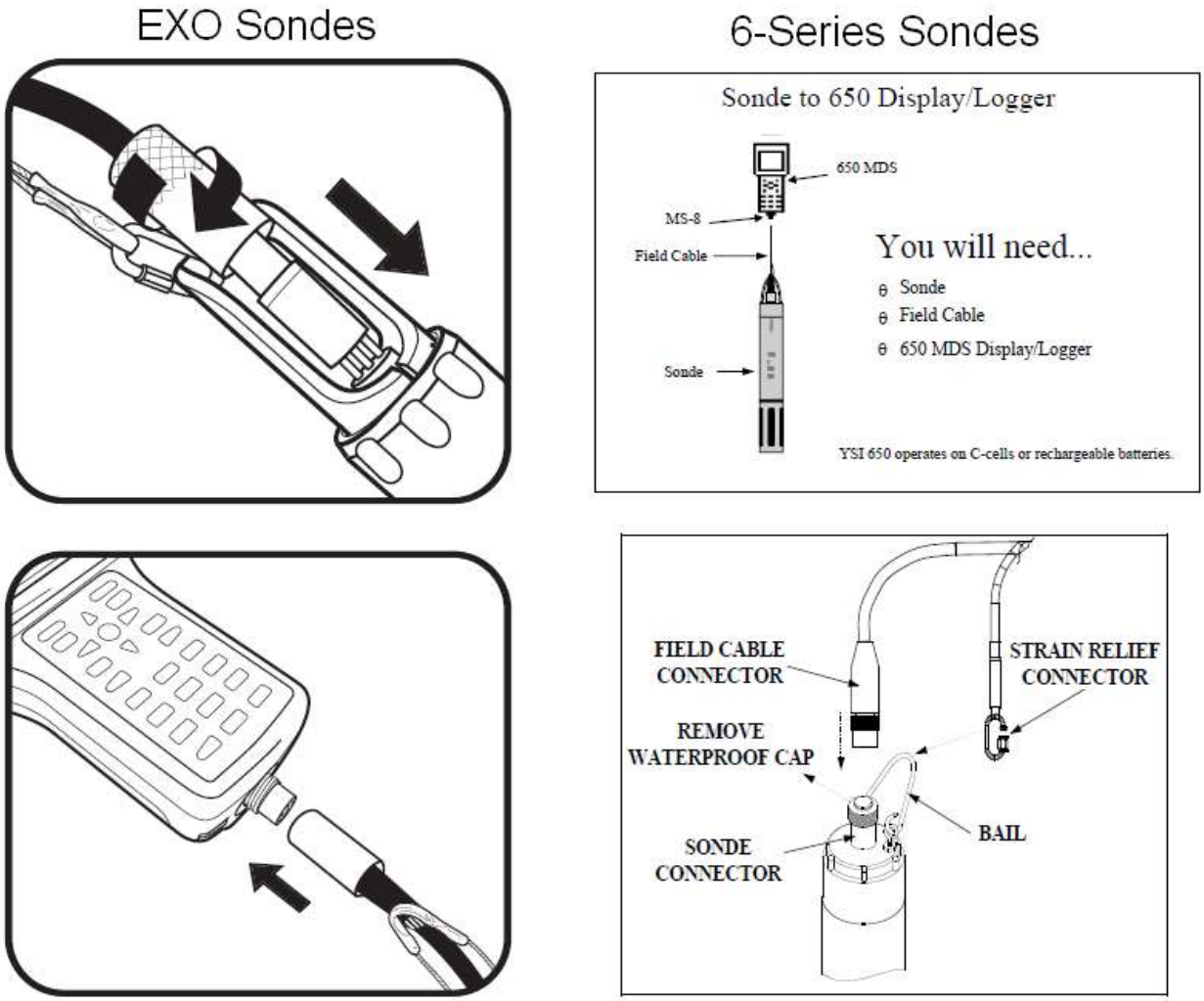

Figure 1: Connecting sonde to handheld (EXO/6-Series User manuals)

6.4 Measuring and Recording Readings

- At each site data is collected and recorded at 0.5 m below the surface then 1.0 m and in 1-meter increments to 0.2 above the lake bottom. This is known as a "profile" of the water column.
- Lower the sonde unit to depth and wait for the readings to equalize (especially D.O., temp, and specific conductivity readings) before selecting the Capture data/Log one sample key to save the displayed information.

- When the readings are stabilized, press Capture data/Log one sample. Now the reading for that depth is stored into the file of the handheld and is safe from human error. **Before pressing store be sure to read the file that you are storing to. The handheld may bring up another file that is in the unit.**

7.0 Forms

8.0 Data Storage

Upon returning from the field, the data stored in the handheld must be extracted from the unit(s) and imported into a spreadsheet file on the computer. This procedure is called "dumping". File extraction procedures vary between the 6-Series and the Exo. The supervising F.T.E. will demonstrate this process upon returning to the OWRB office.

8.1 Organize Files in Excel

After the files have been successfully downloaded from the surveyor, organize the data in excel for easy analysis data later. Clean up data by doing the following:

- Open Excel ➔ File ➔ Open ➔ Find the file ➔Double click on the appropriate file ➔Delimited ➔ Next ➔ Check separate with comma's box and make sure tab is also checked ➔ Finish
- You will now see your data displayed in an excel file. Clean up the file by making sure all the data is in the correct order (as follows).
- Date/Time/Site#/Depth/D.O. mg/L/D.O. %/pH/SpCond/Salinity/ORP/pH mV/BP
- The file may further be cleaned up by making sure the depths are at 1.0 meter intervals on whole numbers. Files may need to be altered slightly if the data was saved slightly off the whole meter (example 12.1 meters can be changed to 12.0 meters).
- Remember to Save any changes that you make

9.0 References

YSI Incorporated. YSI 6-Series 6600 V2, 6600EDS V2, 6920 V2, 6820 V2, 600 OMS V2, 600XL, 600XLM, 600LS, 600R, and 600QS Multiparameter Water Quality Sondes User Manual, November 2010, Revision G

YSI Incorporated. EXO User manual Advanced Water Quality Monitoring Platform, December 2012, Revision C

YSI Environmental. Measuring ORP on YSI 6-Series Sondes: Tips, Cautions and Limitations, 2005