New Mexico Environment Department (NMED) Surface Water Quality Bureau (SWQB)

Standard Operating Procedure (SOP) for

LONG-TERM DEPLOYMENT DATA LOGGER QUALITY ASSURANCE AND SQUID UPLOAD

Approval Signatures

Kristopher Barrios Digitally signed by Kristopher Barrios Date: 2021.01.05 15:16:34 -07'00'

Kristopher Barrios — Date
Subject Matter Expert

Miguel Montoya Digitally signed by Miguel Montoya Date: 2021.01.05 15:35:32 -07'00'

Miguel Montoya — Date
Quality Assurance Officer

Kristopher Barrios Digitally signed by Kristopher Barrios Date: 2021.01.05 15:17:19 -07'00'

Kristopher Barrios — Date
Program Manager - Monitoring, Assessment and Standards Section

1.0 Purpose and Scope

The purpose of this document is to describe the procedures for: (1) retrieving recorded data from sondes and data loggers; (2) qualifying datasets retrieved from sondes and data loggers; (3) standardizing data formatting in Excel; and (4) uploading data into the SQUID database. This procedure covers the above processes using the following instruments: Onset HOBO® Dissolved Oxygen (DO) data loggers (U-26-001), Onset HOBO® Conductivity data loggers (U24-001), Onset HOBO® Water Temp Pro V2 data loggers (U22-001), Onset HOBO® TidbiT® MX Temp 400 (MX2203) data loggers, and In-Situ Aqua TROLL® 600 Multiparameter Sondes.

2.0 Personnel Responsibilities

The Quality Assurance Officer (QAO) is involved in the development and revision of this SOP to ensure the SOP meets the requirements of the SWQB's Quality Assurance Project Plan. The QAO, along with the Subject Matter Expert and Program Manager will determine if any revisions to this SOP are needed at a minimum of every two (2) years in accordance with SWQB SOP 1.1 for the Creation and Maintenance of SOPs. Pending the review and approval of the document, the QAO will ensure the SOP is accessible through the SWQB's website.

Personnel who upload or manage data generated from Long-term Deployment (LTD) data loggers are responsible for offloading data from the logger to a PC, storing and cropping data, ensuring that sensors were in calibration during the sampling period, correcting and qualifying data within the interpolation range, reviewing data for periods of anomalous data points, assigning data qualifiers, formatting and saving data in Excel, populating statistical metadata, and uploading data into the SQUID database. Personnel implementing this procedure shall acknowledge such by signing the ***SOP 6.4 Long-term Deployment Data Logger (Temperature Logger and Sonde) Data Logger Quality Assurance and SQUID Upload*** acknowledgment form.

The Subject Matter Expert and/or the Project Manager(s) are responsible for training field personnel, as needed, so they are capable of operating sondes and data loggers, including calibration, post-deployment checking, and data recording.

Personnel who use sondes and/or data loggers are responsible for:

- ensuring sondes are properly maintained and stored;
- maintaining the "Sonde Tracker" spreadsheet;
- maintaining electronic data files on NMED's internal server;
- maintaining deployment/retrieval field sheets;
- maintaining calibration sheets in binders stored in the laboratory and the office project binder;
- creation of sampling events in SQUID and upload of data files; and,
- validation and verification of database records, data files, and field forms.

3.0 Background and Precautions

3.1 Background

This procedure provides guidelines for the proper management and storage of data logger and sonde datasets recorded autonomously in the field.

3.2 Procedural Precautions

Individuals using a sonde or data logger should have a thorough understanding of its proper use and care and be familiar with the instrument's operational manual and this SOP in order to ensure data are not invalidated due to calibration or user error. Do not delete files from a data logger or sonde prior to verification that the file is copied to a secure network archive. It is important to preserve original unedited data files on network storage.

3.3 Safety Precautions

This SOP has not identified specific precautions in regard to its procedure beyond those found in a typical office environment and general field hazards.

4.0 Definitions

Conductivity data logger – a water quality monitoring device that measures and records conductivity and temperature used for unattended monitoring.

Data logger – a water quality monitoring device that measures one or more parameters and can be deployed for unattended monitoring. Note: the term data logger in this SOP most often refers to a temperature logger, as the term "sonde" is used to refer to a multiparameter (>3 probe) sonde, conductivity logger, or DO logger.

Deployment – use of a sonde/data logger at a monitoring location to perform and record unattended measurements of water quality.

Dissolved Oxygen data logger (DO logger)– a water quality monitoring device that measures and records dissolved oxygen (percent saturation and concentration) and temperature used for unattended monitoring.

Field measurement – An instrument reading collected manually at a single point in time. Synonymous with grab or instantaneous measurements.

Field parameter – individual characteristic of water quality capable of being measured by a sonde or data logger. Typical field parameters include pH, dissolved oxygen saturation and concentration, specific conductance, turbidity, and temperature.

Handset – a device used to display information from a sonde or data logger. Note: for some sonde types the handset used is a Bluetooth enabled mobile device or tablet.

Long-term Deployment (LTD) – installation of a sonde or data logging device at a monitoring location to perform and record unattended measurements at discrete intervals.

Macro – an automated routine used to complete an operation.

Program Manager – An individual within the SWQB that manages a program such as the Monitoring, Assessment and Standards Section (MASS). The Program Manager may be the same individual as the Subject Matter Expert.

Project Manager – An individual responsible for a specific project. This individual, in most cases, holds a different title within the organization. The Program Manager and Project Manager are not necessarily synonymous. The Project Manager may be the same individual as the Subject Matter Expert.

Quality Assurance Officer (QAO) – An individual within the MASS that is responsible for overseeing the development and implementation of all quality assurance procedures and processes within the SWQB including those projects that receive support or funding from the SWQB. The QAO is also responsible for validating and verifying data sets for potential use in assessment of surface waters.

Quality Assurance Project Plan (QAPP) – A formal planning document for environmental data collection activities that describes the data collection procedures and the quality assurance and quality control activities that must be implemented to ensure that the results are sufficient and adequate to satisfy the stated performance criteria.

Quality Management Plan (QMP) – establishes the principles, requirements, and practices necessary to implement the quality system for the SWQB's environmental data operations.

Sonde – a device used to measure multiple water quality parameters. Note: the term "sonde" is used interchangeably in this document to describe In-Situ Sondes and Onset HOBO® Dissolved Oxygen and Conductivity Loggers.

Standard Operating Procedure (SOP) – A document that lists the steps that should be completed when performing a task.

Subject Matter Expert (SME) – A person who is familiar with the purpose and procedure for accomplishing a task. The SME may be the same individual as the Program or Project Manager.

Surface Water Quality Bureau (SWQB) – A Bureau under the Water Protection Division of the New Mexico Environment Department. The SWQB's mission is to preserve, protect, and improve New Mexico's surface water quality for present and future generations.

SQUID – **S**urface **w**ater **QU**ality **I**nformation **D**atabase: the SWQB database for storing, retrieving and reporting laboratory results, field observations, biologic assemblage data, LTD data, and stream habitat/geomorphic data.

Thermograph – a water quality monitoring device that measures and records temperature.

5.0 Equipment and Tools

5.1 Sonde and Data Logger Specifications

The primary field instruments employed by SWQB are manufactured by Onset Computer Corporation and In-Situ, Inc.

Onset Computer Corporation 470 MacArthur Blvd, Bourne, MA 02532 Phone: (800) 564-4377 Email: sales@onsetcomp.com Internet: www.onsetcomp.com
In-Situ, Inc. 221 E. Lincoln Ave., Fort Collins, CO 80524 Phone: (800) 446-7488 Email: support@in-situ.com Internet: www.in-situ.com

The specific Onset devices are the HOBO® Water Temp Pro v2 Data Logger model U22-001, HOBO® DO Logger model U26-001 and Conductivity Logger model U24-001, all of which use the proprietary software HOBOware Pro to communicate with a PC. The HOBO® TidbiT® MX Temp 400 is managed through the HOBOmobile app on a mobile device and also uses HOBOware Pro software for file display and processing. The specific In-Situ sonde model number is Aqua TROLL® 600. This instrument can either be used with In-Situ's proprietary software, Win-Situ, for communication with PCs or a mobile app, Vu-Situ, for communication with tablets and mobile devices.

Sonde and sensor characteristics are described in the SWQB SOP 6.1, Table 1. Temperature logger characteristics are described in the SWQB SOP 6.3, Table 2. Instruction manuals for the sondes and data loggers are available on the SWQB file server. Instrument-specific procedures in the following sections are based largely on information in these manuals.

Other equipment and tools required for data logger uploads include:

1. Device specific handset (i.e., shuttle or base station, laptop/tablet or cell phone with Bluetooth connection)
2. Connecting cable or Bluetooth capability (depending on unit and receiver)
3. Appropriate software (e.g., HOBOWare, VuSitu etc.)
4. Access to the SWQB network and SQUID database

6.0 Step-by-step Process Description

6.1 Instructions for uploading datasets

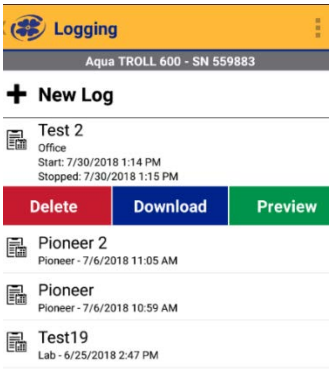
Refer to the SWQB SOP 6.2 Sonde Deployment and SOP 6.3 Temperature Data Loggers for procedures regarding preparing sondes and loggers for unattended data collection. This section covers the retrieval and upload of logged datasets from these instruments.

Do not delete files from a sonde, data logger, or shuttle until file copies have been transferred to network storage and backed up. Best practice is to ensure raw files as well as cropped and saved Excel data records have been stored on the network before deleting original raw files from sondes or loggers.

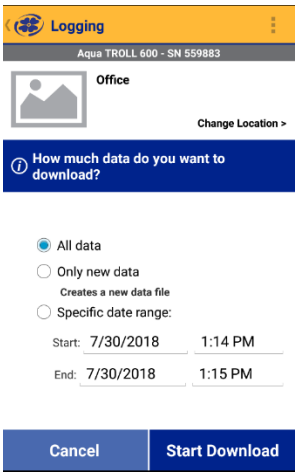
6.1.3 In-Situ Aqua Troll® 600 Sonde Data Upload Instructions

Uploading from the In-Situ Sonde to Mobile Device

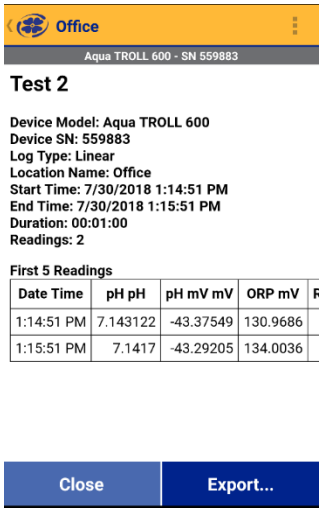
A. Activate the sonde by turning it upside down (sensors pointing up) for five seconds.
B. Turn on the mobile device and open the Vu-Situ app.
C. Connect to the sonde via available Bluetooth connections in the Vu-Situ app. If the sonde is not auto-discovered by the app, select Choose or **Add a device** and select the sonde (identified by its serial number) from the previous devices connected list.
D. Once a Bluetooth connection is established, select **Logging** from the main menu.
E. Select **Stop Logging** if the sonde is actively logging.
F. Select the file/site that you wish to download.



G. Select **Preview** to view the first and last five recorded measurements
H. Select **Download** to download the file.



I. Select **All data** then select **Start Download**.
J. After download is complete select **Export**.



K. Select the **VuSitu** Folder. The file will then be downloaded to the VuSitu file on the mobile device. If a cable is not available to download the file from the VuSitu file to a PC, the file can be sent as an email attachment.
L. Proceed to Section for Uploading from a Mobile Device to PC.

Uploading from a Mobile Device to PC

A. Connect the mobile device to a PC using the appropriate USB cable.
B. Using the PC file explorer locate the **VuSitu** folder contained in the mobile device file drive. Open the file for the station and copy the HTM/HTML file. Navigate to the raw data subfolder within the project folder and paste the file.
C. Open the HTM/HTML file using the PC internet browser. In the header of the document, select export to CSV and save the file in the processed data subfolder in the project folder. Alternatively, you may either copy and paste into an Excel file or open the HTM/HTML file directly in Excel. File can be saved as either a .csv or .xlsx type.
D. Crop the data to the deployment period (i.e., delete data points occurring before and after the instrument was taking legitimate recordings within the water at the deployment location, as indicated by the "deployed" and "retrieved" time and dates on the instrument's Deployment Form) and save the file.
E. Rename the Excel file using the site name, deployment date and instrument type. For example: "Comanche_abv_Costilla_2017_Apr_26_MP.xlsx". In this example "MP" stands for "multiparameter" to indicate the data is from a multiparameter sonde.

6.1.4 Onset HOBO® Dissolved Oxygen Logger Data Upload Instructions

Onset HOBO® DO Logger upload to Shuttle

Preparing Shuttle

The Onset Hobo Waterproof Shuttle may be used for interim downloads of DO Loggers in the field. Ensure that the shuttle batteries have sufficient life, sufficient memory is available, the shuttle's clock is set to the correct time and the correct coupler cap is installed on the shuttle. If shuttle batteries need to be replaced, the shuttle must be relaunched on a PC after battery replacement. Batteries must be replaced before the shuttle is taken into the field.

A. Unthread the center cap of the shuttle
B. Connect the shuttle to a PC USB port using the communication cable (USB Mini B to USB A).
C. Start Onset HOBOware Pro software
D. In the HOBOware application, select **Device > Manage Shuttle**
E. Review the Device Details panel for time on the shuttle clock, memory capacity and battery condition.
F. Replace the batteries at 2.2V or less.

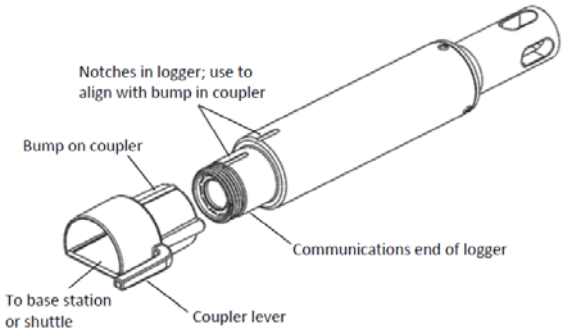
See the Onset manual for more information.

Uploading Logger to Shuttle

IMPORTANT!!!: See note in Section for "Processing Onset HOBO® DO Logger Files" prior to implementing the following procedure! If a partial data set is to be recorded to a shuttle at least one water-saturated air data point **MUST** be recorded at elevation before any data is transferred to the shuttle, and again after the transfer is completed and the logger is relaunched, before the logger is replaced into the water.

A. Remove the optical port cap from the logger.

B. Insert the logger into the Shuttle communication coupler aligning the bump/arrow on the coupler with the notch on the logger.



C. Press the coupler lever to initiate upload from the logger to shuttle. During upload, the status LED on the shuttle will flash amber. Do not remove.
D. Once upload is completed, the shuttle will synchronize the logger's clock and relaunch the logger using the settings from the previous launch.
E. Upon completion of relaunching, the status LED on the shuttle will blink green.
F. Remove the logger from the coupler and reattach the optical port cap.
G. Proceed to HOBO® Shuttle upload to PC.

Onset HOBO® Shuttle upload to PC

A. Connect the communication cable from the shuttle to a PC.
B. Start the Onset HOBOware Pro software.
C. From the HOBOware menu, select **Device > Manage Shuttle**
D. Choose files to upload in the Shuttle Management window then press **Offload Checked**.
E. Choose files to save and project file location then press **Save Checked**. Save the HOBO raw data file in the project's raw data folder. File name consists of the station name followed by the logger serial number then the date in year/month/date format and type of logger data. For example: Cabresto_Cr_@_NM_38_10502448_2018July6_DO.hobo. Note that the date used in the file name is the date of deployment, not retrieval.
F. Click "**save**."
G. Proceed to file processing.

Onset HOBO® DO Logger upload directly to PC

A. Remove the optical port cap from the logger.
B. Connect the Onset Base Station cord to the desktop or laptop USB port.
C. Open HOBOware Pro software on computer. Note: HOBOware Pro, as opposed to regular HOBOware software must be used to have access to the Dissolved Oxygen Assistant.
D. Insert the logger into the Base Station aligning the bump/arrow on the coupler with the notch on the logger.
E. A dialog box may appear showing the logger and computer are preparing for communication. Once the logger is set up to communicate another dialog box will appear notifying the user and the logger serial number will appear at the bottom right of the screen.

F. In HOBOware, select **Device > Readout**, or click on the icon for this function in the upper left corner of the application.
G. Save the HOBO raw data file in the project's raw data folder. File name consists of the station name followed by the logger serial number then the date in year/month/date format and type of logger data. For example: Cabresto_Cr_@_NM_38_10502448_2018July6_DO.hobo. Note that the date used in the file name is the date of deployment, not retrieval. Click "**save.**"
H. Proceed to file processing.

Processing Onset HOBO® DO Logger Files

HOBOware Pro software includes a feature to compensate for DO drift during unattended sampling (Dissolved Oxygen Assistant). Use of this feature requires recording of DO, temperature, conductivity, and pressure at the time of deployment and retrieval with a sonde, or by logging values in 100% water saturated air (refer to SWQB SOP 6.2 "Sonde Deployment").

Upon transferring data from the logger to the computer or if opening a *.hobo file on the computer, a dialog box in HOBOware Pro will open with the Dissolved Oxygen Assistant highlighted in blue. Then,

A. Enable **DO concentration** and **Temp**, then double click the DO Assistant, and the Dissolved Oxygen Data Assistant dialog box will open.
B. Ensure that the "**Adjust for salinity**" checkbox is checked (enabled), as DO concentration can vary significantly with changes in specific conductance or salinity.
C. Enter the specific conductance value recorded on the DO Logger Deployment Form. If a specific conductance reading was recorded at both deployment and retrieval, enter the average. If a coincident specific conductance data file exists for the deployment, select the data file by pressing the **Choose** button.
D. Ensure that the "**Use barometric pressure (for percent saturation)**" checkbox is checked and the "**Barometric data value**" radio button is selected. Enter the barometric pressure from a field measurement or a dissolved oxygen solubility table. If a barometric pressure reading was recorded at both deployment and retrieval, enter the average.
E. Under "**Resultant Series Information**" check "**DO Adj. Conc."** and "**DO Percent Sat.**"
F. Check "**Perform Field Calibration**"
G. Option 1 (Using Dissolved Oxygen Meter or Dissolved Oxygen Titration):
    1. Select the "**Using Dissolved Oxygen Meter or Dissolved Oxygen Titration**" radio button.
    2. Check the "**Starting calibration point**" box and select the starting calibration point from the drop-down list and enter the DO concentration recorded at deployment on the DO Logger Deployment/Upload/Retrieval Field Sheet.
    3. Check the "**Ending calibration point**" box and select the ending calibration point from the drop-down list and enter the DO concentration recorded at retrieval on the DO Logger Deployment/Upload/Retrieval Field Sheet.
G. Option 2 (Using 100% Water-Saturated Air):
    1. Select the "**Using 100% Water-Saturated Air**" radio button
    2. Select the measurement time corresponding to 100% water-saturated air at deployment and enter the starting barometric pressure.
    3. Select the measurement time corresponding to 100% water-saturated air at retrieval and enter the ending barometric pressure.

NOTE: Option 2 is preferable to Option 1. In order to use this option, at least one 100% water-saturated air data point **MUST** be recorded at elevation prior to deployment of the logger in the water, and subsequent to removal of the logger from the water, also at elevation (i.e., before leaving the station). If a partial data set is to be recorded to a shuttle, the 100% water-saturated air data points **MUST** be recorded before the data are transferred to the shuttle and again after the transfer is completed and the logger is relaunched, before the logger is replaced into the water. Even if the operator is planning on performing a dissolved oxygen saturation adjustment using Option 2, it is ***strongly*** suggested that deployment and retrieval sonde measurements (DO conc., percent sat, barometric pressure, and specific conductance) be taken as a backup in the event that 100% water-saturated air at elevation measurements (for Option 2) are skewed or otherwise recorded incorrectly.

H. Click the "**Create New Series**" button and a new dialog box will open. Enable **DO conc, Temp, DO Adj Conc,** and **DO Percent Sat**. Then click the "**Plot**" button at the lower right.
I. Compare the DO concentration value (ensuring that it is a data point taken while the logger was still submerged) or percent water-saturated air value (if using 100% saturated air for calibration verification) at the retrieval date and time to the DO concentration value or 100% water-saturated air value from a calibrated sonde. The in-stream sonde reading taken at retrieval are recorded on the retrieval form under Field Calibration > Retrieval > Sonde Readings. If the difference is ≤ 5 percent from the field calibration values, no data qualification is necessary. If the difference is > 5, but ≤ 30 percent, the data must be qualified as corrected. If the difference is > 30 percent, the data are qualified as rejected (see section 6.2.1 "Reviewing Data and Applying Data Corrections"). Note: Rejections are not applied during this step; .hproj files should be unaltered with the exception of corrections applied by the DO Assistant and cropping to the deployment period.
J. Crop the data to the deployment period. Select the series with the arrow tool, right-click, then select crop.
K. Save the file as a *.hproj file in the project's processed data folder using the same naming format as the raw data file consisting of the station name followed by the logger serial number then the date in year/month/date format and type of logger data. Note: The date used in the file name is the date of deployment, not retrieval.
L. To merge multiple data files from a single deployment, select **File > Merge Datafile(s)** and choose files to merge.
M. Export the data by selecting **File > Export Table Data** and choose the parameters to export (e.g. Temp and Dissolved Oxygen) and click the Export button to save as a *.csv or *.xlsx file in the processed data directory. Follow the same naming format as the raw and .hproj files for the saving processed .csv or .xlsx file in the processed data project folder.

6.1.5 Onset HOBO® Conductivity Logger Upload Instructions

Onset HOBO® Conductivity Logger upload to Shuttle

Preparing Shuttle

The Onset Hobo Waterproof Shuttle may be used for interim downloads of Conductivity Loggers in the field. Ensure that the shuttle batteries have sufficient life, sufficient memory

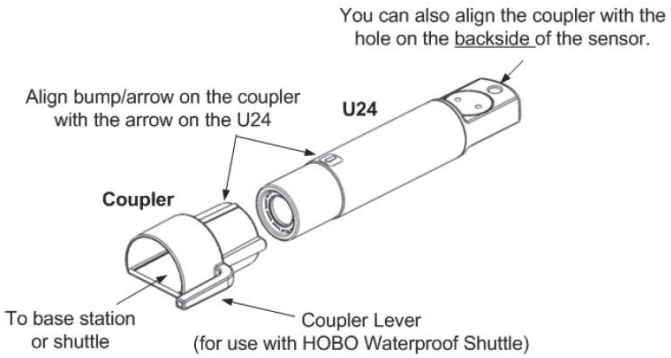
is available, the shuttle's clock is set to the correct time and the correct coupler cap is installed on the shuttle. If shuttle batteries need to be replaced, the shuttle must be relaunched on a PC subsequent to battery replacement. Batteries must be replaced before the shuttle is taken into the field.

A. Unthread the center cap of the shuttle
B. Connect the shuttle to a PC USB port using the communication cable (USB Mini B to USB A).
C. Start Onset HOBOware Pro software
D. In the HOBOware application, select **Device > Manage Shuttle**
E. Review the Device Details panel for time on the shuttle clock, memory capacity and battery condition.
F. Replace the batteries at 2.2V or less.

See the Onset manual for more information.

Uploading Logger to Shuttle

A. Remove the optical port cap from the logger.
B. Insert the logger into the Shuttle communication coupler aligning the bump/arrow on the coupler with the notch on the logger.



C. Press the coupler lever to initiate upload from the logger to shuttle. During upload, the status LED on the shuttle will flash amber. Do not remove.
D. Once upload is completed, the shuttle will synchronize the logger's clock and relaunch the logger using the settings from the previous launch.
E. Upon completion of relaunching, the status LED on the shuttle will blink green.
F. Remove the logger from the coupler and reattach the optical port cap.
NOTE: Be sure to record actual (not specific) conductivity with a calibrated sonde at the time of upload to shuttle (this is necessary for HOBOware Pro to perform a drift correction).
G. Proceed to HOBO® Shuttle upload to PC.

Onset HOBO® Shuttle upload to PC

A. Connect the communication cable from the shuttle to a PC.
B. Start the Onset HOBOware Pro software.
C. From the HOBOware menu, select **Device > Manage Shuttle**
D. Choose files to upload in the Shuttle Management window then press **Offload**

Checked.

E. Choose files to save and project file location then press **Save Checked**. Save the HOBO® raw data file in the project's raw data folder. File name consists of the station name followed by the logger serial number then the date in year/month/date format and type of logger data. For example: Cabresto_Cr_@_NM_38_10502448_2018July6_Cond.hobo. Note that the date used in the file name is the date of deployment, not retrieval. Click "**save**."
F. Proceed to file processing.

Onset HOBO® Conductivity Logger upload directly to PC

A. Remove the optical port cap from the logger.
B. Connect the Onset Base Station cord to the desktop or laptop USB port.
C. Open HOBOware Pro software on computer. Note: HOBOware Pro, as opposed to regular HOBOware software must be used to have access to the Conductivity Assistant.
D. Insert the logger into the Base Station aligning the bump/arrow on the coupler with the notch on the logger.
E. A dialog box may appear showing the logger and computer are preparing for communication. Once the logger is set up to communicate another dialog box will appear notifying the user and the logger serial number will appear at the bottom right of the screen.
F. In HOBOware, select **Device > Readout**, or click on the icon for this function in the upper left corner of the application.
G. Save the HOBO raw data file in the project's raw data folder. File name consists of the station name followed by the logger serial number then the date in year/month/date format and type of logger data. For example: Cabresto_Cr_@_NM_38_10502448_2018July6_Cond.hobo. Click "save." Note that the date used in the file name is the date of deployment, not retrieval.
H. Proceed to file processing

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Processing Onset HOBO® Conductivity Logger Files

HOBOware Pro software includes a feature to calculate specific conductivity and compensate for drift during unattended sampling (Conductivity Assistant). Use of this feature requires field calibration (refer to SWQB SOP 6.2 "Sonde Deployment"), which is accomplished by recording the actual conductivity (not specific conductivity) at the time of deployment and retrieval with a sonde.

Upon transferring data from the logger to the computer or if opening a *.hobo file on the computer, a dialog box will open with the Conductivity Assistant highlighted in blue. Then,

A. Enable the check boxes for **Temp** and the corresponding range of conductivity data monitored. Check **Low Range** for values between 0 to 10,000 µS/cm or **High Range** for values greater than 5000 µS/cm.
B. Double click the Conductivity Assistant or click the **Process** button to continue.
C. Select the appropriate conductivity series, either low or full range.
D. Under Temperature Compensation, select "**Non-linear, Natural Water Compensation per EN27888**."

E. In the Calibration section, select "**Use measured points for calibration**" and enter the starting and ending sonde measured actual conductivity with corresponding logger measurement times recorded on the Conductivity Logger Deployment/Retrieval Field Sheet.
F. Click the **Create New Series** button to generate the specific conductance time series and chart the data.
G. Compare the conductance value (ensuring that it is a data point taken while the logger was still submerged) at the retrieval date and time to the conductance value from a calibrated sonde. Sonde conductivity values are recorded on the Conductivity Logger Deployment/Retrieval Field Sheet. If the difference is ≤ 5 percent from the difference at deployment, no data qualification is necessary. If the difference is > 5, but ≤ 30 percent, the data must be qualified as corrected. If the difference is >30 percent, the data are qualified as rejected (see section 6.2.1 "Reviewing Data and Applying Data Corrections"). Note: Rejections are not applied during this step; .hproj files should be unaltered with the exception of corrections applied by the Conductivity Assistant and cropping to the deployment period.
H. Crop the data to the deployment period.
I. Save the resulting data as a HOBOware project file (*.hproj) in the project processed data folder using the same naming format as the raw data file consisting of the station name followed by the logger serial number then the date in year/month/date format and type of logger data. Note: The date in file name is the date of deployment, not retrieval.
J. To merge multiple data files from a single deployment, select **File > Merge Datafile(s)** and choose files to merge.
K. Export the data by selecting **File > Export Table Data** and choose the parameters to export (Temp and Specific Conductance) and click the Export button to save as a *.csv file in the processed data directory. Follow the same naming format as the raw and .hproj files for the saving processed .csv or .xlsx file in the processed data project folder.

6.1.6 Onset HOBO® Water Temp Pro V2

Onset HOBO® Water Temp Pro V2 upload to Shuttle

Preparing Shuttle

The Onset Hobo Waterproof Shuttle may be used for interim downloads of Temperature Loggers in the field. Ensure that the shuttle batteries have sufficient life, sufficient memory is available, the shuttle's clock is set to the correct time and the correct coupler cap is installed on the shuttle. If shuttle batteries need to be replaced, the shuttle must be relaunched on a PC after battery replacement. Batteries must be replaced before the shuttle is taken into the field.

A. Unthread the center cap of the shuttle
B. Connect the shuttle to a PC USB port using the communication cable (USB Mini B to USB A).
C. Start Onset HOBOware Pro software
D. In the HOBOware application, select **Device > Manage Shuttle**
E. Review the Device Details panel for time on the shuttle clock, memory capacity and battery condition.

F. Replace the batteries at 2.2V or less.

See the Onset manual for more information.

Uploading Logger to Shuttle

A. Insert the logger into the Shuttle communication coupler aligning the bump/arrow on the coupler with the notch on the logger.
B. Press the coupler lever to initiate upload from the logger to shuttle. During upload, the status LED on the shuttle will flash amber. Do not remove.
C. Once upload is completed, the shuttle will synchronize the logger's clock and relaunch the logger using the settings from the previous launch.
D. Upon completion of relaunching, the status LED on the shuttle will blink green.
E. Remove the logger from the coupler and reattach the optical port cap.
F. Proceed to upload from Shuttle to PC.

Onset HOBO® Water Temp Pro V2 upload from Shuttle to PC

A. Connect the communication cable from the shuttle to a PC.
B. Start the Onset HOBOware Pro software.
C. From the HOBOware menu, select **Device > Manage Shuttle**
D. Choose files to upload in the Shuttle Management window then press **Offload Checked.**
E. Choose files to save and project file location then press **Save Checked**. Save the HOBO® raw data file in the project's raw data folder. File name consists of the station name followed by the logger serial number then the date in year/month/date format and type of logger data. For example: Cabresto_Cr_@_NM_38_10502448_2018July6_Temp.hobo. Click "**save**." Note: the date used in the file name is the date of deployment, not retrieval.
F. Proceed to file processing.

Onset HOBO® Water Temp Pro V2 upload directly to PC

A. Connect the Onset Base Station cord to the desktop or laptop USB port.
B. Open HOBOware Pro software on computer.
C. Insert the logger into the Base Station aligning the bump/arrow on the coupler with the notch on the logger.
D. A dialog box may appear showing the logger and computer are preparing for communication. Once the logger is set up to communicate another dialog box will appear notifying the user and the logger serial number will appear at the bottom right of the screen.
E. In HOBOware, select **Device > Readout**, or click on the icon for this function in the upper left corner of the application.
F. Save the HOBO® raw data file in the project's raw data folder. File name consists of the station name followed by the logger serial number then the date in year/month/date format and type of logger data. For example: Cabresto_Cr_@_NM_38_10502448_2018July6_Temp.hobo. Click "**save**." Note: the date used in the file name is the date of deployment, not retrieval.
G. Proceed to file processing.

Processing Onset HOBO® Temperature Logger Files

NOTE: This section applies to files generated from either the Water Temp Pro V2 or the TidbiT® MX Temp 400. Upon transferring data from the logger to the computer or if opening a *.hobo file on the computer, a dialog box will open for the Plot Setup. Then,

A. Enable the check box for "Temp" and ensure units are in °C.
B. Click the Plot button to generate the temperature time series and chart the data.
C. Crop the data to the deployment period.
D. Save the resulting data as a HOBOware project file (*.hproj) in the project processed data directory.
E. To merge multiple data files from a single deployment, select **File > Merge Datafile(s)** and choose files to merge.
F. Export the data by selecting **File > Export Table Data** and choose the parameters to export (Temp) and click the Export button to save as a *.csv file in the processed data directory.

6.1.7 Onset HOBO® MX TidbiT® 400

Upload to Mobile Device

A. Using the HOBOmobile app, connect to the logger that you want to upload data from.
B. Choose **Readout.**
C. Choose **Data Files.**
D. In the upper right corner, choose **Select,** then tap the check box next to the graph.
E. In the lower left corner, choose **Share.**
F. In the dialog box that opens, choose the file type you wish to export (typically, this will be a *.hobo file).
G. Choose the method to share by (typically, we will email the file(s)).
H. Save the emailed .hobo file to the server within the project "raw data" folder and follow the instructions in 6.1.6 above for processing Onset HOBO® Temperature Logger Files.

6.2 Long-term Deployment (LTD) Data File Management

Original LTD raw data files from sondes and data loggers are archived in the raw data subfolder of the project folder, exported to Excel and checked for data integrity, then saved within the processed data subfolder of the project folder for further processing and upload. Access to these files as well as access to the completed Sonde Calibration Worksheet and Logger Deployment/Retrieval Form are required to implement this SOP and as well as the software to upload and view thermograph and sonde data directly from the data loggers.

Formatting the LTD Excel files for database (SQUID) upload is best accomplished by using the SWQB's Data Management Spreadsheet. LTD Data Management Spreadsheet templates for both one hour and fifteen-minute data are located on the SWQB SOP webpage (https://www.env.nm.gov/surface-water-quality/sop/). Each template is formatted with designated rows and columns that must remain the same in order for summary statistics to calculate correctly. Use of additional columns and rows for other parameters or calculated metrics that are desired should not be included on the first sheet of the LTD Data Management Spreadsheet as they will interfere with upload of the Excel file into SQUID. The final saved upload format Excel file must only include the first sheet of the LTD Data Management Spreadsheet. Graphs relating to the data will also not be saved or included in the uploaded Excel file, however the spreadsheet with these graphs will remain in the processed data folder. The LTD Data Management Spreadsheet formatting steps are summarized below:

1. Use input routines (macros) provided in the LTD Data Management Spreadsheet template or, alternatively, copy and paste data for each parameter into the specific column on the Excel template. If directly copy/pasting data into the spreadsheet, reference the raw data filename/filepath in the cell to the right of the site location ID.
2. Fill in the Site Location ID (e.g. 50PecosR666.7); Type and Serial #/Sonde ID of LTD equipment (e.g. "DO/10944486," or, "MP AT 19"); and Location Latitude/Longitude coordinates. Convert and format all parameter units to match the template format, such as date, time, decimal places, and measurement units. ***Note:*** The DATE field must contain only the date in MM/DD/YYYY format and the DATE+TIME field must contain date and time formatted in HH:MM:SS format, with no decimal seconds.
3. Crop the data to reflect the actual long-term deployment period indicated on the Deployment and Retrieval Form, if not previously completed within the sonde or thermograph software. Do not delete entire rows from the spreadsheet as this can remove data placeholders within the template. Instead, only delete specific cells or groups of cells.

6.2.1 Reviewing Data and Applying Data Corrections and Rejections

Verify that sonde calibration and post-deployment calibration checks were performed as required by SOP 6.1 and 6.2 and that all sensors were in calibration during the sampling period. If measurements were recorded while the instrument was within the In-Calibration Range indicated by Table 1, adjustment of the data is not necessary. If measurements resulted in values between the In-Calibration Range and the Linear Interpolation Range (Max Allowable Limits) as identified in Table 1, perform a drift correction (unless already performed using HOBOware pro software, i.e., DO or Conductivity Assistants) and assign a parameter-specific qualifier flag as identified in Table 2 to these data indicating that they are corrected. Parameter specific corrected qualifier and rejected qualifier codes are also indicated on the first page of the LTD Data Management Spreadsheet. All qualifier codes should be entered in the "qualifier" column of this spreadsheet adjacent to the data to be qualified. Comments indicating the nature of the qualifier or the reason it was applied should be indicated in the comments field adjacent to the qualifier. Data coded as rejected are automatically excluded from summary statistics.

Onset DO and conductivity loggers include drift correction data assistants with HOBOware Pro for data processing (see sections 6.1.4 and 6.1.5 for "DO Assistant" and "Conductivity Assistant" procedures, respectively). To ascertain whether a "corrected' qualifier should be indicated in the LTD Data Management Spreadsheet if the HOBOware data assistant correction software was used, compare the ending unadjusted DO concentration value from the raw data file (ensuring that it is a data point taken while the logger was still submerged) or percent water-saturated air value (if using 100% saturated air for calibration verification) at the retrieval date and time to the DO concentration value or 100% water-saturated air value from a calibrated sone reading recorded on the retrieval form under Field Calibration > Retrieval > Sonde Readings. If the difference is ≤ 5 percent from the field calibration, no data qualification is necessary. If the difference is > 5, but ≤ 30 percent, the data must be qualified as corrected. If the difference is >30 percent, the data are qualified as rejected.

If Onset DO and conductivity logger data cannot be corrected using HOBOware software, adjust the data collected following the point at which the instrument was initially calibrated and deployed, or instrument drift was first identified (such as following large changes in measured parameters or surface water discharge), as instructed in the LTD Data Management Spreadsheet and by using the input routines. Indicate in the LTD Data Management Spreadsheet comments that alternative data processing was completed. If field-calibration and calibration validation values indicate that measurements were taken outside of the Linear Interpolation Range (Max Allowable Limits), assign a parameter-specific qualifier flag to these data indicating that they are rejected. Rejected qualifiers should be assigned during the time the instrument malfunctioned. This is determined by inspecting coincident information such as battery voltage or other parameters that indicate sonde or sensor malfunction. If a discrete time of malfunction is unknown, rejected qualifiers should be assigned back to the time the instrument was initially calibrated and deployed. Parameter-specific qualifier codes are located in Table 2.

In-Situ sondes and Onset HOBO® thermographs currently do not have a software solution for instrument drift, fouling drift, or offsets. If a calibration verification results in a value greater than the in-calibration range and less than or equal to the maximum allowable correction limit for that parameter, a correction must be applied to the dataset. There may be circumstances where an offset or drift correction is not appropriate and must be documented in the LTD Data Management Spreadsheet comments. If a specific event or time can be identified as the start or stop of the drift, the correction should encapsulate that period, otherwise the correction should cover the period between calibration and calibration verification. Linear drift is the most common form of correction since the sensors on a sonde or data logger are calibrated by adjusting slope and/or offset. However, non-linear drift may be preferred under certain conditions. Contact the instrument manufacturer if any question exists on the suitable correction for a given parameter. Linear drift is applied to a dataset using the following formula:

$$Data_{corrected} = Data_{original} + (value_{standard} - value_{measured}) * N/N_{total}$$

where N equals the sequential number of the data point and N_{total} equals the total number of corrected data points. To assist with applying linear drift corrections to continuous data, use the Drift Correction on the LTD Data Management Spreadsheet located on the SWQB SOP webpage (https://www.env.nm.gov/surface-water-quality/sop/). Follow the instructions included on the spreadsheet for the parameter of interest. Parameters with multiple calibration points and verifications (such as pH and turbidity) have corrections applied based on independent offset and slope corrections. The spreadsheet automatically calculates corrections for DO-mg/L from %-saturation corrections. However, if a significant amount of time passes between either the initial calibration and deployment or retrieval and calibration verification, greater uncertainty arises as to

how much instrument drift occurred during the deployment itself. For that reason, sonde and data logger calibrations and verifications that are not completed within 48 hours of deployment and retrieval, respectively must have drift correction reviewed by the SME, Project Manager, or QAO. Apply the parameter-specific qualifier codes located in Table 2.

Table 1. Calibration Criteria

Parameter	Standard	Standard Value	In-Calibration Range	Linear Interpolation Range (Max Allowable Limits)
Temperature, °C	NIST Traceable Thermometer	Ambient Temperature	± 0.5	± 2
Conductivity µS/cm	Standard Solution	1413	± 5%	± 30%
Dissolved Oxygen, %	Water-Saturated Air	100%	±5%	± 30%
pH, SU	Buffer Solution	4, 7, 10	± 0.2	± 1
Turbidity, NTU	DI Water	0	± 1	± 10
	Standard Solution	100	± 5	± 30
		1000	± 50	± 300

Note: If DO% is out of calibration range and a linear interpolation is required, then DO concentration in mg/L must be recalculated using the same linear adjustment as those used to correct DO%. This correction is completed concurrently using the LTD Management Spreadsheet linear correction function.

Review the data for points or periods of anomalous data and consider, as appropriate, other data recorded on the Sonde Calibration Sheet, such as battery voltage and millivolt reading at pH calibration, when completing inspection. The data review is most easily completed by looking at a graph of the data. Example graphs of unusual data points, drifts, or unaccounted-for swings or spikes are included in QA Examples (**https://www.env.nm.gov/surface-water-quality/sop/**). These graphs may indicate fouling or wiper failure or exhibit periods of flat lines or small or no changes that may indicate burial, or show extreme temperature swings that may indicate exposure to air.

When reviewing LTD datasets for errant data determine the likelihood of whether the LTD device recorded data while either buried in sediment or exposed and out of the water. This can be determined by a review of the deployment/retrieval forms (which should include comments by field staff of observations made at the time of interim uploads and retrieval) and by a thorough review of the graphed data. Unusually high diel temperature fluctuations or periods of extremely low conductivity are indicative of air exposure; unusually shallow diel temperature swings or extended periods of extremely low DO are indicative of burial. This is easiest to see on a graph but in general, a temperature change of more than 3°C per hour is usually an indication of exposure to air. Specific conductivity values can also be used to assess potential logger air exposure; specific conductance of air (indicating exposure) is nearly zero, while most freshwater streams in New Mexico have specific conductance values ranging from 50 to 500 µS/cm (Griffith 2014). Those

portions of the data set that exhibit evidence of either air exposure or burial should be excluded from the summary statistics and assessment by using the parameter-specific rejected qualifier in Table 2, but not discarded.

Outliers and aberrant data may demand special attention, especially when those data represent the minimum or maximum values within the dataset or are prolonged enough to affect the time threshold calculation for certain assessment values (such as the 4T3, 6T3, or the maximum allowable duration for turbidity). Outliers can be errant data points that occur from sensor malfunction, debris trapped within the sonde cage, localized biological activity, or other causes not representative of the overall water quality of the stream. One method to determine whether a data point or swing is an outlier is to look at coincident readings from other sonde sensors to see if they also exhibit unusual data points or swings. For example, a spike in turbidity may coincide with an anomalous response in conductivity (either up or down) or changes in temperature data often correlate with changes in oxygen concentrations. A review of weather or stream flow records may also offer insight into anomalous data. A spike or swing in one sensor without coincident responses in other sensors may be a good indication of erroneous data. Caution must be exercised when assigning qualifiers to outliers that cannot be readily explained and therefore require further analysis to determine their significance. Data points that are not associated with an overall trend, are episodic in nature, and have differences in values that are greater than 3 standard deviations from the mean should be qualified as rejected but not discarded. The SWQB LTD Data Management spreadsheet contains an outlier detection Excel macro function (for values >3 times the difference between the first and third quartile added to the third quartile or subtracted from the first quartile) that flags potential outlier values for review. All flagged values will be highlighted in red. Review these values for data that may be unrepresentative of the actual condition of the water body at the time of recording. Examples of outlier data points that should be rejected are temperature data that spike as the result of stormwater runoff from a heated landscape (e.g. asphalt) during a storm event, or dissolved oxygen levels that spike or crash suddenly in response to runoff or temporary logger burial. Examples of outlier data points that should not necessarily be rejected include brief spikes in turbidity due to storm events, or brief but marked changes in specific conductance or temperature as a result of changing water conditions during a storm event. As long as anomalous or outlier data are not prolonged it will not affect the assessment conclusion in the majority of cases as many parameters require both a time and data value threshold component to incur an exceedance.

Graphing of data can occur in either the data logger software or Excel and is not standardized, which allows for personal preferences and individual analysis specific to projects or programs that generate separate metrics. Customized graphs, conditional formatting, and ancillary metrics, such as battery charge, will not be included as part of the SQUID upload file. Also, for the purposes of data upload into SQUID, all data points between deployment and retrieval will be included regardless of whether the data were rejected or corrected. However, only assessed valid data, excluding rejected data, will be used to generate summary statistics. The template spreadsheets are designed to assess data based on assigned data qualifiers. If needed, assign the appropriate parameter-specific qualifier from Table 2. Any LTD data that has been qualified must be documented according to SOP 15.0 Verification and Validation Procedures.

Table 2. Parameter Qualifier Codes

Parameter	Corrected	Rejected
Temperature, °C	**CT**	**RT**
Conductivity, µS/cm	**CSC**	**RSC**
Dissolved Oxygen, %	**C%**	**R%**

Dissolved Oxygen, mg/L	**CDO**	**RDO**
pH	**CPH**	**RPH**
Turbidity, NTU	**CY**	**RY**

In certain cases, a parameter may pass QA criteria (not rejected) but the parameter dataset may still not qualify for assessment or may only partially qualify for assessment. Examples include data not collected during an index period, temperature datasets that do not capture the summer season high temperatures, datasets recorded for less than the minimum period required, etc. See the current Comprehensive Assessment and Listing Methodology (CALM, https://www.env.nm.gov/surface-water-quality/calm/) for data assessment requirements. Place the appropriate qualifier within the assessability field for each parameter measured using the qualifiers listed in Table 3. **Important note:** In order for a thermograph dataset to be used to determine "full support," it must include the portion of the year with the highest temperatures. Temperature data that do not include the ascending and descending limb of seasonal temperatures (whether this is due to rejected data or the deployment period) can only be used for determining a non-support assessment (or, if there is less than 72 hours of usable data it qualifies for "neither"). Other parameters from logger long-term datasets (including dissolved oxygen, turbidity, pH, and conductivity) must include at least 72 hours with a maximum one-hour frequency interval to meet the requirements for assessing "full support".

Table 3. Assessability Qualifier Codes

Assessability	Qualifier
Full Support and Non-Support	**BOTH**
Non-Support Only	**NON**
Not Assessable	**NEITHER**

6.2.3 Calculations

In addition to the minimum, maximum and mean statistics, the LTD Data Management Spreadsheet contains automated routines to calculate other statistics used for assessment of datasets. Follow the steps below to calculate the additional temperature, dissolved oxygen and turbidity statistics.

A. Enter all qualifiers and comments for the dataset then press the "QA and Verify Data" button to run the QA documentation macro.
B. The LTD spreadsheet template will automatically update the minimum, average and maximum values for each parameter of the dataset.
C. If the 4T3, 6T3, and MWAT temperature statistics are desired, press the "Run 4T3/6T3/MWAT" button to run the calculation macro.
D. If the maximum 24-hour delta dissolved oxygen concentration statistic is desired, press the "Calculate Delta DO" button to run the calculation macro.
E. If the maximum turbidity duration statistics are desired, press the "Run Turbidity Results" button to run the calculation macro.
F. Review the LTD template spreadsheet for completeness and calculation or formatting errors.

Tip: If errors calculating summary statistics occur, begin the problem-solving process by ensuring that the data in each column have been entered correctly (e.g. date and time, no decimals in time, etc.).

6.2.4 Saving LTD File and Creating Upload File

When finished with the quality assurance and calculation procedures, save the Excel file as an *.xlsx file in the LTD archived folders in MASS > Monitoring Team > Archived Logger Data. Graphs created during the V&V process will not be saved in the upload file format and are preserved in only the macro-enabled Excel file. The "Save and Create Upload" macro will create new files with correct formatting for database upload. If saving the upload file in *.csv format without using the macro, be sure that first sheet of the template is the active sheet. Excel files saved in *.csv format will only save the current active sheet and this needs to be first sheet for each template containing all data, which is then uploaded into SQUID.

6.3 SQUID LTD Sampling Event Creation and Excel Data Upload Instructions

6.3.1 Creating an LTD Sampling Event Within a Station

A. Select the *Projects* tab on the SQUID home page and select the appropriate project or use the *Project Filter* to search
B. Select the *View/Add Monitoring Location* page
C. Select the *Sampling Events* page for the specific station to which you are attaching LTD data.
D. Under the *Add New Sampling Event* tab select *Long Term Deployment* under the *Sampling Event Type* drop down list and click the *Add New Sampling Event* button.
E. Under the *General* tab, populate the sampling event with the appropriate metadata
   1. *Start/End Date* – this should correspond to the start/end dates for the data file
   2. *Field Staff at Deployment*
   3. *Comments*
   4. *Media Type: Water/Air*
   5. *Data Logger Type: Sonde/Thermograph*
   6. *Data Logger Name and Number*
   7. When metadata entry is complete select *Save*

6.3.2 Attaching an Excel Data File to the Sampling Event

A. On the *Sampling Event* page, under the *Type* column, go to the long-term deployment row for the particular monitoring site, and date and time and select *Add/Upload LTD Data* under the *Uploads* column
B. Select *Browse* within the filename window and navigate to the appropriate LTD file on SWQB public
C. Select *Upload File*
D. Ensure the file uploaded by following procedures in 6.3.3 below.

6.3.3 Correcting Uploaded LTD Data

If the logger upload file needs to be modified for any reason (if, for instance, more data was rejected during the validation and verification process) simply navigate to the station within the project file, locate the *Long Term Deployment* line item (ensuring it is the correct deployment), select the link under the *Uploads* column that allows for *Add/Update LTD Data*. Navigate to the corrected upload file and select *Upload*. Once the upload is complete navigate to the Long Term Deployment sampling event "details" page and ensure that the file under *Logger Data* contains the corrected data (and click on file link and download to view the uploaded file).

6.3.4 Viewing LTD Sampling Event Metadata and Summary Statistics

A. Metadata can be viewed for a LTD sampling event by selecting the *Activities* page for the Long Term Deployment event
B. Within the *Activities* page, select *Results* within the "LTD_DATA" ID row
C. Metadata and summary statistics will be displayed under *Water Measurements Results for Activity*

6.3.5 Displaying Metadata and Summary Statistics in Excel

A. Select the *Adhoc Report* tab from the SQUID home page
B. Select the desired project and monitoring location
C. Under *Sampling Event Types*, select *Long Term Deployment*
D. Select *Date Range*
E. Under the *LTD* tab at the bottom of the screen, select *LTD Assessment Report*
F. Open the *.xlsx file to view metadata and summary statistics

6.3.6 Retrieving Original LTD File From SQUID

A. Within the sampling events page for the particular monitoring location, go to LONG TERM DEPLOYMENT under the *Type* column, choose the appropriate start date and select *Details.*
B. Within the *Sampling Event Details* dialog box *General* tab, select the blue-highlighted box under *Logger Data*
C. The Excel file will download. Open the file to view the originally uploaded LTD file.

7.0 Data and Records Management

Raw, unaltered sonde and data logger files are stored in the raw data subfolder within the project's file location on the NMED server. Edited data files and completed upload templates are stored in the processed data subfolder. Upon completion of verification and validation of the project's LTD data, the files are transferred to the archived logger data subfolder. LTD sampling events and data are also stored in the SQUID database. Sonde and data logger deployment forms are stored in the project binder located in the SWQB file storage cabinets. Per 1.21.2.436 NMAC, water quality records are to be maintained for five years from close of file and then transferred to archives for permanent storage.

8.0 Quality Control and Quality Assurance

Quality Control and Quality Assurance of field data collection and data management from sondes/data loggers, both instantaneous and long-term deployment, are done through adherence to the process outlined in this SOP, SOPs 6.1 Sonde Calibration and Maintenance, 6.2 Sonde Deployment, 6.3 Thermographs and 15.0 Data Verification and Validation, all with QAO oversight. Accuracy and precision are monitored by instrument calibration and calibration verification. Completeness is calculated based on the required number of samples. Sensitivity is monitored through instrument calibration and the determination of method detection and reporting limits. The three qualitative data quality indicators (bias, representativeness and comparability) are assessed through the sample design process and selection of methods. In addition to standardized methods, proper training of personnel represents a critical aspect of meeting the data quality objectives in order to fulfill the goals of the SWQB's QAPP (NMED/SWQB. 2018). If, at any time, the QAO determines this process is not being adhered to, the QAO has the authority to cease activities specific to this SOP with prior support and approval by the SWQB Bureau Chief and MASS Program Manager, until such a time that the issue can be resolved. All personnel who deploy and/or retrieve data loggers for surface water monitoring, must be familiar with the protocols described in this

SOP, sign the acknowledgment form associated with this specific SOP and perform procedures as defined in this SOP.

9.0 Related Forms

Conductivity Logger Deployment/Retrieval Form (see SOP 6.2)
DO Logger Deployment/Retrieval Form (see SOP 6.2)
Temperature Logger Deployment/Retrieval Form (see SOP 6.3)
LTD Data Management Spreadsheet
Sonde Deployment/Retrieval Form (see SOP 6.2)
Sonde Calibration Form (see SOP 6.1)
Stream Field Data Form (see SOP 8.2)

10.0 Revision History

Original. Effective April 2013.

Revision 1. Effective April 2014. Added calibration and correction procedures for the Onset HOBO DO loggers.
Jody Kougioulis, QAO; Scott Murray, SME (Sondes); Gary Schiffmiller, SME (Thermographs); Jeff Scarano, Program Manager MASS

Revision 2. Effective April 2015. Added logger download instructions, clarified file management procedures.
Jody Kougioulis, QAO; Scott Murray, SME (Sondes); Gary Schiffmiller, SME (Thermographs); James Hogan, Acting Program Manager MASS

Revision 3. Effective March 2016. Updated LTD processing and upload file creation to include the macro additions to the LTD Excel template, addition of drift correction spreadsheet, reformatted to SOP 1.1 standard.
Shelly Lemon, Acting QAO; Kristopher Barrios, SME; Shelly Lemon, Program Manager MASS

Revision 4**.** Effective August 2018. Minor updates and clarifications, added information for In-Situ sondes, updated formatting to SOP 1.1 requirements, merged Sonde Upload Instructions, updated Onset HOBO DO and Onset HOBO Conductivity data logger data management, added thermograph upload instructions, added instructions for assessability qualifier, added Delta DO and Turbidity statistic calculations.
Miguel Montoya, QAO; Kristopher Barrios, SME/Program Manager MASS

Revision 5. Effective January 2021. Removed Hydrolab and YSI sonde procedures. Minor corrections in database procedures.
Miguel Montoya, QAO; Kristopher Barrios, SME/Program Manager MASS

11.0 References

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