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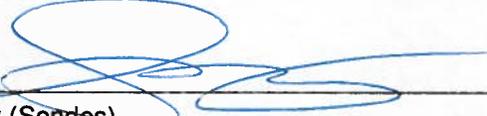
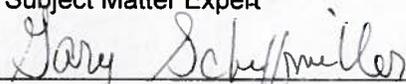
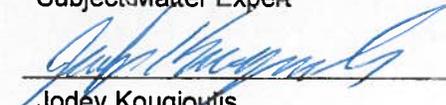
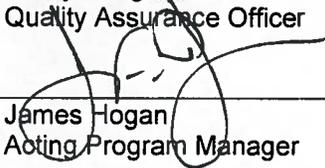
New Mexico Environment Department
Surface Water Quality Bureau

Standard Operating Procedure

for

LONG TERM DEPLOYMENT DATA LOGGER (THERMOGRAPHS AND SONDES) DATA QUALITY ASSURANCE AND EDAS UPLOAD INSTRUCTIONS.

Approval Signatures

 Scott Murray (Sondes) Subject Matter Expert	<u>4-20-15</u> Date
 Gary Schiffmiller (Thermographs) Subject Matter Expert	<u>4/29/2015</u> Date
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1.0 Purpose and Scope

The purpose of this document is to describe the procedures for 1) assessing the quality of data from Long Term Deployment (LTD) data loggers (sondes and thermographs) in water; 2) standardizing data formatting in Excel; and 3) uploading data into SQUID.

2.0 Personnel Responsibilities

Personnel who are responsible for uploading or managing data generated from LTD data loggers are responsible for implementing this procedure.

This includes ensuring that sensors were in calibration during the sampling period, adjusting 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. Table 1 indicates the range of readings for which adjustment is not necessary, the range of readings for which linear adjustment is required, and the range for which data are rejected based on post calibration values.

These data management activities will be performed using files on SWQB Public. All staff will have access to read the files in this directory, but editing permissions will be limited to designated project leads or the LTD coordinator for data security. After validation and verification and quality assurance procedures are performed, data files will be uploaded to SQUID.

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3.0 LTD Data File Management

3.1 Data Download

YSI

1. Connect the YSI handset (650MDS) to the deployed sonde
2. Select "sonde menu", "file", "upload", select file to upload, "comma delimited". File will transfer to the 650MDS
3. Connect the 650MDS to a PC, open EcoWatch, connect to sonde , choose the appropriate COM port. "#" will appear in the dialogue box indicating a successful connection
4. From the 650MDS main menu, select "file", "upload to PC", select file to transfer and press enter. Progress of the transfer is displayed on the PC screen.
5. Once transfer is complete, open the file in EcoWatch, review of the data (section 4.1 below), export a comma delimited file (CDF) to the project folder.

Hydrolab

1. Using the PDA, open Hydras 3 Pocket, connect to sonde.
2. Select "Log Files" from the main menu.
3. Select file to transfer and click "Download". Depending on file size, this could take up to several minutes.
4. Choose "Graph" to review the data, or select "Save" to save the file to the PDA. Assign a filename and select "Save".
5. Connect the PDA to a PC using the USB port (a square connector is required for the PDA). Turn on the PDA.
6. Using Microsoft Explorer, select the "Tripod Data Systems Recon" from the home screen, then navigate to the file in the "my documents" folder. Open the file in Excel and use the "text to columns" tool to organize the data.

HOBO DO Logger

1. Open HOBOWare Pro software
2. Attach logger to interface device (either base station or shuttle) ensuring proper alignment of logger and interface device.
3. Select Readout (either the icon on the toolbar, or from the menu bar choose Device\Readout, or Ctrl + R) and click OK.
4. Choose an appropriate file name and location and save.
5. In the Plot Setup, choose the parameters to plot and click Plot.

3.2 File Management

LTD raw data files from either sondes or thermographs will be exported to Excel and then saved within the project folder. Access to these files as well as access to the completed Sonde Calibration Worksheet and Deployment/Retrieval Sheet are required to implement this SOP and, if necessary, the software to upload and view thermograph and sonde data directly from the data loggers. For specific instructions for downloading data logger files from sondes and thermographs to either PDAs or PCs see SOP 6.2 and 6.3, respectively.

Format the LTD Excel files for upload using the sonde and thermograph Excel templates that are located on the SWQB SOP webpage (<http://www.nmenv.state.nm.us/swqb/SOP/>). Each template is formatted with designated units and columns that must remain the same in order for summary statistics to calculate correctly. Use of additional columns for other parameters or calculated metrics that are desired should not be included on the first sheet of the Excel templates and will not be included in the uploaded Excel csv file into SQUID. The final saved Excel csv file will only include the first sheet of the sonde or thermograph templates. Graphs relating to the data will also not be saved or included in the uploaded Excel csv file. Excel LTD template formatting steps are summarized below:

- 1) Cut and paste data for each parameter into the specific column on the Excel template
- 2) Crop the data to reflect the actual deployment period indicated on the Deployment and Retrieval Form if not previously completed within the sonde or thermograph software

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- 3) Fill in the Site Location ID; Type and ID# of LTD equipment; and Location Lat/Long
- 4) Convert and format all parameter units to match the template format, such as date, time, and temperature

4.0 Verification and Quality Assurance

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 were taken while the instrument was between the *In-Calibration Range* and the *Maximum Allowable Limits* criteria, perform a linear adjustment (daily adjustment equals the total adjustment divided by the number of days) and assign a parameter-specific qualifier flag to these data indicating that they are corrected. Adjust the data collected back to the point at which the instrument was initially calibrated and deployed. If measurements were taken outside of the *Maximum Allowable Limits*, assign a parameter-specific qualifier flag to these data indicating that they are rejected. Rejected qualifiers should be assigned back to the time the instrument malfunctioned. This is determined by inspecting coincident information such as DO charge, battery voltage, or other parameters that indicate sonde or sensor malfunction or exposure/burial. 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.

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Table 1. Calibration Criteria

Measurement	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, 8974, 10000	± 10%	± 30%
Dissolved Oxygen, %	Saturated Air	100	± 10	± 30
pH, SU	Buffer Solution	4, 7, 10	± 0.2	± 1
Turbidity, NTU	DI Water	0	± 5	± 10
	Standard Solution	100 (HL), 126 (YSI)	± 10	± 30

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 corrected DO%.

Onset HOBOWare DO Logger

HOBOWare Pro software includes a feature to compensate for DO drift during unattended sampling, the Dissolved Oxygen Assistant. Use of this feature requires field calibration (see SOP 6.1), which is accomplished by recording the DO at the time of deployment and retrieval with a sonde.

Upon transferring data from the logger to the computer, a dialog box will open with the Dissolved Oxygen Assistant highlighted in blue. Then,

- A. Enable DO conc 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 unchecked (disabled), as the Hydrolab and YSI sondes that are used for field calibration do not account for salinity.
- C. Ensure that the “Use barometric pressure (for percent saturation)” checkbox is checked and the “Barometric data value” radio button is selected. Enter barometric pressure from an elevation table.
- D. Under “Resultant Series Information” check “DO Adj. Conc.” and “DO Percent Sat.”
- E. Check “Perform Field Calibration” and select the “Using Dissolved Oxygen Meter or Dissolved Oxygen Titration” radio button.
- F. Initially, when checking for drift, check only the “Starting calibration point” box. Later, when adjusting the entire data set, the “Ending calibration point” box will also be enabled.
- G. Choose the starting calibration point from the drop down list and enter the DO concentration from the deployment field calibration.
- H. Click the “Creat 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 at the retrieval date and time (ensuring that it is a data point taken while the logger was still submerged) to the DO concentration value from the retrieval field calibration. If the difference is ≤ 10 percentage points, no data qualification is necessary. If the difference is > 10, but ≤ 30 percentage points, the data must be qualified. If the difference is > 30 percentage points, the data are rejected.
- J. Close, then re-open the file. Go through Steps A-H as before, but this time in Step F, enable the “Ending calibration point” checkbox, and in Step G, choose the retrieval date and time from the drop down list, and enable the “Only report data between selected points” checkbox.
- K. The resulting data are saved as a HOBOWare project file (*.hproj) and the adjusted DO concentration and percent saturation data are to be transferred to the upload template and ultimately uploaded to SQUIUD.

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4.1 Visual Inspection of Data

Review the data for points or periods of anomalous data and consider, as appropriate, other data recorded on the Sonde Calibration Sheet, such as DO charge 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 Appendix A. These may indicate fouling or wiper failure; or periods of flat lines or small or no change that may indicate burial, or extreme temperature swings that may indicate exposure to air.

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 also by review of a graph of the data. Unusually high diel temperature fluctuations or periods of extremely low conductivity are indicative of air exposure; unusually low diel temperature swings or periods of extremely low DO are indicative of burial. This is easiest to see on a graph but in general, a temperature change more than 3°C between consecutive hourly data points is usually an indication of exposure. Those portions of the data set that exhibit evidence of either exposure or burial should be excluded from assessment, but not discarded.

Outliers and unaccounted for spikes may demand special attention, especially when those data represent the minimum or maximum of the dataset. 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 sigma should be qualified as rejected but not discarded.

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.

Table 2. Parameter Qualifier Codes

Parameter	Corrected Qualifier	Rejected Qualifier
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

Separate multiple qualifiers for individual parameters with a comma within the Excel cell. If qualifiers and comments are not needed, the blank cells must be populated with "NIL". The Excel templates are set with "NIL" as the default and should only be changed when assigning a qualifier or providing comments. When finished with the quality assurance procedures, name the file and save the Excel file as a *.csv formatted

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file in the LTD archived folders in MASS Core Documents . Graphs created during the V&V process will not be saved in the *.csv file format and must be saved independently in order to preserve the graphs. Send V&V excel graphs via email to the Assessment Coordinator for later reference. When saving in *.csv format, 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.

5.0 SQUID LTD Sampling Event Creation and Excel Data Upload Instructions

5.1 Creating a LTD Sampling Event Within a Station

- 1) Select the *Projects* tab on the SQUID home page and select the appropriate project or use the *Project Filter* to search
- 2) Select the *View/Add Monitoring Location* page
- 3) Select the *Sampling Events* page for the specific station to which you are attaching LTD data
- 4) 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
- 5) Under the *General* tab, populate the sampling event with the appropriate metadata
 - a. *Start/End Date* – this should correspond to the start/end dates for the csv data file
 - b. *Field Staff at Deployment*
 - c. *Comments*
 - d. *Media Type: Water/Air*
 - e. *Data Logger Type: Sonde/Thermograph*
 - f. *Data Logger Name and Number*
- 6) Under the *Field Measurements* tab enter the summary statistics (AVG. MAX. MIN.) for each parameter generated from the LTD Excel template spreadsheet
- 7) When metadata entry is complete select *Save*

5.2 Attaching an Excel (csv.) Data File to the Sampling Event

- 1) On the *Sampling Event* page, under the *Type* column, go to the long term deployment row for the particular monitoring date and time and select *Add/Upload LTD Data* under the *Uploads* column
- 2) Select *Browse* within the filename window and navigate to the appropriate LTD csv file on SWQB public
- 3) Select *Upload File*

5.3 Viewing LTD Sampling Event Metadata and Summary Statistics

- 1) Metadata can be viewed for a LTD sampling event by selecting the *Activities* page for the event
- 2) Within the *Activities* page, select *Results*
- 3) Metadata and summary statistics will be displayed under *Water Measurements Results for Activity*

5.4 Displaying Metadata and Summary Statistics in Excel

- 1) Select the *Adhoc Report* tab from the SQUID home page
- 2) Select the desired project and monitoring location
- 3) Under *Sampling Event Types*, select *Long Term Deployment*
- 4) Select *Date Range*
- 5) Under the *LTD* tab at the bottom of the screen, select *LTD Summary Statistics*
- 6) Open the csv file to view metadata and summary statistics

5.6 Retrieving Original LTD csv. File from SQUID

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- 1) 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*
Note: There are two *Details* pages generated for each event, the metadata file will be populated with 18 results with an ID name structure of LTD_DATA_(DATE) and the Excel data file will have zero results with an ID name structure of LTD_(STATION_NAME)
- 2) Within the *Sampling Event Details* dialog box select the "LTD_STATION_NAME.csv" file
- 3) The csv file will open in Excel
- 4) This may also be accomplished by using the *Activity Filter* to search by the unique ATTACHMENT_ACT_ID from an LTD data report

6.0 Related Forms

Thermograph and Sonde Deployment/Upload/Retrieval Field Sheets
Dissolved Oxygen Deployment/Upload/Retrieval Field Sheets
Sonde Calibration Sheet
Sonde and Thermograph Excel template spreadsheets

7.0 Revision History

Revision 2 (4/15/2015) – Added logger download instructions, clarified file management procedures.
Revision 1 (4/10/2014) – Added calibration and correction procedures for the Onset HOBO DO loggers.
Revision 0 (4/5/2013) – Original

8.0 References

None