



MassDEP

**Massachusetts Department of Environmental Protection
Bureau of Water Resources
Division of Watershed Management
Watershed Planning Program**

STANDARD OPERATING PROCEDURE

Water Quality Data Validation Procedures
for CONTINUOUS PROBE DATA

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I Applicability

These procedures apply to continuous (“unattended”) water quality probe data generated by MassDEP’s Watershed Planning Program (WPP) using multiprobe sondes and temperature-only data loggers. Each year, WPP monitoring staff deploy pre-programmed probes with internal data logging capabilities in streams, rivers, lakes, and ponds throughout the State. These continuous probes collect water quality data at pre-set time intervals primarily for dissolved oxygen (DO) and temperature (T), although pH and specific conductance (SpCond) may also be collected. Probe deployment durations range from 2-3 days to 12 months, depending on need and circumstances. (For QC purposes, discrete (“attended”) probe readings are collected “side-by-side” with the deployed units to allow comparison between readings.) Probes calibration is checked before and after each survey. On an approximate monthly basis, recorded data files from unattended loggers are uploaded to the WPP data management network.

II Overview

These procedures document WPP’s approach to collating, processing, validating and finalizing continuous probe data files collected via unattended fashion (programmed to record at set intervals and deployed in-situ for long-term data collection). The steps consist of both automated and manual processes applied to individual-year data sets by WPP data management and quality assurance (QA) staff. Essentially, raw probe data files that have previously been uploaded to WPP’s network are assembled, checked for completeness, pre-processed to link up with field sheet meta data, trimmed to delete erroneous data at the beginning and/or end of each file, checked against field and laboratory QC data, and then reviewed against acceptance criteria. Based on checks against acceptance criteria, data are either accepted “as is”, qualified or censored. At the completion of these steps, data are provided to Principal Investigators for further review prior to finalization using standardized output formats.

III Prerequisites for Initiating Procedures

The following information is required in order to initiate processing and validation steps:

- 1) Raw continuous probe data files (.xmd, .csv, or .xls/.xlsx formats)
- 2) Laboratory QC summary reports (documented in the Instrument Lab Workbook “ILW”)
- 3) Proofed electronic field sheet files (entered in relational database, such as the Water Quality Database “WQD” or EDGE/EQuIS)
- 4) Final (QC4) discrete probe (field QC) data file
- 5) Validation Decision Criteria tables for each probe parameter (see **Appendix A**)
- 6) Program software/languages (MS Windows based): MS Excel, Visual Basic for Applications (VBA), Visual Basic Script (VBScript)

Working files are managed using MS Excel (.xlsx or .xlsm, if macro-enabled). Data management and QA staff should be well-versed in MS Excel, VBA and VBScript coding, and process documentation.



IV Assumptions

These procedures have the following underlying assumptions:

- 1) Proofed fieldsheet files are accurate (based on 100% data entry QC), until shown to be inaccurate. Any required changes to fieldsheet information are documented) and transferred to other databases as needed.
- 2) Validation decisions applied to a parameter in a trimmed continuous probe file (e.g., DO censored) may apply to all data for that parameter or to sections of the data (for example: specific data points that are missing due to logger/sonde power losses or malfunctions, or that are censored for suspected low water, out of water, tidal conditions, evidence of sensor fouling, or significant deviation from attended QA readings).
- 3) Any decision applied to DO applies automatically to DO saturation (DOsat) and any decision applied to SpCond applies automatically to total dissolved solids (TDS).
- 4) SpCond data represent temperature-compensated values (typically referenced to 25°C). If uncompensated conductivity readings are collected, values are converted to SpCond using the relation: $SpCond = Cond / (1 + r(T - 25))$, where r = temperature coefficient of variation (assumed to be 0.02), and T is in °C.
- 5) If discrete probe QC readings were not collected immediately adjacent to (side-by-side) the deployed probe, then the applicability of the QC readings will be assessed during manual QC2 review.
- 6) Validation of the unattended data is contingent on prior validation of the attended QC data (see separate SOP).
- 7) All deployments resulting in final data are assumed to be representative of ambient surface water quality conditions for the duration of the deployment, unless qualified with “r” (representativeness) or “t” (tidal).
- 8) All deployments resulting in final data are assumed to have been generated using approved methods.

V Roles and Responsibilities

Field Staff are responsible for conducting water quality surveys (under pre-defined project names) where discrete probe measurements are collected, following appropriate SOPs for field methods. They are responsible for accurately filling out field sheets that track probe serial numbers, dates/times of measurements, sample IDs (OWMIDs), and noting any field issues either on the field sheet directly or by emailing the Data Manager, Quality Assurance Officer, and/or Field & Lab Operations Coordinator. Each **Principal Investigator** in charge of a water quality project should submit Probe Request forms to the Field & Lab Operations Coordinator in advance of the monitoring season for planning and calibration purposes.

The **Field & Lab Operations Coordinator** is responsible for preparing probes and loggers for field use, calibrating probes prior to surveys, and completing probe request forms with serial numbers



assigned to projects for specific dates/locations. Data files from data loggers are also downloaded and stored in a commonly accessible file-sharing space

The **Data Manager** compiles field sheet information from appropriate data bases, runs automated scripts to process/check probe data files, and prepares files for review by the QA Officer.

The **QA Officer** performs manual quality assurance checks on probe data and overrides automated decisions where necessary.

VI Continuous Probe Data Validation Procedures

1. Multiprobe data file pre-processing steps (manual) Role: Data Manager
 - a. Collect all raw continuous probe data files in .xlsx or .csv format (Field & Lab Operations Coordinator is responsible for downloading data files from data loggers and storing in a commonly accessible file-sharing space)
 - b. File location: place files in Data Pre-Process folder by data year and logger/sonde type (Multiprobe vs. Temperature) and appropriate subfolders by format type:
 - i. Multiprobe file subfolders by type: HOBO COND, HOBO DO_T, Hydrolab
 - ii. Temperature file subfolders by type: Tidbits T
 - c. File formats:
 - i. Multiprobe files
 1. Hydrolab™
 - a. Should be comma-delimited (.xmd, .csv) or Excel (.xlsx, .xls)
 - b. Must follow the native Hydrolab format (.xmd) in terms of header placement, column spacing, and presence of individual date and time columns (*not* dates presented on single rows, as with the .txt files)
 - c. Must include the OWMID in the header block after "Log File Name:"
 2. Onset HOBO™
 - a. Should be comma-delimited (.csv) or Excel (.xlsx, .xls)
 - b. must include the date and time in a single column which later gets split into separate Date and Time columns
 - c. must include the logger serial number in the header block (after "Plot Title:" or "Serial Number:") (the serial number and file start and end dates get matched to field sheet meta data to identify the unique sample identifier (OWMID) for the file)
 - ii. Temperature logger files
 1. Should be comma-delimited (.csv) or Excel (.xlsx, .xls)



2. Must include the date and time in a single column which later gets split into separate Date and Time columns
 3. Must include the logger serial number in the header block (after "Plot Title:" or "Serial Number:") (the serial number and file start and end dates get matched to field sheet meta data to identify the OWMID for the file)
- d. Correct file formats as necessary

2. Process raw continuous probe data files (AUTOMATED/MANUAL) Role: Data Manager

- a. Run visual basic script **UnAtt_ProcessRawFiles.wsf** (.wsf = Windows script host file) to create a standardized output file format (automated)
 - i. Generates individual files in .xlsx format (in Data Post-Process folder) with standardized headings
 - ii. Matches probe serial numbers against field sheet meta data file to associate unique sample IDs (OWMIDs) to each file and to rename the files
- b. Review log file YYYY_PPStatus.txt (where YYYY is the data year) for errors (manual)
 - i. see **Appendix D** for explanation of errors, potential problems and solutions
 - ii. Possible corrections include, but are not limited to, removing data files from the Data PreProcess folder to "DO NOT USE" folders (e.g., air-temperature deploys files with incorrect file formats, duplicate files, etc.), re-exporting data files, adding/deleting rows in data files, changing header format in data files, changing worksheet names in data files, changing time format in data files and changing field sheet meta data.
- c. Rerun program in 2a) until items in 2b) appear to have been completely addressed

3. Compile probe calibration information and associated probe request information (automated/manual) Role: Data Manager/ Field & Lab Operations Coordinator

- a. Gather probe request worksheets from Field & Lab Operations Coordinator
- b. Compile probe calibration information by project name, calibration date, pre-survey calibration date, post-survey calibration date, and serial numbers, including:
 - i. Identification of sondes calibrated for particular parameters only (for later application of "NO CAL" flag and "-" to indicate no data)
 - ii. Calibration standards used for pH and SpCond (for later use in applying "c" qualifier; see **Appendix A, Validation Decision Criteria Tables**)
 - iii. Identification of parameters that violated inaccuracy ("i") criteria (see **Appendix A, Validation Decision Criteria Tables**)
- c. Run visual basic script called **ILW_QC_Summary.wsf** to compile individual instrument calibration files and probe request files

4. Produce QC2 file for QA review (automated) Role: Data Manager



- a. Run visual basic script called **UnAtt_TrimQA.wsf**
 - i. Processes individual OWMID files
 - 1. Trims files using date/times from validated discrete probe QC data identified from field sheet meta data (see separate files)
 - 2. Includes initial QC decision for each probe parameter based on combination of lab and field QC decisions (see **Appendix A**)
 - 3. Adds graphs for each parameter (note that any censored data will be suppressed from graphs)
 - ii. Produces master QC2 summary file for all continuous probe files in a data year
 - 1. including flagged issues (e.g. data spikes, missing values, potentially incorrect date/times)
 - 2. comparison of laboratory calibration/discrete probe validation criteria
 - 3. generates list of “Unmatched Lab QC OWMIDs”—OWMIDs found in the lab calibration files without a match to the unattended OWMIDs
 - 4. generates list of “Unmatched Unatt OWMIDs”—unattended OWMIDs without matching laboratory calibration information
 - 5. initial QC2 decisions based on validation criteria (see **Appendix A**)
 - iii. Output files (.xlsx, .xlsm format) are created in QC2 folder for year (YYYY) being processed

5. Review QC2 summary workbook for errors (manual) Role: Data Manager

- a. Lab QC
 - i. Review “Unmatched Lab QC OWMIDs” worksheet
 - ii. Review “Unmatched Unatt OWMIDs” worksheet
 - 1. Exceptions:
 - a. T logger files will always be listed because pre- and post-survey calibrations are not completed (QC checks on an annual basis only)
 - b. Unattended OWMIDS marked as not collected may be listed if the probes were not calibrated
 - iii. Review “Lab QC Checks” worksheet
 - 1. Review values that do not match between field sheet meta data and laboratory calibration file in columns labeled Proj Name Check, Sonde Check, Date Check (filter for “check” values)
 - 2. Make appropriate changes to field sheet meta data and/or laboratory calibration files to resolve issues
 - iv. Review “Unattended-Attended OWMID Sets” worksheet
 - 1. Check sample types (column SmpTypNm) not equal to “In-situ: QC Cal Check” (discrete probe QC samples associated with continuous probes through field sheet data)



2. Comments indicating potential data issues (incorrect/missing probe serial numbers, probes lost or malfunctioning or replaced)
- b. Review “Flags” worksheet for potential errors
 - i. Time errors (columns marked yes: missing drop off QC time, missing pick up QC time, Unattended starts after attended QC, Unattended stops earlier than attended QC, File start date doesn’t match FS [field sheet], File stop date doesn’t match FS)
- c. Review Analytes Present worksheet for potential errors
 - i. File Gear Matches FS Gear? If No, then manually fix continuous probe serial number in the field sheet file and/or the data files as necessary
- d. Regenerate QC2 files by re-running **UnAtt_TrimQA.wsf** as needed to fix errors identified above

6. Review final QC2 files for data quality (Manual) Role: QA Officer

- a. Download NOAA Daily National Weather Service (NWS) Summaries from <https://www.ncdc.noaa.gov/cdo-web/search> (download “Daily Summary” as a .csv file for all MA stations)
- b. Gather the files needed:
 - i. Weather data: *Weather-Precipitation-NOAA-MAstations-yyyy-yyyy*
 - ii. Metadata (from Data Manager): *MetaDatayyyy*
 - iii. Unattended Summary (from Data Manager): *YYYY_Unattended_QC2_Summary_(filedate)*
 - iv. QC3 Attended data (from Data Manager): *YYYY_attended_QC3_(filedate)*
 - v. Individual continuous probe files by sample ID (OWMID) for the data year (from Data Manager): e.g. *25-0105_QC2_(filedate)*
 - vi. Read Me files (from Data Manager): *readme_UNATT-QC4-(filedate)* and *readme_UNATT-QC2-(filedate)*
 - vii. Unattended QC Action items (from Data Manager): *yyyy Unattended Action Items (filedate)*
 - viii. QC2 working checklist: *YYYY_UnattQC2_Checklist*
- c. Review the individual OWMID QC2 files using the QC2 Checklist as a guide (if useful)
 - i. Look at *QC Summary* sheet for field QC, lab QC, and overall (combined field and lab QC) decision for each parameter
 - ii. Check the auto-generated graphs first. If more information is needed to assess the file, it is useful to graph:
 1. All the parameters for a station together (e.g. T, DO, SpCond) and in related groups (e.g. T/flow, SpCond/flow)
 2. Deployed readings vs. QC readings (if there are attended QC readings taken side-by-side with the deployed instruments) – manually enter the QC readings for graphing



3. Daily Min/Max of water probe parameter measurements against local NWS daily weather observations (which are generally available in daily min/max/average) – find the nearest weather station, manually add the daily weather summary data, use a pivot table to generate daily min/max data from the deployed record
 - a. daily min/max of water Ts vs. daily min/max of air Ts
 - b. daily min/max of SpCond vs. daily precipitation (sometimes snow pack)
 - c. daily min/max of DO vs T, precipitation, flow
- iii. Visually review graphs to look for:
 1. Large jumps or periods of instability in readings (all parameters) that do not coincide with weather or flow events that might suggest that the readings are "real" (qualify/censor "u").
 2. Water Ts $< -0.1^{\circ}\text{C}$ are likely in ice (qualify "i"); censor water Ts $< -0.5^{\circ}\text{C}$ as likely iced-in and out of water (censor "i").
 3. Jumps in reading times not related to instrument servicing or changes to/from daylight savings time – possible instrument problems, check field sheet comments
 4. Periods of time when water Ts mirror or exceed daily min/max air Ts likely indicate that the probe is out-of-water (censor "r"). Daily min/max of water Ts should stay between the daily min/max of air Ts except in the winter when water temps hover around 0°C .
 5. Unusual patterns in daily min/max of SpCond vs. precipitation (qualify/censor "u" or "r" depending on the problem).
Common winter pattern: spike or spike/dip in SpCond follows a precipitation event when temperatures are low and road salt application is likely; sometimes the spike is delayed if the Ts remain cold and melting doesn't occur for a few days. Common summer pattern: dips in SpCond follow almost immediately a precipitation event (precipitation diluting riverwater). Notes from Massachusetts Department of Conservation and Recreation (MassDCR): in small tributary streams they commonly observe a slow rise in average SpCond as summer flows get lower (and evapotranspiration (ET) gets higher) possibly indicating groundwater influence with chloride contamination and decreases in SpCond readings at the end of the growing season.
 6. DO readings getting erratic and dropping to near zero as streamflows get very low (possibly sediment or groundwater effects) (qualify/censor "r"). Low DO and a drop in water temperatures may indicate groundwater influence. Check the nearest U.S. Geological Survey (USGS)



gage for an indication of overall streamflows

(<https://maps.waterdata.usgs.gov/mapper/index.html>)

7. SpCond readings >1500 uS/cm may indicate tidal influence in coastal streams (qualify “t”). Check against tide charts:

https://tidesandcurrents.noaa.gov/tide_predictions.html

iv. Field sheet meta data and e-mail correspondence with **Principal Investigators**

1. Review sample comments (“Comments” column) and general field sheet comments (“FS Comments” column) (available in files *MetaDatayyyy* and *yyyy_Unattended_QC2_Summary_(filedate) / Unattended-Attended OWMID Sets* worksheet) for any notes related to errors, probe malfunction, out-of-water situations, etc.
2. Review e-mails (filed with the raw data for the year) for information that would cause data to be suspect (probe misplacement, out-of-water, low flow, etc.) and warrant parameter qualification or censoring

d. QC2 Summary workbook (*yyyy_Unattended_QC2_Summary_(filedate).xlsm*)

i. Review Flags worksheet for indications of data qualification/censoring

1. Power loss, data gaps, Potential tidal influence, no water for Attended QC columns = yes
2. Parameter thresholds (for threshold values used in the code, see Flags worksheet explanation, **Appendix C**)
3. Parameter spikes (for spike definitions (Δ parameter value/ Δ time) used in the code, see Flags worksheet explanation, **Appendix C**)

ii. QC Decision Summary worksheet

1. make notes about changes to be applied to individual rows of each OWMID data file in the “Actions Needed” column (DO NOT make changes to individual rows in OWMID data files yet; QC2 final decisions/qualifiers must first be applied (see step 7 below)). For changes affecting less than the full record, note the range of records (date/time, inclusive) affected. General review notes should be added to the “QC2 Comments” field. Initial and date each comment made.
2. Note cases where attended QC readings were missing or censored resulting in OWMID files not being trimmed at beginning or end of file
3. Add Final QC2 decisions for each parameter (DO, T, SpCond) and add qualifiers as needed (to be applied to entire column for each parameter)
4. Identify the duplicate sample OWMIDs NOT to be included in the final dataset

- a. Add “X” to the “Dups Not 2 Use” column

e. Update the QC2 “read me” Excel file for changes in processes (by data year)

7. Apply final QC2 review decisions to unattended files (AUTOMATED) Role: Data Manager



- a. Run VBA subprocedure: **apply_qcstatus** (located within the QC2 Summary workbook)
 - i. Enable macros (this may require re-opening the QC2 Summary workbook to see the enable macros button on the ribbon bar)
 - ii. Go to Developer tab → Macros button → select **apply_qcstatus** and hit Run
 - iii. Macro will:
 1. Check the QC2 Decision Summary worksheet for errors (such as capitalized or unrecognized qualifiers, blank decisions, and QUALIFY or CENSOR decisions without qualifiers, etc.)
 2. Open individual QC2 files and apply the QC2 final decisions/qualifiers to:
 - a. QC2 Decision Summary sheet
 - b. Data sheet (named after the OWMID)
- b. For cases of missing/censored attended QC data at probe drop off or pick up noted in QC2 Decision Summary worksheet:
 - i. Manually trim the files by deleting the appropriate rows at the beginning and/or end of each file (changes must be made to the OWMID data sheet, the OWMID backup sheet, the graphs-stats sheet, and the final sheet)

8. Edit individual unattended files for row-by-row censoring decisions (MANUAL) Role: QA Officer

- a. Apply row-by-row censoring or missing data decisions to the parameter QC Decision column and add the associated qualifiers to the parameter qualifier column (MISSING or NO DATA in the qualifier column overrides any values in the QC decision column for each parameter; any other qualifiers present with the MISSING keyword are ignored)
- b. Review all auto and manually applied decisions

9. Calculate OWMID summary statistics (AUTOMATED) Role: Data Manager

- a. Run VBScript: **UnAtt_CalcStats.wsf** for individual OWMID files
 - i. Calculates summary statistics (total count (all rows), observed count (excluding censored, missing, no data rows), average, standard deviation, minimum, maximum, median, interquartile range) for each OWMID file and parameter
 - ii. Adds statistics to the "Statistics" worksheet within each OWMID file
 - iii. Adds statistics to the "Statistics" worksheet in the QC2 summary workbook

10. Generate QC2 FINAL files and QC3 Review Files (AUTOMATED) Role: Data Manager

- a. Run VBScript called **UnAtt_QC3_V6.wsf** to generate QC3 files for review changes
 - i. Generates separate QC3 files by OWMID based on the QC2 file format used to make QC3 review changes
 - ii. Generates QC3 Summary workbook based on the QC2 file

11. QC3 Review Process (MANUAL) Role: Principal Investigators for each project

- a. Staff principal investigators review QC2 FINAL files for issues/errors



- i. Examine project file for completeness (are all data that were collected present; if not, why? Do any data appear to be missing?)
 - ii. Are data presented reasonable based on field conditions and professional judgment (e.g., are there outlier data that are not “real”)?
 - iii. Examine project file for any errors and inaccuracies you may find
 - iv. Other “problems”
- b. Staff principal investigators submit their QC3 review comments to QA Officer

12. Review comments received during QC3 review (manual) Role: QA Officer/Data Manager

- a. In collaboration with Data Manager, write a response to the QC3 comments for the Principal Investigators.
- b. QA Officer records changes needed to individual QC3 OWMID files in the QC3 Summary workbook on the “QC2 QC3 Decisions” sheet:
 - i. Summarize QC3 review comments received by Principal Investigators in the QC3 Review column and the QA Officer’s response (initial and date)
 - ii. Record only the changes needed to OWMID files in the QC3 Actions Needed column; if no change needed add “None”
- c. Apply QC3 Review changes to the individual QC3 files
 - i. if final decisions have changed
 - 1. change individual cells by filtering for previous value (don’t fill down because there may be row by row censored or missing values)
 - ii. if individual rows/cells have changed
 - 1. change individual cells by filtering for previous value (don’t fill down because there may be row by row censored or missing values)
- b. Update the QC4 “read me” Excel file for changes in processes (by data year).

13. Recalculate OWMID summary statistics (AUTOMATED) (if required) Role: Data Manager

- a. Statistics must be recalculated if:
 - i. Individual data files have changed (censored or missing cell changes only) for the year in question
- b. Run VBscript: **Unatt_CalcStats_8.wsf**

14. Create station files (AUTOMATED/MANUAL) Role: Data Manager

- a. Run vbscript: **Unatt_CreateStationFiles_V7.wsf** (Automated)
 - i. Compiles station files for each UniqueID using the individual OWMID data files as indicated in the field sheet meta data file. Because there may be different probe types for each site,
 - 1. Multiprobe files are labeled “M1, M2”, etc.
 - 2. Temperature files are labeled “T1, T2”, etc.



- ii. Data sheet becomes UniqueID sheet with each OWMID file added by date (earliest to latest)
 - 1. Rows are added to fill in discontinuous dates/times using NO DATA qualifier
- iii. Station Statistics sheet is blank
- iv. Graphs show all OWMIDs for the station in question for the data year/probe type and are renamed with the UniqueID in place of the OWMID
- b. Files are reviewed for overlapping dates/times by OWMID or for multiple OWMIDs by probe type (from different projects) (MANUAL)
 - i. If more than one OWMID exists for the probe type, select the most representative/complete file for use in the station file and delete the rows for the unneeded OWMID
 - ii. If OWMID files overlap by date/time, select most representative data block and delete rows for the overlapping/unneeded OWMID

15. Calculate station statistics (AUTOMATED) Role: Data Manager

- a. Run VBScript: **UnAtt_CalcStats.wsf** for individual station files
 - i. Calculates summary statistics (total count (all rows), observed count (excluding censored, missing, no data rows), average, standard deviation, minimum, maximum, median, interquartile range) for each UniqueID file and parameter
 - ii. Adds statistics to the "Summary Statistics" worksheet within each UniqueID file
 - iii. Adds statistics to the "Station Statistics" worksheet in the QC3 summary workbook
 - iv. Adds station information (Watershed, Water Body, Station Description, Mile Point, Latitude, Longitude) from separate Excel file

16. Generate QC4 FINAL files (AUTOMATED) Role: Data Manager

- a. Make sure there is a read me file for unattended QC4 data
- b. OWMID files
 - i. Run vbscript: **Unatt_QC4.wsf**
- c. Station files
 - i. Run vbscript: **Unatt_Stations_Finalize.wsf**

17. Check QC4 data files (Manual) QA Officer

- a. Look for any missing information
- b. Filter the data columns to look at range of reported values, missing values, or other issues
- c. Review the summary of qualifiers in project summary files



APPENDIX A: Validation Decision Criteria

Field Discrete Probe Data Criteria

Temperature (T)

		Acceptance Criteria			Notes
Qualifier		Accept	Qualify	Censor	
Stability ("u")	Limits (°C)	<0.3 °C	0.3-0.6 °C	>0.6 °C	Compare 5-minute RANGE of probe readings from 1st stable reading to "best line"
	Lake Metalimnion* Limits (°C)	<0.6 °C	0.6-1.2 °C	>1.2 °C	<i>*If the temperature difference from the reading 1m above is >1.0 deg C., then the readings are within the thermocline</i>
	Other criteria			Erratic readings; probe damage	
Accuracy ("i")	Limits (°C)	<0.2 °C	0.2-0.45 °C	>0.45 °C	Compare probe to NIST Thermometer (semi-annually or as needed)
	Other criteria	T ≥ 0.1 °C	-0.5 °C ≤ T < 0.1 °C	T < -0.5 °C	
Tidally-influenced ("t")	Other criteria		SpCond qualified for "t"		
Method not followed ("m")	Time Difference (min.)	≥2 min.	1-2 min.	<1 min.	Compare probe start time to end time (usually same as stable best line) For lakes, evaluate each depth separately
Representativeness ("r")	Other criteria		Stagnant conditions or beaver impoundment noted on field sheet		
Manual data ("s")	Other criteria		field sheet data were used in place of electronic data (i.e., no electronic records available)		



Dissolved Oxygen (DO)

Qualifier		Acceptance Criteria			Notes
		Accept	Qualify	Censor	
Stability ("u")	Limits (mg/l)	<0.4 mg/l	0.4-0.8 mg/l	>0.8 mg/l	Compare 5-minute RANGE of probe readings from 1st stable reading to "best line" <i>DOsat QC Result follows decision for DO</i>
	Lake Metalimnion* Limits (mg/l)	<0.8 mg/l	0.8-2.4 mg/l	>2.4 mg/l	<i>*If the temperature difference from the reading 1m above is >1.0 deg C., then the readings are within the thermocline</i>
	Other criteria		T censored for "u"	Erratic readings; probe damage	
Accuracy ("i")	Limits (mg/l)	<0.2 mg/l	0.2-0.5 mg/l	>0.5 mg/l	Compare probe reading to theoretical 100% saturation value at post-survey check <i>DOsat QC Result follows decision for DO</i>
	Other criteria		T censored for "i"; no post-survey calibration check	Erratic readings; probe damage	
Tidally-influenced ("t")	Other criteria		SpCond qualified for "t"		
Method not followed ("m")	Time Difference (min.)	≥2 min.	1-2 min.	<1 min.	Compare probe start time to end time (usually same as stable best line) For lakes, evaluate each depth separately
Representativeness ("r")	Other criteria		Stagnant conditions or beaver impoundment noted on field sheet		
Manual data ("s")	Other criteria		field sheet data were used in place of electronic data (i.e., no electronic records available)		



Specific Conductance (SpCond)

		Acceptance Criteria			Notes
Qualifier		Accept	Qualify	Censor	
Stability ("u")	Limits (%)	<2 %	2-5 %	>5 %	Compare 5-minute RANGE of probe readings from 1st stable reading to "best line" <i>TDS QC Result follows decision for SpCond</i>
	Lake Metalimnion* Limits (%)	<2 %	2-5 %	>5 %	<i>*If the temperature difference from the reading 1m above is >1.0 deg C., then the readings are within the thermocline</i>
	Other criteria		T censored for "u"	Erratic readings; probe damage	
Accuracy ("i")	Limits (%)	<2 %	2-5 %	>5 %	Compare probe reading to post-survey check value <i>TDS QC Result follows decision for SpCond</i>
	Other criteria		T censored for "i"; no post-survey calibration check	Erratic readings; probe damage	
Calibration Range ("c")	Limits (µS/cm)	<= High Standard	> High Standard to <= 2 * High Standard	> 2 * High Standard	Compare probe value to highest standard used <i>TDS QC Result follows decision for SpCond</i>
	Other criteria		relatively low value compared to a very high standard (e.g., 1200 result after calibration standard 58640 used)		
Tidally-influenced ("t")	Limits (µS/cm)	<1500 (µS/cm)	>=1500 (µS/cm)	None	
	Other criteria		Field sheet comment; proximity to coast; lack of tidal restrictions		<i>*verify location and lack of tidal restrictions (e.g., dams) in GIS</i>



		Acceptance Criteria			
Qualifier		Accept	Qualify	Censor	Notes
Method not followed ("m")	Time Difference (min.)	≥2 min.	1-2 min.	<1 min.	Compare probe start time to end time (usually same as stable best line) For lakes, evaluate each depth separately
Representativeness ("r")	Other criteria		Stagnant conditions or beaver impoundment noted on field sheet		
Manual data ("s")	Other criteria		field sheet data were used in place of electronic data (i.e., no electronic records available)		

pH

		Acceptance Criteria			
Qualifier		Accept	Qualify	Censor	Notes
Stability ("u")	Limits (SU)	<0.4	0.4-0.6	>0.6	Compare 5-minute RANGE of probe readings from 1st stable reading to "best line" <i>DOsat QC Result follows decision for DO</i>
	Lake Metalimnion* Limits (SU)	<0.4	0.4-0.6	>0.6	<i>*If the temperature difference from the reading 1m above is >1.0 deg C., then the readings are within the thermocline</i>
	Other criteria		T censored for "u"	Erratic readings; probe damage	
Accuracy ("i")	Limits (SU)	<0.2	0.2-0.4	>0.4	Compare probe reading to post-survey check value
	Other criteria		T censored for "i"; no post-survey calibration check	Erratic readings; probe damage	
Calibration Range ("c")	Limits (SU)	Low Standard to High Standard	< Low Standard or > High Standard	None	Compare probe value to highest and lowest standards used



Qualifier		Acceptance Criteria			Notes
		Accept	Qualify	Censor	
Tidally-influenced ("t")	Other criteria		SpCond qualified for "t"		
Method not followed ("m")	Time Difference (min.)	≥2 min.	1-2 min.	<1 min.	Compare probe start time to end time (usually same as stable best line) For lakes, evaluate each depth separately
Representativeness ("r")	Other criteria		Stagnant conditions or beaver impoundment noted on field sheet		
Manual data ("s")	Other criteria		field sheet data were used in place of electronic data (i.e., no electronic records available)		

Depth

Qualifier		Acceptance Criteria			Notes
		Accept	Qualify	Censor	
Accuracy ("i")	Limits (m)	>0 m	0 m	<0 or >100 m	Analyze probe reading <i>*Criteria applied after reporting rules applied (depth rounded to 1 decimal place)</i>
	Other criteria		faulty sensor	Erratic readings; faulty sensor	
Tidally-influenced ("t")	Other criteria		SpCond qualified for "t"		
Method not followed ("m")	Time Difference (min.)	≥2 min.	1-2 min.	<1 min.	Compare probe start time to end time (usually same as stable best line) For lakes, evaluate each depth separately
Manual data ("s")	Other criteria		field sheet data were used in place		Qualifier also applies to hand-held probes where no logger is used



Qualifier		Acceptance Criteria			Notes
		Accept	Qualify	Censor	
			of electronic data (i.e., no electronic records available)		

Laboratory Probe Criteria

Temperature (T)

Compare continuous probe to NIST Thermometer (semi-annually or as needed).

Dissolved Oxygen (DO)

Qualifier		Acceptance Criteria			Notes
		Accept	Qualify	Censor	
Accuracy ("i")	Limits (mg/l)	<0.2 mg/l	0.2-0.5 mg/l	>0.5 mg/l	Compare continuous probe reading in low ionic standard solution at post-survey check to theoretical table value for DO (based on T and barometric pressure in the lab) <i>DOsat QC Result follows decision for DO</i>
	Other criteria		no post-survey calibration check		

Specific Conductance (SpCond)

Qualifier		Acceptance Criteria			Notes
		Accept	Qualify	Censor	
Accuracy ("i")	Limits (%)	<2 %	2-5 %	>5 %	Compare continuous probe readings in low ionic standard solution before and after survey, using relation: $100 \times (1 - \text{pre-survey value/post-survey value})$ <i>TDS QC Result follows decision for SpCond</i>
	Other criteria		no pre- or post-survey calibration check		



pH

Qualifier		Acceptance Criteria			Notes
		Accept	Qualify	Censor	
Accuracy ("i")	Limits (SU)	<0.2	0.2-0.4	>0.4	Compare continuous probe reading in low ionic standard solution before and after survey
	Other criteria		no pre- or post-survey calibration check		

Continuous Probe Criteria

Continuous probe criteria applied through automated processes are applied to all data rows by analyte for each file, not on an individual datum basis. Continuous data review, either by the QA Officer or through recommendations by the Principal Investigators, may override automated decisions, resulting in criteria being applied on specific data blocks by parameter or on an individual datum by parameter.

Continuous probe criteria by parameter, shown in the tables below, are based on the combination of field discrete probe and laboratory criteria for the accuracy "i" qualifier. Lab and field decisions are decided independently from continuous probe data processing and serve as inputs to the automated continuous data workflow. Additional qualifiers (representativeness "r", stability "u", method not followed "m" or tidally influenced "t") may be applied by the QA Officer during manual review of the continuous probe data to all rows for a given parameter, for specific data blocks, or by individual datum.

QC Decision for each qualifier	
code	Description
A	Accepted: data are accepted without qualification
Q	Qualified: data are usable and reported with qualifier indicated
C	Censored: data are censored with appropriate qualifier applied and not reported (reported as "##" instead)
none	Not enough information available to make a decision

Type of QC	
code	Description



F	Field QC Decision: Average of individual differences between discrete probe QC readings and continuous probe readings (for DO, T, pH) for as many discrete probe readings collected on a field sheet (at drop off of deployed probe, at pick up of deployed probe, or for any intermediate site visits where discrete probe QC readings are taken). For SpCond: calculate relative percent difference (RPD) between each discrete probe QC and continuous probe reading for each QC reading taken; use average RPD for limits
L	Lab QC Decision: Comparison of continuous probe reading against laboratory calibration standards (see Laboratory Probe Criteria above)



Temperature (T)

		FA	FQ	FC	F None
	Limits (°C)	< 0.3	0.3-0.6	>0.6	N/A
LA	<0.3	A	Q	Q	Q
LQ	0.3-0.6	Q	Q	C	Q
LC	>0.6	Q	C	C	C
L None	N/A	A	Q	C	C

Additional constraint on T

	A	Q	C
Limits (°C)	$T \geq 0.1$	$-0.5 \leq T < 0.1$	$T < -0.5$

Dissolved Oxygen (DO)

		FA	FQ	FC	F None
	Limits (mg/l)	< 0.5	0.5-1.0	>1.0	N/A
LA	<0.2	A	Q	Q	Q
LQ	0.2-0.5	Q	Q	C	Q
LC	>0.5	Q	C	C	C
L None	N/A	A	Q	C	C

Additional constraint on DO

DO status compared to associated T status:

	DO Status		
T Status	A	Q	C
C	Q	Q	C



Specific Conductance (SpCond)

		FA	FQ	FC	F None
	Limits (%)	< 2%	2-5%	> 5%	N/A
LA	< 2%	A	A	Q	A
LQ	2-5%	A	Q	Q	Q
LC	> 5%	Q	Q	C	C
L None	N/A	A	Q	C	C

Additional constraint on SpCond/TDS:

Adjust SpCond/TDS status compared to associated T status

	SpCond/TDS Status		
T Status	A	Q	C
C	Q	Q	C

pH

		FA	FQ	FC	F None
	Limits (SU)	<0.2	0.2-0.4	>0.4	N/A
LA	<0.2	A	A	Q	A
LQ	0.2-0.4	A	Q	Q	Q
LC	>0.4	Q	Q	C	C
L None	N/A	A	Q	C	C

Additional constraint on pH:

Adjust pH status compared to associated T status

	pH Status		
T Status	A	Q	C



C	Q	Q	C
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APPENDIX B: Reporting rules for Continuous Probe Parameters

Reporting rules for typical probe results

Probe Parameter	Rounding rule	Raw QC0 Result	Final QC4 Result
Dissolved Oxygen	10 th decimal	0.25111	0.3
Dissolved Oxygen saturation	Whole number	105.27	105
Specific Conductance	Whole number	25037.577	25038
Temperature	10 th decimal	31.333	31.3
pH	10 th decimal	5.62	5.6

Reporting rules for Instrument Detection Limits

Probe Parameter	Rounding rule	Raw QC0 Result	Final QC4 Result
Dissolved Oxygen	10 th decimal	0.097	<0.2
Dissolved Oxygen saturation	Whole number	1.97	<2
Specific Conductance*	Whole number	25037.577	25038
Temperature	10 th decimal	-0.23	<0.1
pH*	10 th decimal	5.62	5.6

*no lower limit (IDL) currently applies



APPENDIX C: QC2/QC3 Summary Workbook Explanation

General worksheet explanation:

Worksheet Name	General Description	Purpose
Read me	Explanation of worksheets (this sheet)	Informational
File Process Info	Lists code modules used and dates when automated processes were completed	Informational
Analytes Present	Lists summary information for each OWMID by parameter, including whether data are present for all rows, some rows, or no rows; the percent of data present by parameter; the percent of zeros present by parameter; for more specific information see below	Mainly informational; Some error checking (File Gear Matches FS Gear column)
Flags	Lists summary information for each OWMID, including whether threshold values were tripped for each parameter, the number of spikes calculated per parameter, and other QC information (time-related errors); for more specific information see below	Error checking; data qualification/censoring
Unattended-Attended OWMID Sets	Abbreviated version of Meta Data file; shows unattended OWMIDs and associated attended QC OWMIDs by field sheet log, including start date/time and stop/date times, count of # of attended QC OWMIDs, and type of attended QC (drop off, intermediate, pickup)	Mainly informational; Some error checking (missing attended QC OWMIDs or multiple attended QC types (drop off, intermediate, pickup) associated with same unattended OWMID)
Statistics	Summary statistics for each unattended OWMID by parameter (DO, T only)	Informational



Worksheet Name	General Description	Purpose
QC2 Decision Summary	For each unattended OWMID (DO, T only), lists automated field and Lab QC decisions, along with any qualifiers; includes columns for applying final QC2 review (manual) decisions, qualifiers, and comments; after final decisions are made code is run to automatically apply the final decisions to the individual OWMID files; for more specific information see below	QC Decisions
Initial Lab & Field QC Summary	Lists QC Summary sheet information from individual OWMID files (comparison of attended QC data to unattended data points, field QC decision, lab QC decision, and initial automated QC2 decision for DO and T)	Informational; use to identify OWMID files where data have been auto-censored or auto-qualified
All Lab QC	Summary of lab calibration information from the ILW files, used to match attended OWMIDs to unattended OWMIDs and apply automated QC decisions	Informational
Lab QC Checks	Compares information from data files/field sheets against information from All Lab QC sheet and flags cases where project name, sonde ID, or dates don't match	Error checking
Unmatched Lab QC OWMIDs	List of attended QC OWMIDs from All lab QC sheet that did not match up with any unattended OWMIDs	Error checking
Unmatched Unatt OWMIDs	List of unattended OWMIDs without associated lab QC information from All Lab QC sheet (note that T logger OWMIDs and unattended samples not collected will always be listed here)	Error checking

Flags sheet explanation:

Values determined after post-processed files were trimmed

Column Label	Data Type	Description
Power Loss	Yes/No	pre-processed file indicated power loss in one or more rows



Column Label	Data Type	Description
Data gaps	Yes/No	post-processed file shows data gaps where rows were inserted (usually associated with power loss in file)
T, etc. Threshold Tripped	Numeric	Count of # of times (data rows) where parameter threshold was tripped (see table below for threshold values)
T spikes	Numeric	Count of # of times (data rows) where spikes occurred (see table below for spike values); note that the delta values are calculated between the current and next row, so the total # of delta values equals the total data rows - 1
missing drop off QC time	Yes/No	Indicates whether drop off attended QC was missing a time (so no trimming could occur, no delta value could be computed between unattended and attended point)
missing pick up QC time	Yes/No	Indicates whether pick up attended QC was missing a time (so no trimming could occur, no delta value could be computed between unattended and attended point)
Unattended starts after attended QC	Yes/No	Indicates cases where the unattended file start date/time occurs after the attended QC date/time
Unattended stops earlier than attended QC	Yes/No	Indicates cases where the unattended file stop date/time occurs before the attended QC date/time
Potential tidal influence	Yes/No	If any of the attended QC samples had a "t" qualifier for any parameter, then potential tidal influence for the unattended file is indicated

Parameter	Threshold Values	Delta value	Units	Time interval (minutes)	Spike (Delta/time) value	Units
Batt	<6.4	N/A	volts	30	N/A	N/A
T	<5, >30	1	Degrees C	30	0.033	degrees C/min
DO	<1, >12	1	mg/l	30	0.033	mg/l/min
pH	<5, >8	0.5	SU	30	0.017	SU/min
SpC	<20	10	μS/cm	30	0.333	μS/cm/min



Analytes Present sheet explanation:

Values determined prior to trimming post-processed files

Column Label	Data Type	Description
File Gear Matches FS Gear?	Yes/No	Checks whether file sondeID (File Gear) matches field sheet sondeID (SNSampGear)
Avg. Time Interval	Numeric	Average time interval (in minutes) between points in the data file
Total Data Rows	Numeric	Total # of data rows (prior to trimming)
T, pH, DO, SpC, Dosat, TDS	Text	DATA IN ALL ROWS (100% of rows contain data), SOME DATA (< 100% but > 0% of rows contain data), NO DATA (0 % of rows contain data); note that zeros are included in the count of data points
T, etc. Percent	Numeric (percent)	For the parameter listed, percent of file that contains data, calculated as # of rows where a value is present (excluding rows with blanks or indicators of no data in SS column) divided by total # of data rows
T, etc. Zeros	Numeric (percent)	For the parameter listed, percent of file that contains zeros, calculated as the # of rows where a zero is present (excluding rows with blank values or indicators of no data in SS column) divided by the total # of data rows

QC2/QC3 Decision Summary explanation:

Column Label	Data Type	Description
Duplicates Not 2 Use	Text	For duplicate unattended deployments (on same field sheet), indicate OWMID of duplicate (not to be validated)
Avg Delta T	Numeric	Average delta between the unattended and attended QC points, value determines Field QC Decision
T Field QC Count	Numeric	Number of field QC associated with unattended OWMID for parameter shown
T Field QC Decision	Text	Accept, Qualify, Censor (based on average delta value between unattended and attended)
T Lab QC Decision	Text	Accept, Qualify, Censor (based on lab calibration information, e.g. entered into the ILW files)
T Initial QC2 Decision (i Qualifier)	Text	Accept, Qualify, Censor (based on decision matrix between lab and field QC decisions)
Avg Delta DO	Numeric	Average delta between the unattended and attended QC points, value determines Field QC Decision



Column Label	Data Type	Description
DO Field QC Count	Numeric	Number of field QC associated with unattended OWMID for parameter shown
DO Field QC Decision	Text	Accept, Qualify, Censor (based on average delta value between unattended and attended)
DO Lab QC Decision	Text	Accept, Qualify, Censor (based on lab calibration information, e.g. entered into the ILW files)
DO Initial QC2 Decision (i Qualifier)	Text	Accept, Qualify, Censor (based on decision matrix between lab and field QC decisions)
Avg RPD SPC	Numeric	Average RPD between the unattended and attended QC points, value determines Field QC Decision
SPC Field QC Count	Numeric	Number of field QC associated with unattended OWMID for parameter shown
SPC Field QC Decision	Text	Accept, Qualify, Censor (based on average RPD value between unattended and attended)
SPC Lab QC Decision	Text	Accept, Qualify, Censor (based on lab calibration information, e.g. entered into the ILW files)
SPC Initial QC2 Decision (i Qualifier)	Text	Accept, Qualify, Censor (based on decision matrix between lab and field QC decisions)
Avg Delta PH	Numeric	Average delta between the unattended and attended QC points, value determines Field QC Decision
PH Field QC Count	Numeric	Number of field QC associated with unattended OWMID for parameter shown
PH Field QC Decision	Text	Accept, Qualify, Censor (based on average delta value between unattended and attended)
PH Lab QC Decision	Text	Accept, Qualify, Censor (based on lab calibration information, e.g. entered into the ILW files)
PH Initial QC2 Decision (i Qualifier)	Text	Accept, Qualify, Censor (based on decision matrix between lab and field QC decisions)
T Final QC2 Decision	Text	Placeholder for QC2 review adjustments to initial QC decision for "i" qualifier
T all qualifiers	Text	Placeholder for QC2 review: qualifiers that apply to all rows in unattended file
T Rationale	Text	QC2 review rationale for parameter shown
DO Final QC2 Decision	Text	Placeholder for QC2 review adjustments to initial QC decision for "i" qualifier
DO all qualifiers	Text	Placeholder for QC2 review: qualifiers that apply to all rows in unattended file
DO Rationale	Text	QC2 review rationale for parameter shown
SPC Final QC2 Decision	Text	Placeholder for QC2 review adjustments to initial QC decision for "i" qualifier
SPC all qualifiers	Text	Placeholder for QC2 review: qualifiers that apply to all rows in unattended file
SPC Rationale	Text	QC2 review rationale for parameter shown
PH Final QC2 Decision	Text	Placeholder for QC2 review adjustments to initial QC decision for "i" qualifier
PH all qualifiers	Text	Placeholder for QC2 review: qualifiers that apply to all rows in unattended file



Column Label	Data Type	Description
PH Rationale	Text	QC2 review rationale for parameter shown
Actions Needed	Text	QC2 review changes needed to individual OWMID files
QC2 Review Comments	Text	QC2 review comments (for all parameters)
QC3 Actions Needed	Text	QC3 review changes needed to individual OWMID files
QC3 Review Comments	Text	QC3 review comments (for all parameters)

Lab QC Checks Explanation:

Column Label	Data Type	Description
OWMID	Text	Sample unique identifier
Lab QC Proj Name	Text	Project name listed in lab QC workbook for OWMID
UnAtt Proj Name	Text	Project name listed on field sheet and entered into WQD
Proj Name Check	Text	"Check" if Lab QC Proj Name doesn't match UnAtt Proj Name
Lab QC Sonde	Text	Sonde serial number listed in lab QC workbook for OWMID
UnAtt Sonde	Text	Sonde serial number listed on field sheet and entered into WQD
Sonde Check	Text	"Check" if Lab QC Sonde doesn't match UnAtt Sonde
Pre-Cal Date	Date	Sonde pre-calibration date listed in lab QC workbook
Post-Cal Date	Date	Sonde post-calibration date listed in lab QC workbook
UnAtt StartDate	Date	Sonde deployment start date listed on field sheet and entered into WQD
Date Check	Text	"Check" if UnAtt StartDate is before Pre-Cal Date or if UnAtt StartDate is after Post-Cal Date
Not_Collected	True/False	Indicates sample marked as not collected on field sheet



APPENDIX D: Post-Processed Status File Messages

Explanation of messages found in file PPStatus.txt, located in the unattended_QA “year” folder under Data_PostProcess, and common solutions are found in the table below. All corrections should be made to the electronic field sheet or the data files in the Data_PreProcess folder for the year in question. In some cases it may be necessary to delete or remove files from the PreProcess folder (for example, if some files are found to be redundant, test, empty, or for incorrect years, etc.) After corrections are made, the code will be re-run and the error message/data reconciliation process will continue until the messages are resolved.

Error Messages/Analyte Headings Not Found	Applies to File Type	Potential Problem(s)	Potential Solution(s)
Added XX new rows (where XX is a number)	Multiprobe, Temperature Logger	N/A (text is informational only)	N/A (text is informational only)
Deleted XX bad rows (where XX is a number)	Multiprobe, Temperature Logger	N/A (text is informational only)	N/A (text is informational only)
Header Not Found	Multiprobe, Temperature Logger	Multiprobe file doesn't contain Log File Name header followed by OWMID; Temperature file doesn't contain Plot Title or Serial Number header followed by serial number	Add the header row above where the data starts to data pre-process file; re-export file from lab PC
Incorrect Data Worksheet Name	Multiprobe, Temperature Logger	Worksheet name must be the same name as the file	Change data worksheet name of pre-process data file to match file name
Incorrect Sample Type (SmpTypName) on Field Sheet	Multiprobe	Field sheet SmpTypName field shows a value other than “In-situ: Un-attended”	Change SmpTypName on electronic field sheet for OWMID in question to “In-situ: Un-attended”



Error Messages/Analyte Headings Not Found	Applies to File Type	Potential Problem(s)	Potential Solution(s)
Incorrect Time Format	Multiprobe	Time column in file appears as HHMMSS (without colon separators)	Insert colons between hours, minutes, and seconds (HH:MM:SS)
Interval between rows < 0.5 x File Time Interval	Multiprobe, Temperature Logger	Date/Time between adjacent rows is incorrect (e.g. previous row shows 7/31/10 11:30:00 PM and current row shows 7/31/10 12:00:00 AM), OR time interval between adjacent rows is less than the file time interval (previous row 7/31/10 10:00 AM, current row 7/31/10 10:01 AM, next row 7/31/10 10:30 AM, file time interval is 30 minutes)	Check that dates that were manually filled in (for example text files that were converted to .xlsx) are correct (in example: previous row should be 7/30/10 11:30:00 PM and current row remains 7/31/10 12:00:00 AM); manually delete rows where time interval is not correct (in example: current row 7/31/10 10:01 AM should be deleted)
More than 1 match found in field sheet file for OWMID	Multiprobe	OWMID has been duplicated in field sheet	Check field sheet file against paper field sheets, make correction to field sheet as needed
More than 1 match found in field sheet file for Serial Number	Temperature Logger	Serial number of temperature logger has been duplicated in field sheet for SmpTypName = "In-situ: Unattended"	Check field sheet file against paper field sheets, make correction to field sheet as needed
No Match found in field sheet file for OWMID	Multiprobe	OWMID of multiprobe is incorrect or missing in data file; OWMID is missing from field sheet file; OWMID must be listed after the heading Log File Name:	Check file in Data_PreProcess folder; re-export file from lab PC or manually correct file so that it may be post-processed; if probe was not deployed, OWMID may be missing on electronic field sheet (add new record to field sheet); OWMID may have been incorrectly entered into datalogger file (check for number transposition)



Error Messages/Analyte Headings Not Found	Applies to File Type	Potential Problem(s)	Potential Solution(s)
No Match found in field sheet file for Serial Number	Temperature Logger	serial number of temperature logger is incorrect or missing in first row of data file; serial number must be listed after the heading Plot Title: or Serial Number:	Check file in Data_PreProcess folder; re-export file from lab PC or manually correct file so that it may be post-processed; if probe was not deployed, serial number may be missing on electronic field sheet (add as needed to SNSampGear field) or OWMID may not have been entered (add new record to field sheet)
Power loss	Multiprobe	N/A (text is informational only)	N/A (text is informational only)
Specific analyte name is listed	Multiprobe, Temperature	Analyte was not sampled or programmed; analyte name was misspelled	check the file in Data_PreProcess folder; if heading is there, check spelling, correct spelling in file if necessary; if heading is not there, but you suspect it should be, re-export file from the lab computer or check lab calibration book to see what analytes were calibrated for on the sonde
Temperature converted from degrees F to C	Temperature Logger	Temperature recorded in raw data file was in Fahrenheit	No changes needed; alert lets user know that temperature was automatically converted from Fahrenheit to degrees C
Time Interval (MIN) = XX (where XX is a number)	Multiprobe, Temperature	N/A (text is informational only)	N/A (text is informational only)
Unrecognized Date Format/Empty File	Multiprobe, Temperature Logger	Date/Time format is incorrect or data file is empty (multiprobe files must list date and time in separate columns; temperature probe files must list date and time in same column)	Change Date and Time format of file in Data_PreProcess folder; re-export file from lab PC
Unrecognized file format	Multiprobe, Temperature Logger	Raw data file does not have the correct extension (.xmd, .csv, .xls, .xlsx)	Re-export file from lab PC with correct file extension and format or open file and save with correct extension