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

Standard Operating Procedure (SOP) for

SONDES

Approval Signatures

Emily Miller Digitally signed by Emily Miller
Date: 2025.07.28 11:01:45 -06'00'

Emily Miller
Quality Assurance Officer

Date

Lynette Guevara Digitally signed by Lynette Guevara
Date: 2025.07.25 12:46:09 -06'00'

Lynette Guevara
Program Manager - Monitoring, Assessment and Standards Section

Date

1.0 Purpose and Scope

The purpose of this Standard Operating Procedure (SOP) is to describe calibration, deployment, and maintenance and storage of sondes used for water quality monitoring. The SOP is also used as a training mechanism and was developed to maintain consistency with data collection activities. This procedure covers the use of the In-Situ Aqua TROLL® 600 sondes. For procedures related to quality assurance of logger data sets and data processing, refer to the most current SWQB SOP 6.4 Long-term Deployment Data Logger QA and SQUID Upload and SOP 15.0 Data Verification and Validation[1].

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; the Monitoring, Assessment, and Standards Section (MASS) Program Manager; and SWQB quality subject matter experts (e.g., the MASS Monitoring Team Lead and field staff scientists) will determine if any revisions to this SOP are needed at a minimum of every two (2) years in accordance with the most current SOP 1.1 for the Creation and Maintenance of SOPs (NMED/SWQB 2020). Pending the review and approval of the document, the QAO will ensure the SOP is accessible through the SWQB's website.

The Sonde Equipment Coordinator keeps a record of the disposition, maintenance, and any other pertinent information of each sonde for MASS within the Equipment Inventory database [2]. Responsibilities are detailed below. The Sonde Equipment Coordinator is required to implement field staff responsibilities as applicable (e.g., when deploying sondes and/or collecting instantaneous measurements).

The Sonde Equipment Coordinator is responsible for:

- Ensuring sondes are properly maintained and stored;
- Maintaining and ordering of equipment, sensors, and calibration solutions related to sondes;
- Maintaining the Equipment Inventory for sondes and related probes;
- Providing technical assistance to SWQB personnel, as needed, so they are capable of sonde operating, calibration, post-deployment calibration verifying, and data recording; and
- Conducting yearly and mid-season temperature accuracy checks as detailed in this SOP.

Field Staff are responsible for their specific sample run which includes the following processes:

- Coordinating with the Sonde Equipment Coordinator on the scope of the project and use of the equipment;
- Calibrating the sonde(s) and maintaining electronic calibration sheets on NMED's internal server;
- Maintaining electronic deployment sheets and data files on NMED's internal server;
- Post-checking sonde calibration within 48 hours of sampling run completion, reporting post-deployment calibration values on the calibration sheet and storing on NMED's interval server;
- Investigating calibration and calibration verification failures and reporting equipment malfunction to the Sonde Equipment Coordinator, as applicable;
- Filing calibration & calibration verification sheets, deployment sheets and data in the appropriate survey project folder on NMED's internal server upon completion of sampling run;

[1] Available at https://www.env.nm.gov/surface-water-quality/sop/.
[2] Stored at \\FS01\Data$\WPD\SWQB\MASS\Monitoring Team\Lab Inventory.

- Managing and saving sonde data in accordance with the SWQB's SOP 6.4 (LTD Data Logger QA and Upload SOP 6.4);
- Performing data verification and validation including flagging LTD (unattended) data and grab data in accordance with the SWQB's SOP 15.0 (Data Verification and Validation); and
- Ensuring equipment is cleaned and stored in accordance with this SOP.

The Monitoring Team Supervisor is responsible for:

- Providing technical expertise and guidance to Sonde Equipment Coordinator and Field Staff, as needed.

Bureau personnel who operate water quality monitoring sondes are responsible for ensuring that the sondes are properly calibrated, checked, and maintained, and that the data are properly recorded in accordance with this SOP and shall acknowledge such by signing the SOP 6.1 Sonde Calibration and Maintenance Acknowledgment Form.

3.0 Background and Precautions

3.1 Background

This Procedure is based on the capabilities of the In-Situ Aqua TROLL® 600, sondes, and sensors.

3.2 Procedural Precautions

Individuals using a sonde should have a thorough understanding of its proper use and care and be familiar with the instrument's operational manual in order to ensure data are not invalidated due to calibration or user error. Vented sondes should only be used by experts, should not be used for long-term deployments, and only used for instantaneous measurements by submerging the restrictor (i.e., where probes are housed) and not the entire sonde. The battery compartment and instrument connector should not be in contact with water unless a vented cable is connected. See instrument manual for more information.

3.3 Safety Precautions

Operators must have a signed acknowledgment form for the Chemical Hygiene Plan (CHP) on file and be familiar with applicable Safety Data Sheets (SDS) stored in the laboratory which details the calibration solution safety precautions. Operators must also have a signature for the Sampling Job Hazard Analysis on file and be aware of hazards that might be present, develop, and/or are unique to the position.

Wading across a streambed can be dangerous depending on flow and substrate conditions. Do not attempt to wade into a stream if the depth (in feet) multiplied by the velocity (in feet/second) equals or exceeds ten (10).

4.0 Definitions and Acronyms

For common definitions and acronyms not defined in this SOP, refer to the most up to date SWQB Quality Management Plan for Environmental Data Operations.

Equipment Inventory – a detailed record or list of all the physical tools, machines, devices, and other tangible assets owned or used by an organization. It includes information such as item descriptions, quantities, serial numbers, purchase dates, locations, conditions, and maintenance schedules.

Long-term Deployment (LTD) – deployment of a sonde for unattended monitoring at a monitoring location to perform and record measurements of water quality at repeated discrete intervals.

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

Sample Run – is used to define the most common collecting period or grouping of sampling activities that are indicative of a SWQB MASS sampling operation. Typically, most monitoring is conducted during multi-day collection events that depart and return to the office in a week (M-F). Typically, sampling run consists of the same staff, using the same equipment, vehicle, and reagents. When multiple, single day sampling runs are conducted within a given week that maintain constant variables as described above, the single day sampling runs are considered collectively as a single sampling run. At least one (1) sampling staff must remain consistent throughout the sampling run to meet quality control requirements.

Sonde – A water quality monitoring device that is placed in the water to gather water quality data. Sondes usually have multiple sensors and are capable of recording or displaying multiple water quality parameters.

Sonde Equipment Coordinator – A designated individual within each Section (e.g., MASS, WPS) of the SWQB. The Sonde Equipment Coordinator is responsible for keeping a record of the disposition of each Section's sondes.

Subject Matter Experts (SMEs) – Staff who are familiar with the purpose and procedure for accomplishing a task. All MASS Monitoring Team staff are considered and expected to be subject matter experts with all activities related to sonde calibration, deployment, and maintenance, and storage.

5.0 Equipment and Tools

5.1 Sonde Specifications

The sonde used by the SWQB is the In-Situ Aqua TROLL® 600. This instrument can be used with In-Situ's mobile app, VuSitu, for communication with Bluetooth enabled tablets and mobile devices. Sonde and sensors are described in **Table 1**, and in the Aqua TROLL 600 Owner's Manual[3].

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

[3] Stored at \\FS01\Data$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment\In-Situ Sondes

Table 1. In-Situ Aqua TROLL® 600 Sonde and Sensor Characteristics

Sensor #	Parameter	Units	Range	Accuracy
63460	Temperature	°C	-5 to 50	± 0.10 °C
63460	Conductivity	µS/cm	0 – 350,000	± 0.5% of reading; ± 1 µS/cm for 0-100,000, ± 1% of reading for 100,000 to 200,000, ±2% of reading from 200,000 to 350,000 µS/cm
63450	Dissolved Oxygen	mg/L	0 – 60	± 0.1 mg/L for 0–20 mg/L; ± 0.2 mg/L for greater than 20 mg/L
63470	pH	SU	0 – 14	± 0.1 SU
63480	Turbidity	NTU	0 – 4,000	± 2% of reading; ± 0.5 NTU
AT600	Barometric Pressure	mbar	300 - 1,100	±1.0 mbar
AT600	Pressure (Depth)	m	0-9 0-30 0-76 0-200	±0.01% Full Scale Range
38900	Chlorophyll a	RFU	0-100 RFU 0-1000 µg/L	0.1 µg/L Chl a in MeOH
38920	Phycocyanin	RFU	0-100 RFU 0-1000 µg/L	1.0 µg/L PC standard

5.2 List of Equipment Required for Sonde Calibration and Maintenance

Sondes:

- In-Situ Aqua TROLL® 600 sonde, complete with probe guard and the following sensors installed: pH, conductivity/temperature, dissolved oxygen, and turbidity, and a wiper or wiper port plug
- Smartphone or other Bluetooth enabled device with VuSitu software installed
- RDO calibration sponge
- **Sonde Calibration Worksheet or Sonde Deployment/Retrieval Field Sheet**
- Calibration solutions:
    - Deionized (DI) water
    - pH buffer solutions (e.g., pH 4.0, pH 7.0, pH 10.0) sufficient to bracket samples
    - Turbidity standards (e.g., 100 NTU, 1000 NTU) sufficient to bracket samples
    - Specific conductivity standard (e.g., 1413 µS/cm) sufficient to bracket samples
- Standard solution rinsate and disposal containers
- Sonde maintenance kit (includes silicon grease, O-rings, hex key set for unlocking sonde sensors, pH junctions, junction fluid, desiccant, etc.) and small flathead screwdriver
- Barometer (integrated on Aqua TROLL® 600 sonde)

- Abrasion-free cleaning cloth (e.g., Kim wipe) and compressed air

5.3 List of Equipment Required for LTD of a Sonde

• Nylon Cable Ties	• Five-gallon Bucket	• Steel T-posts
• Hose Clamps	• Spare Batteries	• T-post driver
• Pipe wrench (10" and 12")	• Diagonal pliers	• Steel rebar
• Modified mattock	• Lineman's pliers	• Cable, padlock, and key

6.0 Step-by-step Procedures for Connecting, Calibration, Deployment, Post-check Calibration Verification, and Maintenance and Storage of a Sonde

6.0.1 Connecting to a Sonde

Begin by connecting the Aqua TROLL® 600 sonde via Bluetooth to a smartphone or a tablet with the VuSitu application installed. The following steps should be utilized:

1. Invert sonde for 3 seconds to turn on sonde. The digital screen on the sonde will illuminate when the sonde is turned on.
2. Establish a Bluetooth connection with the sonde by navigating to the Bluetooth menu on the handheld device and scanning for available devices. To pair the sonde with the handheld device, select the sonde's serial number (which can be found inscribed on the side of the sonde) from the list of available devices on smart phone or tablet. This usually only needs to be conducted the first time you connect to a new sonde.
3. Open the VuSitu app on a handheld device (e.g., tablet, smart phone).
4. Select the sonde based on serial number from the list that comes up when you first open the app. If the sonde does not appear as a connected instrument, select **Scan for More** and select the sonde out of the list of available connections. Once the sonde is connected to the handheld device, it is ready for calibration, calibration verifications, software updates, or live readings. Refer to the quick start guide or the operator's manual for the manufacturer's connection instructions and field operation instructions (In-Situ, 2017 and 2024).

6.0.2 General Sonde Calibration Information

Sonde calibration should be conducted in the lab prior to each sampling run (except for Dissolved Oxygen) to ensure sensors and devices are working properly. Conduct calibration in the order of parameters listed in this SOP.

6.0.3 Calibration Standard Solutions

Be certain to avoid cross-contamination of standard solutions to avoid calibrations bias. Inscribe the date on the standard solution container when opening a new bottle. Bulk standard solutions (that do not get exposed to air) expire according to the manufacturer's expiration date inscribed on the container. Standard transferred from a bulk container to a smaller container requires the date of transfer on the smaller container and expires after one month (exception: pH standard solutions, see Section 6.1.4). Expired standard can be used as a rinse before calibration. Fresh standard used for calibration may be placed in a labeled rinse container and reused as rinse solution for subsequent calibrations.

6.0.4 General Sonde Calibration Documentation

Record calibration data on the **Sonde Calibration Worksheet**[4], Calibration records must not be discarded. Completed calibration worksheets must be filed in the network server under the appropriate survey. If hard copies were used to record calibration they must be scanned and filed as detailed in this SOP. Post-checks (calibration verification) must be recorded on the **Sonde Calibration Worksheet**. The **Sonde Calibration Worksheets** should be saved electronically in the shared drive with the field sheets for the stations at which the sonde was used.

6.0.5 Calibration Range

Calibration range limits are shown in **Table 2**. If sensors cannot be calibrated within these limits, the instrument should be returned to the Sonde Equipment Coordinator for maintenance. Refer to Section 8.1 on temperature accuracy check procedures for determining whether thermistors are within in-calibration range.

Table 2. In-Calibration and Interpolation Ranges for Sonde Calibration

Parameter	Standard	Standard Value	In-Calibration Range	Linear Interpolation Range (Max Allowable Limits)
Temperature, °C	NIST Traceable Thermometer	4-10 °C 35-40 °C	± 0.5 °C	± 2 °C
Conductivity, µS/cm	Standard Solution	1413 µS/cm	± 5%	± 30%
Dissolved Oxygen, %	Saturated Air	100 %	± 5%	± 30%
pH, s.u.	Buffer Solution	4.0, 7.0, 10.0	± 0.2	± 1
Turbidity, NTU	DI Water	0 NTU	± 1 NTU	± 10 NTU
	Standard Solution	100 NTU	± 5 NTU	± 30 NTU
		1000 NTU	± 50 NTU	± 300 NTU
Parameter	**Corrected Qualifier (LTD only)**		**Rejected Qualifier**	
Temperature, °C	**CT**		**RT**	
Conductivity, µS/cm	**CSC**		**RSC**	
Dissolved Oxygen, %	**C%**		**R%**	
Dissolved Oxygen, mg/L	**CDO**		**RDO**	
pH, s.u.	**CPH**		**RPH**	
Turbidity, NTU	**CY**		**RY**	

6.1 Multiparameter Sonde Calibration Procedures (In-Situ Aqua TROLL®)

Calibration of all probes except DO, which must be done in the field, is conducted in a controlled environment, typically the Runnels Sample Management Facility. Conduct calibration in the order of parameters listed in this SOP (Section 6.1.3 through 6.1.6). The chlorophyll a probe should be calibrated 1st when being utilized. If a sensor does not calibrate according to specification in this SOP, staff must notify the Sonde Equipment Coordinator for troubleshooting, repairs, or if necessary, replacement. Another sonde should be selected for the monitoring event. If unable to utilize a working sonde, staff should ensure data from the failing sensor is non-essential for the particular field event and note "MDP" for missing-data-point on the field form. After all the above probes are calibrated, fill the cup with pH 4 solution. **IMPORTANT NOTE:** *Never store the sonde dry. This will ruin the pH sensor.*

6.1.1 Temperature Sensors

[4] Available under "Related SOP Forms" for SOP 6.1 at: https://www.env.nm.gov/surface-water-quality/sop/.

In-Situ sonde thermistors cannot be calibrated. Annually, when a malfunction is suspected, or when replacing a temperature/conductivity probe, the Sonde Equipment Coordinator will check the temperature reading against a NIST traceable thermometer to ensure the instrument temperature readings are within an acceptable in-calibration range (±0.5 °C) (refer to Section 8.1 of this SOP). The manufacturer recommends a mid-season one-point check (early July) in a cold-water bath, which is the responsibility of the Sonde Equipment Coordinator. The mid-season one-point verification check will be documented on the **Temperature Accuracy Verification Spreadsheet**[5] by the Sonde Equipment Coordinator. The **Temperature Accuracy Verification Spreadsheet** must indicate the date the temperature verification was performed, the technician (i.e., Sonde Equipment Coordinator) conducting procedures, and if verification passed or failed.

6.1.3 Specific Conductivity Calibration

Conductivity standards are very sensitive to contamination, so take particular care to avoid cross-contamination of standards. ***Important:*** Always perform conductivity calibrations prior to calibrating pH, as pH standard is extremely conductive, and contamination could skew calibration values. The SWQB Monitoring Supervisor will evaluate MASS sonde conductivity sensor cell constant values for probes installed more than 1.5 years ago through the review of the electronic calibration reports. The cell constant should be 1 +/- 0.3.

1. Rinse all sensors and the entire inside of the calibration cell once with DI water.
2. With the restrictor in calibration mode and the sonde inverted pour 10-20 mL (1/2” above the sensor face) of conductivity standard on top of the sensors. Holding the sonde vertically, swirl the solution, so that it makes contact with all areas of the sensors and the restrictor. It may be necessary to reinstall the end cap while gently swirling to ensure a good rinse. Discard the rinse standard and repeat once.
3. Pour fresh standard into the restrictor 1 cm above the sensors. Cover with end cap. Go to the main Calibrations screen and select **Conductivity**. In VuSitu, a screen will appear asking to choose a reference temperature for calibration. Choose 25°C then tap Next and Next again.
4. The VuSitu application will auto-detect the standard that is being used. If it fails to detect the correct standard, the correct value can be manually entered when prompted.
5. Once the conductivity values and temperature have stabilized (indicated by green checkmarks next to each parameter), select **Accept** to complete the calibration (**Figure 1**).

[5] Stored on the SWQB shared drive at: \\FS01\Data$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment\Temperature QC.

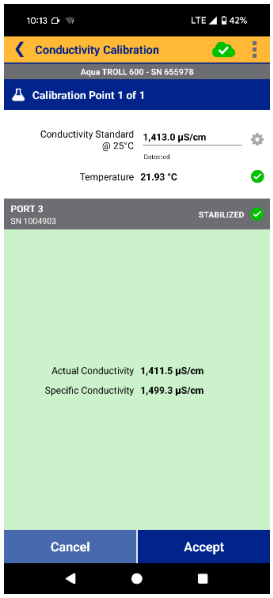


Figure 1. Specific Conductivity Calibration

6. Record the standard value. standard lot number, and the initial readings for specific conductivity and temperature on the **Sonde Calibration Worksheet** (Figure 2).
7. Next, record the conductivity calibration value from the automatically generated calibration report in VuSitu under the Calibrated Reading Section of the **Sonde Calibration Worksheet**.

Specific Conductance				Pass Criteria: ± 5%
Standard Value	Standard Lot #	Initial µS/cm	Calibrated µS/cm	Temp (°C)
1413				

Figure 2. Specific Conductivity Calibration Documentation

8. If the calibrated value is out of range, troubleshoot the error according to **Table 3** and retry calibration. As a last resort, a restoration of factory calibration defaults may solve calibration problems. To restore factory calibration defaults, select **Restore Calibration Defaults** under **Instrument Settings** (***IMPORTANT NOTE****: Do not choose* ***Restore Factory Settings***) and follow the instructions. If the calibrated value is out of range after troubleshooting, return the sonde to the Sonde Equipment Coordinator for maintenance and troubleshooting.

6.1.4 pH Calibration

The pH buffers contain high concentrations of phosphate. Take care during calibration to avoid leaving traces of buffer on equipment or workspaces that could contaminate nutrient water samples. Standard transferred from a bulk container to a smaller container expires after six months, with the exception of pH 10.0 buffer, which, once opened, expires within three months if transferred to another container and exposed to air.

Calibrate the pH sensor with buffers of pH 7.0, and either pH 4.0 for acidic waters or pH 10.0 for alkaline waters. If the expected pH of the water being sampled is unknown or the sonde is being used for a LTD, then a three-point calibration should be performed in the following order: pH 7.0, 4.0, then 10.0. For most watersheds within the state, a pH 4.0 calibration is not necessary (the most well-known acidic stream in NM is Sulphur Creek in the Jemez River watershed); most waters in the state are alkaline and

will only require a two-point calibration with pH 7.0 and pH 10.0 for sonde grab data. All two-point calibrations should begin with pH 7.0.

The MASS Monitoring Team Supervisor will maintain and track the sensor's slope.

1. Go back to the main **Calibrations** screen. Select **pH**. Select either **2-point** or **3-point Calibration (Figure 3)**.

Figure 3. pH Calibration Verification

2. Rinse all sensors and the entire inside of the calibration cell once with tap water.
3. Pour 10-20 mL (1/2" above the sensor face) of pH buffer on top of the sensors. Holding the sonde vertically, swirl the solution so that it makes contact with all areas of the sensors and the restrictor. It may be necessary to reinstall the end cap while gently swirling to ensure a good rinse. Discard the rinse standard and repeat once.
4. Next, pour fresh standard into the restrictor 1 cm above the sensors. The application will auto-detect the pH standard being used. If it does not, the value can be entered manually. Wait for the sensor reading to stabilize. Once the sensor has stabilized (indicated by a green check mark next to pH, mV, and temperature, **Figure 4**) continue to step 5.

Figure 4. pH Values

5. Repeat steps 2–4 with the next standard. If performing a two-point calibration, calibrate in the following order: pH 7.0, then either pH 10.0 or pH 4.0. Then hit **Next** in the app. If performing a three-point calibration, calibrate in the following order: pH 7.0, pH 4.0, then pH 10.0. Discard the standard.
6. After the last calibration has been performed, select **Accept (Figure 4).**
7. Record all temperature, pH values and mV from the automatically generated calibration report in VuSitu on the **Sonde Calibration Worksheet** (**Figure 5)**. **NOTE:** The post calibration value may not exactly equal the buffer value, depending on temperature.

pH						Pass Criteria ±0.2
Value	Buffer Lot #	Initial	Calibrated	mV*	Temp	Range (mV)
7						(0 ± 30)
4						(180 ± 50)
10						(-180 ± 50)
* Note: Difference in mV between ph 4 and 7, and 7 and 10 should be approximately 165 to 180 mV. If not probe should be reconditioned and recalibrated.						

Figure 5. pH Calibration Documentation

8. If the calibrated value is out of range, troubleshoot the error according to **Table 3** and retry calibration. As a last resort, a restoration of factory calibration defaults may solve calibration problems. To restore factory calibration defaults, select **Restore Calibration Defaults** under **Instrument Settings** (***IMPORTANT NOTE****: Do not choose* ***Restore Factory Settings***) and follow the instructions. If the calibrated value is out of range after troubleshooting, return the sonde to the Sonde Equipment Coordinator for maintenance and troubleshooting.
9. If the mV reading exceeds the range on the **Sonde Calibration Worksheet (Figure 5)**, the filling solution needs to be replaced. Return to the Sonde Equipment Coordinator.

6.1.5 Turbidity Calibration

Calibration standard expires by the manufacturer's expiration date listed on the container. Be sure to inscribe the opening date on the container. Expired standard can be used as a rinse before calibration. The MASS Monitoring Team Supervisor will maintain and track the sensor's slope. The slope should gradually change over time and be 1 +/- 0.3. ***IMPORTANT NOTE:*** Use only In-Situ brand or Hach StablCal formazin standards for calibrations rather than other polymer-suspension (e.g., AMCO) turbidity standards.

1. Go back to the **Calibration screen.** Select **Turbidity**. Select **2-point Calibration (Figure 6)**.

Figure 6. Turbidity Calibration Verification

2. Rinse all sensors and the entire inside of the calibration cell with DI water by adding 10-20 mL of DI water to the restrictor and swirl or invert the sonde so that the water comes in contact with all areas of the sonde sensors and restrictor. It may be necessary to reinstall the restrictor cap while gently swirling to ensure a good rinse, however it is not necessary to keep the cap on during calibration. Discard the DI water.
3. Pour DI water into the restrictor 1 cm above the sensors. Cover with end cap. Tap **Next**.

4. Manually enter 0 NTU when prompted. The VuSitu application will not auto-detect the turbidity of DI water.
5. Once the application indicates that the sensor has stabilized (indicated by a green checkmark), record the pre-calibration turbidity value on the **Sonde Calibration Worksheet** (**Figure 7**) and tap **Next** to continue the calibration. Discard the DI water.
6. Pour 10-20 mL of rinse 100 or 1,000 NTU standard (or whichever value is being used for calibration) on top of the sensors. Move the sonde around to allow the standard to make contact with all areas of the sensors and the restrictor. It may be necessary to reinstall the cap while gently swirling to ensure a good rinse. Discard the rinse standard. Note: the rinse standard must be the same value as the calibration standard.
7. Next, invert the bottle of fresh standard 20 times to mix.
8. Pour fresh standard into the restrictor 1 cm above the sensors.
9. The application will auto-detect the turbidity standard being used (**Figure 8**). If it does not, the correct value can be entered manually. Let it sit undisturbed for two minutes. Wait for the sensor reading to stabilize.
10. Once the application indicates that the sensor has stabilized, record the pre-calibration turbidity value on the **Sonde Calibration Worksheet** under Initial Reading **(Figure 7).**

Turbidity				Pass Criteria
Value	Standard Lot#	Initial (NTU)	Calibrated (NTU)	
0	DI			± 1 NTU
100				± 5 NTU
1000				± 50 NTU

Figure 7. Turbidity Calibration Documentation

11. After the two-point calibration is complete, select **Accept**, VuSitu will generate an updated **calibration report**. Ensure the **calibration report** is saved in HydroVu. Record the turbidity post-calibration values from this report on the **Sonde Calibration Worksheet** under Calibrated Reading (**Figure 7**).
12. If the calibrated value is out of range, troubleshoot the error according to **Table 3** and retry calibration. As a last resort, a restoration of factory calibration defaults may solve calibration problems. To restore factory calibration defaults, select **Restore Calibration Defaults** under **Instrument Settings** (***IMPORTANT NOTE****: Do not choose* ***Restore Factory Settings***) and follow the instructions. If the calibrated value is out of range after troubleshooting, return the sonde to the Sonde Equipment Coordinator for maintenance and troubleshooting if errors persist.

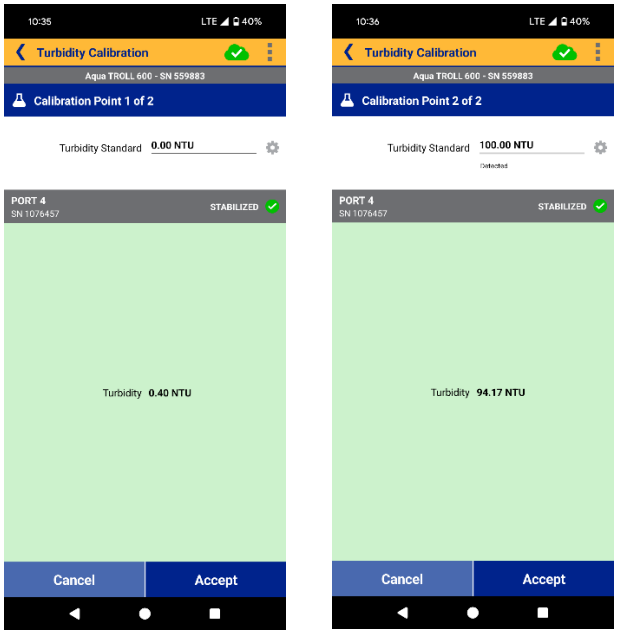


Figure 18. Turbidity Calibration Verification

After all the above probes are calibrated, fill the cup with pH 4 solution. **IMPORTANT NOTE:** *Never store the sonde dry. This will ruin the pH sensor.*

6.1.6 Dissolved Oxygen Calibration

Conduct dissolved oxygen (DO) probe calibration upon arriving at a field sampling location to ensure accurate measurements. Unlike other calibrations, this calibration is not conducted in the lab before the sampling run. The barometric pressure is used in the calibration, and barometric pressure changes with elevation. Calibration should be recorded on the **Sonde Calibration Worksheet**. Changes in elevation greater than 500 feet (152 meters) from one sampling location to another require a recalibration to local barometric pressure.

The SWQB Monitoring Supervisor will evaluate MASS Sonde RDO probe slope values for probes installed more than 1.5 years through the review of the electronic calibration reports. The slope should be 1 +/- 0.3 and should gradually increase over time.

1. Remove the sonde restrictor and end cap and thoroughly dry the RDO sensor face with KimWipe lint-free cloths. Place the sonde restrictor back on the sonde in calibration mode (i.e., restrictor openings are located opposite of the sensors, so the restrictor forms a calibration cup for holding liquid).
2. Saturate a small sponge with water. Place the sponge on the restrictor cap. Attach the cap by turning it *a quarter to half rotation*. Allow five minutes to reach 100% saturation of the air within the sonde calibration chamber.

    a. ***Important:*** *Do NOT* fully seal the end cap on the restrictor as this may cause a build-up of pressure within the calibration cell and provide inaccurate readings. Also note that the sensor face should be dry. Make certain that the sponge is only damp, not dripping water onto the sensor face. If there are water droplets on the sensor foil it can cause the calibration to be skewed very high.

3. Within the VuSitu app tap the VuSitu menu icon and select **Connected Instrument** from the list. Select **Calibrations**. Select **RDO saturation**. Select **100% Saturation (Figure 9)**.

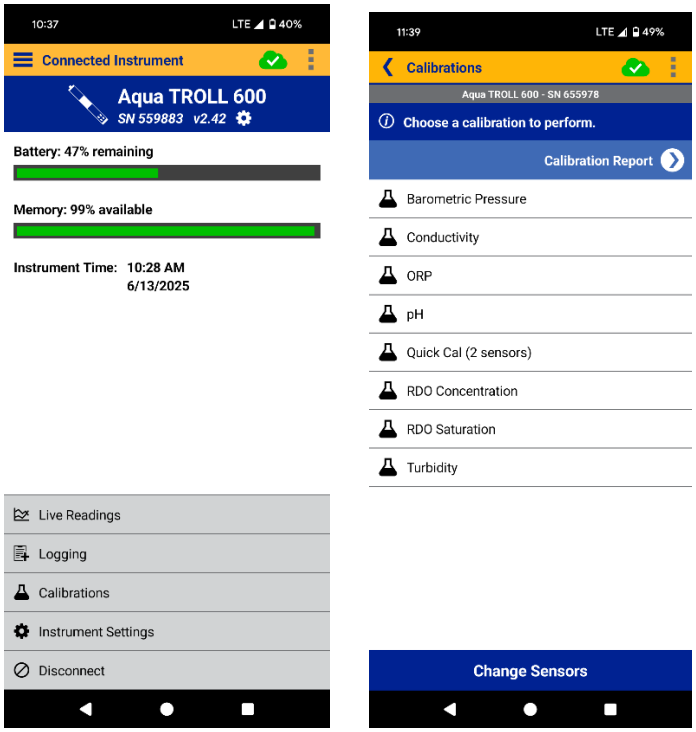


Figure 9. DO Calibration

4. Follow prompts in the app to set the barometric pressure on the sonde by opening the battery cover (twist off plastic battery compartment cover opposite of the restrictor) and exposing the barometer. Barometric pressure will appear on the sonde digital screen. Wait for the pressure to stabilize, indicated by a check mark next to the pressure, before replacing and tightening the battery cover. Record the barometric pressure on the **Sonde Calibration Worksheet (Figure 10).**

Dissolved Oxygen Barometric Pressure _____ mmHg				Pass Criteria: ± 5%
Initial Reading		Calibrated Reading		Temperature (°C)
%	mg/L	%	mg/L	

Figure 10. DO Calibration Documentation

5. In VuSitu, tap **Next**. Wait ample time to allow the DO and temperature readings to stabilize. Once the concentration, % saturation, and temperature have all stabilized (indicated by a green check mark next to each parameter, **Figure 11**) record the pre-calibration values on the **Sonde Calibration Worksheet** under Initial Reading Section (**Figure 10**).
6. Tap **Accept** to complete calibration (**Figure 11**).
7. Record the dissolved oxygen calibration values from the automatically generated calibration report in VuSitu on the Calibrated Reading Section of the **Sonde Calibration Worksheet** (**Figure 10**).
8. If the calibrated value is out of range, begin troubleshooting the error or retry calibration. As a last resort, a restoration of factory calibration defaults may solve calibration problems. To restore factory calibration defaults, select **Restore Calibration Defaults** under **Instrument**

Settings (***IMPORTANT NOTE****: Do not choose* ***Restore Factory Settings***) and follow the instructions. Return the sonde to the Sonde Equipment Coordinator for maintenance and troubleshooting if errors persist.

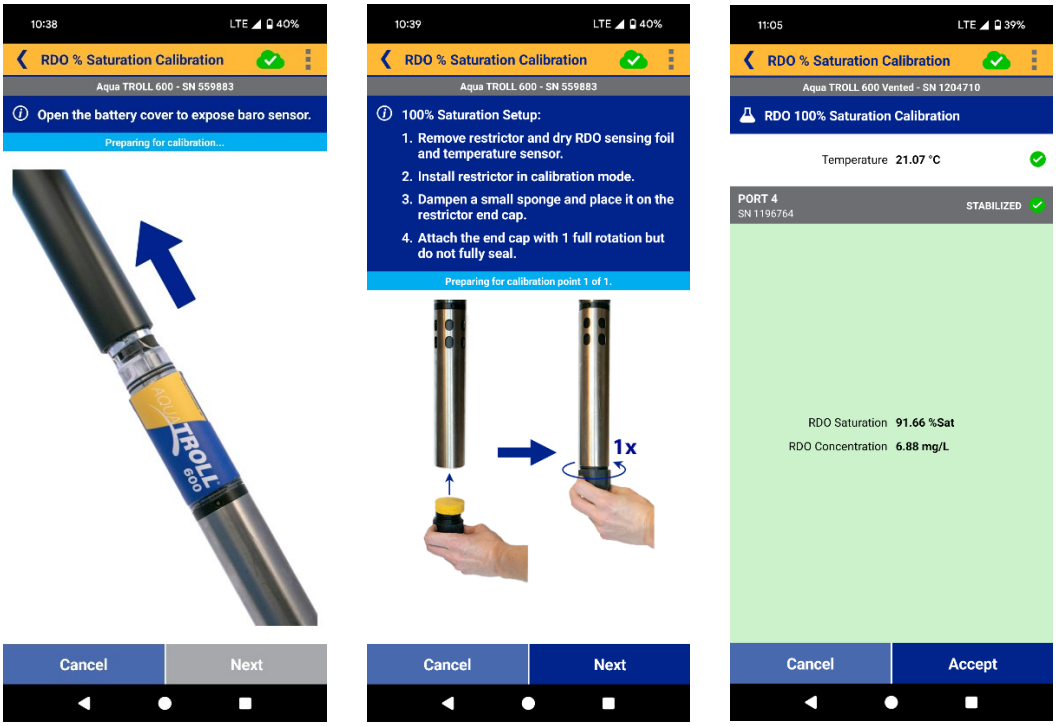


Figure 11. DO Calibration

Note: After calibration, ensure the calibration report has been uploaded to HydroVu.

6.1.7 Calibration Constants

The calibration constants listed below will be tracked[6] SWQB Monitoring Supervisor because an excursion may indicate possible sensor failure and a subsequent determination that the sensor must be retired.

Conductivity	DO	Turbidity	pH 4	pH 7	pH 10	pH
Cell constant 1 +/- 0.3	Slope 1 +/ -0.3	Slope 1 +/- 0.3	mV 180 +/- 50	mV 0 +/- 30	mV -180 +/- 50	Slope -66 to -50

6.1.8 Barometric Pressure Calibration

The Sonde Equipment Coordinator must restore barometric pressure to calibration defaults annually (prior to field season), and when anomalous values are observed or barometric readings in the lab deviate from expected values. Restoring barometric pressure defaults is implemented to ensure that dissolved oxygen saturation can be properly calibrated. The annual process of restoring barometric pressure to calibration defaults for each sonde will be documented in the Equipment Inventory, indicating the date the calibration default was performed and the technician (i.e., Sonde Equipment Coordinator) responsible for the process. Calibration defaults can be restored by going to instrument setting in the VuSitu application.

[6] Calibration constants are tracked here: \\FS01\Data$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment\In-Situ Sondes

6.1.9 Depth Sensor Calibration

In-Situ sondes with depth sensing capability have an external water pressure (proxy for depth) sensor that should be calibrated to zero depth within ambient air at the barometric pressure at which the sonde is being immediately used for depth sensing capabilities (i.e., if the sonde is being used to measure a lake's depth, then calibrate for zero depth while at that specific lake).

> **Note:** Ensure that In-Situ depth readings are within one meter of the marked instrument cable or tagline. If not, use the marked cable or tagline to determine profiling and sample depths.

The Aqua TROLL® 600 sonde uses its pressure reading and specific gravity value to calculate the sonde depth. The pressure sensor is located at the center of the instrument, but depth is reported on the smart sensor faces. An embedded gyroscope compensates for the distance between these sensors and allows the sonde to be deployed in any orientation (vertical, horizontal, angled).

1. Follow the procedures outlined in Section 6.0 to establish a connection between the Bluetooth handheld device and the sonde.
2. Within the VuSitu app, tap the VuSitu menu icon and select **Connected Instrument** from the list. Select **Calibrations**. Select **Level**.
3. Follow the on-screen prompt to open the battery cover to expose the sonde's internal barometric pressure sensor to ambient pressure. Allow the pressure on the sonde screen to update and stabilize (indicated by a check mark next to the pressure value).
4. Follow the on-screen prompt to expose the external water/air pressure sensor to the atmosphere (ambient air). Tap **Next.**
5. Allow Zero-in-Air calibration to stabilize. When it is stabilized a green screen with a "stabilized" message and check mark will appear and the barometric pressure displayed will also have a green checkmark next to it. Tap **Accept**.
6. If calibration is not successful or out of range, use a tagline or marked cable for determining depths and not the depth sensor.

> ***Note:*** If the barometric pressure has recently been updated the sonde will not prompt the user to remove the battery cover to reset barometric pressure. If the sonde is being used to measure level at a different location than where barometric pressure was last reset (>500 feet elevation difference), force a barometric pressure reset on the sonde by exiting out of the calibrations menu and simply opening the battery compartment and allowing the barometric pressure reading on the sonde body's screen to stabilize (indicated by a check mark next to the value) before closing the battery compartment.

6.1.10 Chlorophyll a and Phycocyanin Calibration

A one point calibration should be conducted with DI water prior to data collection. The calibration report should be saved and upload to HydroVu, if possible.

6.2 Collection of Instantaneous Measurements and LTD

Prior to collecting data, the sonde must be calibrated. Measure field parameters during each sampling event as specified in the approved project's field sampling plan. Always calibrate and take two sondes into the field. It is a requirement to have a backup sonde for data collection on sampling runs.

6.2.1 Instantaneous Measurement

Sample Location

In streams and rivers, attempt to take measurements where the stream is flowing and well mixed. Avoid stirring up sediment when placing the sonde in the water. If the stream is not well mixed, it may be necessary to move to a location that is mixed (up to 500 meters before a new station must be created). Avoid sampling in backwaters, eddies, and directly below a confluence or discharge.

When collecting data, replace the calibration cup with the sensor guard and carefully place the sonde in the water with the sensors exposed to oncoming current and above bottom sediments. Place the sonde directly in a representative stretch of the water body to be sampled upstream of where flow measurements occur and/or samples are collected as this work may stir up sediment. Allow at least two minutes to equilibrate while water samples are collected. Readings are generally considered stable when temperature no longer changes by more than a tenth of a degree. When water depth is too shallow to allow vertical orientation of the sonde, it may be placed horizontally in the water column, with sensors facing upstream and into the flow.

> **Note: A vented sonde should not be used for instantaneous measurements unless the individual is an expert in utilizing vented sondes. Vented sondes that are submerged without a vented cable connected will damage internal components of sondes, cause malfunction of electronic components, and void warranty.**

When instantaneous field parameters (e.g., pH, dissolved oxygen, specific conductivity, turbidity, and temperature) cannot be measured due to low flow, they may be measured in the calibration cup/restrictor, or a bucket used for sample collection. A small container can be used to fill the calibration cup/restrictor in very shallow situations. Use a bucket that is large enough to allow full immersion of the sensors and bring the bucket to the same temperature as the water before it is filled. If a bucket is used, make clear notes on the Stream Field Data Form indicating what methods were used to obtain an adequate water sample volume. Also, consider building small dams or depressions to create water deep enough to submerge the sonde sensors, if possible. Allow suspended sediment to clear before collecting readings with the sonde.

Data Recording

For instantaneous measurements (grab data), record data using the Snapshot function in the VuSitu app and transfer to the Stream Field Data Form upon completion of data collection at each sampling site. Enter additional comments regarding sampling conditions or equipment status as appropriate. If a reading is clearly unreasonable, put a comment on the field form and record the measurement as missing data point (MDP). An example of an unreasonable reading is less than zero for temperature. Use best professional judgement. After each sampling trip, transfer the information to the SWQB water quality database and store the Stream Field Data Form in the project folder in the shared drive. Note: Dissolved oxygen should be calibrated at elevation when monitoring stations vary in elevation by 500 feet (152 meters).

Field Procedure for Instantaneous Measurements

1. Activate Bluetooth on mobile device.
2. Hold the sonde upside down (sensors pointed up) for three seconds to turn it on.
3. Open the VuSitu App and connect to the sonde.
4. Remove the restrictor and place it in sampling mode.
5. Select **Live Readings**.
6. Make sure Recording Mode is set to snapshot mode, indicated by the camera icon, by toggling the button in the bottom left corner.
7. Place the sonde representative stretch of the water body to be sampled upstream of where flow measurements occur and/or samples are collected. Allow at least two minutes to stabilize.
8. Once the readings are stable, select "**Save Snapshot Reading"** in VuSitu. Readings are generally considered stable when temperature no longer changes by more than a tenth of a degree. The sonde will create a new data file each day and append new readings in a new row of that file. Transfer measurements to the Stream Field Data Form at each sampling site.

After the measurements have been recorded, remove the restrictor and reinstall it in storage mode. Fill the restrictor with river or tap water to keep the sensors moist. The pH sensor, in particular, needs to be kept moist as much as possible. Never fill the restrictor with DI water as this will damage the pH sensor.

6.2.2 Sonde Long-Term Deployment (LTD)

Sample Location

Sondes are frequently deployed mounted to T-posts or rebar driven into the stream substrate for LTD. Avoid driving T-post or rebar into the stream bottom where underground utilities are suspected. If there is any question of whether underground utilities are present at the monitoring location, call "811" or visit www.nm811.org to schedule a utility location. Rebar and T-posts present trip and impalement hazards. Exercise caution when working around driven rebar and T-posts. Do not install rebar or T-posts in areas used for recreation or adjacent to trails or stream crossings. Avoid mid-channel placements in waters with boat traffic.

The Sonde Deployment/Retrieval Form must be utilized when deploying sondes for LTD and completed in its entirety at field site. Sondes deployed for LTD are to be inspected monthly (if practicable) and at the end of deployment. Sonde and sensors should be placed so they do not come in contact with stream substrate, if possible. Secure the sonde with a chain or cable to a tree or other immovable object and lock it with a weather resistant padlock. If the sonde cannot be safely deployed due to a high risk of vandalism, theft, or imminent flooding, it should not be deployed until favorable conditions are met.

> **Note: A vented sonde cannot be used for LTD. LTD of a vented sonde will cause the internal components of the sonde to malfunction and void the warranty. Vented sondes must be used with a vented cable to avoid internal water damage.**

Field Procedure for LTD

1. Activate Bluetooth on mobile device.
2. Hold the sonde upside down (sensors pointed up) for three seconds to turn it on.
3. Open the VuSitu App and connect to the sonde.
4. Remove the restrictor and place it in sampling mode.
5. Select **Live Logging**.
6. Select **New Log**.
7. Name the log. Select **Next**.
8. Select **Add New Location**.
9. Name the location. Enter the GPS location of the site or allow the app to autofill the location if the device GPS is turned on. Select **Save**.
10. Select the site just created.
11. Choose parameters and units to be collected. Select **Next**.
12. Set the salinity to automatic. Select **Next**.
13. Select the linear logging method. Select next.
14. Set the sonde to record at least every 15 minutes, but no greater than one hour.
15. Select scheduled start and stop. Select a time at the logging interval selected (e.g. If deploying sonde at 10:55 a.m., set sonde to begin at 11:00 a.m.)
16. Install the sonde at the monitoring location, as described in the Sample Location Section for LTD.

LTD Retrieval

Upon retrieving a sonde, perform a post-deployment check of the DO calibration at the monitoring station. The post-deployment check for the other parameters (e.g., conductivity, pH, turbidity) can be done either at the monitoring station or at another location but must be completed within 48 hours after retrieval if practically possible to accurately measure instrument drift. This check is not a recalibration, but an accuracy test to verify that the sensors are still functioning properly and to check for drift in the readings. Implement the following steps:

Field Procedure for Retrieval of a Sonde after LTD

1. Collect and document a live reading from a second sonde before retrieval.
2. Remove the sonde from the waterbody.
3. Remove the restrictor, reinstall it in calibration mode, and fill it with river or tap water.
4. If a manual stop was selected connect the sonde to a smart phone or tablet via Bluetooth.
5. Select **Logging**.
6. Select the more tab, and stop logging.
7. Implement the Sonde Calibration Verification Section of this SOP.
8. Follow In-Situ Sonde Data Upload Instructions from SOP 6.4 *Datalogger (Thermograph and Sonde) Data Management, Quality Assurance and Upload Instructions.*

6.2.3 Chlorophyll a and Phycocyanin Measurements

The field procedure for instantaneous measurements should be utilized (steps 1-8) for chlorophyll a and phycocyanin data collection. Lake data collection for chlorophyll a should be taken from the top, middle and bottom of the euphotic zone, if possible. See SWQB SOP 12.1 for more information regarding the determination of the euphotic zone (NMED/SWQB 2025). Phycocyanin should be taken at the lake surface.

6.3 Sonde Calibration Verification

Calibration verifications, sometimes referred to as "post checks" will be conducted following grab data collections at the completion of a sampling runs and after LTDs for DO Saturation, specific conductivity, pH and turbidity. Calibration verification should be completed within 48 hours of the last grab sample during a sample run and retrieval of a sonde deployed after LTD (NMED/SWQB 2021 or most current). DO calibration verification should be completed at the last monitoring location of the sampling run. Always perform specific conductivity calibration verifications prior to pH calibration verification due to the high conductivity of pH buffers.

The purpose of calibration verification is to check for instrument drift and ensure the accuracy of field readings. Calibration verifications are conducted by viewing the sonde's live readings of a calibration standard or buffer or in 100% saturated air for DO. Fill out the bottom half of the **Sonde Calibration Worksheet** under "Calibration Verification."

Calibration verification results that fail to meet the in-calibration (or interpolation range for LTD) range must be flagged with correct qualifier code. SWQB SOP 15.0 Data Verification and Validation Procedures contains more information on qualifier codes and the verification and validation process (NMED/SWQB 2023 or most current version). **Table 2** of this SOP also lists valid in-calibration and interpolation values for sondes used by the SWQB.

Calibration Verification	Date/Time:			Initials:	
Dissolved Oxygen		Temp.	Pressure (mmHg)		P/F
%	mg/L				
Specific Conductance		Standard Lot#	Reading	Temp	P/F
pH Value	Buffer Lot #	Reading	mV	Temp	P/F
7					
4					
10					
Turbidity (NTU)	Standard Lot#		Reading (NTU)		P/F
0	DI				
100					
1000					

Figure 22. Calibration Verification Documentation

6.3.1 Dissolved Oxygen (DO) Calibration Verification

Perform the DO calibration verification at the last site of a sampling run where the sonde was field-calibrated. If unable to perform the calibration at the last site of a sampling run where the sonde was field-calibrated, follow the steps below under (6)(a).

1. Remove the sonde restrictor and end cap and thoroughly dry the RDO sensor face with KimWipe lint-free cloths. Place the sonde restrictor back on the sonde in calibration mode (i.e., restrictor openings are located opposite the sensors, so the restrictor forms a calibration cup for holding liquid).

2. Saturate a small sponge with water. Place the sponge on the restrictor cap. Attach the end cap by turning it *a quarter to half rotation*. Allow five minutes to reach 100% saturation of the air within the sonde calibration chamber.

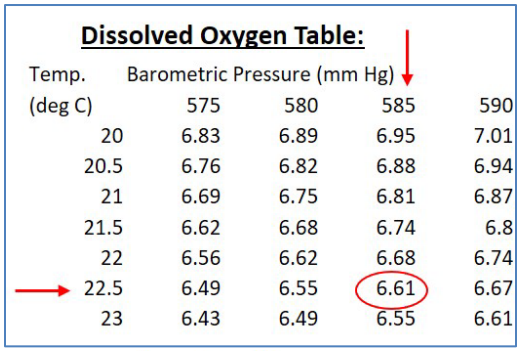
    a. ***Important***: Do *NOT* fully seal the end cap on the restrictor as this may cause a build-up of pressure within the calibration cell and provide inaccurate readings. Also note that the sensor face should be dry. Make certain that the sponge is only damp, not dripping water onto the sensors. If there are water droplets on the sensor face, it can cause the calibration to be skewed very high.

3. Follow the process detailed in the Step-by-Step Procedure for Connecting to a Sonde (Section 6.0) for establishing a connection between the Bluetooth handheld device and the sonde.
4. Within the VuSitu app tap the VuSitu menu icon and select **Connected Instrument** from the list. Select **Live Readings**.
5. Record the DO values and temperature in the post-check section of the **Sonde Calibration Worksheet**. Indicate if the calibration passed (i.e., was in-calibration range according to Table 2) or failed on the Pass/Fail portion of the worksheet.
6. DO saturation calibration verifications performed off site or in the lab will require the use of a Dissolved Oxygen Solubility Tables to determine the correct percent concentration. When performing a DO % saturation calibration verification using this method, follow the above procedures for beginning a DO calibration verification. Once the Live Reading temperature and DO concentration (mg/L) have stabilized, record these values on the calibration verification section of the worksheet, along with the barometric pressure.

    a. Then, use the Oxygen Solubility Table in the **National Field Manual for the Collection of Water-Quality Data (NFM)** at https://pubs.usgs.gov/tm/09/a6.2/tm9a6.2.pdf to find the "expected" DO concentration (mg/L) (based on 100% solubility) at the recorded temperature, and current barometric pressure (**Figure 14**). Divide the live reading DO concentration written on the worksheet by this "expected" DO concentration and multiply by 100 to find the "true" DO percent saturation. Record this number as the DO percent saturation on the worksheet.

Calibration Verification		Date/Time 6/12/2025 14:03		Initials:	ND
Dissolved Oxygen		Temp.	Pressure (mmHg)		P/F
%	mg/L				
97.58	6.45	22.51	586.1		P

Figure 13. DO Calibration Verification Documentation



Dissolved Oxygen Table:

Temp. (deg C)	Barometric Pressure (mm Hg) 575	580	585	590
20	6.83	6.89	6.95	7.01
20.5	6.76	6.82	6.88	6.94
21	6.69	6.75	6.81	6.87
21.5	6.62	6.68	6.74	6.8
22	6.56	6.62	6.68	6.74
22.5	6.49	6.55	6.61	6.67
23	6.43	6.49	6.55	6.61

$$\frac{\text{"observed concentration"}}{\text{"expected concentration"}} = \frac{6.45\ mg/L}{6.61\ mg/L} \times 100 = 97.58\%\ \text{saturation}$$

Figure 34. DO Table Example

6.3.2 Specific Conductivity Calibration Verification

1. Gently rinse all sensors and the entire inside of calibration cup once with DI water.
2. Next, rinse twice with conductivity standard by adding standard into the calibration cell and gently swirling the sonde while holding it upright so the standard makes contact with all areas of the sonde sensors before discarding.
3. Fill the cup with fresh conductivity standard 1 cm above the sensors. In VuSitu, select **Live Readings** and allow at least two minutes for specific conductivity value and temperature to stabilize.
4. Record the required sensor readings in the Calibration Verification section of the **Sonde Calibration Worksheet** for grab data.

Specific Conductance	Standard Lot#	Reading	Temp	P/F

Figure 45. Specific Conductivity Calibration Verification Documentation

5. If the specific conductivity calibration verification reading is within the in-calibration range, write “pass” or “P” in the pass/fail section of the proper calibration worksheet. If the calibration verification is not within the in-calibration range, write “fail” or “F” in the pass/fail section of the **Sonde Calibration Worksheet** (see **Table 2** and the SWQB SOP 15.0).
6. Discard the standard.

6.3.3 pH Calibration Verification

Calibration verification for pH is required for both pH 7.0 and 10.0 for all grab data and deployments. If pH values of less than 5.5 were observed, then a calibration verification of pH 4.0 must also be conducted.

1. Gently rinse all sensors and the entire inside of calibration cup once with tap water.
2. Next, rinse twice with pH 7.0 standard by adding standard into the calibration cell and gently swirling the sonde while holding it upright so the standard makes contact with all areas of the sonde sensors before discarding.
3. Fill the cup with fresh pH 7.0 standard. In VuSitu, select **Live Readings** and allow pH value to stabilize.

4. Record the required sensor readings in the Calibration Verification section of the **Sonde Calibration Worksheet** for grab data.

pH Value	Buffer Lot #	Reading	mV	Temp	P/F
7					
4					
10					

Figure 16. pH Calibration Verification Documentation

5. If the pH calibration verification reading is within the in-calibration range, write "pass" or "P" in the pass/fail section of the calibration worksheet. If the calibration verification is not within the in-calibration range and was not used for LTD, write "fail" or "F" in the pass/fail section of the **Sonde Calibration Worksheet**. If the sonde was used for LTD and the pH calibration verification reading is between the in-calibration range and the linear interpolation range, record the parameter-specific code for correction (CPH) in the pass/fail section of the **Sonde Deployment/Retrieval Field Form** (**Figure 16**). If the LTD calibration verification is not within the linear interpolation range, record the parameter-specific code for rejection (RPH) in the pass/fail section of the **Sonde Deployment/Retrieval Form.**
6. Discard the pH 7.0.
7. Repeat steps 1-5 for the second and possibly third pH values. If required, perform a pH 4.0 post-check before performing a pH 10.0 post-check.

6.3.4 Turbidity Calibration Verification

Turbidity calibration verification should be conducted for 0 NTU with DI water and a high range of 100 NTU or 1,000 NTU turbidity standard (whichever value was used for calibration).

1. Gently rinse all sensors and the entire inside of calibration cup twice with DI water.
2. Fill the cup with fresh DI water. In VuSitu, select **Live Readings** and allow turbidity value to stabilize.
3. Record turbidity value in the Calibration Verification section of the **Sonde Calibration Worksheet** for grab data. LTD post check reading should be recorded on the **Sonde Deployment/Retrieval Field Sheet (Figure 17**).

Turbidity (NTU)	Standard Lot#	Reading (NTU)	P/F
0	DI		
100			
1000			

Figure 17. Turbidity Calibration Verification Documentation

4. If the turbidity calibration verification reading is within the in-calibration range, write "pass" or "P" in the pass/fail section of the calibration worksheet. If the calibration verification reading is out-of-range, write "fail" or "F" in the pass/fail section of the **Sonde Calibration Worksheet**. If the sonde was used for LTD and the turbidity calibration verification reading is between the in-calibration range and the linear interpolation range, record the parameter-specific code for correction (CY) in the pass/fail section of the **Sonde Deployment/Retrieval Field Form** (**Figure 17**). If the LTD calibration verification is not within the linear interpolation range, record the parameter-specific code for rejection (RPH) in the pass/fail section of the **Sonde Deployment/Retrieval Form.**

5. Discard the DI water.
6. Next, rinse twice with high range turbidity standard (at least 100 NTU) by adding standard into the calibration cell and gently swirling the sonde while holding it upright so the standard makes contact with all areas of the sonde sensors before discarding.
7. For the high range calibration verification, add fresh turbidity standard of at least 100 NTU to 1 cm above the sensors. The turbidity standard value used to calibrate the sonde should be used for post check verification.
8. Next, repeat steps in letter 1-4 for high range turbidity calibration verification.
9. Discard the turbidity solution.

6.5 Sonde Maintenance

If the sonde is dirty or fouled, rinse the sonde thoroughly. Clean with warm water and mild soap, then rinse the sonde again. Air dry. Follow the maintenance schedule listed in the Operator's Manual, replacement kits, and/or sensor instruction sheets. Follow the unit-specific procedures for sensor maintenance and cleaning procedures. Refer to the instrument manual or manufacturer for detailed maintenance requirements specific to In-Situ sondes. Electronic .pdf copies of all manuals are kept on the SWQB file server.

Any staff member who performs maintenance activities (e.g., sensor replacement, junction fluid refills, probe winterization etc.) is responsible for notifying the Sonde Equipment Coordinator.. However, maintenance of sondes is the primary responsibility of the Sonde Equipment Coordinator. Staff must coordinate with the Sonde Equipment Coordinator regarding maintenance of sondes.

6.5.1 Sonde Replacement Parts

See the Sonde Equipment Coordinator for replacement parts. Do not discard any malfunctioning parts, as these may be under warranty.

6.5.2 Sonde O-rings

In-Situ sondes have several O-rings that can be maintained by applying silicone grease to new and old O-rings. Check O-rings for cracks or other damage quarterly and replace as needed. If the O-rings and sealing surfaces on the sondes are not maintained properly, water can enter the battery compartment and/or sensor or cable connector ports of the sonde. Water can severely damage the battery terminals or sensor ports causing loss of battery power during a deployment, inaccurate readings and corrosion to the contacts.

Therefore, when the battery compartment lid is removed from In-Situ sondes, the O-rings that provide the seal should be carefully inspected for contamination (e.g., hair, grit, etc.) and cleaned if necessary. The same inspection should be made of the O-rings associated with sensors, port plugs and field cable connectors when they are removed. If no dirt or damage to the O-rings is evident, they should be lightly greased (see below) with a pea-sized amount of grease without removal from their groove. If there is any indication at all of damage, the O-ring can be replaced with an identical item from the Maintenance Kit supplied with the sonde. At the time of O-ring replacement, the entire O-ring assembly should be cleaned. See the manufacturer's instrument manual for details regarding O-ring removal and installation.

> ***Important:*** Do not use alcohol on O-rings as this may cause a loss of elasticity and promote cracking. Do not use a sharp object to remove the O-rings. Damage to the O-ring or the groove itself may result. Before re-installing the O-rings, make sure that you are using a clean

workspace, clean hands, and are avoiding contact with anything that may leave fibers on the O-ring or grooves, potentially causing a leak. Do not over-grease the O-rings. In-Situ recommends using a pea-sized amount of grease. The excess grease may collect grit particles that can compromise the seal. Excess grease can also cause the waterproofing capabilities of the O-ring to diminish, potentially causing leaks into the compartment. If excess grease is present, remove it using lens cloth or lint-free cloth.

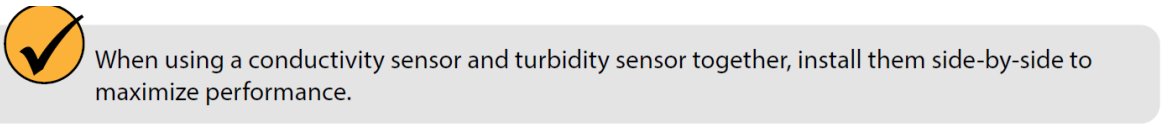
NOTE: Silicon grease is NOT a sealant. It is a lubricant only and must be used sparingly.

6.5.3 Sonde Cable Connector Port

The cable connector port at the top of the sonde should be covered at all times. When a communications cable is not connected to the cable connector port, the protective cap supplied with the instrument must be securely tightened in place. If moisture has entered the connector port, dry it completely using 95% ethanol and compressed air.

6.5.4 Sonde Probes (i.e., sensors)

Whenever installing, or replacing sensors or port plugs, thoroughly dry the sensor port plugs and the ports of the Aqua TROLL sonde body before any installation to prevent any shortages that may cause damage to the sensor or the sonde. Ensure that the sensor's O-rings are in good condition and are properly greased with lubricant. This will prevent water from entering the ports where the wires connect the sensors to the sonde body. Following removal of sensor or plug, examine the connector inside the sonde sensor port for any moisture. If any moisture is present in both the port where the connector is and the sensor, dry thoroughly with KimWipe lint-free cloth. Compressed air may also be used. If debris is found in the port of the sonde body, remove with a KimWipe lint-free cloth or compressed air. Sensors may be gently wiped with a clean cloth prior to removal to help prevent moisture from getting in during the removal process. Make sure that the sensors are in the proper configuration from Aqua TROLL Owner's Manual (**Figure 18**).



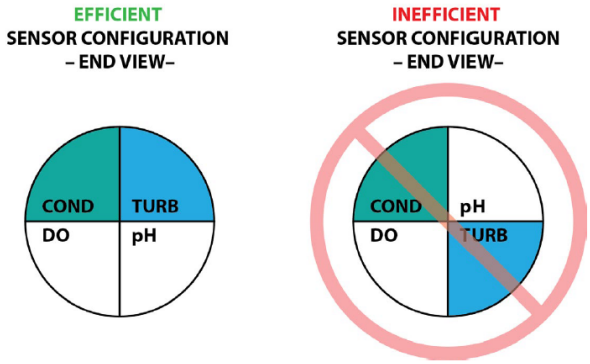


Figure 18. Proper Placement of Probes

Sonde DO Sensor

When turning on the sonde, note the time until expiration of the RDO sensor cap. Replace when recommended. Clean with mild soap and water when dirty. Do not clean with anything abrasive this could mess up the film on the cap. Replace if film on cap is overly scratched. If extensive fouling or mineral buildup is present, soak the sensor in vinegar for 15 minutes, then soak in deionized water for 15 minutes.

When changing the sensor cap, clean optical window by first removing the sensor cap and then gently wiping the sensing window with KimWipe lint free cloth.

Sonde pH Sensor

If the ORP platinum electrode is dull or dirty, it can be cleaned with a swab and methanol or isopropyl alcohol. Rub the electrode gently until it is shiny. The pH sensor must be kept moist for the life of the sensor.

The sensor reference junction filling solution has a shelf life of 2 years. Replace the reference junction filling solution every 5 to 6 months or when:

- The sensor fails to calibrate within the acceptable slope and offset range (refer to **Sonde Calibration Worksheet**).
- Sensor readings vary.
- Readings during calibration at pH 7.0 are greater than +30 mV or less than -30 mV.
- Sensor is slow to respond.
- Sensor error notice appears during live readings or calibrations.

If the sensor fails to calibrate after you replace the pH reference junction filling solution, replace the reference junction.

Replacing the pH Reference Junction Filling Solution:

1. Remove the pH sensor from the port. The hex wrench provided with the sonde is necessary to unscrew the sensor before it can be removed.
2. Install the dust cap on the connector end of the sensor or wrap the connector end in a paper towel to prevent solution from entering the connector.
3. Unscrew the reference junction on the head of the sensor using a small flathead screwdriver.
4. Hold the sensor at an angle and shake out the old filling solution into a paper towel and discard.
5. Mix the new filling solution by inverting the bottle four times without introducing any bubbles.
6. Using the elongated dispenser cap on the filling solution bottle, insert the tube into the bottom of the empty reference junction reservoir. Squeeze a steady stream of filling solution while slowly removing the tube from the reservoir. Tap the port end of the sensor on a surface to remove any bubbles. Then, overfill the reservoir slightly. This ensures the reservoir is completely full and bubble-free.
7. Screw the reference junction back on to the sensor until it touches the sensor body. Then, tighten it one quarter turn more to secure. Some filling solution will overflow. Wipe the excess off the sensor body.
8. Rise the sensor with tap water.
9. Reinstall the sensor and calibrate (refer to Section 6.1.4).

10. Replace the pH junction when the pH sensor fails to calibrate with a reasonable slope and offset, even after you have replaced the filling solution.

Cleaning
If the sensor is dirty or fouled, begin with the gentlest cleaning method and continue to the others only if necessary. Leave the sensor cap on. Do not directly wipe the glass bulb. To clean the pH sensor, gently rinse with cold water. If further cleaning is required, follow the steps below.

To remove crystalline deposits:
1. Clean the sensor with warm water and mild soap.
2. Soak the sensor in 5% HCl solution for 10 to 30 minutes.
3. If deposits persist, alternate soaking in 5% HCl and 5% NaOH solutions.

To remove oily or greasy residue, clean the sensor with warm water and mild soap. If necessary, soak in methanol or isopropyl alcohol for one hour.

To remove protein-like material, or slimy film:
1. Clean the sensor with warm water and mild soap.
2. Soak the sensor in 0.1 M HCl solution for 10 minutes and then rinse with deionized water.

Do not use organic solvents—they will damage the sensor cap. Do not remove the sensor cap when rinsing or brushing.

<u>Sonde Conductivity Sensor</u>
Cleaning
If the sensor is dirty or fouled, begin with the gentlest cleaning method and continue to the other methods only if necessary. To clean the conductivity sensor face, gently rinse with clean, cold water.

To remove crystalline deposits*:*
1. Clean the sensor face with warm water and mild soap.
2. Use a soft brush to gently clean the sensor pins and temperature button. Ensure removal of all debris around the base of the pins and button.
3. If crystalline deposits persist, soak in 5% HCl for 10 to 30 minutes followed by warm soapy water and soft brushing.
4. If deposits persist, alternate soaking in 5% HCl and 5% NaOH solutions followed by warm soapy water and soft brushing.

To remove oily or greasy residue, clean the sensor face with warm water and mild soap.
1. Using a soft brush, gently clean the sensor pins. Ensure removal of all residues around the base of the pins.
2. If necessary, soak in methanol or isopropyl alcohol for one hour.

To remove protein-like material, or slimy film*:*

1. Clean the sensor face with warm water and mild soap.
2. Using a soft brush, gently clean the sensor pins and temperature button. Ensure removal of all material/film around the base of the pins and temperature button.
3. Soak the sensor in 0.10% HCl for 10 minutes and then rinse thoroughly with distilled water.

Do not soak in strong solvents such as chlorinated solvents, ethers or ketones (such as acetone).

Sonde Turbidity Sensor

Cleaning

The optical windows should be clear of foreign material. To clear material gently rub the sensing windows using clean water and a soft cloth or swab. If more thorough cleaning is needed, remove the sensor, and soak it in a solution of dish soap with warm water. Then, brush it gently with a soft bristle brush. If there is hard fouling that needs to be removed, soak the sensor in a solution of one part water and one part vinegar. Then, scrub it gently with a soft bristle brush. Repeat either of these steps as needed. Do not use solvents, abrasives, or metal scraping tools on the sensor.

Table 3 Troubleshooting Sonde Probes provides a detailed summary regarding sonde probe issues, the possible cause of the problem, and actions staff can take to address the root cause. If the issues are not captured in **Table 3**, see In-Situ Aqua TROLL® 600 sonde manual for more information.

Table 3. Troubleshooting Sonde Probes

Symptoms	Possible Cause	Action
DO reading unstable or inaccurate	Sensor not properly calibrated	Follow DO calibration procedures
	End cap on sonde is too tight	Loosen the end cap, ensuring it is turned only one rotation
	Water droplets on the DO sensing foil or thermistor	Gently dry sensing foil or thermistor with a Kimwipe. Ensure sponge is not dripping water – only moistened
	Water in sensor port	Dry port; reinstall sensor
	Algae or other contaminant clinging to DO sensor	Rinse DO sensor with clean water and wipe gently with a Kimwipe
	Calibrated using improper barometric pressure	Repeat DO calibration procedure using proper barometric pressure
	Calibrated at extreme temperature	Recalibrate at (or near) sample temperature
pH readings are unstable or inaccurate. Error messages appear during calibration.	Sensor requires cleaning	Follow sensor cleaning procedure
	Sensor requires calibration	Follow calibration procedures
	pH sensor has dried out from improper storage.	Re-hydrate pH sensor by storing pH 4.0 fluid in the calibration cup overnight. Change the pH reference junction fluid. If necessary, replace reference junction.
	Water in sensor connector	Dry connector; reinstall sensor
	Sensor has been damaged or has expired	Replace sensor

Symptoms	Possible Cause	Action
	Calibration solutions out of spec or contaminated with other solution	Use new calibration solutions
	pH value out of range	If all of the above solutions do not fix the problem, replace the pH probe
Specific conductivity unstable or inaccurate. Error messages appear during calibration.	Conductivity improperly calibrated.	Follow calibration procedure
	Conductivity sensor requires cleaning	Follow cleaning procedure
	Conductivity sensor damaged or has expired	Replace sensor
	Calibration solution out of spec or contaminated	Rinse with DI water and use new calibration solution
	Internal failure	Return sonde for service
	Calibration solution or sample does not cover entire sensor.	Immerse sensor fully
Temperature, unstable or inaccurate	Water in connector	Dry connector; reinstall sensor
	Sensor has been damaged	Replace the sensor
Turbidity sensor: general	Sensor requires cleaning	Follow sensor cleaning procedure
	Sensor requires calibration	Follow calibration procedures
	Sensor has been damaged or has expired	Replace sensor
	Water in sensor connector	Dry connector; reinstall sensor
	Calibration solutions out of spec	Use new calibration solutions
	Wiper is fouled or damaged	Clean or replace wiper
	Internal failure	Return sensor for service
Installed sensor has no reading	Sensor has been disabled	Enable sensor
	Water in sensor port	Dry port; reinstall sensor
	Sensor has been damaged	Replace the sensor
	Report output improperly set up	Set up report output
	Internal failure	Return sonde for service

6.5.5 Desiccant

The Aqua TROLL® 600 sonde contains a small, replaceable desiccant capsule in the battery compartment. This capsule prevents moisture from causing damage to the electronic components. It is filled with color-indicating silica that changes from blue to pink as the desiccant's effectiveness decreases. Desiccant is included in the maintenance kit. Replace the desiccant where it has turned pink. Desiccant can be dried out in incubator, if this does not return desiccant to blue color toss the desiccant and replace.

6.6.6 Sonde Storage

Short-term (<1 Month or during the field season)

The sonde restrictor can be used as a storage cup. Tap water is safe for storing less than one week. However, pH 4.0 solution should be used for storing more than one week to prevent the pH probe from dehydrating while the sonde is not in use.

1. Remove the end cap from the restrictor.
2. Remove the restrictor from the sonde body.
3. Replace the restrictor onto the sonde body in storage mode.
4. Pour 15 mL (0.5 oz.) of clean tap water or pH 4.0 solution (not DI water) into the calibration cup.
5. Screw end cap back on to the restrictor so that the liquid is contained in the calibration cup.

Long-term (>1 Month during the off season)

Note: The pH sensor should not be removed from the sonde during the field season even if it will be in temporary storage for more than one month. It is acceptable to store the sonde with pH 4.0 during periods of storage while the field season is ongoing. This protocol should be used to prepare sondes for off-season storage.

1. Remove the pH/ORP sensor and place a sensor port plug into the empty pH/ORP port.
2. Dampen thew sponge inside the pH sensor storage cap with pH 4.0 calibration solution (0083210).
3. Place the storage cap firmly on the sensor. Use electrical tape to seal the cap to the sensor.
4. Place a dust cap on the sensor connector. Store the sensor in its original box in a cool location.
5. Thread the restrictor onto the sonde.
6. Store the sonde and pH/ORP sensor at temperatures between -40° to 65° C.

Prior to using the pH sensor after long-term storage, rinse the sensor with tap water and then soak it in pH 4 buffer for 1 or 2 hours. This will saturate the glass bulb with hydrogen ions and prepare it for use. Do not store the pH sensor in DI water because it will deplete the reference solution and drastically reduce the life of the sensor.

7.0 Data and Records Management

The following files are generated following the procedures outlined in this SOP:

- Sonde Calibration Worksheet
- Sonde Deployment/Retrieval Field Sheet (calibration and calibration verification)
- VuSitu data file and calibration report
- Temperature Accuracy Verification Spreadsheet

All calibration files (calibration and calibration verification) and deployment/retrieval sheets must be retained for a minimum of 3 years from the date of project verification and validation on the SWQB's internal server.

For the SWQB MASS the records of the disposition for each sonde are documented within Equipment Inventory. Available within a folder \\FS01\Data$\WPD\SWQB\MASS\Monitoring Team\Lab Inventory.

8.0 Quality Control and Quality Assurance

Standardized methods that are documented in this SOP are used to control the quality of sonde data. All personnel who calibrate, deploy, or maintain sondes must be familiar with these protocols and the related documents (e.g., field forms) and sign the acknowledgment form associated with this specific SOP. 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 2024 or most current). 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.

Between each field season, the Sonde Equipment Coordinator verifies that each sonde is reading temperature within ±0.5°C of a NIST-traceable and calibrated thermometer at a minimum of two temperatures (approximately 4-10 °C and 35-40 °C) bracketing the range of water quality standards. The annual temperature verification will be documented by the Sonde Equipment Coordinator[7]. The **Sonde Calibration Worksheet** must indicate the date the verification was performed, the technician (i.e., Sonde Equipment Coordinator) conducting procedures, if verification passed or failed, and any important notes. New sondes do not require accuracy verification prior to first use. The Temperature Accuracy Procedure is detailed below. Certified thermometers should be certified at two temperatures before the calibration due date listed on the certificate of calibration. Also, see the Temperature Sensor Section of this SOP, for the required mid-season one-point temperature verification check.

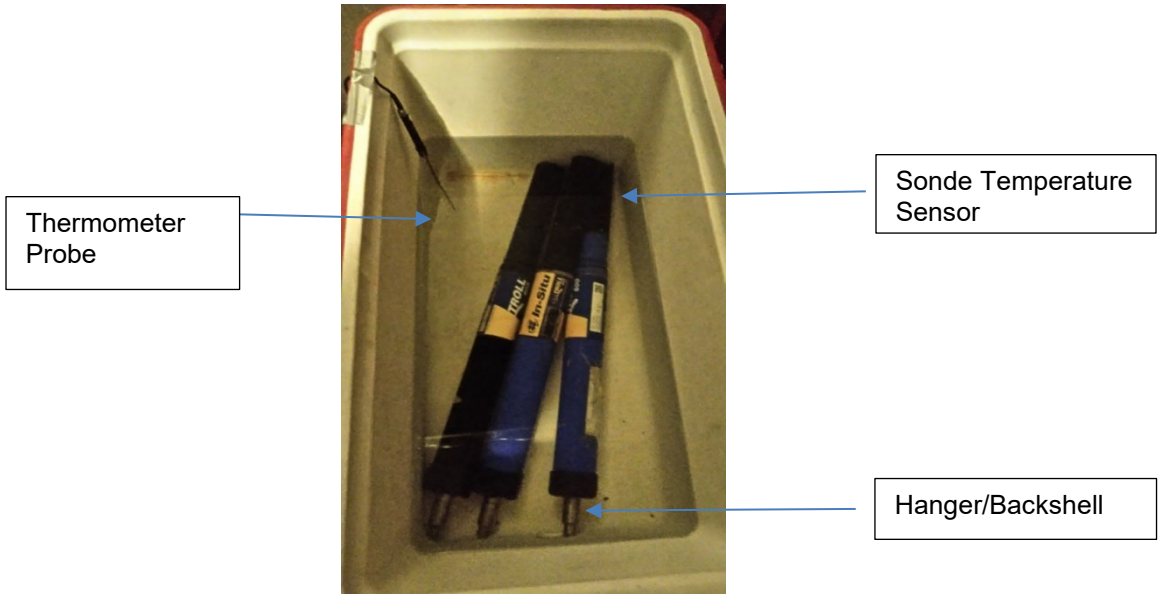
8.1 Temperature Accuracy Check Procedure

Verify the accuracy of the temperature sensor on sonde(s) between field seasons by completing a temperature validation using a 2-point verification procedure which utilizes a cold bath and then a warm bath. The temperature accuracy verification procedure for sonde(s) is detailed below in a step-by-step process.

1. Begin by preparing a low range cold-water bath between 4-10 °C for the 1st-point of the temperature verification. The cold-water bath can be prepared by using a refrigerator and a container large enough to submerge the sondes such as an ice chest. Typically, the SWQB will use a sample ice chest and the large walk-in refrigerator located in the laboratory of the Harold Runnels Building.
2. First, fill the container that will be used for the temperature accuracy check with cold water from the tap, shut the lid, and place in refrigerator (e.g., walk-in refrigerator).
3. Next, ensure sonde(s) internal clock are set to the correct time and the battery percentage is greater than 10%.
4. After time and voltage are confirmed, ensure the sonde is watertight (i.e., waterproof) to prevent damage to any internal electrical components. This is completed by inspecting sonde(s) O-rings to ensure they are in good condition and the metal back-endcap(s) (hanger/backshell) are securely fastened.
5. Next, utilize the logging feature (See LTD Section of this SOP) to program sonde(s) to simultaneously record at least 3 temperature readings, each 5 minutes apart. When programing the sonde, staff need to account for the stabilization and acclimation period, at least 15 hours to reduce stratification of water.

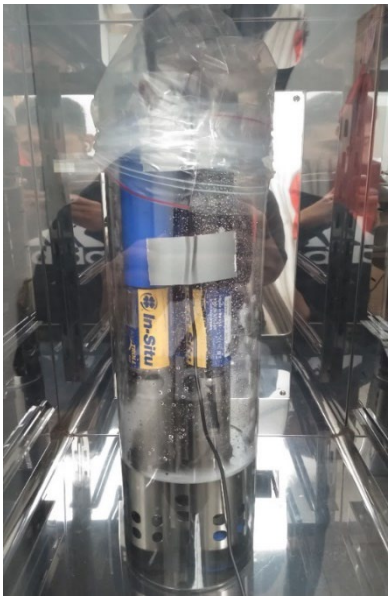
[7] Stored at \\FS01\Data$\WPD\SWQB\MASS\Monitoring Team\Monitoring Equipment.

6. Next, place sonde(s) in cold-water bath. Ensure sonde(s) temperature sensor(s) are at equal depths. Note: Avoid overcrowding of sondes in the cold-water bath to reduce stratification for more stable temperature measurements.
7. Next, place NIST certified thermometer temperature sensor in the container and ensure temperature sensor tip is at an equal depth as the sonde temperature sensors. See picture below for an example of sondes and thermometer sensor in cold-water bath. Note: The slightest offset (e.g., an inch or two) may make a difference in temperature readings (sonde(s) and thermometer) due to water stratification. Stratification of water may cause invalidation temperature verification.
8. After sondes(s) and the thermometer sensor are placed in the cold-water bath, place in the walk-in refrigerator. If using an ice chest, place the lid on the ice chest. Allow sensors to equilibrate with water in container for at least 15 hours before moving to the next step. Note: Keeping the ice chest lid shut and walk-in refrigerator door closed to help maintain stable temperatures and preserve the mechanical parts of the walk-in refrigerator from rusting.



9. Next, record the temperature of the water displayed on the NIST certified thermometer at the same time interval (set in Step F) set for sondes(s) to collect data points on the **Temperature Accuracy Verification Spreadsheet**. Ensure at least 3 temperature measurements are recorded at least 5 minutes apart between 4-10 °C. Datalogging thermometers can be set to record and store data at 5 minutes increments or staff may record the temperatures manually. For instructions on setting thermometer logging interval and data retrieval see the thermometer manual.
10. When complete with collection of the cold-water bath measurements, the sonde(s) and thermometer may be removed from cold-water bath and the steps below may be initiated.
11. Prepare a warm-water bath 35-40 °C for the 2nd-point of the temperature verification procedure. The warm-water bath temperature range is intended to bracket the highest temperature criterion established in 20.6.4 New Mexico Administrative Code (NMAC), which is currently 34 °C (NMAC 2023).

12. Typically, the SWQB will prepare the warm-water bath using warm-water from the tap and the incubator located in the SWQB laboratory of the Harold Runnels Building.
13. Prepare a warm-water bath by pouring warm-water from the tap into a container large enough to submerge sondes. The container must be placed into the incubator, so plan accordingly. Note: Shelves must be removed from the incubator.
14. The incubator temperature should be set to a temperature so that the water in the container can reach 35-40°C. Typically, the incubator temperature is set to 38-39°C to account for heat absorption.
15. Next, utilize the logging feature (See LTD Section of this SOP) to program sonde(s) to simultaneously record at least 3 temperature readings, each 5 minutes apart. When programing the sonde, staff need to account for the stabilization and acclimation period, at least 15 hours to reduce stratification of water.
16. After sonde(s) have been programmed, place sondes in warm-water bath and place the thermometer temperature sensor tip at the same depth as sonde temperature probes and attempt to seal container. See picture below.
17. Use a Ziplock® or trash bag can be used to enclose the sonde(s) in the warm-water bath. Enclosing the bath will reduce temperature fluctuations and stratification as well as prevent rusting the incubator. Below is a picture of the sonde warm-water bath setup. Allow at least 15 hours for water temperature to stabilize before proceeding to the next step.



18. Next, record the temperature of the water displayed on the NIST certified thermometer at the same time interval set for sondes(s) to record data points on the **Temperature Accuracy Verification Spreadsheet**. Ensure at least 3 temperature measurements are recorded at least 5 minutes apart between 35-40 °C.
19. Next, offload data from sonde(s) and thermometer and store each temperature log in the appropriate Temperature QC folder for the current year located on NMED's internal server (i.e., SWQB\MASS\Monitoring Team\Monitoring Equipment\Temperature QC). Sonde temperature logs may be obtained by HydroVu or sent by e-mail. See thermometer manual for instructions on how to offload data.

20. Review offloaded sonde temperature files and verify that the sonde collected at least 3 temperatures at the same time intervals as temperatures were recorded from the NIST certified thermometer.
21. Compare data from the sonde and thermometer. All information is recorded on the **Temperature Accuracy Verification Spreadsheet** located on the NMED internal server.
    a. Record sonde type, sonde serial number, thermometer serial number, reference temperature correction factor, name of staff member conducting the temperature accuracy check, and test date. **Note: the reference temperature correction factor can be found on the thermometer Certificate of Calibration.**
    b. Record the low and high reference temperatures from the thermometer. If the NIST certified thermometer has an associated temperature reporting error from when it was last certified, add or subtract the error to the documented temperature. For example, if the thermometer reads 5.8°C but the lab that checked the thermometer noted an error of -0.2°C, then the reported temperature should be 6.0°C, not 5.8°C.
    c. Calculate and record the low/high temperature discrepancy between sonde temperature readings and reference temperatures. Verify that the sonde temperature is within ±0.5°C of the NIST certified thermometer at the time of at least one logging interval following the stabilization period.

Any temperature sensors that fall outside the acceptable accuracy range in **Table 4** should be returned to the manufacturer by the Sonde Equipment Coordinator. For grab data, if sondes/loggers fall outside the in-calibration range (**Table 4**), reject all temperature data collected by the instrument and qualify all temperature-dependent measurements as suspect. Temperature-dependent measurements include but are not limited to specific conductivity, salinity, dissolved oxygen, and pH.

For long term datasets, if sondes were used to collect data during the current year and the temperature check falls outside the in-calibration range but within the linear interpolation range, all temperature data collected using the sonde/logger in question should be flagged "CT" on the **Long Term Data Management Spreadsheet** for all deployments (SOP 6.4). If the temperature check falls outside of the linear interpolation range, all temperature data collected using the sonde/logger in questions should be flagged “RT” and all temperature-dependent measurements qualified as suspect.

Table 4. Accuracy Verification Criteria and Maximum Allowable Limits for Data Adjustment

Measurement	Standard	Standard Value	In-calibration Range	Linear Interpolation Range (Max Allowable Limits)
Temperature, °C	NIST Certified Thermometer	Ambient Temperature	± 0.5	± 2

9.0 Related Forms

- Sonde Calibration Worksheet
- Sonde Deployment/Retrieval Field Sheet
- Stream/River Field Data Form (see SOP 8.2)
- Long Term Data Management Spreadsheet (see SOP 6.4)
- Temperature Accuracy Verification Spreadsheet

10.0 Revision History

Original modified from SOP 2007.

Revision 1. February 2012. updated to incorporate Hydrolab sondes.

Revision 2. February 2013. updated to incorporate Onset HOBO DO Loggers, updated Table 2 to current Calibration Range values. Directed "Sonde Data Manager" duties to the survey Project Coordinators Jodey Kougioulis, QAO; Scott Murray, SME; Jeff Scarano, Program Manager MASS

Revision 3. February 2016. updated to include instructions for YSI V2 sondes, requirements for calibration verification bracketing, and maintenance documentation, formatted to SOP 1.1.
Jodey Kougioulis, QAO; Scott Murray, SME; James Hogan, Acting Program Manager MASS

Revision 4. January 2017. Updated to incorporate In-Situ sondes and HOBO Conductivity Loggers, added post check procedures and in-calibration range table, formatted to SOP 1.1 (2017).
Jennifer Fullam, Acting QAO; Chuck Dentino, SME; Kristopher Barrios, Program Manager MASS

Revision 5. October 2020. Removed references to YSI and Hydrolab sondes. Revised sonde calibration information and organization. Added barometric pressure and depth sensor calibration.
Miguel Montoya, QAO; Meredith Ziegler, SME; Kristopher Barrios, Program Manager MASS

Revision 6. February 2021. Revised content in letter E of the Temperature Accuracy Check Procedure due to a quality control issue in the example provided. The value +.02°C was changed to -0.2°C to make example true. Miguel Montoya, QAO; Meredith Ziegler, SME; Kristopher Barrios, Program Manager MASS

Revision 7. April 10, 2024. Removed Hobo data loggers (DO and specific conductivity) from SOP. Added clarity to the Temperature Accuracy Verification Procedure. Renumbered sections. Combined Sonde Deployment SOP with Sonde Calibration and Maintenance SOP. Also added procedure for removing data from the sonde and uploading into SWQB network server. Removed Subject Matter Expert (SME) requirement to approve SOP. Removed Sonde Manager (and Alternate) and replaced with Sonde Equipment Coordinator.
Miguel Montoya, Acting QAO; Lynette Guevara, Program Manager MASS

Revision 8. July 25, 2025. Moved DO calibration steps below other parameters and revised process so DO calibration is only performed in field, not in lab. Changed the description of solution quantity used during calibration. Removed requirement to swirl turbidity solution prior to calibration. Performed miscellaneous organizational and grammatical revisions. Changed field procedure to indicate staff should allow at least two minutes for sonde to stabilize. Changed tracking of sonde maintenance from

Sonde Tracker Spreadsheet to Equipment Inventory. Changed procedure for mixing turbidity solution to more align with manufacturer procedure. Update screenshots. Changed time required for temp check to 15 hours. Addition of chlorophyll a and phycocyanin sensor.
Emily Miller, QAO; Lynette Guevara, Program Manager MASS

11.0 References

In-Situ Inc. 2024. Aqua TROLL® 600 Multiparameter Sonde Operator's Manual. September 2024.

In-Situ Inc. 2017. Aqua TROLL® 600 Multiparameter Sonde Quick Start Guide. Revision 3. March 2017.

New Mexico Environment Department/ Surface Water Quality Bureau (NMED/SWQB). 2024 or most current. New Mexico Environment Department Surface Water Quality Bureau Chemical Hygiene Plan for Runnels Building Laboratory.

NMED/SWQB. 2024 or most current. Quality Assurance Project Plan for Water Quality Management Programs. Available at: https://www.env.nm.gov/surface-water-quality/protocols-and-planning/

NMED/SWQB Standard Operating Procedures (SOPs): Available at: https://www.env.nm.gov/surface-water-quality/sop/

NMED/SWQB. 2020 or most current SOP 1.1 for the Creation and Maintenance of Standard Operating Procedures.

NMED/SWQB. 2021 or most current. SOP 6.4 for Long-term Deployment Data Logger QA and SQUID Upload.

NMED/SWQB. 2023 or most current. SOP 15.0 for Data Verification and Validation Procedures.

NMED/SWQB. 2025 or most current. SOP 12.1 for Lake Sampling.

New Mexico Water Quality Standards for Interstate and Intrastate Surface Waters, 20.6.4 New Mexico Administrative Code (NMAC). 2025. Available at: https://www.env.nm.gov/surface-water-quality/wqs/

US Geological Survey (USGS). 2018. National Field Manual for the Collection of Water-Quality Data: Techniques of Water-Resources Investigations, Book 9. U.S. Geological Survey. Available at: https://water.usgs.gov/owq/FieldManual/