

**STANDARD OPERATING PROCEDURE (SOP) – Water Quality Planning Division**

**Title: Measurement of Water Level and Sensor Depth in Surface Water using the In-Situ Level TROLL 500**

Team Leader: \_\_\_\_\_ Date: \_\_\_\_\_

Quality Control Review: \_\_\_\_\_ Date: \_\_\_\_\_

Section Manager: \_\_\_\_\_ Date: \_\_\_\_\_

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1.0	PURPOSE	

This document describes the analytical procedures for continuous measurement of water level and sensor depth, in ambient surface water. **Note:** Texas Commission on Environmental Quality (TCEQ) uses the term water level to describe the height of surface water above a datum (reference point). Stage and gauge height are terms that can also be used to describe the height of surface water above a datum. Sensor depth is the depth of the sensor below the surface of the water.

**2.0 SCOPE AND APPLICABILITY**

- 2.1 This procedure is intended for use in the Continuous Water Quality Monitoring Network (CWQMN).
- 2.2 Water level and sensor depth measurements can be used for water quality data interpretations.
- 2.3 Water level or sensor depth measurements made at CWQMN sites can be used as an indicator to determine if sonde multi-probe sensors are submerged in the water

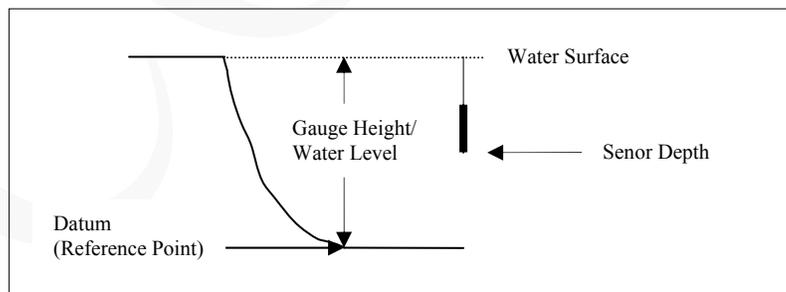
- body. Water level or sensor depth information can be used for sonde multi-probes and Aqualab Analyzer data validation decisions.
- 2.4 Water level or sensor depth measurements using the Level TROLL 500 can be used as a triggering mechanism for the Aqualab analyzer to start and stop sample collection and analysis based on water level set points.
  - 2.5 The working ranges of the sensor are listed below.

**Table 2-1**

Parameter	Working Range	Accuracy
Water Level/Sensor Depth	0 - 11 meters / 0 – 35 feet	
Pressure	15 pounds per square inch (PSI)	± 0.1% Full Scale (-5 degrees Centigrade (°C) to + 50° C)

**3.0 METHOD SUMMARY**

- 3.1 Water level and sensor depth measurements are made at a fixed point in the water column.
- 3.2 The sensor utilizes a pressure transducer that measures changes in pressure (in force per square unit of surface area) exerted by water. The transducer is vented and measures pressure of the water column plus atmospheric pressure above the water. Vented sensors subtract the atmospheric pressure component from the absolute pressure measurement. For use in the CWQMN the sensor can be configured for measuring water level or sensor depth.
- 3.2 During water level sensor configuration the height of the surface water is determined from a datum (reference point) at the location where the sensor is deployed (usually from the bottom of the water body). The Level Troll calculates water level based on sensor depth measurements and the gauge height measured during sensor configuration. See Figure 1.



**Figure 3.1**

**4.0 LIMITATIONS**

- 4.1 Sensors and deployment mounts can be damaged during high flow or flooding events.
- 4.2 In rivers that have high sediment loading, sensors can periodically become covered with sediment.

- 4.3 When configured for water level, the sensor calculates water level based on the datum (reference point). If the datum changes (due to changes in water body morphology) the sensor will not accurately measure water level.

## 5.0 SAFETY

This procedure includes processes that can be hazardous. Therefore, before attempting this process, review the *TCEQ Chemical Hygiene Plan* for proper equipment and procedures necessary for the safe completion of this procedure.

## 6.0 EQUIPMENT AND REAGENTS

### 6.1 Equipment

- In-Situ Level TROLL 500 Sensor
- Personnel Computer (PC) or Lap Top computer with Win-Situ software
- TROLL Com™ (connects Rugged Cable™ to PC's serial port)
- Communication cable - stripped and tinned
- Rugged Cable™
- Outboard Desiccant
- Staff gauge or other measuring device to set datum reference point.
- Instrument logbook

### 6.2 Standards and Reagents (none)

## 7.0 PROCEDURE

Before water level or sensor depth is monitored, the sensor is configured and calibrated. Quality control (QC) checks are performed at a minimum of once every three months. The Level TROLL 500 water level and sensor depth parameters are monitored by the site operator remotely to evaluate operational status of the sensor.

### 7.1 Monitoring

The sensor is deployed at a fixed secure point in the water column. The sensor is typically deployed in an open ended aluminum (or poly vinyl chloride [PVC]) tube that is mounted to a sonde support structure, stream bed or other available structures.

- 7.1.1 The sensor should be deployed in a representative section of the water body.
- 7.1.2 Do not kink or bend the Rugged Cable. A sensor vent tube to atmosphere is contained within this cable.
- 7.1.3 When using sensor depth measurements for sonde multi-probe validation information the sensor must be placed in the water column at the same location as the sonde multi-probe sensors.

### 7.2 Station Monitoring

The site operator should monitor measurement parameters daily to ensure the station is operational.

- 7.2.1 Every business day the site operator will monitor (via TCEQ website [http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/swqm\\_realttime\\_alt.html#data](http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/swqm_realttime_alt.html#data)) TCEQ website. The site operator will ensure data communications to TCEQ are functional and screen water

level or sensor depth measurements for anomalies. If problems are identified, a site visit may be needed to correct any problems.

7.2.2 Water level or sensor depth measurements can be used as an indicator to whether sonde sensors are submerged in the water body or that the sonde may need to be adjusted to the correct depth.

7.3 Water level and sensor depth measurement verifications QC checks are performed once every three months. For further details, see Section 9.0.

7.4 Water level Sensor Configuration and Calibration

Calibrate and configure sensor for either sensor depth or water level. This procedure will store the configuration settings in the Level TROLL sensor. Enter datum information in the LEADS operator log.

7.4.1 Sensor Calibration

The following procedure is used to Zero the sensor's offset. This is accomplished with a dry sensor in air.

- Following procedures in Section 7.4.2 to connect the sensor to the WS software interface in the Win-Situ LT window.
- Click the **Sensors tab**  and select the sensor.
- Click the **Calibrate button** . A calibrate window will appear. You will be prompted to ensure the device is dry and in air.
- With the device in air, click **Calibrate**. The pressure reading will be set to zero.

7.4.2 Sensor Configuration

- Disconnect the Stripped & Tinned Rugged cable from the Rugged Cable. Connect TROLL Com. Cable to Rugged Cable and to the RS232 computer serial port. The computer is now directly connected to the sensor.
- Open Win-Situ by selecting **WS** desktop shortcut created during software installation.
- Win-Situ LT window will appear and from the File Menu drop down box select **Settings**.
- A sub Win-Situ Settings window will appear and in the Communication Settings field select **COM1** from drop down menu and click the **OK button** .
- On the bottom right hand corner of the Win-Situ LT window click the **Connect Button** , to connect to the level TROLL. The software will connect to the level TROLL and display current water level/sensor depth, pressure, and temperature readings.
- Click the **Sensors tab**  and select the sensor.
- Select the **Configure button** .
- The Sensor Setup window will appear. In the Parameter drop down box select **depth** and in the Units drop box select **feet**. Then, click the **Configure Level** button
- The Level Setup Wizard window will appear. Under Surface Water choose the desired sensor output, either **Depth** (this is sensor depth) or

**Gauge Height/Stage** (this is water level). Depending on output option chosen proceed to applicable set of instructions below.

**Depth** (sensor depth)

- After **Depth** is chosen click the **Next** button .
- A Level Setup Wizard window will appear containing Specific Gravity options. Select Fresh Water and click the **OK** button .
- The Sensor Setup window will appear and click the **OK** button . The sensor is now configured.

**Gauge Height/Stage** (water level)

- After **Gauge Height/Stage** is chosen click the **Next** button .
- A Level Setup Wizard window will appear and choose **Set Level Reference for Gauge Height/Stage**  and in the field enter the gauge height in feet. Then, click the **Next** button .
- A Level Setup Wizard window will appear containing Specific Gravity options. Select appropriate water type and click the **OK** button .
- The Sensor Setup window will appear and click the **OK** button . The sensor is now configured.

7.4.3 LEADS Datum Operator Log

When level sensor is configured for water level enter operator log into LEADS with datum information, date, time, and water body conditions (low flow, high flow etc.)

8.0 CALCULATIONS

8.1 Vented Pressure ( $VP$ ) is calculated using the following equation:

$$VP = P_{absolute} - P_{atmosphere}$$

Where:

$P_{absolute}$  = pressure of water column plus atmospheric pressure

$P_{atmosphere}$  = atmospheric pressure

8.2 Water Level in feet ( $WL_f$ )

$WL_f$  is calculated using the following equation:

$$WL_f = GH_f + (\Delta SD_f)$$

Where:

$GH_f$  = gauge height/water level in feet measured during sensor configuration

$\Delta SD_f$  = change in sensor depth in feet after configuration

8.3 QC Calculations (none)

9.0 QC

QC verification checks are used to ensure that acceptable data quality is maintained throughout the process and to help assess data validation. QC checks performed for this procedure are verification of water level or sensor depth measurements.

Any deviation from the procedures documented in the SOP, including any QC checks which do not meet the frequency requirement or acceptance criteria, need to be documented in the operators log. The log entry should contain a description of the exception, the cause (if known), the affected data, and the impact on data. Any affected data should be qualified accordingly.

9.1 QC Checks

Water level and sensor depth measurements are verified by using another method to measure water level or sensor depth. This can be accomplished using a separate depth sensor or various other linear measurement devices. Water level and sensor depth QC checks are performed once every three months.

9.1.1 Sensor Depth

Sensor depth is checked by using a second measurement device to measure the vertical distance from the end of the deployed sensor to the water surface. The measurement made using the second device is subtracted from the water level measurement of the deployed sensor. The deployed depth sensor must be  $\pm 6.0$  inches of the second measuring device. If the check does not meet acceptance criteria, corrective action needs to be performed.

9.1.2 Water Level

Water Level is checked by using a second measurement device to measure the gauge height (water level) at the fixed location of the deployed sensor. The gauge height/water level measurement made using the second device is subtracted from the gauge height measured by the deployed sensor. The deployed depth sensor gauge height readings must be  $\pm 6.0$  inches of the second measuring device. If the check does not meet acceptance criteria, corrective action needs to be performed.

**Table 9-1 QC Checks**

QC Check	Purpose	Frequency	Acceptance Criteria	Response Action
Sensor Depth	To assess sensor depth measurement accuracy	Once every three months	$\pm 6.0$ inches	1) Perform corrective action and/or re-calibrate
Water Level	To assess water level measurement accuracy and to adjust (datum) reference point if necessary	Once every three months or after an event that could change water body morphology	$\pm 6.0$ inches	1) Perform corrective action and/or re-calibrate 2) Reconfigure sensor with new gauge height measurement

10.0 DEFINITIONS

See Appendix A of the *Laboratory and Mobile Monitoring Quality Manual*  
 Surface Water Quality Monitoring *Quality Assurance Project Plan*

## 11.0 REFERENCES

*U.S. Geological Survey TWRI Book 9*  
*TCEQ Operating Policies and Procedures, Chapter 6.13*  
*Laboratory and Mobile Monitoring Quality Manual*  
*Surface Water Quality Monitoring procedures Manual, Volume I*  
*Continuous Water Quality Monitoring Network Quality Assurance Project Plan*  
*Monitoring Operations Hazardous Waste Disposal Plan*  
*TCEQ Chemical Hygiene Plan*  
Chapter 6.13 of the *TCEQ Operating Policies and Procedures*

## 12.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

Supervisors, sampling personnel, and laboratory analysts should identify and implement innovative and cost-saving waste reduction procedures as part of the method development, review, and revision of standard operating procedures. Wastes that do result from these procedures are managed and disposed of in accordance with appropriate state and federal regulations.

Refer to Chapter 6.13 of the *TCEQ Operating Policies and Procedures* for guidelines on general recycling, waste reduction, and water and energy conservation. Review these procedures for specific employee responsibilities and mechanisms for office-related waste prevention and management. Consult the *Monitoring Operations Hazardous Waste Disposal Plan* for laboratory-specific waste minimization recommendations and requirements for proper handling of hazardous waste that result from laboratory procedures.

## 13.0 SHORTHAND PROCEDURE

- Set-up Procedures (Section 7.4)
  - Configure and calibrate sensor.
  - Deploy sensor.
- Monitoring and Sensor Verification (Section 7.2 and 7.3)
  - Monitor sensor every business day via internet.
  - Verify sensor water level or depth measurements every three months.