Standard Operating Procedure #012
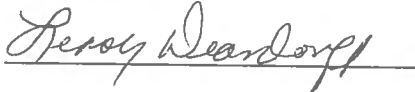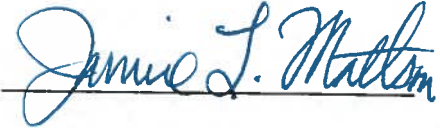# Telog Water Level Logger

Version 1.0
October 2018

Prepared by:
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Natural Resources Department
Lummi Indian Business Council

Prepared for:
EPA Region 10

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REVISION RECORD

Approval	Date	Responsible Person	Description of Change	Location of Change
1	October 2018	Kara Kuhlman	Initial Approval and Release of Version 1.0	N/A
2				
3				

SIGNATURE PAGE

Document: Telog Water Level Logger SOP #012

Version 1.0

The following technical staff have read this manual. A copy of this page will be distributed to the employee training record file.

Signature	**Date**

Name (printed)	**Title**

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1. INTRODUCTION

The Telog Water Level Logger (Telog logger; logger) is a continuous water level logger that can be used for continuous monitoring of aquifer level at groundwater sites. The Standard Operating Procedures (SOP) for the Telog Water Level Logger should be followed any time the Telog logger is used. This document describes the standard operating procedures and best practices for using the Telog logger, including calibration, quality assurance and quality control (QA/QC) activities, troubleshooting, logger setup and data download, and maintenance activities. This document is to be used in conjunction with the relevant project Quality Assurance Project Plan (QAPP; LWRD 2018a) and the Telog R-2100e Series Recorders Hardware and Installation Manual (Telog 1995) and Telogers for Windows User Guide for Version 2 (Telog 1999).

1.1 Method Summary

Telog loggers are programmed prior to deployment in the field to specify water level measurement recording interval, to correct the scaling of the logger, and to convert to desired user units. Telog loggers are calibrated annually, and field QA/QC checks and maintenance activities occur on a frequency determined by the recording interval. Field QA/QC checks include zero water level accuracy checks. Maintenance activities include checking and changing batteries, desiccant packs, and vent filters.

1.2 Health and Safety Warnings

No water quality measurement is worth risking injury or death. Field personnel must be aware of the environment, use common sense and training, and not exceed their abilities or limits. Field work is never conducted alone. All Lummi Natural Resources (LNR) Water Resources Division (LWRD) Health and Safety Plan (LWRD 2015) requirements and guidelines are followed at all times while conducting fieldwork.

1.3 Quality Assurance/Quality Control (QA/QC)

Quality assurance/quality control activities are integral to logger maintenance and provide information to the sampler and analyst about logger condition and data reliability. The QA/QC activities for assessment of logger operation occur before loggers are deployed and during field visits. Logger problems or failure to meet QA/QC activity acceptance criteria initiates corrective actions.

The sampler can take corrective actions based on the results of QA/QC activities to ensure that measurements have a known accuracy, precision, and traceability. All problems, corrective actions, outcomes, and resolution are documented in Water Database or on field datasheet (LWRD 2018b,c).

2. INSTRUMENT PREPARATION FOR USE

The Telog loggers consist of two parts: the pressure sensor and the recorder. As a unit, the pressure sensor must be deployed and the logger must be set up to log measurements at project-specified intervals and to convert measured units to transmitted units to user units (*i.e.,* adjusting the scaling). Scaling adjustment allows for reporting of units as required in the relevant project QAPP.

2.1 Logger Setup

Prior to deployment, the Telog logger is programmed to record measurements every hour and to display units as feet of water.

1. Connect the logger to the field computer using the serial port connector

2. Open Telogers for Windows

3. Setup > Modify > Select the name of the recorder

    o The Recorder ID is the serial number of the recorder

    o Recorder Name is specified in the project QAPP

    o Recording interval is specified in the project QAPP

    o Sample rate is specified in the project QAPP

    o Excitation delay is 15 milliseconds

    o Range should show 0 – maximum mAmps depending on the type of sensor

    o Enable Min Avg Max cutoff

4. Under Scaling:

    o Channel Scaling tab

    o Shows mAmp output of the sensor

    o User Units are ft H2O

    o Displayed Format is #,##0.0#

    o Channel Point #1 is lowest mAmp output (*e.g.,* 4 for 4-20 mAmp transmitter and 10 psi pressure sensor)

    o User units point #1 is 0

    o Channel Point #2 is the highest mAmp output (*e.g.,* 20 for 4-20 mAmp transmitter and 10 psi pressure sensor)

    o User units point #2 is the scaling unit specified in the manual (*e.g.,* 23.067 for 4-20 mAmp transmitter and 10 psi pressure sensor)

    o Press OK to update changes

5. Press Program to save programming changes

2.2 Scaling

Water level is measured by a pressure sensor that sends an electrical signal to the recorder. The pressure sensors can have varying pressure ranges with the maximum psi listed on the sensor itself, usually 10 or 20 psi. The sensor sends an electrical signal through the transmitter to the recorder, which is rated as a 0-20 or 4-20 mA transmitter. The pressure sensor measures the pressure of water present above the sensor as a percentage of its maximum pressure range, and translates this to a related percentage of the transmission range. Finally, the recorder can be set up to show the measurement in feet of water above the sensor by using a scaling unit that converts the pressure in psi to feet H_2O. Table 2.1 summarizes the scaling conversion for Telog loggers from pressure to voltage to water level (feet H_2O).

Table 2.1 Scaling Conversion for Telog Water Level Loggers

Pressure (psi)	Voltage (mAmps)	Water Level (feet H_2O)
0	Minimum voltage	0
Pressure rating of sensor	Maximum voltage	Scaling chart (depends on psi) on (Telog 1995, page 25)

3. INSTRUMENT USE IN THE FIELD

Telog loggers are designed for data to be downloaded in the field without removing the pressure sensor from the groundwater well. As the loggers continue to measure water level (as pressure converted to feet H_2O above the logger), instantaneous water level can be viewed using Telogers for Windows software on a field laptop.

3.1 Data Download

Detailed instructions for downloading data from the Telog logger follows:

1. Check that the date/time on the field laptop are correct. Note: time is Pacific Standard Time. Do not adjust time to reflect daylight savings time; adjustment will result in logger-field laptop time discrepancy twice per year.

2. Connect field laptop to data logger using the serial port connector

3. Open Telogers for Windows

4. Select Communicate > With Local Recorder > Collect Data > Start

5. A window will appear to download the data from the recorder

6. File > Analyze Data From Database > Select Data to Analyze

7. Select the appropriate groundwater well and click OK

8. Scroll down in the window to the right to view the last data point recorded before the download. The logger collects a reading every hour; therefore, the last data point recorded should be an hour or less prior to the site visit time.

3.2 Instantaneous Water Level

When the logger is connected to a field laptop, instantaneous water level readings can be viewed using Telogers for Windows. The steps below provide the details for viewing instantaneous water level:

1. Connect field laptop to data logger using the serial port connector

2. Open Telogers for Windows

3. Select Communicate > With Local Recorder > Display Latest Readings > Start

4. The instantaneous water levels will be displayed on the screen

3.3 Saving Data Files

Data files can be saved as .CSV files on a local or network server.

1. Open Telogers for Windows on the field laptop

2. Select the "Db" icon in the Telog software

3. An "Analyze Dataset from Database" window will appear

4. Under the "Select Data to Analyze" tab, select a logger (typically identified by the name of the well in which it is deployed) by checking the box next to the selected logger

5. Select Dataset Properties

6. In the Select Start Date menu, identify and click to highlight the selected start date of the data range to save. Alternatively, the check-box can be selected to "Set to oldest data available."

7. In the Select Stop Date menu, identify and click to highlight the selected end date of the data range to save. Alternatively, the check-box can be selected to "Set to oldest data available." on the right of the display screen, make sure the check-box next to "Set to most recent data available" is selected (this will ensure you have included and backed up the most recent data that has been downloaded).

8. Click OK

9. This should bring you to a display page with a graph of well results and a spreadsheet of data. Scroll down the spreadsheet to get the date of the last data point collected – this date will be used later to organize and name files.

10. File > Save Data Set As…

   o A window with a menu to save the current data set will appear
   o File location and file naming conventions are specified in the project QAPP

4. QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

4.1 Calibration

Telog loggers are calibrated by the manufacturer when accuracy check acceptance criteria are not met (Mayoue 2016 pers comm). The manufacturer does not recommend calibration by the instrument user (*i.e.,* LNR staff) because of the difficulty of generating a steady, accurate pressure to the sensor during calibration (Paine 2016 pers comm).

In the event that the manufacturer determines that a particular logger can hold calibration and does not require recalibration on an annual basis, the manufacturer calibration frequency can be extended to two years. In this case, zero accuracy checks are conducted annually to ensure that loggers have known and acceptable accuracy, bias, and precision.

4.2 Accuracy Checks

Proper function of the Telog loggers can be checked by conducting accuracy checks.

4.2.1 Paired Readings

Paired readings of the logger and an independent water level measuring instrument (*e.g.,* Waterline Envirotech 500-ft electric tape with engineering scale) can be used to:

1. Confirm the deployment location of the logger

2. Allow conversion of units from feet of water above the logger to feet of water below a determined measuring point

3. Track calibration drift over the duration of the deployment

Frequency and procedures for conducting paired readings depend on the project. Details for conducting paired readings and acceptance criteria are provided in the relevant project QAPP.

4.2.2 Zero Accuracy Check

A zero accuracy check is conducted by viewing the instantaneous readings from the logger in air. If functioning properly, when the logger is removed from the well and held in the air (*i.e.,* not under water), the instantaneous readings should show zero. See Section 3.2 for instructions for viewing instantaneous readings. Refer to relevant project QAPP for details on acceptance criteria for the zero accuracy check, as limit depends on data use.

5. TROUBLESHOOTING

For all troubleshooting activities, document observations, corrective actions, and outcomes in Water Database or on field datasheets, as specified by the relevant project QAPP. The sections below provide steps to be taken to identify and remedy equipment problems as they arise during performance of QA/QC activities and data download in the field. Troubleshooting for logger deployment is site specific and not covered in this SOP, see relevant project QAPP for details.

5.1 Data Download Issues

For problems downloading data from the Telog logger, attempt the following corrective actions:

1. Ensure that the serial port connector is securely connected to both the field laptop and the recorder.

2. Ensure that the field laptop recognizes that the recorder is connected. Make sure that the recorder is connected before opening Telogers for Windows.

3. Local port must be activated in order for the computer to recognize the recorder. In Telogers for Windows go to Setup > Options. Select the Communications tab, and turn on "Enable Local Comm" and select the appropriate Local port. The Local port (*i.e.,* USB drive) into which the recorder is plugged in should automatically show up in the list.

4. If data still cannot be downloaded, attempt to view the logger activity in instantaneous water level mode (Section 3.2).

   o If instantaneous water level does not show, the logger may not be properly connected to the computer, or the battery charge is too low.

   o If instantaneous water level shows, re-attempt data download. If data still cannot be downloaded, the battery charge may be too low to transmit data.

5. If the computer cannot connect to the recorder, there may be a problem with the serial connector. Check communication from the communication port on the computer to the end of the serial connector as follows.

   o Disconnect the serial port from the recorder.

   o With the serial port oriented with the five prongs on top (four prongs on bottom), connect the second and third prongs from the left on the top (five prongs) with a metal paper clip.

   o Open Telogers for Windows.

   o Select Communicate > With Local Recorder > Collect Data > Start.

   o At the bottom of the Telogers screen, monitor the text. If communication was sent from the computer to the end of the serial port (with the paper clip) and

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   o Disconnect the serial port from the recorder.

   o With the serial port oriented with the five prongs on top (four prongs on bottom), connect the second and third prongs from the left on the top (five prongs) with a metal paper clip.

   o Open Telogers for Windows.

   o Select Communicate > With Local Recorder > Collect Data > Start.

   o At the bottom of the Telogers screen, monitor the text. If communication was sent from the computer to the end of the serial port (with the paper clip) and

back to the computer, a logger will be identified. If there is no change in the text, there is a problem with the cable.

- o Contact Telog technical support for assistance with cable problems.

6. Check the battery charge. If the battery charge is log, change the battery (Section 7.1). Re-attempt data download.

- o If data still cannot be downloaded, the data may have been lost due to slow battery charge or damage to the logger

- o Check deployment settings and view instantaneous water level mode (Section 3.2) to ensure that the logger is able to measure water levels

7. If damage to the recorder is suspected (*i.e.,* because logger will not show instantaneous water level measurements even after battery change), remove Telog logger from the well and contact manufacturer for further guidance.

5.2 Accuracy Check Issues

If accuracy checks do not meet acceptance criteria, attempt the corrective actions outlined in the relevant project QAPP. General corrective actions for Telog loggers follow:

1. Repeat accuracy check using best practices

2. Check the scaling in the deployment settings (Sections 2.1 and 2.2)

3. Clean pressure sensor gently to ensure that dirt has not become lodged in the pressure sensor. See Section 7 for cleaning instructions

4. Remove Telog logger from the well and contact manufacturer for further guidance

6. INSTRUMENT SPECIFICATIONS

Table 6.1 lists the instrument specifications for the Telog water level loggers and recorders.

Table 6.1 Range, Accuracy, and Resolution for WLS-2102e Level Trackers and R-2102e Recorders

Component	Range	Accuracy	Resolution
R-2102e Recorder	0-20 or 4-20 mA transmitter	±0.15% of sensor full scale at constant temperature; ±0.01% of sensor full scale per °C change	5 µA (0.005 mA)
WLS 2102e Level Tracker (sensor)	1, 2.5, 5, 10, 15, 20, 30, 50, or 100 psi	±0.1%	None Specified
Full System	Depends on recorder and sensor combination	±0.25% of sensor full scale at constant temperature	0.01 feet

The accuracy of the full system, in feet of water, depends on the water level measurement and psi rating of the sensor. For a 10 psi sensor at its maximum range (23.067 feet water), the accuracy is 0.058 feet. For a 20 psi sensor at its maximum range (46.133 feet water), the accuracy is 0.115 feet.

Accuracy acceptance criteria for Telog loggers depend on project goals and are specified in the relevant project QAPP.

7. MAINTENANCE

Maintenance activities include battery and desiccant replacement, and vent filter and pressure sensor cleaning. Details are provided in the Telog R-2100e Series Hardware Manual (Telog 1995).

7.1 Battery Replacement

A 14-Vdc lithium battery pack is located on the inside of the recorder cover. Battery pack voltage is tested during each field visit using a digital multimeter set to 20 V. Batteries are replaced when the pack voltage is below 13.5 Vdc. The battery packs must be changed within 20 seconds to avoid loss of memory and programmed settings. The battery pack is attached to the cover with a Velcro strip and to the circuit board by two wires and a connector. The connectors are color-coded to assure proper polarity and installation. Used battery packs can be discarded in the garbage, or recycled if appropriate facilities are available. Additional details on battery replacement are provided in the Telog R-2100e Series Hardware Manual (Telog 1995; pages 30-31).

7.2 Desiccant Pack Replacement

A desiccant pack is attached to the inside of the recorder cover with a Velcro strip, adjacent to the battery pack. The desiccant pack plays a vital role in limiting moisture inside the recorder enclosure; excess moisture can impede proper sensor operation and result in recording of inaccurate data. The desiccant packs are checked during each field visit by inspecting the color of the internal desiccant material. When fresh, the desiccant is a very dark blue; when moisture has been absorbed by the desiccant, the material will turn light pink. When the desiccant turns light pink, the pack needs to be replaced with a fresh one.

The desiccant packs can be regenerated by baking at 300°F (150°C) in a vented oven for approximately three hours, or until the blue color returns. Old Velcro strip and any adhesive should be removed before baking. A new Velcro strip is attached after the desiccant pack has been regenerated and allowed to cool. Regenerated desiccant packs are stored in double-bagged ziplock bags.

7.3 Pressure Sensor

The pressure sensor is rinsed gently on an as-needed basis. Remove the plastic bottom tip of the pressure sensor and remove the screen. Rinse the pressure sensor gently with distilled water to remove any dirt that may have become lodged in the sensor. The plastic tip and screen can also be cleaned. Do not probe the pressure sensor with any solid object (such as a Q-tip) to remove debris as the pressure sensor can become punctured. If debris is visible, but cannot be removed with water by rinsing, return the pressure sensor to the manufacturer for proper cleaning.

7.4 Vent Filter

The vent filter is located on the side of the recorder and vents the enclosure interior to the atmosphere, eliminating the effects of atmospheric pressure changes on readings. During field visits, the vent filter is checked to ensure that it is not blocked by debris. A small brush is used to remove grit or grime that may be blocking the filter. If the filter becomes clogged and cannot be cleaned, it can be replaced with a spare or a vent filter from a recorder that is not currently in use. Details on vent filter replacement are provided on pages 36-37 of the Telog R-2100e Series Hardware Manual (Telog 1995). Replacement vent filters are no longer available from the manufacturer; if the vent filter is completely clogged and no other vent filters are available, contact the manufacturer.

8. ACRONYMS AND ABBREVIATIONS

LIBC   Lummi Indian Business Council

LNR   Lummi Natural Resources

LWRD   Lummi Water Resources Division

QAPP   Quality Assurance Project Plan

QA/QC   Quality Assurance/Quality Control

SOP   Standard Operating Procedure

9. REFERENCES

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