NEON SENSOR COMMAND, CONTROL AND CONFIGURATION (C3) DOCUMENT: SUBSYSTEM, WATER LEVEL/CONDUCTIVITY/TEMPERATURE, GROUNDWATER WELL

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See configuration management system for approval history.

The National Ecological Observatory Network is a project solely funded by the National Science Foundation and managed under cooperative agreement by Battelle. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A	02/19/2014	ECO-01541	Initial release
B	09/20/2018	ECO-05322	Updated Aqua TROLL 200 location and configuration requirements to cease logging. Updated template, too and added requisite missing information, aligned with ATBD in AD [05], and updated information herein.
C	03/06/2019	ECO-06063	Added the appendix table for surface water temperature (digital thermistor) and conductivity data products.
D	03/08/2022	ECO-06786	• Revised logo

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1 DESCRIPTION

1.1 Purpose

This document specifies the command, control, and configuration details for operating a NEON sensor used for instrumental observations. It includes a detailed discussion of all necessary requirements for operational control parameters, conditions/constraints, set points, and any necessary error handling. All Level 0 Data Products generated by the sensor should be identified.

1.2 Scope

This document specifies the command, control, and configuration that are needed for operating this sensor. It does not provide implementation details, except for cases where these stem directly from the sensor conditions as described here.

A complete set of the Level 0 data products generated in this document can be found in appendix.

The Water Level/Conductivity/Temperature, Groundwater Well assembly will consist of the following Data Generating Devices (DGD) based on Data Generating Device DGD List and Hierarchies doc (AD [05]):

DGD Agile PN	DGD Agile Description
0317730000	Sensor In-Situ Aqua TROLL 200 15 psig Vented Conductivity/Temperature/Water Level for Groundwater Wells

Further detailed sensor info is as follows:

1. Under 0317730000:
    a. 0317730000, Sensor In-Situ Aqua TROLL 200 15 psig Vented Conductivity/Temperature/Water Level Groundwater Sensor, Firmware Version 1.26

Additional components with no assigned DGD maintained in maintenance plans in Section 2:

b. 0320150002 Desiccant canister - size Large, refillable, titanium twistlock connector. (Used with In-Situ Level Troll and Aqua Troll sensors.)
c. 0317730001 Sensor Accessory In-Situ TROLL Shield Antifouling Guard for Aqua TROLL 200 Sensor

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

Applicable documents contain information that shall be applied in the current document. Examples are higher level requirements documents, standards, rules and regulations.

AD [01]	NEON.DOC.000001	NEON Observatory Design (NOD) Requirements
AD [02]	NEON.DOC.000291	NEON Configured Sensor List
AD [03]	NEON.DOC.005003	NEON Scientific Data Products Catalog
AD [04]	NEON.DOC.005005	NEON Level 0 Data Products Catalog
AD [05]	NEON.DOC.001104	Data Generating Device DGD List and Hierarchies
AD [06]	NEON.DOC.001328	NEON Algorithm Theoretical Basis Document: Groundwater Level, Temperature, and Specific Conductivity
AD [07]	NEON.DOC.004362	NEON Preventive Maintenance Procedure: AIS Groundwater Wells
AD [08]	NEON.DOC.004470	Groundwater Well Data Acquisition System (DAS) Formal Verification Procedures

2.2 Reference Documents

Reference documents contain information complementing, explaining, detailing, or otherwise supporting the information included in the current document.

RD [01]	NEON.DOC.000008	NEON Acronym List
RD [02]	NEON.DOC.000243	NEON Glossary of Terms
RD [03]	NEON.DOC.004569	How-To: Configure AIS Ground Water Well (GWW) Radios

2.3 Acronyms

Acronym	Explanation
ATBD	Algorithm Theoretical Basis Document
C^3	Command, Control, and Configuration Document
SOP	Standard Operating Procedures
QA/QC	Quality Assurance/Quality Control
TIS	Terrestrial Instrument System
L0	Level 0
L1	Level 1
ENG	NEON Engineering group
CI	NEON Cyberinfrastructure group
DPS	NEON Data Products group
CVAL	NEON Calibration, Validation, and Audit Laboratory

3 WATER LEVEL/CONDUCTIVITY/TEMPERATURE, GROUNDWATER WELL INTRODUCTION (0317730000)

The AT200 contains three sensors, one for each parameter - level, temperature, and conductance. The sensor has an internal Analog to Digital (A/D) converter and outputs data in digital form. Obtaining raw analog signals are not possible from this sensor.

The In-Situ, Inc. Aqua TROLL 200 measures these parameters in each groundwater well location at NEON aquatic instrument sites (AIS). Each NEON Aquatic site has up to eight groundwater wells surrounding the aquatic feature (no less than three per Requirement NEON.AIS.4.1094).

Most sensors connect to a wireless radio transmitter (*see RD [03] for more information*) to transmit data to a Grape data logger; however, where connections allow, groundwater well sensors directly connect to their own Grape data logger. For sites where wireless or direct connection is unavailable, Field Operations manually downloads the data every two weeks ("sneaker-net" data transmission; *see NEON.DOC.004651 for additional information*). The Grape transmits data to the Aquatic Portal through a local AIS Device Post (Network Ethernet connection/PoE Switch) for packaging and transmission to NEON HQ, Cyber Infrastructure (CI). The analog to digital conversion, as well as the conversion to calibrated units, occurs within the Aqua TROLL 200 prior to the output of data for ingestion by the data acquisition system (DAS). Default communication settings for this sensor are, as follows: Baud (9600), Data bits (8), Stop bits (1), Mode (Modbus-ASCII), Default device address (1)*. *Reference AD [07] and AD [08] for additional information.*

** The default device address may vary in the field. CVAL configures the Aqua TROLLS Device Address to "1" as a default setting. If FOPS is initially connecting to an Aqua TROLL post-sensor refresh to configure its settings, the Device Address must be "1". However, post-installation and verification of the sensor, the Device Address will correspond to the GWW number (e.g., for example, the Device Address for an Aqua TROLL at GWW 4 must use "4" instead of "1").*

4 WATER LEVEL/CONDUCTIVITY/TEMPERATURE OVERVIEW OF SENSOR CONFIGURATION (0317730000)

Per AD [05], measurement of temperature, level, and conductivity occurs every 5 minutes in each well. The sensors obtain data simultaneously from all ground wells and to measure and report specific temperature, level, and conductivity parameters as a linear average. Each sensor is internally programmed to collect three individual measurements for each temperature, level, and conductivity parameter over a 15-second interval centered on the scheduled time of the measurement. The sensor internally computes the average and reports this value as a single measurement in the data stream from the sensor. Retrieval of each individual measurement is not possible from the sensor, therefore the L0 data consists of measurement averages. *See AD [05] for additional information.*

Table 1 provides the configuration settings for the Aqua TROLL 200 in groundwater and surface water.

Table 1. 0317730000 Sensor configuration settings for groundwater and surface water.

Parameter	Default Setting (groundwater)	Default Setting (surface water)
Acquisition rate	*1/300 Hz (.00333 Hz)*	*1/60 Hz (.016667 Hz)*
Pressure Unit of Measure	*Kilopascal*	*Kilopascal*
Conductivity Unit of Measure	*µS/cm*	*µS/cm*
Temperature Unit of Measure	*Celsius*	*Celsius*
Measurement mode	*Output*	*Output*
Data Logging	*Off**	*Off**

**Due to the inability to process the data from the sensor's internal data storage and constraints with the sensor's internal battery, data logging is OFF until further notice.*

See **Table 2** for a list of L0 data products that transform into L1 AIS Groundwater Well Data Products per AD [06].

5 WATER LEVEL/CONDUCTIVITY/TEMPERATURE COMMAND AND CONTROL (0317730000)

5.1 Error handling

This sensor provides no error notification.

5.2 Sensor controls specification

Installation of the Aqua TROLL 200 in the groundwater well is set at fixed position depending on total well depth. Sensors install at a depth of 0.50 meters +/- 0.01 meters less than the total well depth for groundwater wells with total well depths greater than 3.00 meters, or a depth of 0.20 meters +/- 0.01 meters less than the total well depth for total well depths less than 3.00 meters. Total well depth within this requirement is the distance from the top of PVC well casing with the cap removed to the bottom of the well. Routine preventive maintenance addresses sensor bio-fouling, groundwater well structural integrity (water clarity tests and annual redevelopment) and verifies sensor position in well post-Sensor Refresh in accordance with **Figure 1**.

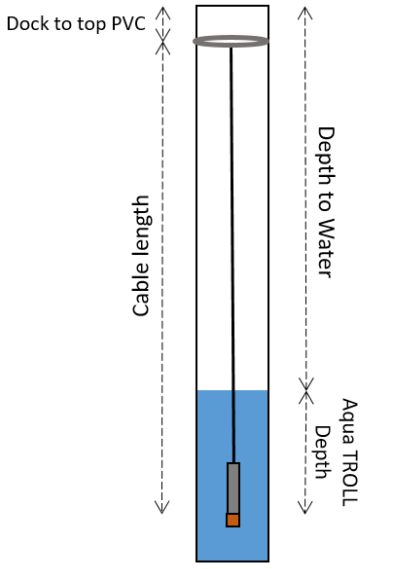

Figure 1. Measurements for Setting and Checking Sensor Position

6 ASSEMBLY INTEGRATION

The majority of Aqua TROLL 200 sensors attach to a wireless radio transmitter. Configuration is in accordance with AD [08] and verification per AD [07]. The Aqua TROLL 200 will receive a query by the location controller (LC). The Aqua TROLL 200 responds with the preconfigured data stream per **Table 2**.

7 APPENDIX

7.1 List of Level 0 data products

Table 2 & 3 provides a list of Aqua TROLL 200 related L0 Data Products. Conductance, groundwaterPressure, and groundwaterTemp transform into L1 AIS Groundwater Well Data Products per AD [06] and surface water data products, which include Temperature (digital thermistor) of surface water (DP1.20054.001) and Specific Conductivity of surface water (DP1.20008.001).

Table 2. List of Aqua TROLL 200 related L0 Data Products. Conductance, groundwaterPressure, and groundwaterTemp transform into L1 AIS Groundwater Well Data Products per AD [06].

DGD Agile PN	DPNumber	fieldName	Description	Acquisition frequency (Hz)	Data Type	Units
0317730000	NEON.DOM.SITE.DP0.20015.001.01371.HOR.VER.000	conductance	Conductivity at ambient temperature	.00333 Hz	real	microsiemens PerCentimeter
	NEON.DOM.SITE.DP0.20015.001.01372.HOR.VER.000	batteryVoltage	Battery voltage	.00333 Hz	real	volt
	NEON.DOM.SITE.DP0.20015.001.01373.HOR.VER.000	conductanceDataQualityID	Data quality code from sensor for conductance	.00333 Hz	real	NA
	NEON.DOM.SITE.DP0.20015.001.01374.HOR.VER.000	groundwaterTemp	Temperature in groundwater	.00333 Hz	real	Celsius
	NEON.DOM.SITE.DP0.20015.001.01375.HOR.VER.000	tempDataQualityID	Data quality code from sensor for temperature	.00333 Hz	real	NA
	NEON.DOM.SITE.DP0.20015.001.01376.HOR.VER.000	groundwaterPressure	Pressure of groundwater	.00333 Hz	real	kilopascal
	NEON.DOM.SITE.DP0.20015.001.01377.HOR.VER.000	pressureDataQualityID	Data quality code from sensor for pressure	.00333 Hz	real	NA

Table 3. List of Aqua TROLL 200 related surface water L0 Data streams. **Note, some term names contain "groundwater", but are actually surface water mounted sensors.

DGD Agile PN	DPNumber	fieldName	Description	Acquisition frequency (Hz)	Data Type	Units
0317730000	NEON.DOM.SITE.DP0.20054.001.01371.HOR.VER.000	conductance	Conductivity at ambient temperature	0.016667 Hz	real	microsiemens PerCentimeter
	NEON.DOM.SITE.DP0.20054.001.01372.HOR.VER.000	batteryVoltage	Battery voltage	0.016667 Hz	real	volt
	NEON.DOM.SITE.DP0.20054.001.01373.HOR.VER.000	conductanceDataQualityID	Data quality code from sensor for conductance	0.016667 Hz	real	NA
	NEON.DOM.SITE.DP0.20054.001.01374.HOR.VER.000	groundwaterTemp	Temperature in groundwater	0.016667 Hz	real	Celsius
	NEON.DOM.SITE.DP0.20054.001.01375.HOR.VER.000	tempDataQualityID	Data quality code from sensor for temperature	0.016667 Hz	real	NA
	NEON.DOM.SITE.DP0.20054.001.01376.HOR.VER.000	groundwaterPressure	Pressure of groundwater	0.016667 Hz	real	kilopascal
	NEON.DOM.SITE.DP0.20054.001.01377.HOR.VER.000	pressureDataQualityID	Data quality code from sensor for pressure	0.016667 Hz	real	NA

7.2 Assembly schematic drawing

N/A

8 BIBLIOGRAPHY

In-Situ, Inc. "Operators Manual – Aqua TROLL 100, Aqua TROLL 200" Revision 006, May 2012. Published Online. http://www.in-situ.com/products/water-quality/aqua-troll-instruments/aqua-troll-200-instrument/resources