

User Guide

AquaVent™

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Solinst®

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NOTE

To use the AquaVent with Version 4.2 Levellogger Software, the AquaVent logger must be using Firmware Version 1.000 or higher. The Wellhead must use Firmware Version 1.000 or higher.



Figure 1-1 AquaVent Logger

NOTE

The Model number refers to the depth of submergence below water level that the pressure sensor can withstand. i.e.: The AquaVent which is available in M5, M10, and M20 ranges has actual water level ranges of 5 m (16.40 ft), 10 m (32.80 ft), and 20 m (65.60 ft) respectively.

1 Introduction

This user guide explains the capability, operation, and maintenance of the AquaVent water level and temperature datalogger. Focus is on use with Solinst Levellogger Software (Solinst Protocol), with separate User Guides discussing use with SDI-12 and MODBUS protocols.

To begin using your AquaVent, we recommend you install Levellogger Software Version 4.2 (or higher). Please visit: www.solinst.com/downloads/ to download the current version or check for updates.

1.1 AquaVent™ Water Level Datalogger

The AquaVent is an accurate water level and temperature datalogger. It uses a gauged (vented) pressure transducer. The pressure sensor is open to the atmosphere via a vented cable to surface, therefore, provides water level measurements that are automatically compensated for barometric effects, as well as temperature.

The AquaVent logger contains a desiccant and hydrophobic filter where the Vented Cable connects. There is no need to replace the desiccant or filter, they are designed to provide protection from moisture over the lifetime of the instrument, while still allowing air to vent to the transducer.

AquaVent Logger Technical Specifications		
Level Sensor:	Piezoresistive Silicon with Hastelloy Sensor	
Ranges:	5, 10, 20 m (15, 30, 65 ft.)	
Accuracy	± 0.05% FS	
Normalization:	Automatic Temperature Compensation	
Temp. Comp. Range:	0°C to 50°C	
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)	
Temp. Sensor Accuracy:	± 0.05°C	
Temp. Sensor Resolution:	0.003°C	
General:		
Battery Life:	8 Years - based on 1 reading/minute (user replaceable in Wellhead)	
Clock Accuracy:	± 1 minute/year (-20°C to 80°C)	
Operating Temperature:	-20°C to 80°C	
Maximum # Readings:	40,000 (up to 120,000 using data compression)	
Memory:	Built-in FRAM: Continuous or Slate mode	
Communication Speed:	9600 bps Solinst USB, 1200 baud SDI-12, MODBUS RS-232/RS-485 (various speeds), data download speed: 57,600 bps	
Size:	7/8" x 7" (22 mm x 178 mm)	
Weight:	129 grams (4.5 oz.)	
Wetted Materials:	Delrin®, Viton®, 316L Stainless Steel	
Sampling Modes (using Levellogger Software):	Linear, Event & User-Selectable Schedule with Repeat Mode, Future Start, Future Stop, Real Time View	
Measurement Rates:	0.125 second to 99 hours	
Barometric Compensation:	Automatic	
AquaVent Models	Full Scale	Accuracy
M5	5 m (16.4 ft.)	± 0.3 cm (0.010 ft.)
M10	10 m (32.8 ft.)	± 0.5 cm (0.016 ft.)
M20	20 m (65.6 ft.)	± 1 cm (0.032 ft.)

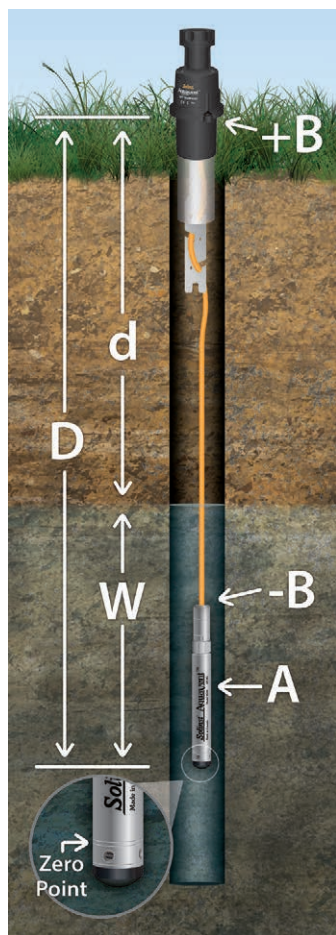


Figure 1-2
AquaVent Measurement Fundamentals

1.2 Measurement Parameters

1.2.1 Level

AquaVent transducers detect both water (**W**) and barometric pressure (**+B**). **However**, a vent tube to surface allows barometric effects on the pressure sensor to be eliminated (**-B**). Therefore, the AquaVent provides readings of the actual pressure of just water above the pressure sensor zero point (**A**). This equation represents how the AquaVent pressure sensor works:

$$A = (W + +B) + (-B)$$

Therefore, **A=W** (See Figure 1-2).

- A** = AquaVent readings
- W** = Water column height
- +B** = Barometric pressure detected by the pressor sensor
- B** = Barometric pressure applied through the vented cable

$$A = D \text{ (depth of AquaVent Zero Point)} - d \text{ (depth to water measurement)}$$

1.2.1.1 Pressure Calibration

The AquaVent is calibrated against a range of set reference points to an accuracy of 3 decimal places. During the calibration procedure, the AquaVent logger is fully submerged in a highly accurate water bath. The bath is set to 6°C and allowed to stabilize. The pressure is then calibrated to six separate pressure points covering the entire range of pressure for that particular AquaVent to check for any non-linearity. The process is repeated again at 18°C and 36°C to check for temperature effects. Once done, the AquaVent is approved after all specifications for accuracy, precision, stability and hysteresis have been met. The AquaVent should be calibrated for the life-time of the instrument, as long as it is used within its specified range.

1.2.2 Temperature

The AquaVent records temperature compensated water levels. Groundwater and surface water temperature measurements are particularly important in situations where temperatures may fluctuate significantly, and when temperature is used in determining liquid level, viscosity and hydraulic conductivity. Temperature monitoring is vital in the calculation of certain temperature dependent contaminant reaction rates. A Platinum Resistance Temperature Detector is used to accurately compensate for temperature changes within the range of 0 to +50°C for the AquaVent. The AquaVent will record temperature in its thermal range of -20 to +80°C, but outside the range, compensation will be less accurate.

1.3 AquaVent System Components

The AquaVent requires the following components to complete a monitoring system:

- AquaVent Logger
- AquaVent Communication Wellhead and Connector Cable(s)
- Vented Cable
- Solinst Levellogger Software

! NOTE

The Wellhead Connector Cables are 15 ft (4.5 m) in length.

! NOTE

The Wellhead Connector Cables to be used with the SP Wellhead are identified with a orange band at the 10-pin connection. The 10-pin (Solinst Protocol) connection on the Wellhead is also labeled orange.



Figure 1-3 Complete AquaVent System

1.3.1 Communication Wellhead and Connector Cables

The AquaVent Wellhead fits conveniently onto a 2" (50 mm) well casing (a 4" Adaptor is also available). There are two options: the SP Wellhead has a 10-pin connection (Solinst Protocol) for cables communicating with Solinst software and accessories; the SPX Wellhead has an additional 12-pin connection for cables communicating with third party dataloggers or telemetry systems using MODBUS or SDI-12 protocols (see separate User Guides).

There are two Connector Cable options for the SP Wellhead:

- The USB Connector Cable connects to a PC for communication with Levellogger Software.
- App/DataGrabber Connector Cable for connection to a Levellogger App Interface or DataGrabber. See separate User Guide/Instructions.

! NOTE

A Levellogger USB PC Interface Cable can also be used to connect from an App/DataGrabber Connector Cable to the USB Port on a PC. See the Levellogger User Guide for USB Driver installation Instructions for the PC Interface Cable.

! NOTE

The small internal AquaVent logger battery is only used to maintain the internal clock of the AquaVent logger when it is not connected to the Wellhead, and during any firmware upgrades.

! NOTE

Solinst recommends using 1.5V AA lithium batteries in the Wellhead.

! NOTE

The Wellhead Connector Cables to be used with the SP Wellhead are identified with a orange band at the 10-pin connection. The 10-pin (Solinst Protocol) connection on the Wellhead is also labeled orange.

! NOTE

LED definitions for the SPX Wellhead can be found in separate User Guides for SDI-12 and MODBUS.

Each Wellhead comes with four (4) user-replaceable 1.5V AA lithium batteries that power the AquaVent (see Section 8.1 for battery installation instructions and battery life estimates). They can last 8 years based on 1 reading per minute.

The Wellheads contain multiple desiccants and have a hydrophobic filter where the Vented Cable terminates at surface. There is no need to replace desiccants or the filters, they are designed to provide protection from moisture over the lifetime of the instrument. The filter protects the cable from moisture, while still allowing air to flow through the vent tube, resulting in the cancellation effect of barometric pressure on the AquaVent logger.

A well cap sleeve that fits on 2" well casing comes with each Wellhead; a cable support hanger bracket is also available to secure the Vented Cable. See section 8.2 for installation instructions.



Figure 1-4 SP Wellhead and Connector Cable Options

1.3.1.1 SP Wellhead LED Status

The AquaVent Wellheads have a multicolour LED light which indicates the status and operation of the AquaVent:

- ⦿ Fast Multicolour cycle 3 times: Wellhead is powering-on
- ⦿ Fast 10 cycles alternating blue/green: Wellhead has successfully connected to the PC using the USB Connector Cable
- ⦿ Fast 10 cycles alternating blue/red: USB connection has been dropped
- ⦿ Flashing yellow: The Wellhead is communicating with the PC Software over USB

! NOTE

Before the Vented Cables are shipped, the vent tubes are blown dry with nitrogen gas, and capped, to ensure no moisture during transport.

! NOTE

For diagnostic purposes, you may wish to install the end of the Vented Cable with the serial number, to the Wellhead connection at surface.

! NOTE

See Section 8.2 for installing the well cap sleeve and the Support Hanger Bracket for securing the cable when deployed.

! NOTE

Ensure you save all the storage caps for future use.

1.3.2 Vented Cable

Vented Cables contain power and communication wires, as well as a vent tube running the length of the cable. Vented Cables provide direct read communication from the AquaVent logger to the Wellhead. The vent tube and wires are jacketed in polyurethane, providing durability and protection. The cable is 0.320" (8 mm) in diameter, while the connectors are 0.860" (22 mm) in diameter.

Vented Cables are custom-built to length. Lengths up to 500 feet are available.

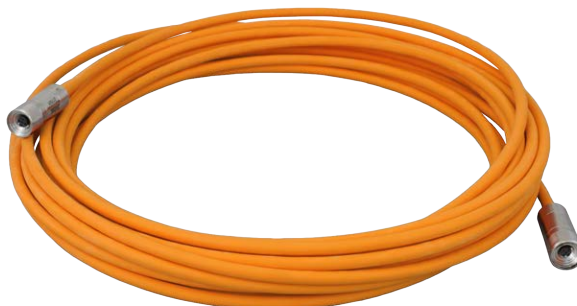


Figure 1-5 AquaVent Vented Cable

1.3.2.1 Vented Cable Connections

The Vented Cable ends terminate with female twist connections for the AquaVent logger and the Wellhead. Therefore, the Vented Cables are interchangeable (i.e. it does not matter which end is installed on the Wellhead or AquaVent logger).

The steps below show how to connect a Vented Cable to a Wellhead and AquaVent logger.

Connecting a Vented Cable to the Wellhead



Remove the storage caps from the connectors on the Wellhead and Vented Cable.

! NOTE

For diagnostic purposes, you may wish to install the end of the Vented Cable with the serial number, to the Wellhead connection at surface.

Alignment pin in the Wellhead connector



Alignment socket in the Vented Cable connectors



Thumb in line with pin



Thumb in line with socket



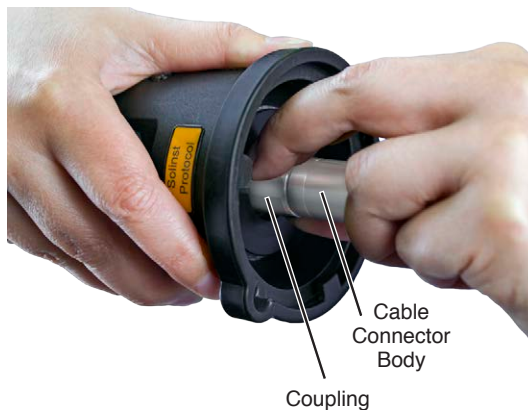
Line up the alignment socket in the Vented Cable connector with the alignment pin in the Wellhead connector.



Carefully push the connectors together. Twist the cable connector **slightly** until you will feel a **small click** when the properly aligned connection is made.

! NOTE

Do not twist the Vented Cable or stainless steel cable connector body when connecting to a Wellhead or AquaVent logger. **Only twist the stainless steel coupling.**



Coupling

Cable Connector Body

Tighten the stainless steel coupling while holding the stainless steel cable connector body still. Tighten the stainless steel coupling until it seats. **Do not twist the Vented Cable or Wellhead.**

Figure 1-6 Connecting a Vented Cable to the Wellhead

! NOTE

Ensure you save all the storage caps for future use.

! NOTE

Do not twist the Vented Cable or stainless steel cable connector body when connecting to a Wellhead or AquaVent logger. **Only twist the stainless steel coupling.**

! NOTE

A Support Hanger Bracket is available for securing the Vented Cable in a well or other application. See Section 8 for deployment tips.

Connecting a Vented Cable to the AquaVent Logger



Remove the storage caps from the connectors on the AquaVent logger and other end of the Vented Cable.



Line up the alignment pin in the AquaVent logger connector with the alignment socket in the Vented Cable connector. **Carefully** push the connectors together. Twist the cable connector **slightly**; you will feel a small click when the properly aligned connection is made.



Tighten the stainless steel coupling while holding the stainless steel cable connector body still. Tighten the stainless steel coupling until it seats. **Do not twist the Vented Cable or the logger.**

Figure 1-7 Connecting a Vented Cable to the AquaVent Logger

1.3.2.2 Vented Cable Precautions

If the cable needs to bend during installation, ensure the vent tube does not get kinked inside the cable. Do not allow the vent to become squeezed or flattened inside the cable. Flattening or a kink in the tube can cause erroneous barometric compensation. **To avoid crimping the vent tube, do not coil the cable tighter than a 1" (25 mm) radius.**

A specially designed Support Hanger Bracket is available from Solinst, for securing the Vented Cable when deployed. See section 8.2 for instructions to install the bracket.

During installation, be careful not to nick the cable on a sharp edge. Cutting through the protective jacket of the cable can cause moisture to access the wiring inside, which can cause communication issues, or moisture to travel down the cable.

! NOTE

It is always recommended to use the most recent version of software and firmware.

Let Solinst keep you up-to-date with each new software and firmware release.

Register your software at:
www.solinst.com/Registration/
to receive these updates automatically.

2. Solinst Levellogger Software

This Windows based software provides many convenient features. You can view and program AquaVent settings, begin logging sessions, monitor real-time readings, download data, manage data files, perform data adjustments, and save and export data files.

Levellogger Software is used to program all Solinst dataloggers. The software intuitively detects the type of datalogger connected, and will only display the setting options specific to that datalogger type.

2.1 System Requirements

The minimal hardware and software requirements for software installation and operation are:

Hardware	Software
Memory: 32 MB or more	OS: Windows 7, 8 or 10
Display: VGA: 800 x 600 pixels, 256 colour	
Ports: USB or RS-232 Serial Port	

Communication port setting for AquaVent communications:

Bits per second	9600 (57,600 data download)
Data bits	8
Stop bits	1
Flow control	None

2.2 Software Installation

Web Download

Download the newest version of Levellogger Software by visiting:
www.solinst.com/downloads/

CD Installation

1. Insert the software CD provided.
2. If the installer does not automatically start, to activate the software install click on the 'setup.exe' file located on the software CD.
3. The Software Installation Wizard will guide you through the remaining installation process. Figure 2-1 shows the Software Installation Wizard.
4. Restart the computer after installation is completed. Default Directory is:
C:\Program Files\Solinst\Levellogger4_2

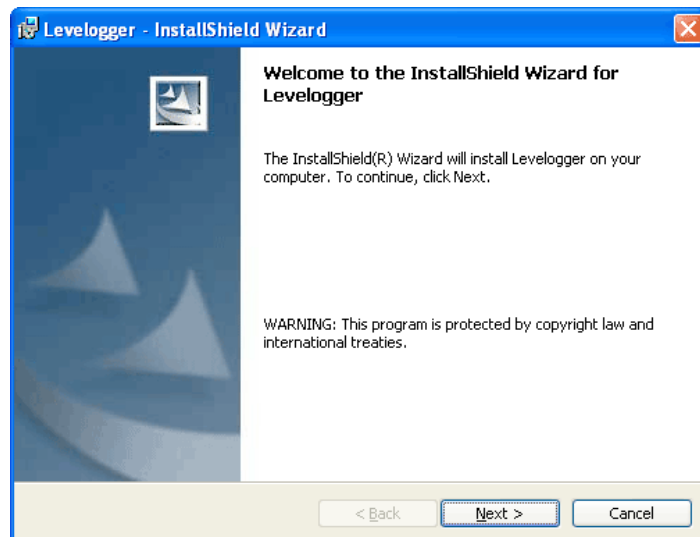


Figure 2-1 Found New Hardware Wizard

2.3 Software Communication

Levellogger Software is Windows based, and is therefore used with a desktop or laptop PC. The AquaVent communicates to a laptop or desktop PC using a USB Connector Cable connected to the AquaVent Wellhead. The USB Connector Cable connects to the 10-pin (Solinst Protocol) connector on a SP or SPX Wellhead.



Figure 2-2 Communicating with Levellogger Software

! NOTE

Always plug in the USB Connector Cable before starting the Software.

! NOTE


Your PC must have an internet connection to check for software and firmware updates.

You can also check for updates using the Help menu.

3 Software Startup, Configurations and Settings

3.1 Startup

Plug in the USB Connector Cable before starting the Levellogger Software.

To start the software, click , or click the Start button and select:

Programs > Solinst > Levellogger 4 > Levellogger 4.2

Once the program is started, you can set up the parameters for the Software.

3.1.1 Software/Firmware Update Checks

Each time the software is opened, it automatically checks for software updates. If there is an update, "[Software Update Available](#)" will appear in the top right of the menu bar. When you click the message, it will open a web page where you can download the software update.

The Software also checks for firmware updates once you have retrieved settings from a connected AquaVent (see Section 4). "[Firmware Update Available](#)" will appear in the top right menu bar. Clicking the message will open a web page where you can download the firmware update. See Section 11 for firmware update instructions.

3.2 Configuration and Settings

3.2.1 Data Directory

The program will save data downloaded to the following default directory: <C:\Program Files\Solinst\Levellogger4_2\Data> unless otherwise specified in the Default Directory field of the Application Settings window (Figure 3-1).

Click the Configuration menu at the top of the program window, select Application Settings and input or navigate to a different folder destination. After completing the Application Settings, click the OK button to confirm and save the settings.

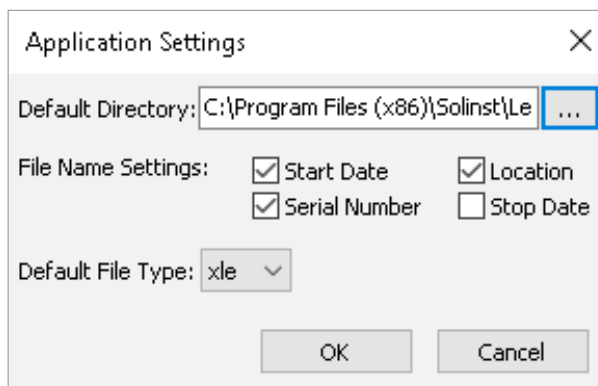


Figure 3-1 Application Settings Window

3.2.2 File Name Settings

From the Application Settings window in the Configuration menu, you can set what information will be included in your default file names of downloaded data (see Figure 3-1). You can include Start Date, Stop Date, Serial Number, and Location. Check-off the information you would like included.

After completing the Application Settings, click the OK button to confirm and save the settings.

3.2.3 Default File Type

From the Application Settings window in the Configuration menu, you can set the default file type you would like to use for downloaded, saved and exported data files. You can select between either *.xle (default) or *.lev file types (see Figure 3-1). For more information about the two file types, see Section 5.1.1.

After completing the Application Settings, click the OK button to confirm and save the settings.

! NOTE

Click on ? icons to get an explanation of that software feature.

! NOTE

After retrieving the settings, If the Wellhead batteries have drained to 20% charge or lower, a warning message will appear to replace the batteries.

4 AquaVent Programming

After you start Levellogger Software, the Main Window will appear, with the Datalogger Settings tab open.

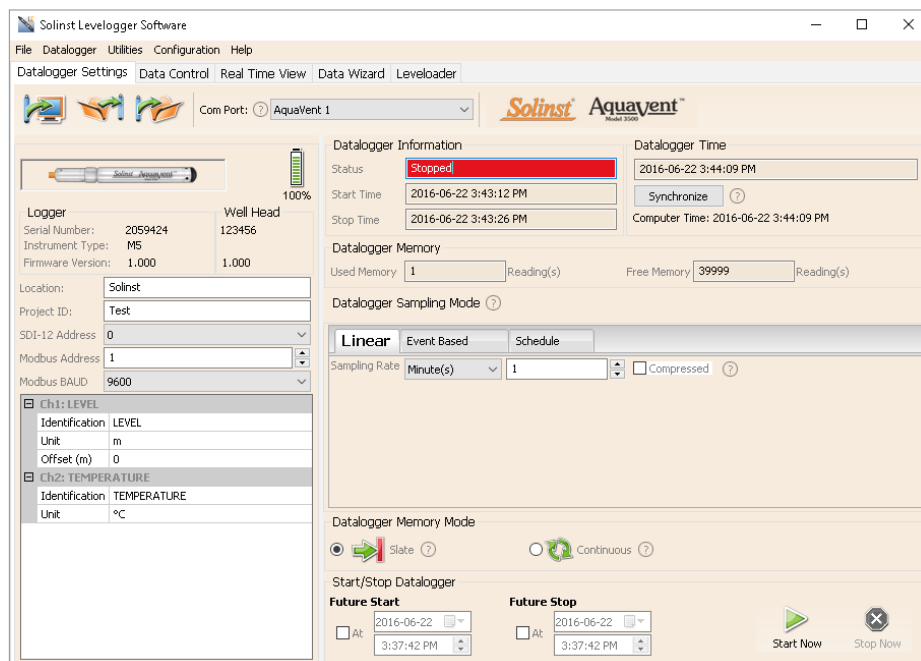


Figure 4-1 Dataloggers Settings Tab

Select the appropriate device from the centre Com Port drop-down menu.

Click  to retrieve the current settings from the connected AquaVent.

4.1 Datalogger Settings

After you have retrieved the settings of the connected AquaVent, the Datalogger Settings tab will identify the Instrument Type, Serial Numbers, Firmware Versions, Project ID, Location, and the Channel Settings.

- **Instrument Type:** will display the model of the attached datalogger, i.e.: M5
- **Serial Numbers:** the unique serial numbers of the attached AquaVent logger and Wellhead will be displayed.
- **Firmware Versions:** shows the firmware versions of the connected AquaVent logger and Wellhead.
- **Project ID:** input your own identification system. The Project ID is limited to 32 characters.
- **Location:** input specific site / location information. The location is limited to 32 characters.

The MODBUS and SDI-12 Address, and Baud Rate settings are only for use with the SPX Wellhead. See separate User Guides for communication using MODBUS and SDI-12 protocols.

! NOTE

The AquaVent which is available in M5, M10, and M20 ranges has actual water level ranges of 5 m (16.40 ft), 10 m (32.80 ft), and 20 m (65.60 ft) respectively.

4.1.1 Setting Up Channel Information

In the lower left portion of the Datalogger Settings tab is the area for setting channel parameters (level, temperature). The software will detect the available channels when the datalogger settings are retrieved.

4.1.1.1 Level Channel (Ch1)

- **Identification** describes the measurement parameter of the channel and has already been configured as 'LEVEL'. The channel can be re-named to suit each project. The channel monitors water column equivalent pressure. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Unit** refers to the channel's unit of measurement. There are six options for water level measurement: m (default), cm, ft, kPa, bar, and psi.
- **Offset** refers to an adjustment, such as the distance between the tip of the AquaVent logger and the monitoring well cap or static water level. It is recommended that the value of 0.00 be used, as this keeps all subsequent readings relative to the tip of the logger. The reference range is -1000 to 16,400 ft or -300 m to 5000 m.

! NOTE

Readings can be converted to other units using the Data Wizard.

Readings can be corrected or offset with respect to a specific reference elevation or datum for a much wider spectrum of numeric offsets as part of the Data Wizard.

Ch1: LEVEL	
Identification	LEVEL
Unit	m
Offset (m)	0
Ch2: TEMPERATURE	
Identification	TEMPERATURE
Unit	°C

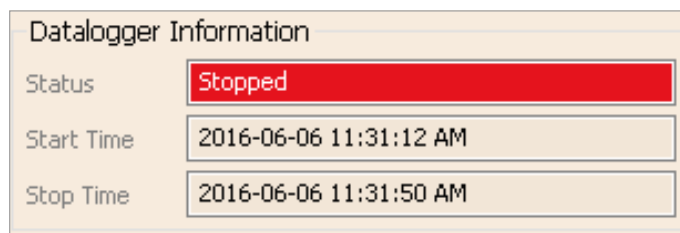
Figure 4-2 AquaVent Channel Setup

4.1.1.2 Temperature Channel (Ch2)

- **Identification** describes the measurement parameter of the channel and has already been configured as "TEMPERATURE". The channel can be re-named to suit each project. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Unit** refers to the channel's unit of measurement. The temperature channel can be set to °C (default) or °F.

4.2 Datalogger Information

The Datalogger Information section shows the Status of the attached AquaVent (i.e.: Started, Stopped, Future Start) and the Start Time and Stop Time of the AquaVent. When a Future Start and/or Stop time is set (see Section 4.8), the Start Time and Stop Time fields will fill in. The fields will update each time the AquaVent is stopped and started.

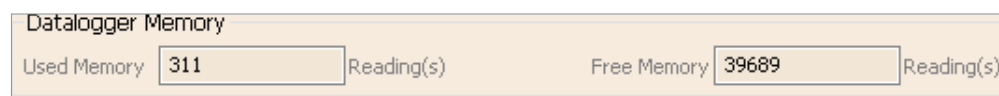


Datalogger Information	
Status	Stopped
Start Time	2016-06-06 11:31:12 AM
Stop Time	2016-06-06 11:31:50 AM

Figure 4-3 Datalogger Information

4.3 Datalogger Memory

The Datalogger Memory section shows the amount of memory used, and the amount of memory remaining (number of readings).



Datalogger Memory	
Used Memory	311 Reading(s)
Free Memory	39689 Reading(s)

Figure 4-4 Datalogger Memory Remaining

! NOTE

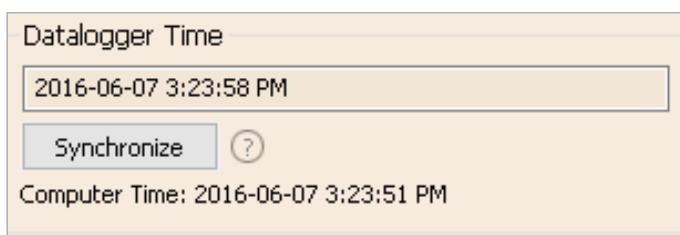
To synchronize to a different time/ time zone you first must adjust the computer time using the Windows Operating System Date and Time Settings menu. Then re-start the Solinst Levelogger Software and synchronize your dataloggers to the new time.

If the Data Compression option is selected (see Section 4.5), the amount of free memory shown is approximated as a visual status bar.

4.4 Datalogger Time

The Datalogger Time section provides the controls for setting the AquaVent clock. If you want to synchronize the AquaVent's clock to the computer clock, click Synchronize to set the time in the AquaVent.

If you start the AquaVent without synchronizing the clock and the time difference between the AquaVent and the PC is more than 3 seconds, the software will give you a message asking 'Do you want to synchronize the logger time to system time?'. Click Yes to synchronize the clock.



Datalogger Time	
2016-06-07 3:23:58 PM	
Synchronize	?
Computer Time: 2016-06-07 3:23:51 PM	

Figure 4-5 Datalogger Time

! NOTES

The battery life of the AquaVent Wellhead is 8-10 Years, based on 1 reading per minute. More rapid readings will reduce the battery life. For example, if an AquaVent is setup in Continuous Mode at a sampling rate of 1 second, the battery will be depleted in approximately 3 months.

! NOTES

In Event Based sampling mode, the AquaVent has a total memory of 25,000 readings of level and temperature.

In Event Based sampling mode, battery consumption is mainly a function of sampling rate. Therefore, with a smaller sampling interval, battery power will be used up quickly whether readings are stored or not.

! NOTE

A schedule can be saved and applied to other AquaVents, by saving the Settings file (see Section 4.7).

4.5 Datalogger Sampling Mode

The Datalogger Sampling Mode section allows you to choose the sampling measurement type. Options for the AquaVent are Linear, Event Based and Schedule.

Linear refers to a set time interval between collection of readings. Sample Rate can be any number from 0.125 seconds to 99 hours for the AquaVent. There is a data compression option available for the AquaVent. This increases the memory capacity from 40,000 readings to up to a maximum of 120,000. Check the Data Compression box to allow data compression.

Data Compression works by only saving data changes in memory. For example, if you have linear sampling set to record each second, and your water level varies a little for 60 seconds, the memory will only record incremental values for the 60 seconds. When your data is exported, it will display all 60 intervals with the corresponding level data.

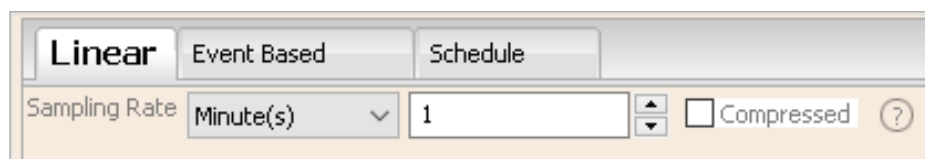


Figure 4-6 Linear Sampling Setup

Event Based sample collection is the most memory efficient means of data collection. In Event mode, the AquaVent will be activated at every defined 'Sample Rate' to check if readings have changed by the selected 'Change' from the last recorded reading.

For the AquaVent, 'LEVEL' or 'TEMPERATURE' is the selected parameter where change is monitored. The AquaVent will record a new reading only if the specified change in the parameter has occurred, at the specific point in time, as defined by the 'Sample Rate'.

A default reading will also be stored in the AquaVent memory, every 24 hours from the last recording, if no 'Change' occurs.

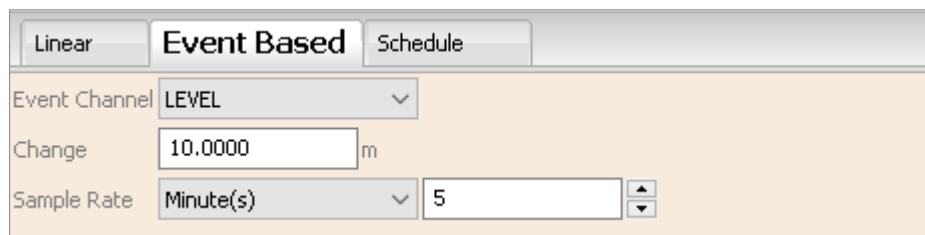


Figure 4-7 Event Based Sampling Setup

Schedule Sampling allows you to select a logarithmic style sampling schedule adapted to the needs of each application.

Schedule Sampling is set by using the plus and minus buttons to add or subtract line items in the Schedule window. The maximum number of line items in a schedule is 30, each with its own sampling interval of seconds, minutes or hours and duration of seconds, minutes, hours, days or weeks. A 'Pause' interval can also be selected, which stops the AquaVent from recording for the specified duration.

Running totals of the number of readings still available, from the total possible, and the run time to date are shown. If the number of readings selected exceeds the datalogger's memory capacity an error message appears.



By checking Repeat, the AquaVent will continue to run through the schedule until its memory is full, or it is stopped.

	Interval	Duration	
1)	1 Second(s)	5 Minute(s)	<input checked="" type="checkbox"/> Repeat ?
2)	5 Second(s)	10 Hour(s)	
3)	3 Second(s)	24 Hour(s)	
4)	1 Second(s)	60 Second(s)	
5)	1 Pause	24 Hour(s)	

Readings Available: 3639 Run Time: 2 day(s) 10 hour(s) 6 minute(s)

Figure 4-8 Schedule sampling Setup

4.6 Datalogger Memory Mode

Datalogger Memory Mode selection will only appear when **Linear** sampling mode is selected. When using an AquaVent in Linear Mode, there is a choice of **Continuous** Logging (wrap around)  or **Slate** Logging .

Compressed Linear, Event Based and Schedule sampling modes can only use the Slate Mode option.

In Continuous Logging, the new log is started at the end of any previous log and continues logging, eventually recording over the first logged data. As one of the download options is to 'Append Data', Continuous Logging can be a preferred choice when logging long-term (see Section 5.1.2).

In Slate Logging, the new log is also started at the end of any previous log, but will stop recording after 40,000 readings (or up to 120,000 readings), so that the beginning of the current log will not be written over.

Datalogger Memory Mode


☒  Slate ?
 ☐  Continuous ?

Figure 4-9 Datalogger Memory Mode

! NOTES

If a setting has been changed, it will be highlighted in yellow as a reminder before the AquaVent is started.

If a setting has been entered incorrectly, it will be highlighted in red.

Changed settings are applied to the AquaVent automatically when the Start icon is selected.

! NOTE

Remember to download any data from the AquaVent before starting a new session. When starting a new logging session, any data from previous recording sessions will be erased.

! NOTE

Retrieve the AquaVent settings in order to refresh the status (i.e. when the status changes from Future Start to Started).

4.7 Saving and Retrieving AquaVent Settings Files

To store settings as defaults, click . It will store the settings of the AquaVent into an *.dtf file as a series of defaults. The *.dtf file will save the Project ID, Location, Sample Mode, Sample Rate, Channel ID, Unit, and Offset.

To retrieve settings from defaults, click from a selected *.dtf file. This is particularly useful if programming several dataloggers with similar or identical settings. Keep in mind that Project ID and Location identification information will be identical and should be distinguished from logger to logger or monitoring point to point.

4.8 Starting and Stopping the AquaVent

Starting the AquaVent

There are two ways to start logging: **Start Now** or by programming a **Future Start** time.

When starting a new logging session, any data from the previous recording session will be erased (see Section 5 for downloading data).

To start logging immediately, do not fill in a Future Start time and click, . It should say Start Now below the icon to indicate an immediate start.

Any changed settings will automatically be applied to the AquaVent, and it will start logging. Datalogger Status will change from Stopped to Started.

After the AquaVent is started, and begins collecting readings, the Start icon will be greyed out, and only the Stop icon and Future Stop settings will be active.

Figure 4-10 Starting the AquaVent Immediately


Check **Future Start** 'At' to set logging to start at a later date and/or time. This Start mode is referred to as Future Start in the Status field. Click to apply the Future Start time and any changes to the datalogger settings.

When the Future Start time is reached, the AquaVent will start logging and the Status will change from Future Start to Started.

Figure 4-11 Future Start Setting

Stopping the AquaVent

There are two ways to stop logging: Stop Now or at a programmed Future Stop time for the AquaVent.

To stop the AquaVent immediately when it is logging, click  , (it should say Stop Now below the icon).

The AquaVent can be stopped at any time before it reaches the maximum reading capacity. **Starting again begins a new recording session and clears previously stored data readings.**

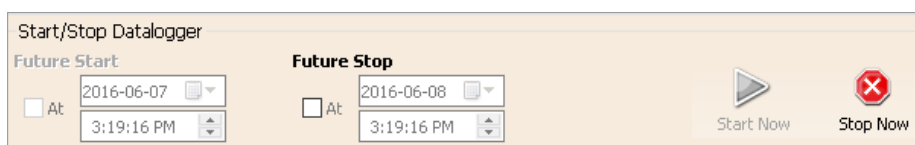




Figure 4-12 Stopping the AquaVent immediately

! NOTE

If you have set a Future Stop time, but wish to stop the datalogger immediately, uncheck the Future Stop 'At' box, and the Stop icon should say Stop Now. Click the icon to stop logging.

To program a **Future Stop** time for your AquaVent, check Future Stop 'At' and fill in the desired stop time. The Future Stop time will be applied to the AquaVent once  is selected for an immediate or future start.

You can also program a Future Stop time after you have started the AquaVent, by checking Future Stop 'At' and filling in the desired stop time. Select  to apply the Future Stop time (it should say Future Stop below the icon). The Stop Time should be shown in the Datalogger Status section.

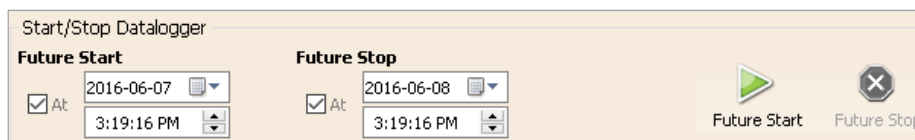


Figure 4-13 Future Stop Setting

It is critical to note that when the AquaVent logs data in Slate mode, it means it will record data until stopped or their memory is full. When the memory fills, the AquaVent will stop recording. For this reason, it is important to determine, based on your start time and sampling rate, the date and time at which the memory will be full and the AquaVent will stop recording. The AquaVent records in Slate mode if Event, Schedule, or Compressed logging. Standard Linear mode, however, can be set to Slate or to Continuous logging.

5 Data Control

(Downloading and Viewing Data using Levellogger Software)

Click the Data Control tab on the Main Window. From the Data Control tab you can download data from an AquaVent, display data in tabular or graphic format, and save and export data files.

NOTE

When you click on a data point in the graph, the corresponding data point will be highlighted in the table. You can also highlight a section of data in the graph.

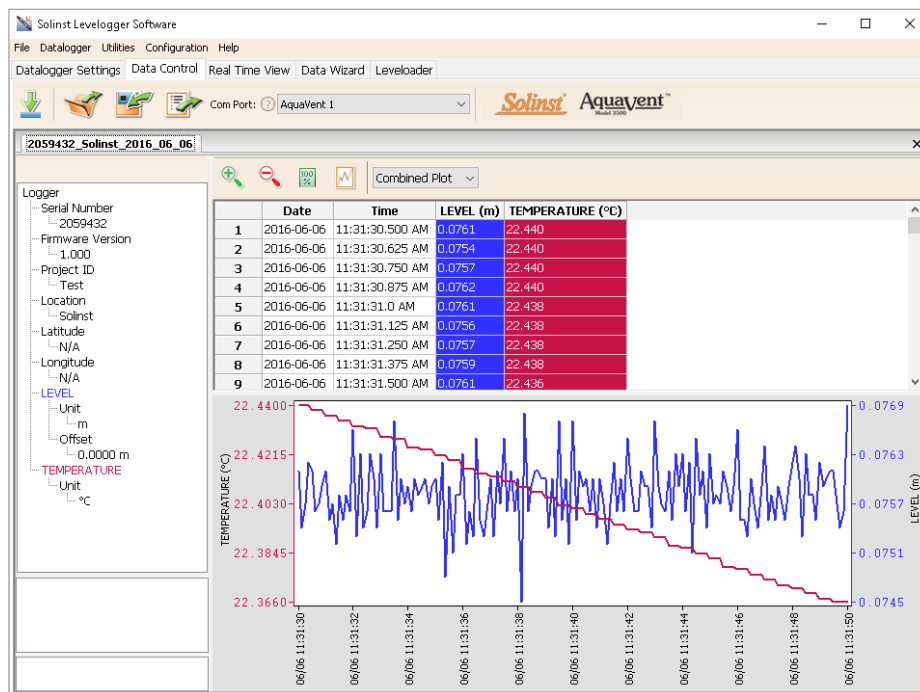


Figure 5-1 Data Control Tab

Click to open a *.xle or *.lev file. Multiple files can be opened at the same time and are available for viewing by clicking the File Name Tab on top of the data table.

All the AquaVent settings and the channel information effective during data collection are shown on the top left of the window. The bottom left sections of the window are used to display information after a data compensation has been performed, such as offsets or unit conversions (see Section 6).

5.1 Downloading Options and Saving Data Files

5.1.1 Default File Format


The default file type for Levellogger Software Version 4 and up is *.xle, unless changed to *.lev in the Application Settings (see Section 3.2.3). Previous Levellogger Software used *.lev files as the default. The *.xle file type is a *.xml format, which allows for enhanced functionality. The *.xle files can be exported as *.xml files, which can be integrated into external database programs.

The *.lev files of previous downloads are compatible with Levellogger Software Version 4 and up, however, *.xle files are not compatible with previous software versions. To ensure compatibility, all Levellogger Software versions allow data to be exported as *.csv files for use in external spreadsheet programs. See Section 5.3 for Export options.


NOTE

The default file type is *.xle, unless changed in the Application Settings (see Section 3.2.3).

! NOTE

Before downloading data you must select the Com Port that the AquaVent is connected to and retrieve the settings from the attached datalogger by clicking  in Datalogger Settings tab.

5.1.2 Downloading Data

Click  from the Data Control tab to download data from a connected AquaVent. There are four options for downloading data. They are: **All Data**, **Append Download**, **Partial Download** and **Recover Previous Log**.

If you select **All Data**, the program will download all the data from the current logging session of an AquaVent into a *.xle file.

The default directory for saved data is in the 'Data' folder:
<C:\Program\Files\Solinst\Levellogger4_2\Data>.

If you select **Append Download**, the program will append the data in an opened *.xle file from the AquaVent. The opened *.xle file and the attached AquaVent should have the same serial number and start time, otherwise an error will occur.

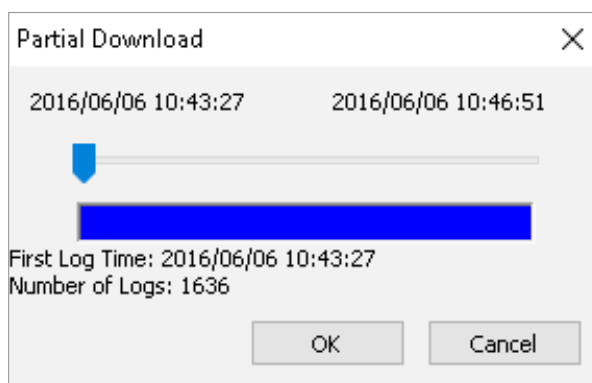



Figure 5-2 Partial Download Window

If you select **Partial Download**, a Partial Download Selection Window will open. The window shows the time stamp of the first and last reading in the logging session. Use the slider to select the time interval you would like data from. Once you click OK, all the data within that time will be downloaded to a *.xle file.

If you select **Recover Previous Log**, the software will try to recover the data from the previous log session and download the data to a *.xle file.

Once the data is downloaded from an AquaVent, it is automatically saved in a temporary file.

5.1.3 Saving Data

Click  to save the data in a specific *.xle file.

The default directory for saved data is in the 'Data' folder:
<C:\Program\Files\Solinst\Levellogger4_2\Data>.

However, the default directory for saved files can be changed by clicking the Configuration menu at the top of the program window, selecting 'Application Settings' and inputting or navigating to a different folder destination. If an error is experienced in saving your first data file such as depicted in Figure 5-3, you may not have file writing privileges to the default directory. In this case, create and set as the default file save folder, a new data folder within the My Documents folder and attempt the file save procedure again.

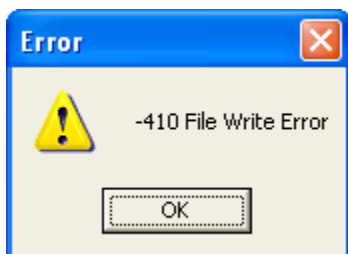




Figure 5-3 File Write Error Message

! NOTE

Right click, and drag the mouse to scan the data graph.

5.2 Graph Manipulation and Zoom Function

To perform the Zoom In function on the graph, click .

To perform a Zoom Out function on the graph click . Click  to undo all the zoom functions.

The Zoom functions can also be used for data selections in the graph.

Click  to open the Graph Option Dialog. The Graph Dialog is shown in Figure 5-4.

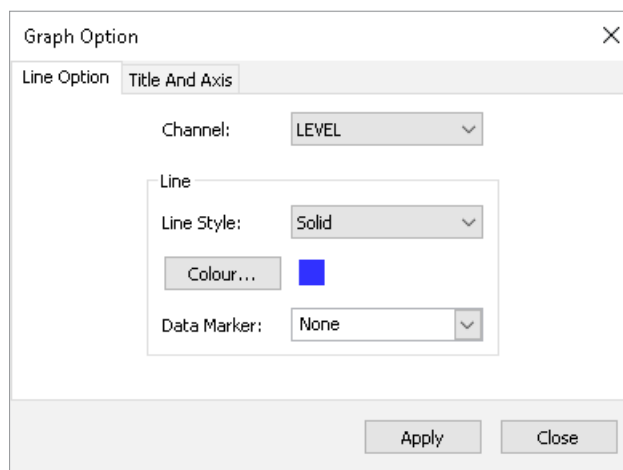


Figure 5-4 Line Option Window

The Line Option is used to adjust the style and colour of the line in the graph for each channel. The user can also select the shape of the data marker or remove the data marker.

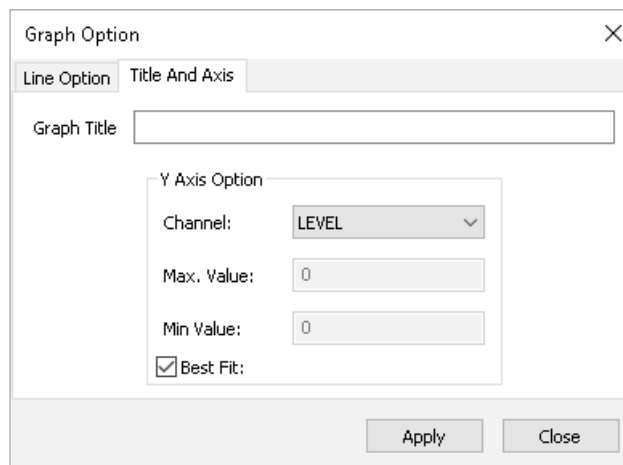


Figure 5-5 Title and Axis Option window

The Title and Axis Option is used to enter the title of the graph and change the Y axis label or user selected scale. Check the Best Fit box to enable the software to determine the best fit scale. If the Best Fit box is not checked, the user has to enter a maximum and minimum value of the selected channel. The X axis is logging time.

There is the option to show Combined Plot graphs or Separated Plot graphs of the data. Choosing a Combined Plot will show the data from each of the channels in one graph. The Separated Plot option will show a separate graph for each data channel.

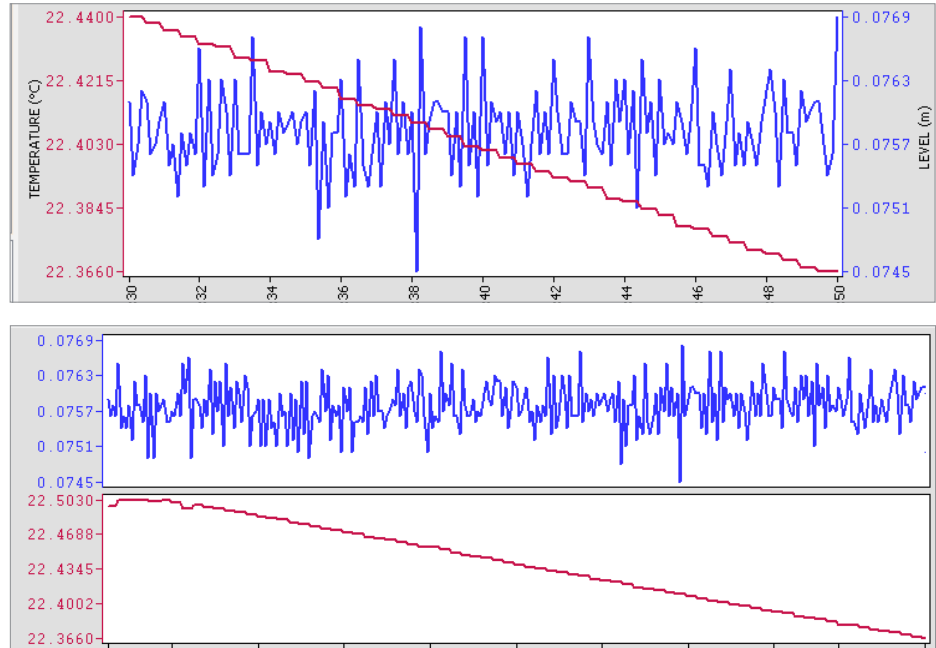


Figure 5-6 Combined and Separated Plot Graphs

There is also the option to view more than one graph at a time. Click and drag a File Name Tab and drop it when you see a shaded area on the window to open a separate graph of that data file. You can view any number of graphs at one time by re-sizing your window as required.

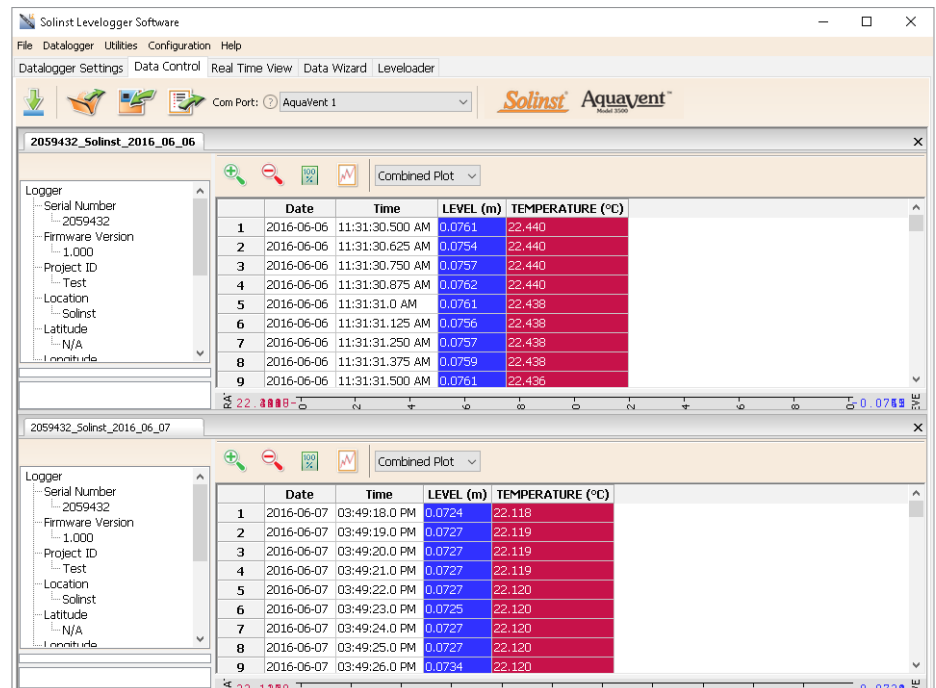



Figure 5-7 Viewing Two Graphs

5.3 File Export and Print Function

Data can be exported in *.csv (comma separated value) file format or *.xml (extensible markup language) file format by clicking File > Export > Data or .

The *.csv and *.xml file formats are supported and can be imported by most spreadsheet and database programs.

Also, the data graph can be exported to a *.bmp file or a *.png file by clicking File > Export > Graph.

The Datalogger Settings, data table and data graph can be printed. Click File > Print Preview, to open the Print Preview window. Figure 5-9 shows the print preview of the Datalogger Settings. The Datalogger Settings are always on the first page of the document. The data graph is on the second page of the document and the rest of the document is the data table.

Click Print..., to open the print dialog. You can choose to print the entire document or just a selection. You can also click File > Print, to open the print dialog.

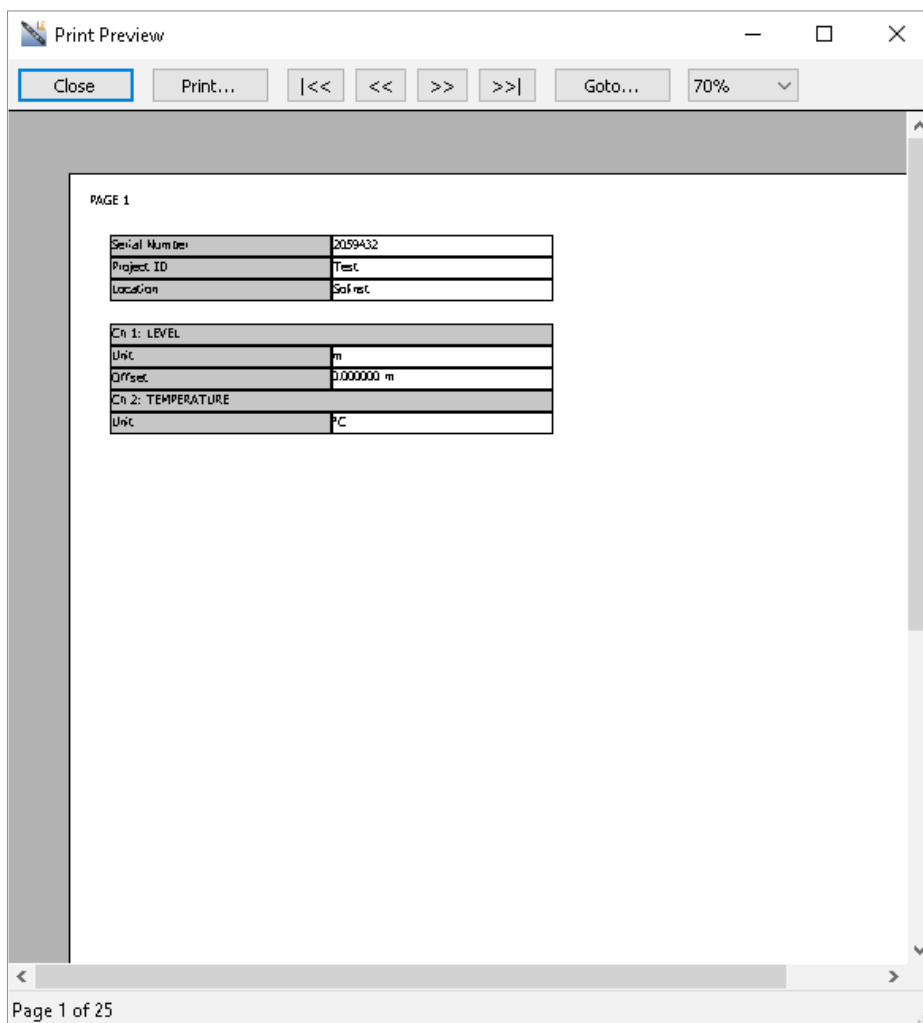


Figure 5-8 Print Preview Screen

! NOTE

Multiple AquaVent files can be compensated at once.

6 Data Compensation

Data Compensations, such as Manual Data Adjustments and Parameter Adjustments can be performed automatically using the software Data Wizard, or manually, by exporting data to an external spreadsheet program.

6.1 Data Wizard

Open the Data Wizard tab. The first step is to select your Data Compensation Path. The AquaVent will only have the Advanced option available.

The **Advanced** option allows you to perform Manual Data Adjustments and Parameter Adjustments.

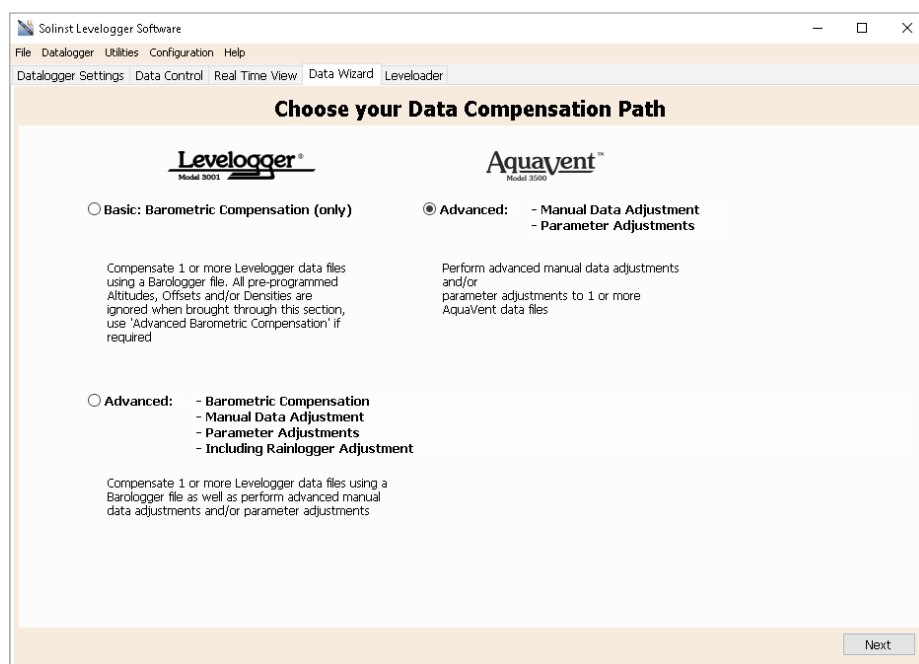


Figure 6-1 Data Wizard

Manual Data Adjustment allows you to enter a manual water level measurement or reference point as a field zero, which all AquaVent water level readings can then be adjusted to. There is the option to convert readings to Depth to Water Level measurements (e.g. from the top of a well casing to water level), or Elevation of Water Level measurements (e.g. above sea level).

Parameter Adjustments allow you to change AquaVent data to different units of measurements, add an offset, or adjust density.

- **Unit** conversion allows you to convert level readings in a AquaVent file to different units (m, cm, ft, kPa, bar or psi), or temperature readings to °C or °F,
- **Offset** allows you to enter any value, positive or negative, which will be added to each reading in the selected AquaVent file to be offset by that amount. It is recommended to stay with the default zero value, unless a known offset has been determined (e.g. to correct for pressure sensor drift. See Solinst Technical Bulletin: Understanding Pressure Sensor Drift).

! NOTE

Manual Data Adjustment, and Parameter Adjustments are useful for correcting AquaVent data files to make data consistent across a project.

- **Density Adjustment** corrects the range of the level channel in the AquaVent data file based on a user input adjustment of fluid density. The range of the density adjustment is from 0.9 kg/L to 1.1 kg/L.

When you select **Advanced** compensation, the Data Compensation Options window will open.

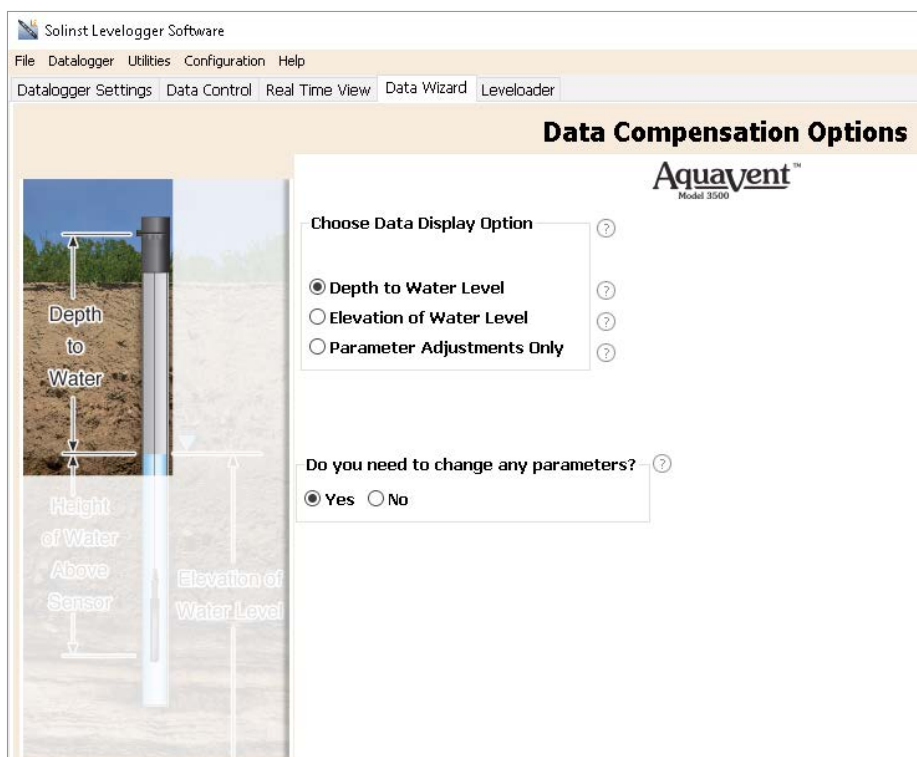


Figure 6-2 Data Compensation Options


First, you will select how you want your data displayed (Manual Data Adjustment):

- **Depth to Water Level** adjusts water level data to represent depth to water level readings (from the top of a well casing or other reference point) by entering a field zero, such as a manual depth to water level measurement. Adjustments can be made to one or more data files.
- **Elevation of Water Level** adjusts water level data to represent elevation of water level readings (above sea level or other reference point) by entering a measuring point elevation, and a field zero, such as a staff gauge measurement from that point. Adjustments can be made to one or more data files.
- **Parameter Adjustments Only** allows you to adjust one or more data files to different units, density, etc., while keeping the sensor diaphragm (zero point) as the reference point for AquaVent.

Next, you will select Yes or No to performing any **Parameter Adjustments** on the data files (will not be active if you selected Parameter Adjustments Only).

Click Next, after you have selected all of your Data Compensation options.

In the next window, you will choose the AquaVent file(s) you would like to use in the compensation. Any files you have open in the Data Control tab will be listed.

Use the directory on the left of the window or click  to open any other data files you would like to compensate. Ensure the files you want to compensate are highlighted in the list. Do this by clicking the file name. To de-select a file, click again. Select Next to continue.

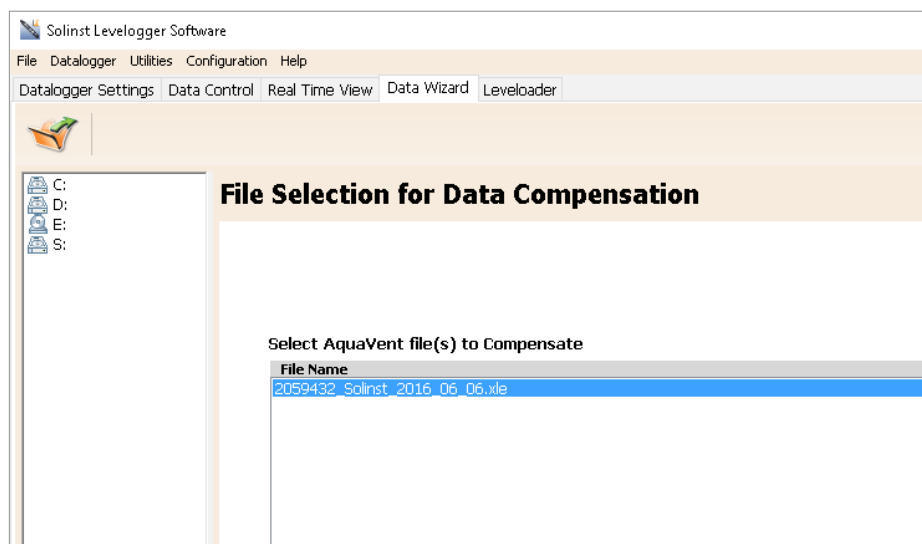


Figure 6-3 Selecting Files for Compensation

! NOTE

When adjusting Units, if you select apply to all, the same unit change will be applied to all of the files being compensated at that time.

If you have selected yes to **Parameter Adjustments**, or selected the **Parameter Adjustments Only** option, in the next window you will enter these. If you did not select to change any parameters, this window will not be shown.

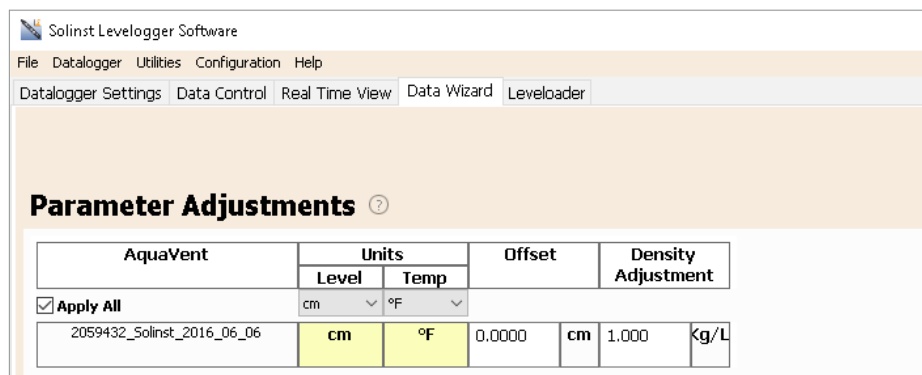


Figure 6-4 Parameter Adjustments

NOTE

The date and time of measurement of the Field Zero must be recorded to complete the adjustment. The Field Zero must replace an actual reading the AquaVent file. I.e. take a manual measurement immediately after starting the AquaVent, and note that time.

Next, for each selected AquaVent file, you will enter the Field Zero(s) you would like to use to manually adjust your AquaVent data. (If you have selected **Parameter Adjustments Only**, this window will not be shown.)

For **Depth to Water Level** adjustments, enter a **Field Zero (A)**. If the static water level is below your Field Zero measurement, the Field Zero is input as a positive value (e.g. a manual water level meter measurement taken from the top of a well casing. See Example 6.1). If the static water level is above your Field Zero, the Field Zero is input as a negative value (such as in an artesian condition).

The Time the Field Zero measurement was taken must replace an actual reading in the AquaVent file. This is selected from the drop-down menu showing all time stamps in the AquaVent file. Click 'Add' to apply the adjustment. If you need to change a Field Zero, click 'Update' after any edits.

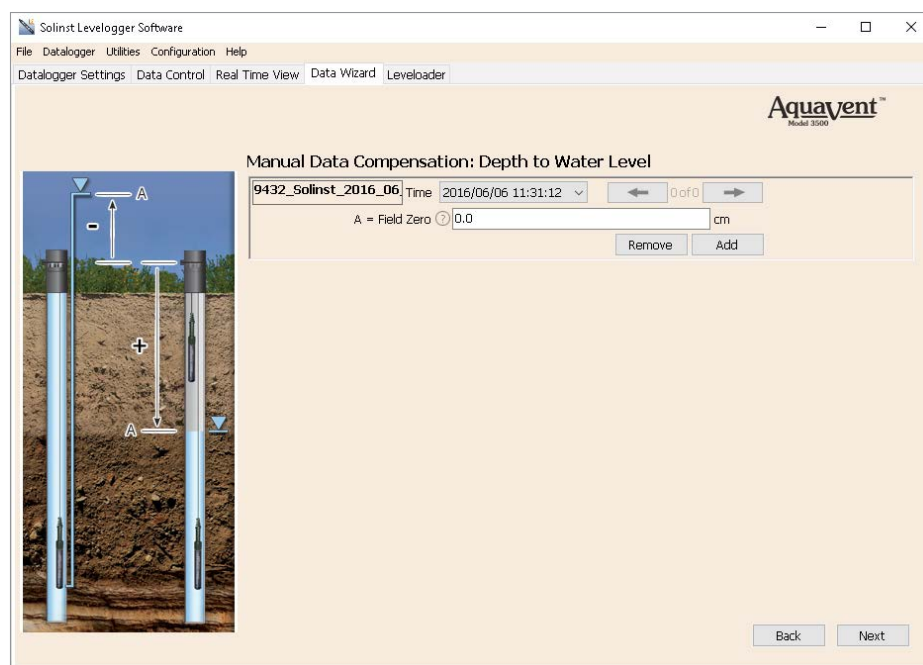
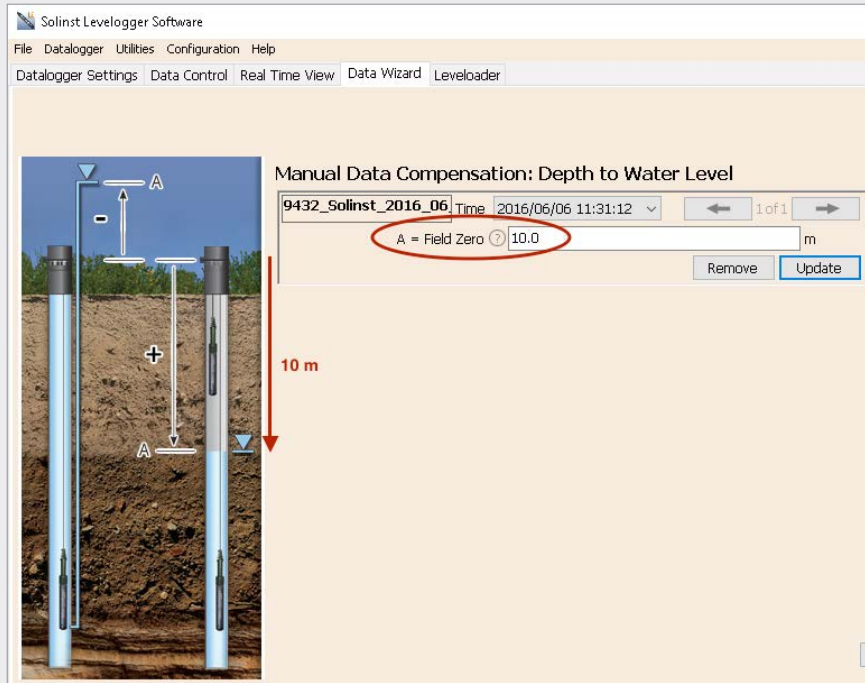


Figure 6-5 Manual Data Adjustment - Depth to Water Level



Example 6.1 Depth to Water Level Adjustment

When using a manual depth to water measurement taken from the top of a well casing as a Field Zero, enter it as a positive value (e.g. 10 m).

In your adjusted data file, your readings will increase in value as the water level decreases. This is because the depth to static water level from the top of the well casing is increasing. The adjusted readings will decrease in value as the static water level rises.

Original AquaVent Data (height of water above sensor)	8.75 m	8.50 m	8.75 m	9.5 m	9.75 m
Adjusted AquaVent Data (depth to water)	(A) 10.0 m	10.25 m	10.0 m	9.25 m	9.0 m

For **Elevation of Water Level** adjustments, enter a **Measuring Point Elevation (A)** and a **Field Zero (B)** from that Measuring Point.

If the static water level is below your Measuring Point, the Field Zero is input as a positive value (e.g. if you are using a manual depth to water measurement as a Field Zero, from the top of a well casing as the Measuring Point).

If the static water level is above your Measuring Point, the Field Zero is input as a negative value (such as an artesian condition). The Measuring Point elevation may also be entered as a negative value.

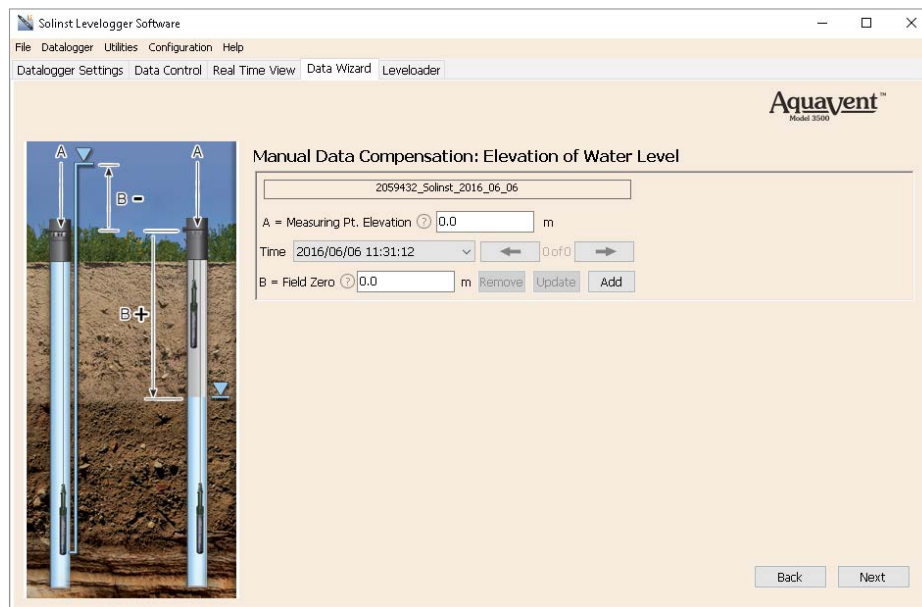


Figure 6-6 Manual Data Adjustment - Elevation of Water

NOTE

The date and time of measurement of the Field Zero must be recorded to complete the adjustment. The Field Zero must replace an actual reading the AquaVent file, i.e. take a manual measurement immediately after starting the AquaVent, and note that time.

The Time the Field Zero measurement was taken, must replace an actual reading in the AquaVent file, and is selected from the drop-down menu showing all time stamps in the AquaVent file. Click 'Add' to apply the adjustment. If you need to change a Field Zero, click 'Update' after any edits.

You can make multiple adjustments to one data file by selecting 'Add' again to enter another Field Zero. All readings after this Time, will be adjusted to this second measurement. You can add as many adjustments to one AquaVent data file as you would like (as long as it doesn't exceed the total number of readings in that file).

Select Next to complete the compensation.

! NOTE

All data files are saved to the default location: <C:\Program Files\Solinst\Levellogger4_2\Data>. However, the default directory for saved files can be changed by clicking the Configuration menu at the top of the program window, selecting 'Application Settings' and inputting or navigating to a different folder destination.

The compensated data will automatically be saved in a new *.xle file. The default file name will be the <original AquaVent file name> with the word <compensated> added to the file name prefix. Alternatively, the user can rename the compensated file by saving it in the Data Control tab. Do not change or delete the file extension. All data files are saved to the default location: <C:\Program Files\Solinst\Levellogger4_2\Data>.

The next window will show the results of the compensation. If the compensation was unsuccessful, there will be an explanation in the Reason column. You can still view the compensated file in the Data Control tab, by clicking 'Open' in the Action column. If the compensation is successful, select 'Open', to view the compensated data file in the Data Control tab.

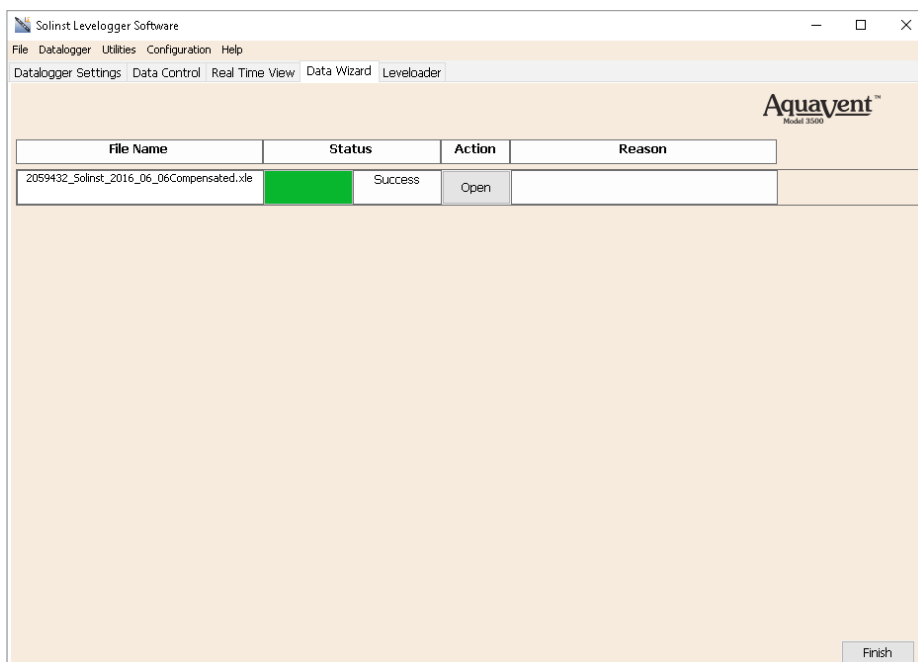


Figure 6-7 Data Compensation Results

From the Data Control tab, you can view the data, save the compensated file with a new filename and/or export the data (see Section 5).

All the original AquaVent settings and the channel information effective during data collection are shown on the top left of the window. The bottom left sections of the window are used to display the compensation information.

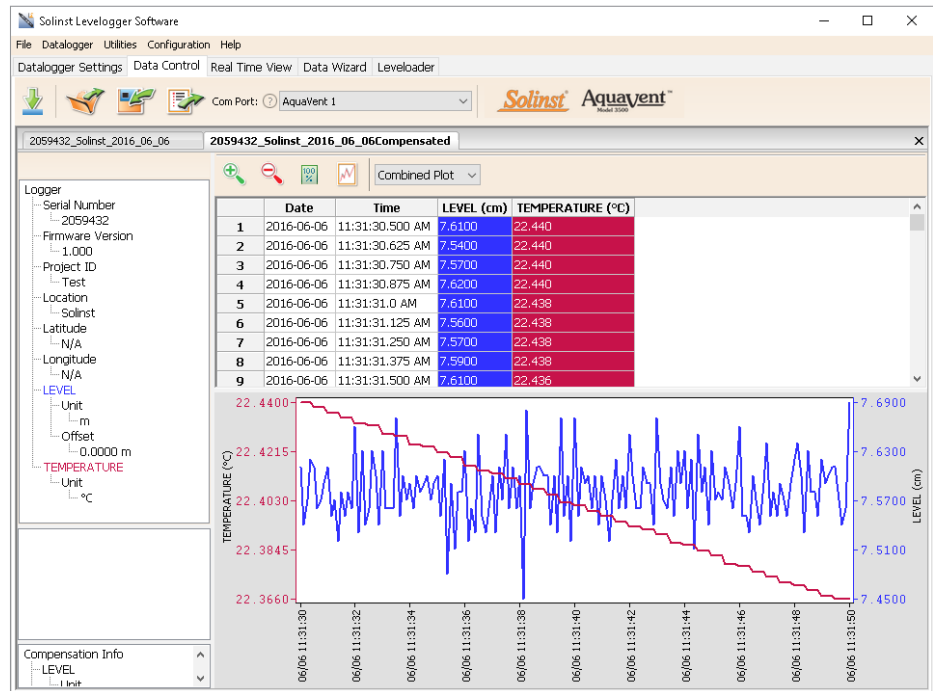


Figure 6-8 Viewing Compensated Files in the Data Control Tab

! NOTE

Datalogger settings can not be changed in the Real Time tab. Changes must be made in the Datalogger Settings tab. The changes are applied when the Real Time readings are started.



7 Real Time View

Click the Real Time View tab from the Main Window (Figure 7-1). The purpose of this tab is to provide on-screen measurement as data is being recorded by the connected AquaVent. The data is displayed in tabular and graphical format. All the channel information and AquaVent settings are displayed on the left of the window.

First, select a non-logged view rate . This rate can be set independently of the logging period of the AquaVent and does not interfere with any logging taking place in the AquaVent itself.

Checking, **Enable Manual Data Adjustment**, allows you to enter a datum/ field zero (e.g. depth to water level) to which the change in Real Time View level measurements are then adjusted against. This is only available when you are taking readings in m, cm, or ft.

Real Time View readings can be displayed as a graph or in tabular format. The same graphing options as the Data Control tab are available for Real Time View readings. Real Time View readings are being recorded within the Levellogger Software and prior to closing the window, they can be saved by exporting the data into a *.csv file, by choosing the file export option

To start the current readings, click . The readings will be displayed immediately.

To take a reading at any specific time, click the button and that reading will be added to the displayed data. To turn the Real Time View monitoring off, decide if you want to save the data as described above, and simply click .

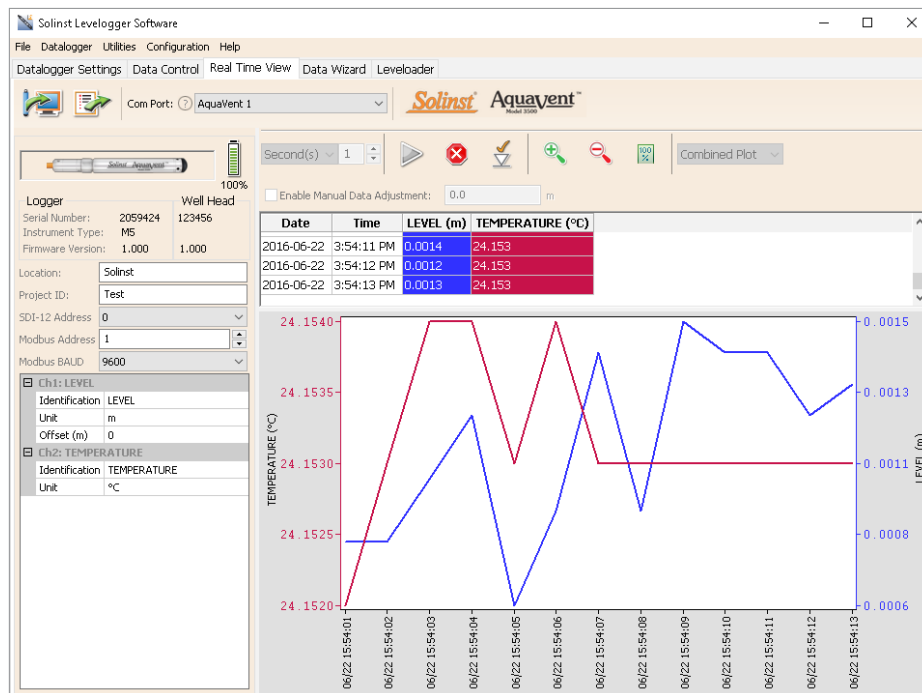


Figure 7-1 Real Time View Window

8 Installing the AquaVent

The AquaVent system is designed to be conveniently installed on a 2" well casing (4" with an adaptor). However, other installations are acceptable, if proper precautions and recommendations are followed.

The AquaVent Wellheads have a rating of IP 64 (dust and splash resistant), so should not be submerged at anytime. They can be secured inside an enclosure, however, it must be vented to equalize atmospheric pressure. The Wellhead measures \varnothing 4.0" x 5.5" (102 mm x 140 mm).

Begin by ensuring you have correctly connected your AquaVent logger to the Vented Cable, and the Vented Cable to the Wellhead. See Section 1.3.2.1 for connection instructions. See Section 8.2 for installation using the well cap sleeve and the Support Hanger Bracket.

8.1 Installing Wellhead Batteries

Each Wellhead uses four (4) 1.5V AA replaceable lithium batteries. To install the batteries, follow the steps below:

1. Unscrew the top of the Wellhead to access the battery compartment.
2. Carefully remove the battery holder from the compartment.
3. Install the four batteries in the holder. Ensure proper polarity when placing the batteries, paying attention to the positive (+) and negative (-) symbols etched in the holder.
4. Slide the battery holder back into the compartment. Ensure proper alignment; the spring contacts in the housing should be lined up with the protruding contacts on the bottom of the battery holder.
5. Screw the top cap firmly back onto the Wellhead.
6. After replacing the batteries, to reset the battery indicator in the Levellogger Software, use the Diagnostic Utility (see Section 10.6).



Figure 8-1 Installing Wellhead Batteries

8.1.1 Wellhead Battery Life Estimates

AquaVent Sampling Rate	Battery Life Estimate
8 readings per second	10 days
1 reading per second	3 months
1 reading per minute	8 years

NOTE

After retrieving the settings in Levellogger Software, If the Wellhead batteries have drained to 20% charge or lower, a warning message will appear to replace the batteries.

NOTE

After replacing the batteries, to reset the battery indicator in the Levellogger Software, use the Diagnostic Utility (see Section 10.6).

! NOTE

There are three holes in the top of the Support Hanger Bracket that can be used to secure it in the well cap sleeve with screws.

! NOTE

Ensure you save the storage caps supplied on each end of the Vented Cable for future use.

! NOTE

For diagnostic purposes, you may wish to install the end of the Vented Cable with the serial number, to the Wellhead connection at surface.

8.2 Vented Cable Support Hanger Bracket

An optional Support Hanger Bracket is available to secure the Vented Cable to the Wellhead when deployed.

The support system consists of the 2" well cap sleeve (which comes with the Wellhead) and the Support Hanger Bracket. To accommodate 4" wells, an adaptor is available for use with the 2" well cap sleeve.

The steps below show how to install the Support Hanger Bracket:



Insert the Hanger Bracket through the top of the well cap sleeve so it seats on the shoulder in the sleeve.



Bring the Vented Cable through the bottom of the well cap sleeve.



Connect the Vented Cable to the Wellhead. See section 1.3.2.1 for more details.



Slide the well cap sleeve up to the Wellhead and twist the well cap sleeve into the Wellhead until it seats.



Wrap the cable around the Hanger Bracket and insert into the cutouts to secure the cable to the bracket.

! NOTE

The holes in the hanger bracket can accommodate twist ties or zip ties to secure the cable to the bracket if desired.

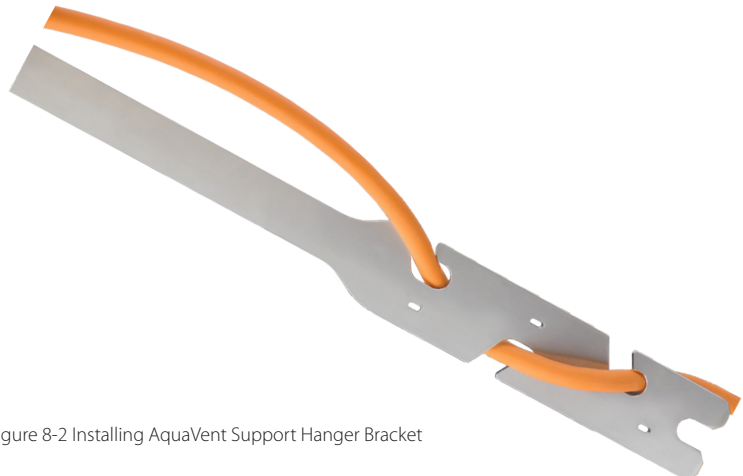


Figure 8-2 Installing AquaVent Support Hanger Bracket



Figure 8-3
AquaVent Measurement Line

8.3 AquaVent Orientation

It is recommended that the AquaVent sensor logger be installed in a vertical orientation. However, inclined or horizontal installation is acceptable.

The pressure sensor measurement line is indicated by the machined line around the AquaVent logger body, just above the pressure access holes (Figure 8-3).

The pressure transducer is oriented in a plane normal to the long axis of the body, and detects pressure directed along the plane of the long axis. In vertical orientations, the sensor detects pressure above the pressure transducer line. In non-vertical orientations, the pressure zero point is proportional to the angle of inclination.

8.4 AquaVent Installation Depth

Properly estimate the minimum and maximum water levels expected during the monitoring period. As it measures height of water above the sensor, the AquaVent needs to be installed so it remains submerged at all times. However, the AquaVent should not be installed deep enough to touch the bottom of a well or channel (avoid submergence in sediments).

Maximum submergence depth must also remain within its specified range throughout the monitoring period. The pressure transducer can be damaged, if the AquaVent is over-pressurized by submerging it below its intended range. The AquaVent is warranted up to 200% of their full scale range, however, accuracy can not be guaranteed beyond full scale.

8.5 Installation Precautions

Carefully lower the AquaVent into water. The impact of suddenly dropping the AquaVent into water could permanently damage the transducer. Care should be taken to avoid dropping the AquaVent against a hard surface.

Other important considerations when installing the AquaVent in pressurized or intermittently pressurized locations such as pressure vessels, pressurized pipes, pulse flow conditions, drop structures or near hydraulics works, is to keep in mind the potential effect of water or steam hammer and hydraulic jump.

Water hammer is caused by an abrupt alteration of flow direction resulting in pressure surges. Steam hammer occurs when steam enters a cold pipe partially filled with water. The hammer effect has the potential to significantly increase hydraulic pressure possibly exposing the pressure sensor to pressures beyond its maximum rating.

Hydraulic jump is a phenomenon that occurs when water is 'lifted' or 'ramped' by velocity or flow obstructions. Hydraulic jump causes turbulence and creates non-representative head conditions in the water column. Care should be taken to avoid installation at points susceptible to hydraulic jump.

! NOTE

Although precautions can be taken, placing an AquaVent in a situation where the water may freeze solid can permanently damage the sensor.

8.6 Installation in Extreme Environments

8.6.1 Freezing or High Temperature Conditions

AquaVent installation in locations that may be at risk of freezing, is not recommended without taking precautions. When water freezes it expands approximately 9% by volume. A 9% expansion can equate to extreme pressure. Therefore, solid freezing has the potential to damage the pressure transducer, which is rated to withstand up to 200% of its depth fluctuation range. As such, care should be taken when choosing the appropriate pressure transducer range for your application.

If monitoring shallow water bodies or groundwater zones susceptible to freezing, the easiest way to avoid transducer damage is to lower the transducer to a point in the water column below the frost line or ice formation depth. In water bodies such as shallow streams, wetlands or ponds where freezing may penetrate to the bottom, install the AquaVent in a vented stilling well imbedded into the bottom of the water body beyond the frost line.

In cases where the above noted precautions cannot be taken and the AquaVent must be installed in the freezing zone, it is recommended that the AquaVent be placed inside a thick membrane balloon filled with a non-toxic, non-corrosive anti-freeze solution and sealed. Place the balloon in a section of perforated, 1.25" (30 mm) ID pipe and install the AquaVent in the monitored water. The antifreeze solution will protect the AquaVent from ice expansion at the pressure transducer, yet transmit any pressure and temperature fluctuations that occur. However, it should be noted that even if these precautions are taken, there is still the risk that placing an AquaVent in a situation where the water may freeze solid can permanently damage the sensor.

Please note that a similar installation protection can be used when the AquaVent is monitoring liquids which are incompatible with its wetted materials.

The operating temperature range for the AquaVent is -20° to 80°C (-4° to 180°F). At the opposite end of the thermal scale, exposing the AquaVent to temperatures beyond 80°C may damage the thermistor and otherwise affect the AquaVent.

8.6.2 Marine or Brackish Installations

When installing the AquaVent in salt or brackish water or in a liquid having a specific gravity (density) different than fresh water, the density difference is compensated for by inputting the density of the monitored fluid in the Data Wizard (see Section 6.)

The AquaVent can be used for monitoring in salt or brackish water. However, long term use of the stainless steel body in salt or brackish water is not recommended, as the salt or other pollutants may cause pitting which can lead to perforation of the AquaVent's casing. To minimize this effect, regularly lift the AquaVent from the liquid; within seconds a thin protective layer will be formed by oxidation.

If using an AquaVent in a continuous salt/brackish monitoring scenario, the stainless steel body of the logger can be protected in a manner similar to the freezing protection method described in Section 8.6.1. The AquaVent can be placed in a thick membrane balloon filled with non-corrosive/ non-toxic fluid, such as tap water. As pressure changes, the fluid encasing the AquaVent will transmit the pressure differential to the pressure transducer.



Figure 8-4 Biofoul Screen Dimensions

8.6.3 Biofouling Conditions

Biofouling is the unwanted buildup of microorganisms, plants, algae, or organisms such as barnacles and muscles on a wetted surface. When a AquaVent is deployed for an extended period of time, especially in a saltwater environment, there is the risk of biofouling. Biofouling on the pressure sensor can compromise the accuracy of the measurements.

A Solinst Biofoul Screen can be used to protect the AquaVent from biofouling. The copper-coiled Delrin screen naturally reduces biofouling, and lengthens the time a AquaVent can be deployed before maintenance is required. The Biofoul Screen simply slips onto the sensor end of the AquaVent logger where it is held in place with its compression fitting. It adds about 3/4" (19 mm) to the length of the AquaVent logger. It allows water to freely enter the pressure transducer inlets. It is replaced as required.



Figure 8-5 Solinst Biofoul Screen

9 AquaVent Maintenance

As with any groundwater or surface water monitoring project, you should select the proper equipment and determine a maintenance schedule based on the monitoring environment specific to your application.

For the AquaVent, this means selecting the appropriate pressure range, ensuring the monitoring temperatures are within the instruments specifications, and making sure the wetted materials are compatible with site chemistry.

9.1 AquaVent Logger Maintenance

AquaVent logger maintenance consists of cleaning the outside casing and the circulation holes. The required frequency of cleaning is dependent on several aspects of the monitored water quality. In freshwater with good to excellent water quality, the AquaVent cleaning requirements will be very minimal; amounting to a seasonal or even annual maintenance inspection.

In most cases cleaning can be accomplished by rinsing the AquaVent and using mild, non-residual, non-abrasive household cleaners with a very soft-plastic, bristled, pipe-cleaner type brush. Do not insert any object through the circulation holes at the sensor end of the AquaVent.

In some cases simple cleaners are insufficient to properly clean the AquaVent. Several commonly occurring water conditions require specific maintenance methods. These include hard water, high suspended solids loading, biological or chemical fouling and salt or brackish water conditions.

Hard water monitoring can result in the precipitation of calcium and magnesium deposits on the pressure transducer as well as other components of the AquaVent. These deposits can be safely dissolved using a diluted solution (typically $\leq 10\%$ strength) of acetic or phosphoric acid. Commercially available products for dissolving hard water scaling are also available and can be used if designed for household use. Some industrial strength hard water scaling removers are much higher strength and are not recommended for cleaning the AquaVent.

High suspended solids load may block the circulation ports or clog the internal pressure cell of the AquaVent. The potential clogging effect of solids deposition can be minimized by placing the AquaVent in zones of flow. To remove solids build up, rinse the AquaVent under a low flow of tap water until particles have been washed away.

Bacteriological or chemical fouling can be an important consideration in many ground and surface water monitoring projects. Sessile bacteria will often utilize installed instrumentation as an attachment substrate. Chemical deposit can be the result of electrical charge differential between the instrumentation of the monitored liquid or the result of biological or algal activity. Both forms of fouling can result in difficult to remove deposits on the AquaVent transducer, the conductivity wires and the AquaVent casing. To remove fouling use a diluted ($\leq 10\%$) solution of sulfuric acid. Persistent material may require soaking for several hours.

Replacing the o-ring should be done on a regular basis. The o-ring ensures a tight seal at the Vented Cable connection, which is important for keeping moisture out. Replacement O-rings are available in sets of ten from Solinst.



Figure 9-1 O-Ring at the Vented Cable Connection

Proper storage when not in use is important. The AquaVent should be stored with the protective cap threaded onto the Vented Cable connector. The hard case that the AquaVent logger was received in, should also be used to protect the logger during storage.



Figure 9-2 AquaVent Logger with Storage Cap and Protective Case

! NOTE

Before the Vented Cables are shipped, the vent tubes are blown dry with nitrogen gas, and capped, to ensure no moisture during transport. These caps should be retained.

9.2 Vented Cable Maintenance

Proper storage of the Vented Cable is very important. The Vented Cables are shipped with the ends capped; these caps should be retained, and used to seal the Vented Cable connections when not in use and during periods of storage. It is also recommended the Vented Cable be stored on the spool it was received on (for longer lengths). This protects the Cable and avoids the vent tube from being kinked.

To ensure the vent tube is dry before deployment or storage, Solinst offers a special fitting that allows you to blow nitrogen gas through the tube. See Section 9.2.1.

Cleaning the connections ensures a proper seal. A cotton swab can be used to clear any moisture or debris from the connectors.

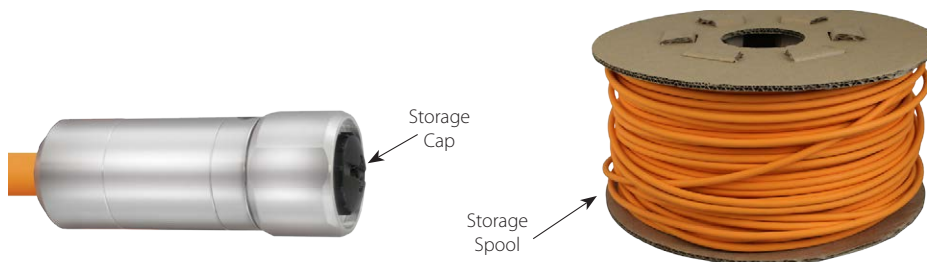


Figure 9-3 Vented Cable Maintenance

9.2.1 Vented Cable Blowout Fitting

Using the Vented Cable Blowout Fitting to dry the vent tube is recommended before starting any new project or before storing the Vented Cable.



Figure 9-4 Vented Cable Blowout Fitting

To use the Vented Cable Blowout Fitting:

1. Remove the storage caps from both ends of the Vented Cable (remember to save the caps). Or if deployed, remove the AquaVent logger and Wellhead.
2. Connect one end of the Vented Cable to the correct connection on the Blowout Fitting. Ensure proper alignment before pushing the connection together. Twist the stainless steel coupling onto the Blowout Fitting until it seats. Do not twist the Vented Cable, cable connector body, or Blowout Fitting.

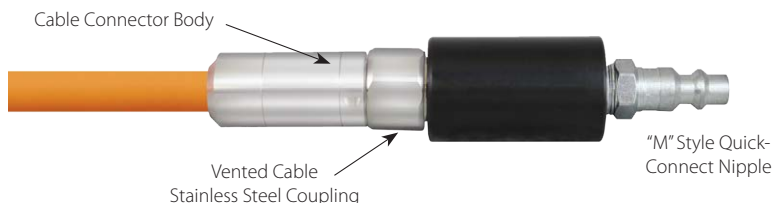


Figure 9-5 Vented Cable Connected to the Blowout Fitting

3. Connect the other end of the Blowout Fitting to the nitrogen gas tank hose fitting.



Figure 9-6 Nitrogen Gas Being Blown Through the Vented Cable

4. Slowly apply 25-30 psi of nitrogen gas to the Vented Cable. Let pressure flow through the cable for about 5 minutes. If you hear no air flow, you can apply up to 50 psi of pressure to clear any blockages.
5. Turn off the nitrogen gas flow and remove the Vented Cable from the Blowout Fitting.
6. If deploying the AquaVent, immediately connect one end of the Vented Cable to the AquaVent logger, and the other to the Wellhead. See Section 1.3.2.1 for connection instructions.
7. If storing the Vented Cable, immediately install the storage caps to both ends of the Vented Cable.

! NOTE

Do not twist the Blowout Fitting, Vented Cable or stainless steel cable connector body when connecting to the fitting. Only twist the stainless steel coupling.

! NOTE

Do not exceed 50 psi of pressure when using the Vented Cable Blowout Fitting.

! NOTE

After retrieving the settings in Levelogger Software, If the Wellhead batteries have drained to 20% charge or lower, a warning message will appear to replace the batteries.

9.3 AquaVent Wellhead Maintenance

Replacing the batteries will have to be done on a regular basis, and is based on usage. See Section 8.1 for battery life estimates and installation instructions.

Replacing the o-ring at the Vented Cable connector should also be done regularly. The o-ring ensures a tight seal at the Vented Cable connection, which is important for keeping moisture out. Replacement O-rings are available in sets of ten from Solinst.

When not in use, the Wellhead should be stored with the dust cap on the Vented Cable Connector. The blue dust caps should also be secured to the cable connector(s) on the side of the Wellhead.



Figure 9-7 Wellhead O-ring and Dust Cap at the Vented Cable Connection

10 Diagnostics Utility

The Levellogger Software Diagnostics Utility can be used for troubleshooting the AquaVent and obtaining information about that AquaVent, which can assist the Solinst Technical Support representative to identify and fix any problems you may encounter. The Diagnostics Utility can be launched from the Utilities menu at the top of the software. The utility can be used to run a self-test, do a Memory Dump, create and email reports, and reset the AquaVent battery indicator.

10.1 Run Diagnostics

The Run Diagnostics function reads the following information from the AquaVent:

- 1) Logger and Wellhead Serial Numbers
- 2) Model Number
- 3) Logger and Wellhead Firmware Versions
- 4) Battery Voltage
- 5) Charge Level
- 6) Current Level Reading
- 7) Current Temperature Reading
- 8) Max/Min Pressure Reading
- 9) Max/Min Temperature Reading
- 10) Max/Min Conductivity Reading
- 11) Total Number of Logs

This information can be used to identify firmware, battery and/or temperature/pressure sensor problems. This function also performs a series of self-tests on the AquaVent to check for problems with the battery, memory, pressure/temperature sensor. If any of these tests fail then a report should be created and emailed to Solinst Technical Support. To execute this function simply click the 'Run Diagnostics' button.

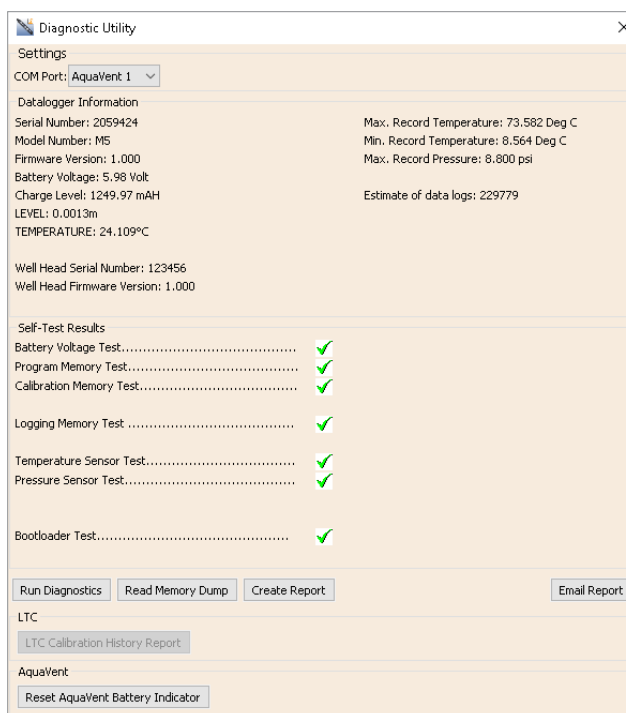


Figure 10-1 Run Diagnostics

! NOTE

It is recommended that, before attempting to use this function, you use the 'Create Report' function to send a report to the Solinst Technical Support.

10.2 Read Memory Dump

This function creates a complete dump of the AquaVent's memory, which can then be sent to Solinst Technical Support for analyzing.

To execute this function simply click the Read Memory Dump button. Performing a memory dump will create a *.xle file of the data to save.

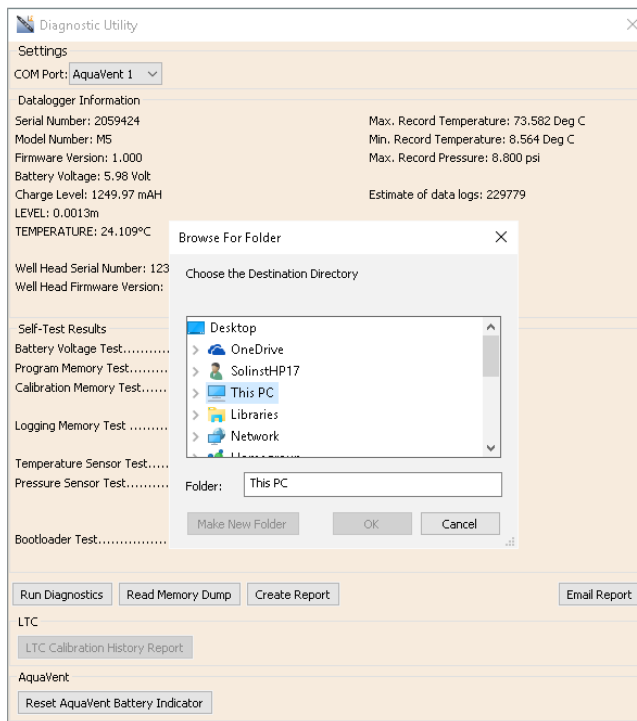


Figure 10-2 Read Memory Dump

! NOTE

The 'Email Report' option automatically creates a report and attaches it to an email to send to Solinst - all in one step.

10.3 Create Report

This function simply creates a text file containing the information obtained from the Run Diagnostics function. When you click the Create Report button, a window will pop up asking you to fill out your company information. Simply fill this out and the resulting report can be saved or sent to Solinst Technical Support for troubleshooting.

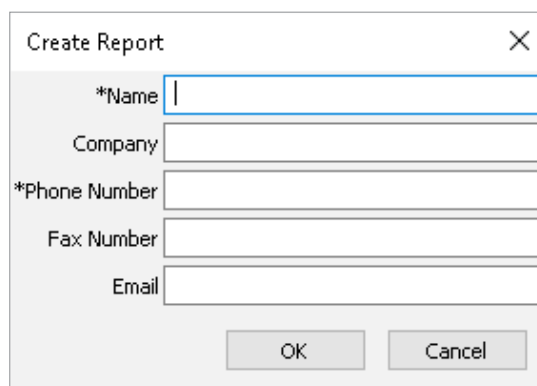
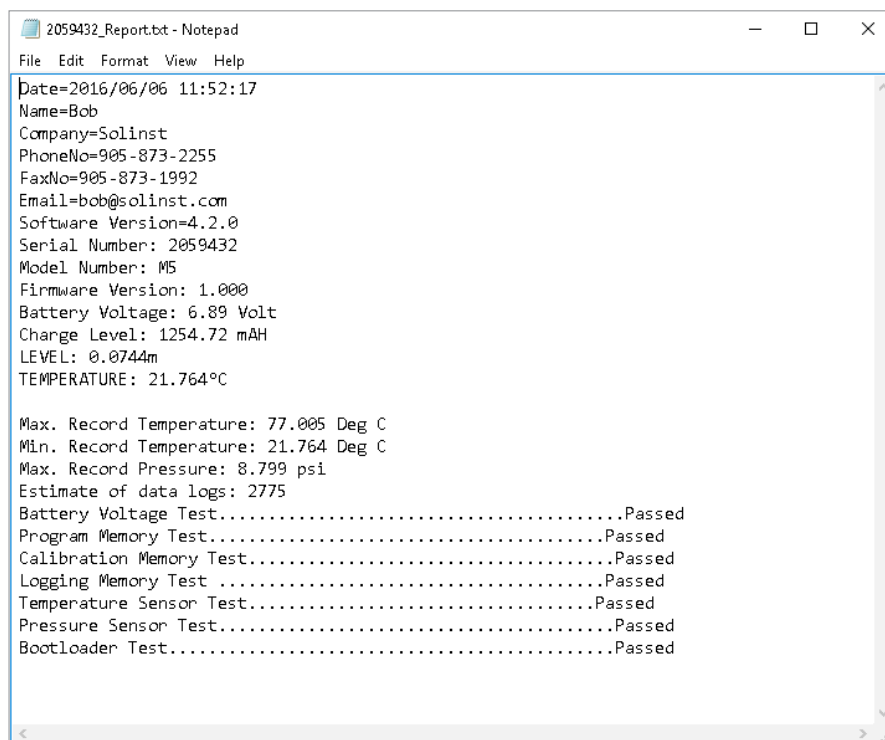


Figure 10-3 Customer Info Input Window



```

2059432_Report.txt - Notepad
File Edit Format View Help
Date=2016/06/06 11:52:17
Name=Bob
Company=Solinst
PhoneNo=905-873-2255
FaxNo=905-873-1992
Email=bob@solinst.com
Software Version=4.2.0
Serial Number: 2059432
Model Number: M5
Firmware Version: 1.000
Battery Voltage: 6.89 Volt
Charge Level: 1254.72 mAH
LEVEL: 0.0744m
TEMPERATURE: 21.764°C

Max. Record Temperature: 77.005 Deg C
Min. Record Temperature: 21.764 Deg C
Max. Record Pressure: 8.799 psi
Estimate of data logs: 2775
Battery Voltage Test.....Passed
Program Memory Test.....Passed
Calibration Memory Test.....Passed
Logging Memory Test .....Passed
Temperature Sensor Test.....Passed
Pressure Sensor Test.....Passed
Bootloader Test.....Passed
    
```

Figure 10-4 Report Example

10.4 Email Report

Clicking Email Report will guide you through the process of creating a Diagnostics Report, and it will automatically attach the report to an email to send to Solinst Technical Staff for troubleshooting.

10.5 Software/Firmware Updates

Each time the Diagnostic Utility is opened, it automatically checks for software updates. If there is an update, "[Software Update Available](#)" will appear in the top right of the window. When you click the message, a web page will open, allowing you to download the software update.

The Utility also checks for firmware updates. "[Firmware Update Available](#)" will appear in the top right of the window. Clicking the message will open a web page where you can download the firmware update. See Section 11 for firmware update instructions.

10.6 Reset AquaVent Battery Indicator

After replacing the Wellhead batteries, in order to reset the battery indicator in the Levelogger Software, click the "Run Diagnostics" button, then click "Reset AquaVent Battery Indicator".

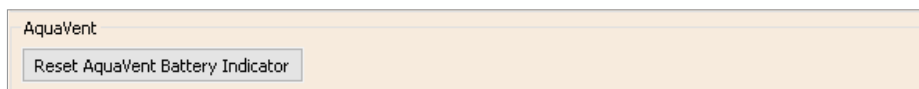


Figure 10-5 Reset AquaVent Battery Indicator

! NOTE

Your Computer must have an Internet connection to check for software and firmware updates.

You can also check for updates using the Help menu.

! NOTE

To check for firmware updates using Levellogger Software, retrieve settings from the connected AquaVent (see Section 4). "Firmware Update Available" will appear in the top right menu bar if there is an update available. Clicking the message will open a web page where you can download the firmware update. You can also use the Software's Help menu.

! NOTE

It is important that the communication between the PC and the AquaVent is not interrupted during a firmware upload, so please make sure to close any other running programs, including screen savers, and do not disconnect the AquaVent before the upload is finished.

! NOTE

While the firmware is being updated, the SPX Wellhead will ignore or provide time-out response to any requests from the MODBUS or SDI-12 network.

! NOTE

If an upgrade process in the SPX Wellhead fails or is interrupted, then recovery may require a power cycle, usually accomplished by unplugging the USB Connector Cable and SDI-12/MODBUS Connector Cable, then re-connecting after 30 seconds.

11 Firmware Upgrade Utility



With the AquaVent logger connected to the Wellhead by the Vented Cable, use the USB Connector Cable to connect the SP or SPX Wellhead to the PC.

The SPX Wellhead also needs a power supply connected to the SDI-12/MODBUS Connector Cable in order to perform the firmware upgrade. See separate User Guides for power connection instructions.

The Firmware Upgrade Utility is used to upload new firmware files to an AquaVent logger and/or SP/SPX Wellhead. The Firmware Upgrade Utility can be launched from the Utilities menu at the top of the Levellogger Software. The zipped firmware file can be obtained from: <http://www.solinst.com/downloads/>

Make sure to unzip the firmware file after you have downloaded it, so you can access the *.ssf file. There are two separate firmware files available; one for the AquaVent logger and one for the SP/SPX Wellheads. Update each hardware component separately; update the Wellhead before updating the AquaVent logger.

To upload new firmware to an AquaVent, follow these steps:

- 1) Open the Solinst Firmware Upgrade Utility from the Utilities menu in the Main Levellogger Software Window. Pick the Com Port to which the AquaVent is connected and make sure the Baud Rate is set to 9600.
- 2) Click the 'Open' button , which should open a file dialog asking for the firmware file (*.ssf) to upload. Navigate to the directory where the firmware file was saved on your PC, then click on the file and click 'Open'.
- 3) Check the 'Firmware File Information' box to make sure the opened file is correct.
- 4) Click the 'Upload Firmware' button , to start the firmware upload process.
- 5) If a communication error occurs and is indicated in the AquaVent Information Window (Figure 11-1) either before the 'Verified Program Checksum' message or after the 'Program Information Section', then restart the upgrade process.
- 6) If, however, a communication error occurs between the 'Verified Program Checksum' and the 'Program Information Section' messages, then please contact Solinst. You will need to give the AquaVent serial numbers and explain the exact positioning of the error message.

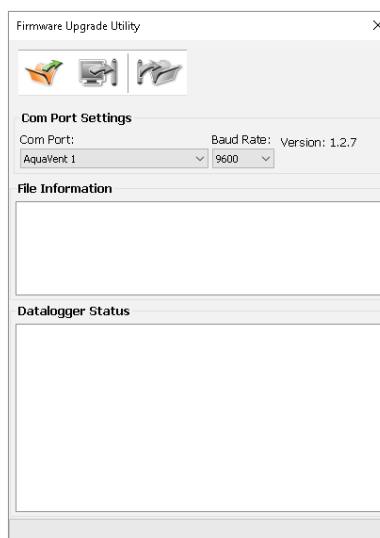


Figure 11-1 Firmware Upgrade Utility Window

12 Troubleshooting

12.1 Problems During Installation of Levellogger Software

‘Class not Registered’ or ‘DLL not found’ or ‘Access violation’

- 1) You may not have Administrator Rights to install the software in the Windows 7/8/10 environment.
 - Ask your System Administrator for assistance.
- 2) Some files got corrupted during installation of the Levellogger Software. Use ‘Add/Remove Programs’ to uninstall then re-install Levellogger Software.

12.2 Error During Software Uninstall Process

The ‘Add/Remove Program’ cannot locate the Levellogger <setup.exe> file of the software or the link between the software and the ‘Add/Remove Program’ is damaged.

The record in the Registry Table must be removed:

- 1) Ask your System Administrator to remove this.
- 2) Refer to the following link from Microsoft Website for instructions:
<http://support.microsoft.com/default.aspx?scid=kb;en-us;247501>

12.3 Data Has Been Erased Accidentally

If AquaVent has been restarted and old data has not been saved, go to Download Options and choose Data Recovery. It downloads the immediately previous log.

12.4 Error Messages During Use of Software

‘Communication Time Out’ or ‘Communication Error’ or ‘The Command that is sent to the Levellogger Edge is not defined’

- 1) Try communicating with another AquaVent Logger, Wellhead, Vented Cable or USB Connector Cable.
- 2) Clean the Vented Cable connections to the AquaVent logger and Wellhead.
- 3) Check that the USB Connector Cable is connected to the same Com Port that is chosen in the upper middle of the Main Window of the Levellogger Software.
- 4) Check the Com Port settings. They should be as follows:
 - Bits per second: 9600
 - Data bits: 8
 - Parity: None
 - Stop bits: 1
 - Flow control: None
(This may have been set to Xon/Xoff – change it to None, Select [OK] and back out of this pathway.)

The route to view your Com Port settings is as follows:

- a. Select Control Panels
 - b. Double click on System
 - c. Select the Device Manager Tab
 - d. Double click on Ports
 - e. Double click on Communications Port(s)
 - f. Choose the Port Settings Tab
- 5) Try using a different computer, to see if this is the cause of the problem.
 - 6) If problem persists, contact Solinst.

'Port Cannot Open'

- 1) Ensure you have plugged the USB Connector Cable into the PC before starting Levelogger Software.
- 2) Ensure the correct Com Port is selected in the upper middle of the Main Window of the Levelogger Software.
- 3) Check if some other software is using the same Com Port in the background. Shut that software down or choose another Com Port if available. Such background software may be anti-virus software or PDA software.
- 4) Make sure your Com Port has been enabled:
 - a. Select Control Panel
 - b. Double click on System
 - c. Select the Device Manager Tab
 - d. Double click on Ports
 - e. Double click on Communications Port(s)
 - f. Choose General
 - g. Uncheck 'Disable in this hardware profile box'

'File Create Error' and 'File Write Error'

- 1) If you do not have file-writing privileges to the default data folder, change the folder as follows: in the Levelogger Software, click 'Configuration' then 'Application Settings'. Under 'Default Directory', enter a new destination folder, to which you have file writing privileges, e.g. 'My Documents'. Follow the same procedure if you have the same problem when you export the data file in csv format.
- 2) Ask your System Administrator for assistance.

'File Open Error' and 'File Read Error'

- 1) Shut down or disable any other software that is active and using the same file.
- 2) In Notepad or Wordpad, open the <*.xle> file to check for corruptions. How are the AquaVent files ended?
- 3) If problems persist contact Solinst for assistance.

‘A different type of Levellogger is detected’

Try clicking the Retrieve Settings icon again, or replace the AquaVent currently connected, with the one that was previously being worked on, and complete the operation.

‘Data Corrupted’

Contact Solinst for assistance. Use Levellogger Diagnostic Utility to do a memory dump and sent the dump file to Solinst for further analysis.

‘Internal Error’

Contact Solinst for assistance.

‘Fail to append data - A different Levellogger has been detected!’ or ‘Fail to append data - A different start time has been detected!’ or ‘Fail to append data - New data is not available in the Levellogger!’

The Levellogger Software can only append data to a file that has the same serial number and start time as the connected AquaVent. Find the correct file, or use ‘All Data’ to download the complete file.

‘Only Levellogger Gold/Edge supports this function’

The ‘Append Data’, ‘Partial Download’ and ‘Data Recovery’ functions are only supported by the Levellogger Gold/Edge/AquaVent.

‘Schedule cannot be empty’

When using the ‘Schedule’ sampling option in an AquaVent, the schedule must contain at least one item.

‘Readings in schedule exceed the maximum’

The number of readings in a schedule should not result in more than 40,000 individual readings.



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High Quality Groundwater and Surface Water Monitoring Instrumentation

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