Choosing a Water Level Logger

5 Things You Should Know

As the demand for water resources continues to grow in the United States and abroad, the ability to assess the impact of urban development and agriculture on water resources is more important than ever. To meet this growing demand, water resource managers, engineers and geologists have a greater need to monitor ground and surface water levels with water level data loggers in order to document baseline and changing water levels over time.

Water level loggers typically incorporate built-in micro processing, pressure sensors, and battery power in a rugged enclosure designed for long-term underwater deployment. They can be deployed and left unattended for months at a time, collecting water level data at user-defined intervals and storing it digitally into logger memory. By operating in a continuous 24/7 monitoring mode, water level loggers eliminate many of the hassles of manual data collection approaches and facilitate monitoring of multiple locations at the same time.

Water level loggers also automate the process of archiving and reporting data. Hydrologists can simply offload the logger data to an office or laptop PC and create detailed graphs or tables with the click of a mouse button. The charts can be easily printed for documentation purposes while the electronic data is automatically archived.

While water level loggers have become the data collection instrument of choice for an increasing number of hydrologists, the myriad of product choices available today can make it difficult to determine which product is right for your application.

Whether you have previous experience with water level logging, or are just getting started, this report can help you choose the right products for your needs. It points out the five most important things you should be aware of, and offers tips on specific features to look for.

1. Accuracy specs can be misleading

When evaluating water level accuracy, there are a number of things you need to be aware of with respect to specifications. Questions you'll want to ask the manufacturer include:

- Does the accuracy specification apply across the full-calibrated measurement range of the logger? The accuracy a water level logger can achieve at the high or low end of a given range may be far different from the accuracy at the middle of the range. For this reason, it's important to find out if the logger's accuracy specification refers to a single point or the entire measurement range. Knowing the full-range accuracy of a water level logger will give you assurance that the logger will meet your accuracy requirements.
- Do temperature variations cause additional error outside of the accuracy spec? Some water level loggers are not able to effectively compensate for temperature changes, which cause incorrect pressure readings. For this reason, it's important to find out if error that results from temperature changes is included in the accuracy specification, of if there is a separate error term that must be added. Data loggers with reduced overall mass will equilibrate more quickly to changing temperature conditions to increase dynamic response during changing conditions. The response time specifications will indicate how quickly the logger will equilibrate.
- Does the accuracy specified relate to only the logger's sensor, or to the entire logger? A water level logger's sensor and analog-to-digital (ADC) converter both contribute accuracy error. The error from the ADC can be just as significant as sensor error. For this reason, you'll want to confirm with the manufacturer that the specified accuracy refers to the entire instrument rather than just the sensor. To realize a 0.01 foot water level resolution requires at least a 12-bit ADC with a 30 psi water level sensor.
- Is drift important? The pressure sensors in water level loggers will drift over time. Whether or not you need to be concerned about drift depends on your application. Drift is important in cases when absolute pressure

values are needed, or if there are no recent reference level or depth measurements available. This may be the case if a water level logger is deployed for more than one year and no reference level readings are taken during that deployment. Otherwise, drift is not a significant factor since it will be offset by regular (i.e. monthly) manual reference level readings.

Regardless of whether drift will impact your data, it is a good idea to ask the logger manufacturer for their drift specifications.

In addition to these questions, be sure to ask the manufacturer if the logger's accuracy has been verified or measured against NIST-traceable standards. Some companies stand behind their accuracy specifications by providing a calibration certificate of accuracy with each logger.

2. Vented vs. non-vented loggers

There are two primary types of water level loggers – vented and non-vented.

Vented loggers incorporate a vent tube built into the cable that enables them to automatically compensate for atmospheric pressure changes. By equalizing these changes on both sides of the pressure sensor, a well-designed and maintained vented water level logger can provide high-accuracy water level data.

Non-vented loggers do not use vent tubes. Instead, these loggers can be barometrically compensated using a barometric pressure logger and a simple software function to perform the mathematics. Barometric pressure values can also be obtained from nearby weather stations within a 10-mile radius.

When comparing vented and non-vented loggers, be aware that while vented loggers have the potential to provide the greatest accuracy, they have a number of limitations that cause problems and result in bad data and/or data loss:

- Vented loggers are bulkier than non-vented loggers. This makes transporting them out to field sites more difficult – especially when several units need to be deployed. In many cases, the bulkiness of a vent cable can also become a problem when trying to fit the logger down a narrow well opening. The cable must be protected when extended over sharp casing edges, and the end must be stored in a watertight location while the logger is deployed.
- Most vented loggers require the use of desiccants for moisture protection. While desiccants can effectively keep moisture out of the logger, they typically need to be changed on a regular basis. This adds to the amount of logger maintenance required, which, in turn, increases the total cost of ownership of the logger.
- Vent tubes with contaminant-resistant material must be used if contaminants are present in the ground or surface water being monitored. This can add to the cost of a water level logger. Additionally, if a logger has been deployed in contaminated water, it must be decontaminated before it can be redeployed. This may take a considerable amount of time since vent tubes are typically 25 feet in length or longer.
- Vented loggers are not flexible when it comes to deploying them at various depths. Their cables cannot be lengthened without sending them back to the supplier, and cables typically cost several dollars per foot. Shortening the cable requires the user to delicately coil the cable without creating any kinks.
- Condensation can easily build up in vented loggers, which can lead to accuracy problems.
- If the end of the vented logger cable is inundated by rising water, all subsequent data are compromised due to unknown pressure compensation dynamics during the flood event. This is significant problem when monitoring water levels of streams and rivers during storm events.

These limitations highlight the advantages of a non-vented logger. Non-vented loggers are more compact, require minimal maintenance, can be easily deployed in wells of varying depths, and are not affected by flood water.

3. Software features that really matter

Just as water level loggers can vary considerably from model to model, so too can the graphing and analysis software applications that accompany them. From a general standpoint, it's a good idea to look for a logger with software that is Windows®-based and highly intuitive so the learning curve is as short as possible. The software should enable you to quickly and easily perform tasks such as configuring parameters, launching the logger, and offloading data, with point-and-click simplicity.

In terms of specific features, you'll want to make sure that the logger software supports the following:

- Barometric compensation – To convert a non-vented logger's pressure readings to barometrically corrected water level values, make sure the logger software has a barometric compensation utility. These tools typically allow you to enter reference level, water density and other values into a dialogue box, and then automatically perform the pressure-to-water level conversion.

- Multi-logger graphing – When monitoring water levels at multiple sites, it is often advantageous to be able to view and analyze data from each water level logger on a single graph. Be sure to ask the manufacturer about this capability.
- Easy data export – Because water level data often needs to be incorporated into other software programs such as spreadsheets or modeling programs, make sure the logger software allows you to quickly and easily export data with the click of a mouse. The software should also allow you to copy and paste graph images into other programs for generating reports.
- Project save and recall – While the ability to save and recall projects may seem like a basic feature of any logger software package, the reality is that many do not support this capability. Since a project typically involves a number of steps including merging multiple data files together, converting pressure readings to water level units, and formatting charts, you'll want to be sure that the logger's software will allow you to save your work so it can be easily recalled and added to in the future.

4. Buying vs. renting

In the past, the relatively high price of water level loggers has prevented many hydrologists from purchasing their own supply of loggers. Many have chosen to rent loggers instead. While renting can be a convenient option for short-term deployments, it is important to be aware that the price of water level loggers has recently come down to the point where purchasing is more cost-effective for many applications.

If you provide hydrology or groundwater services, owning your own inventory of water level loggers may give you a competitive edge since you'll be able to waive additional equipment rental fees for your customers.

5. Choose the right PC interface

When choosing a water level logger, you'll want to make sure that the logger's PC interface enables quick and easy hookup to a laptop or office computer. If you are using a PC equipped with USB ports (most computers manufactured today have them) then you'll want to choose a logger with a direct USB interface. Direct USB enables plug-and-play easy-of-use, which can be particularly useful when offloading data in the field. Direct USB also enables you to offload data in a matter of seconds compared to the minutes it takes via serial communications.

Loggers that rely on mechanical plug-in connectors can be damaged by water in the field and cause logger failures. Water level loggers with an optical interface that is completely sealed within the logger's housing eliminate the possibility of water-related damage and/or failures.

For more information about data loggers, please contact Onset Computer Corporation at www.onsetcomp.com or call 1-800-564-4377.

About Onset

Onset Computer Corporation has been producing small, inexpensive, battery-powered data loggers and embedded controllers since 1981, and has sold over one million loggers that are used around the world by over 50,000 customers. The company manufactures a broad range of data logger and weather station products that are used to measure temperature, humidity, light intensity, voltage, and a broad range of other parameters. Onset products are used widely in research, commercial, industrial, and educational applications.

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