

Region 4
U.S. Environmental Protection Agency
Laboratory Services and Applied Science Division
Athens, Georgia

Operating Procedure

Title: Groundwater Level and Well Depth Measurement

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Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when determining water levels and depths of wells.

Scope/Application

The procedures contained in this document are to be used by field investigators to measure water levels and depths of wells. On the occasion that LSASD field investigators determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used for water level or depth determination, the variant procedure(s) will be documented in the field logbook and the subsequent investigation report, along with a description of the circumstances requiring its use.

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1 General Information

1.1 Documentation/Verification

This procedure was prepared by persons deemed technically competent by LSASD management, following LSASDPROC-1003, Training and Competency, current version based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the LSASD Local Area Network. The Document Control Coordinator is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.2 General Precautions

1.2.1 Safety

Proper safety precautions must be observed when measuring water levels in wells and determining their depths. Refer to the LSASD Safety, Health and Environmental Management Program Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. At a minimum, protective gloves should be worn when working with contaminated well water. If possible, address chemicals that pose safety concerns and follow any other relevant requirements, as appropriate.

1.2.2 Procedural Precautions

The following precautions should be considered when measuring water levels and depths of wells:

- Special care must be taken to minimize the risk of cross-contamination between wells when conducting water level and depth measurements. This is accomplished primarily by decontaminating the sounders or other measuring devices between wells, according to LSASD Operating Procedure for Field Equipment Cleaning and Decontamination, (LSASDPROC-205) and maintaining the sounders in a clean environment while in transit between wells. If known, it is a general rule to measure wells in order of least contaminated to most contaminated.
- Water levels and well depths measured according to these procedures should be recorded in a logbook dedicated to the project as per LSASD Operating Procedure for Logbooks (LSASDPROC-1002). Serial numbers, property numbers or other unique identification for the water level indicator or sounder must also be recorded.

2 Quality Control Issues

There are several specific quality control issues pertinent to conducting water level and depth measurements at wells. These are:

- Devices used to measure groundwater levels should be verified annually against a National Institute of Standards and Technology (NIST) traceable measuring tape. These devices should check to within 0.01 foot per 10 feet of length with an allowable error of 0.03 foot in the first 30 feet. Before each use, these devices should be prepared according to the manufacturer's instructions (if appropriate) and checked for obvious damage. All verification and maintenance data should be documented electronically or recorded in a logbook maintained at the Field Equipment Center (FEC) as per the LSASD Operating Procedure for Equipment Inventory and Management (LSASDPROC-1009). The functional check and tape length verification should be performed according to the instructions included in SESDFORM-043, *Well Sounder Function Check and Verification*, which also includes the form for recording the required information.
- These devices should be decontaminated according to the procedures specified in LSASD Operating Procedure for Field Equipment Cleaning and Decontamination (LSASDPROC-205) prior to use at the next well. Specifically for well sounders or tapes, LSASDPROC-205 states that it is only necessary to decontaminate the wetted portion of the sounder or tape. Decontamination entails washing with Liquinox® detergent and tap water, rinse with tap water, then provide a final rinse with deionized water.

3 Water Level and Depth Measurement Procedures

3.1 General

The measurement of groundwater levels in wells are frequently conducted in conjunction with groundwater sampling to determine the phreatic water surface. This potentiometric surface measurement can be used to establish ground water direction and gradients. Groundwater level and well depth measurements are needed to determine the volume of water or drawdown in the well casing for proper purging.

Water levels should be allowed to equilibrate prior to measurement after removing sealing caps. There are no set guidelines and appropriate equilibration times can range from minutes to hours depending on well recharge, local geology and topography, and project objectives.

All groundwater level and well depth measurements should be made relative to an established reference point on the well casing and should be documented in the field records. This reference point is usually identified by the well installer using a permanent marker for PVC wells, or by notching the top of casing with a chisel for stainless steel wells. By convention, this marking is usually placed on the north side of the top of casing. If no mark is apparent, the person performing the measurements should take both water level and depth measurements from the north side of the top of casing and note this procedure in the field logbook.

To be useful for establishing groundwater gradient, the reference point should be tied in with the NAVD88 (North American Vertical Datum of 1988) or a local datum. For an isolated group of wells, it is acceptable to use an arbitrary datum common to all wells in that group.

3.2 Specific Groundwater Level Measurement Techniques

Measuring the depth to the phreatic ground water surface can be accomplished by the following methods. Method accuracies are noted for each of the specific methods described below.

- **Electronic Water Level Indicators** – These types of instruments consist of a spool of dual conductor wire, a probe attached to the end and an indicator. When the probe encounters the water, the circuit is closed and a meter light and/or audible buzzer attached to the spool will signal contact. Penlight or 9-volt batteries are normally used as a power source. Measurements should be made and recorded to the nearest 0.01 foot.
- **Other Methods** – There are other types of water level indicators and recorders available on the market, such as weighted steel tape, chalked tape, sliding float method, air line pressure method and automatic recording methods. These methods are primarily used for closed systems or permanent monitoring wells. Acoustic water level indicators are also available which measure water levels based on the measured return of an emitted acoustical impulse. Accuracies for these methods vary and should be evaluated before selection. Any method not capable of providing measurements to within 0.1 foot should not be used.

3.3 Special Considerations for Water Level Measurements at Sites with Shallow Groundwater Gradient

Groundwater gradients at some sites can be very shallow. If gradient and groundwater flow pattern (gradient direction) determination are part of the project objectives, it is critical that groundwater level measurements obtained from wells are as accurate as possible. Special care should be taken to allow

the water level to equilibrate after removing sealing caps and the same sounder should be used for all measurements, if possible. The sounding activity should be coordinated to allow all wells to be sounded within the minimum possible time. This is particularly important in areas with potential tidal influences.

3.4 Total Well Depth Measurement Techniques

The well sounder, weighted tape or electronic water level indicators can be used to determine the total well depth. This is accomplished by lowering the tape or cable until the weighted end is felt resting on the bottom of the well. Because of tape buoyancy and weight effects encountered in deep wells with long water columns, it may be difficult to determine when the tape end is touching the bottom of the well and sediment in the bottom of the well can also make it difficult to determine total depth. Care must be taken in these situations to ensure accurate measurements. The operator may find it easier to allow the weight to touch bottom and then detect the 'tug' on the tape while lifting the weight off the well bottom. All total depth measurements must be made and recorded to the nearest 0.1 foot. As a cautionary note, when measuring well depths with the electronic water level indicators, the person performing the measurement must measure and add the length of the probe beneath the circuit closing electrodes to the depth measured to obtain the true depth. This is necessary because the tape distance markings are referenced to the electrodes, rather than the end of the probe. For electronic sounders maintained at the LSASD FEC, the sounder reel will be marked with the appropriate additional length identified as the 'TD adder'.

3.5 Equipment Available

The following equipment is available for ground water level and total depth measurements:

- Weighted steel measuring tapes
- Electronic water level indicators

4 Establishment of Top of Casing Elevations

To establish groundwater surface elevations, the measured distance from the top of casing to the water surface is subtracted from the well top of casing (TOC) elevation. Obtaining accurate TOC elevations is crucial to developing an accurate groundwater surface elevation map and determination of groundwater flow direction.

The only acceptable means of surveying well TOC elevations is differential leveling conducted to third order standards. Third order differential leveling has allowable error defined by the following formula:

$$\text{Allowable Error (ft)} = 0.05 \times \sqrt{\text{Survey loop length (miles)}}$$

This work must be conducted with an auto level as the leveling instrument. Surveying TOC elevations with a total station or survey-grade GPS will not provide the requisite accuracy.

When adding wells to a monitoring network, it is permissible to tie the new well elevations to the known TOC elevations of existing wells in the network. The elevations of several wells in the existing network should be checked to assure that the relative differences in elevation match the recorded elevation data.

Generally, the ground surface elevations at each well should be surveyed at the same time.

5 References

LSASD Operating Procedure for Equipment Inventory and Management, LSASDPROC-1009, Most Recent Version

LSASD Operating Procedure for Field Equipment Cleaning and Decontamination, LSASDPROC-205, Most Recent Version

LSASD Operating Procedure for Logbooks, LSASDPROC-1002, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 LSASD, Athens, GA, Most Recent Version

6 Revision History

History	Effective Date
FSBPROC-105-R6, <i>Groundwater Level and Well Depth Measurement</i> , replaces LSASDPROC-105-R5 General: Corrected the formula found in section 4 and corrected the page numbers for the document. Other minor edits (e.g., reference updates) and formatting changes throughout.	April 21, 2025
LSASDPROC-105-R5, Replaced Chief with Supervisor	April 22, 2023
LSASDPROC-105-R4, <i>Groundwater Level and Well Depth Measurement</i> , replaces SESDPROC-105-R3 General: Corrected any typographical, grammatical, and/or editorial errors. Updated document template and naming convention. Changed references to SESD to LSASD and FSB to ASB due to organizational name changes from Agency re-alignment. Reformatted and updated naming convention.	May 15, 2020
SESDPROC-105-R3, <i>Groundwater Level and Well Depth Measurement</i> , replaces SESDPROC-105-R2 General: Corrected any typographical, grammatical, and/or editorial errors. Title Page: Author changed from Tim Simpson to Brian Striggow. Changed the Field Quality Manager from Bobby Lewis to Hunter Johnson. Updated cover page to represent LSASD reorganization. John Deatrick was not listed as the Chief of the Applied Services Branch Section 4: Added section on the Establishment of Well Top of Casing Elevations.	November 3, 2016
SESDPROC-105-R2, <i>Groundwater Level and Well Depth Measurement</i> , replaces SESDPROC-105-R1	January 29, 2013
SESDPROC-105-R1, <i>Groundwater Level and Well Depth Measurement</i> , replaces SESDPROC-105-R0	November 1, 2007
SESDPROC-105-R0, Groundwater Level and Well Depth Measurement, Original Issue	February 05, 2007