Options for Measuring Groundwater Extraction Volumes

BACKGROUND

The Sustainable Groundwater Management Act (SGMA) requires extractors in unmanaged areas or basins designated as probationary by the State Water Resources Control Board (State Water Board) to file groundwater extraction reports with the State Water Board. Extraction reports must include monthly extraction volumes for the preceding water year. SGMA requires that extraction volumes be measured by a device or method satisfactory to the State Water Board.[1]

This document provides options for measuring extraction volumes. The first section describes measurement methods. For details on reporting requirements, unmanaged areas, and probationary basins, visit the State Intervention webpage (https://www.waterboards.ca.gov/sgma/intervention.html).

OPTIONS FOR MEASURING EXTRACTION VOLUMES

The State Water Board has identified two approaches that have reasonable accuracy for measuring extraction volumes. Other possible approaches are discussed on the next pages.

1) **Totalizing flowmeter**. A totalizing flowmeter is permanently attached to the well and tracks the cumulative volume of water extracted from a well, similar to the odometer in a car. This is the most robust and automated method for measuring groundwater extractions. A flowmeter can be installed by individuals experienced in installation, calibration, and general functionality of totalizing flowmeters. A flowmeter must meet the requirements of California Code of Regulations, title 23, section 1042 in order to be used for reporting purposes. Please review the following requirements from the Board's SGMA reporting regulations:

   > To qualify as a "meter" used to measure groundwater extractions from the well for purposes of the State Water Board's SGMA reporting regulations, a measurement device must be installed, maintained, operated, inspected, and monitored to ensure accuracy; readily accessible for reading, inspection, testing, repair and replacement; and reasonably accessible and available for inspection by an authorized representative of the State Water Board upon request.

[1] Water Code section 5203, et. seq.

The meter must be equipped with a totalizer that:

1) Records the total volume of groundwater extracted from the well.

2) Measures volume in units of acre-feet, cubic feet, or gallons (as seen on the readout device).

3) Uses a sufficient number of digits or multipliers to prevent rollover or inaccurate readings.

4) Is incapable of moving backwards from its totalized value or otherwise deviating from its actual value without obvious and apparent signs of tampering.

Additionally, the meter must be permanently attached to the well discharge pipe between the point of extraction and the point of delivery with no intervening diversions or obstructions that interfere with flow accuracy and must be calibrated to an accuracy of within five (5) percent by volume. It is common for flowmeter sensors to deviate from their factory calibration (drift) upon installation or over time for a variety of reasons including sensor contamination, aging, and fouling. Drift is a phenomenon that is poorly understood and may happen at any time. Therefore, flowmeters must be calibrated by a qualified individual upon installation and at least once every five years thereafter, or more frequently if necessary to ensure accuracy is maintained. Proof of calibration must also be submitted from the time the totalizing flow meter is installed, and every five years thereafter.

2) **Run time method**. For wells without a totalizing flowmeter, extraction volumes may be estimated with the following equation:

   Extraction volume = Run time × Flow rate
   Run time is the amount of time the well pump is on.
   Flow rate is the amount of water produced by the well over a period of time, such as gallons per minute (GPM) or cubic feet per second (CFS).

The State Water Board has identified two ways to determine the ***run time*** of a pump:

- **Hour meter**. An hour meter (also known as a pump run time meter) is permanently attached to the pump motor and tracks the cumulative amount of time the pump is running, similar to a car's odometer.
- **Manual record**. For wells that are not equipped with an hour meter, the extractor can keep a written record of the time the pump switched on and off.

The State Water Board has identified three ways to determine the ***flow rate*** of a well:

- **Flowmeter**. A flowmeter can track the flow rate of a well, similar to a car's speedometer.
- **Pump efficiency test**. A pump efficiency test measures various aspects of a pump's operation, including flow rate. Pump tests may be available from pump dealers, public utilities, or independent companies. Often, a pump test is conducted when the pump is first installed.
- **Pump curve**. If a flowmeter is not installed and recent pump test data are not available, flow rate can be estimated with a pump curve from the manufacturer and the pump lift or suction lift (height that the respective pump can lift water to the surface of the well).

Because a well's flow rate can fluctuate due to changes in groundwater levels, throughout the water year, the State Water Board recommends that extractors measure flow rate on a monthly or seasonal basis and use the most representative flow rate value for each month when estimating monthly extraction volumes.

OTHER APPROACHES

There may be other approaches for measuring or estimating extraction volumes. If an extractor chooses to use a different approach, the device or method must be satisfactory to the State Water Board pursuant to Water Code section 5203, subdivision (e). The State Water Board will evaluate each approach on a case-by-case basis.

Extractors need to ensure their selected approach is measuring or estimating the actual volume of water extracted from the well. This includes water losses, such as deep percolation, offsite surface runoff, and conveyance leakage between the well and the place of use. Other factors that may arise to interfere with measuring actual volumes should be noted and addressed when reporting to the State Water Board, so compliance with reporting regulations can be evaluated. Extractors also need to consider the accuracy of the chosen approach, because approaches with low accuracy may not be acceptable. Other methods of measuring groundwater extraction that may be within the accuracy standards set forth by SGMA include the following:

1) Methods that combine the use of a singular well's power consumption, the well's respective pump curve, and computer-based algorithms to estimate extraction volumes may be permissible on a case-by-case basis. However, the Board does not identify power consumption alone as a method to estimate extraction volumes when used independently. This is because applying average pump efficiency and energy consumption values to individual pumps without considering factors that can affect pump efficiency typically produces inaccurate estimates of the volume of water extracted from the well.

2) The use of satellite-based or Actual Evapotranspiration (ETa) may be an appropriate approach for estimating groundwater extractions, and will be evaluated on a case-by-case basis. In general, Evapotranspiration (ET) is the sum of all processes by which water moves from the land surface to the atmosphere by both evaporation and transpiration. ETa is especially useful for estimating groundwater extractions for agriculture irrigated solely with groundwater. However, in regions where both groundwater and surface water are used, ETa models use known surface water availability and apportions the remaining water demand to groundwater pumping. The State Water Board has identified two methods to estimate groundwater extractions for reporting purposes:

- Self-estimate – Estimates of ETa for irrigated parcels are publicly available through OpenET.[2] The remotely sensed estimates of ETa can then be used to estimate groundwater pumping. If groundwater users decide to use ETa or crop water demand as a proxy to estimate groundwater extraction, water users will be required to submit the methodology, volume of surface water used for irrigation, precipitation amounts for the associated parcels, and, if applicable, the volume of groundwater pumped for export or other uses not captured by ETa (e.g., animal/human consumption, irrigation in greenhouses, processing and manufacturing facilities, and maintaining environmental flows). The allowable use of self-estimates of groundwater through OpenET will be determined on a case-by-case basis using specific considerations which include but are not limited to whether 1) groundwater is extracted for uses not captured by evapotranspiration, 2) sufficient details about crop irrigation and irrigation efficiency are provided, and 3) contributions of precipitation and other sources of consumptive use are known and accounted for.

- Explore 3rd party options – Some extractors already use 3rd party products for automated water use and ETa data. These include data subscription services that can be purchased and can provide automated water use and extraction data using remote sensing data (ETa, among others). Staff will evaluate these options and approaches on a case-by-case basis to ensure that the methods are reasonably accurate for estimating the volume of extracted groundwater.

[2] https://etdata.org/

It is the responsibility of the extractor to provide adequate explanation and documentation of the chosen approach in the groundwater extraction report and maintain adequate measurement records. Inadequate explanations, documentation, or records may not be accepted by the State Water Board.

CONTACT US

For more information or if you have questions, please contact the State Water Board's Groundwater Management Program.

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