Water and Resource Conservation Paul Gosselin, Director

308 Nelson Avenue
Oroville, California 95965

T: 530.538.4343
F: 530.538.3807

buttecounty.net/waterresourceconservation
bcwater@buttecounty.net

MEMORANDUM

DATE: April 17, 2020

TO: Butte Advisory Board, Butte Subbasin

FROM: Christina Buck, Assistant Director

RE: Recommendation Regarding Principal Aquifers in the Butte Subbasin

Background

The Groundwater Sustainability Plan (GSP) regulations require identification of "principal aquifer(s)" in each groundwater basin. Per GSP regulations, "Principal aquifers refer to aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems."

The Basin Setting project led by Davids Engineering and their team is developing certain GSP content for the three subbasins: Vina, Butte and Wyandotte Creek. In order to develop and produce GSP content, the principal aquifer(s) in each subbasin must be defined.

Defining and justifying one or more principal aquifers in each subbasin requires knowledge of the hydrogeology and groundwater conditions within the subbasin. The Sacramento Valley basin is not like parts of the southern Central Valley where the Corcoran Clay is a dominant feature clearly distinguishing an upper aquifer system from a lower aquifer system in some areas. For purposes of SGMA, in those subbasins, this could translate into defining two principal aquifers. Without such an obvious distinguishing geologic feature in the Sacramento Valley, the default may be to describe each subbasin as having one principal aquifer, unless there is evidence suggesting otherwise. Available sources of data used to identify more than one principal aquifer include hydrographs from multi-completion wells with continuous water level data, lithology descriptions from well logs, pump tests, and local knowledge of the hydrogeology.

Principal Aquifer Evaluation

Through an examination of hydrographs from multi-completion monitoring wells and discussion with the Butte County Water Commission's Technical Advisory Committee and Butte Subbasin GSA Managers, staff proposes defining two principal aquifers in the Butte Subbasin:

1. Primary Aquifer
2. Very Deep Aquifer

The following observations and tentative conclusions drawn from monitoring wells with continuous data in the Butte Subbasin support this recommendation:

- Generally, the shallow, intermediate and deep zones of the aquifer systems in the Butte Subbasin show similar patterns of variability in groundwater levels (within and between years).

- However, some zones appear to be more heavily affected by groundwater pumping than other zones (evidenced by greater variability in water levels during the irrigation season).

- A vertical gradient, indicating upward or downward groundwater flow, occurs when different pressures exist at different depths of the groundwater system. This can be observed in groundwater level monitoring data from multi-completion wells. A vertical gradient exists in most multi-completion wells in the Butte Subbasin as shown by hydrographs depicting different groundwater levels in different zones of the aquifer system. In some cases, the direction of the vertical gradient (upward or downward) changes seasonally or over time from year to year.

- Monitoring wells across the subbasin with screened intervals 700 feet below ground surface or deeper have shared characteristics and patterns in their observed water levels. This led to identification of the "Very Deep" zone.

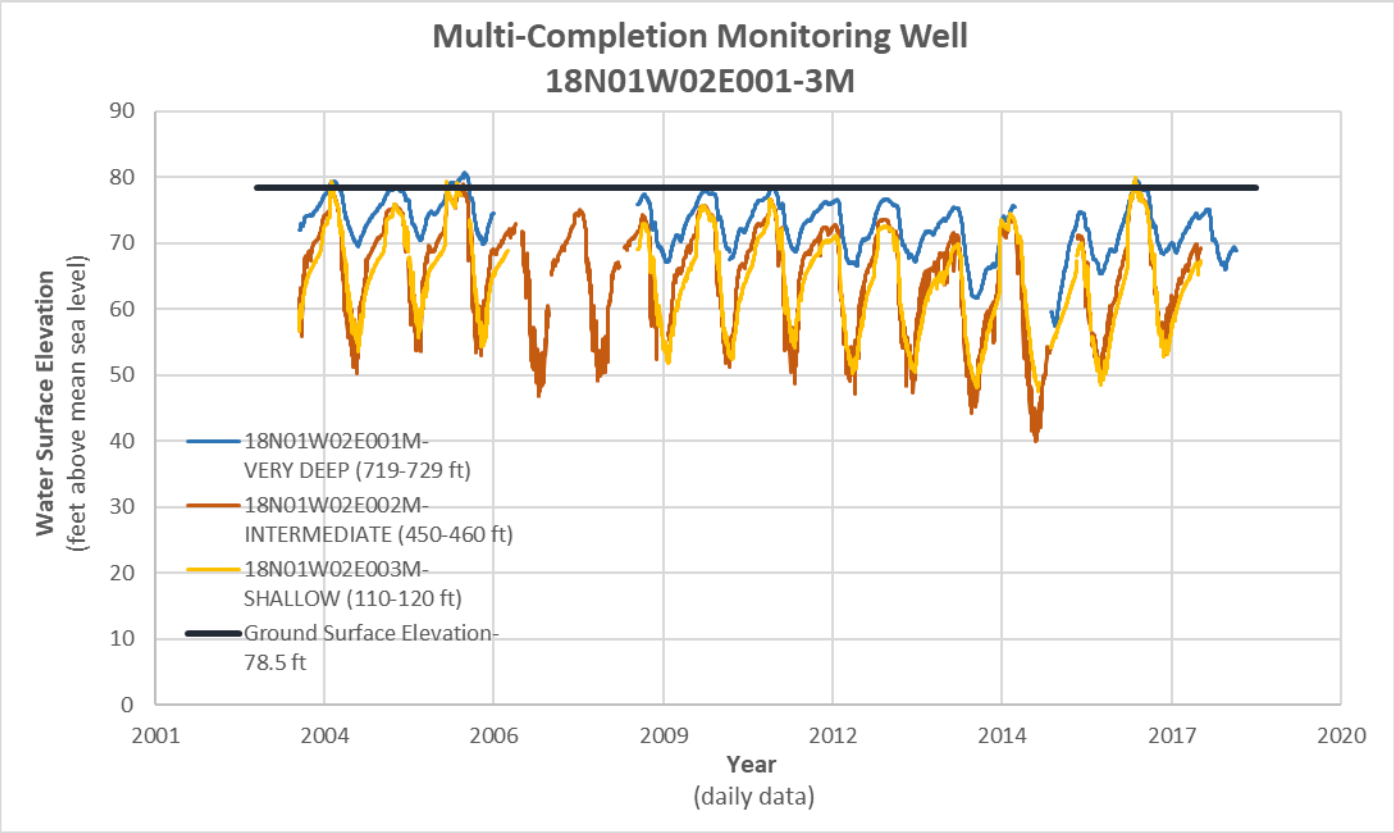
- Although the Very Deep zone shows similar patterns in the timing of groundwater level variability from year to year compared to shallower zones, groundwater levels also show some distinct characteristics. Groundwater levels change more gradually over time (hydrographs appear "smoother" with less extremes) and water levels are higher than in shallower zones. The latter indicates an upward vertical gradient from a pressurized aquifer system in the Very Deep zone.

- Vertical gradients suggest these different zones of the aquifer system are semi-confined and aquifer materials at various depths likely have different hydrogeologic properties. In addition, pumping activity concentrated in different zones likely also contributes to the differences in groundwater levels and gradients between zones.

- Lithology descriptions from a number of the monitoring wells show thick intervals of clay or fine grained material (50-200 feet thick) separating screened intervals in multi-completion wells.

- Despite these thick fine grained layers, trends and patterns in water levels within and between years show a connection between the shallow and deepest zones of the aquifer system.

Groundwater levels shown in the hydrograph of multi-completion monitoring well 18N01W02E001-003 located near Butte City reflect many of the observations outlined above.



Relevant Excerpts from GSP Regulations

Defining a primary aquifer and very deep aquifer in the Butte Subbasin has implications for how a number of specific sections of the GSP are developed, mostly in the Basin Setting sections.

The following excerpts from the GSP regulations highlight the components of the plan that rely on defining principal aquifer(s) in the subbasin:

1. Data and Reporting Standards. Wells used to monitor groundwater conditions shall identify the principal aquifers monitored.

2. The Hydrogeologic Conceptual Model (HCM) shall be summarized in a written description that includes...
   (4) Principal aquifers and aquitards, including the following information:
      (A) Formation names, if defined.
      (B) Physical properties of aquifers and aquitards, including the vertical and lateral extent, hydraulic conductivity, and storativity, which may be based on existing technical studies or other best available information.
      (C) Structural properties of the basin that restrict groundwater flow within the principal aquifers, including information regarding stratigraphic changes, truncation of units, or other features.
      (D) General water quality of the principal aquifers, which may be based on information derived from existing technical studies or regulatory programs.
      (E) Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply.

3. Groundwater Conditions. GSP shall provide a description of current and historical groundwater conditions in the basin…that includes the following:
   (a) Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including:
      (1) Groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin.
      (2) Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.

4. Monitoring Network. Each monitoring network shall be designed to accomplish the following for each sustainability indicator:
   (1) Chronic Lowering of Groundwater Levels. Demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features by the following methods:
      (A) A sufficient density of monitoring wells to collect representative measurements through depth-discrete perforated intervals to characterize the groundwater table or potentiometric surface for each principal aquifer.
   (4) Degraded Water Quality. Collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues.

5. Annual Reports. Shall include:
   (1) Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows:

(A) Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions.

(5) Change in groundwater in storage shall include the following:

(A) Change in groundwater in storage maps for each principal aquifer in the basin.

Recommendation

Staff proposes defining two principal aquifers in the Butte Subbasin:

3. Primary Aquifer
4. Very Deep Aquifer (generally observed by monitoring wells with screened intervals greater than 700 feet deep)

Recognizing and monitoring conditions in the deeper, pressurized aquifer system over time may be important for effective management of the Primary Aquifer since the shallow and deep zones, although distinguishable, appear to be hydraulically connected.

Definition of the Very Deep Aquifer will be further refined through additional evaluation of multi-completion well logs. This includes a more specific description of its depth and extent. This documentation will be included in the Basin Setting section of the GSP.

Please contact Christina Buck with questions or comments.