# TECHNICAL MEMORANDUM

FORMATION ENVIRONMENTAL

# APPROACH FOR DETERMINING WHETHER A PROPOSED NEW WELL QUALIFIES AS A REPLACEMENT WELL

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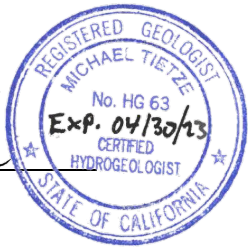


## 1. INTRODUCTION

In 2014, the State of California adopted the Sustainable Groundwater Management Act (SGMA). The legislation required the formation of local Groundwater Sustainability Agencies (GSAs). These GSAs were mandated to develop and implement long-term Groundwater Sustainability Plans (GSPs) for managing and using groundwater. In late 2014, Stanislaus County adopted a Groundwater Ordinance (Chapter 9.37 of the County Code), that was the first in the State to require that applicants for permits to install new wells provide evidence that their wells will extract groundwater consistent with the sustainability criteria included in SGMA. In March 2022, Governor Gavin Newsom issued Executive Order N-7-22, which requires that prior to issuing permits for new wells, the County must first determine they are consistent with the GSP that has been adopted for the groundwater subbasin in which the well is located. The agency that is authorized to make this consistency determination is the local GSA.

Replacement wells are exempt from the County Groundwater Ordinance and are typically found to be consistent with the adopted GSPs in the County. That is because replacement of an existing well, by definition, does not introduce any new groundwater demand on the aquifer system. A "like-for-like" replacement of a well would be consistent with the historical well usage and groundwater extraction, and the resulting drawdown and other well effects would not change, and would be generally reflected in the prevailing hydrologic baseline conditions used in the water budgets prepared for the GSP. Any newly proposed well that does introduce a new groundwater demand would require more detailed analysis to make a finding of consistency with the GSP, or a finding of sustainable groundwater management under the Groundwater Ordinance. This memorandum outlines criteria that can be used to determine whether a proposed new well qualifies as a replacement well that meets these requirements.

# 2. BACKGROUND

New wells that are replacement wells are exempt from the requirements of the County Groundwater Ordinance and are generally presumed to be consistent with GSPs that have been adopted by the GSAs in the County. In order to be considered a replacement well, a well must withdraw groundwater from the same aquifer in which the original well that is being replaced was completed. That means the well must have a similar completion depth and screen interval as indicated in Section 3.1, below.

A complication to this finding occurs because the Stanislaus County Well Siting and Construction Guidelines (Formation 2022b) establishes Special Management Area 1 (SMA 1), which is underlain by a two-aquifer-system where an Upper and a Lower Zone are separated by the Corcoran Clay (JJ&A 2018), and SMA 2, which consists of alluvial fan deposits that also include an Upper Zone and a Lower Zone. In these areas, many existing production supply wells were historically constructed as composite wells that are screened in the Upper and Lower Zones in a single well for the purpose of maximizing their production yield. These types of wells would be prohibited to be constructed or replaced as a like-for-like replacement well under the Stanislaus County Well Siting and Construction Guidelines. Specifically, the County updated the procedures and siting criteria pertaining to its well construction permitting program (Formation 2022b). These guidelines include the following prohibition pertaining to wells located in SMA1:

> "All wells located within the area underlain by the Corcoran Clay and penetrating the Corcoran Clay shall be constructed in a manner that prevents the intermixing of water above and below the Corcoran clay layer. **There shall be no perforations above and below the Corcoran clay layer in the same casing of any well. There shall be no gravel pack installed above and below the Corcoran clay layer in the same borehole.** The annular well seal of all wells with screen intervals and gravel packs below the Corcoran Clay shall extend to the bottom of the Corcoran Clay, as verified by lithologic or geophysical logging during drilling of the well".

Furthermore, the guidelines include the following prohibition pertaining to wells located in SMA2:

> "All wells located within SMA2 shall be constructed in a manner that prevents the intermixing of water between the Upper Zone and underlying aquifers. **There shall be no perforations within the Upper Zone and the aquifer system underlying the Upper Zone in the same casing of any well**. There shall be no gravel pack installed within and below the Upper Zone in the same borehole.

Thus, the like-for-like replacement of an existing well with composite construction (dual aquifer) would be prohibited; however, it may be found that the replacement of an existing composite constructed well could be found to be consistent with the GSP and the Groundwater Ordinance if the replacement well were completed in a single zone of the aquifer and did not introduce any new groundwater demand to that zone of the aquifer system. The question to be resolved is how to apportion the pumping from the composite well into the individual zones of the aquifer system.

This memorandum outlines the approach to determining whether a proposed well qualifies as a replacement well that would be exempt from the County Groundwater Ordinance and consistent with the GSPs adopted within the County. In instances where composite wells in SMA1 and SMA2 are to be replaced, this memorandum outlines a procedure to follow that assigns the percentage of well volume pumped from each zone such that a replacement well, completed in either the Upper Aquifer Zone or the Lower Aquifer Zone (or separate wells in both), can have a withdrawal limit assigned to it that does not introduce any increase in groundwater withdrawals, and the replacement well(s) is generally located in the near vicinity of the existing well it is replacing.

# 3. METHODOLOGY AND EVALUATION

## 3.1. GENERAL REPLACEMENT WELL CRITERIA IN SMA1, SMA2 AND SMA3

Important considerations in evaluating whether a proposed replacement well functions in a hydraulically similar fashion as the well it is replacing include the location of the well, the well completion depth and screen interval, and the groundwater extraction rate. All three of these must be similar, within certain parameters, in order for a well to function as a replacement well. Specific considerations include:

- **Well Location.** In order for a well to function as a replacement well, it must be located in close proximity to the well it is replacing or the distribution of drawdown relative to existing wells or other potentially sensitive receptors may change. It has generally been the County's practice to require that a replacement well be located in the near vicinity of the existing well it is replacing and located on the same parcel or an adjacent contiguous parcel under the same ownership.

- **Well Completion Depth and Screen Interval.** Similar well completion depths and screen intervals will help to ensure that a replacement well interacts with the aquifer system in a similar fashion as the well it is replacing and does not introduce changes in drawdown that result in different impacts. Well construction information for an existing well may be obtained from a Well Completion Report (DWR Form 188) filed for the well, or alternatively from a downhole video log of the well.

- **Groundwater Extraction Rate.** In order to have a similar effect on the aquifer system and be considered as a replacement well, the groundwater extraction rate from the replacement well must not exceed the extraction rate from original well. To verify this, the County currently requires an applicant to provide information regarding the groundwater demand that is to be met by the well and the demand that was historically met by the well it is replacing. Summary irrigation water demand and other forms are being used to document historical and proposed groundwater uses. If the demand is the same or less, or if other information provided by the applicant indicates that the long-term average annual groundwater extraction from the replacement well will not be greater than the well that is being replaced, the proposed well may be considered a replacement well. In order for a new well to qualify as a replacement well, the applicant will be required to attest in writing that the replacement well will not be used in any manner that increases the historical groundwater demand from any portion of the aquifer system.

We note that an applicant could request to operate a well at a higher extraction rate, but it would not qualify as replacement well and therefore may be subject to the County Groundwater Ordinance, and may not be consistent with the applicable GSP. Additional evaluation would be required to evaluate whether that is the case.

## 3.2. REPLACEMENT OF COMPOSITE WELLS IN SMA1 AND SMA2

Notwithstanding the general requirements for a replacement well to be (1) located in the near vicinity of the existing well it is replacing, (2) completed in a similar fashion as the existing well it is replacing and (3) extracting no more groundwater than the well it is replacing, there are also additional concerns pertaining to these requirements in regards to the replacement of composite wells as discussed in Section 2. The sections below outline an approach to determine the maximum groundwater withdrawal rates of a single well completed in either (or both) the Upper and Lower Zones in SMA1 or SMA2 that can be considered a replacement well (or replacement wells) for an existing composite well. The approach is intended to assure that groundwater extraction from a replacement well completed in either the Upper or Lower Aquifer Zone (or separate wells in both), extracts no more groundwater from each zone than the composite well being replaced.

To support this approach, hydraulic conductivity (K) values were determined for the Upper and Lower Zones of the aquifer systems by using K values derived from the Central Valley Groundwater-Surface Water Simulation Model (C2VSim) model developed by the California Department of Water Resources (DWR 2021) for this area of Stanislaus County. The 25$^{th}$ percentile K value was calculated for each aquifer area for Layers 1 and 2 of the model to represent the Upper and Lower Zones, respectively (Formation 2022a). Use of the 25$^{th}$ percentile K value provides a conservatively low value of hydraulic conductivity suitable for screening use throughout the County and is consistent with the same values that were used in developing the approach used for determining minimum setback distances in compliance with Section 9b of Executive Order N-7-22 (Formation 2022a).

### *3.2.1. PROCEDURE*

A step-by-step outline of the method to be used is presented below. This procedure may be implemented by the County, or, at the applicant's discretion, by a Qualified Professional (QP), defined in the County's well permitting guidelines as a licensed Professional Engineer or Professional Geologist experienced with hydrogeology and wells (Formation 2022b).

1. Obtain a copy of the Well Completion Report (WCR) for the existing well that is being replaced. If a WCR is not available, a video log that identifies the well completion casing and screen intervals may be used.

2. Determine the screened interval length for each segment of the well completed in the Upper Zone (UZ) and the Lower Zone (LZ) from the construction specifications identified in the WCR. The screened interval(s) in each zone are used to represent the aquifer saturated thickness (b) from which the well withdraws groundwater.

3. For the purposes outlined in this memorandum, the following K values from Formation 2022a are used:

| Aquifer Zone | SMA1 | SMA2 (Western) | SMA2 (Eastern) |
|---|---|---|---|
| Upper Zone | 75 ft/day | 66 ft/day | 30 ft/day |
| Lower Zone | 20 ft/day | 11 ft/day | 9 ft/day |

   At the applicant's discretion, site specific K may be provided. Such information, if used, would be provided by a QP.

4. The transmissivity (T) for each interval is determined by multiplying the screened aquifer saturated thickness (b) times the appropriate K value for that interval:

$$\mathbf{T_{UZ} = K_{UZ} \times b_{UZ}}$$

$$\mathbf{T_{LZ} = K_{LZ} \times b_{LZ}}$$

5. Determine the historical long-term annual pumping extraction ($Q_T$) for the well that is proposed to be replaced as indicated above.

6. The maximum pumping rate from the Upper Zone ($\mathbf{Q_{UZ}}$) for a well to be considered a replacement well can be calculated as follows:

$$\mathbf{Q_{UZ} = [T_{UZ}/(T_{UZ} + T_{LZ})] \times Q_T}$$

7. The maximum pumping rate from the Lower Zone ($\mathbf{Q_{LZ}}$) for w well to be considered a replacement well can be calculated as follows:

$$\mathbf{Q_{LZ} = [T_{LZ}/(T_{UZ} + T_{LZ})] \times Q_T}$$

### *3.2.2. EXAMPLES*

The following examples are used to demonstrate the methodology for apportioning the amount of water extracted by a composite-screened production well.

***Example 1: 50%/50% (Upper Zone/Lower Zone) Apportionment in SMA1***

A well completion report is provided for an existing composite well that is proposed to be replaced that shows the following construction:

Screened Interval for Upper Zone ($b_{UZ}$) = 80 feet

Transmissivity for the Upper Zone ($T_{UZ}$) = 80 feet x 75 ft/day = 6,000 $ft^2$/day

Screened Interval for Lower Zone ($b_{LZ}$) = 300 feet

Transmissivity for the Lower Zone ($T_{LZ}$) = 300 feet x 20 ft/day = 6,000 $ft^2$/day

Historical Annual Groundwater Pumping ($Q_T$) = 600 acre feet

$Q_{UZ} = [T_{UZ}/(T_{UZ}+ T_{LZ}) * Q_T] =[ 6,000/(6,000 + 6000)] * 600$ AFY = 300 AFY (50%)

$Q_{LZ}= [T_{LZ}/(T_{UZ}+ T_{LZ}) * Q_T] =[ 6,000/(6,000 + 6,000)] * 600$ AFY = 300 AFY (50%)

**Conclusion**: A replacement well could be completed in the Upper Zone with an annual withdrawal limit of 300 AF, a replacement well could be completed in the Lower Zone with an annual withdrawal limit of 300 AF or, two wells could be drilled; one in the Upper Zone with an annual limit of 300 AF and another in the Lower Zone with an annual limit of 300 AF.

***Example 2: 83%/17% (Upper Zone/Lower Zone) Apportionment in SMA2 (Western)***

A well completion report is provided for an existing composite well that is proposed to be replaced that shows the following construction:

Screened Interval for Upper Zone ($b_{UZ}$) = 120 feet

Transmissivity for the Upper Zone ($T_{UZ}$) = 120 feet x 66 ft/day = 7,920 $ft^2$/day

Screened Interval for Lower Zone ($b_{LZ}$) = 150 feet

Transmissivity for the Lower Zone ($T_{LZ}$) = 150 feet x 11 ft/day = 1,650 $ft^2$/day

Historical Annual Groundwater Pumping ($Q_T$) = 360 acre feet

$Q_{UZ} = [T_{UZ}/(T_{UZ}+ T_{LZ}) * Q_T] =[ 7,920/(7,920 + 1,650)] * 360$ AFY = 298 AFY (83%)

$Q_{LZ} = [T_{LZ}/(T_{UZ}+ T_{LZ}) * Q_T] =[ 1,650/(7,920 + 1,650)] * 360$ AFY = 62 AFY (17%)

**Conclusion**: A replacement well could be completed in the Upper Zone with an annual withdrawal limit of 298 AF or, a replacement well could be completed in the Lower Zone with an annual withdrawal limit of 62 AF or, two wells could be drilled; one in the Upper Zone with an annual limit of 298 AF and another in the Lower Zone with an annual limit of 62 AF.

***Example 3: 23%/77% (Upper Zone/Lower Zone) Apportionment in SMA2 (Eastern)***

A well completion report is provided for an existing well that is proposed to be replaced that shows the following construction:

Screened Interval for Upper Zone ($b_{UZ}$) = 20 feet

Transmissivity for the Upper Zone ($T_{UZ}$) = 20 feet x 30 ft/day = 600 $ft^2$/day

Screened Interval for Lower Zone ($b_{LZ}$) = 225 feet

Transmissivity for the Lower Zone ($T_{LZ}$) = 225 feet x 9 ft/day = 2,025 $ft^2$/day

Historical Annual Groundwater Pumping ($Q_T$) = 160 acre feet

$Q_{UZ} = [T_{UZ}/(T_{UZ}+ T_{LZ}) * Q_T] =[ 600/(600 + 2,025)] * 160$ AFY = 36.5 AFY (23%)

$Q_{LZ} = [T_{LZ}/(T_{UZ}+ T_{LZ}) * Q_T] =[ 2,025/(600 + 2,025] * 160$ AFY = 123 AFY (77%)

**Conclusion**: A replacement well could be completed in the Upper Zone with an annual withdrawal limit of 36.5 AF or, a replacement well could be completed in the Lower Zone with an annual withdrawal limit of 123 AF or, two wells could be drilled; one in the Upper Zone with an annual limit of 36.5 AF and another in the Lower Zone with an annual limit of 123 AF.

# 4. REFERENCES

California Department of Water Resources (DWR), 2021. C2VSimFG version 1.0. Released April 27.

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