4. MONITORING NETWORKS

4.1 Monitoring Network Objectives

The objective of the existing monitoring networks is to observe and record data on groundwater levels, quality, and related conditions, such as the interconnection of surface water and groundwater and subsidence. Wells included in the existing monitoring networks were selected based on spatial density, quality and frequency of historically collected data to detect short-term, seasonal, and long-term trends and evaluate conditions related to the effectiveness of the GSP. Parameters that have been monitored provide historic baseline information for establishing the current status of relevant SI that will be useful in tracking these SI as the GSP is being implemented. The complete list of SI is presented below:

1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued
2. Significant and unreasonable reduction of groundwater storage
3. Significant and unreasonable seawater intrusion
4. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies
5. Significant and unreasonable land subsidence that substantially interferes with surface land uses
6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

The existing monitoring networks form a pool of monitoring locations that will serve as the backbone of the representative monitoring network used to assess SGMA compliance as discussed in Section 3. The existing network will support improved understanding of conditions in the Wyandotte Creek Subbasin, inform ongoing management of the subbasin, and contribute to future updates to the GSP. These objectives will be implemented in a manner that will:

- Demonstrate progress toward achieving MO, MT, and IM
- Monitor impacts to the beneficial uses or users of groundwater
- Monitor changes in groundwater conditions
- Quantify annual changes in water budget components

Data collected from the monitoring network will be used to track changes in groundwater elevations, water quality constituent concentrations, groundwater and surface water interactions and rates of subsidence at monitoring locations throughout the Wyandotte Creek Subbasin. At locations where MO differ substantially from current conditions, the monitoring data from the RMS (Section 4.9) will be used to determine whether local projects and management actions are meeting IM presented in the GSP as indicators of progress toward attainment of MO. MOs will be monitored directly through measurement of groundwater levels and water quality constituents.

Groundwater elevations will be used as a proxy for evaluating reduction in groundwater storage, depletions of interconnected surface waters, and for land subsidence where either of these potential undesirable results is associated with declining groundwater elevations. In each of these instances, "significant and unreasonable" reductions are the guideposts used to warn of unsustainable groundwater conditions. For interconnected surface waters, the GSA in the Wyandotte Creek Subbasin intends to further evaluate this SMC to avoid undesirable results to aquatic ecosystems and GDEs. To that end, an Interconnected Surface Water SMC framework has been developed for the GSP, as described in Section 3.8. This framework will guide future data collection efforts to fill data gaps, either as part of GSP projects and management actions or as plan implementation. As additional data are collected and evaluated, the Wyandotte Creek Subbasin commits to developing additional SMC, as appropriate, for specific stream reaches and associated habitat where there is a clear connection to groundwater pumping in the principal aquifer.

In addition to being central to SGMA compliance by enabling tracking of SI, data collected through the monitoring network will be used to update inputs to the water budget and to guide interpretation of water budget results. Monitoring data will also be used to assess impacts of groundwater management on various categories of beneficial uses and users and to monitor overall groundwater conditions from local and subbasin-wide perspectives.

The monitoring networks for groundwater levels, water quality, land subsidence, and depletions of interconnected surface water are described below. The BBGM and / or groundwater level data will be used to estimate changes in groundwater storage based on observed changes in groundwater levels.

Seawater intrusion is not considered to be an SI relevant to the Wyandotte Creek Subbasin as seawater intrusion is not present and is not likely to occur in the Wyandotte Creek Subbasin due to the distance from the Pacific Ocean, bays, deltas, or inlets. However, there is some evidence that connate groundwater of a quality characteristic of its ancient marine origins is present in the Wyandotte Creek Subbasin and that this water has the potential to affect beneficial uses due to brackish characteristics. Ancient marine layers pose a water quality (saline) risk by contaminating groundwater from groundwater pumping. This GSP will address this risk through the water quality SI.

The location of existing sites and the frequency of monitoring at each site are presented below as is the spatial density of locations in each of the monitoring networks. Data gaps and plans to fill these gaps are also discussed as part of the program for defining the representative monitoring network to be used in monitoring SI to ensure SGMA compliance. Explanations of how gaps identified in the monitoring network will be filled are provided in Section 4.10.

The goal of defining the existing monitoring network, identifying gaps in the network, and developing and implementing a program to fill those gaps is to develop a representative monitoring network capable of collecting information needed to address:

- Short-term trends in groundwater and related surface water conditions
- Seasonal trends in groundwater and related surface water conditions

- Long-term trends in groundwater and related surface water conditions
- Provide adequate coverage by establishing sufficient density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends listed above

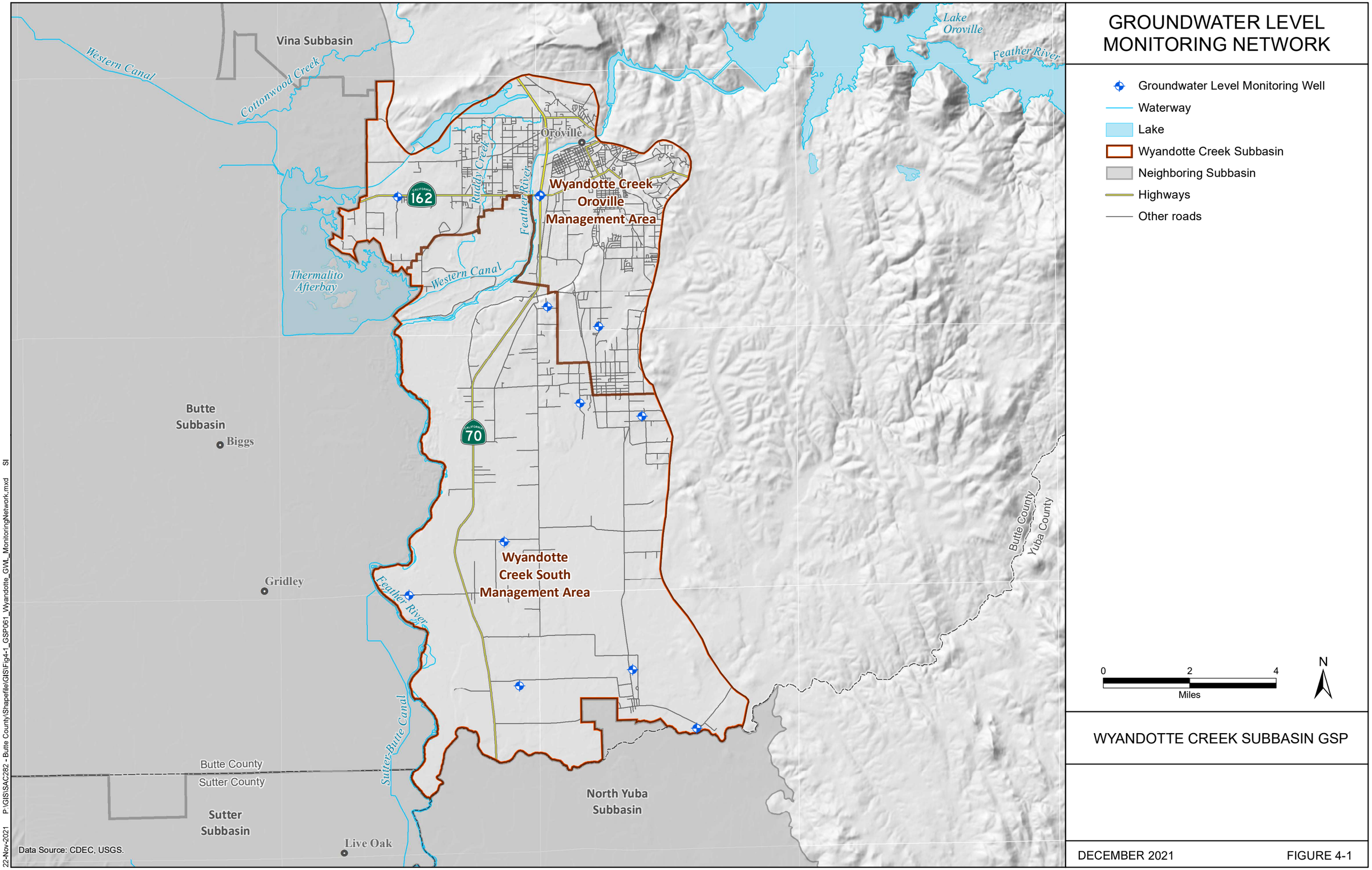
4.2 Groundwater Level Monitoring

Groundwater level monitoring in the Wyandotte Creek Subbasin is conducted through a network of monitoring wells used for observation of groundwater levels and computation of hydraulic gradients and flow directions in the principal aquifer. The network also allows for characterization of the groundwater table or potentiometric surface of the principal aquifer.

The 13 wells included in the network were selected based on the degree to which data from these wells represents conditions in the area, use in existing monitoring programs, permission of the well owner to access the well, and the length and continuity of the monitoring record. Of the 13 wells, 5 are located in the Wyandotte Creek - Oroville MA, and 8 in the Wyandotte Creek - South MA. Table 4-1 lists wells now used for monitoring in each MA and Figure 4-1 shows the locations of these wells (except for municipal wells) in their respective MAs. Multi-completion wells are sites where more than one monitoring well has been installed at a single location. The wells are drilled and screened at different depths with each well designed to measure groundwater elevations at a selected zone in the underlying aquifer. A multi-completion well was recently installed as shown in Figure 4-6 by DWR under the TSS program and will be used for both groundwater level and water quality assessments (Section 4.9.2). No other multi-completion wells are located within the Wyandotte Creek Subbasin.

Table 4-1: Wyandotte Creek Subbasin Groundwater Level Broad Monitoring Network Well Locations

Well ID	Monitoring Frequency	Multi-Completion (number of wells at site)	Well Type
Wyandotte Creek – Oroville Management Area			
19N03E1600Q	Quarterly	No	Residential
19N04E3200P	Quarterly	No	Residential
CWS-01	Quarterly	No	Municipal
CWS-02	Quarterly	No	Municipal
CWS-03	Quarterly	No	Municipal
Wyandotte Creek – South Management Area			
17N03E0300D	Quarterly	No	Irrigation
17N03E1300B	Quarterly	No	Irrigation
17N04E0900N	Quarterly	No	Irrigation
17N04E2200B	Quarterly	No	Residential
18N03E2500N	Quarterly	No	Irrigation
18N04E0800M	Quarterly	No	Irrigation
18N04E1600C	Quarterly	No	Irrigation
19N04E31F	Quarterly	No	Residential


GROUNDWATER LEVEL MONITORING NETWORK
Groundwater Level Monitoring Well
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
Vina Subbasin
Western Canal
Cottonwood Creek
Lake Oroville
Feather River
Oroville
Reddy Creek
Feather River
Wyandotte Creek Oroville Management Area
162
Thermalito Afterbay
Western Canal
Butte Subbasin
Biggs
70
Wyandotte Creek South Management Area
Gridley
Feather River
Sutter-Butte Canal
Butte County
Yuba County
Butte County
Sutter County
Sutter Subbasin
North Yuba Subbasin
Live Oak
Data Source: CDEC, USGS.
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 4-1
22-Nov-2021 P:\GIS\SAC282 - Butte County\Shapefile\GIS\Fig4-1_GSP061_Wyandotte_GWL_MonitoringNetwork.mxd SI

4.2.1 Density of Monitoring Sites and Frequency of Measurement

Each of the wells in the existing network is monitored either by Cal Water, Butte County, DWR, or the associated CASGEM collaborators in the subbasin. Each of the wells are reported quarterly.

For the purpose of SGMA compliance, water levels in the RMS (Section 4.9) in the Wyandotte Creek Subbasin will be monitored at least biannually by the County or DWR within 14 days of one another.

Groundwater pumping typically peaks during the summer growing season and slows in the fall and winter. Therefore, spring levels represent an annual high prior to summer irrigation demands while fall levels represent an annual low for static (non-pumping) conditions. For wells that cannot be observed on the regular monitoring schedule or for which readings are questionable, it will be noted in the standard data sheet that the well was unable to be measured.

Groundwater elevation data will be used to observe seasonal and annual changes and for analysis of short-term and long-term trends. Analysis of trends in groundwater levels together with data on surface water deliveries and groundwater extraction will be important tools for tracking the Wyandotte Creek Subbasin's progress in meeting its MO and in determining the need for additional projects and management actions or modifications to projects and management actions to meet the MO.

A total of 13 wells are included in the network for monitoring groundwater levels. These wells are distributed over the 93 square- mile area of the Wyandotte Creek Subbasin with a distribution equivalent to a spatial density of 14 wells per 100 square miles, a network density that significantly exceeds those presented in the BMP Monitoring Networks and Identification of Data Gaps. Table 4-2 is taken from the BMP and shows a range of recommended monitoring network densities.

Table 4-2: Monitoring Well Density Considerations

Reference	Well Density (wells per 100 miles)
Heath (1976)	0.2 – 10
Sophocleous (1983)	6.3
Basins pumping more than 10,000 acre-feet/year per 100 miles	4.0
Basins pumping between 1,000 and 10,000 acre-feet/year per 100 miles	2.0
Basins pumping between 250 and 1,000 acre-feet/year per 100 miles	1.0
Basins pumping between 100 and 250 acre-feet/year per 100 miles	0.7

Annual groundwater pumping presented in the water balance section of the GSP shows a historical rate of pumping in the Wyandotte Creek Subbasin of 47,100 AFY (50,645 AFY per 100 square miles) and a current condition pumping rate of 43,000 AFY (46,237AFY per 100 square miles).

Each monitoring site is located in one of the Wyandotte Creek Subbasin's two MAs:

- Wyandotte Creek – Oroville: 5 wells in an area of 29 square miles, spatial density of 17 wells per 100 square miles.
- Wyandotte Creek – South: 8 wells in an area of 64 square miles, spatial density of 12.5 wells per 100 square miles.

4.3 Groundwater Storage Monitoring

4.3.1 Background

The BMP for Groundwater Monitoring (DWR, 2016) notes:

> *While change in groundwater storage is not directly measurable, change in storage can be estimated based on measured changes in groundwater levels… and a clear understanding of the Hydrogeologic Conceptual Model…. The HCM describes discrete aquifer units and the specific yield values associated with these units. These data, together with information on aquifer thickness and connectivity, can be used to calculate changes in the volume of groundwater storage associated with observed changes in groundwater elevation.*

As suggested in the preceding passage from DWR's BMP on Groundwater Monitoring, measured changes in groundwater levels can serve as a proxy for changes in storage. For this reason, the network for monitoring changes in groundwater storage is the same as that used for monitoring changes in groundwater levels. Monitoring sites and wells included in this network are presented above in Table 4-1 with well locations shown in Figure 4-1.

4.3.2 Frequency of Measurement

The data from the bi-annual frequency of monitoring groundwater levels described above will enable observed changes in levels to serve as a proxy to indicate changes in groundwater storage. Data presented in the HCM on parameters such as aquifer layer composition and thickness and the specific yield and hydraulic conductivity of these layers are integrated in the BBGM, and allow the model to be used to estimate changes in groundwater storage that result from observed changes in groundwater elevations. As data on aquifer characteristics and modeling capabilities improve, the methodologies used to relate changes in groundwater elevations with corresponding changes in storage will be updated.

4.4 Groundwater Quality

4.4.1 Background

Assessment of groundwater quality in the Wyandotte Creek Subbasin focuses on annual observation of salinity (through monitoring of specific conductance), temperature, and pH in the principal aquifer. Each of these parameters is influenced by ambient conditions and the parent material of the principal aquifer. Specific conductance and pH are also influenced by human activity. While only salinity will be used to monitor attainment of MO and avoidance of breaches in MT, changes in pH and temperature may indicate shifting groundwater conditions that trigger additional investigation.

The groundwater quality monitoring network implemented for representative monitoring under SGMA will build upon the County's existing program. Additional monitoring will continue to be conducted by other agencies to track constituents not managed under this GSP including a variety of minerals, metals, pesticides, and herbicides. Data from the ongoing monitoring by various state and federal agencies will be available to the GSA to augment local understanding of water quality in the Wyandotte Creek Subbasin and can be found on the State Board's GAMA program at https://www.waterboards.ca.gov/gama/. Water quality programs conducted by other agencies are summarized in section 1.5. The locations of all water quality monitoring wells are in Figure 4-2.

A total of two sites are part of the County's ongoing water quality monitoring programs. These wells have been selected based on the existing period of record, depth of well screens, and the quality of data reported and subject to permission of the well owner to monitor the well. Water quality monitoring has historically been conducted by Butte County during the summer. Both of the wells are located in the Oroville MA.

Table 4-3 presents information on each of the wells monitored by Butte County in the Wyandotte Creek Subbasin groundwater quality monitoring network. Figure 4-2 shows the locations of the wells.

Table 4-3: Butte County Groundwater Quality Monitoring Program Sites

State Well ID Number	Local Name	Well Type
Wyandotte Creek – Oroville Management Area		
19N04E06E002M	Thermalito	Municipal and Industrial
N/A	Thermalito domestic	Domestic

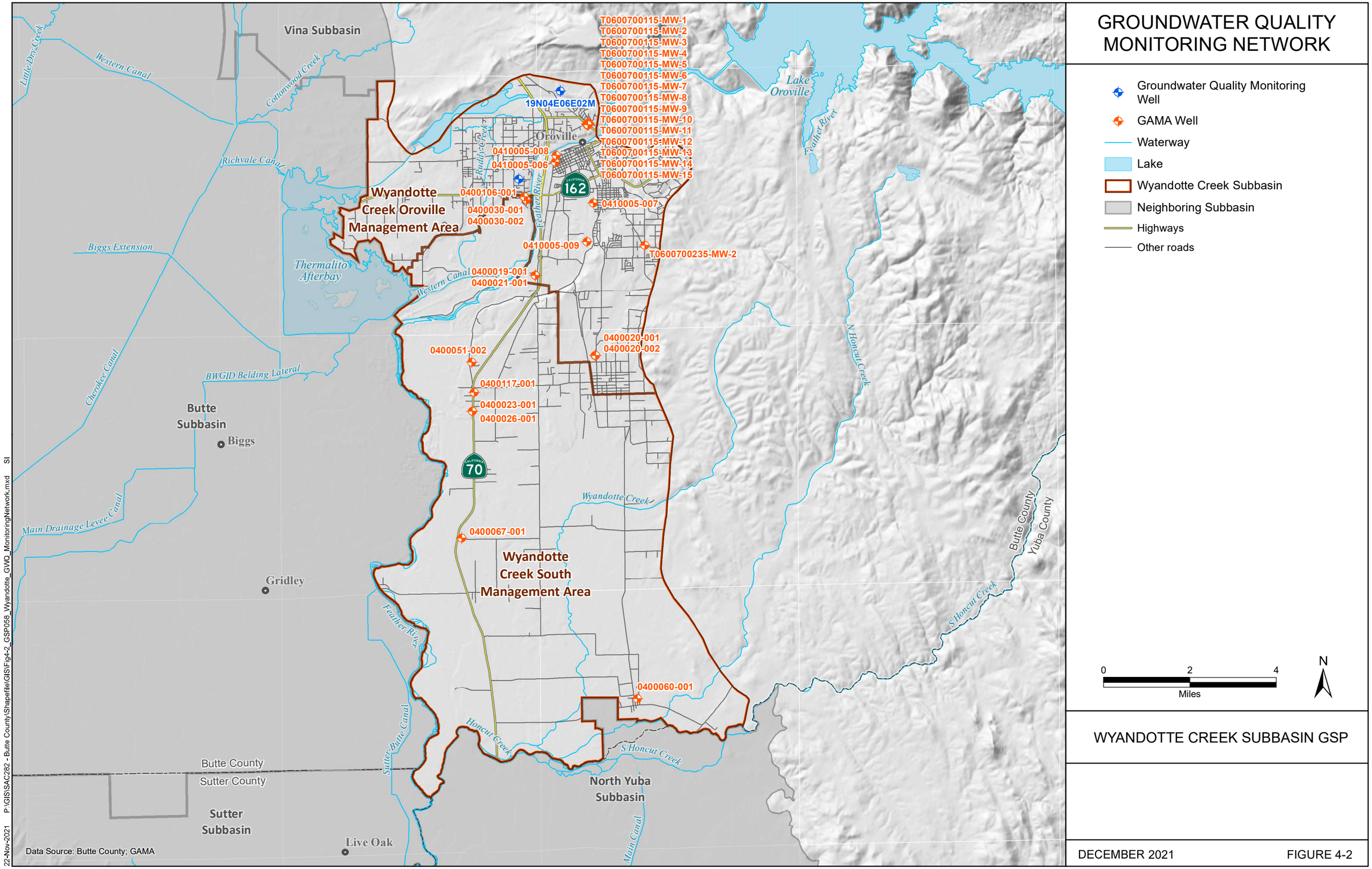
4.4.2 Density of Monitoring Sites and Frequency of Measurement

Following the County's ongoing water quality monitoring program, data will be collected annually for monitoring the groundwater quality sustainability in July which is near the peak season for groundwater demand. The groundwater quality monitoring sites are distributed over the 93 square-mile area of the Wyandotte Creek Subbasin resulting in a monitoring network with a spatial density of 2.1 sites per 100 square miles.

4.5 Land Subsidence

4.5.1 Background

Inelastic land subsidence has the potential to be of major concern in areas of active groundwater extraction due to infrastructure damage, permanent reduction in the storage capacity of an aquifer, well casing collapse, and increased flood risk in low lying areas. Inelastic subsidence typically occurs in the clay layers within aquifers and aquitards due to the withdrawal of water from storage within these layers. This water supports the structure of the clay layers, and dewatering permanently rearranges or collapses this structure, a process that cannot be reversed as groundwater cannot re-enter the clay structure after collapse.


GROUNDWATER QUALITY MONITORING NETWORK
Groundwater Quality Monitoring Well
GAMA Well
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0 2 4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 4-2
Vina Subbasin
Butte Subbasin
Sutter Subbasin
North Yuba Subbasin
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
Oroville
Biggs
Gridley
Live Oak
Butte County
Sutter County
Yuba County
Lake Oroville
Thermalito Afterbay
Feather River
Wyandotte Creek
Honcut Creek
S Honcut Creek
N Honcut Creek
Western Canal
Richvale Canal
Biggs Extension
BWGID Belding Lateral
Cherokee Canal
Main Drainage Levee Canal
Sutter-Butte Canal
Main Canal
Little Dry Creek
Cottonwood Creek
Reddy Creek
19N04E06E02M
T0600700115-MW-1
T0600700115-MW-2
T0600700115-MW-3
T0600700115-MW-4
T0600700115-MW-5
T0600700115-MW-6
T0600700115-MW-7
T0600700115-MW-8
T0600700115-MW-9
T0600700115-MW-10
T0600700115-MW-11
T0600700115-MW-12
T0600700115-MW-13
T0600700115-MW-14
T0600700115-MW-15
0410005-008
0410005-006
0400106-001
0400030-001
0400030-002
0410005-007
0410005-009
T0600700235-MW-2
0400019-001
0400021-001
0400020-001
0400020-002
0400051-002
0400117-001
0400023-001
0400026-001
0400067-001
0400060-001
162
70
Data Source: Butte County; GAMA
22-Nov-2021 P:\GIS\SAC282 - Butte County\Shapefile\GIS\Fig4-2_GSP058_Wyandotte_GWQ_MonitoringNetwork.mxd SI

Available data indicate that inelastic land subsidence due to groundwater withdrawal has not occurred in the Wyandotte Creek Subbasin. This is likely due to relatively stable groundwater levels and subsurface materials that are not conducive to compaction.

The primary mechanism for subsidence monitoring in the Wyandotte Creek Subbasin is a group of GPS monuments established to create the Sacramento Valley GPS Subsidence Monitoring Network. This program has been developed jointly by DWR and Reclamation with cooperation and assistance from local entities, including Butte County. The locations of these monuments are shown in Figure 4-3. Monuments used to monitor subsidence in the Wyandotte Creek Subbasin network include six monuments located either in the interior of the Wyandotte Creek Subbasin or on the boundary between the Wyandotte Creek and the Butte and Vina subbasins. Data from this monitoring network is collected, analyzed and reported by DWR as the data becomes available.

Data from monuments in the Wyandotte Creek Subbasin portion of the Sacramento Valley GPS Subsidence Monitoring Network have been used to monitor cumulative subsidence in the Wyandotte Creek Subbasin in 2008 and 2017, a period used to satisfy the SGMA requirement to evaluate historical subsidence.

Observations from the GPS Subsidence Monitoring Network will be supplemented by InSAR data released by DWR. This information reports vertical ground surface displacement using data collected by the European Space Agency Sentinel-1A satellite and processed by NASA's JPL. Data released to date from DWR's InSAR program provides cumulative vertical ground surface displacements from June 2015 through September 2019 and is used in the GSP to fulfill the requirement to estimate the rate and extent of recent subsidence.

InSAR data collection and mapping is regional and is not based on a defined network of monitoring locations. Therefore, no InSAR sites are shown in Figure 4-3.

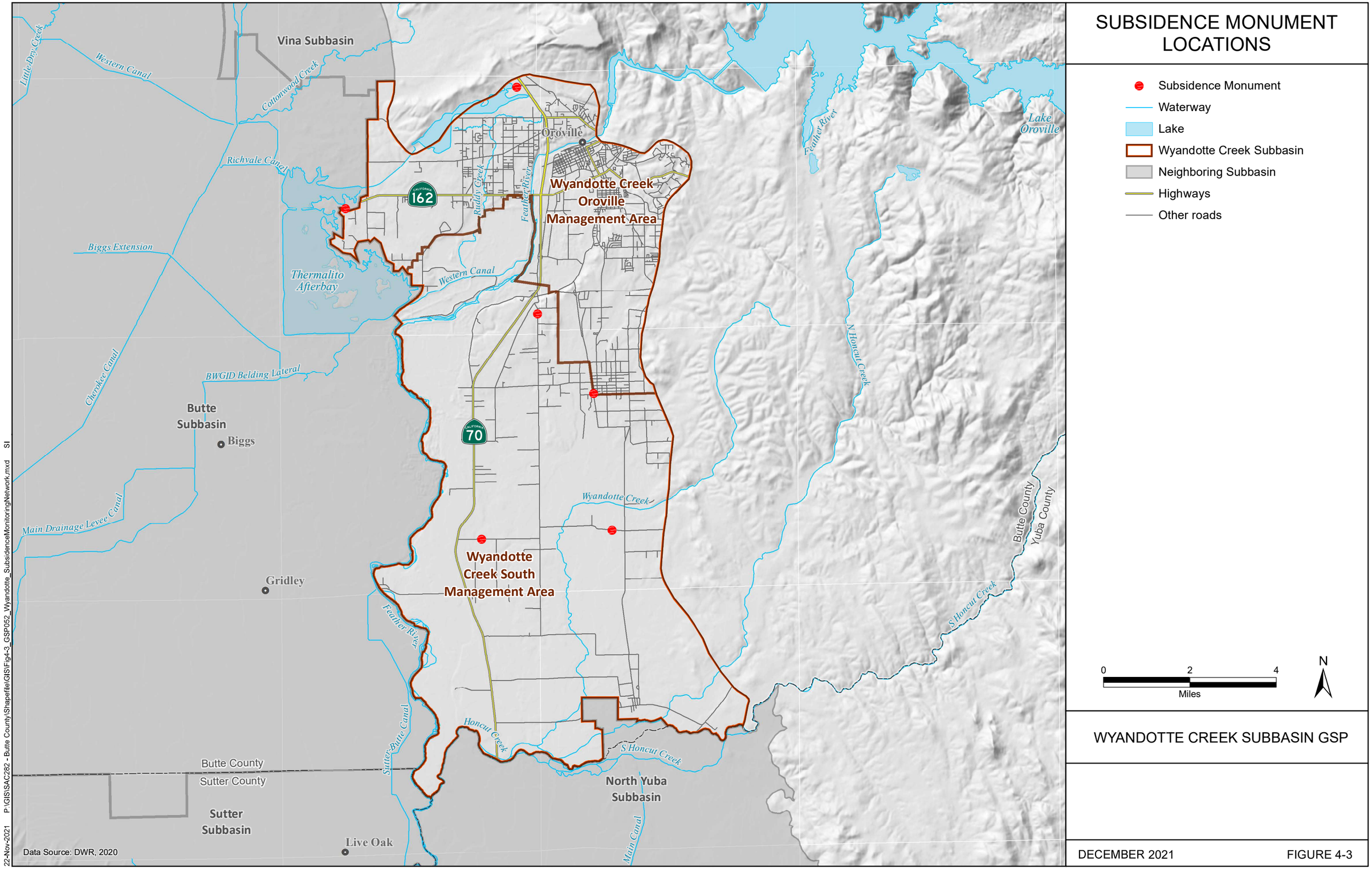
4.5.2 Location and Density of Monitoring Sites and Frequency of Measurement

The Sacramento Valley GPS Monitoring Network includes monuments that were measured in 2008 and 2017, while the InSAR program monitors subsidence on a continual basis. Data collected from both sources requires post processing and analysis, therefore the frequency of reporting is dependent on the work performed by DWR and by NASA's JPL. No extensometers exist in the Wyandotte Creek Subbasin.

4.6 Interconnected Surface Waters

4.6.1 Background

Monitoring depletions of interconnected surface water is conducted by monitoring water levels (stage) in streams and groundwater levels to characterize spatial and temporal exchanges between surface water and groundwater and to calibrate and apply the tools and methods necessary to estimate depletions. The existing monitoring network incorporates data from active stream gages reported to the California Data Exchange Center (CDEC), the California WDL, and the USGS National Water Information System and groundwater level monitoring, utilizing a subset of the locations described under the Wyandotte Creek Subbasin's groundwater level monitoring network.


SUBSIDENCE MONUMENT LOCATIONS
Subsidence Monument
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 4-3
Vina Subbasin
Butte Subbasin
Sutter Subbasin
North Yuba Subbasin
Wyandotte Creek Oroville Management Area
Wyandotte Creek South Management Area
Oroville
Biggs
Gridley
Live Oak
Thermalito Afterbay
Lake Oroville
Butte County
Sutter County
Yuba County
162
70
Little Dry Creek
Western Canal
Cottonwood Creek
Richvale Canal
Biggs Extension
Cherokee Canal
BWGID Belding Lateral
Main Drainage Levee Canal
Ruddy Creek
Feather River
Wyandotte Creek
Honcut Creek
S Honcut Creek
N Honcut Creek
Sutter-Butte Canal
Main Canal
Data Source: DWR, 2020
22-Nov-2021 P:\GIS\SAC282 - Butte County\Shapefile\GIS\Fig4-3_GSP052_Wyandotte_SubsidenceMonitoringNetwork.mxd SI

The monitoring sites for the Wyandotte Creek Subbasin include the stream gages found in Table 4-4 and Figure 4-4 and the groundwater quality monitoring sites shown above in Table 4-3 and Figure 4-2. The groundwater level monitoring sites selected for observing groundwater and surface water interactions include the entire array of existing wells in the groundwater level monitoring network as described in Section 4.2, above, that form the pool of potential RMS used to assess surface water and groundwater interactions. As discussed in Section 4.1, the GSA in the Wyandotte Creek Subbasin intends to further evaluate the SMC for interconnected surface waters to avoid undesirable results to aquatic ecosystems and GDEs. As additional data are collected and evaluated, the Wyandotte Creek Subbasin commits to developing additional SMC and installation of monitoring points, as appropriate, for specific stream reaches and associated habitat where there is a clear connection to groundwater pumping in the principal aquifer.

As with locations used for monitoring of other SIs, the network of stream gages and wells used to monitor interactions between groundwater and streamflow includes sites selected for their period of record, the quality of data reported and subject to permission of the landowner to monitor the well.

In addition to being used to identify relations between groundwater levels and streamflow, data from the network of stream gages and monitoring wells may be used to update and refine the calibration of the BBGM. This model will be used to combine data on groundwater levels and stream flows with data on aquifer parameters and water use to estimate the relation between groundwater conditions and stream flow and to identify instances where groundwater use depletes surface water.

Table 4-4: Wyandotte Creek Subbasin Surface Water Stream Gauges

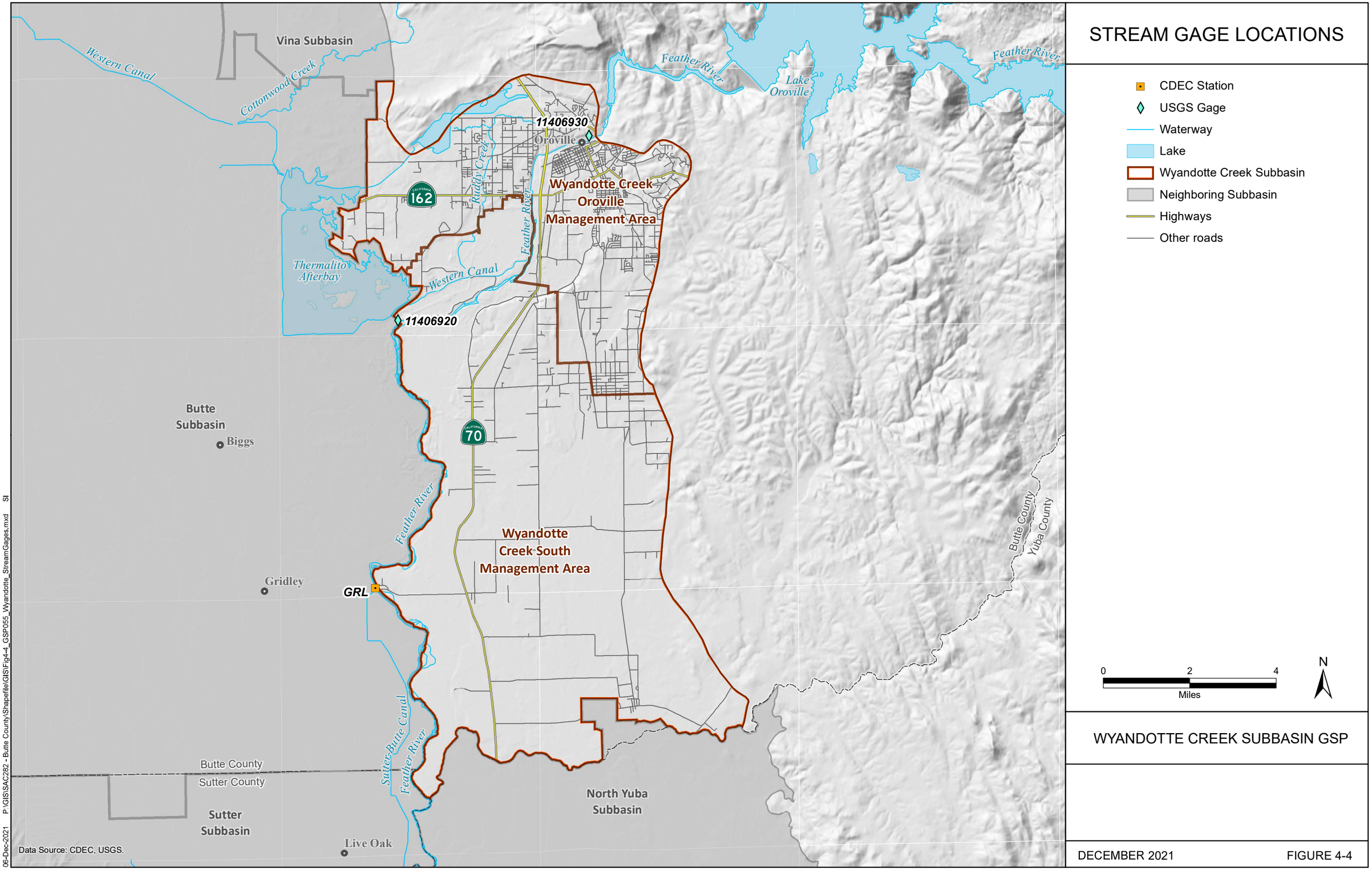
Stream Monitored	Gage ID	Well Network	Measurement Frequency
Oroville Management Area			
Feather River	11406930	USGS	Daily
South Management Area			
Feather River	11406920	USGS	Daily
Feather River	GRL	CDEC	Hourly

A total of 13 monitoring wells and 3 stream gages are included in the Wyandotte Creek Subbasin's network for monitoring groundwater and streamflow interactions.

4.7 Monitoring Protocols for Data Collection

4.7.1 Monitoring Protocols and Frequency for Groundwater Levels

Each of the wells in the monitoring network is monitored either by Cal Water, Butte County, DWR, or the associated CASGEM entity. Access agreements, including written description of each site location, access instructions, and point of contact, will be arranged prior to initiation of field data collection.


STREAM GAGE LOCATIONS
CDEC Station
USGS Gage
Waterway
Lake
Wyandotte Creek Subbasin
Neighboring Subbasin
Highways
Other roads
0
2
4
Miles
N
WYANDOTTE CREEK SUBBASIN GSP
DECEMBER 2021
FIGURE 4-4
Vina Subbasin
Western Canal
Cottonwood Creek
Feather River
Lake Oroville
Feather River
11406930
Oroville
Reddy Creek
162
Wyandotte Creek Oroville Management Area
Feather River
Thermalito Afterbay
Western Canal
11406920
Butte Subbasin
Biggs
70
Feather River
Wyandotte Creek South Management Area
Gridley
GRL
Butte County
Yuba County
Sutter-Butte Canal
Feather River
Butte County
Sutter County
Sutter Subbasin
North Yuba Subbasin
Live Oak
Data Source: CDEC, USGS.
06-Dec-2021 P:\GIS\SAC282 - Butte County\Shapefile\GIS\Fig4-4_GSP055_Wyandotte_StreamGages.mxd SI

Monitoring for purposes of the GSP will be conducted in accordance with DWR guidelines (DWR, 2016) to ensure groundwater level data are:

- Taken from the correct location, well ID, and screen interval depth
- Accurate and reproducible
- Representative of conditions that inform appropriate basin management data quality objectives
- Recorded with all salient information to correct, if necessary, and compare data
- Handled in a way that ensures data integrity
- Taken using a CASGEM-approved water-level measurement method to ensure consistency across measurements

Methods include:

- Establishing a reference point
- Using one of four approved methods (steel tape, electric sounding tape, sonic water-level meter, or pressure transducer) to measure groundwater levels

Groundwater level data will include at a minimum the well identification number, measurement date, depth to water (to the nearest 0.01 or .1 foot depending on equipment) from the established reference point, measurement method, measurement quality descriptors (for no measurement or questionable measurement), and observations of well and/or site conditions (including modifications to the well). The equipment used to collect groundwater level data will be recorded to include the equipment manufacturer, model, and serial number, as applicable. Equipment used for data collection will be operated and maintained according the manufacturer's recommendations.

Each well in the network has an established reference point in North American Vertical Datum 1988.

The general procedure for groundwater level monitoring is as follows:

- The well port (cap, plug, or lid) for access will be removed. Pressure inside the well casing will be allowed to equalize to ambient conditions prior to data collection.
- Non-dedicated equipment will be decontaminated by washing with a non-phosphate soap solution and triple rinse of distilled water.
- Groundwater level data (described above) will be recorded.
- Groundwater elevation will be recorded (groundwater elevation = reference point elevation – depth to water).
- The well port (and lock, if applicable) will be replaced.

Groundwater level data will be entered into the data management system (DMS) as soon as possible following collection.

Monitoring frequency for each well will occur at a minimum of bi-annually. Monitoring will be conducted in the Spring (March) and Fall (October). Select wells are monitored more frequently via dataloggers, at an hourly basis, but will only be reported bi-annually. Each RMS will be monitored within the same calendar month to ensure consistency for comparability over time. This monitoring frequency will achieve the goal of obtaining sufficient data to evaluate the seasonal, short-, and long-term trends in groundwater.

4.7.2 Monitoring Protocols and Frequency for Water Quality

Each of the wells in the existing network is monitored for water quality by DWR and other agencies, both private and public, including Butte County.

Monitoring for purposes of the GSP will be conducted in accordance with DWR guidelines (BMP 1) to ensure water quality data:

- Are taken from the correct location
- Are accurate and reproducible
- Represent conditions that inform appropriate basin management and are consistent with the data quality objectives
- Are handled in a way that ensures data integrity
- Include pertinent information that is recorded to normalize, if necessary, and compare data

Water quality will be measured for compliance through monitoring of specific conductance. However, pH and temperature may also be recorded for informational purposes. Water quality samples will be assessed in the field and will not require laboratory analysis.

Groundwater quality data will include at a minimum the well identification number, sample time and date, groundwater elevation data if available (as described in Section 4.2), water quality values for pH, specific conductance, and temperature, sample quality descriptors (for no measurement or questionable measurement), and observations of well and/or site conditions (including modifications to the well). The equipment used to collect groundwater quality data will be recorded to include the equipment manufacturer, model and serial number, as applicable. Equipment used for data collection will be calibrated, operated and maintained according to the manufacturer's recommendations.

The general procedures for groundwater quality sampling include:

- For wells with dedicated pumps, the sample will be collected near the wellhead.
- The sampling port and/or sampling equipment will be decontaminated by washing with a non-phosphate soap solution and triple rinse of distilled water prior to sample collection.

- With the exception of observation wells, the well will be purged of three well casing volumes prior to sampling (if not equipped with dedicated low-flow or passive equipment).
- Samples will be collected under laminar flow conditions.
- Equipment will be field calibrated to assess drift.

Monitoring for water quality for each well will occur annually in July or August. Select wells may be monitored more frequently but will only be reported annually. Each RMS will be monitored within one calendar month to ensure consistency for comparability over time. This monitoring frequency will achieve the goal of obtaining sufficient data to evaluate the seasonal, short-, and long-term trends in groundwater.

4.8 Representative Monitoring Sites

RMS wells are intended to be representative of general conditions within the area. This approach allows for a focused and specific monitoring location to effectively represent a larger geographical area. The data gathered from the RMS will be used to quantify the MAs groundwater conditions for the five SIs and evaluate GSP implementation.

RMS wells were selected using the following criteria:

1. Adequate Spatial Distribution – RMS were selected from the monitoring network to maximize the geographical coverage across each of the three MAs and avoid overlapping or redundant coverage.
2. Existing Data – RMS with a longer period of record and a greater number of historical measurements were selected to provide insight into long-term trends that can provide information about groundwater conditions through varying climatic periods such a droughts and wet periods. Historical data may also show changes in groundwater conditions through anthropogenic effects as well. While some sites chosen may not have extensive historical data, they may still be selected because there are no wells nearby with longer records.
3. Increased Density in Heavily Pumped Areas – Selection of additional wells in heavily pumped areas such as within urban residential areas in the city of Oroville will provide additional data where high groundwater use occurs.
4. Multi-Completion Wells – The utilization of wells with different screen intervals is important to collect data on the groundwater conditions at different elevations within the aquifer. This can be achieved by using wells with different screen depths that are close to one another, or by using multi-completion wells.
5. Consistency with BMPs – The BMPs provided by DWR encourage consistency across subbasins and compliance with established regulations.
6. Well Construction Data – Well data such as perforation depths, construction date, and well depth was considered for selection.

7. Accessibility – Consideration for accessibility to the physical well location and to the existing data was incorporated into the selection of RMS wells. RMS in the network include residential, municipal, agricultural, and governmental wells that are owned and operated by various private and public entities.
8. Professional Judgement – Professional judgement was used to make the final decision about each well, particularly when more than one suitable well exists in an area of interest.

4.9 Representative Monitoring Sites for Sustainability Indicators

Each of the associated SMC for each SI described in Section 3 have RMS wells identified for monitoring and evaluation with the exception of seawater intrusion as it is not applicable to the Wyandotte Creek Subbasin. The selected RMS wells for each SI are discussed in the following sections.

4.9.1 Groundwater Levels

The RMS wells will be used as compliance points to record groundwater elevations for the evaluation of chronic lowering of groundwater levels. SGMA allows groundwater elevations to be used as proxy for monitoring other SI if a significant correlation exists between groundwater elevations and the other SI and if the MO for groundwater elevation include a reasonable margin of operational flexibility to avoid undesirable results.

Groundwater storage is directly connected to groundwater elevation, and therefore the MO for groundwater levels will adequately serve as proxy for groundwater storage. Land subsidence occurs when compressible subsurface soils are dewatered. Soil units in the Wyandotte Creek Subbasin have not historically been susceptible to compression during periods of declining groundwater elevations. Therefore, the MO for groundwater levels will adequately serve as proxy for land subsidence.

Surface waters may manifest a depletion in volume if groundwater levels fall below the established MO. Such depletion is not evident in the historical records available, however more information may be required to adequately characterize interactions. See Section 3.8 for a discussion of interconnected surface water assessment. As indicated in this section, an Interconnected Surface Water SMC framework has been developed for the GSP. This framework will guide future data collection efforts to fill data gaps, either as part of GSP projects and management actions or plan implementation. As additional data are collected and evaluated, the Wyandotte Creek Subbasin commits to developing additional SMC and installation of RMS as appropriate, for specific stream reaches and associated habitat where there is a clear connection to groundwater pumping in the principal aquifer.

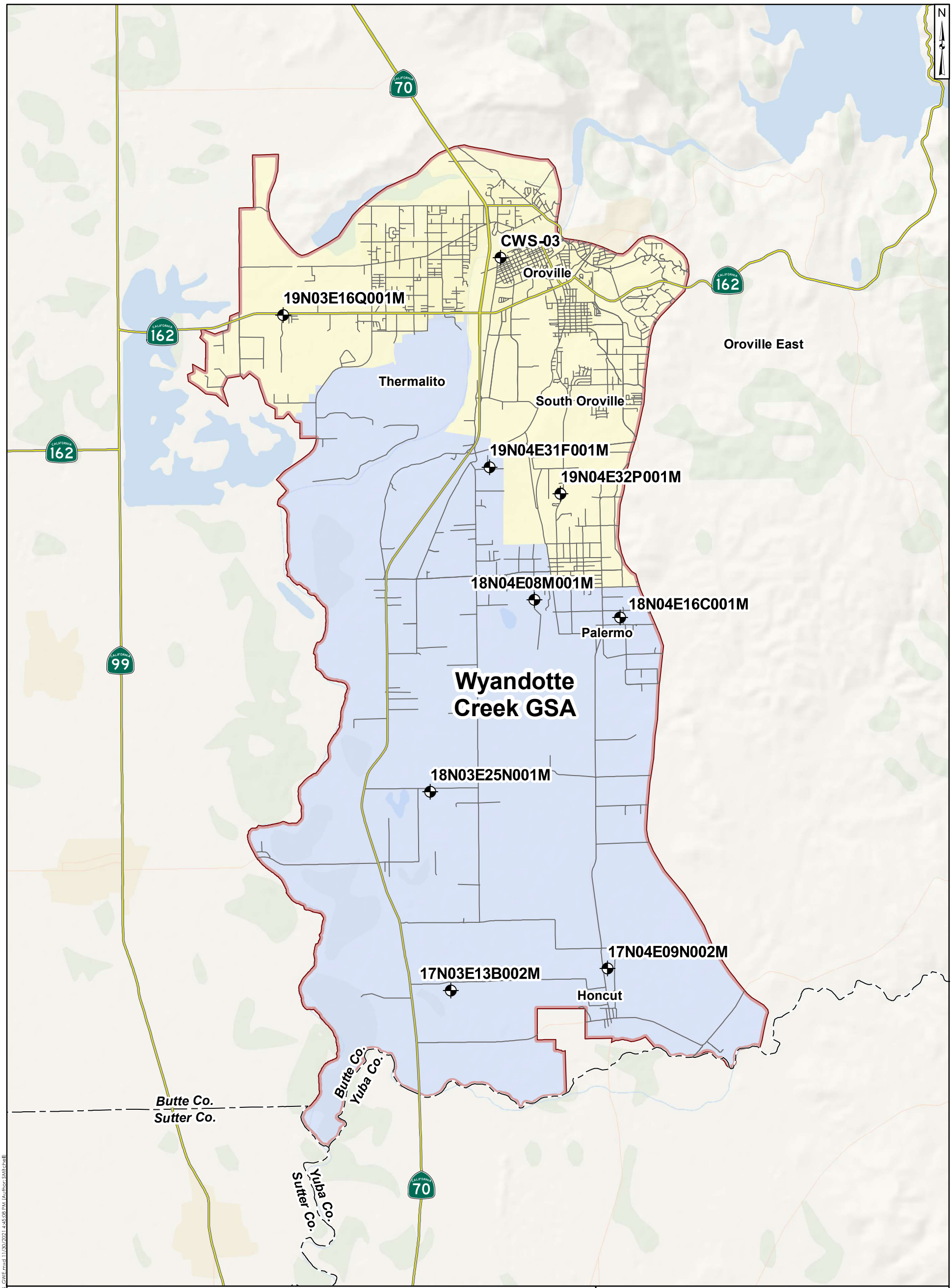
For the purposes of this GSP, groundwater elevations will be used as a proxy for monitoring of SMC of groundwater storage, land subsidence, and interconnected surface water.

A total of nine RMS wells were selected as compliance points for monitoring of groundwater levels (Figure 4-5). They will be monitored for the SMC listed in Section 3.9. Each well (except CWS-03) was selected independently of the wells discussed in Section 4.2 and are not listed in Table 4-1 (CWS-03 is listed in Table 4-1). Table 4-5 summarizes the RMS well construction details and Table 4-6 summarizes the RMS well location details.

Table 4-5: Groundwater Levels Representative Monitoring Site Well Construction Details

RMS Well ID	State Well Number (Site Name)	Total Depth (feet bgs)	Screened Interval (feet bgs)	Reference Point Elevation[1] (feet)	Reference Point Description	Ground Surface Elevation[1] (feet)
Wyandotte Creek Subbasin – Oroville Management Area						
16Q001M	19N03E16Q001M	120	100-120	180.32	Top of casing	179.32
32P001M	19N04E32P001M	N/A	N/A	188	Between plate and casing on west side	187
CWS-03	CWS-03	<200	---	195	---	---
Wyandotte Creek Subbasin – South Management Area						
13B002M	17N03E13B002M	320	N/A	89.57	Top of casing	89.27
09N002M	17N04E09N002M	325	N/A	103.26	N/A	102.26
25N001M	18N03E25N001M	164	N/A	128.26	Top of casing	127.26
08M001M	18N04E08M001M	656	168-244	147.56	Between metal plate and top of casing	147.26
16C001M	18N04E16C001M	165	N/A	204.46	Top of casing	203.26
31F001M	19N04E31F001M	200	160-200	260.97	Top of casing	259.27

Note:
1 – North American Vertical Datum 1988.
N/A – Not available
--- Details of public supply wells not disclosed



Legend

Groundwater Sustainability Agency (GSA)[1]

Wyandotte Creek GSA

RMS GWE Monitoring Wells

Well

Boundaries[2]

County boundaries

Wyandotte Creek Subbasin Management Areas

Wyandotte Creek Oroville

Wyandotte Creek South

Roads[2]

Highways

Other roads

Notes:
1) California Department of Water Resources (CA DWR).
2) TIGER/Line, U.S. Census Bureau.

2 1 0 2 Miles

Groundwater Level RMS Wells
Wyandotte Creek Subbasin GSP

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Figure 4-5

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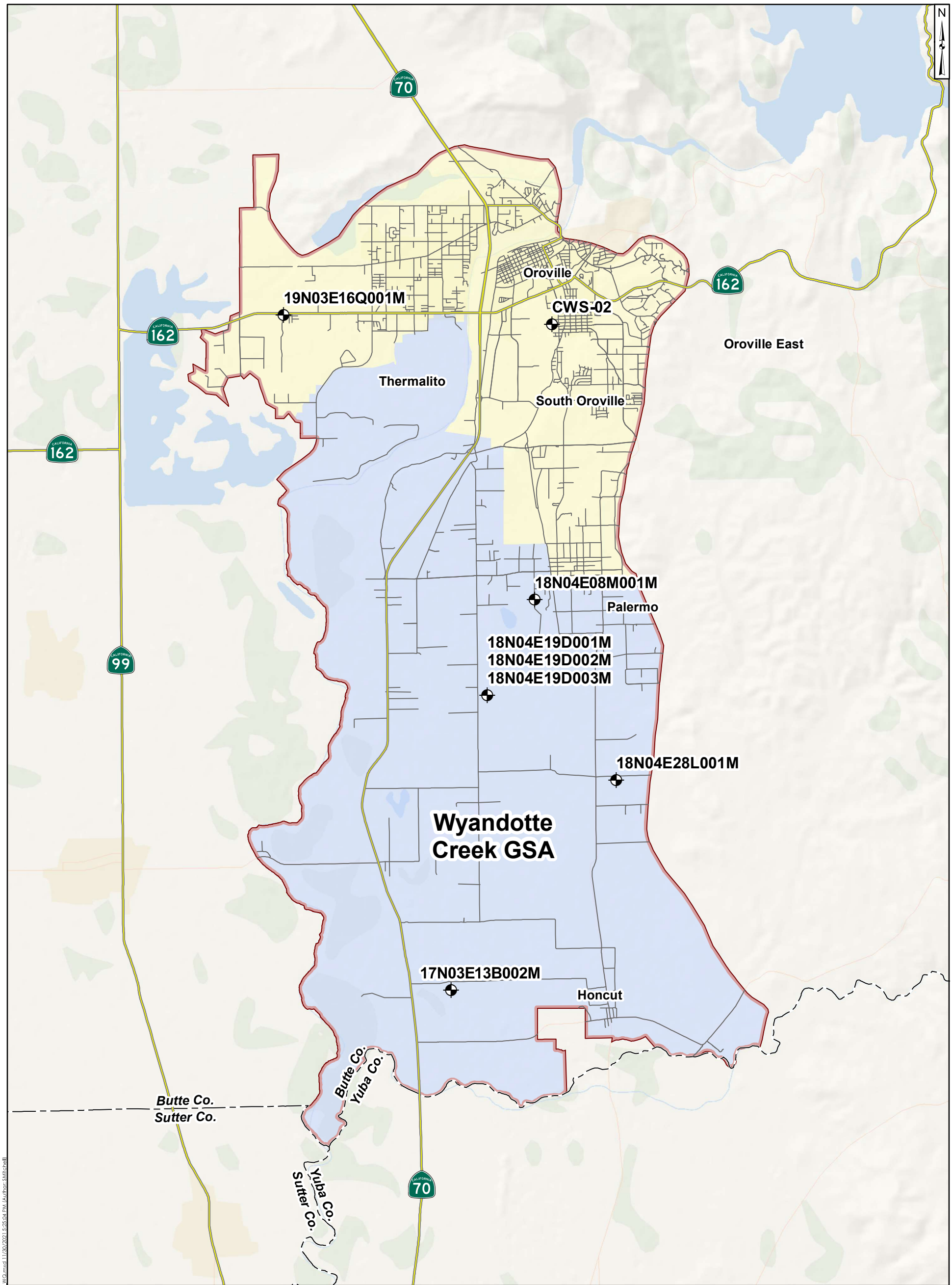
Table 4-6: Groundwater Levels Representative Monitoring Site Well Location Details

RMS Well ID	State Well Number (Site Name)	Latitude[1]	Longitude[1]
Wyandotte Creek Subbasin – Oroville Management Area			
16Q001M	19N03E16Q001M	39.4977	-121.6369
32P001M	19N04E32P001M	39.4540	-121.5503
CWS-03	CWS-03	---	---
Wyandotte Creek Subbasin – South Management Area			
13B002M	17N03E13B002M	39.3336	-121.5853
09N002M	17N04E09N002M	39.3387	-121.5363
25N001M	18N03E25N001M	39.3818	-121.59156
16C001M	18N04E16C001M	39.4239	-121.5318
08M001M	18N04E08M001M	39.4283	-121.5586
31F001M	19N04E31F001M	39.4606	-121.5725

Note:
1 – North American Datum 1983 (NAD83).
--- Location of public supply wells not disclosed

4.9.2 Water Quality

A total of eight RMS wells were selected as compliance points for monitoring of water quality (Figure 4-5). They will be monitored for the SMC listed in Section 3.9. Each well was selected independently of the wells discussed in Section 4.4 and thus not all wells are listed in Table 4-3. Table 4-7 summarizes the well construction details and Table 4-8 summarizes the well location details. As discussed in Section 4.2, one of these wells, designated as 19D001 - 19D003M , was currently installed, as shown in Figure 4-6 by DWR under the TSS program.



Legend

Groundwater Sustainability Agency (GSA)[1]

- Wyandotte Creek GSA

RMS WQ Monitoring Wells

- Well

Boundaries[2]

- County boundaries

Wyandotte Creek Subbasin Management Areas

- Wyandotte Creek Oroville
- Wyandotte Creek South

Roads[2]

- Highways
- Other roads

2 1 0 2 Miles

Water Quality RMS Wells
Wyandotte Creek Subbasin GSP

Geosyntec consultants

Figure **4-6**

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Notes:
1) California Department of Water Resources (CA DWR).
2) TIGER/Line, U.S. Census Bureau.

Table 4-7: Water Quality Representative Monitoring Site Well Construction Details

RMS Well ID	State Well Number (Site Name)	Total Depth (feet bgs)	Screen Interval (feet bgs)	Reference Point Elevation[1] (feet)	Reference Point Description	Ground Surface Elevation[1] (feet)
Wyandotte Creek Subbasin – Oroville Management Area						
16Q001M	19N03E16Q001M	120	100-120	180.32	Top of casing	179.32
CWS-02	CWS-02	< 600	---	---	---	---
Wyandotte Creek Subbasin – South Management Area						
13B002M	17N03E13B002M	320	N/A	89.57	Top of casing	89.27
08M001M	18N04E08M001M	656	168-244	147.56	Between metal plate and top of casing	147.26
19D001M 19D002M 19D003M	18N04E19D001M[2] 18N04E19D002M 18N04E19D003M	1000	700-720 430-450, 550-570 120-130, 190-200	NR	NR	NR
28L001M	18N04E28L001M[3]	190	N/A	137.75	N/A	137.25

Notes:
1. North American Datum 1983 (NAD83).
2. New nested well installed by DWR under TSS Program.
3. If access cannot be obtained for this well, a new well will be obtained.
--- Details of public supply wells not disclosed
N/A – Not available
NR – Not yet reported by DWR

Table 4-8: Water Quality Representative Monitoring Site Well Location Details

RMS Well ID	State Well Number (Site Name)	Latitude[1]	Longitude[1]
Wyandotte Creek Subbasin – Oroville Management Area			
16Q001M	19N03E16Q001M	39.4977	-121.6369
CWS-02	CWS-02	---	---
Wyandotte Creek Subbasin – South Management Area			
13B002M	17N03E13B002M	39.3336	-121.5853
08M001M	18N04E08M001M	39.4283	-121.5586
19D001M 19D002M 19D003M	18N04E19D001M[2] 18N04E19D002M 18N04E19D003M	39.40512	-121.57363
28L001M	18N04E28L001M[3]	39.3844	-121.5333

Note:
1. North American Datum 1983 (NAD83).
2. New well installed by DWR under TSS Program.
3. If access cannot be obtained for this well, a new well will be obtained.
--- Location of public supply wells not disclosed
N/A – Not available

4.10 Network Assessment and Improvements

An assessment of the monitoring network is required to determine uncertainty and identify data gaps that could affect the achievement of sustainability goals. Improvements to the network to address data gaps will be planned and implemented to manage, focus, and prioritize monitoring.

Data gaps can result from monitoring information that is not of sufficient quantity or quality. Monitoring network data gaps can influence the development and understanding of the basin setting, including the HCM, groundwater conditions, and water budget; and proposed MTs and MOs. Updates to the data gaps will be included with the annual reporting and 5-year assessment of the GSP.

The following data gaps and proposed resolutions have been identified in the Wyandotte Creek Subbasin:

- Water Quality – Temporal data gaps exist for water quality samples collected within the Wyandotte Creek – South RMS wells. The frequency of sampling proposed in the GSP is anticipated to provide consistent and comparable data to fill this data gap. In addition, one well in this MA, 18N04E28L001M (28L001M) (Figure 4-6), had reported specific conductance levels above 2,000 micrograms per liter in 1986. No samples have been collected since this time and it is unknown if these levels still exist. Well 28L001M may no longer be accessible. If not, to fill this data gap, a new existing well will be identified with a similar screen interval(s) (total depth of well approximately 200 feet bgs) or a new well may be installed.

- Interconnected Surface Water/Associated impacts on GDEs – There is a lack of sufficient data to analyze interaction of streams and pumping within the primary aquifer system. Additional wells and other monitoring networks will be installed, as appropriate, following the framework discussed in Section 3.8.