Oxnard Subbasin Groundwater Sustainability Plan 2021 Annual Report: Covering Water Year 2020

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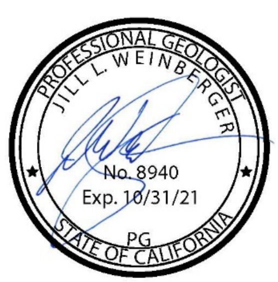

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Table of Contents

SECTION | **PAGE NO.**

EXECUTIVE SUMMARY 1-1

1 BACKGROUND AND PLAN AREA 1-1
1.1 Background 1-1
1.1.1 Fox Canyon Groundwater Management Agency 1-1
1.1.2 Oxnard Subbasin Groundwater Sustainability Plan 1-2
1.2 Plan Area 1-2
1.2.1 Climate 1-3
1.2.2 Surface Water Bodies and Gauging Stations 1-3
1.3 Annual Report Organization 1-4

2 GROUNDWATER CONDITIONS 2-1
2.1 Groundwater Elevations 2-1
2.1.1 Groundwater Elevation Contour Maps 2-1
2.1.2 Groundwater Elevation Hydrographs 2-5
2.2 Groundwater Extraction 2-9
2.3 Surface Water Supply 2-11
2.4 Total Water Available 2-12
2.5 Change in Groundwater Storage 2-14
2.5.1 Oxnard Aquifer 2-14
2.5.2 Mugu Aquifer 2-14
2.5.3 Hueneme Aquifer 2-15
2.5.4 Fox Canyon Aquifer 2-15
2.5.5 Grimes Canyon Aquifer 2-15
2.5.6 Total Change in Storage in the Subbasin 2-15

3 GSP IMPLEMENTATION PROGRESS 3-1

4 REFERENCES 4-1

TABLES

1-1 Cumulative Daily Average Flows at VCWPD Gauges 723 and 776 in the Oxnard Subbasin 1-4
2-1 Water Year 2020 Groundwater Elevations, Minimum Thresholds, Measurable Objectives, and Interim Milestones for Representative Monitoring Wells in the Oxnard Subbasin 2-7
2-2 Calendar Year Groundwater Extractions in the Oxnard Subbasin by Aquifer System and Water Use Sector 2-10
2-3 Summary of Surface Water Deliveries to the Oxnard Subbasin 2-11
2-4 Total Water Available in the Oxnard Subbasin 2-13

2-5a Annual Change in Groundwater Storage in the Oxnard Subbasin 2-17
2-5b Cumulative Change in Groundwater Storage in the Oxnard Subbasin 2-17

FIGURES

Figure 1-1 Vicinity Map for the Oxnard Subbasin
Figure 1-2 Weather Stations and Stream Gauge Locations
Figure 1-3 Oxnard Subbasin Historical Water Year Precipitation
Figure 1-4 Oxnard Subbasin Stream Gauge Data
Figure 2-1 Groundwater Elevation Contours in the Oxnard Aquifer, September 30 to October 31, 2019
Figure 2-2 Groundwater Elevation Contours in the Oxnard Aquifer, February 23 to April 4, 2020
Figure 2-3 Groundwater Elevation Contours in the Mugu Aquifer, September 30 to October 31, 2019
Figure 2-4 Groundwater Elevation Contours in the Mugu Aquifer, February 23 to April 4, 2020
Figure 2-5 Groundwater Elevation Contours in the Hueneme Aquifer, September 30 to October 31, 2019
Figure 2-6 Groundwater Elevation Contours in the Hueneme Aquifer, February 23 to April 4, 2020
Figure 2-7 Groundwater Elevation Contours in the Fox Canyon Aquifer, September 30 to October 31, 2019
Figure 2-8 Groundwater Elevation Contours in the Fox Canyon Aquifer, February 23 to April 4, 2020
Figure 2-9 Groundwater Elevation Contours in the Grimes Canyon Aquifer, September 30 to October 31, 2019
Figure 2-10 Groundwater Elevation Contours in the Grimes Canyon Aquifer, February 23 to April 4, 2020
Figure 2-11 Groundwater Elevation Hydrographs for Representative Wells Screened in the Oxnard Aquifer
Figure 2-12 Groundwater Elevation Hydrographs for Representative Wells Screened in the Mugu Aquifer
Figure 2-13 Groundwater Elevation Hydrographs for Representative Wells Screened in the Hueneme Aquifer
Figure 2-14 Groundwater Elevation Hydrographs for Representative Wells Screened in the Fox Canyon Aquifer
Figure 2-15 Groundwater Elevation Hydrographs for Representative Wells Screened in the Grimes Canyon Aquifer and Multiple Aquifers
Figure 2-16 Groundwater Production from the UAS in Calendar Year 2020
Figure 2-17 Groundwater Production from the LAS in Calendar Year 2020
Figure 2-18 Change in Storage in the Oxnard Aquifer: Spring 2019 to Spring 2020
Figure 2-19 Change in Storage in the Mugu Aquifer: Spring 2019 to Spring 2020
Figure 2-20 Change in Storage in the Hueneme Aquifer: Spring 2019 to Spring 2020
Figure 2-21 Change in Storage in the Fox Canyon Aquifer: Spring 2019 to Spring 2020
Figure 2-22 Change in Storage in the Grimes Canyon Aquifer: Spring 2019 to Spring 2020
Figure 2-23 Water Year Type, Groundwater Use, and Annual Change in Storage in the Oxnard Subbasin
Figure 2-24 Water Year Type, Groundwater Use, and Cumulative Change in Storage in the Oxnard Subbasin

APPENDICES

A Corections to Oxnard Subbasin Groundwater Sustainability Plan 2020 Annual Report: Covering Water Years 2016 through 2019

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Executive Summary

The Fox Canyon Groundwater Management Agency (FCGMA), the Groundwater Sustainability Agency (GSA) for the portions of the Oxnard Subbasin (Subbasin) within its jurisdictional boundaries, in coordination with the other two GSAs in the Subbasin, has prepared this second annual report for the Oxnard Subbasin Groundwater Sustainability Plan (GSP) in compliance with the 2014 Sustainable Groundwater Management Act (SGMA) (California Water Code, Section 10720 et seq.). This annual report covers the entire Subbasin. The GSP for the Oxnard Subbasin was submitted to the Department of Water Resources (DWR) on January 13, 2020. SGMA regulations require that an annual report be submitted to the Department of Water Resources (DWR) by April 1 of each year following the adoption of the GSP. The data presented in the Oxnard Subbasin GSP ends in water year 2015. The first annual report provided an update on conditions in the Subbasin from water year 2016 through water year 2019. This annual report provides an update on the groundwater conditions for water year 2020 (October 1, 2019 through September 30, 2020).

Water year 2020 was a below normal water year, in which precipitation was approximately 10% lower than the historical average precipitation within the Subbasin. Groundwater elevations measured in spring 2020 were similar to spring 2015 groundwater elevations across the majority of the Oxnard, Mugu, and Fox Canyon aquifers. Despite the consistently lower than average precipitation received since 2015, United Water Conservation District (UWCD) recharged approximately 28,300 acre-feet (AF) of surface water in water year 2020, which helped elevate groundwater levels across the Subbasin.

In the Upper Aquifer System (UAS), groundwater elevations were higher in spring 2020 than spring 2019. The increase in groundwater elevations resulted in a net increase in groundwater storage within the UAS of approximately 11,300 AF between spring 2019 and spring 2020. In the Lower Aquifer System (LAS), groundwater elevation changes varied by geographic location. In the central portion of the Subbasin, spring groundwater conditions were stable between 2019 and 2020. Along the coast, near Port Hueneme, spring groundwater elevations rose by approximately six to ten feet between 2019 and 2020. In the southwestern region of the saline intrusion management area, spring groundwater elevations declined by approximately one to nine feet between 2019 and 2020. Groundwater in storage in the LAS increased by approximately 200 AF between spring 2019 and 2020.

Data gaps identified in the GSP remain in this annual report. Some of the critical data gaps include the timing and number of groundwater elevation measurements available for preparing spring and fall contour maps, the availability of data on surface water diversions from agencies reporting to FCGMA, and the current timeframe for reporting groundwater production, which facilitates reporting groundwater production on a calendar year, rather than on a water year basis. Progress has been made on switching to a water year reporting system, and spatial data gaps are being filled as results from newly installed nested groundwater monitoring wells are collected. The data gaps identified in the GSP will continue to be addressed as implementation of the GSP progresses.

FCGMA has undertaken several steps toward implementing the GSP, with implementation planning occurring concurrently with the GSP development process and throughout the past year. Through DWR's Technical Support Services (TSS) program, a new nested groundwater well cluster was installed near the Revolon Slough to better delineate groundwater elevations in individual aquifers in the pumping depression management area. The FCGMA Board of Directors adopted a new extraction allocation ordinance effective October 1, 2020, which transitions to water year reporting and provides the regulatory framework the manage extraction consistent with the sustainable yield of the Subbasin. Additionally, FCGMA successfully conducted ongoing stakeholder discussions and meetings facilitated by DWR's Facilitation Support Services program. These discussions resulted in the development of a recommended suite of projects that will be modeled and evaluated as part of an overall basin optimization and seawater intrusion mitigation strategy for ongoing basin management. The FCGMA Board of Directors continues to prioritize stakeholder feedback in the implementation phase of the GSP because of the vital role stakeholders play in ensuring the long-term sustainable use of groundwater resources in the Oxnard Subbasin.

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1 Background and Plan Area

1.1 Background

FCGMA, the GSA for the portions of the Subbasin within its jurisdictional boundaries, in coordination with the other two GSAs in the Subbasin, has prepared this annual report for the Oxnard Subbasin GSP in compliance with SGMA (California Water Code, Section 10720 et seq.). SGMA requires that an annual report be submitted to DWR by April 1 of each year following the adoption of the GSP. FCGMA adopted a GSP for the Oxnard Subbasin in December 2019 and submitted the GSP to DWR on January 13, 2020 (DWR 2020) for the entire Subbasin. FCGMA submitted the first annual report for the Subbasin April 1, 2020.

FCGMA is one of three Groundwater Sustainability Agencies (GSAs) in the Subbasin. The other two GSAs are the Camrosa Water District (CWD)–Oxnard GSA and the Oxnard Outlying Areas GSA (County of Ventura). This annual report applies to the entirety of the Subbasin, including those portions of the Subbasin that lie outside FCGMA's boundary. To coordinate management and reporting in the Subbasin, FCGMA and CWD have executed a Memorandum of Understanding, and FCGMA and the County have formed a Joint Powers Authority.

1.1.1 Fox Canyon Groundwater Management Agency

FCGMA is an independent special district formed by the California Legislature in 1982 to manage and protect the aquifers within its jurisdiction for the common benefit of the public and all agricultural, and M&I users (FCGMA et al. 2007). FCGMA's boundaries include all land overlying the Fox Canyon aquifer (FCA) and includes portions of the Oxnard Subbasin and the Las Posas Valley Basin (LPVB), the Pleasant Valley Basin (PVB), and the Arroyo Santa Rosa Valley Basin (ASRVB).

FCGMA is governed by a Board of Directors (Board) with five members who represent: (1) the County of Ventura (County), (2) the United Water Conservation District (UWCD), (3) seven mutual water companies and water districts within the Agency[1], (4) five incorporated cities which are all or a portion of each is within the FCGMA jurisdictional area[2], and (5) a farmer representative. The Board members representing the County, UWCD, the mutual water companies and water districts, and the incorporated cities are appointed by their respective organizations or groups. The representative for the farmers is appointed by the other four seated Board members from a list of candidates jointly supplied by the Ventura County Farm Bureau and the Ventura County Agricultural Association. An alternate Board member is selected by each appointing agency or group in the same manner as the regular member and acts in place of the regular member in case of absence or inability to act. All members and alternates serve for a 2-year term of office, or until the member or alternate is no longer an eligible official of the member agency. Information regarding current FCGMA Board representatives can be found on the FCGMA website (FCGMA 2020).

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1 The seven mutual water companies and water districts are: Alta Mutual Water Company, Pleasant Valley County Water District (PVCWD), Berylwood Mutual Water Company, Calleguas Municipal Water District (CMWD), CWD, Zone Mutual Water Company, and Del Norte Mutual Water Company.

2 The five incorporated cities within the FCGMA jurisdictional area are: Ventura, Oxnard, Camarillo, Port Hueneme, and Moorpark.

1.1.2 Oxnard Subbasin Groundwater Sustainability Plan

The GSP for the Oxnard Subbasin defined the conditions under which the groundwater resources of the entire Oxnard Subbasin will be managed sustainably in the future (FCGMA 2019a). Groundwater conditions were evaluated in five primary aquifers in the Subbasin. These aquifers are commonly grouped into an upper and lower aquifer system. The Oxnard and Mugu aquifers compose the Upper Aquifer System (UAS), and the Hueneme, Fox Canyon, and Grimes Canyon aquifers compose the Lower Aquifer System (LAS). The primary sustainability goal for the Oxnard Subbasin, set forth in the GSP, is "to increase groundwater elevations inland of the Pacific coast in the aquifers that compose the Upper Aquifer System and the Lower Aquifer System to elevations that will prevent the long-term, or climatic cycle net (net), landward migration of the 2015 saline water impact front; prevent net seawater intrusion in the UAS; and prevent net seawater intrusion in the LAS." (FCGMA 2019a). This goal was established based on both historical and potential future undesirable results to the groundwater resources of the Subbasin from six sustainability indicators: chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, degraded water quality, land subsidence, and depletions of interconnected surface water.

The GSP established minimum threshold groundwater elevations, defined for the Oxnard Subbasin, as groundwater levels that: (1) limit seawater intrusion, and (2) allow declines in groundwater elevations during periods of future drought to be offset by recoveries during future periods of above-average rainfall (FCGMA 2019a). The GSP also established measurable objective groundwater elevations, which were defined as "the groundwater levels throughout the Subbasin at which there is neither seawater flow into, nor freshwater flow out of the UAS or LAS." (FCGMA 2019a). Minimum threshold and measurable objective groundwater elevations were established at 34 representative monitoring points (or "key wells") in the Oxnard Subbasin (Table 1). Collectively, these wells are screened in each of the five primary aquifers and are located in four of the five management areas established for the Subbasin (FCGMA 2019a).

The GSP documented conditions throughout the Oxnard Subbasin through the fall of 2015. The first annual report evaluated progress toward sustainability based on a review of groundwater elevation data, groundwater extraction data, surface water supply used, or surface water supply available for use, total water used, and change in groundwater storage between the fall of 2015 and the end of water year 2019[3]. This annual report documents the conditions in the Oxnard Subbasin and the progress toward sustainability for water year 2020.

1.2 Plan Area

The Oxnard Subbasin of the Santa Clara River Valley Groundwater Basin (DWR Bulletin 118 Groundwater Basin 4-004.02) is a coastal alluvial groundwater subbasin, underlying the Oxnard Plain in Ventura County, California (Figure 1-1 Vicinity Map for the Oxnard Subbasin). The Oxnard Subbasin is in hydrologic communication, to varying degrees with, the LPVB and PVB to the east, the Mound and Santa Paula Groundwater Subbasins of the Santa Clara River Valley Basin to the north, and with the Pacific Ocean to the west and southwest (FCGMA 2019a). The contact between permeable alluvium and semi-permeable rocks of the Santa Monica Mountains defines the southeastern boundary of the Oxnard Subbasin, and the Oak Ridge and McGrath faults form the northern boundary of the Oxnard Subbasin (DWR 2018). A facies change between the predominantly coarser-grained sand and gravel deposits that compose the UAS to the west and the finer-grained clay and silt-rich deposits of the UAS to

[3] A water year begins on October 1 and ends on September 30 of the following year. The convention for naming the water year is to name the water year based on the year in which it ends. For example, the 2019 water year begins on October 1, 2018, and ends on September 30, 2019.

the east defines the boundary between the Oxnard Subbasin and PVB. The boundary between the Las Posas Valley Basin to the northeast and Oxnard Subbasin to the southwest is a jurisdictional boundary that follows parcel lines (DWR 2018).

1.2.1 Climate

The climate of the Oxnard Subbasin is typical of coastal Southern California, with average daily temperatures ranging generally from 50°F to 78°F in summer and from 40°F to 75°F in the winter (FCGMA 2019a). The majority of the precipitation in the Ventura County region falls between November and April. Precipitation is measured at several stations in the Oxnard Subbasin (Figure 1-2; Precipitation and Stream Gauges in the Oxnard Subbasin). Water year precipitation, measured at Station 168, in the northwestern portion of the Subbasin is highly variable, ranging from 3.7 inches in 1990 to 38.1 inches in 1998 (Figure 1-3; Oxnard Subbasin Historical Water Year Precipitation). On average, the Subbasin received approximately 14.1 inches of precipitation per water year between 1957 and 2020.

The GSP for the Oxnard Subbasin included precipitation through the 2015 water year (FCGMA 2019a) and the 2020 annual report included precipitation for water years 2016 through 2019 (FCGMA 2020a). Between water years 2016 and 2019, the Subbasin experienced two above normal[4] water years (2017 and 2019), and two critical water years (2016 and 2018). Water year 2020 was a below normal water year, during which the Subbasin received 12.7 inches of rainfall. Overall, the Subbasin has continued to experience drier than average conditions since 2015.

1.2.2 Surface Water Bodies and Gauging Stations

The Santa Clara River, Revolon Slough, and Calleguas Creek are the predominant surface water bodies in the Oxnard Subbasin (FCGMA 2019a). All three surface water bodies drain watersheds that extend beyond the boundaries of the Subbasin. Neither the Revolon Slough nor Calleguas Creek are in direct contact with the primary aquifers in the Subbasin. These surface water bodies are separated from the underlying groundwater aquifers by extensive clay layers. In contrast, flow in the Santa Clara River, which generally parallels the northern boundary of the Subbasin, infiltrates into sediments overlying the Forebay Management Area (Figure 1-2) and is a critical source of recharge to the primary groundwater aquifers in the Subbasin. In addition to recharge provided by flow in the river channel, UWCD, under permit, diverts surface water from the Santa Clara River at the Freeman Diversion and discharges the diverted Santa Clara River flows to infiltration basins overlying the Forebay Management Area (Figure 1-2). West of the Forebay Management Area, the Santa Clara River channel overlies a confining clay layer and does not communicate directly with the confined aquifers of the UAS and the LAS.

Two stream gauges recorded average daily flows in the Oxnard Subbasin since 2015 (Table 1-1; Figure 1-4). These gauges are gauge 723 on the Santa Clara River, near Victoria Avenue, and gauge 776 on the Revolon Slough, at Pleasant Valley Road. Average daily flows for water years 2018, 2019, and 2020 measured at gauge 723 were not available during preparation of the water year 2020 Annual Report..

During water year 2020, gauge 776 measured stream flows for the period from October 1, 2019 through April 6, 2020. During this seven-month period, average daily flows ranged from approximately 2 to 180 cubic feet per

[4] Water years have been classified into five types based on their relationship to the mean water year precipitation. The five types are: critical, dry, below normal, above normal, and wet. Critical water years are < 50% of the mean annual precipitation. Dry water years are ≥ 50% and <75% of the mean annual precipitation. Below normal water years are ≥ 75% and <100% of the mean annual precipitation. Above normal water years are ≥ 100% and <150% of the mean annual precipitation. Wet water years are ≥ 150% of the mean annual precipitation.

second (cfs) and averaged approximately 11.9 cfs (Table 1-1, Figure 1-4). Between water years 2006 and 2019, flows measured at gauge 776 for the months of October through April averaged approximately 14.6 cfs, which is higher than the water year 2020 average flow. Lower than average flows measured in water year 2020 reflect the below-average water year type experienced within the Subbasin.

Table 1-1. Cumulative Daily Average Flows at VCWPD Gauges 723 and 776 in the Oxnard Subbasin

Water Year	Average Flow (cfs) at Gauge 723	Average Flow (cfs) at Gauge 776
2010	102.5	12.6
2011	167.5	19.3
2012	13.0	10.1
2013	0.6	11.2
2014	40.3	6.1
2015	5.0	7.0
2016	97.5	5.5
2017	1,049.5	5.7
2018	-Data Not Available-	12.2
2019	-Data Not Available-	9.0
2020	-Data Not Available-	11.9

Notes: cfs = cubic feet per second

1.3 Annual Report Organization

This is the second Annual Report prepared since the GSP for the Oxnard Subbasin was submitted to DWR. This report is organized according to the GSP Emergency Regulations. Chapter 1 provides the background information regarding the GSP, the Oxnard Subbasin, and the Fox Canyon Groundwater Management Agency. Chapter 2 provides information on the groundwater conditions in the Subbasin since 2015, including groundwater elevations, groundwater extractions, surface water supply, total water available, and change in groundwater storage. Chapter 3 provides an update on the GSP implementation process.

2 Groundwater Conditions

This chapter presents the change in groundwater conditions in the Subbasin from water year 2019. Comparison of water year 2020 conditions to water year 2019 conditions characterizes the impact that water year type, groundwater production, surface and recycled water availability, and surface water spreading in water year 2020 have had on groundwater conditions in the Subbasin. Additionally, data from water years 2016 through 2018 are provided as context. These data were discussed in detail in the first annual report (FCGMA 2020a).

2.1 Groundwater Elevations

2.1.1 Groundwater Elevation Contour Maps

Groundwater elevation contour maps for each aquifer in the Oxnard Subbasin are presented in Figures 2-1 through 2-10: the Oxnard aquifer in Figures 2-1 and 2-2, the Mugu aquifer in Figures 2-3 through 2-4, the Hueneme aquifer in Figures 2-5 through 2-6, the Fox Canyon aquifer in Figures 2-7 through 2-8, and the Grimes Canyon aquifer in Figures 2-9 through 2-10. These maps show the seasonal low (fall 2019) and high (spring 2020) groundwater elevations. Spring groundwater elevations were defined as any groundwater elevation measured within a six-week window between February 23 and April 4 of each year. This six-week window expands on the four-week window used when generating groundwater elevation contour maps for the 2020 Annual Report and for the GSP. This expansion was necessary to incorporate a similar spatial coverage of groundwater elevation measurements for comparison of groundwater contours, and corresponding changes in groundwater in storage, between water years 2016, 2017, 2018, 2019, and 2020. Fall groundwater elevations were defined as any groundwater elevation measured between September 30 and October 31 of each year. This four-week window is similar to the measurement window used to contour groundwater elevations in the 2020 Annual Report for the Oxnard Subbasin. The GSP recommended collecting groundwater elevations within a two-week window in the future (FCGMA 2019a). FCGMA has begun the process of prioritizing recommendations made in the GSP and evaluating the timeframe and feasibility of implementing these recommendations.

The groundwater elevation contour maps are based on the groundwater elevations measured at wells screened solely within an individual aquifer. The intent of using groundwater elevations from wells screened within a single aquifer is to accurately represent groundwater flow directions within an aquifer, as well as vertical gradients between aquifers. It is important to note, however, that throughout the Oxnard Subbasin, production wells are typically screened across multiple aquifers. Therefore, using wells only screened within an individual aquifer limits the spatial coverage for each contour map. This limitation is particularly apparent in an area of high groundwater production in the Oxnard Subbasin and adjoining PVB that extends south from Highway 101 (FCGMA 2019a). This area was identified as being impacted by groundwater production based on groundwater elevations measured in wells screened in multiple aquifers and was identified in the GSP as the Pumping Depression Management Area (FCGMA 2019a). By using wells screened only within an individual aquifer, the lateral extent of the pumping depression is not well characterized.

DWR installed a nested monitoring well cluster that uses two separate completions through its TSS program. The nested wells cluster is located adjacent to the Revolon Slough within the Pumping Depression Management Area. The shallow well cluster, which was completed on November 22, 2019, contains three monitoring wells individually screened in the Oxnard, Mugu, and Hueneme aquifers. The deep well cluster, which was completed on March 19, 2020, contains three monitoring wells individually screened within the Fox Canyon-Upper, Fox Canyon-Basal, and

Grimes Canyon aquifers. FCGMA anticipates that groundwater elevations measured at the shallow and deep well clusters will be available to incorporate into the 2022 Annual Report for the Oxnard Subbasin.

2.1.1.1 Oxnard Aquifer

Spring groundwater elevations in the western part of the Subbasin, near Port Hueneme, were approximately 3 to 7 feet higher in 2020 than 2019 (Figure 2-2; FCGMA 202a). Groundwater elevations in this region of the Subbasin in spring 2020, which ranged from approximately -9 feet mean sea level (ft msl) to -2 ft msl, were approximately 1 to 2 feet lower than groundwater elevations measured in spring 2015. Between spring 2015 and spring 2020, groundwater elevations near the coastline were consistently lowest in the southwestern portion of the Subbasin. Groundwater elevations measured at well 01S21W08L04 in spring 2020 were approximately 3 feet lower than spring 2019 conditions. However, groundwater elevations at wells 01N22W36K09, 01N21W31A09, 01N21W32Q06, and 01N21W31A08, to the north and farther inland from well 01S21W08L04, , either changed by less than 1 foot or increased by up to three feet between spring 2019 and spring 2020 (Figure 2-2).

In the central portion of the Subbasin adjacent to the boundary with the PVB, groundwater elevations were approximately 9 to 10 feet higher in spring 2020 than they were in spring 2019. Spring 2020 groundwater elevations in this area of the Subbasin are approximately 5 to 13 feet higher than spring 2015 groundwater elevations.

Seasonal low groundwater elevations in the Oxnard aquifer show similar trends in groundwater elevation changes as the changes observed between seasonal high groundwater elevations. Near the Pacific Ocean, groundwater elevations in the Oxnard Aquifer were approximately 1 to 5 feet higher in the fall 2019 than they were in fall 2018 (Figure 2-1; FCGMA 2020a). In the central and southeastern portion of the Subbasin, downgradient of the Forebay Management Area and adjacent to the PVB, groundwater elevations were approximately 10 feet higher in fall 2019 than in fall 2018. Fall 2019 groundwater elevations in this portion of the Subbasin are similar to groundwater elevation measured in fall 2015.

2.1.1.2 Mugu Aquifer

Groundwater elevations measured in spring 2020 rose by approximately 5 to 10 feet from spring 2019 conditions in the Mugu aquifer. In the Forebay Management Area, groundwater elevations ranged from approximately 1 ft to 40 ft msl. These groundwater elevations are approximately 20 to 40 feet higher than groundwater elevations measured in the Forebay Management Area in spring 2015, reflecting UWCD's spreading operations during water years 2019 and 2020 (See Section 2.3).

Groundwater elevations along the coast in the southwestern portion of the Subbasin and near the boundary between the Oxnard Subbasin and PVB, declined approximately 5 to 10 feet between spring 2019 and spring 2020 (e.g., 01N21W032Q05 and 01N21W31A07, Figure 2-4). Groundwater elevations in these areas were 2 to 5 feet higher than spring 2015 elevations.

Seasonal low groundwater elevations measured in the Forebay Management Area were approximately 35 feet higher in the fall of 2019 than they were in the fall of 2018 (Figure 2-3). During water year 2019, UWCD spread approximately 36,800 AF of surface water via the Saticoy, Noble, and El Rio spreading grounds (See Section 2.3).

The rise in groundwater elevations in the Forebay Management Area between fall 2018 and fall 2019 reflects UWCD's spreading operations during water year 2019.

Along the western boundary of the Subbasin, adjacent to the Pacific Ocean, fall groundwater elevations rose between 2018 and 2019. Near Port Hueneme, groundwater elevations at 01N22W29D04 rose by approximately 1 foot, while farther inland, groundwater elevations at 01N22W20J07 rose by approximately 5 feet. In the southwestern portion of the Subbasin, groundwater elevations rose by 2 to 7 feet. Between fall 2015 and fall 2019, groundwater elevations in the Mugu aquifer were consistently lowest in the southwestern portion of the Subbasin. In this region of the Subbasin, groundwater elevation changes between fall 2015 and fall 2019, from groundwater elevation declines of approximately 1 ft (e.g. 01N22W27R03) to groundwater elevations increases of approximately 3 ft (e.g.01N21W37Q05).

2.1.1.3 Hueneme Aquifer

Groundwater elevations in the Forebay Management Area of the Hueneme aquifer ranged from approximately -63 ft msl to approximately 17 ft msl (Figure 2-6). The groundwater elevation low in the Forebay of -63 ft msl, measured at well 02N22W23B04 (Figure 2-6), is approximately 5 feet higher than the lowest groundwater elevation measured in the Forebay Management Area in spring 2019. Conversely, the highest groundwater elevations measured in the Forebay Management Area in spring 2020 were approximately 60 feet lower than those measured in spring 2019. The difference in groundwater elevations measured in spring 2019 and spring 2020 reflects 2019 and 2020 spreading operations by UWCD and reduced pumping from the LAS in the Forebay Management Area (Table 2-3; Figure 2-17). Adjacent to the coast, groundwater elevations in the Hueneme aquifer were 5 to 10 feet higher in spring 2020 than in spring 2019 and were similar to spring 2015 elevations. Groundwater elevation recoveries along the coast are similar to recoveries measured near the boundary between the Oxnard Subbasin and PVB (e.g. 02N21W31P03, Figure 2-6).

In fall 2019, seasonal low groundwater elevations in the Forebay Management Area were approximately 20 to 40 feet higher than groundwater elevations measured in fall 2018. Along the coast, groundwater elevations in the Hueneme generally increased by 5 to 10 feet between fall 2018 and fall 2019. Seasonal low groundwater elevations measured in fall 2019 along the coast, near Port Hueneme, ranged from approximately 3 feet lower than fall 2015 conditions (e.g. 01N22W29D03) to approximately 1 foot higher than fall 2015 conditions (e.g. 01N22W20J05; Figure 2-5).

2.1.1.4 Fox Canyon Aquifer

Spring 2020 groundwater elevations in the Forebay Management Area of the Fox Canyon aquifer declined by approximately 5 to 15 feet from spring 2019 groundwater elevations. This decline is coincident with the below normal water year type that characterized water year 2020, which followed an above normal water year type in 2019. In the pumping depression management area (orange hashed region in Figure 2-8), groundwater elevations in spring 2020 were approximately 5 feet higher than they were in spring 2019. There are only four wells screened solely in the FCA in the Pumping Depression Management Area. As noted in Section 2.1, DWR recently completed construction of a shallow and deep monitoring well cluster to better constrain groundwater elevations in this region of the Subbasin (Figure 2-8).

Spring 2020 groundwater elevations in the southwestern portion of the saline intrusion management area (green hashed region of Figure 2-8) were approximately 10 feet lower than groundwater elevations measured in spring 2019.

In this region of the saline intrusion management area, groundwater elevations ranged from approximately -63 ft msl (measured at well 01N20W32Q04) to approximately -39 ft. msl (measured at well 01S22W01H02; Figure 2-8). These elevations are locally similar to spring 2015 groundwater conditions (e.g. 01N22W36K06; Figure 2-8), while also showing regions of local groundwater elevation recoveries of up to 10 feet (e.g. 01N21W32K01, Figure 2-8).

In the northwestern portion of the saline intrusion management area, near Port Hueneme, groundwater elevations rose by 5 to 10 feet between spring 2019 and spring 2020. Here, groundwater elevations ranged from approximately -31 ft msl (measured at well 01N22W29D01) to approximately -16 ft msl (measured at well 01N22W28G02; Figure 2-8). Groundwater elevations measured in spring 2020 near Port Hueneme were 1 to 2 feet higher than spring 2015 conditions.

Changes in seasonal low groundwater elevations in the FCA varied by geographic location. In the Forebay Management Area, groundwater elevations declined by approximately 15 to 20 feet between fall 2018 and fall 2019. Groundwater elevation changes within the pumping depression management area varied between groundwater elevation declines of approximately 1 foot (e.g. 02N21W33R02, Figure 2-7) to groundwater elevation recoveries of approximately 3 ft (e.g. 02N21W32E01, Figure 2-7). Well 01N21W06J05 was measured in fall 2019 but not in fall 2018 and provides additional characterization of groundwater elevations along the boundary between the Oxnard Subbasin and PVB (Figure 2-7). The fall 2019 groundwater elevation at well 01N21W06J05 was -151 ft msl, which is approximately 10-feet lower than water levels measured within the pumping depression management area in fall 2018.

Seasonal low groundwater elevations in the saline intrusion management area increased by approximately 5 to 10 feet at all wells except 01N21W36K07 and 01N21W36K06 between fall 2018 and fall 2019 (Figure 2-7). Within the saline intrusion management area, groundwater elevations ranged from approximately -110 ft msl (measured at well 01N21W36K06) to approximately -23 ft msl (measured at well 01N22W29D01; Figure 2-7). At wells 01N21W36K06 and 01N21W36K07, groundwater elevations declined by approximately 10 feet between fall 2018 and fall 2019. Seasonal low groundwater elevations in the saline intrusion management area range from approximately 1 foot lower than 2015 conditions (e.g. 01N22W36K07) to approximately 5 feet higher than 2015 conditions (e.g. 01N21W32K01; Figure 2-7).

2.1.1.5 Grimes Canyon Aquifer

There are only six wells screened solely in the Grimes Canyon aquifer, all of which are located in the southwestern part of the subbasin (Figures 2-9 and 2-10). Groundwater elevations declined in each of these wells between spring 2019 and spring 2020. The largest groundwater elevation declines during this period were measured at well 01S21W08L03, the southwestern-most well located within the saline intrusion management area, where groundwater elevations declined by approximately 13 feet between spring 2019 and spring 2020. Groundwater elevations measured along the coast in the Grimes Canyon aquifer were 1to 5 feet higher than those measured in spring 2015.

Fall groundwater elevations in the Grimes Canyon aquifer rose by approximately 3 to 10 feet between 2018 and 2019 and remained higher that groundwater elevations measured in fall 2015.

2.1.2 Groundwater Elevation Hydrographs

Groundwater elevation hydrographs for each of the key wells identified in the GSP are presented in Figures 2-11 through 2-15. These key wells are the designated representative monitoring sites for the Subbasin (FCGMA 2019a). The fall 2019 and spring 2020 water levels measured at each of these representative monitoring sites are presented in Table 2-1, which also provides a comparison of fall and spring water levels to: (i) water year 2019 conditions, (ii) the established minimum threshold groundwater elevations, (iii) the established measurable objective groundwater elevations, and (iv) the interim milestones for dry climate conditions. The dry climate interim milestone is used for comparison in this annual report because the precipitation measured in the Subbasin between water years 2016 and 2020 is below average. However, it should also be noted that the first interim milestone is set for 2025, not 2020, and the groundwater elevations in the representative wells screened in the Oxnard aquifer have five years to reach this first interim milestone.

In the fall of 2019, the groundwater elevations in the representative wells screened in the Oxnard aquifer were approximately 9 to 25 feet below the minimum thresholds (Table 2-1). In the spring of 2020, groundwater elevations in the representative wells screened in the Oxnard aquifer were approximately 7 to 15 feet below the minimum threshold for each well (Table 2-1; Figure 2-11). Groundwater elevations at each of the representative monitoring wells increased from the previous water year fall and spring measurement events. Fall groundwater elevations measured at the representative monitoring sites in Oxnard aquifer were below the interim milestones described in the GSP for dry climate conditions (Table 2-1; FCGMA 2019a). Groundwater elevations measured at wells 01N21W32Q06 and 01N22W26J04 in spring 2020 were higher than the 2025 interim milestones described in the GSP for dry climate conditions (Table 2-1; FCGMA 2019a).

In fall 2019, groundwater elevations were 23 to 100 feet below the minimum threshold groundwater elevations in all representative monitoring wells screened within the Mugu aquifer except well 02N21W07L06S. Well 02N21W07L06S is located in the Forebay Management Area, where groundwater elevations are influenced by water year type and surface water spreading operations. Since 2018, water levels measured at 02N21W07L06S have varied, with maximum groundwater elevations that exceed the established measurable objective and minimum groundwater elevations that drop below the established minimum threshold. The groundwater elevation measured at well 02N21W07L06S was approximately 6 feet higher than established minimum threshold groundwater elevation. At the other key wells, spring 2020 groundwater elevations ranged from approximately 16 to 60 feet below the minimum threshold groundwater elevations

Groundwater elevations were above the 2025 interim milestones in the Mugu aquifer in fall 2019 at wells 02N21W07L06S and 02N22W23B07S, which are both located in the Forebay Management Area (Table 2-1). Groundwater elevations measured at wells 01N21W32Q05S, 01N21W32Q07S, and 01N22W27C02S were below the 2025 interim milestone groundwater elevations in fall 2019 but were higher than the 2025 interim milestone groundwater elevations in spring 2020 (Table 2-1). These three wells are located near the coast, within the saline intrusion management area (Figures 2-3 and 2-4). Groundwater elevations in wells 01N21W32Q05S and 01N21W32Q07S declined by approximately 7 and 4 feet, respectively, from spring 2019 to spring 2020.

In the Hueneme aquifer, fall 2019 groundwater elevations measured at the representative monitoring sites were approximately 23 to 83 feet below the established minimum threshold groundwater elevations (Table 2-1). Groundwater elevations were 20 to 60 feet below the established minimum thresholds in spring 2020. Groundwater elevations remained below the 2025 interim milestones in all representative monitoring sites screened in the Hueneme except wells 02N22W23B05S and 02N22W23B06S. the groundwater elevations at these two wells, which are located in the Forebay Management Area, were approximately 5 to 15 feet higher than the 2025 interim milestones (Table 2-1).

In the fall of 2019, groundwater elevations in the representative monitoring wells screened in the Fox Canyon aquifer were approximately 28 to 78 feet lower than the minimum threshold groundwater elevations. Groundwater elevations in the representative monitoring wells screened in the FCA were approximately 11 to 60 feet lower than the minimum threshold groundwater elevations in the spring of 2020 (Table 2-1; Figure 2-39). Compared to fall 2018 and spring 2019 water levels, groundwater elevations increased in all the representative monitoring sites screened within the FCA except wells 01N21W32Q04S and 02N21W07L04S. Well 01N21W32Q04S is located in the saline intrusion management area and has historically exhibited seasonal water level fluctuations that vary by approximately 50 feet from seasonal high to seasonal low (Figure 2-14). Groundwater elevations at 01N21W32Q04S have risen since October 2016 (Figure 2-14). Well 02N21W07L04S is located in the Forebay Management Area and has historically exhibited annual water level fluctuations that exceed 100-feet in response to water year type and surface water spreading operations.

Spring 2020 groundwater elevations were higher than the 2025 interim milestone groundwater elevation for a dry climate in wells 01N21W32Q04, 01N22W26K03S, and 02N21W07L04. Groundwater elevations measured in wells 01N22W20J04, 01N23W01C02, and 02N22W23B03 were approximately 1 to 7 feet lower than the 2025 interim milestone groundwater elevations for a dry climate (Table 2-1).

Groundwater elevations measured at wells 01N21W32Q02 and 01N21W32Q03 in the Grimes Canyon aquifer were approximately 75 to 87 feet lower than the minimum threshold groundwater elevation in the fall of 2019 (Table 2-1). In the spring of 2020, groundwater elevations in these wells were approximately 38 to 49 feet lower than the minimum threshold groundwater elevations (Table 2-1; Figure 2-40). The spring 2020 groundwater elevations at wells 01N21W32Q02 and 01N21W32Q03 were approximately 8 and 11 feet lower, respectively, than groundwater elevations measured in spring 2019 (Table 2-1). The spring 2020 groundwater elevations were 11 and 7 feet higher than the interim milestone groundwater elevations for a dry climate (Table 2-1).

Table 2-1. Water Year 2020 Groundwater Elevations, Minimum Thresholds, Measurable Objectives, and Interim Milestones for Representative Monitoring Wells in the Oxnard Subbasin

Well Number	Aquifer	Fall Groundwater Conditions		Spring Groundwater Conditions		Minimum Threshold (ft MSL)	Measurable Objective (ft MSL)	2025 Interim Milestone Dry Climate (ft MSL)
		2019 Groundwater Elevation (ft MSL)	Change from 2018 to 2019 (feet)[a]	2020 Groundwater Elevation (ft MSL)	Change from 2019 to 2020 (feet)[a]			
01N21W32Q06S	Oxnard	-19.68	2.78	-10.82	0.14	2	17	-12
01N22W20J08S	Oxnard	-14.38	4.72	-8.71	6.06	7	17	-6
01N22W26J04S	Oxnard	-22.26		-13.01	4.25	2	17	-15
01N22W27C03S	Oxnard	-15.74		-8.48	5.41	7	17	-8
01N23W01C05S	Oxnard	-1.47	2.38	0.06	2.36	7	17	2
02N22W36E06S	Oxnard	NM		NM		12	37	-9
01N21W32Q05S	Mugu	-94.71	7.11	-57.53	-7.32	2	17	-63
01N21W32Q07S	Mugu	-63.74	5.4	-38.54	-3.97	2	17	-41
01N22W20J07S	Mugu	-15.28	5.68	-9.61	5.48	7	17	-8
01N22W26J03S	Mugu	NM		NM		2	17	1
01N22W27C02S	Mugu	-22.64		-12.97	5.71	7	17	-13
02N21W07L06S	Mugu	33.73		43.21	-6.87	27	62	10
02N22W23B07S	Mugu	-13.56	35.14	0.78	16.69	17	47	-14
02N22W36E05S	Mugu	-23.81		-10.41		12	37	-9
01N22W20J05S	Hueneme	-24.74	11.14	-19.16	6.75	2	17	-18
01N23W01C03S	Hueneme	-26.12	13.07	-22.26	7.30	7	22	-19
01N23W01C04S	Hueneme	-22.98	14.34	-18.83	7.12	7	22	-16
02N22W23B04S	Hueneme	-86.3	20.07	-63.55	5.66	-3	17	-63
02N22W23B05S	Hueneme	-56.74	24.71	-51.09	9.75	-3	17	-56
02N22W23B06S	Hueneme	-15.77	33.39	-3.90	16.66	17	47	-18
02N22W36E03S	Hueneme	-21.67		-16.27		12	37	3
02N22W36E04S	Hueneme	-28.92		-11.82		12	37	-11
01N21W32Q04S	Fox Canyon	-100.98	8.51	-62.81	-8.48	-23	2	-74
01N22W20J04S	Fox Canyon	-34.47	11.68	-27.22	5.96	2	17	-25
01N22W26K03S	Fox Canyon	NM		-43.74	1.75	-18	2	-54
01N23W01C02S	Fox Canyon	-31.33	11.42	-28.47	8.26	7	22	-22

Table 2-1. Water Year 2020 Groundwater Elevations, Minimum Thresholds, Measurable Objectives, and Interim Milestones for Representative Monitoring Wells in the Oxnard Subbasin

Well Number	Aquifer	Fall Groundwater Conditions		Spring Groundwater Conditions		Minimum Threshold (ft MSL)	Measurable Objective (ft MSL)	2025 Interim Milestone Dry Climate (ft MSL)
		2019 Groundwater Elevation (ft MSL)	Change from 2018 to 2019 (feet)[a]	2020 Groundwater Elevation (ft MSL)	Change from 2019 to 2020 (feet)[a]			
02N21W07L04S	Fox Canyon	-11.18	23.75	5.98	-14.65	17	42	-3
02N22W23B03S	Fox Canyon	-80.3	19.97	-63.64	5.65	-3	17	-62
01N21W32Q02S	Grimes Canyon	-98.53	9.03	-61.06	-11.59	-23	2	-73
01N21W32Q03S	Grimes Canyon	-110.08	8.72	-72.37	-7.56	-23	2	-80
01N21W07J02S	Multiple	-140.07	-4.33	-62.51	5.81	-38	2	-92
01N21W21H02S	Multiple	-128.63	8.41	-63.09		-68	-8	-111
02N21W07L03S	Multiple	-10.87	22.36	-1.51	-6.27	17	37	-3
02N21W07L05S	Multiple	27.73	39.63	42.34	-25.87	27	57	18

Notes: NM = Not Measured
[a]Data in this column shows the difference between water year 2020 and water year 2019 groundwater elevations measured at each representative monitoring site. Positive (+) values indicate that seasonal high or low groundwater elevations have increased from water year 2019 conditions. Groundwater elevation increases from 2019 conditions are presented in blue font. Negative (-) values indicate that seasonal high or low groundwater elevations have decreased from water year 2019 conditions. Groundwater elevation declines from 2019 conditions are presented in red font with a red-filled cell.

2.2 Groundwater Extraction

Historically, groundwater extractions in the FCGMA have been reported in two periods over the course of a single calendar year. Because groundwater extractions are not reported monthly, groundwater production cannot be reported on a water year basis. Therefore, the groundwater extractions reported in Table 2-2 and shown on Figures 2-16 and 2-17 follow the historical precedent and are for calendar years rather than water years[7] (Table 2-2). It should be noted that extractions reported for 2020 are preliminary and expected to change. Additional extraction reporting is anticipated.

On October 23, 2019, the FCGMA Board of Directors adopted an Ordinance to Establish an Allocation System for the Oxnard and Pleasant Valley Groundwater Basins. The new allocation system went into effect on October 1, 2020 and is designed to "facilitate adoption and implementation of the groundwater sustainability plan and to ensure that the Basins are operated within their sustainable yields" (FCGMA, 2019c). To facilitate implementation and assessment of the new allocation system, FCGMA is in the process of transitioning the groundwater extraction reporting period from a calendar year to a water year basis. The new reporting period went into effect on January 1, 2020 and requires local groundwater producers to report production from the months of October through September. Because this new reporting went into effect in January 2020, groundwater extractions reported for the 2020 period represent extractions for the period between January 1, 2020 through September 30, 2020.

[7] Groundwater Extractions for 2020 are reported during the period from January 1, 2020 through September 30, 2020.

Table 2-2. Calendar Year Groundwater Extractions in the Oxnard Subbasin by Aquifer System and Water Use Sector

Calendar Year	Upper Aquifer System (Acre-Feet)				Lower Aquifer System (Acre-Feet)				Wells in multiple or unassigned aquifer systems (Acre-Feet)				TOTAL (Acre-Feet)
	AG	*Dom*	*M&I*	*Sub-Total*	*AG*	*Dom*	*M&I*	*Sub-Total*	*AG*	*Dom*	*M&I*	*Sub-Total*	
2016	16,045	166	12,654	28,865	31,801	24	10,655	42,480	6,863	5	125	6,993	78,342[a]
2017	16,167	91	14,826	31,084	29,204	27	8,612	37,843	7,722	4	165	7,891	76,818
2018	14,746	70	17,040	31,857	26,191	24	6,596	32,811	7,489	2	184	7,675	72,343
2019[b]	13,238	57	17,540	30,835	22,447	26	6,564	28,128	7,146	36	580	7,761	66,724
2020[c]	7,348	40	14,724	22,112	13,040	8	4,629	17,677	5,327	17	675	6,019	45,808

Notes: AG = Agriculture ; Dom = domestic; M&I = Municipal and Industrial

[a] Total pumping in 2016 includes 4 acre-feet of groundwater production from the semi-perched aquifer that were used by the M&I sector.

[b] 2019 calendar year extractions updated based on receipt of additional extraction data made available after preparation of the 2020 Annual Report.

[c] Preliminary results are expected to change. Groundwater production is from January 1, 2020 through September 30, 2020.

The available data characterizing groundwater extractions between calendar years 2016 and 2019 indicate that groundwater extractions from the UAS increased in the Oxnard Subbasin while extractions from the LAS decreased (Table 2-2). The increase in UAS production is a result of increasing M&I extractions. Between calendar years 2016 and 2019, M&I extractions from the UAS increased by approximately 5,000 AFY; the increasing M&I production in the UAS was offset by a 5,000 AFY reduction in M&I pumping from the LAS.

Agricultural extractions between calendar years 2016 and 2019 decreased within the Oxnard Subbasin (Table 2-2). In the UAS, agricultural extractions declined by approximately 2,800 AFY between 2016 and 2019. Over the same period, agricultural extractions from the LAS declined by approximately 9,400 AFY. It should be noted, however, that a number of agricultural operators have not yet reported their 2019 and 2020 groundwater usage. Groundwater production from wells screened in both the UAS and LAS, and wells with unknown or unassigned screen intervals, increased by approximately 300 acre-feet between calendar years 2016 and 2019 (Table 2-2). Based on the available data, the total groundwater production in the Subbasin decreased by approximately 11,600 acre-feet between calendar years 2016 and 2019 (Table 2-2).

2.3 Surface Water Supply

The primary source of surface water in the Oxnard Subbasin is the Santa Clara River. The UWCD operates the Freeman Diversion, which allows UWCD to divert surface water from the Santa Clara River for delivery to agricultural users in the Oxnard Subbasin and PVB. Diverted surface water is also used to recharge groundwater aquifers in the Oxnard Subbasin via the UWCD spreading basins located in the Forebay Management Area. In addition to diversions from the Santa Clara River, a portion of the surface water diverted from Conejo Creek by CWD is supplied to the Pleasant Valley County Water District (PVCWD) for agricultural irrigation in the Oxnard Subbasin[8]. Surface water deliveries to the Oxnard Subbasin for water years 2016 through 2020 are reported in Table 2-3.

Table 2-3. Summary of Surface Water Deliveries to the Oxnard Subbasin

Water Year	PVCWD	United Water Conservation District			TOTAL (acre-Feet)
		Diversions of Santa Clara River Water			
	Conejo Creek Flows Delivered by CWD to PVCWD for Agriculture (acre-feet)	*PTP (Oxnard Subbasin Only) (acre-feet)*	*Used in Oxnard Subbasin (acre-feet)*	*Recharge to UWCD Spreading Basins (acre-feet)*	
		Total PTP Surface Water	*Total PVP Water for Agriculture*		
2016	1,038	0	0	2,209	3,247
2017	1,774	0	0	10,297	12,071
2018	1,854	0	0	3,126	4,980
2019	2,795	1,059	309	36,768	40,931
2020	2,310	2,494	944	28,327	34,097

Notes: PVCWD = Pleasant Valley County Water District; CWD = Camrosa Water District; PTP = Pumping Trough Pipeline; PVP = Pleasant Valley Pipeline

8 56% of the total CWD deliveries to PVCWD, and 56% of the total PVP surface water deliveries from UWCD, were assigned to the Oxnard Subbasin based on an analysis of the size of PVCWD's service area (FCGMA 2019a).

2.4 Total Water Available

Total water available was tabulated from the groundwater extractions reported in Table 2-2, the surface water supply reported in Table 2-3, and imported water, and recycled water used in the Subbasin. The total water available is reported in Table 2-4 by water year. In order to convert the reported groundwater production from calendar year to water year, 25% of the groundwater production from a given calendar year was assigned to the following water year, and the 75% of the calendar year production was assigned to the current water year. This division, while approximate, is based on the monthly split between water year and calendar year, with January through September (75% of the calendar year) belonging to the current water year, and October through December (25% of the calendar year) belonging to the following water year. Preliminary advanced metering infrastructure (AMI) data reported to FCGMA indicates that this division is reasonable for M&I and domestic groundwater extractions. AMI data from agricultural users in the Subbasin indicate that production can be highly variable, but preliminary data suggest the January through September period accounts for 70% of the total calendar year extractions, while the October through December period accounts for the remaining 30% of the total calendar year extraction. To account for this newly available data, agricultural extractions for water year 2020 are displayed using both the 75%-25% division and the 70%-30% division (italicized). Using this AMI data results in a difference in water year extractions of approximately 2,600 AF, or 7% of the total agricultural extractions for the water year.

As noted in Section 2.2, FCGMA is in the process of switching reporting periods to the water year. When FCGMA groundwater extraction reporting is shifted to a water year schedule, this approximation will no longer be necessary.

Table 2-4. Total Water Available in the Oxnard Subbasin

Water Year	Groundwater [a] (acre-feet)			Surface Water (acre-feet)				Imported Water (acre-feet)	Recycled Water [b] (acre-feet)	TOTAL (acre-feet)
	Ag	*Dom*	*M&I*	*Ag*	*Dom*	*M&I*	*Recharge*	*M&I*	*Ag*	
2016	55,025	195	23,741	1,038	0	0	2,209	11,313	136	93,657
2017	53,479	141	23,562	1,774	0	0	10,297	10,740	1,135	101,128
2018	49,593	103	23,766	1,854	0	0	3,126	12,171	2,194	92,807
2019	44,230	13	23,786	4,163	0	0	36,768	9,998	0	119,675
2020[c]	36,424	94	25,971	5,770	0	0	28,327	9,712	0	106,297

Notes: NR – not reported

a) Groundwater production by water year is estimated from groundwater production by calendar year.
b) Recycled water is from reported GREAT program deliveries to SSF, DRIS-2, and DAVIS
c) Groundwater extraction reporting for 2020 is preliminary and expected to change. Additional extraction reporting is anticipated. Groundwater production is from January 1, 2020 and through September 30, 2020..

2.5 Change in Groundwater Storage

Change in storage estimates were calculated for each principal aquifer in the Subbasin by comparing season high groundwater elevations between 2015 and 2020. Annual change in storage for water years 2016 through 2020 are presented in Tables 2-5a and 2-5b. The change in storage for each principal aquifer between spring 2019 and spring 2020 shown on Figures 2-18 through 2-22. Change in storage for each principal aquifer was calculated using the change in groundwater elevation and the aquifer storage properties defined by the Ventura Regional Groundwater Flow numerical model (UWCD, 2018). Annual and cumulative change in storage for the UAS and LAS are shown in Figures 2-23 and 2-24.

Change in groundwater elevations was calculated by mapping the spring 2015 through spring 2020 groundwater elevation contours onto a uniform grid that covered the areal extent of the Subbasin. Each grid was assigned a groundwater elevation equal to half the elevation of the up-gradient and down-gradient contours. This way the seasonal high groundwater elevation in each grid cell could be subtracted from the previous seasonal high groundwater elevation in the same cell to generate a gridded map of groundwater elevation change on the same scale as the grid used in the Ventura Regional Groundwater Flow numerical model. Change in storage was subsequently calculated for each grid cell using the aquifer properties defined for each grid cell in the model and the change in elevation between sequential spring groundwater measurements (FCGMA 2019b).

Groundwater elevations were not measured over the same areal extent in each aquifer during the spring of each water year. The data coverage between consecutive water years and the common area between all the years for each aquifer is shown as the area within the black line on Figures 2-18 through 2-22.

2.5.1 Oxnard Aquifer

Groundwater in storage increased between spring 2019 and spring 2020 by approximately 11,100 AF (Table 2-5a). This increase in storage was the result of a rise in groundwater elevations near the Forebay Management Area, along the boundary with PVB, and along the coast near Port Hueneme (Figure 2-18). In the central and southwestern portions of the Subbasin, groundwater in storage showed no measurable change from spring 2019 to spring 2020. Since spring 2015, groundwater in storage within the Oxnard aquifer has increased by a cumulative volume of approximately 14,200 AF (Table 2-5a).

2.5.2 Mugu Aquifer

Groundwater in storage within the Mugu aquifer increased by approximately 170 AF between spring 2019 and spring 2020 (Table 2-5a). Geographically, the increase in storage was the result of groundwater elevations in the central portion of the Subbasin that were approximately 10 feet higher than they were in spring 2019 (Figure 2-19). It should be noted, that in this portion of the Subbasin, groundwater contours are largely constrained by water levels measured at a two wells (02N22W36E04 and 01N22W02A02, Figure 2-19) and the resulting estimate of storage change in this portion of the Subbasin is sensitive to the availability of data at these locations. The newly constructed shallow monitoring well cluster located near the boundary between the Oxnard Subbasin and PVB will help constrain groundwater elevations moving into the future. Groundwater in storage along the coast, in the southwestern portion of the Subbasin showed little to no change, or declined, between spring 2019 and 2020.

Since spring 2015, groundwater in storage within the Mugu aquifer has increased by a cumulative volume of approximately 180 AF (Table 2-5a).

2.5.3 Hueneme Aquifer

Groundwater elevation data coverage in the Hueneme aquifer in water years 2016 through 2020 limited the overall area of the aquifer in which change in groundwater storage could be calculated (Figure 2-20). Groundwater storage in the area of the Hueneme aquifer for which data was available, increased between spring 2019 and spring 2020 (Table 2-5a, Figure 2-20).

The change in storage volume presented in the 2020 Annual Report for the period between spring 2018 and spring 2019 reflected an error in the change in storage calculation that biased the result. This calculation was corrected as part of the 2021 Annual Report and the corrected value is presented in Table 2-5a. The corrected change in storage estimate is approximately 70 AF lower than the change in storage volume presented for the same period in 2020 Annual Report. The cause of the error and reconciliation is described in Appendix A.

2.5.4 Fox Canyon Aquifer

Change in groundwater storage in the FCA was calculated for the majority of the area of the Oxnard Subbasin (Figures 2-21). Change in groundwater in storage varied across the Oxnard Subbasin geographically. In the Forebay Management Area, groundwater elevations were lower at 02N22W07L03 and 02N22W 07L04 than spring 2019 conditions causing a reduction in groundwater in storage in the northern reaches of the Subbasin. Directly adjacent, and downgradient of these wells, groundwater elevations increased by approximately 20 feet (e.g. see well 02N22W17F05, Figure 2-21), causing an increase in groundwater in storage along the boundary between the Oxnard Subbasin and the LPVB. Along the coast, groundwater in storage increased between spring 2019 and spring 2020.

Overall, there was a net increase in groundwater in storage of approximately 190 AF between spring 2019 and spring 2020 in the FCA (Table 2-5a). Since the spring of 2015, groundwater in storage within the FCA has increased by approximately 900 AF (Table 2-5a).

2.5.5 Grimes Canyon Aquifer

The Grimes Canyon aquifer is limited to the southern and eastern parts of the Oxnard Subbasin (Turner 1975). In addition to the limited aerial extent of the Grimes Canyon aquifer, groundwater elevation data coverage in the Grimes Canyon aquifer in water years 2016 through 2020 limited the overall area of the aquifer in which change in groundwater storage could be calculated (Figures 2-22). Groundwater storage in the area of the Grimes Canyon aquifer, for which data was available, showed no net change between spring 2019 and spring 2020. Geographically, groundwater storage decreased in the southwestern-most part of the Subbasin and then increased, or showed no measurable change, west of well 01N22W36K05 (Figure 2-22).

2.5.6 Total Change in Storage in the Subbasin

The change in groundwater in storage was calculated for each aquifer in the Subbasin and summed by aquifer system (Tables 2-5a and 2-5b; Figures 2-23 and 2-24). Between spring 2019 and spring 2020, groundwater in storage increased by approximately 11,300 AF, which resulted in a cumulative increase in storage in the UAS since spring 2015 of approximately 14,400 AF. In the LAS, groundwater in storage increased by approximately 200 AF between spring 2019 and spring 2020. Since spring 2015, groundwater in storage in the LAS has increased by a cumulative volume of approximately 1,000 AF (Table 2-5b). The combined change in storage within the UAS and LAS since spring 2015 is an increase of approximately 15,400 AF (Table 2-5b). However, it should be noted that the change in storage volumes reported in Tables 2-5a and 2-5b are an approximate change in storage over the areas of the aquifers in which groundwater elevations were measured.

Annual and cumulative change in storage from 1985 through 2015 were reported in the GSP (FCGMA 2019a). The change in storage volumes reported in the GSP were extracted from the UWCD model and covered the entire lateral extent of each aquifer in the Subbasin. Therefore, the results of the long-term change in storage calculations presented in the GSP cannot be directly compared to the change in storage calculations conducted for this GSP annual update. In general, however, the trends shown in the GSP and annual update agree. On average, the model calculated annual change in storage in the UAS is approximately 10 times the change in storage in the LAS between 1985 and 2015.

Additionally, the change in storage reported for this annual update does not account for seawater intrusion that is known to occur in the Subbasin when groundwater elevations are below the minimum thresholds described in the GSP (FCGMA 2019). As groundwater elevations decline, seawater intrudes the Subbasin, which slows the decline of the groundwater elevations, but replaces fresh water in storage with saltwater. Therefore, the change in storage calculated for this annual report using groundwater elevations that are influenced by potential seawater intrusion may be an underestimate of the total change of fresh water in storage experienced by the Subbasin between water years 2016 and 2020.

Table 2-5a. Annual Change in Groundwater Storage in the Oxnard Subbasin

Water Year	Water Year Type	Oxnard Subbasin							
		Oxnard Aquifer (acre-feet)	*Mugu Aquifer (acre-feet)*	*UAS Annual (acre-feet)*	*Hueneme Aquifer (acre-feet)*	*Fox Canyon Aquifer (acre-feet)*	*Grimes Canyon Aquifer (acre-feet)*	*LAS Annual (acre-feet)*	*Combined Annual (acre-feet)*
2016	Critical	-9,686	-198	**-9,884**	-34	-121	-13	**-168**	**-10,053**
2017	Above Normal	5,365	155	**5,520**	61	524	17	**601**	**6,121**
2018	Critical	-10,173	-209	**-10,382**	-73	-603	-2	**-678**	**-11,061**
2019	Above Normal	17,638	257	**17,895**	53[a]	923	3	**980**	**18,951**
2020	Below Normal	11,103	173	**11,276**	40	185	-2	**223**	**11,499**

[a]Annual storage change reported in the 2020 annual report reflects an error in the storage change calculation. 2019 water year storage change updated as part of the 2021 annual report and described in Appendix A.

Table 2-5b. Cumulative Change in Groundwater Storage in the Oxnard Subbasin

Water Year	Water Year Type	Oxnard Subbasin		
		UAS Cumulative (acre-feet)	*LAS Cumulative (acre-feet)*	*Combined Cumulative Change in Storage (acre-feet)*
2016	Critical	-9,884	-168	**-10,053**
2017	Above Normal	-4,365	433	**-3,932**
2018	Critical	-14,747	-245	**-14,993**
2019	Above Normal	3,147	734[a]	**3,882**
2020	Below Normal	14,423	957	**15,381**

[a]Annual storage change reported in the 2020 annual report reflects an error in the storage change calculation. 2019 water year storage change updated as part of the 2021 annual report and described in Appendix A

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3 GSP Implementation Progress

The GSP for the Oxnard Subbasin was submitted to DWR in January 2020. This is the second annual report to be prepared since the GSP was submitted. The GSP implementation progress reported in this report covers work begun during development of the GSP as well as development of projects and management actions over the 15 months since the GSP was submitted.

Project Implementation Progress

During development of the GSP, FCGMA identified Oxnard Pumping Depression Management Area, adjacent to the boundary between the Oxnard Subbasin and the PVB, as a critical area in which aquifer specific groundwater elevations were lacking. This is an area of known groundwater production, with wells in the area typically screened in multiple aquifers in the LAS. DWR has installed two nested monitoring well clusters to monitor water levels in the individual principal aquifers in the Oxnard Subbasin Pumping Depression Management Area (Figure 2-22). These nested monitoring wells were installed specifically to address the spatial data gap identified in the GSP. Groundwater elevation data from these wells will be incorporated into the next annual report, to better represent groundwater conditions in the Oxnard Subbasin and adjacent PVB.

Since completing the GSP, FCGMA continued conducting stakeholder meetings and in June 2020 a facilitator provided through DWR's Facilitation Support Services program began leading meetings. Participants in these meetings, which targeted stakeholders in both the Oxnard Subbasin and PVB, identified a suite of projects that could help the basins achieve sustainability by 2040. Significant additional projects to those identified in the GSP are included. Upon additional evaluation, the projects committee of the stakeholder group recommended a subset of the projects identified for further assessment and modeling. FCGMA is working with UWCD to develop the numerical groundwater model scenarios that will be used to evaluate the potential effectiveness of the projects identified. DWR funding for the facilitator expired at the end of 2020, but FCGMA contracted with a new facilitator and continues to meet with stakeholders in the Oxnard Subbasin and PVB. The FCGMA Board of Directors continues to prioritize stakeholder feedback in the implementation phase of the GSP, because of the vital role stakeholders play in ensuring the long-term sustainable use of groundwater resources in the Oxnard Subbasin.

Management Action Implementation Progress

FCGMA has made progress on several management actions since publication of the 2020 annual report. First, the allocation system for the Oxnard and Pleasant Valley Basins adopted by the FCGMA Board in 2019 went into effect on October 1, 2020. This allocation system is designed to "facilitate adoption and implementation of the groundwater sustainability plan and to ensure that the Basins are operated within their sustainable yields" (FCGMA, 2019c). As part of the new allocation system, FCGMA changed the reporting time periods for groundwater production to better quantify groundwater production by water-year, rather than calendar year. Additionally, under the new allocation system pumpers will transition from a well-based to a land-based reporting system. Both sets of changes will allow for improved management of the Oxnard Subbasin and PVB, which are managed jointly by the FCGMA, and a more comprehensive understanding of the water use requirements that drive groundwater production in the two basins.

Second, in anticipation of the additional reporting associated with implementing the allocation ordinance, FCGMA is conducting an analysis of its data management system needs. The updated data management system will incorporate the new AMI data and will be structured to allow for land-based extraction assignments. Changes to the data management system will target the specific needs of the FCGMA moving toward sustainable management of the Oxnard Subbasin and PVB by 2040.

Third, FCGMA has begun to evaluate implementing a replenishment fee that could be used to purchase water for recharge in the Oxnard Subbasin or to help fund a voluntary temporary fallowing program to reduce groundwater demand. These management actions can be implemented over a shorter time period than large capital projects and, while not sufficient on their own to achieve sustainability, play an important role in progressing toward sustainable use of the groundwater resources in the Oxnard Subbasin.

The progress made over the past year on projects and management actions applicable to the Oxnard Subbasin demonstrates FCGMA's commitment to allocating the necessary time and resources to achieve long-term sustainable management of the groundwater resources of the Oxnard Subbasin.

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4 References

DWR (California Department of Water Resources). 2018. *California's Groundwater, Bulletin 118*. 2018 Groundwater Basin Boundaries – 4-004.02 Santa Clara River Valley- Oxnard. Published https://water.ca.gov/SearchResults?sort=asc&search=B118%20Basin%20Boundary%20Description%202016&primaryFilters=&secondaryFilters=&tab=documents. Accessed February 17,2020.

DWR (California Department of Water Resources). 2020. DWR SGMA Portal Website: All submitted GSPs. https://sgma.water.ca.gov/portal/gsp/all. Accessed February 17, 2020.

FCGMA (Fox Canyon Groundwater Management Agency). 2019a. Groundwater Sustainability Plan for the Oxnard Subbasin.

FCGMA (Fox Canyon Groundwater Management Agency). 2019b. Groundwater Sustainability Plan for the Las Posas Valley Basin – Appendix K.

FCGMA (Fox Canyon Groundwater Management Agency). 2019c. Ordinance to Establish a New Pumping Allocation System for the Oxnard and Pleasant Valley Basins.

FCGMA (Fox Canyon Groundwater Management Agency). 2020a. Oxnard Subbasin Groundwater Sustainability Plan 2020 Annual Report: Covering Water Years 2016 through 2019.

Turner, J.M. 1975. "Aquifer Delineation in the Oxnard–Calleguas Area, Ventura County." In *Compilation of Technical Information Records for the Ventura County Cooperative Investigation: Volume I,* 1–45. Prepared by the Ventura County Public Works Agency Flood Control and Drainage Department for the California Department of Water Resources.

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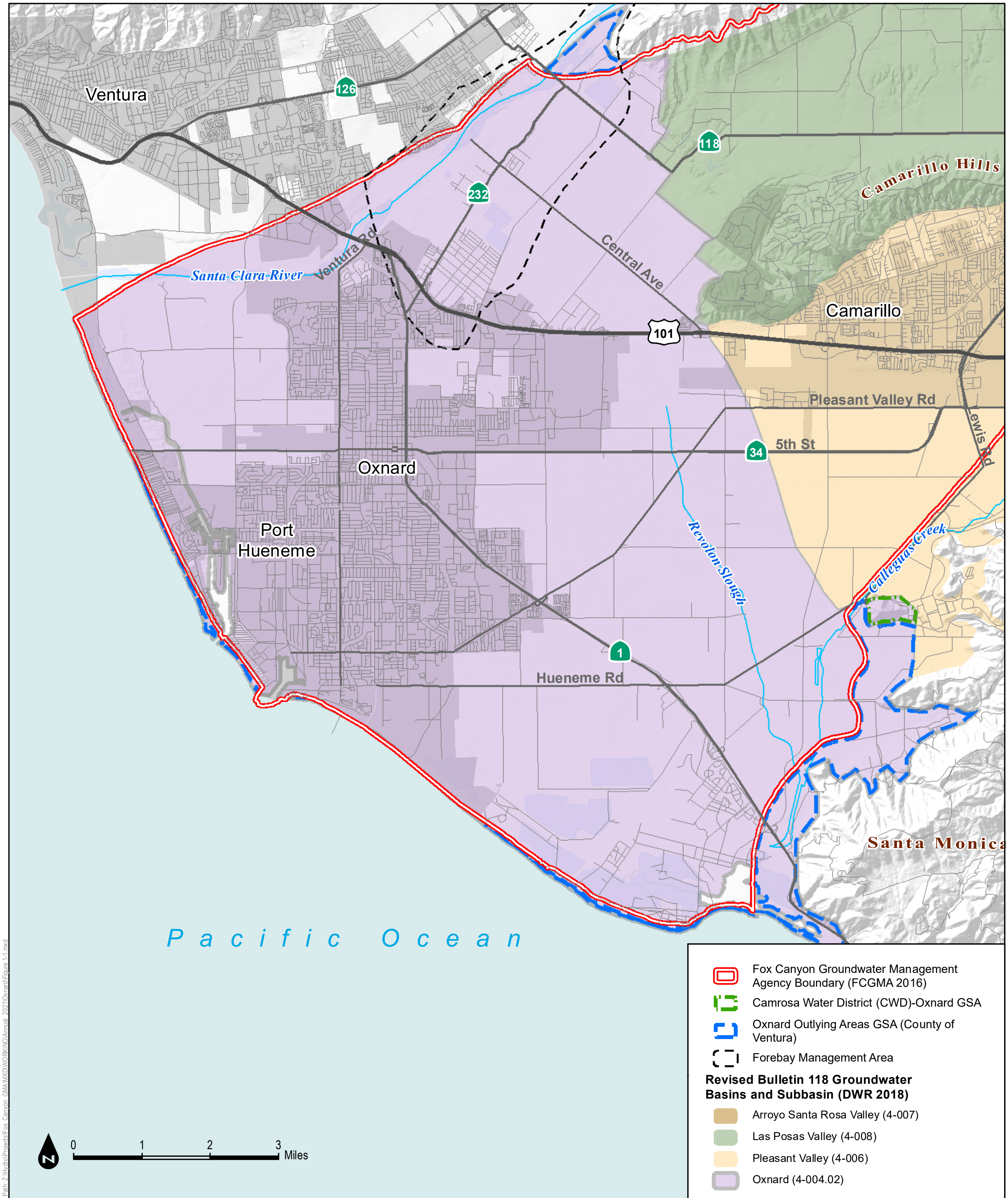
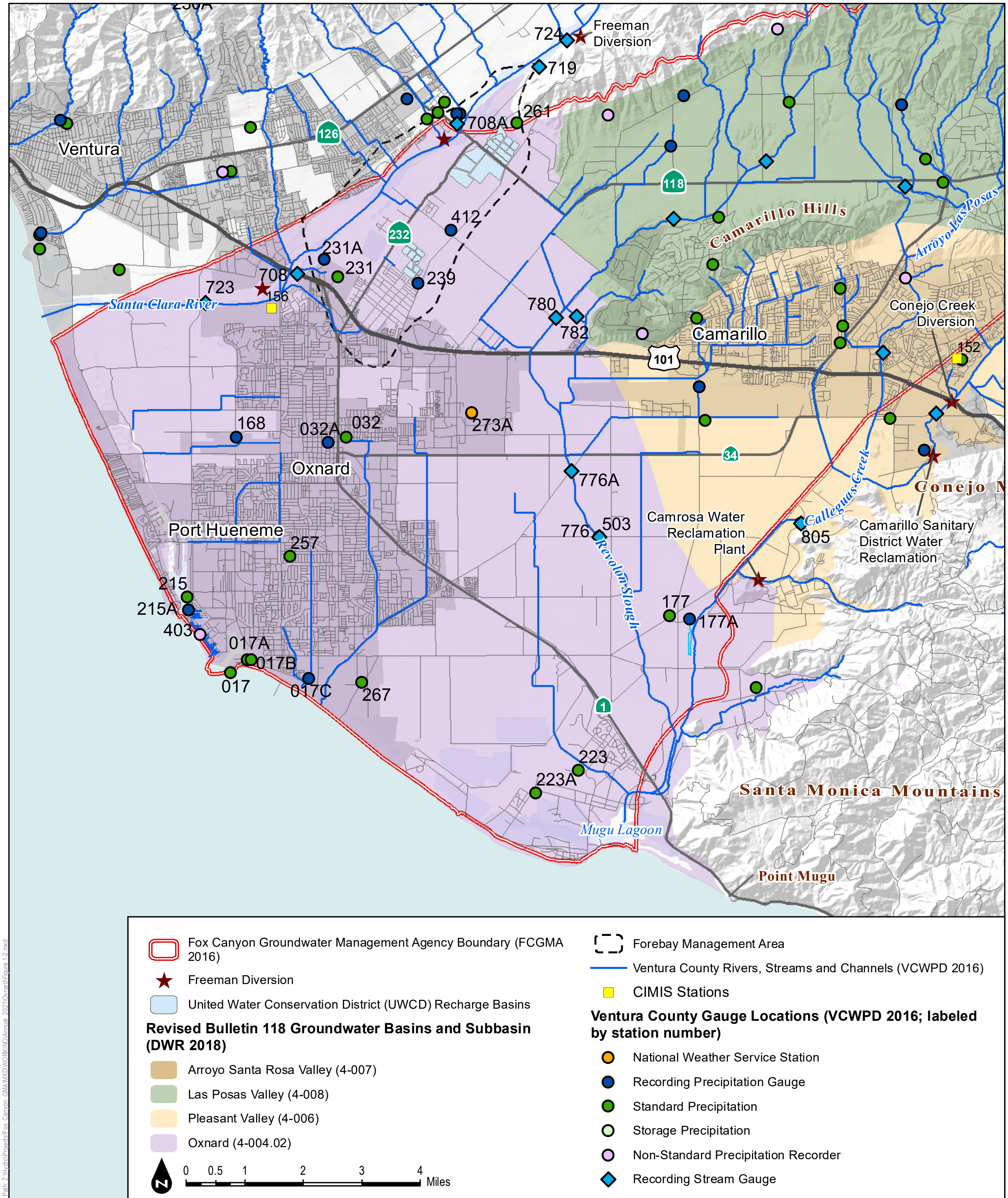


DUDEK

SOURCE: DWR; Santa Barbara County; FCGMA

FIGURE 1-1

Vicinity Map for the Oxnard Subbasin



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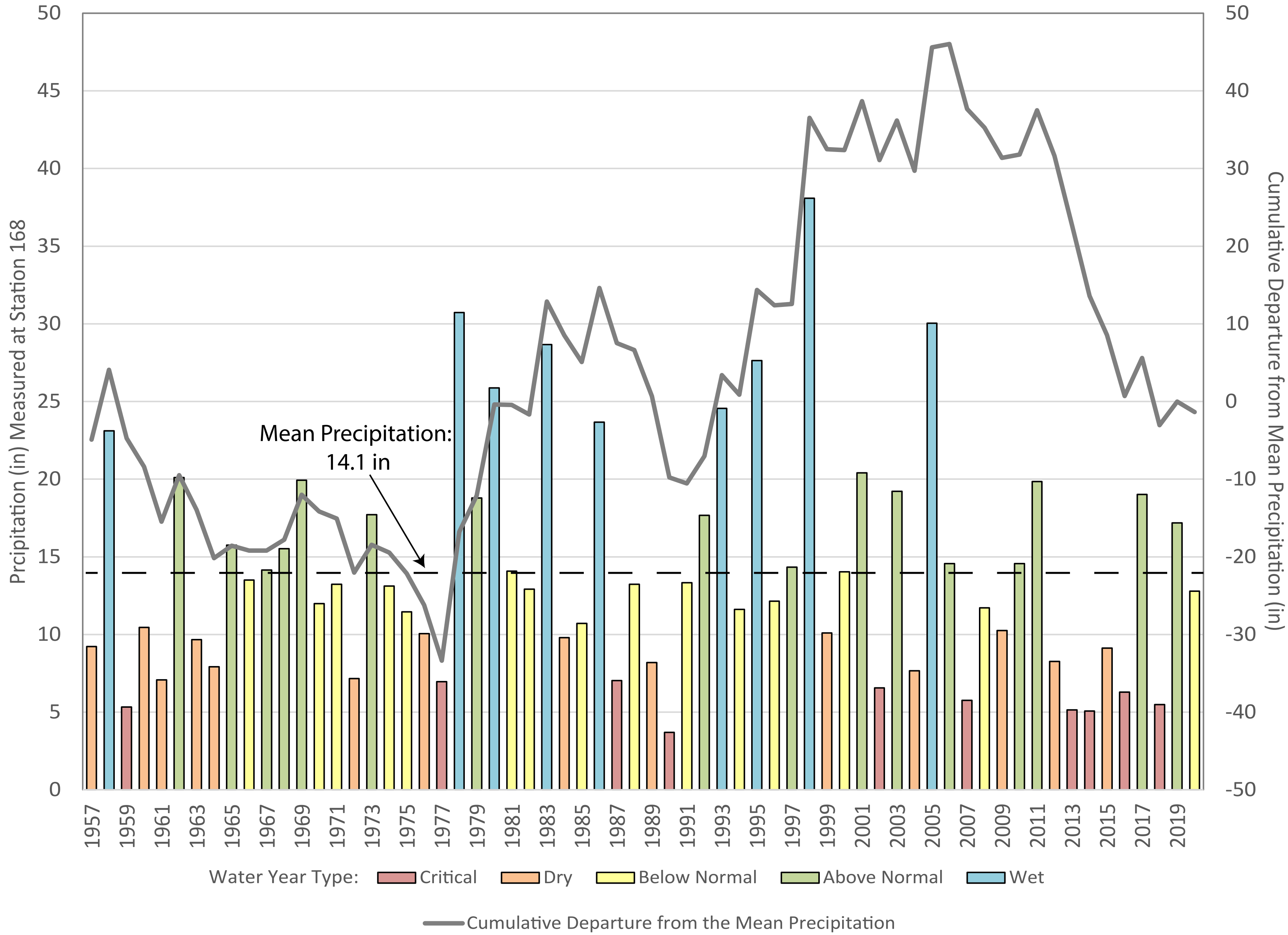
SOURCE: DWR; Santa Barbara County; VCWPD; USGS NHD

FIGURE 1-2

Weather Stations and Stream Gauge Locations

Oxnard Subbasin Groundwater Sustainability Plan 2021 Annual Report



Note: Water year is from October 1 through September 30. Water year type is based on the percentage of the water year precipitation compared to the mean precipitation. Types are defined as: Wet (≥150% of mean), Above Normal (≥100% to <150% of mean), Below Normal (≥75% to <100% of mean), Dry (≥50% to <75% of average), and Critical (<50% of mean)

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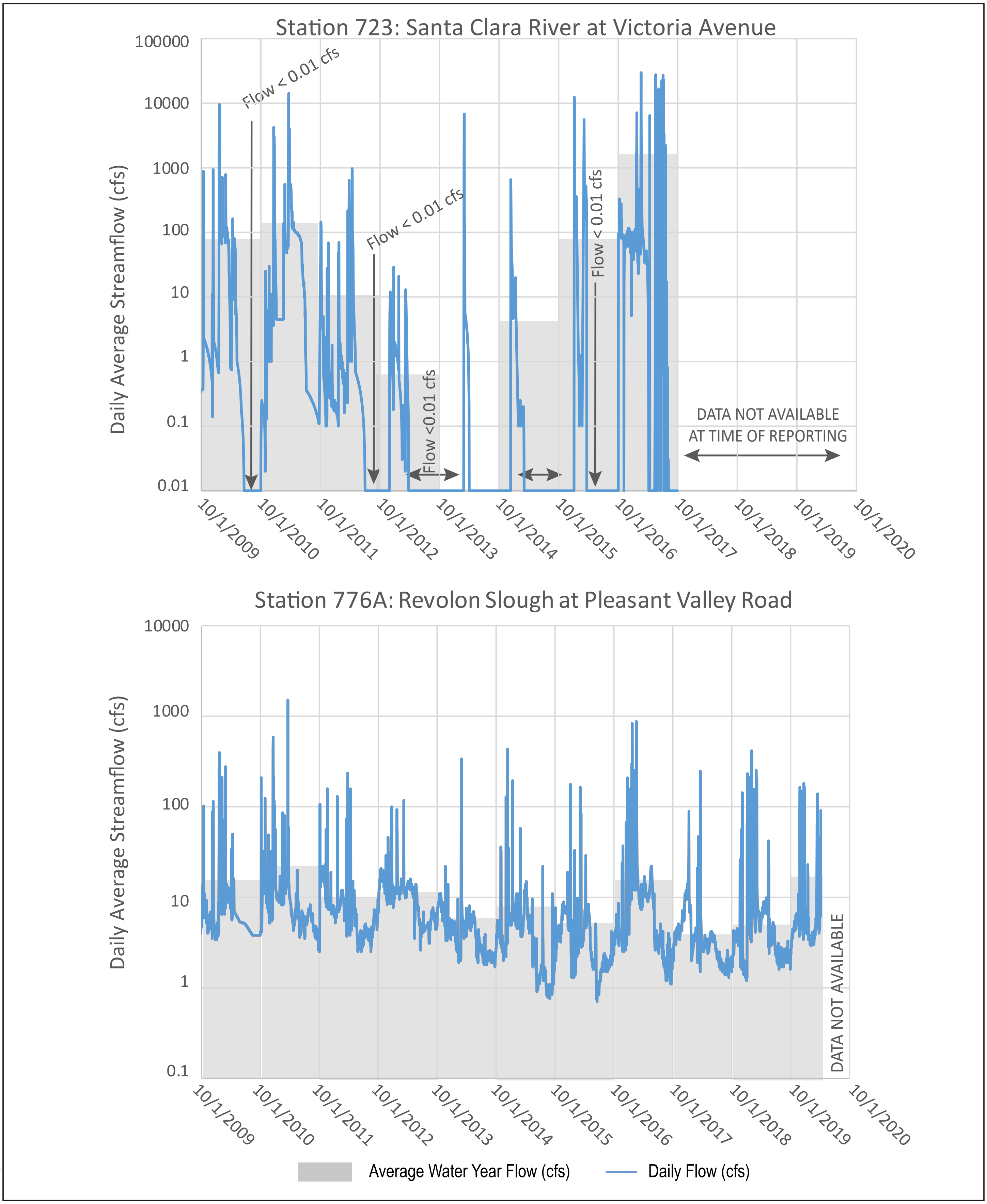
FIGURE 1-3

Oxnard Subbasin Historical Water Year Precipitation

Oxnard Subbasin Groundwater Sustainability Plan 2021 Annual Report



SOURCE: Ventura County Watershed Protection District (VCWPD) Hydrologic Data Server (https://www.vcwatershed.net/hydrodata/)

FIGURE 1-4

Oxnard Subbasin Stream Gauge Data

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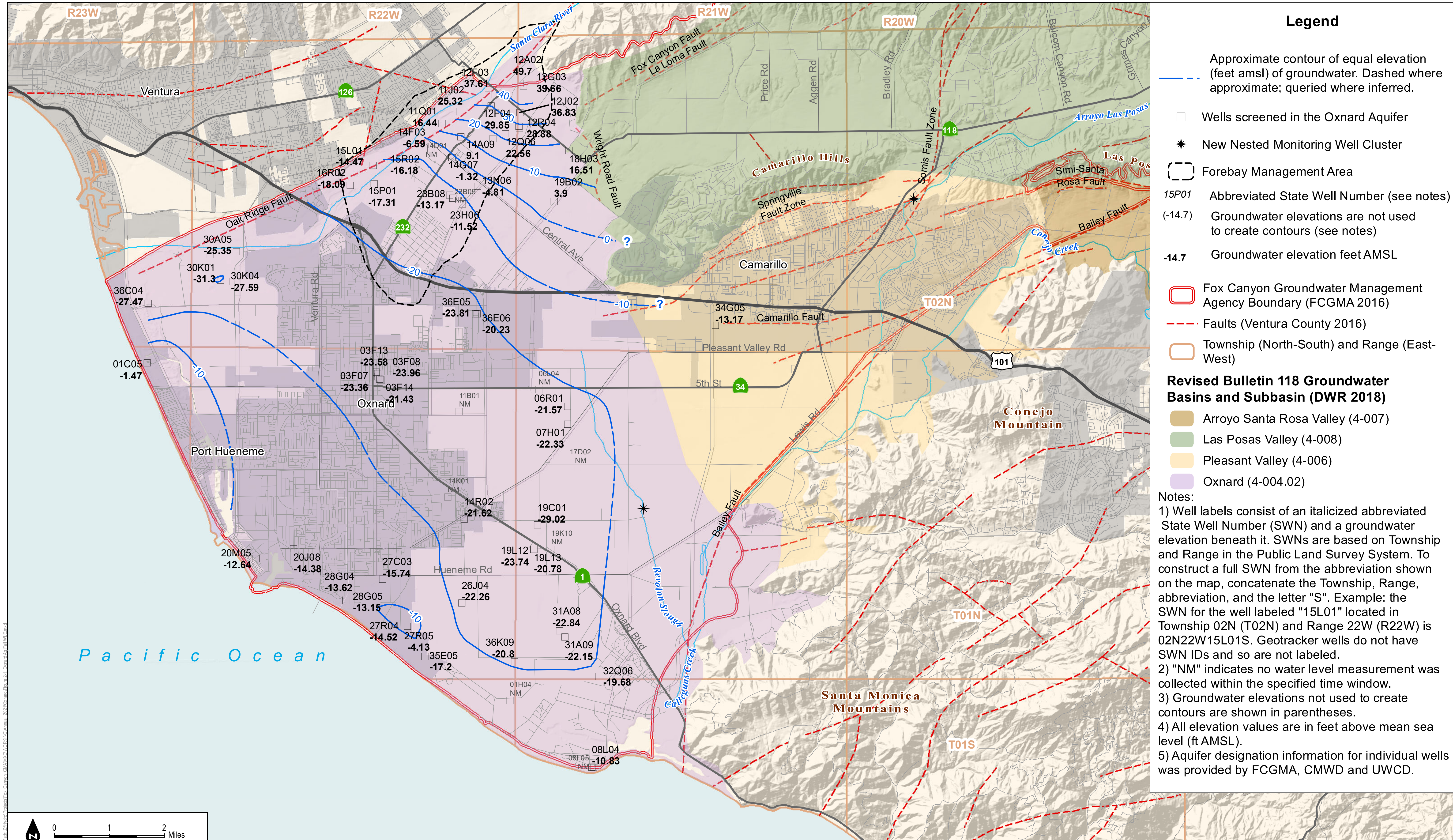

SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 2-1

Groundwater Elevation Contours in the Oxnard Aquifer, September 30 to October 31, 2019

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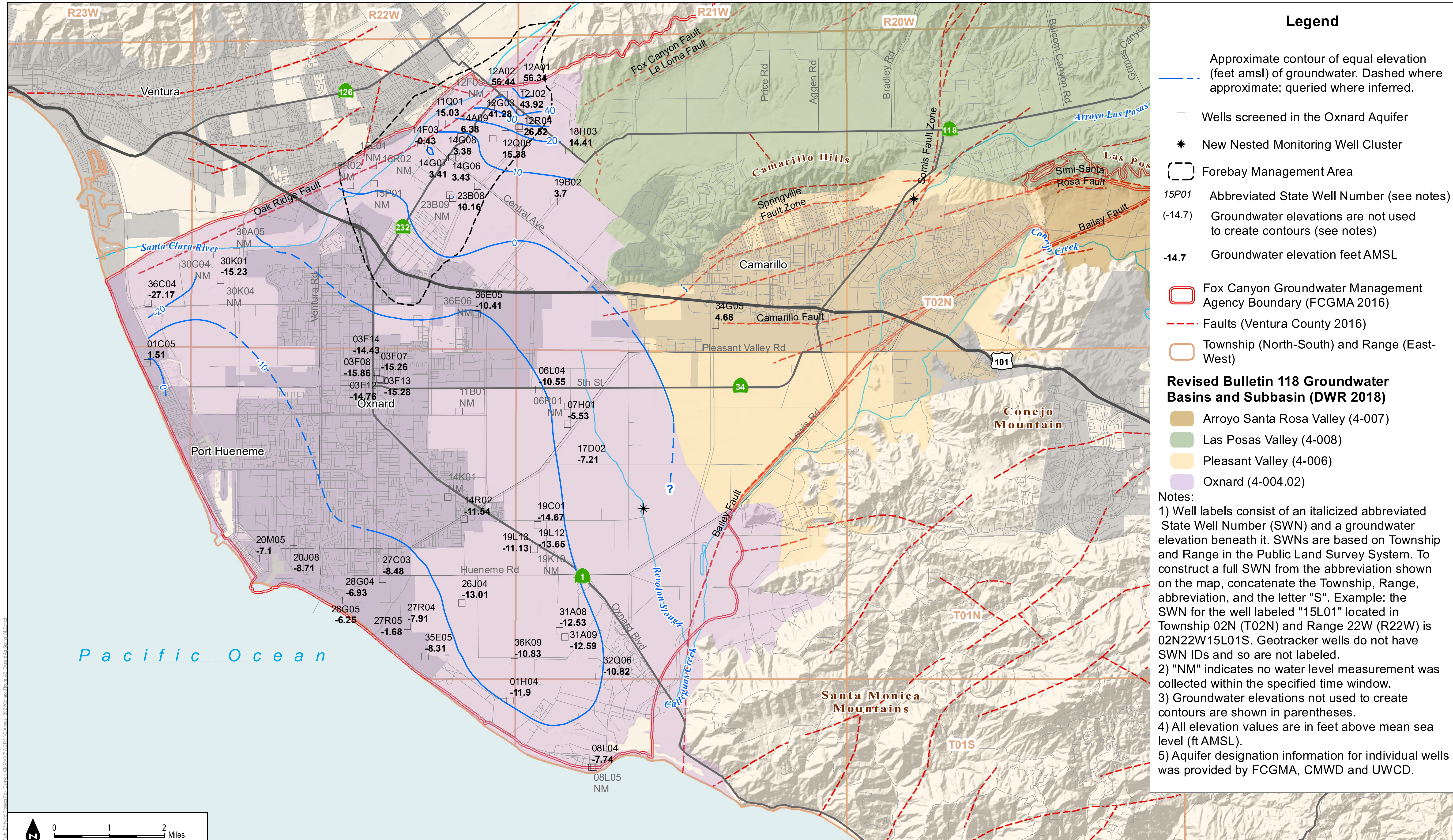
Oxnard Subbasin Groundwater Sustainability Plan 2021 Annual Report

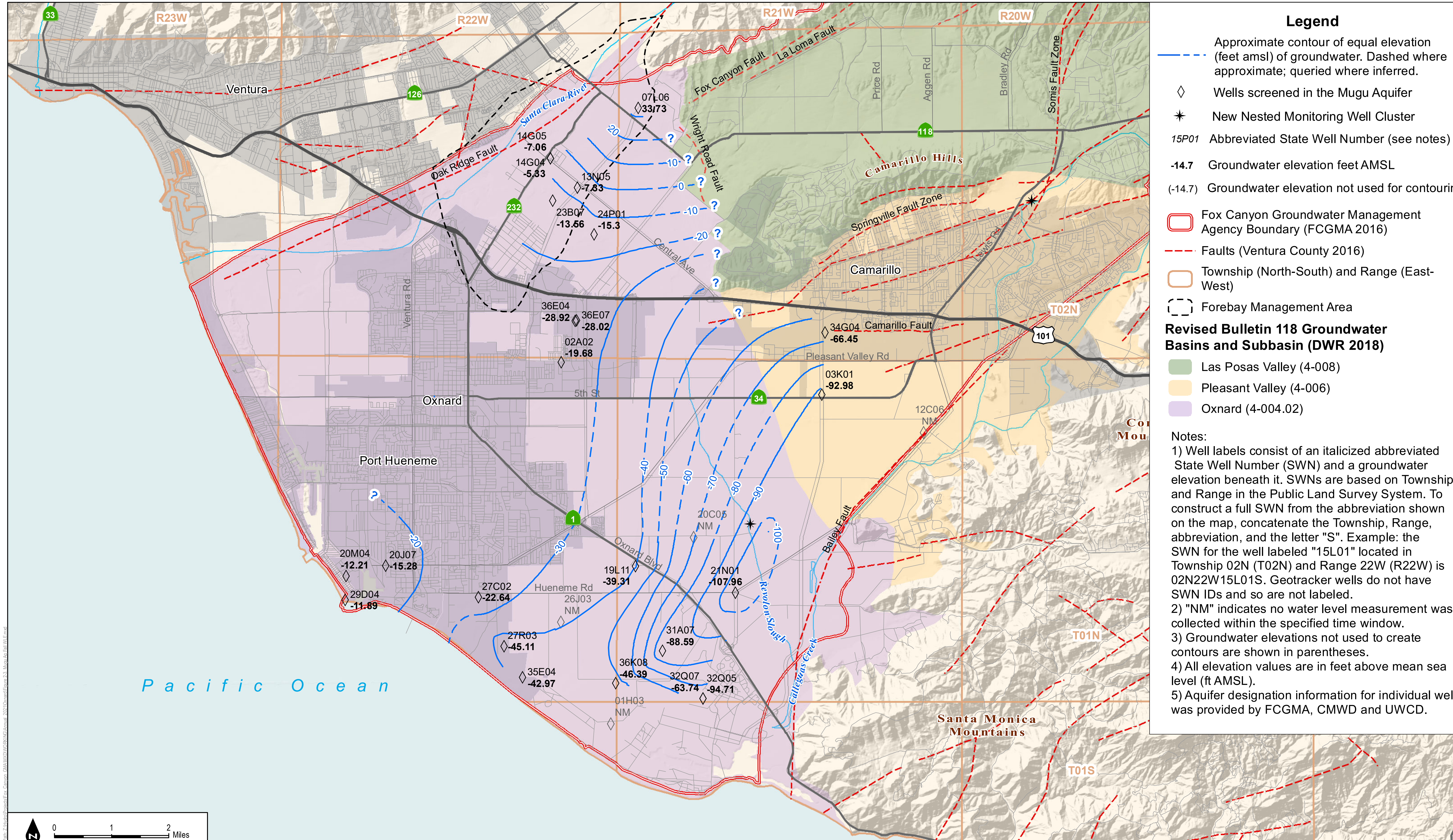


SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 2-2

Groundwater Elevation Contours in the Oxnard Aquifer, February 23 to April 4, 2020

DUDEK



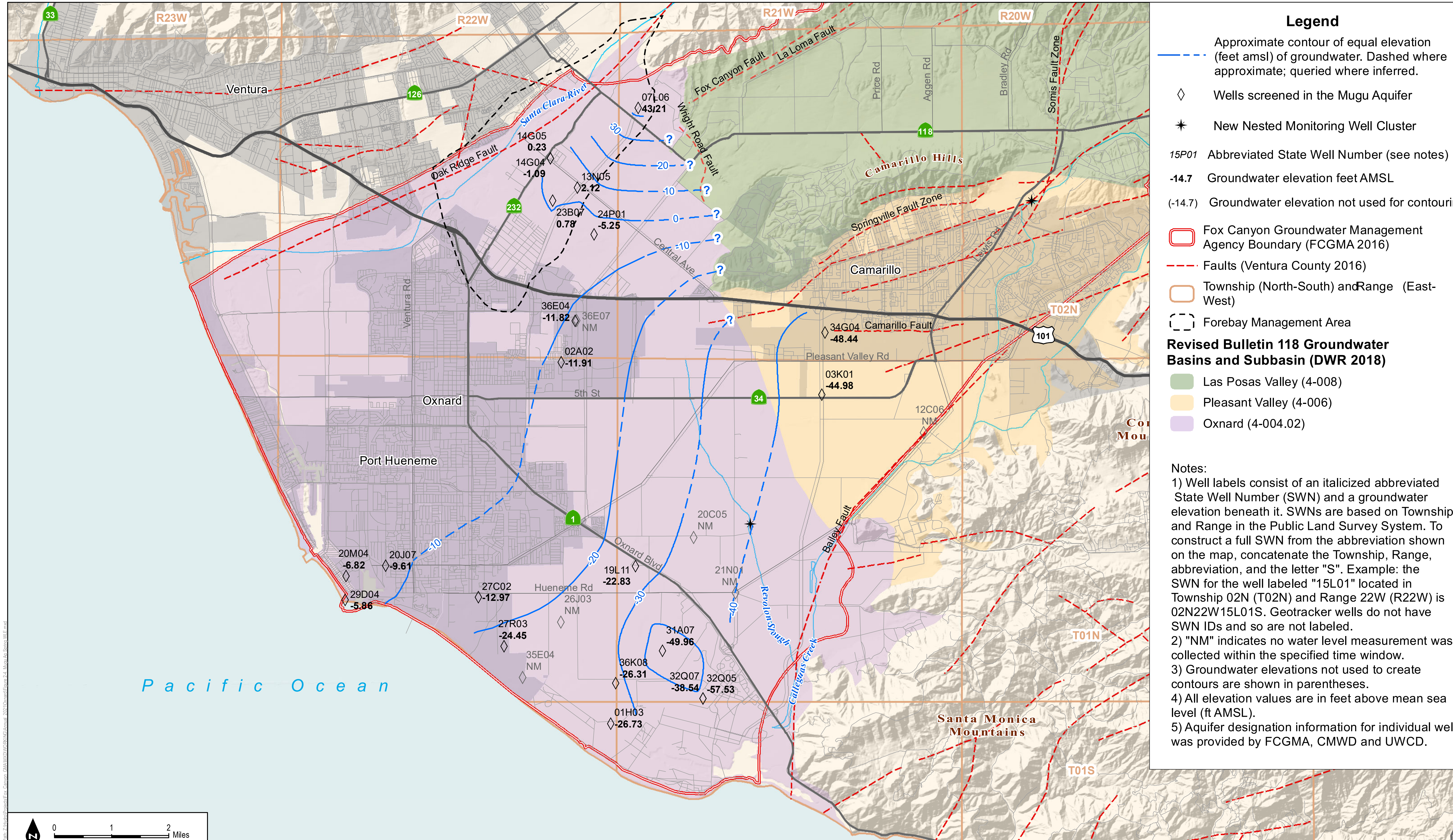
SOURCE: DWR; Ventura County; UWCD; CMWD

DUDEK

FIGURE 2-3

Groundwater Elevation Contours in the Mugu Aquifer, September 30 to October 31, 2019

Oxnard Subbasin Groundwater Sustainability Plan 2021 Annual Report



SOURCE: DWR; Ventura County; UWCD; CMWD

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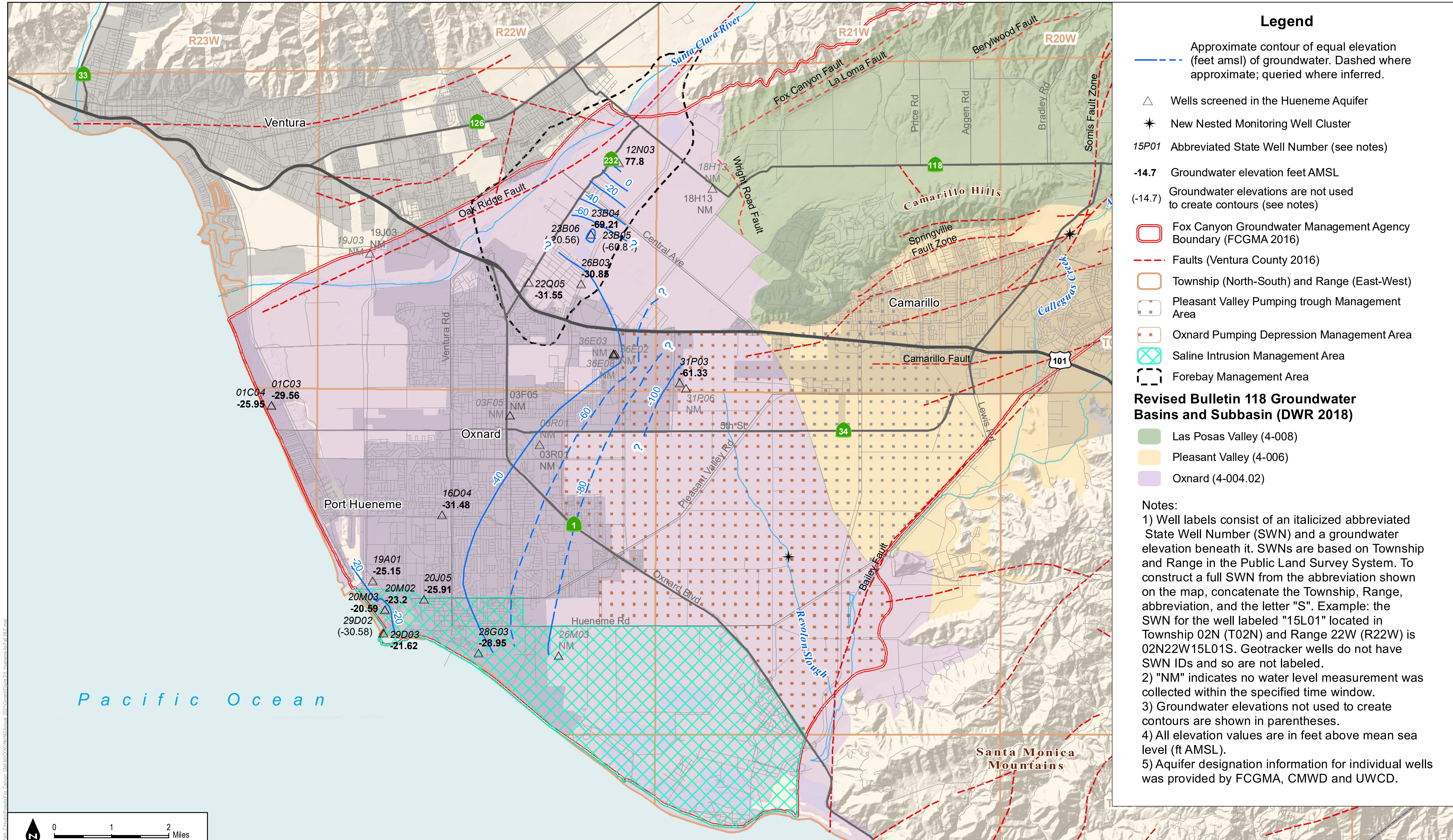
FIGURE 2-4

Groundwater Elevation Contours in the Mugu Aquifer, February 23 to April 4, 2020

Oxnard Subbasin Groundwater Sustainability Plan 2021 Annual Report



SOURCE: DWR; Ventura County; UWCD; CMWD

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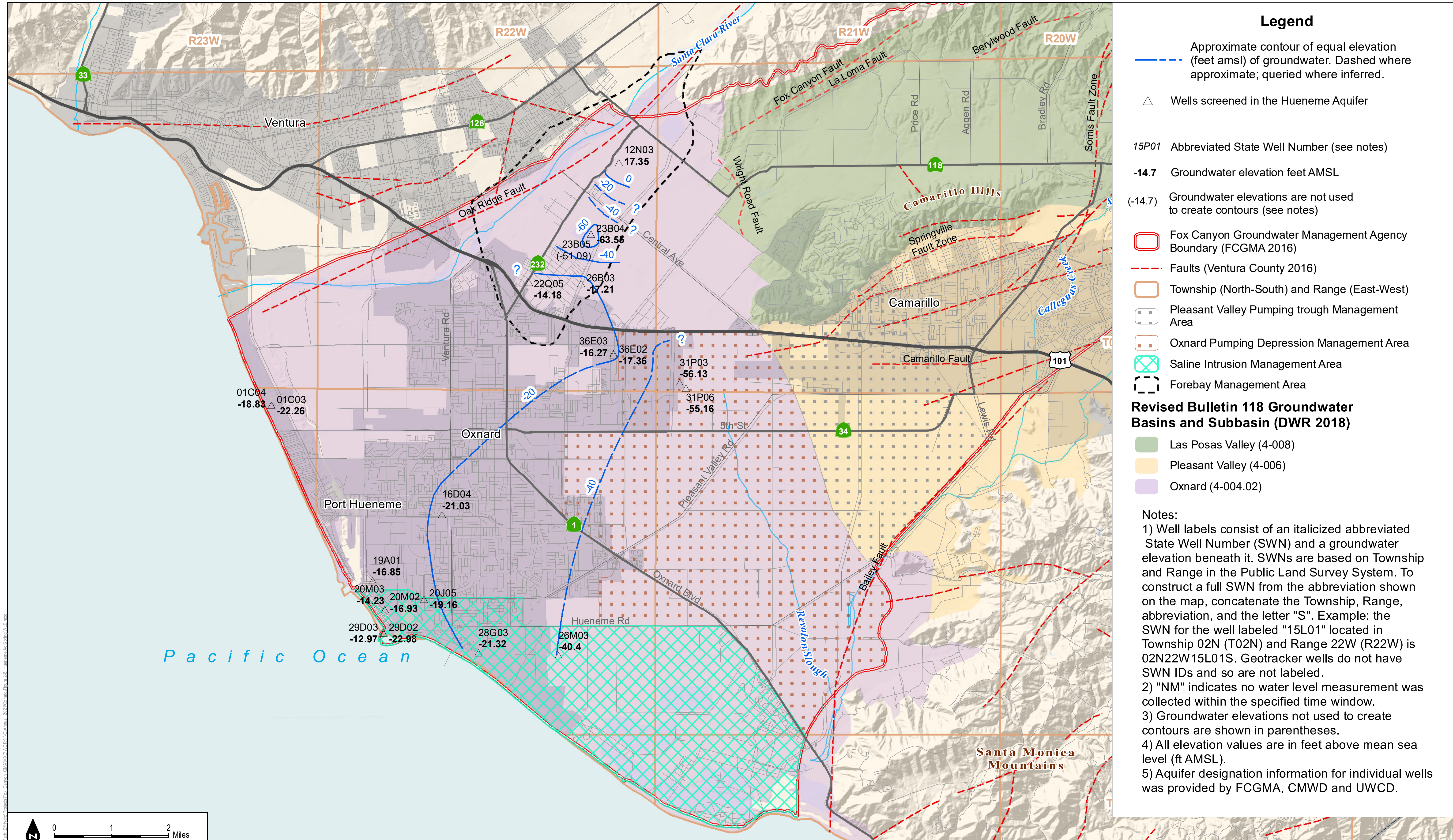
FIGURE 2-5

Groundwater Elevation Contours in the Hueneme Aquifer, September 30 to October 31, 2019

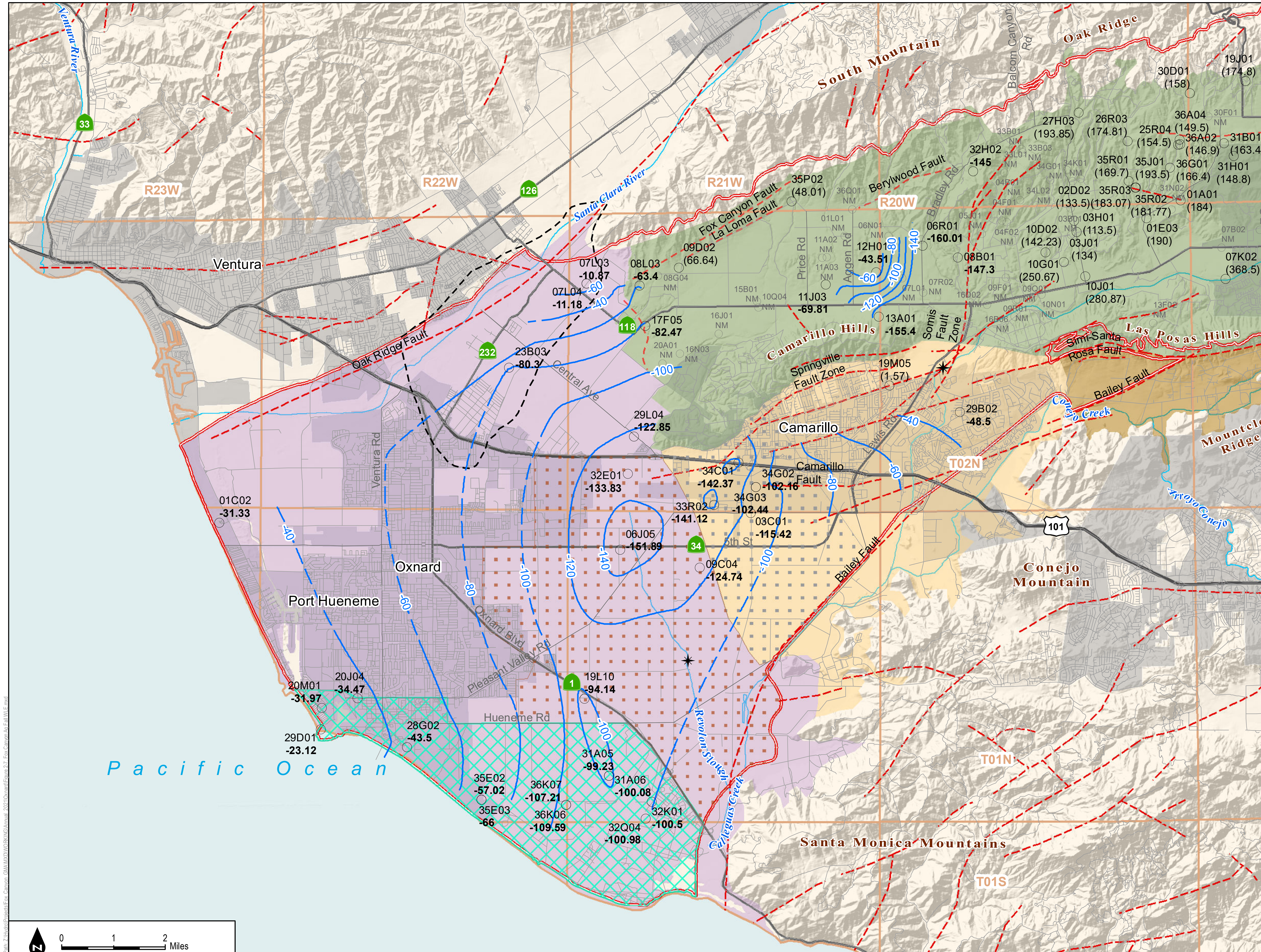


SOURCE: DWR; Ventura County; UWCD; CMWD

DUDEK

FIGURE 2-6

Groundwater Elevation Contours in the Hueneme Aquifer, February 23 to April 4, 2020



Legend

- Approximate contour of equal elevation (feet amsl) of groundwater. Dashed where approximate; queried where inferred.
- Wells Screened in the Fox Canyon Aquifer
- New Nested Monitoring Well Cluster
- *15P01* Abbreviated State Well Number (see notes)
- **-14.7** Groundwater elevation feet AMSL
- (-14.7) Groundwater elevations are not used to create contours (see notes)
- Fox Canyon Groundwater Management Agency Boundary (FCGMA 2016)
- Faults (Ventura County 2016)
- Forebay Management Area
- Oxnard Pumping Depression Management Area
- Pleasant Valley Pumping trough Management Area
- Saline Intrusion Management Area
- Township (North-South) and Range (East-West)

Revised Bulletin 118 Groundwater Basins and Subbasin (DWR 2018)

- Arroyo Santa Rosa Valley (4-007)
- Las Posas Valley (4-008)
- Pleasant Valley (4-006)
- Oxnard (4-004.02)

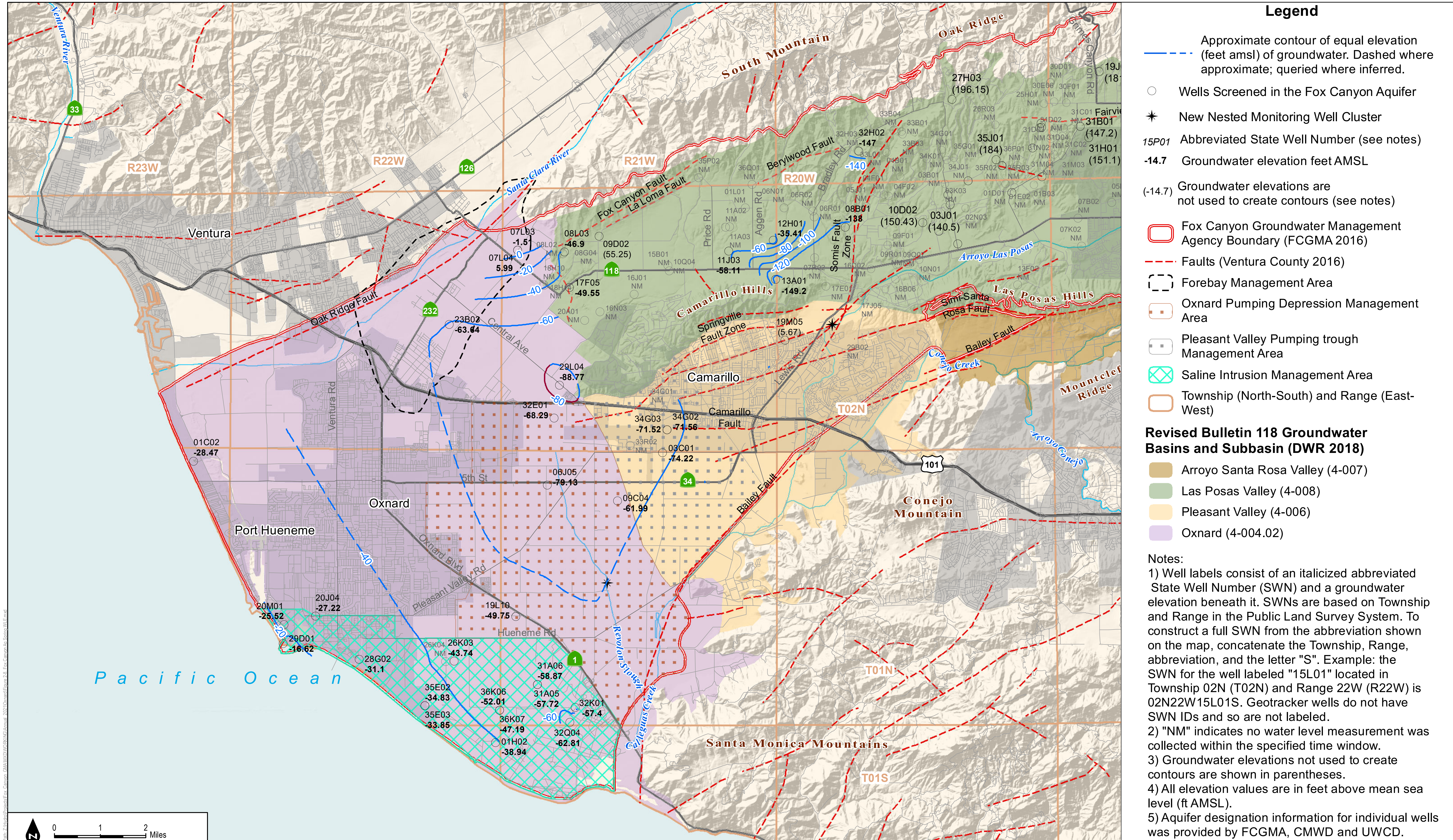
Notes:
1) Well labels consist of an italicized abbreviated State Well Number (SWN) and a groundwater elevation beneath it. SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S". Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S. Geotracker wells do not have SWN IDs and so are not labeled.
2) "NM" indicates no water level measurement was collected within the specified time window.
3) Groundwater elevations not used to create contours are shown in parentheses.
4) All elevation values are in feet above mean sea level (ft AMSL).
5) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

DUDEK

SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 2-7

Groundwater Elevation Contours in the Fox Canyon Aquifer, September 30 to October 31, 2019



SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 2-8

Groundwater Elevation Contours in the Fox Canyon Aquifer, February 23 to April 4, 2020

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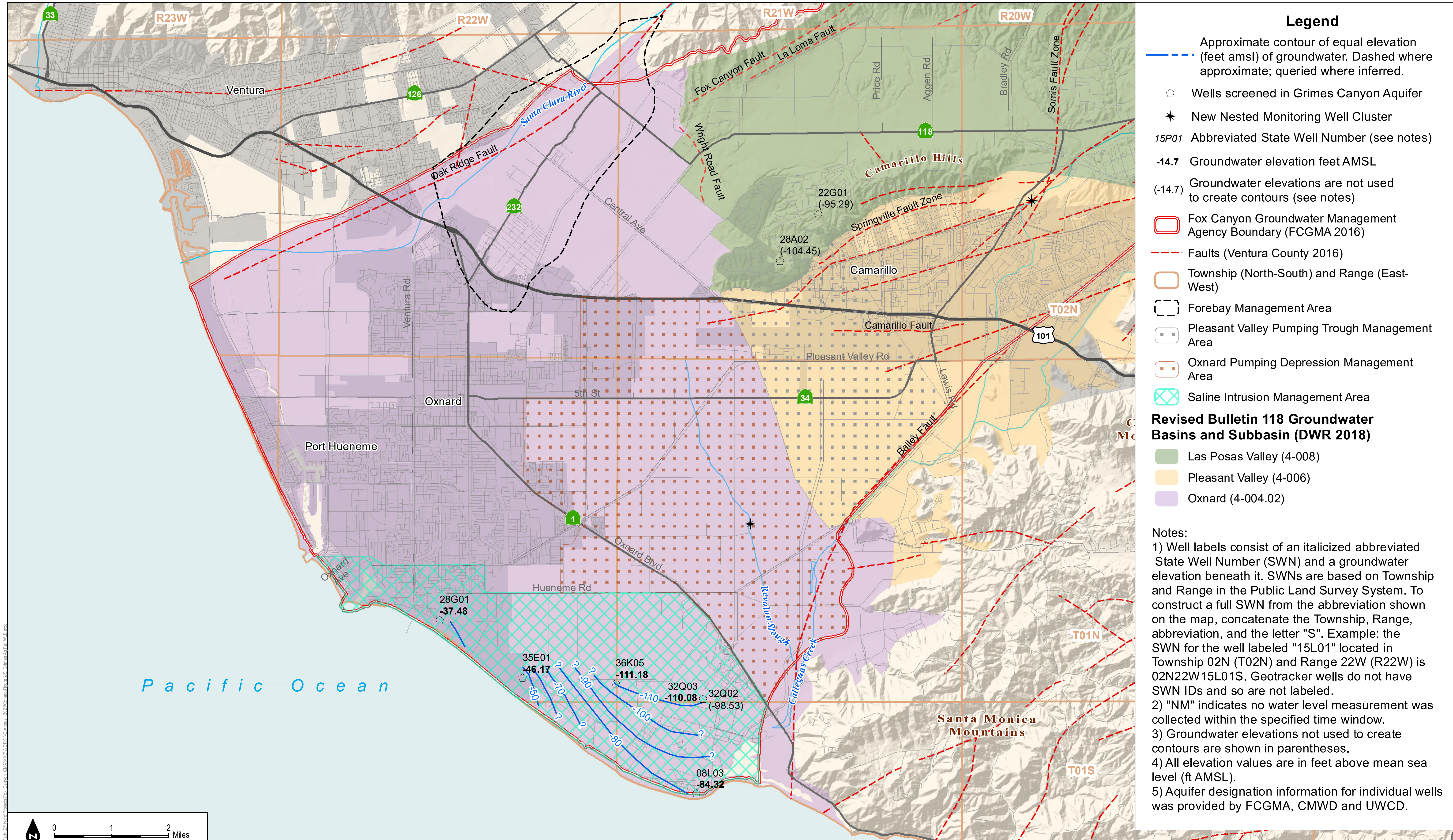
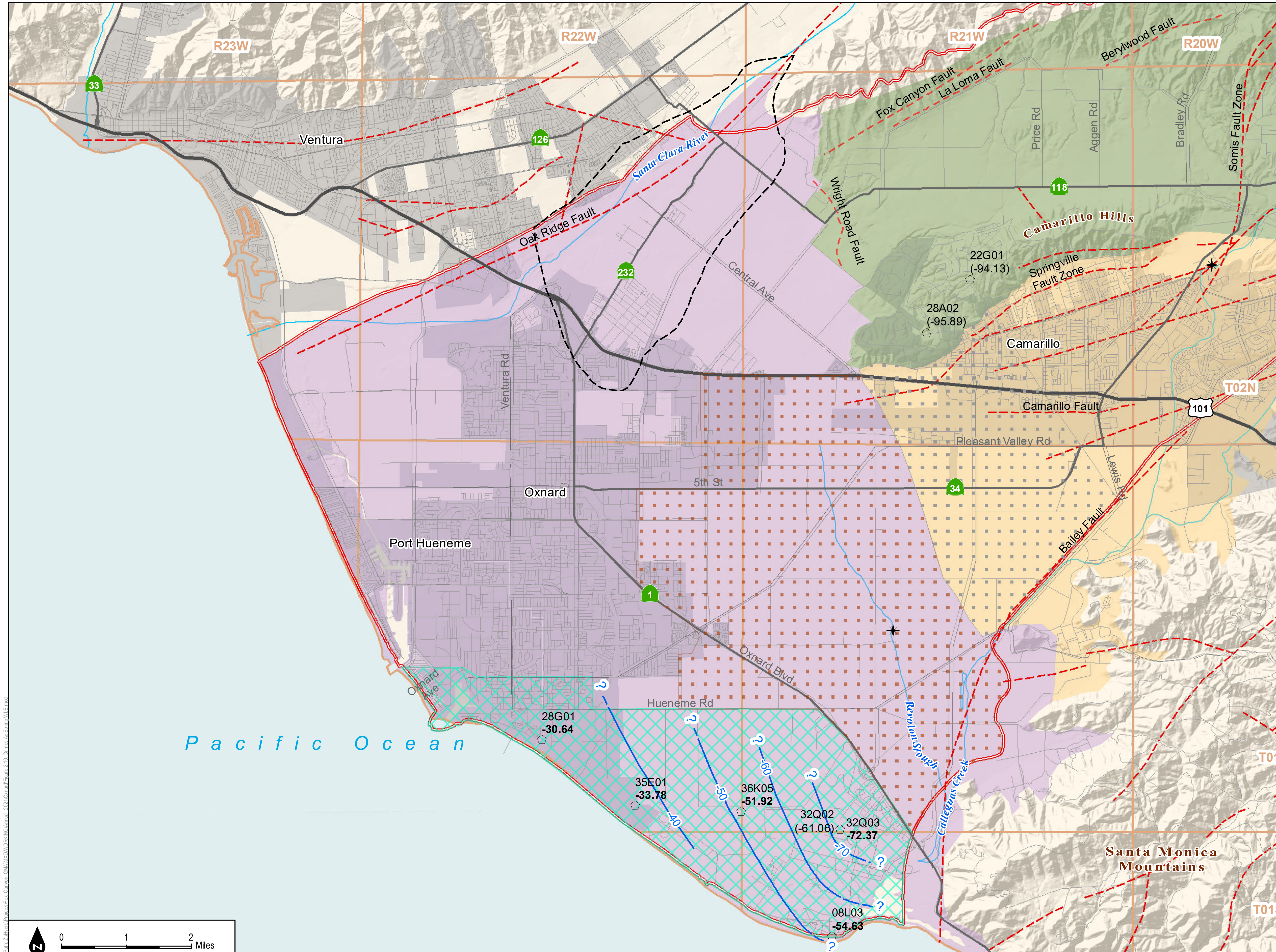


SOURCE: DWR; Ventura County; UWCD; CMWD

DUDEK

FIGURE 2-9

Groundwater Elevation Contours in the Grimes Canyon Aquifer, September 30 to October 31, 2019



Legend

- Approximate contour of equal elevation (feet amsl) of groundwater. Dashed where approximate; queried where inferred.
- Wells screened in Grimes Canyon Aquifer
- New Nested Monitoring Well Cluster
- *15P01* Abbreviated State Well Number (see notes)
- **-14.7** Groundwater elevation feet AMSL
- (-14.7) Groundwater elevations are not used to create contours (see notes)
- Fox Canyon Groundwater Management Agency Boundary (FCGMA 2016)
- Faults (Ventura County 2016)
- Township (North-South) and Range (East-West)
- Forebay Management Area
- Pleasant Valley Pumping Trough Management Area
- Oxnard Pumping Depression Management Area
- Saline Intrusion Management Area

Revised Bulletin 118 Groundwater Basins and Subbasin (DWR 2018)

- Las Posas Valley (4-008)
- Pleasant Valley (4-006)
- Oxnard (4-004.02)

Notes:
1) Well labels consist of an italicized abbreviated State Well Number (SWN) and a groundwater elevation beneath it. SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S". Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S. Geotracker wells do not have SWN IDs and so are not labeled.
2) "NM" indicates no water level measurement was collected within the specified time window.
3) Groundwater elevations not used to create contours are shown in parentheses.
4) All elevation values are in feet above mean sea level (ft AMSL).
5) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

DUDEK

SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 2-10

Groundwater Elevation Contours in the Grimes Canyon Aquifer, February 23 to April 4, 2020

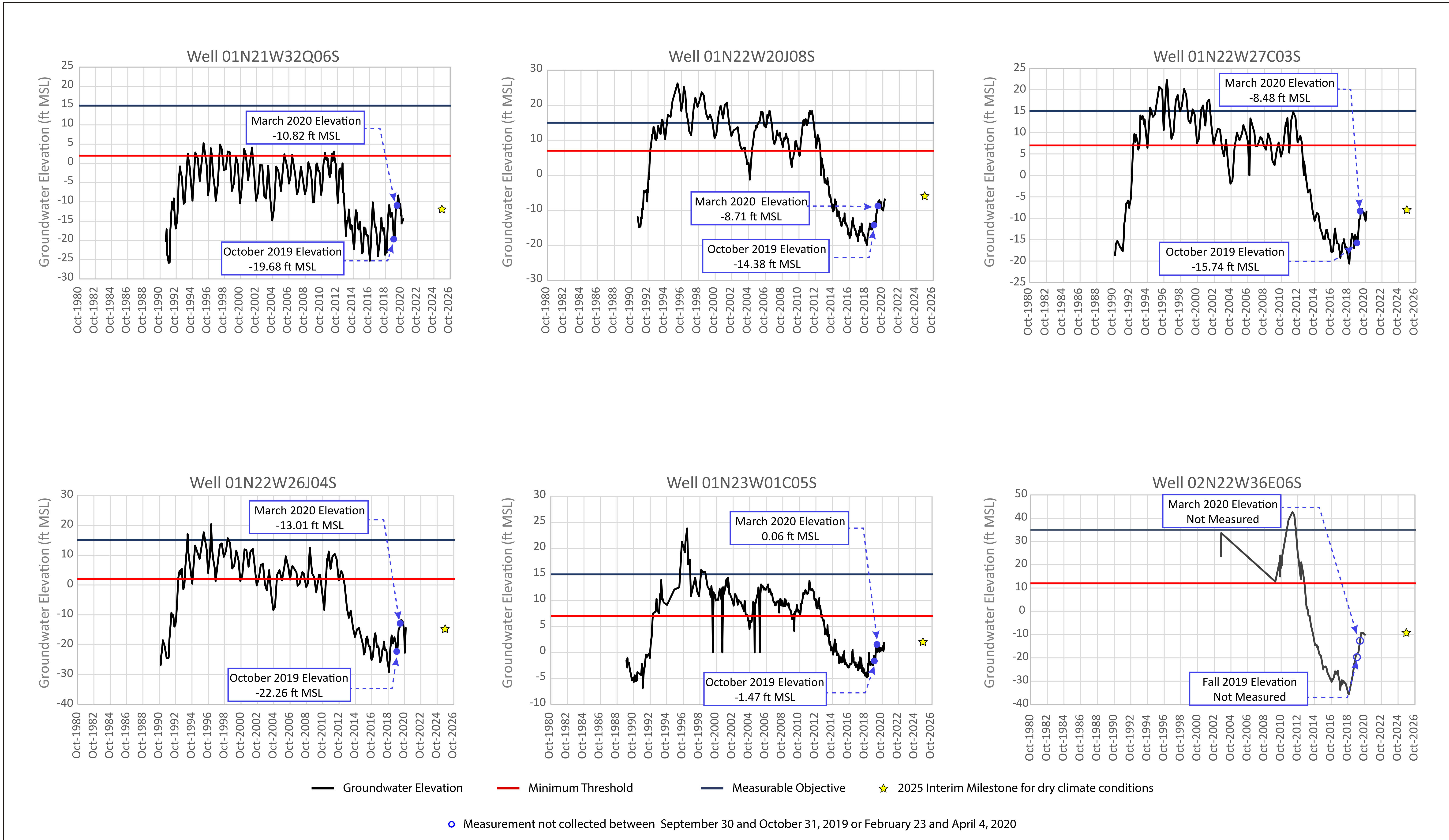


FIGURE 2-11

Groundwater Elevation Hydrographs for Representative Wells Screened in the Oxnard Aquifer

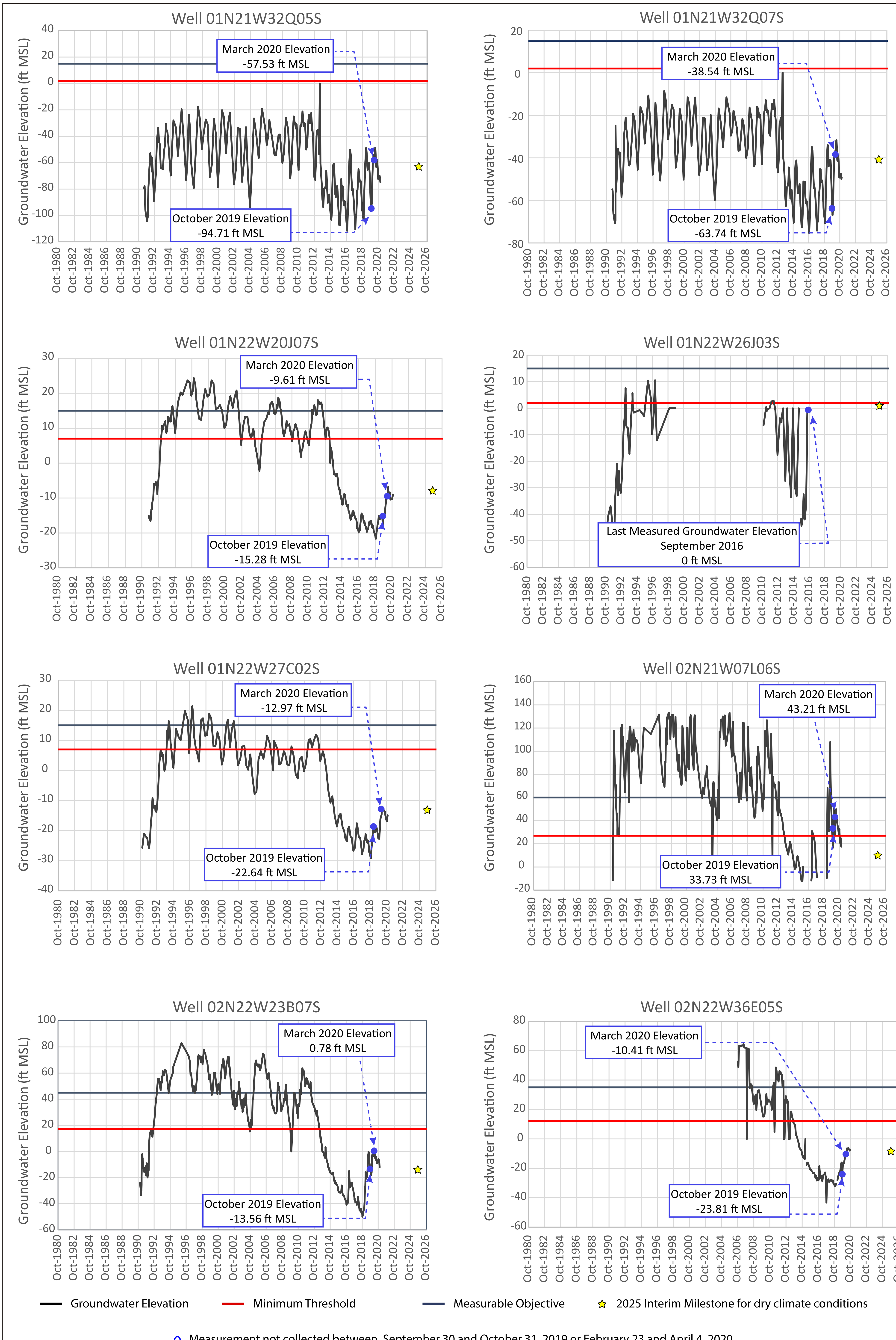


FIGURE 2-12

Groundwater Elevation Hydrographs for Representative Wells Screened in the Mugu Aquifer

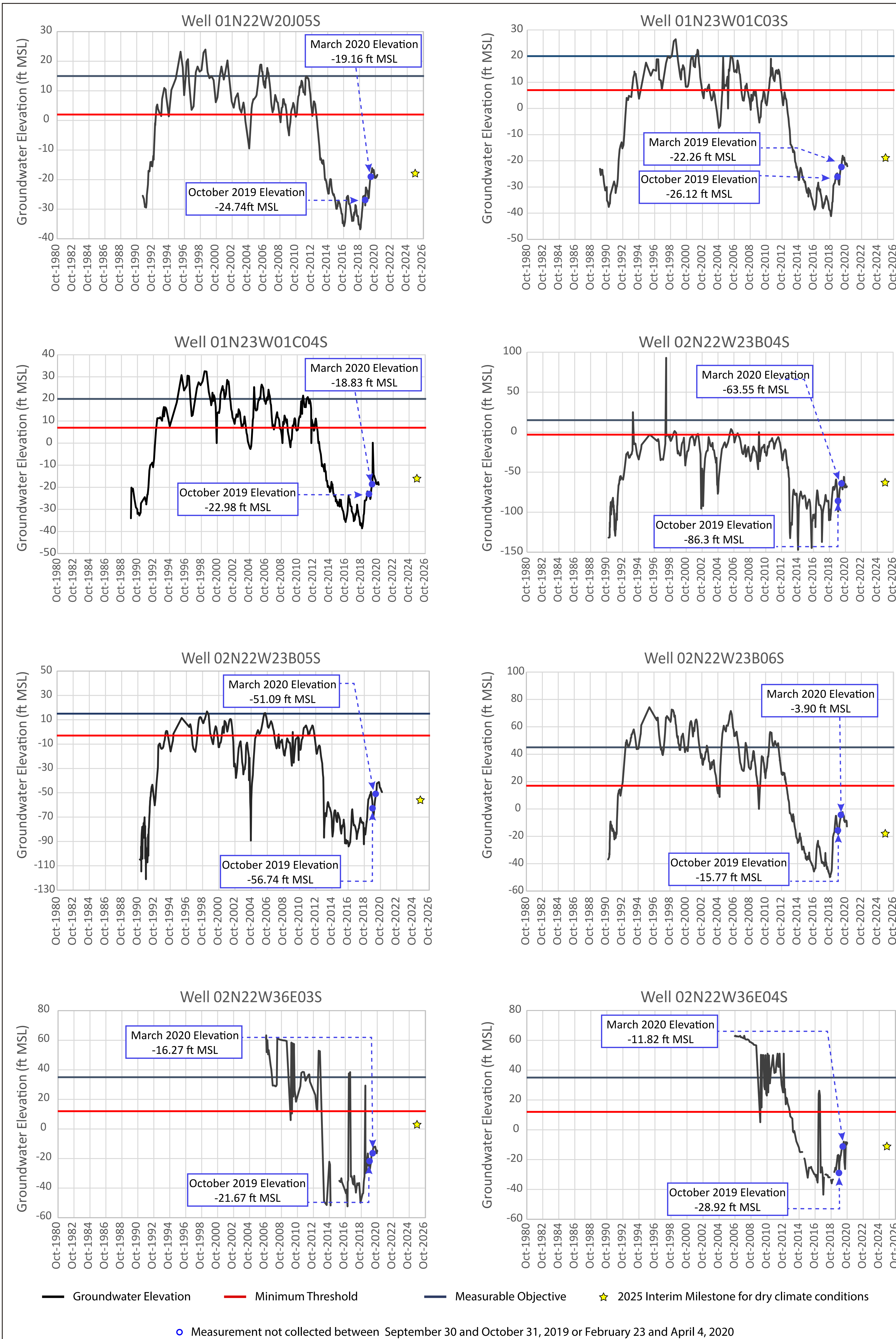


FIGURE 2-13

Groundwater Elevation Hydrographs for Representative Wells Screened in the Hueneme Aquifer

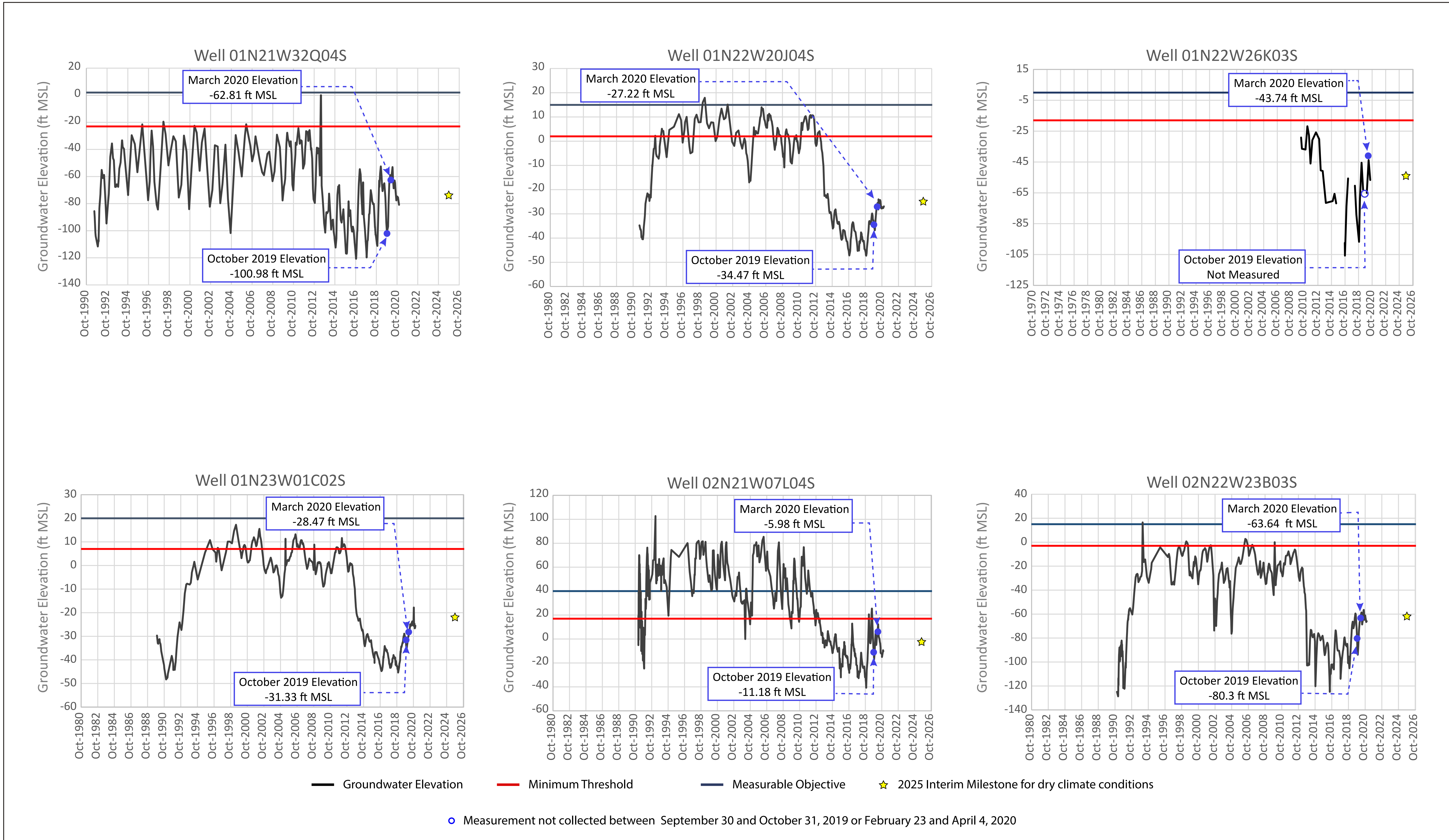


FIGURE 2-14

Groundwater Elevation Hydrographs for Representative Wells Screened in the Fox Canyon Aquifer

DUDEK

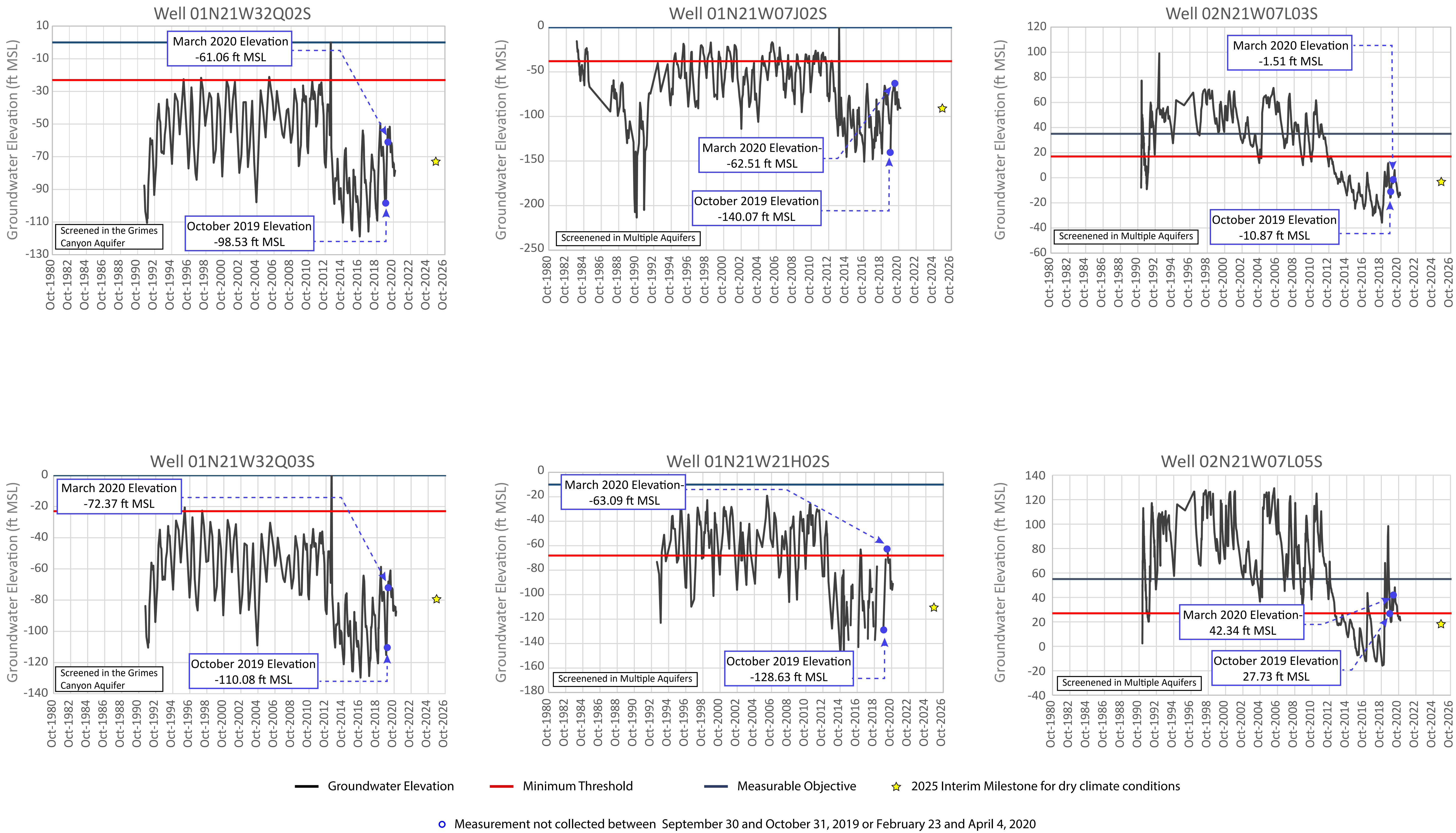
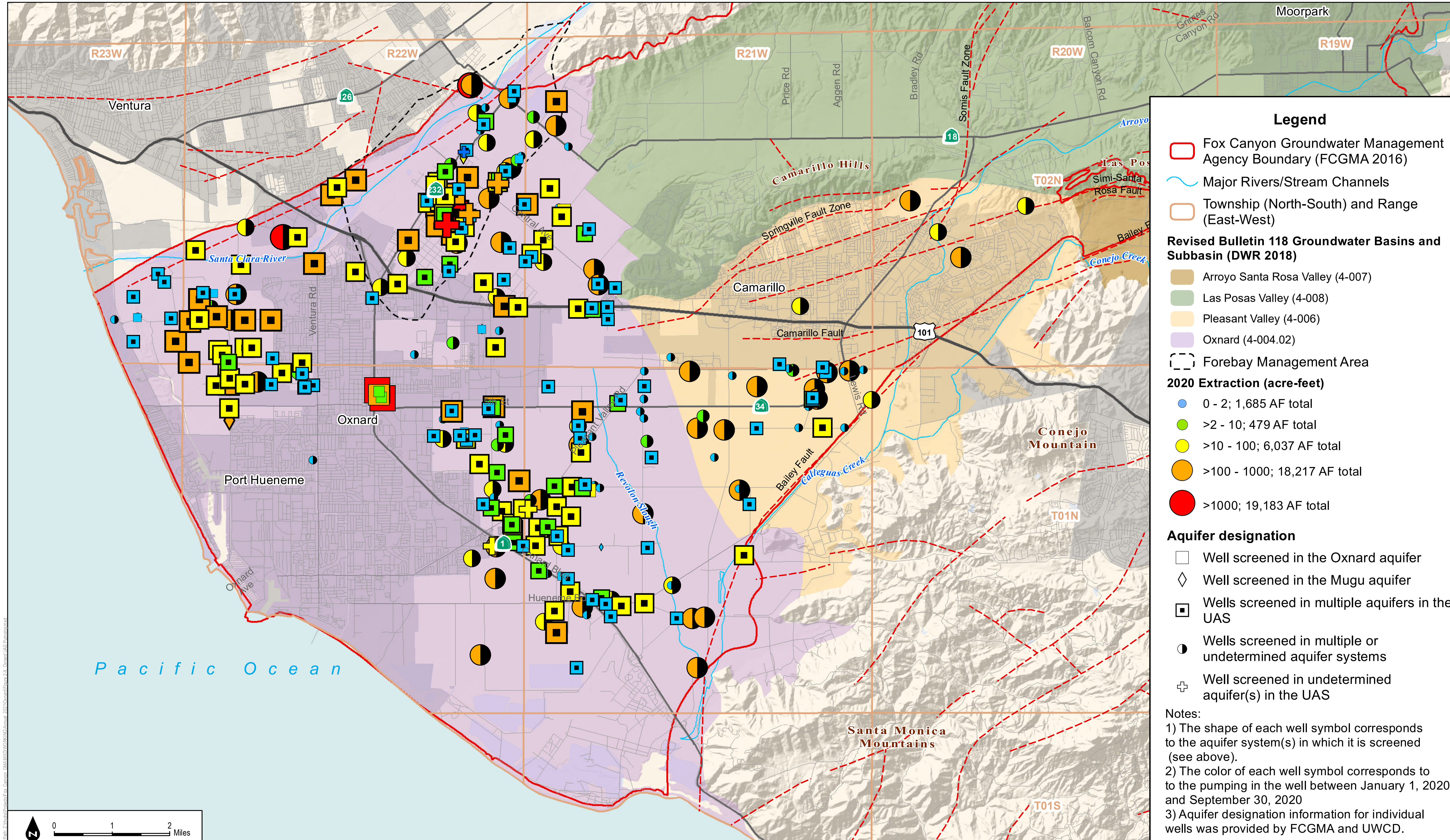


FIGURE 2-15

Groundwater Elevation Hydrographs for Representative Wells Screened in the Grimes Canyon Aquifer and Multiple Aquifers

DUDEK



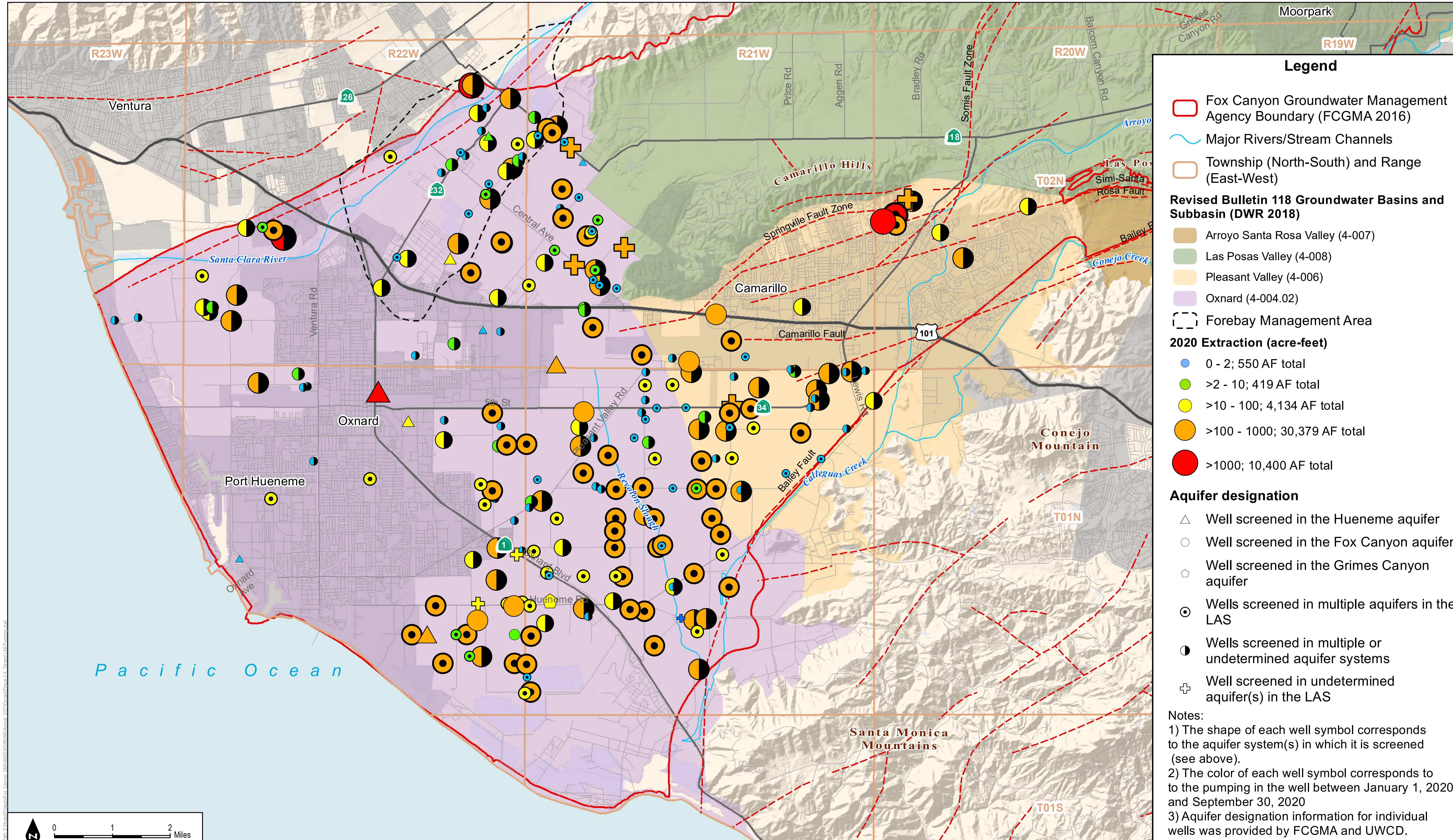
DUDEK

SOURCE: DWR, FCGMA, VCWPD, UWCD

FIGURE 2-16

Groundwater Production from the UAS between January 1, 2020 and September 30, 2020

Oxnard Subbasin Groundwater Sustainability Plan 2021 Annual Report



SOURCE: DWR, FCGMA, VCWPD, UWCD

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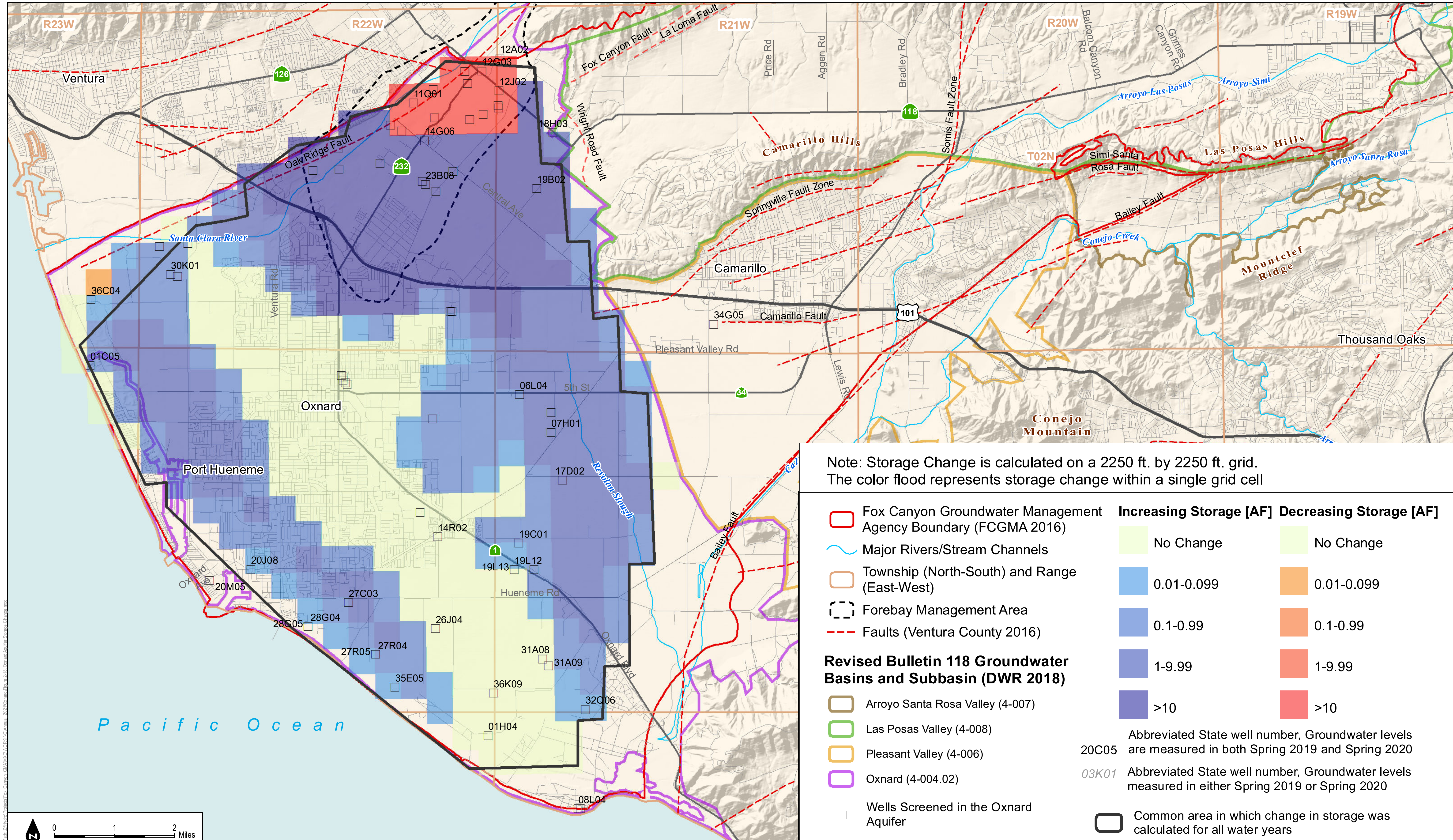
FIGURE 2-17

Groundwater Production from the LAS between January 1, 2020 and September 30, 2020



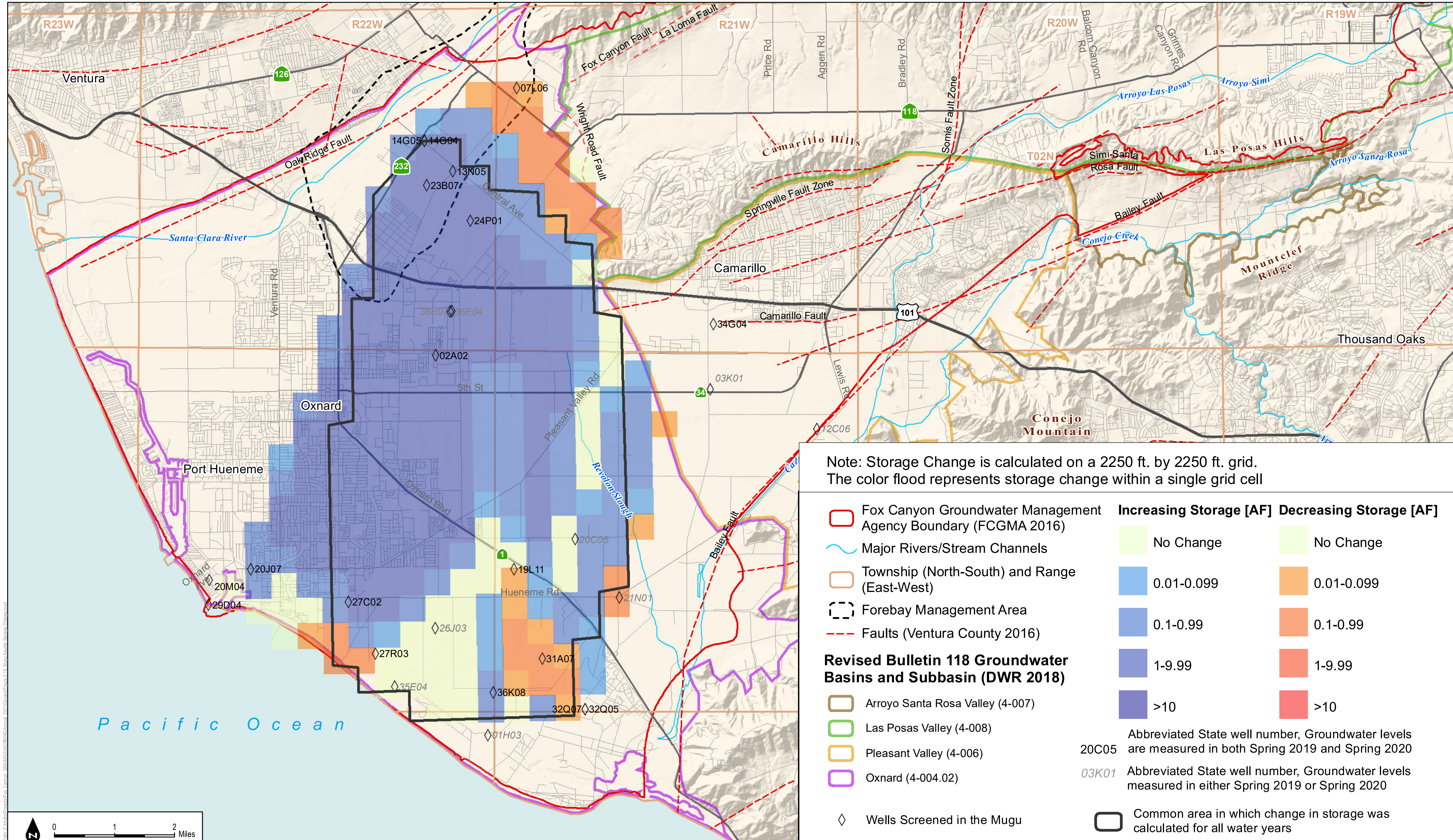
SOURCE: DWR, FCGMA, VCWPD, CMWD, UWCD

DUDEK

FIGURE 2-18

Change in Storage in the Oxnard Aquifer: Spring 2019 to Spring 2020

Oxnard Subbasin Groundwater Sustainability Plan 2021 Annual Report



SOURCE: DWR, FCGMA, VCWPD, CMWD, UWCD

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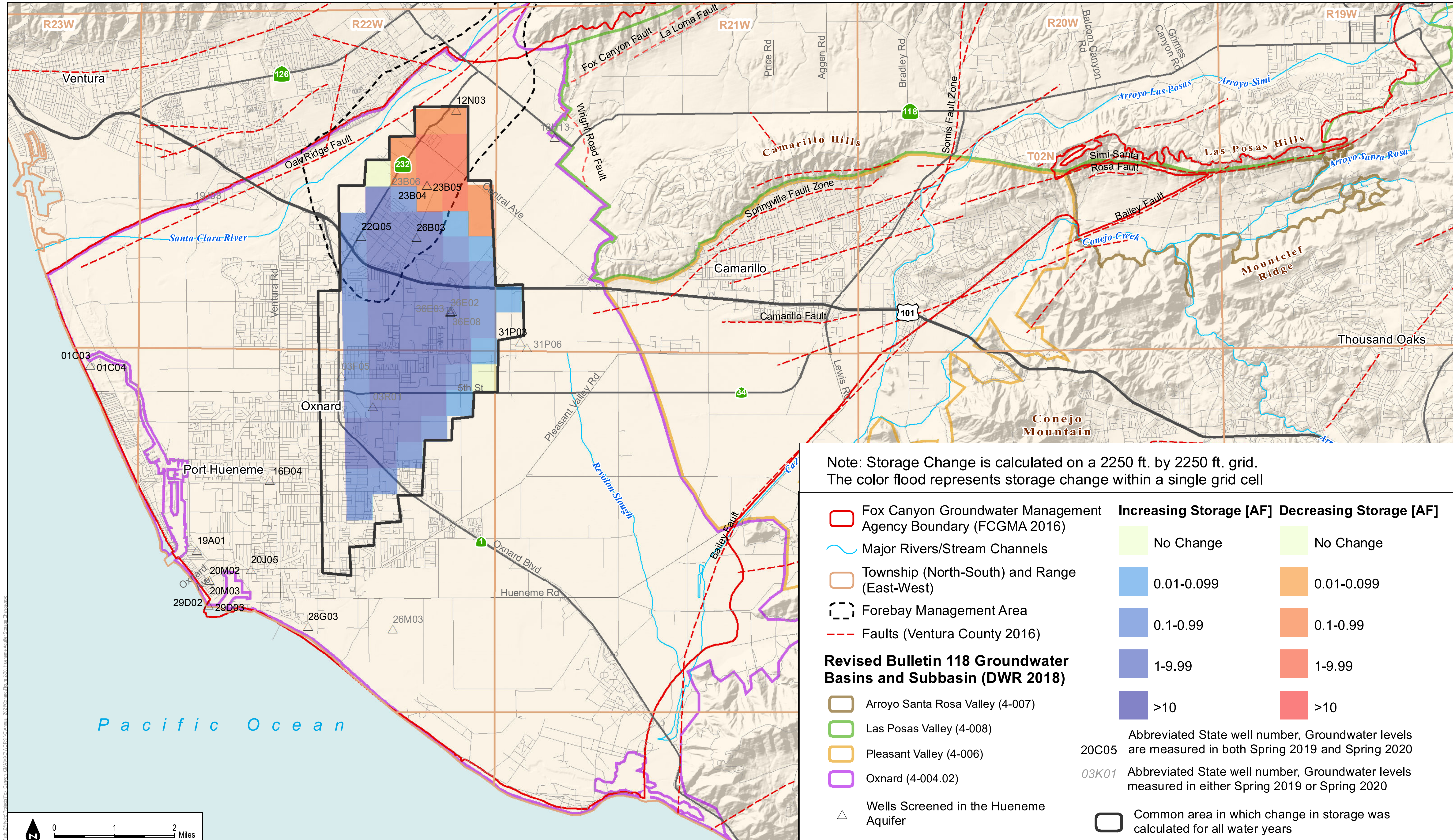
FIGURE 2-19

Change in Storage in the Mugu Aquifer: Spring 2019 to Spring 2020

Oxnard Subbasin Groundwater Sustainability Plan 2021 Annual Report

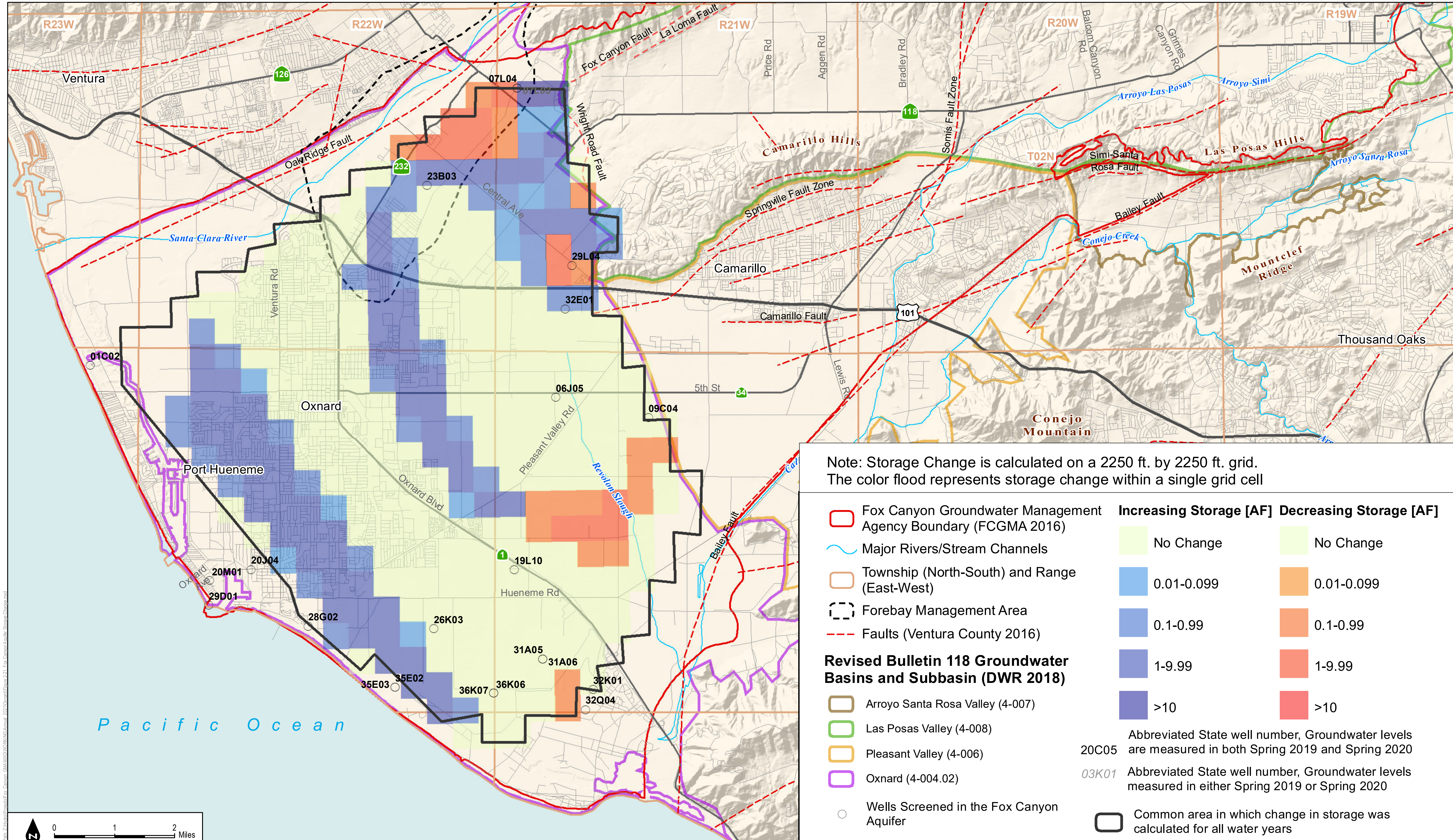


DUDEK

SOURCE: DWR, FCGMA, VCWPD, CMWD, UWCD

FIGURE 2-20

Change in Storage in the Hueneme Aquifer: Spring 2019 to Spring 2020

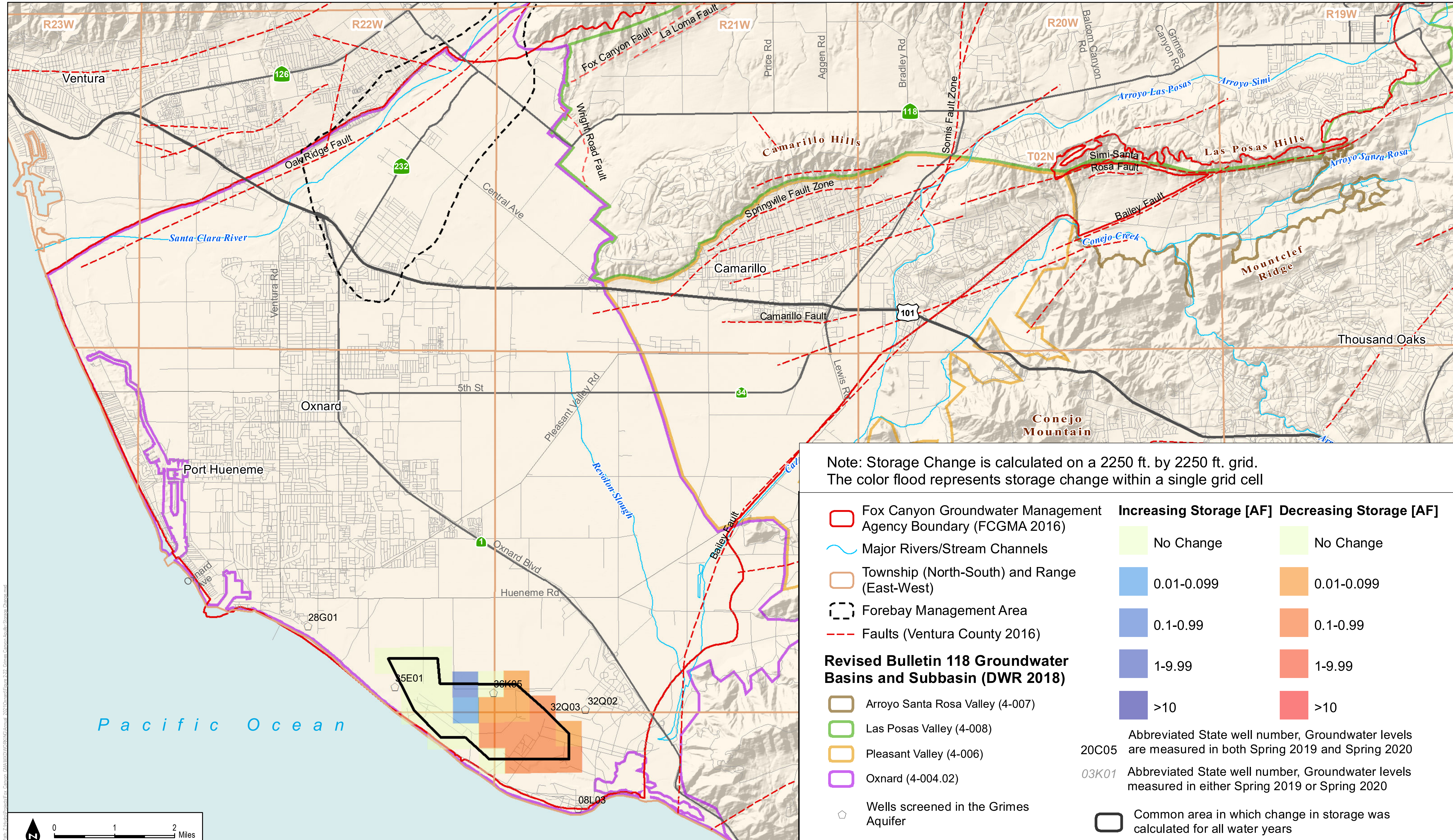


SOURCE: DWR, FCGMA, VCWPD, CMWD, UWCD

DUDEK

FIGURE 2-21

Change in Storage in the Fox Canyon Aquifer: Spring 2019 to Spring 2020

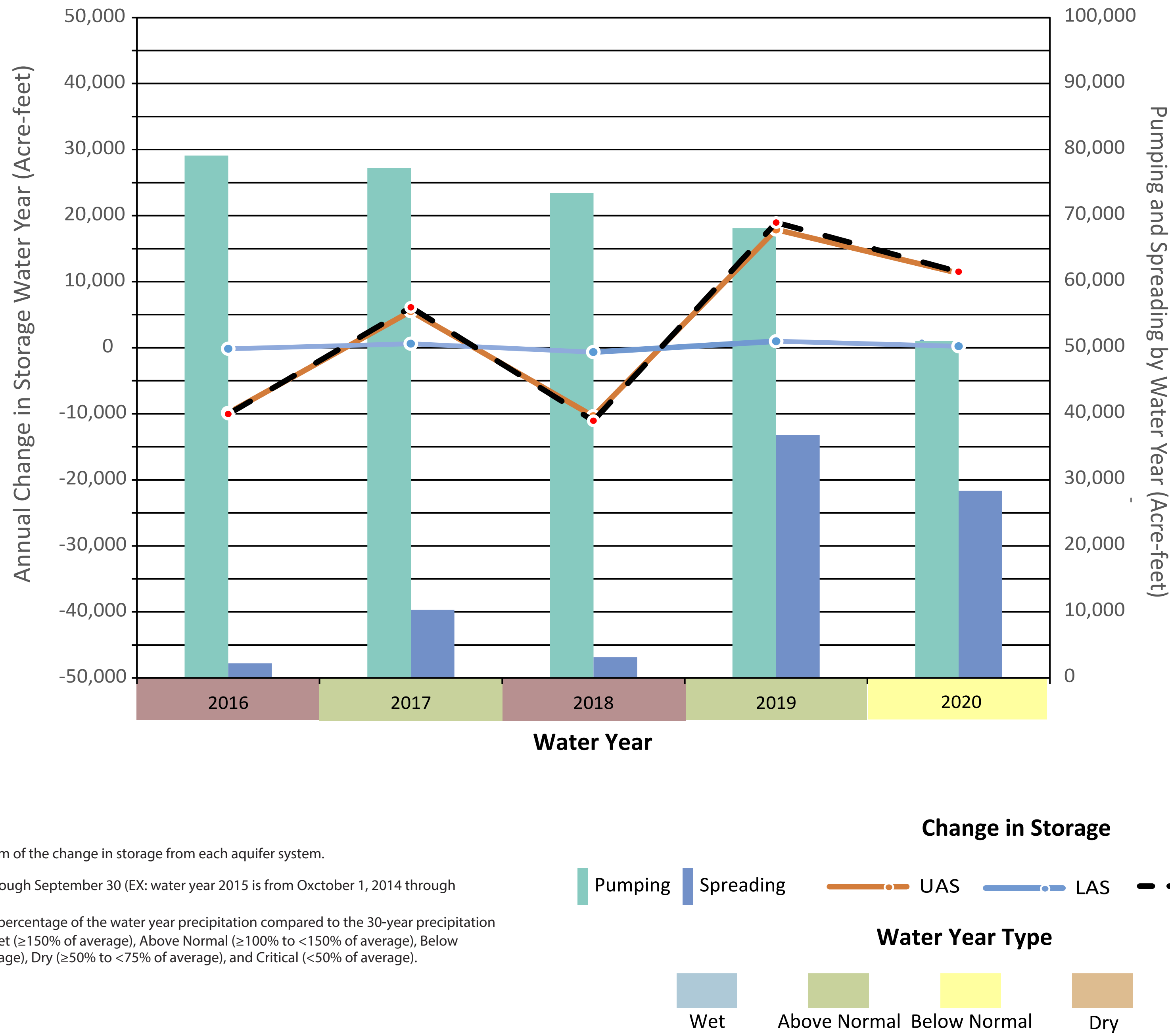


DUDEK

SOURCE: DWR, FCGMA, VCWPD, CMWD, UWCD

FIGURE 2-22

Change in Storage in the Grimes Canyon Aquifer: Spring 2019 to Spring 2020



Notes:

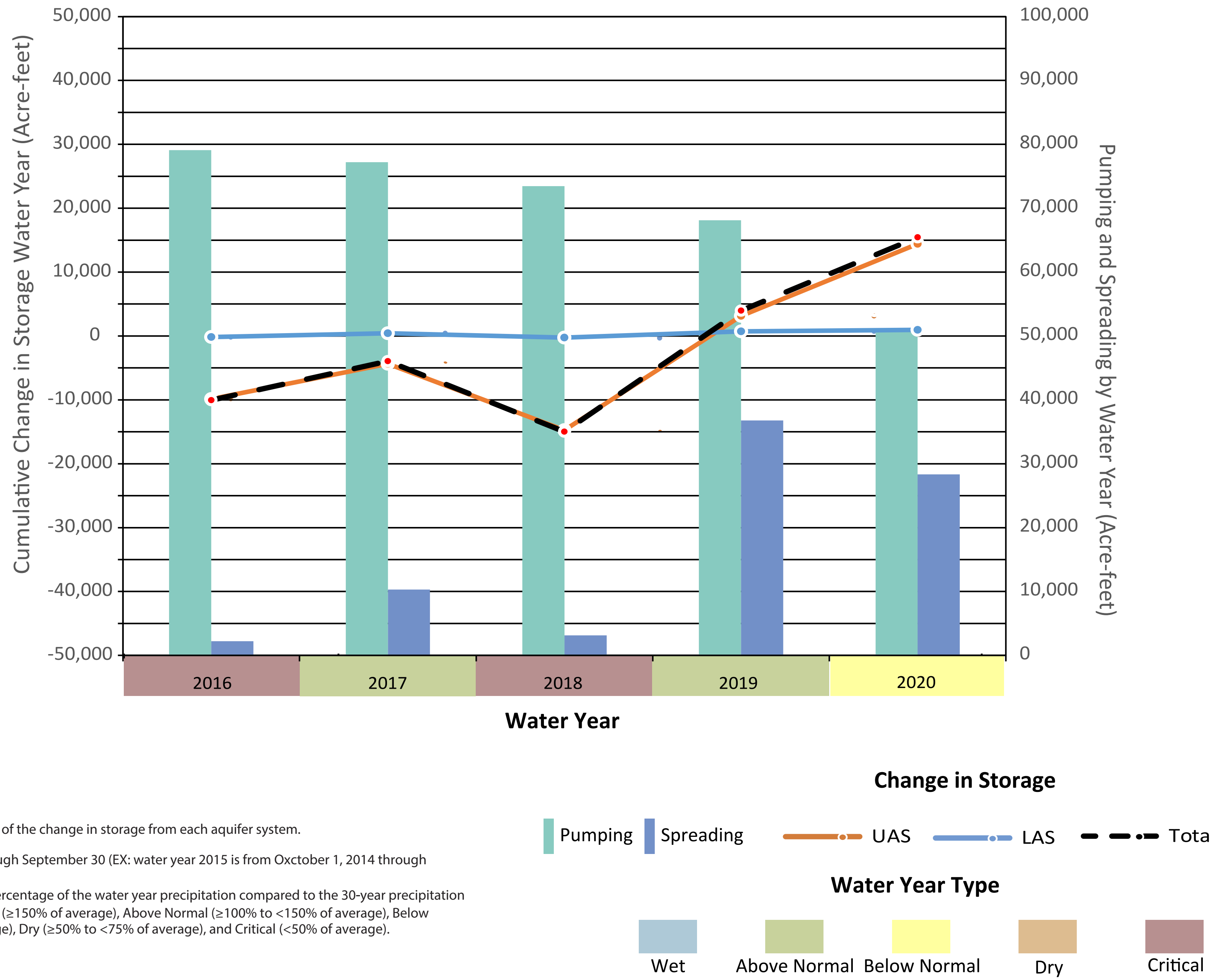
1) Total change in storage is the sum of the change in storage from each aquifer system.

2) Water year is from October 1 through September 30 (EX: water year 2015 is from Oxctober 1, 2014 through September 30, 2015).

3) Water year type is based on the percentage of the water year precipitation compared to the 30-year precipitation average. Types are defined as Wet (≥150% of average), Above Normal (≥100% to <150% of average), Below Normal (≥75% to <100% of average), Dry (≥50% to <75% of average), and Critical (<50% of average).

FIGURE 2-23

Water Year Type, Groundwater Use, and Annual Change in Storage in the Oxnard Subbasin



Notes:

1) Total change in storage is the sum of the change in storage from each aquifer system.

2) Water year is from October 1 through September 30 (EX: water year 2015 is from Oxctober 1, 2014 through September 30, 2015).

3) Water year type is based on the percentage of the water year precipitation compared to the 30-year precipitation average. Types are defined as Wet (≥150% of average), Above Normal (≥100% to <150% of average), Below Normal (≥75% to <100% of average), Dry (≥50% to <75% of average), and Critical (<50% of average).

FIGURE 2-24

Water Year Type, Groundwater Use, and Cumulative Change in Storage in the Oxnard Subbasin

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Appendix A: Corrections to Oxnard Subbasin Groundwater Sustainability Plan 2020 Annual Report

Table A: Corrections to 2020 Annual Report			
Component of the 2020 Annual Report	**Item**	**Error or comment on 2020 Annual Report Representation**	**Updated Data**
Table 2-5a and Table 2-5b			
	1a	The change in storage calculations for water year 2019 in the Hueneme Aquifer contained an error that was the result of mapping draft groundwater elevation contours onto the storage change calculation grid. The groundwater elevation contours for spring 2019 used to compute change in storage in the Hueneme differed from the spring 2019 contours publised in the 2020 Annual Report	Change in groundwater storage between spring 2018 and spring 2019 was recomputed as part of the 2021 Annual Report preparation using the groundwater elevation contours published with the 2020 Annual Report. The updated estimate for change in storage between spring 2018 and spring 2019 is described in Section 2.5.3.