SANTA MARGARITA
Groundwater Agency

2027 GROUNDWATER SUSTAINABILITY PLAN AMENDMENT

DRAFT - SEPTEMBER 2026

REGIONAL WATER
MANAGEMENT FOUNDATION

MONTGOMERY
& ASSOCIATES

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Acronyms & Abbreviations

1,2-DCE 1,2-dichloroethylene
AB .....Assembly Bill
AF .....acre-feet
AFY.....acre-feet per year
AMI.....advanced metering infrastructure
amsl .....above mean sea level
AMTB .....Amah Mutsun Tribal Band
ASR.....Aquifer Storage & Recovery
Basin .....Santa Margarita Groundwater Basin
Basin Plan .....Water Quality Control Plan, Central Coast Region
Basin Model ...Santa Margarita Basin Numerical Groundwater Flow Model
bgs .....below ground surface
BMO .....Basin Management Objective
BMP .....best management practices
C&E Plan .....Communication and Engagement Plan
CALEPA .....California Environmental Protection Agency
CASGEM .....California Statewide Groundwater Elevation Monitoring
CCR.....California Code of Regulations
CCRWQCB....Central Coast Regional Water Quality Control Board
CDFW .....California Department of Fish and Wildlife
CEC.....constituents of emerging concern
CEQA.....California Environmental Quality Act
cfs .....cubic feet per second
CGPS.....continuous global positioning station
cis-1,2-DCE ...cis-1,2-dichloroethene
COC .....constituents of concern
County.....County of Santa Cruz
CWC .....California Water Code
DAC .....Disadvantaged Community
DDW .....State Water Resources Control Board Division of Drinking Water
DMS .....data management system
DTSC .....California Department of Toxic Substances Control
DWR .....California Department of Water Resources
DWSAP.....Drinking Water Source Assessment and Protection
EIR .....Environmental Impact Report
EVI.....Enhanced Vegetation Index
GAC .....granular activated carbon
GDE .....groundwater dependent ecosystem
GPCD.....gallons per capita per day

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GSA .....Groundwater Sustainability Agency
GSP .....Groundwater Sustainability Plan
GWMP .....Groundwater Management Plan
HCM .....Hydrogeologic Conceptual Model
HCP.....Habitat Conservation Plan
InSAR .....Interferometric Synthetic Aperture Radar
IRWM .....Integrated Regional Water Management
ISW .....Interconnected Surface Water
JPA.....Joint Powers Agreement
LAMP .....Local Area Management Program
LID.....low impact development
LUST.....leaking underground storage tank
MCL.....maximum contaminant level
mg/L.....milligrams per liter
MGA .....Santa Cruz Mid-County Groundwater Agency
MGD .....million gallons per day
MHA .....Mount Hermon Association
MNM.....Monitoring Network Module
MTBE .....methyl-tert-butyl ether
N.....nitrogen
NAVD 88.....North American Vertical Datum of 1988
NDMI.....Normalized Difference Moisture Index
NDVI.....Normalized Difference Vegetation Index
ng/L.....nanograms per Liter
NMFS.....National Marine Fisheries Service
NO_3 .....nitrate
NOI .....Notice of Intent
O&M.....operations and maintenance
OWTS .....Onsite Wastewater Treatment Systems
PCE .....tetrachloroethene
QA.....quality assurance
Qal.....Alluvium
QC.....quality control
Qt.....Terrace Deposits
RMP .....Representative Monitoring Point
RP.....Reference Point
SCEH .....County of Santa Cruz Environmental Health
SGMA .....Sustainable Groundwater Management Act
SLVWD .....San Lorenzo Valley Water District
SMC.....sustainable management criteria
SMGWA .....Santa Margarita Groundwater Agency

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SMGWBAC...Santa Margarita Groundwater Basin Advisory Committee
SqCWD.....Soquel Creek Water District
SVWD.....Scotts Valley Water District
SWRCB.....State Water Resources Control Board
SWS .....small water system
TAG .....Surface Water Technical Advisory Group
Tbl.....Lower Butano
Tbm.....Middle Butano
Tbu.....Upper Butano
TCE.....trichloroethene
TDS.....total dissolved solids
Tl.....Locatelli Formation
Tlo.....Lompico Sandstone
Tm.....Monterey Formation
TMDL .....Total Maximum Daily Load
TNC.....The Nature Conservancy
Tp.....Purisima Formation
Tsc.....Santa Cruz Mudstone
Tsm .....Santa Margarita Sandstone
UCMR.....Unregulated Contaminant Monitoring Rule
USBR.....United States Bureau of Reclamation
USDA.....United States Department of Agriculture
USEPA.....United States Environmental Protection Agency
USFWS .....United States Fish and Wildlife Service
USGS .....United States Geological Survey
UST.....underground storage tank
UWMP.....Urban Water Management Plan
VC.....vinyl chloride
VOC.....volatile organic compound
WAAP.....Wasteload Allocation Attainment Program
WHO.....World Health Organization
WISKI.....Water Information Systems by Kisters
WRF.....Water Reclamation Facility
WTP.....Water Treatment Plant
WWTF .....Wastewater Treatment Facility
WY.....water year

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EXECUTIVE SUMMARY

The State of California enacted the Sustainable Groundwater Management Act (SGMA), effective January 1, 2015, as the first legislation in the state's history to mandate comprehensive sustainable groundwater resources management. The Santa Margarita Groundwater Agency (SMGWA) was formed under SGMA to develop the Groundwater Sustainability Plan (GSP or Plan) for the Santa Margarita Groundwater Basin (Basin). The GSP—which provides the basis for ongoing Basin management—describes how SMGWA intends to manage groundwater to achieve sustainability by 2042 and meet SGMA requirements. By following the GSP, SMGWA, its cooperating agencies, and other local stakeholders will collaboratively manage the Basin to maintain a safe and reliable groundwater supply for all beneficial groundwater uses and users.

This GSP is organized into sections per the California Department of Water Resources (DWR) guidance (DWR, 2016c).

The Introduction describes SMGWA's formation and organization, and it introduces the sustainability goals for the Basin. The Plan Area and Basin Setting describe current knowledge of the physical aspects of the Basin, relying on a multitude of studies conducted by SMGWA's cooperating agencies. The Groundwater Conditions section includes a summary of current basin conditions, including groundwater levels, groundwater quality, and interconnected surface water. The Water Budget section provides historical, current, and projected water budgets based on groundwater model simulations. The groundwater conditions are used to identify representative Monitoring Networks and guide development of Sustainable Management Criteria (SMC) for SMGWA to reach during the GSP implementation period. In order for SMGWA to achieve sustainability, additional Projects and Management Actions (PMAs) need to be documented in the GSP. Finally, GSP Implementation describes how SMGWA intends to implement the plan and provides an estimated cost and schedule for the next 5 years.

Groundwater Sustainability Plan Sections

- Executive Summary
- Section 1. Introduction
- Section 2. Plan Area
- Section 3. Basin Setting
- Section 4. Groundwater Conditions
- Section 5. Water Budget
- Section 6. Monitoring Networks
- Section 7. Sustainable Management Criteria
- Section 8. Projects & Management Actions
- Section 9. GSP Implementation
- Section 10. References and Studies

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Introduction

SMGWA has developed the Santa Margarita Basin GSP to provide a roadmap for achieving groundwater sustainability in the Basin. The Introduction section of the GSP describes in detail the SMGWA organization and management structure, and the GSP sustainability goal.

SMGWA has legal authority to perform duties, exercise powers, and accept responsibility for managing groundwater sustainably within the Basin. It was formed through a Joint Powers Agreement (JPA) in June 2017 between the Scotts Valley Water District (SVWD), the San Lorenzo Valley Water District (SLVWD), and the County of Santa Cruz (County). SMGWA is governed by a Board of Directors comprising 2 representatives from each member agency, single representatives from the City of Scotts Valley, City of Santa Cruz, and Mount Hermon Association (MHA), and 2 private well owners.

The Introduction includes the sustainability goal for the Basin used as a guide to develop the GSP. In general, SMGWA's sustainability goal is to achieve and maintain groundwater conditions that support beneficial uses and users and sustain the long-term health of the Basin's community, economy, and environment.

The GSP will successfully be implemented by monitoring and maintaining Basin conditions and practicing cost-effective adaptive management as needed to meet the sustainability goal.

Plan Area

The Santa Margarita Groundwater Basin is a 34.8-square-mile area defined in DWR's Bulletin 118, which is the State's official publication on the occurrence and nature of groundwater in California. The Basin, shown on Figure ES-1, forms a roughly triangular area that extends from Scotts Valley in the east, Boulder Creek in the northwest, and to Felton in the southwest. The Basin is bounded on the north by the Zayante trace of the active, strike-slip Zayante-Vergeles fault zone, on the east by a buried granitic high that separates the Basin from Santa Cruz Mid-County Basin, and on the west by the Ben Lomond fault, except where areas of alluvium lie west of the fault. The southern boundary of the Basin with the West Santa Cruz Terrace Basin is located where Tertiary sedimentary formations thin over a granitic high and give way to young river and coastal terrace deposits.

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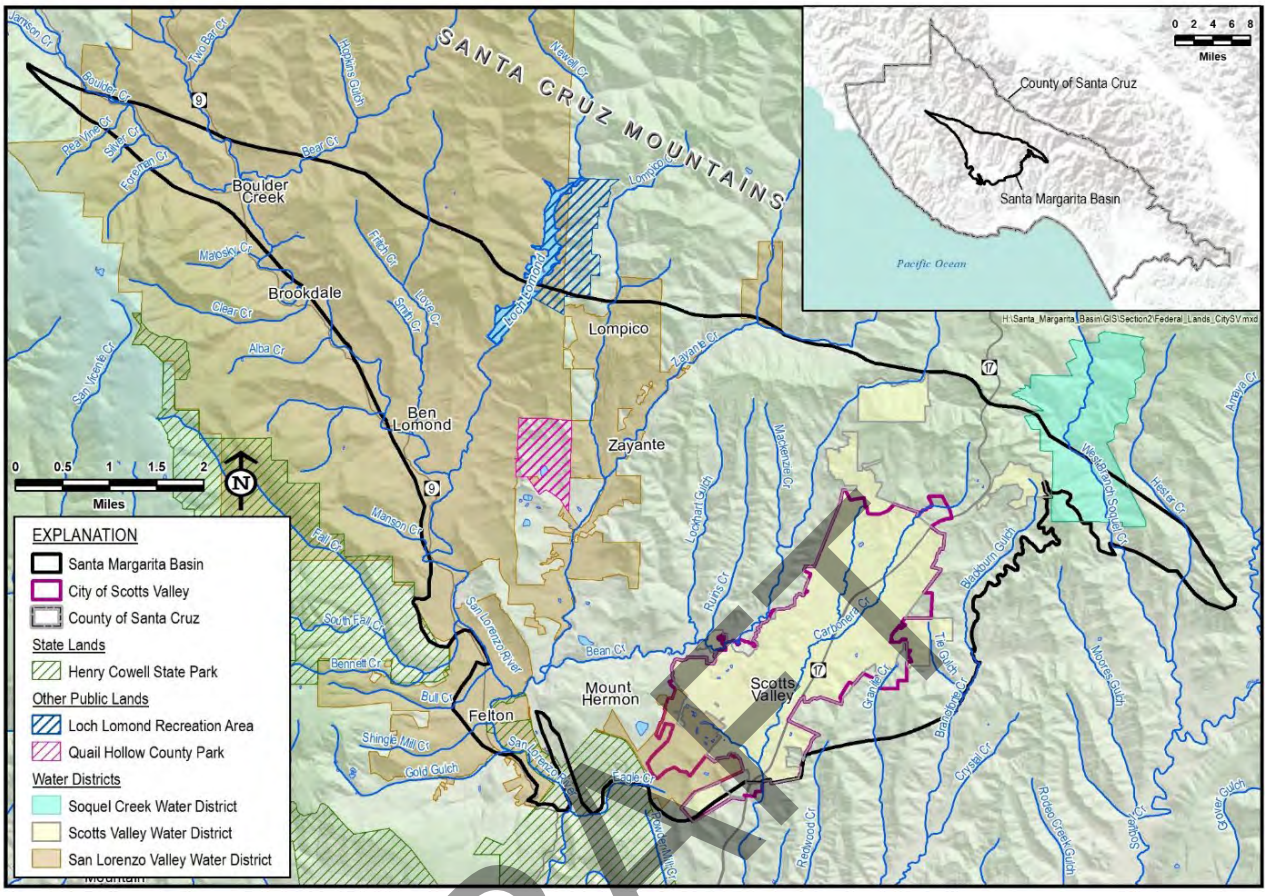

Figure ES-1. Santa Margarita Basin Location

Almost half of the Basin is classified as open space with much of that being moderately rugged, forested terrain. Rural residential development is the next largest land use type, followed by smaller suburban developments in the communities of Scotts Valley, Boulder Creek, Felton, Ben Lomond, and Lompico. Approximately 30,600 people reside in the Basin. The City of Scotts Valley is the only local entity with land use jurisdiction; the County has jurisdiction for all unincorporated areas outside of Scotts Valley. Commercial land use is concentrated in the City of Scotts Valley and the community of Felton. Much of this development occurred during a period of population growth between 1980 and 2000, which coincided with construction of commercial and industrial complexes. General Plans for the County and City of Scotts Valley are reviewed in the GSP to identify local development goals and how the GSP can operate within these confines.

Water supply in the Basin is sourced from groundwater, surface water, springs, and recycled water. The SLVWD and SVWD are the 2 largest water suppliers in the Basin, with both dependent on local water sources.

SLVWD's water supply is from surface water diverted on tributaries of the San Lorenzo River just outside of the Basin, and from springs and groundwater. The SLVWD supplies water to a 5.6-square-mile service area with about 13,000 customers in the Basin.

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SVWD uses groundwater exclusively for potable supply and recycled water for non-potable supply. The SVWD supplies water to a 5.5-square-mile service area with about 10,700 customers in the Basin.

The remaining approximately 5,300 people residing in the Basin use groundwater pumped by small water systems or their own private domestic wells. MHA is the largest private water supplier that includes a year-round conference center and camp that serves more than 60,000 guests each year and a permanent community of approximately 1,300 people. There are 12 small water systems in the Basin serving a population of about 1,000. Springs or groundwater are the source of water for 11 of the 12 small water systems. Based on residential parcels that are not served water by one of the water districts, an estimated 777 private wells are pumping less than 2 acre-feet per year (AFY) that supply water to about 3,000 people.

The City of Santa Cruz does not pump any groundwater in the Basin. However, it is an indirect user of groundwater in the Basin because the surface water it diverts from the San Lorenzo River partially comprises baseflows supported by Basin groundwater discharge to creeks. It does own and operate the 2.8-billion-gallon capacity Loch Lomond Reservoir that it uses for water storage. The City has 2 diversion points on the San Lorenzo River: at Felton within the Basin and at Tait Street 5 miles downstream of the Basin. The San Lorenzo River provides roughly 55% and Loch Lomond (Newell Creek) provides roughly 14% of Santa Cruz's municipal water supply.

In addition to public supply and private domestic use, groundwater is used for a few commercial and industrial purposes. It is used for dust control and operations at a single remaining sand quarry and for large-scale landscaping and pond filling at a few locations. There are also a few small wineries that irrigate with groundwater.

The SLVWD and SVWD, prior to SGMA, managed groundwater in the Basin through their master plans, surface water management plans, and independent analyses of water supply availability and reliability. The information generated in past management efforts was instrumental in developing this GSP.

Existing conjunctive use strategies, low impact development, conservation, recycled water, and other water efficiency programs have been used successfully by the water districts to manage groundwater use and to lower potable demand. The water districts comply with all regulatory water quality testing and Drinking Water Source assessments for active supply wells.

The County is also involved in a variety of management efforts related to water quality, stormwater management, threatened and endangered species monitoring, and watershed and stream habitat protection. The County is responsible for all permitting for well construction and destruction.

Regulatory agencies are involved in protecting the Basin's groundwater quality. The County has been working for decades to reduce nitrate loading of surface water. The County's Local Area Management Plan, developed in 2021, allows for the continued use of septic systems in Santa Cruz County

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while providing protection of water quality and public health. The Central Coast Regional Water Quality Control Board and Santa Cruz County Environmental Health (SCEH) are responsible for overseeing point source groundwater pollution from chemical spills or leaks. Several groundwater contamination sites in Scotts Valley and Felton have had past remediation of volatile organic compounds (VOC) and gasoline-related chemicals in groundwater. These remediation programs have generally been resolved and no sites are presently undergoing active groundwater remediation.

Groundwater dependent ecosystems (GDEs) in the Basin support threatened and endangered species. Priority species identified in the GSP that rely on GDEs in the Basin include steelhead trout, coho salmon, lamprey, western pond turtle, California giant salamander, and California red-legged frog. Ongoing programs such as the City of Santa Cruz Habitat Conservation Plan (HCP) and Santa Cruz County's Juvenile Steelhead and Stream Habitat Monitoring Program have monitored steelhead density and stream habitat since 1994, but clear associations between groundwater extraction and a reduction in fish density or available habitat has not been made. The GSP is integrated with these plans by establishing groundwater level and extraction SMC to maintain groundwater conditions that support streamflow, GDE habitat, and aquatic species.

GSP development is a collaborative effort among the SMGWA's cooperating agencies, technical consultants, and other local stakeholders. Decisions shaping policy are made by the SMGWA Board of Directors and informed by public input. Extensive public outreach and engagement efforts before and during GSP development are documented in a Communication and Engagement Plan (C&E Plan) and public comment records.

The GSP considers all beneficial uses and users, in accordance with California Water Code (CWC) §106.3, which recognizes that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes." Beneficial users of groundwater recognized by the GSP include municipal water suppliers, agricultural users, private domestic well owners, small water systems, local land use planning agencies, surface water users, ecological users, California Native American Tribes, disadvantaged communities, protected lands (including recreational areas), and public trust uses (including wildlife, aquatic habitat, fisheries, recreation, and navigation).

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Basin Setting

The Basin Setting section provides the hydrogeologic conceptual model (HCM) for the GSP. The HCM documents the current understanding of the Basin's general physical characteristics related to regional hydrology, land use, geology and geologic structure, groundwater quality, principal aquifers, and aquitards. The HCM also provides the context to develop water budgets, the GSP groundwater model, and monitoring networks. The HCM was developed using prior studies and monitoring data collected by cooperating agencies over the past 35 years.

The Basin's climate is classified as Mediterranean, characterized by warm summers and mild winters. Almost all precipitation occurs from November through April. Due to increased elevation and the orographic effect of Ben Lomond Mountain west of the Basin, precipitation increases across the Basin east to west from about 42 inches to 52 inches per year.

The Basin's subsurface consists of interbedded sandstone, siltstone, mudstone, and shale overlying granitic and metamorphic rocks, all of which have been folded into a geologic trough called the Scotts Valley Syncline. The sandstone units in the geologic sequence are the principal aquifers that supply much of the groundwater produced for local water supply. The Basin's principal aquifers are the Santa Margarita, Lompico, and Butano Sandstones. The Monterey Formation is an aquitard between the Santa Margarita and Lompico Sandstones. The following describes the general characteristics of the principal aquifers and Monterey Formation:

The **Santa Margarita aquifer** is the shallowest principal aquifer, with widespread surface exposures in the southern and central portions of the Basin. It is a high-yielding aquifer that is critical to SLVWD public supply, creek baseflow, and private water supply.

The **Monterey Formation** is a low-yielding aquitard used only for private and small system water supply. The low permeability formation limits recharge of the underlying Lompico aquifer and is associated with surface water discharge and springs sourced by the overlying Santa Margarita aquifer.

The **Lompico aquifer** is used extensively for municipal supply in the Mount Hermon / Scotts Valley area where the formation is thickest. This mostly confined aquifer has significantly less direct recharge from precipitation than the Santa Margarita aquifer because of its much smaller surface exposure. The area where the Monterey Formation is absent beneath the Santa Margarita aquifer in southern Scotts Valley / Camp Evers is important for groundwater recharge of the Lompico aquifer.

The **Butano aquifer** is the deepest of the productive aquifers and only used for water supply in northern Scotts Valley. It is recharged by surface water and precipitation where it is exposed along the Basin's northern boundary. SVWD is the only municipal user of the Butano aquifer, although private well owners pump from it in areas where it occurs at or close to the surface.

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Precipitation is the main source of natural groundwater recharge to the Basin's aquifers. It enters the shallowest aquifers either as direct infiltration through the soil or indirectly from streamflow infiltrating through the streambed. Most creeks in the Basin are fed by groundwater discharges with groundwater accounting for most summer and fall baseflows.

The major creeks and river in the Basin include the San Lorenzo River, Boulder Creek, Love Creek, Newell Creek, Lompico Creek, Zayante Creek, Bean Creek, and Carbonera Creek. Many of these are home to protected species. GDEs are widespread through the Basin and consist of springs, riverine, riparian, open water and groundwater supported wetlands. Fall Creek and the San Lorenzo River have bypass flow requirements that limit diversion timing and rates at certain times of the year.

The HCM is relatively well understood after decades of evaluation and studies. The only remaining data gap identified in the GSP is the lack of a dedicated monitoring well in the deep Butano aquifer where it is used for municipal water supply.

Groundwater Conditions

Groundwater levels have been stable to increasing over the past 20 years and at a level that supports all beneficial uses and users. However, some areas of the Basin have experienced groundwater level declines prior to SGMA that would benefit from continued groundwater level recovery to provide a drought reserve.

Historically, groundwater levels in the Mount Hermon / South Scotts Valley area started to decline as early as the 1970s when there was extensive development in the south Scotts Valley area. Groundwater level declines were exacerbated by an 11-year drought starting in 1984. In this area, a portion of the Santa Margarita aquifer has been dewatered, and the Lompico aquifer has had a 150- to 200-foot groundwater level decline as shown on Figure ES-2. Groundwater levels dropped to pump intakes in several wells screened in the Santa Margarita aquifer and upper parts of the Lompico aquifer, including MHA, SLWVD, and SVWD wells, forcing them to drill new wells screened in deeper parts of the Lompico aquifer. Groundwater extraction has decreased since the mid-1990s and groundwater levels are recovering. Currently, groundwater levels are close to levels observed in 1994.

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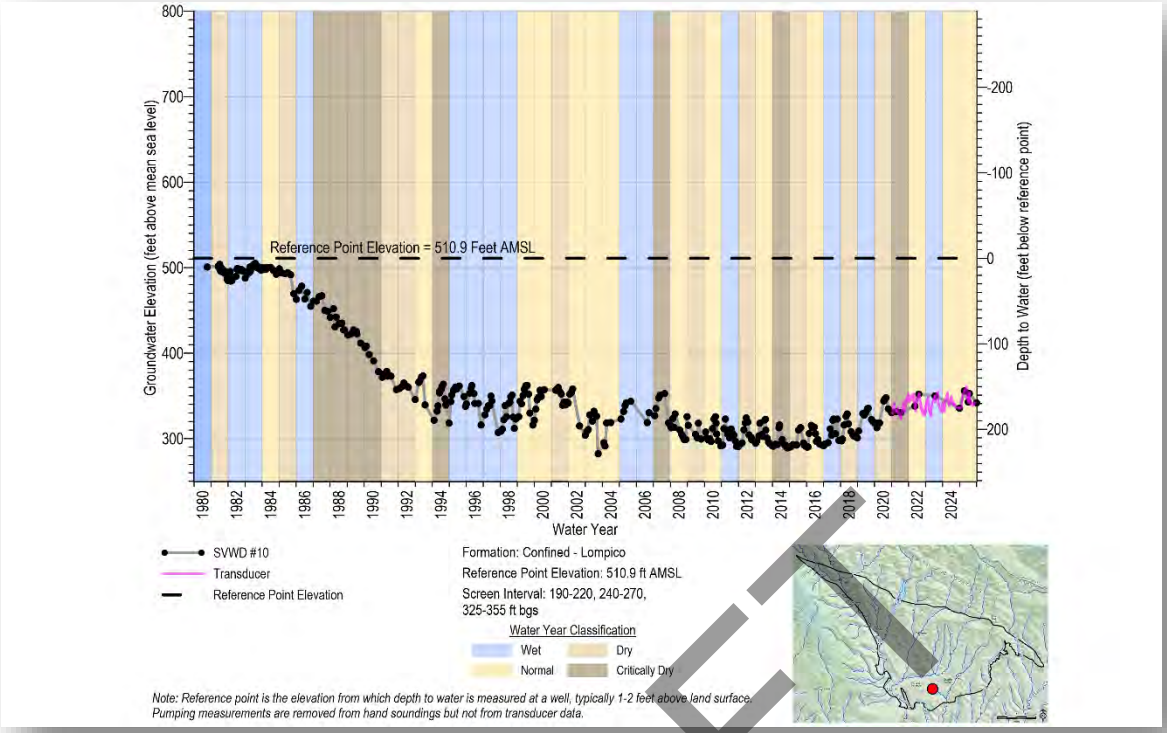

Figure ES-2. Hydrograph at SVWD #10 in the South Scotts Valley Area Showing Long-Term Decline of Groundwater Elevations

Even though the Santa Margarita aquifer recharges quickly when there is average or better rainfall, its groundwater levels in the Mount Hermon / South Scotts Valley area have not recovered much from the initial decline that ended in 1994. The main reason for a lack of recovery is thought to be that lowered groundwater levels, especially in the dewatered portions of the aquifer, cause water infiltrating at the surface to pass through the Santa Margarita aquifer and into the underlying formations instead of remaining in the Santa Margarita aquifer. Underlying formations are either the top of the low permeability Monterey Formation from where it mostly flows out at surface seeps to Bean Creek, or the Lompico aquifer where it is in direct contact with the Santa Margarita aquifer due to the absence of the Monterey Formation.

Climate change is projected to generally result in more variable precipitation (i.e., longer and more extreme droughts with fewer but more extreme rainfall events), slightly lower total precipitation, and warmer temperatures in comparison to current conditions. These climate conditions will 1) reduce natural recharge to groundwater causing further lowering of groundwater levels if groundwater extraction is not supplemented with other sources, and 2) reduce available surface water which at times will result in greater pressure on groundwater to meet water demands within the Basin.

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Declining groundwater levels in certain parts of the Basin caused consistent groundwater in storage losses. However, since the passage of SGMA in 2015, reduced groundwater extraction has allowed groundwater levels to stabilize and recover, resulting in a balanced water budget.

Groundwater in the Basin is generally of good quality and does not regularly exceed primary drinking water standards. However, both naturally occurring and anthropogenic groundwater quality constituents of concern (COCs) are present in some aquifers and areas. The main naturally occurring groundwater quality concerns in the Basin are salinity (measured as total dissolved solids and chloride) and arsenic. The main anthropogenic groundwater quality concern is nitrate from septic and sewer discharges. Historically, point source contaminant releases impacted aquifers used for water supply, but these releases have either been remediated or naturally attenuated.

Surface water is connected to groundwater throughout the Basin and groundwater discharge to creeks is an important source of creek baseflow to support GDEs and priority species habitat. The highly permeable Santa Margarita aquifer is the main source of baseflows to creeks. Groundwater elevations in the Santa Margarita aquifer are consistently higher than the streambed, indicating that groundwater is contributing to streamflow year-round.

There is no evidence of land subsidence occurring in the Basin and the consolidated geology makes subsidence due to groundwater extraction unlikely so this sustainability indicator is not applicable to the Basin.

Water Budget

The GSP includes 4 water budgets: historical pre-SGMA conditions (1985-2014), current conditions (2015-2025), and projected conditions (2026-2072) both with and without climate change. The water budgets summarize inflows and outflows for the land surface, surface water, and groundwater systems.

Surface water flows into and out of the Basin, and is connected to groundwater in many stream reaches. Creeks in the Basin consistently have a net annual gain from groundwater contributions—regardless of water year type—despite there being months of losing reaches. Overall, there is about 2.5 times more groundwater discharge to creeks than creek recharge of groundwater. This results in widespread gaining stream conditions and contributes to greater surface water outflow than inflow.

Figure ES-3 graphically depicts the current (2015-2025) average annual groundwater budget inflows, outflows, and change in storage. The groundwater budget demonstrates the importance of streamflow interactions in the Basin. Current groundwater pumping averages 2,700 AFY, while groundwater discharge to creeks is nearly 10 times greater at 20,500 AFY. Groundwater recharge from precipitation and losing streams offsets groundwater discharging to creeks and extractions to create a near balanced water budget with a

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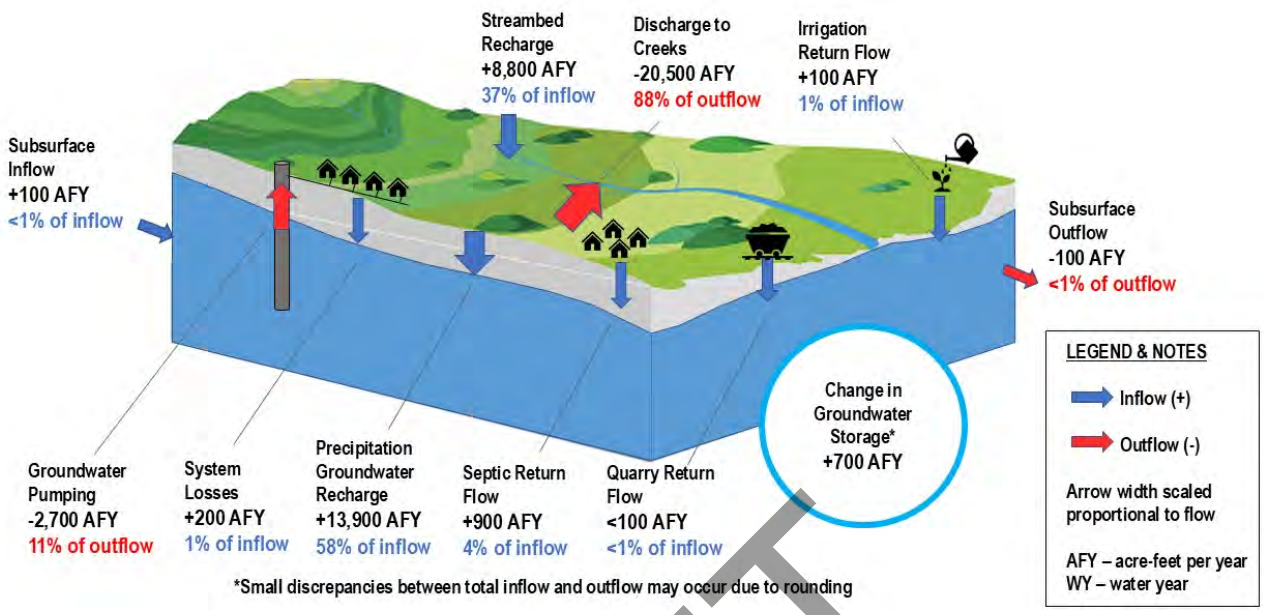

Figure ES-3. Current Groundwater Budget (Average from Water Year 2016 through 2025)

net gain in storage of 700 AFY over the current water budget timeframe.

Historically, the groundwater budget was not in balance with cumulative storage loss of about 1,300 AFY due to overextraction, especially from the Lompico aquifer in the Mount Hermon / South Scotts Valley area. Historical groundwater extraction averaged 3,900 AFY, or 1,200 AFY more than the current timeframe.

In the future, groundwater demands are expected to be similar to the current average extraction which continues to result in balanced volumes of groundwater in storage. Both current and projected periods have average extraction of about 2,600 AFY. If future climate conditions are similar to the historical and current conditions, the groundwater system should remain in balance with 100 AFY loss of storage between WY 2026-2072. However, if climate change results in a hotter and more variable climate, then reduced groundwater recharge will result in greater loss of groundwater in storage of 400 AFY.

The sustainable yield is an estimated volume of groundwater that can be pumped on a long-term average annual basis without causing undesirable results. Table ES-1 shows the historical, current, and projected pumping, which are the basis for the sustainable yield. To achieve groundwater sustainability, the current balanced conditions will need to be maintained and adaptively managed if future water demands or climate change cause groundwater extraction to exceed the sustainable yield and cause undesirable results to occur.

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Sustainable Management Criteria and Monitoring Networks

There are 4 applicable sustainability indicators in the Basin: chronic lowering of groundwater levels, reduction of groundwater in storage, degraded groundwater quality, and depletion of interconnected surface water. The GSP identifies monitoring networks for evaluating conditions for each indicator.

Locally defined, quantitative SMC define what constitutes sustainable groundwater conditions in the Basin. SMC were developed using best available information and science, direction provided by the SMGWA Board, public feedback, and input from stakeholders. Current groundwater conditions are generally sustainable as there are no undesirable results occurring in the Basin. SMGWA and its member agencies will continue to adaptively manage the Basin to maintain sustainable conditions in the future.

Table ES-1. Santa Margarita Basin Sustainable Yield

Aquifer	Historical Extraction 1985 – 2014 (AFY)	Current Extraction 2015 – 2025 (AFY)	Sustainable Yield & Projected Extraction 2026-2072 (AFY)
Santa Margarita (Unconfined Aquifer Total)	1,100	700	700
Monterey	*400*	*200*	*100*
Lompico	*1,800*	*1,200*	*1,200*
Butano	*600*	*500*	*600*
Confined Aquifer Total	2,800	1,900	1,900
Total Extraction	3,900	2,600	2,600

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The SMC for each sustainability indicator includes the following 4 quantitative metrics: undesirable results (URs), minimum thresholds (MTs), measurable objectives (MOs), and interim milestones (IMs) as summarized in Table ES-2. SMC are evaluated at a subset of the existing monitoring network called representative monitoring points (RMPs).

The general approach for each of the Basin's 4 applicable sustainability indicators is summarized below.

Chronic Lowering of Groundwater Levels: Maintain groundwater levels above fall 2013 levels with an objective of achieving fall 2006 levels to provide public water supply reliability, support priority species habitat, protect domestic wells from going dry, maintain high quality groundwater in the water supply aquifers, and create a drought reserve, among other benefits.

Reduction of Groundwater in Storage: Maintain groundwater extractions at or below the sustainable yield on a 5-year rolling average basis to support conjunctive use of groundwater and surface water as a drought resiliency strategy.

Degradation of Groundwater Quality: Manage groundwater extraction and PMAs to prevent degradation of groundwater quality for COCs and exceedance of relevant drinking water standards.

Depletion of Interconnected Surface Water: Manage groundwater levels and extraction to maintain groundwater baseflow to streams that supports GDE and priority species habitat (Figure ES-4) and for public water supply by downstream users in the City of Santa Cruz.

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Figure ES- 4. Lompico Creek Habitat (left) and Olympia Quarry Floor Habitat (right)

Table ES-2. Santa Margarita Basin Sustainable Management Criteria Summary

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Interim Milestones	Undesirable Result
Chronic lowering of groundwater levels	Groundwater elevation measured in representative monitoring point (RMP) wells	Fall 2013 groundwater levels	Fall 2006 groundwater levels	For wells with groundwater levels below the MO, the 2032 IM is 1/3 of the difference and 2037 IM is 2/3 of the difference between the current conditions and MO	• Fall groundwater elevations in 3 or more unconfined aquifer RMPs are below the MT in 2 consecutive years • Fall groundwater elevations in 3 or more confined aquifer RMPs are below the MT in 2 consecutive years
Reduction in groundwater storage	Rolling 5-year average metered and estimated groundwater extractions.	750 AFY in the unconfined aquifer group and 2,250 AFY in the confined aquifer group, totaling 3,000 AFY	700 AFY in the unconfined aquifer group and 1,900 AFY in the confined aquifer group, totaling 2,600 AF	Identical to measurable objectives	• Groundwater extraction volumes exceed the MT in the Unconfined aquifer. • Groundwater extraction volumes exceed the MT in the Confined aquifers.
Degraded groundwater quality	Concentrations of constituents of concern (COCs) in RMP wells	Unique value for each RMP based on degradation from historical concentrations and maintaining drinking water quality below regulatory standards	Unique value for each RMP based on degradation from historical concentrations and maintaining drinking water quality below regulatory standards	Identical to measurable objectives	• 3 or more RMPs experience an MT exceedance for the same constituent for 2 consecutive years
Depletion of interconnected surface water	Groundwater elevations measured in RMP wells as a proxy and extraction volumes are used for measuring depletion of interconnected surface water	Use chronic lowering of groundwater levels as a proxy and reduction in groundwater storage MTs	Use chronic lowering of groundwater levels as a proxy and reduction in groundwater storage MOs	Use chronic lowering of groundwater levels as a proxy and reduction in groundwater storage IMs	• Groundwater elevations in 3 or more RMPs fall below the MT in 2 consecutive years in the Unconfined aquifer • Groundwater elevations in 3 or more RMPs fall below the MT in 2 consecutive years in the Confined aquifers • Groundwater extraction volumes exceed the MT in the Unconfined aquifer • Groundwater extraction volumes exceed the MT in the Confined aquifers

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Projects and Management Actions

SMGWA member agencies have implemented PMAs to manage water resources for decades. Existing and ongoing projects include conjunctive use of groundwater and surface water, conservation, stormwater recharge, and recycled water use. Modeling of projected conditions with future demands indicates that the Basin is generally in balance and will likely be sustainable with limited PMAs. However, additional PMAs are in various planning stages should they be needed to achieve sustainability.

The primary project being developed in the Basin will be to expand SLVWD conjunctive use of surface water and groundwater using existing infrastructure. Expanding conjunctive use will allow SLVWD to optimize use of currently available treated surface water sources in their North System and Felton System by using existing system interties and potential capacity enhancements to offset groundwater pumping in their South System where lowered groundwater levels have occurred and North System where extraction occurs in the Santa Margarita aquifer.

If the primary expanded conjunctive use project is deemed infeasible or anticipated outcomes change, SMGWA may look to supplemental projects to meet SMGWA sustainability goals. SVWD and the City of Santa Cruz are working on a conjunctive use project similar to SLVWD's effort to improve drought resiliency. SVWD and the City of Santa Cruz have constructed

infrastructure to transfer water between them and are planning how to implement the project to maximize benefits and prevent causing undesirable results. Stormwater recharge is a supplemental project that would install small- to medium-scale stormwater capture facilities (10 to 1,000 AFY per site) to recharge the Santa Margarita aquifer at feasible locations.

A management action is for SGMWA and County of Santa Cruz Environmental Health Department (SCEH) to routinely collaborate and share information on potential water quality issues as they arise. This approach will help proactively track and identify issues of emerging concern and will assist SCEH in its oversight role in working with responsible parties to protect the beneficial uses of groundwater.

Groundwater Sustainability Plan Implementation

The estimated cost to implement the GSP over the next 5 years is $1,995,000, or $397,000 annualized over 5 years.

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The budget's major cost categories include:

- Governance, Administration and Business Operations
- SGMA Compliance and GSP Implementation Monitoring and GSP reporting

Each of these cost categories account for about half of the SMGWA budget.

The GSP implementation budget does not include the cost of evaluating, planning, designing, and constructing a project(s) to achieve groundwater sustainability. Individual cooperating agencies will cover their respective costs of these activities because SMGWA will not serve as the lead agency for implementing PMAs. Project costs may be shared between multiple agencies if the project provides greater water supply reliability and resiliency benefit to multiple agencies. Regional collaboration to achieve both basin sustainability and increase regional water supply reliability and resiliency is encouraged by SMGWA.

SMGWA is funded by its member agencies through annual contributions based on a cost sharing agreement. The cost allocation is currently established at 46.4% to SVWD; 31.7% to SLVWD; 12.5% County of Santa Cruz; 5.0% City of Santa Cruz; and 4.5% Mount Hermon Association. Future contribution amounts may be reassessed based upon SMGWA's annual budgetary requirements and equitable cost share rationale between the member and other represented agencies. SMGWA will continue to pursue funding opportunities from state and federal sources to support GSP implementation activities.

As authorized under SGMA Chapter 8, a GSA may impose fees, including, but not limited to, permit fees and fees on groundwater extraction or other regulated activity to help fund the costs for groundwater sustainability planning and program activities and administration. While SMGWA has elected to not assess other private users of groundwater in the Basin, it reserves the right to evaluate assessing fees on other private users of groundwater should they be determined to either cause impacts to Basin sustainability or substantially benefit from SMGWA's management activities. There are no current plans to impose a fee on private users of groundwater in the Basin.

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Glenwood Preserve; photo credit: Brian Largay/Land Trust of Santa Cruz County

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1 INTRODUCTION

1.1 Purpose of the Groundwater Sustainability Plan

In 2014, the State of California enacted the Sustainable Groundwater Management Act (SGMA). This act requires groundwater basins in California designated as medium- or high-priority be managed sustainably. Satisfying the requirements of SGMA generally requires the following 4 basic activities:

1. Forming one or multiple Groundwater Sustainability Agency(s) (GSAs) to fully cover a basin
2. Developing one or multiple Groundwater Sustainability Plan(s) (GSPs) that fully cover the basin
3. Implementing the GSP and managing the basin according to the GSP to achieve quantifiable objectives
4. Regular reporting of groundwater conditions and progress toward sustainability to the California Department of Water Resources (DWR)

This document fulfills the GSP requirement for the Santa Margarita Basin (Basin) categorized as a medium-priority basin. The GSP describes the Basin's physical attributes related to groundwater, surface water, and land use; develops quantifiable management objectives that take into account interests of the Basin's beneficial groundwater uses and users; and identifies a group of projects and management actions (PMAs) that will allow the Basin to achieve sustainability within 20 years of Plan adoption (2042), and to maintain sustainability for an additional 30 years beyond 2042.

The GSP was developed specifically to comply with SGMA's statutory and regulatory requirements. As such, the GSP uses terminology used in these requirements (see Water Code Section (CWC) §10721 and 23 California Code of Regulations (CCR) Section 351) which is oftentimes different from the terminology used in other contexts (e.g. past reports or studies, past analyses, judicial rules or findings). Definitions used in this GSP, including those from SGMA statutes and regulations, are included in Appendix 1A.

1.2 Sustainability Goal

The GSP requires that the GSA for the Basin, called the Santa Margarita Basin Groundwater Agency (SMGWA), establish a sustainability goal that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The 20-year deadline to achieve the sustainability goal is January 2042.

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SMGWA's sustainability goal is to achieve and maintain groundwater conditions that support beneficial uses and users and sustain the long-term health of the Basin's community, economy, and environment.

The sustainability goal will be achieved by the following:

- Monitoring and managing groundwater conditions to meet established sustainable management criteria and striving to achieve measurable objectives to enhance Basin conditions.
- Maintaining groundwater levels sufficient to protect domestic, municipal, agricultural, and industrial supply wells.
- Maintaining groundwater levels that support streamflow and groundwater dependent ecosystems, where applicable.
- Maintaining groundwater quality for current and future beneficial uses.
- Implementing cost-effective adaptive management strategies, including expanding conjunctive use and drought response measures, to enhance drought resilience and long-term supply reliability.

1.3 Agency Information

The Santa Margarita Basin GSP has been developed by one exclusive GSA, SMGWA.

1.3.1 Organization and Management Structure of SMGWA

SMGWA was formed through a Joint Powers Agreement (JPA) in June 2017 among SVWD, SLVWD, and the County of Santa Cruz (County). SLVWD uses both local surface water and groundwater resources to supply potable water to their customers, while SVWD relies only on groundwater resources. The County of Santa Cruz regulates land use, issues well permits, oversees small public water systems, and conducts various watershed management efforts in the Basin.

SMGWA is governed by a Board of Directors comprising 2 representatives from each member agency for a total of 11 directors: 1 representative from the City of Scotts Valley, 1 from the City of Santa Cruz, 1 from Mount Hermon Association (MHA), and 2 private well owner representatives.

Each member agency has one alternate to act as a substitute director. One alternate acts as a substitute director for the 2 directors representing private well owners, and 1 alternate for each entity acts as a substitute director for the City of Scotts Valley, City of Santa Cruz, and MHA.

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Alternate directors have no vote, and do not participate in any discussions or deliberations of the Board unless appearing as a substitute for a director due to absence or conflict of interest.

There are no dedicated SMGWA staff. All staffing support and funding for SMGWA is provided by its 3 member agencies. Although not a member agency, the City of Santa Cruz provides staff support to SMGWA because it obtains approximately 69% of its water supply from the San Lorenzo River watershed, which covers almost the entire groundwater basin.

Mr. David McNair is the authorized representative for the SMGWA. His contact information is listed below:

Mr. David McNair
General Manager
Scotts Valley Water District
2 Civic Center Drive
Scotts Valley, CA 95066
Phone: (831) 600-1902
Email: dmcnair@svwd.org

1.3.2 Legal Authority of the Santa Margarita Groundwater Agency

Figure 1-1 shows the extent of the Santa Margarita Basin. This GSP covers the entire Basin area for which SMGWA is the exclusive GSA. No portion of the Basin is covered by a non-exclusive GSA. Therefore, the SMGWA provides the sole legal authority to implement this GSP throughout the entire Plan area and no authority is needed from any other GSA to implement the GSP.

SMGWA has legal authority to perform duties, exercise powers, and accept responsibility for managing groundwater sustainably within the Santa Margarita Basin. Legal authority comes from SGMA, the JPA signed by SMGWA member agencies effective on June 1, 2017, and JPA Bylaws. The JPA is included as Appendix 1B. Taken together, these laws and agreements provide the necessary legal authority for the SMGWA Board of Directors to prepare and implement the Basin's GSP.

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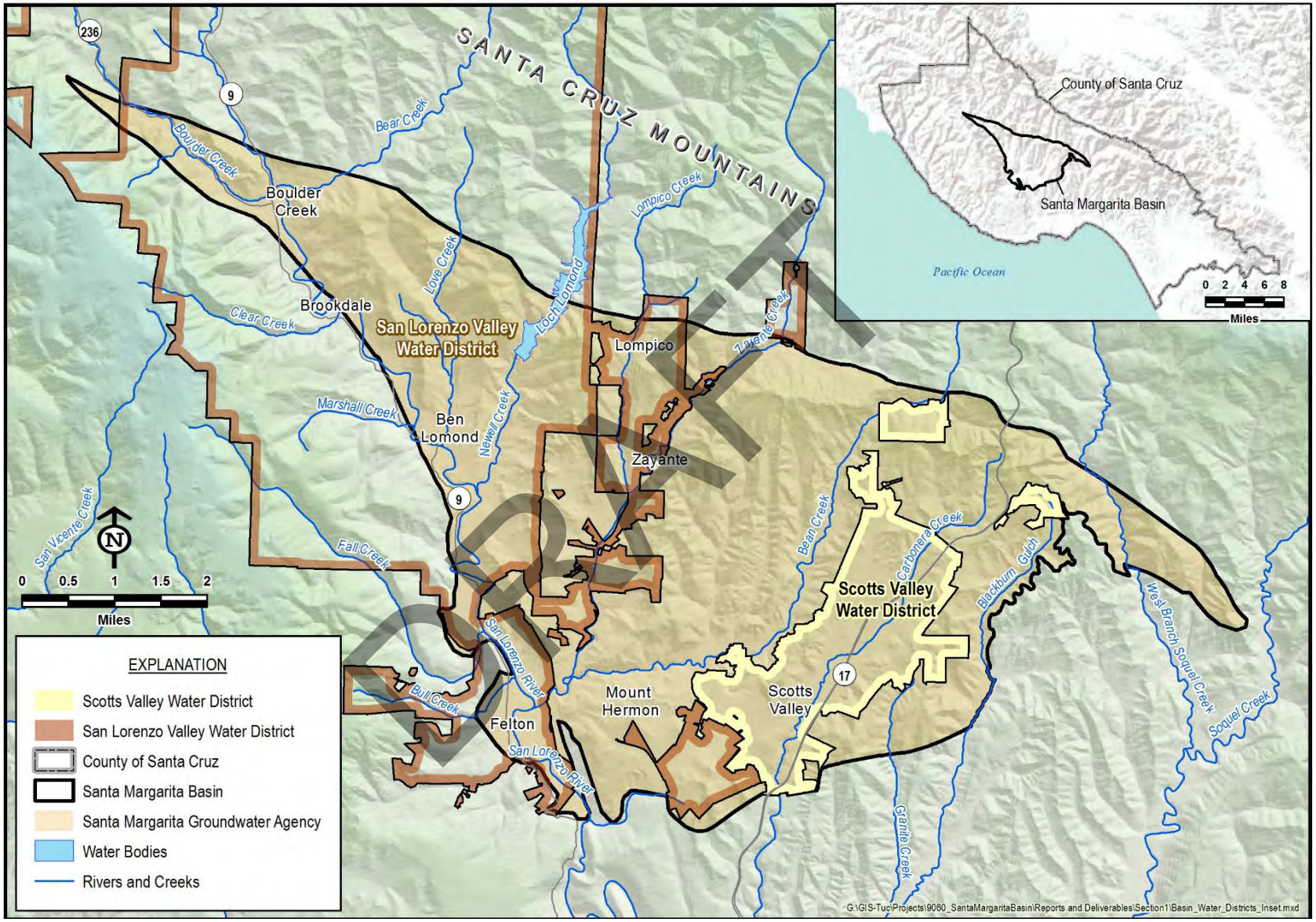

Figure 1-1. Extent of SMGWA GSP Plan Area with Member Agency Boundaries

1.3.3 Santa Margarita Groundwater Agency Guiding Principles

Prior to starting GSP development, the SMGWA Board conducted a joint goal setting process that allowed them to establish a solid foundation for the planning work required during the GSP development. The process was facilitated by Dave Ceppos, a Managing Senior Mediator at California State University Sacramento, College of Continuing Education, Consensus and Collaboration Program. Mr. Ceppos presented a situation assessment and a report on the background reviews he conducted to the Board at its July 2018 meeting.

The Board formed a Facilitation Committee to work with the facilitator in designing and implementing a joint goal setting process. The committee met several times to review the recommendations from the assessment report, preparing guiding principles and determining the appropriate timeline for necessary activities. Collectively they developed a proposed "Santa Margarita Groundwater Agency (SMGWA) Guiding Principles" document (Guiding Principles) that was approved at the November 2018 Board meeting and then amended at the December 2018 Board meeting. The final Guiding Principles are included as Appendix 1C to this GSP.

Development of the Guiding Principles marked a major milestone for SMGWA. They define a set of mutual core values and commitments that the current Board and future Boards will focus their efforts toward. The Guiding Principles add to the SMGWA's other documents, including the agency's JPA (Appendix 1B) and Bylaws, that define how the Agency does and will function. As used by other organizations and agencies, Guiding Principles (and similar) are an important and applied tool that guides the work of a governing body. Among many uses, the SMGWA Guiding Principles can:

- Be provided to the Basin Beneficial Users as a written description of key interests and a commitment/pledge by the Board as to how it will implement SGMA.
- Be used by all Board members to regularly assess the direction of discussions and potential Board decisions and to ensure that said discussions and decisions are consistent with these Guiding Principles.

1.3.4 Estimated Cost of Implementing the GSP and SMGWA's Approach to Meet Costs

Over the next 5 years, the estimated cost to implement the GSP is $1,995,000. The annualized cost over those 5 years is $397,000. Estimated costs by GSP implementation activity are discussed in detail in Section 9.

The estimated cost of implementing the GSP is presented by category identified below but also includes maintaining a prudent fiscal reserve and other miscellaneous costs. The cost estimate's major cost categories include:

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- Governance, Administration, and Business Operations
- SGMA Compliance and GSP Implementation Monitoring and GSP Reporting

Each of these cost categories account for about half of the SMGWA budget.

The GSP implementation cost estimate does not include the cost of evaluating, planning, designing, and constructing a project(s) to achieve groundwater sustainability. As discussed in Sections 8 and 9, cooperating agencies will cover their respective costs of these activities because SMGWA will not serve as the lead agency for implementing PMAs. Project costs may be shared between multiple agencies if the project provides greater water supply reliability and resiliency benefit to multiple agencies. SMGWA encourages regional collaboration to achieve sustainability and increase regional water supply reliability and resiliency.

Costs associated with implementing new projects would be funded through a combination of increased operating revenue and outside funding sources. Potential outside funding sources could include Integrated Regional Water Management (IRWM) Grant Programs, Sustainable Groundwater Management Grant Program, Watershed Resilience, State Revolving Fund low interest loans, United States Department of Agriculture (USDA) grants and/or low interest loans, or United States Bureau of Reclamation (USBR) Drought Resiliency and/or Title XVI Recycled Water. For many projects included in the GSP, securing outside funding to supplement local revenue streams will be critical. Considering the size of the population and scale of the projects required to achieve sustainability, it is important to ensure financial feasibility and long-term affordability.

The SMGWA is funded by its member agencies and other agencies represented on the SMGWA Board through annual contributions. The cost allocation is currently established at: 46.4% to SVWD; 31.7% to SLVWD; 12.5% County of Santa Cruz; 5.0% City of Santa Cruz; and 4.5% Mount Hermon Association. Future contribution amounts may be reassessed based upon SMGWA's annual budgetary requirements and equitable cost share rationale between the member and other represented agencies. The SMGWA will continue to pursue funding opportunities from state and federal sources to support GSP implementation activities.

As authorized under Chapter 8 of SGMA, a GSA may impose fees, including, but not limited to, permit fees and fees on groundwater extraction or other regulated activity, to fund the costs including groundwater sustainability planning and program activities and administration. While the SMGWA has elected not to assess other private users of groundwater in the Basin, SMGWA reserves the right to evaluate assessing fees on other private users of groundwater should they be determined to either cause impacts to Basin sustainability or substantially benefit from SMGWA's management activities.

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1.4 GSP Organization

The SMGWA's GSP is organized based upon the DWR's GSP Annotated Outline with additional information to address content requirements found in the *Preparation Checklist for GSP Submittal* (DWR, 2016c).

The GSP is organized as follows:

Executive Summary

The executive summary presents an overview of the overall GSP, background information on the groundwater conditions in the Basin, an overview of the GSP development process, and key information pertinent to GSP implementation.

Section 1. Introduction

Introduces the purpose of the GSP, the Basin's Sustainably Goal, information about the SMGWA, and organization of the GSP.

Section 2. Plan Area

Describes the beneficial users of groundwater, including existing water resources management efforts that were either incorporated into the GSP or are directly related.

Section 3. Basin Setting

Describes the physical attributes related to groundwater, surface water, and land use in the Basin, including the Hydrogeologic Conceptual Model (HCM).

Section 4. Groundwater Conditions

Summarizes historical and current groundwater conditions for the groundwater sustainability indicators subject to SGMA.

Section 5. Water Budget

Presents the Basin's historical, current, and projected water budgets both with and without climate change to demonstrate how water use and climate relate to groundwater conditions.

Section 6. Monitoring Networks

Describes the monitoring networks and protocols for the groundwater sustainability indicators subject to SGMA.

Section 7. Sustainable Management Criteria

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Documents the sustainable management criteria that are used to evaluate the sustainability of groundwater conditions and use.

Section 8. Projects and Management Actions

Describes PMAs to achieve the Basin's sustainability goal while being responsive to projected changes in future water demand and climate change.

Section 9. Plan Implementation

Provides an estimate of GSP implementation costs and implementation schedule.

Section 10. References and Technical Studies

This final section provides references to the reports and studies cited in the GSP with links to electronic versions where available.

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2 PLAN AREA

2.1 Area Covered by the GSP

This GSP covers the entire Santa Margarita Basin (DWR Basin 3-027) as defined in DWR Bulletin 118 (DWR, 2016b). The Basin is located at the northern end of the Central Coast hydrologic region. The area of the Basin is 34.8 square miles (22,249 acres). To the south and southeast of the Basin is the Santa Cruz Mid-County Basin, and to the south is the West Santa Cruz Terrace Basin. The Santa Margarita Basin includes the City of Scotts Valley and the communities of Boulder Creek, Brookdale, Ben Lomond, Lompico, Zayante, Felton, and Mount Hermon. The Santa Margarita Basin's neighboring basins are shown on Figure 2-1. Based on 2020 census block data, the population of the Basin is approximately 30,600 (U.S. Census Bureau, 2020).

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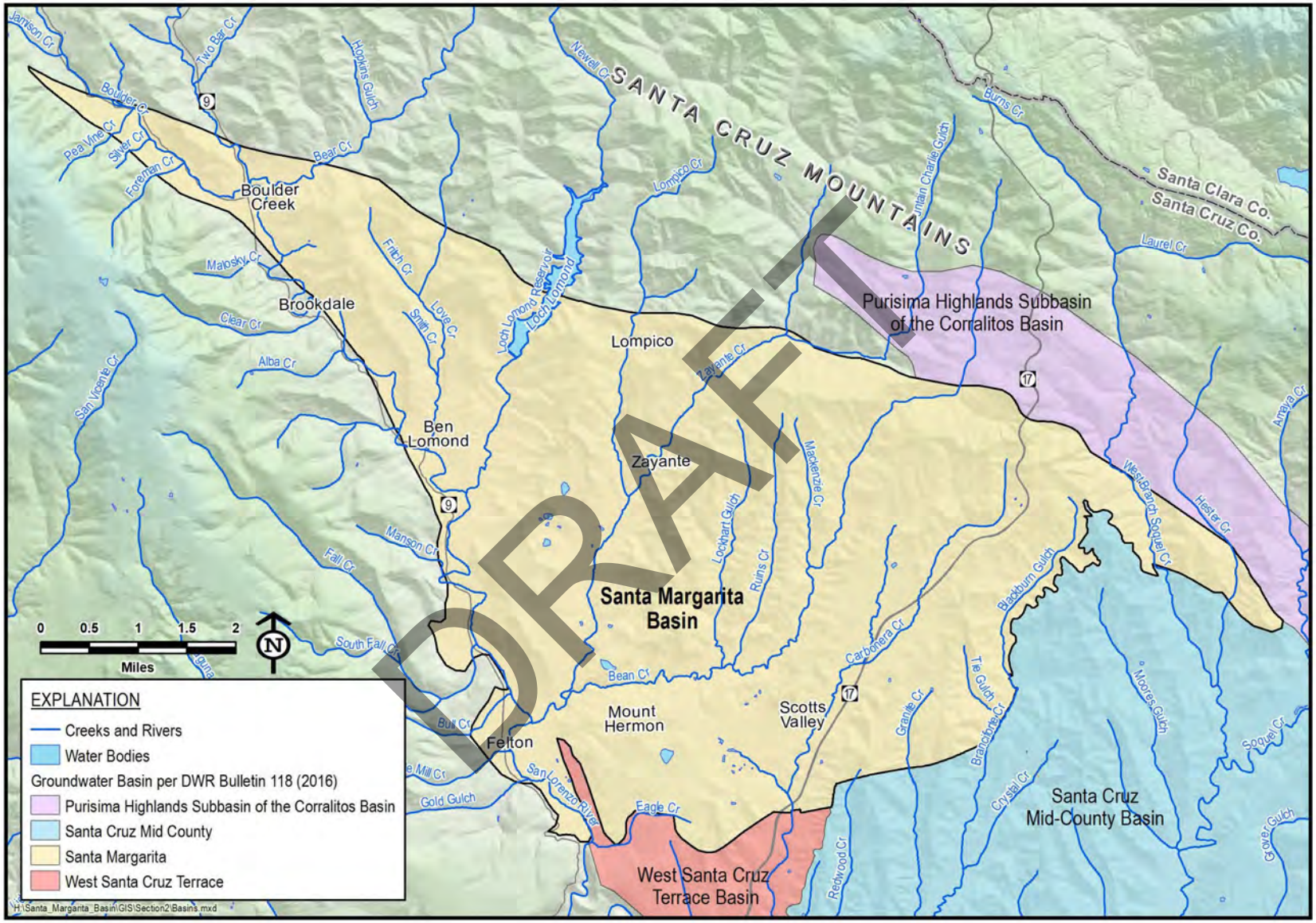

Figure 2-1. Groundwater Basins Adjacent to the Santa Margarita Basin

2.1.1 Jurisdictional Areas

2.1.1.1 County of Santa Cruz

The Basin is completely within the County of Santa Cruz as shown on the inset map of. The County has a total area of 607 square miles (388,480 acres), 445 square miles of which is land area (73%) and the remaining 162 square miles is water (27%) (US Census, 2010).

In the Basin, the County has land use jurisdiction for all unincorporated areas outside of the City of Scotts Valley and is the largest agency with land use jurisdiction. The population residing in the Basin's unincorporated areas is approximately 18,300 (California Department of Finance, 2019). Of the population in unincorporated areas, it is estimated that 5,300 people are within the jurisdictional area of 1 of the Basin's 2 water districts, but because there is no water service to those parcels, they rely on small water systems or private wells.

The County is not a supplier of water but does permit and regulate private groundwater wells and small water systems that serve this population. The County of Santa Cruz Environmental Health Division (SCEH) of the County's Health Services Agency includes the Water Resources Program which participates in countywide planning and management efforts on a variety of water resource programs, including groundwater management, water quality, stormwater management, water conservation, fish (steelhead) monitoring, and watershed and stream habitat protection. The County is a member agency of the SMGWA.

2.1.1.2 Water Districts

2.1.1.2.1 San Lorenzo Valley Water District

The SLVWD is a member agency of the SMGWA. SLVWD, established in 1941, supplies water to the communities of Boulder Creek, Brookdale, Lompico, Ben Lomond, Zayante, Mañana Woods and Felton, and to a portion of the City of Scotts Valley, through a network of over 185 miles of distribution lines, pump stations and reservoirs. SLVWD's jurisdictional boundaries encompass approximately 62 square miles (39,680 acres, Figure 2-3). Its current service area served by existing infrastructure in the Basin is approximately 5.6 square miles (3,885 acres, Figure 2-3). More than 7,900 connections serve approximately 26,000 customers throughout the service area, some of whom are outside of the Basin. The SLVWD serves approximately 13,000 customers in the Basin; the water used to supply them is from 3 sources within the Basin:

1. Nine stream diversions on tributaries to the San Lorenzo River, 4 of which are currently active
2. One groundwater spring
3. Seven active groundwater production wells

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SLVWD owns, operates, and maintains 2 water systems:

1. The *San Lorenzo Valley System* is split into 2 sub-systems: north and south. The North San Lorenzo Valley System includes the unincorporated communities of Boulder Creek, Brookdale, Lompico (SLVWD annexed the Lompico County Water District in 2016), and Ben Lomond. Its source of water is surface water and groundwater. Part of the North San Lorenzo Valley System is outside of the Basin (Figure 2-3). The South San Lorenzo Valley System encompasses portions of the City of Scotts Valley and adjacent unincorporated neighborhoods. The Mañana Woods subdivision became part of the San Lorenzo Valley System because of the District's annexation of the Mañana Woods Mutual Water Company in July 2006. The southern portion of the system is supplied by groundwater pumped in the Pasatiempo area and through an emergency intertie with the northern portion of the system. SLVWD is pursuing efforts to use its emergency interties on a routine basis for conjunctive use and improved resiliency.

2. The *Felton System* was acquired by SLVWD from California American Water in September 2008 and includes the town of Felton and adjacent unincorporated areas. It was owned and operated by Citizen Utilities Company of California prior to 2002. The system is supplied by surface water and springs and covers an area of 2.9 square miles or 1,884 acres. Part of the Felton System is outside of the Santa Margarita Basin (Figure 2-3). The Felton System is connected to the San Lorenzo Valley System by an intertie that is currently only used for emergencies.

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2.1.1.2.2 Scotts Valley Water District

SVWD is a public agency—and member agency of SMGWA—responsible for the management and supply of water to the Scotts Valley area (Figure 2-2). It was formed under the County Water District Law, specifically California Water Code (CWC) §30321 and received certification from the California Secretary of State in 1961. SVWD serves an area of about 5.5 square miles (3,520 acres, Figure 2-2). It provides water to most of the incorporated areas of the City of Scotts Valley and a portion of an unincorporated area to the north. It supplies potable water to approximately 10,700 customers through 4,300 service connections, excluding fire services. SVWD relies exclusively on groundwater from municipal wells for potable water supply while supplementing non-potable demand with recycled water from the City of Scotts Valley Tertiary Treatment Plant. Non-potable recycled water is primarily used for landscape irrigation.

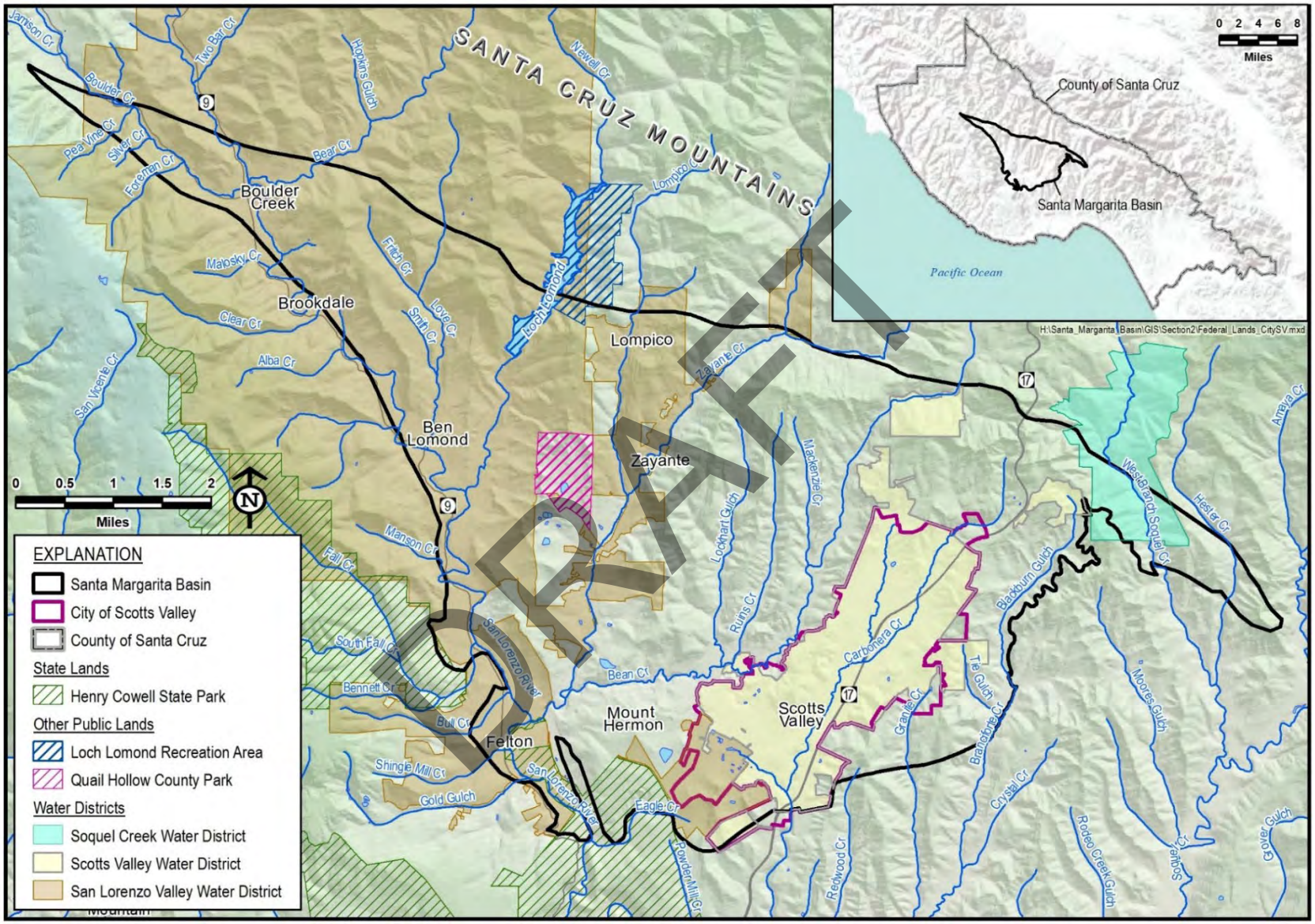

Figure 2-2. Jurisdictional Areas within the Santa Margarita Basin

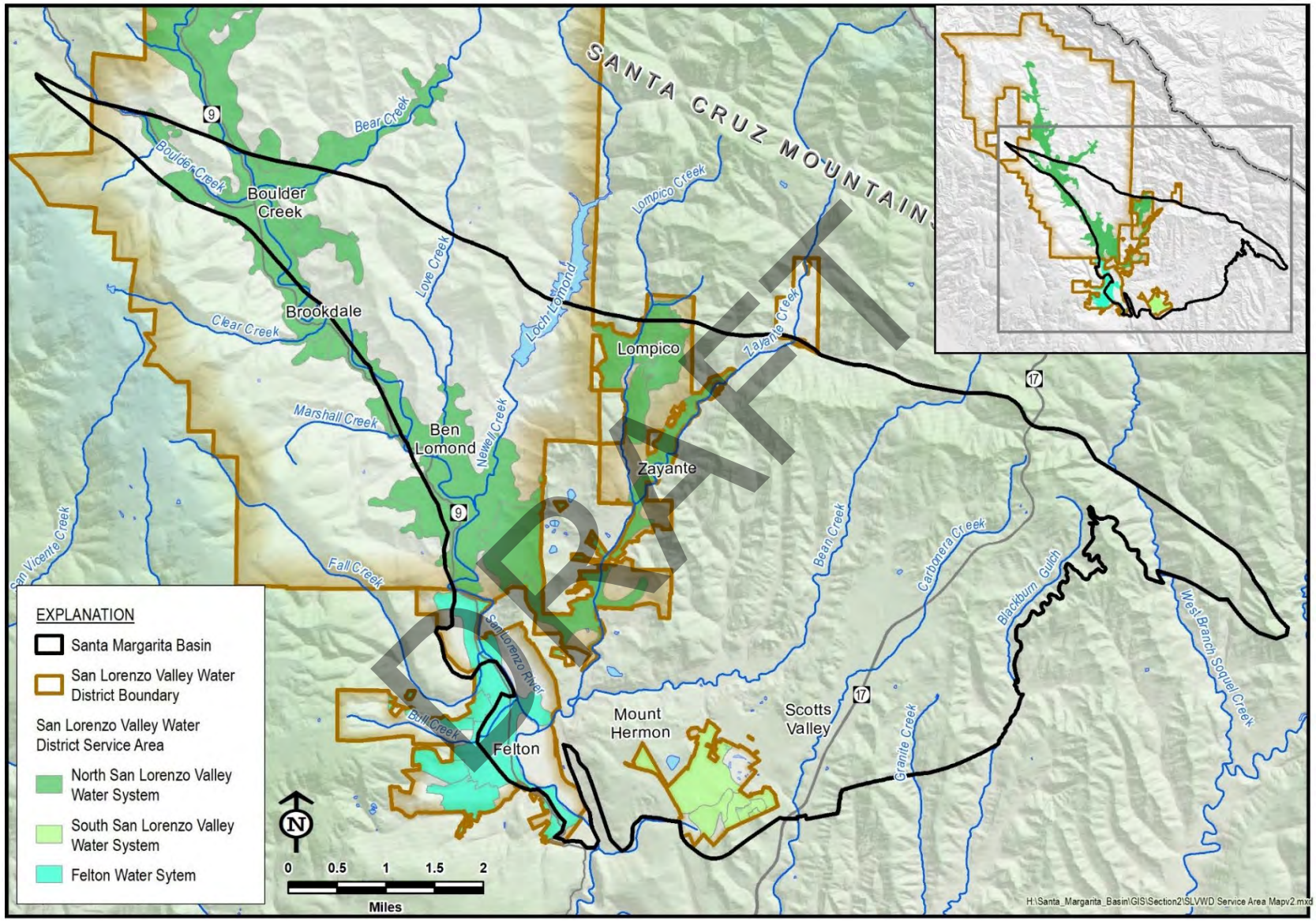

Figure 2-3. San Lorenzo Valley Water District Boundary and Water Systems

2.1.1.2.3 Soquel Creek Water District

The Soquel Creek Water District (SqCWD) owns approximately 1 square mile of land (640 acres) in the northeastern part of the Basin. The jurisdictional area is a legacy of a now-abandoned plan to construct a reservoir on the West Branch of Soquel Creek. SqCWD does not supply or extract water from the Basin.

2.1.1.3 City of Scotts Valley

The City of Scotts Valley is not a potable water supplier, but it is responsible for stormwater and wastewater management. City of Scotts Valley residents and businesses are supplied potable water by SVWD and SLVWD (Figure 2-2). The City of Scotts Valley and SVWD Recycled Water Program is a cooperative effort to reuse treated wastewater. The City of Scotts Valley operates the Scotts Valley Water Reclamation Facility (WRF) and the Tertiary Treatment Plant, which has produced recycled water since 2002 for its own use and for distribution by SVWD. The recycled water is non-potable and is used primarily for landscape irrigation and to a lesser extent for dust control. Effluent from the WRF that is not used in the Basin is transported through a pipeline to the City of Santa Cruz marine outfall in Monterey Bay operated and maintained by the City of Santa Cruz Public Works Department.

2.1.1.4 Federal and State Lands

The only state managed land in the Basin is Henry Cowell State Park (Figure 2-2). There are no federal lands. The United States Geological Survey (USGS) National Map (USGS, 2019) show portions of the Loch Lomond Recreation Area and Quail Hollow County Park as state lands (Figure 2-2). They are, however, managed by the City of Santa Cruz and County of Santa Cruz, respectively.

2.1.1.5 Tribal Lands

There are no federally designated tribal lands and no federally recognized tribes in the Basin. The Basin is located within a California Tribal and Cultural Area that historically belonged to a division of the Ohlone people known as the Awaswas. There is no currently active or known group representing the descendants of the Awaswas. The neighboring tribe to the Awaswas were the Mutsun, now represented through the Amah Mutsun Tribal Band (AMTB). The AMTB people inhabited the land from present-day Davenport to Aptos. Descendants of the Awaswas people are members of the AMTB. The Tribal Band is petitioning the federal government for tribal recognition and has formed the Amah Mutsun Land Trust to access, protect, and steward lands important to the tribe (Amah Mutsun, 2019).

Staff met with a representative of the AMTB who indicated their focus currently is on their ancestral lands; however, they do maintain an interest in the surrounding areas as well. As rivers are of particular importance, SMGWA and contributing agencies will notify the AMTB about

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projects that may impact waterways, and work with them to accommodate any actions they recommend.

2.1.2 City of Santa Cruz

The City of Santa Cruz has no service area in the Basin and is not a member agency of the SMGWA. However, the City is an indirect groundwater user in the Basin because the surface water it diverts from the San Lorenzo River for municipal use partially comprises baseflows supported by Basin groundwater discharge to creeks. The City owns property, which is partly located in the Basin, associated with water supply use and construction of the Loch Lomond Reservoir (Figure 2-2).

The San Lorenzo River and Loch Lomond Reservoir provide about 69% of the water supplied to approximately 95,000 City of Santa Cruz Water Department customers (City of Santa Cruz, 2016a). Surface water from Loch Lomond Reservoir is conveyed by the Newell Creek Pipeline to the Graham Hill Water Treatment Plant (WTP) in the City of Santa Cruz. Surface water from the San Lorenzo River is diverted in 2 locations for use by the City of Santa Cruz. There is 1 diversion location in the Basin in Felton that is used to divert water upstream to the Loch Lomond Reservoir and 1 location downstream of the Basin that is used to divert water to the City treatment plant. Between 2006 and 2015, 14% of the City of Santa Cruz water supply was from Loch Lomond Reservoir storage and 55% was from the San Lorenzo River. Additional details are provided in Section 3.4.8 on surface water bodies in the Basin.

2.1.3 Basin Groundwater Management Areas

2.1.3.1 GSP Management Areas

SGMA allows GSAs to define 1 or more management areas within a groundwater basin if the agency determines that the creation of management areas will facilitate implementation of its GSP. The SMGWA finds no additional benefit to establishing separate management areas within the Basin at this time, although management areas may be needed in the future.

2.1.3.2 Other Basin Management Areas

There are no adjudicated or alternative GSP managed areas within the Basin.

2.2 Water Resources Monitoring and Management Programs

Groundwater resources in the Basin have been used as a shared resource for many decades and collaboratively managed for nearly 2 decades by local agencies. SMGWA was preceded by a local advisory committee called the Santa Margarita Groundwater Basin Advisory Committee (SMGWBAC) that had some of the same functions and same member agencies as the SMGWA. The SMGWBAC was formed by a Memorandum of Understanding in 1995 by the SVWD,

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SLVWD, MHA, Lompico County Water District (merged with SLVWD in 2016), City of Scotts Valley, and County of Santa Cruz. The SMGWBAC consisted of 1 representative and 1 alternate from each member agency. The committee met biannually and was actively involved in all facets of groundwater management of the Basin. In 2016, the SMGWBAC established a GSA Formation Committee, which led the effort of preparing a draft JPA for SMGWA. With the creation of SMGWA, the SMGWBAC function became redundant, and the committee was dissolved in 2017.

SMGWA cooperating agencies have had active roles in groundwater resource management and monitoring in the Basin as members of the SMGWBAC and independently to support their water supply operations. The subsections that follow describe the cooperating agencies' groundwater elevations, groundwater extraction, groundwater quality, and surface water flow and quality management and monitoring programs. The purpose of these monitoring efforts is to responsibly manage the water resources relied upon for public water supply.

Most of the existing water resources monitoring and management programs that use water within the Basin do not have triggers that limit operational flexibility with respect to groundwater or surface water use. However, the City of Santa Cruz, which diverts San Lorenzo River surface water at Felton to Loch Lomond Reservoir and at Tait Street (downstream of the Basin has explicit triggers related to bypass flows at the San Lorenzo River Big Trees gage. The water rights permit for Fall Creek diversions, a tributary to the San Lorenzo River, has similar bypass flow requirements on the San Lorenzo River that influence SLVWD diversion timing and rates. Groundwater and surface water monitoring programs that are in operation in the Basin are incorporated into SMGWA's monitoring network described in Section 6.

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2.2.1 United States Geological Survey Surface Water Monitoring

The USGS has operated and reported on the Big Trees streamflow gage (11160500) on the San Lorenzo River, south of Felton (Section 6.6.1), since October 1937.

2.2.2 California Department of Water Resources Groundwater Level Monitoring Programs

Prior to SGMA, DWR implemented the California Statewide Groundwater Elevation Monitoring (CASGEM) program to evaluate regional groundwater elevations. Groundwater elevation monitoring through CASGEM provided DWR with data needed to track seasonal and long-term groundwater elevation trends. The SCEH administered CASGEM in the Basin.

Under SGMA implementation, groundwater level monitoring is now coordinated through the SGMA Portal and Monitoring Network Module (MNM), which serves as the primary platform for submission, storage, and public dissemination of groundwater elevation and other monitoring

data. CASGEM monitoring sites within the Basin have been incorporated into this broader SGMA monitoring data and are now reported as part of SMGWA's monitoring network.

2.2.3 Central Coast Regional Water Quality Control Board Basin Plan

Surface water and groundwater quality in the Basin is managed per the water quality objectives and beneficial uses described in the Central Coast Region, Water Quality Control Plan (Basin Plan; Central Coast Regional Water Quality Control Board (CCRWQCB), 2019). The Basin Plan is developed by CCRWQCB, the State Water Resources Control Board (SWRCB), and the California Environmental Protection Agency (CALEPA). The Basin Plan lists various beneficial water uses and describes the water quality which must be maintained to allow those uses. Present and potential future beneficial uses for inland waters in the Basin Plan are surface water and groundwater as municipal supply; agricultural; industrial; groundwater recharge; water recreation; cold freshwater habitat; wildlife habitat; sport fishing; rare, threatened or endangered species; migration of aquatic organisms; and spawning, reproduction, and/or early development of fish.

Water quality is an important factor in determining water use and benefit. For example, drinking water must be of higher quality than the water used to irrigate pastures. Since the Santa Margarita Basin does not have its own Basin-specific groundwater quality objectives, the broad groundwater objectives of the Central Coast Region Basin Plan are summarized in Table 2-1. Site-specific median groundwater quality objectives are provided at 2 locations within the Basin: near Felton and near Boulder Creek (Table 2-2). It is unclear from the Basin Plan which aquifers these apply to. The County has interpreted the location near Felton to apply to the Santa Margarita Sandstone, and the location near Boulder Creek to apply to the Butano Sandstone within the Basin (personal communication with John Ricker, March 2020). The Basin Plan also includes mean surface water quality objectives, or concentrations in milligrams per Liter (mg/L) for total dissolved solids (TDS), chloride, sulfate, boron, and sodium for Boulder Creek, Zayante Creek, and the San Lorenzo River (Table 2-2).

The Basin Plan sets limits for nitrate loading in the San Lorenzo River. Nitrate released from septic systems, livestock, fertilizer use, and other sources passes readily through the sandy soil, into the Basin groundwater, and eventually into the San Lorenzo River. As such, the San Lorenzo River has been designated as impaired by the State and the United States Environmental Protection Agency (USEPA) due to elevated levels of nitrate, which stimulate increased algal growth and release of compounds that degrade drinking water quality and require increased cost for treatment. Increased nitrate and algal growth also cause impacts in the San Lorenzo lagoon[1], degrading salmonid habitat and potentially creating harmful algal blooms. Approximately 65%

[1] The San Lorenzo lagoon is found at the mouth of the San Lorenzo River and is most prominent when a sandbar disconnects the river from the ocean.

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of the nitrate load in the San Lorenzo River originates from the Basin's Santa Margarita Sandstone, the majority of which comes from septic systems (County of Santa Cruz, 1995).

To reduce nitrate levels in the San Lorenzo River, the County developed the San Lorenzo Nitrate Management Plan in 1995, and CCRWQCB adopted a Nitrate Total Maximum Daily Load (TMDL) in the Basin Plan. These plans call for various measures to prevent any increased nitrate discharge and to reduce existing sources, particularly requiring individual enhanced treatment systems as existing septic systems in sandy soils are replaced or upgraded. Further, the use of recycled water in the basin requires additional treatment for denitrification before the water can be used.

The Basin Plan update in 2003 described the San Lorenzo River as impaired for both sediment and pathogens. The San Lorenzo River Technical Advisory Committee was formed to help CCRWQCB develop actionable plans to decrease the levels of these constituents in the river. Responsibility for tracking, reporting status, and evaluating the effectiveness of voluntary implementation actions, is shared by the Regional Board and participating members of the San Lorenzo River Technical Advisory Committee. TMDLs have been adopted for both sediments and pathogens and are being implemented to reduce the sources of those pollutants. The technical advisory committee has found that the highly erodible soils of the Santa Margarita Sandstone have been a significant source of sediment in the river. Measures are needed to reduce site disturbance, reduce runoff, promote infiltration, and implement erosion control practices. The pathogen TMDL calls for improved septic system management to reduce failures and address other sources such as livestock, stormwater runoff, and homeless encampments.

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Table 2-1. Central Coast Basin Plan Groundwater Water Quality Objectives Applicable to the Santa Margarita Basin

Chemical Constituent	General Objectives for Groundwater	Objectives for Municipal & Domestic Groundwater Supply
Tastes and odors	Groundwaters shall not contain taste or odor producing substances in concentrations that adversely affect beneficial uses.	---
Radioactivity	Radionuclides shall not be present in concentrations that are deleterious to human, plant, animal, or aquatic life; or result in the accumulation of radionuclides in the food web to an extent which presents a hazard to human, plant, animal, or aquatic life.	Groundwaters shall not contain concentrations of radionuclides in excess of the limits specified in CCR, Title 22, Division 4, Chapter 15, Article 5, Section 64443. This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.
Bacteria	---	The median concentration of coliform organisms over any 7-day period shall be less than 2.2/100 mL
Organic Chemicals	---	Groundwaters shall not contain concentrations of organic chemicals in excess of the maximum contaminant levels for primary drinking water standards specified in CCR, Title 22, Division 4, Chapter 15, Article 5.5, Section 64444, Table 64444-A. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect.
Inorganic Chemicals	---	Groundwaters shall not contain concentrations of inorganic chemicals in excess of the maximum contaminant levels for primary drinking water standards specified in CCR, Title 22, Division 4, Chapter 15, Sections 64431 and 64433.2. This incorporation-by-reference is prospective, including future changes to the incorporated provisions as the changes take effect.

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Table 2-2. Central Coast Basin Plan Groundwater and Surface Water Quality Objectives Applicable in the Santa Margarita Basin (Source: Central Coast Regional Water Quality Control Board, 2019)

Chemical Constituent	Median Groundwater Quality Objectives (mg/L)			Mean Surface Water Quality Objectives (mg/L)		
	Near Felton	Near Boulder Creek	San Lorenzo River (above Bear Creek)	San Lorenzo River (at Tait Street Check Dam)*	Zayante Creek	Boulder Creek
Total dissolved solids	100	250	400	250	500	150
Chloride	20	30	60	30	50	10
Sulfate	10	50	80	60	100	10
Boron	0.2	0.2	0.2	0.2	0.2	0.2
Sodium	10	20	50	25	40	20
Nitrate as N	1	5	---	---	---	---

* Downstream of the Santa Margarita Basin

2.2.4 County of Santa Cruz Monitoring

The County of Santa Cruz has several water resources monitoring and management programs, including programs for groundwater levels, groundwater quality, surface water flow, and nitrate control from septic sources.

2.2.4.1 Groundwater Elevation Monitoring

SCEH has a private well groundwater elevation monitoring network in parts of the County, including in the adjacent Santa Cruz Mid-County Basin. Since the 2022 GSP, SCEH has added a private well in the Weston Road area of Santa Margarita Basin. This was previously identified as a data gap in an area with a high concentration of domestic users.

2.2.4.2 Groundwater Quality Monitoring

2.2.4.2.1 Private Wells

SCEH monitors groundwater quality for domestic wells serving up to 4 parcels in 3 ways:

- At the time of new well construction, water must be tested for 21 different potential contaminants. Treatment may be required to meet primary drinking water standards. Results of the water quality testing are provided to the County.
- At the time that a property served by a domestic well is sold, the water must be tested for the same 21 contaminants, and those results are provided to the buyer and the County. Even if there are exceedances, treatment is not required.

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- The County is partnering with the Regional Water Quality Control Board to provide free water quality testing to all domestic wells in the County. The program will cover testing for 35 potential contaminants for all residents, and income qualifying residents may also have PFAS included. Results are anonymized and made available online at https://gamagroundwater.waterboards.ca.gov/gama/gamamap/public/.

2.2.4.2.2 Small Water Systems

SCEH Drinking Water Program regulates state small water systems (5-14 connections) and public water systems (15-199 connections) to ensure the water provided through these small water systems meets federal and state water quality standards. The County requires sampling, testing, and reporting of chemical and biological parameters and oversees regulatory compliance for these systems. All systems are also required to report their monthly water production at the end of each year.

- State Small Water Systems with 5-14 connections are regulated under both county and state regulations through the SCEH Drinking Water Program. State small water systems are required to provide quarterly bacteriologic water quality results to the County and additional results on a less frequent basis.
- Public Water Systems located within communities serving 15-199 connections and those that serve more than 25 people for more than 60 days a year through non-community or transient uses (businesses, schools, restaurants, etc.) are regulated by the SCEH Drinking Water Program acting for the State Water Resources Control Board Division of Drinking Water (DDW) through a Local Primacy Agency agreement. Public water systems are required to provide monthly bacteriologic sampling results to the County, with other results provided on an annual or less frequent basis.

2.2.4.2.3 Wasteload Allocation Attainment Program

The County's WAAP identifies, prioritizes, and describes programs to reduce contaminant loads in surface water that could impact the health of the community's surface water and drinking water. The program monitors surface water quality for nitrate and *E. coli*, identifies impaired waters by comparing monitoring results to federal water quality standards, identifies the sources of pollution, and prioritizes best management practices (BMPs) to bring impaired surface waters into compliance with federal standards.

2.2.4.3 Local Area Management Program

The County's Local Area Management Program (LAMP) was adopted by the Santa Cruz County Board of Supervisors on August 23, 2022. The purpose of the LAMP is to provide for the continued use of Onsite Wastewater Treatment Systems (OWTS, also known as septic systems) in Santa Cruz County while providing protection of water quality and public health. The LAMP updates and expands the wastewater management approaches conducted by Santa Cruz County since 1985.

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2.2.5 San Lorenzo Valley Water District Groundwater and Surface Water Monitoring and Management

SLVWD conducts routine groundwater extraction, groundwater level, and streamflow monitoring to support its water resource management. It has monitored groundwater production since 1984, with current monthly production monitoring ongoing in its 7 active extraction wells. Groundwater elevations have also been monitored in production areas since the 1960s, with consistent monitoring since the mid-1970s. SLVWD monitors groundwater elevations in all its production wells plus monitoring wells listed in Table 2-3. SLVWD monitors streamflow downstream of its diversions (Section 6.6.1).

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Table 2-3. SLVWD Groundwater Production and Groundwater Elevation Monitoring Wells

Well Name	Well Status	Reference Point Elevation (feet msl)	Primary Screened Formation	Screen Interval Depth (feet bgs)
SLVWD Production Wells – Groundwater Production and Groundwater Elevation Measured Monthly				
San Lorenzo Valley System – Northern Portion				
Quail Hollow #4A	active	600.0	Santa Margarita	180 – 250
Quail Hollow #5A	active	519.0	Santa Margarita	124 – 164
Olympia #2	active	527.0	Santa Margarita	225 – 245, 275 – 298
Olympia #3	active	540.0	Santa Margarita	230 – 308
San Lorenzo Valley System – Southern Portion				
Pasatiempo #5A	active	757.0	Lompico	400 – 700
Pasatiempo #7	active	739.0	Lompico	380 – 440, 495 – 525
Pasatiempo #8	active	780.0	Lompico	560 – 660, 680 – 780
SLVWD Monitoring Wells – Groundwater Elevation Measured Monthly				
San Lorenzo Valley System – Northern Portion				
Quail Hollow MW-A	active	430.7	Santa Margarita	38 – 88
Quail Hollow MW-B	active	578.4	Santa Margarita	95 – 195
Quail Hollow MW-C	active	629.6	Santa Margarita	120 – 220
Quail Hollow #8*	inactive	407.0	Santa Margarita	100 – 130
Olympia #1*	active	448.0	Santa Margarita	131 – 159, 127-157
San Lorenzo Valley System – Southern Portion				
Pasatiempo MW-1	active	788.7	Lompico	600 – 660
Pasatiempo MW-2	active	788.7	Santa Margarita	280 – 340
Pasatiempo #3*	active	570.39	Lompico	23 - 147, 169 - 260

*Former production well
feet msl = elevation in feet relative to mean sea level
feet bgs = depth in feet below ground surface

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2.2.6 Scotts Valley Water District Groundwater Monitoring and Management

The SVWD has been actively managing groundwater since the early 1980s; with the goal of increasing water supply reliability and protecting local water supply sources. In 1983, SVWD instituted a Water Resources Management Plan to monitor and manage water resources in the Scotts Valley area. In 1994, SVWD formally adopted a Groundwater Management Plan ([GWMP], Todd Engineers, 1994) in accordance with Assembly Bill 3030 (AB 3030), also known as the Groundwater Management Act (CWC §10750 *et seq.*). The overall purpose of GWMP was to provide a planning tool that helps guide SVWD manage the quantity and quality of its groundwater supply, and to comply with the requirements of AB3030. The goal of the SVWD GWMP is stated as:

> *By implementation of a groundwater management plan for Scotts Valley, SVWD hopes to preserve and enhance the groundwater resource in terms of quality and quantity, and to minimize the cost of management by coordination of efforts among agencies.*

Development of Basin Management Objectives (BMOs) are required for the GWMP under CWC § 10753.7(a)(1) as a systematic process to support groundwater basin management. The BMOs for SVWD's GWMP are summarized as follows:

- Encouraging public participation through an annual report of groundwater management activities and its presentation at 1 or more public meetings
- Coordinating with other local agencies
- Continued monitoring and evaluating groundwater conditions
- Implementing groundwater augmentation projects
- Investigating groundwater quality and preventing groundwater contamination

These BMOs guided the SVWD groundwater management program and served as major groundwater management objectives. The BMOs are fundamental goals that are incorporated into the GSP.

Starting in 1994, annual reports that analyze and describe the condition of the Basin were produced as part of GWMP implementation. The format of the annual reports has evolved over time to meet the needs of SVWD. Currently, SVWD uses annual spring groundwater conditions reports to help assess water shortages and implement drought contingency plans as needed.

Development of a monitoring network to track Basin conditions within SVWD's service area has been part of GWMP implementation. Table 2-4 lists the SVWD monitoring wells that are currently included in their monitoring network. All existing monitoring wells will be incorporated into the SMGWA monitoring network.

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Table 2-4. Wells Used for the Scotts Valley Water District Groundwater Management & Monitoring Program

Well Name	Well Status	Reference Point Elevation (feet msl)	Primary Screened Formation	Screen Interval Depth (feet bgs)
SVWD Extraction Wells				
SVWD Grace Way	active	585 (lidar elevation)	Lompico, Butano	570-700, 720-950
SVWD Orchard Well	active	716.4	Lompico, Butano	705-784, 805-1063, 1084-1455
SVWD Sucinto	active	660	Lompico, Butano	700-730, 1070-1390
SVWD Well #9	inactive extraction active monitoring	528.1	Monterey	155-195, 315-355
SVWD Well #10	inactive extraction active monitoring	510.9	Lompico	190-220, 240-270, 325-355
SVWD Well #10A	active	512.0	Lompico	280-380, 400-450
SVWD Well #11A	active	602.6	Lompico	399-419, 459-469,495-515
SVWD Well #11B	active	588.0	Lompico	348-388, 423-468, 500-515
SVWD Monitoring Wells				
#15 Monitoring Well[2]	active	660.0	Lompico, Butano	700-1100
#9 Monitoring Well	active	528.1	Monterey	N/A
SVWD AB303 MW-1[1,2]	active	561.7	Santa Margarita	114-124
SVWD AB303 MW-2[2]	active	524.2	Lompico	705-715, 810-850
SVWD AB303 MW-3A[1,2]	active	526.2	Lompico	630-680
SVWD AB303 MW-3B[1,2]	active	524.4	Santa Margarita	120-125
SVWD Canham[2]	active	782.8	Butano	1,281-1,381
SVWD Stonewood[2]	active	898.5	Butano	799-859
SVWD SV1-MW	inactive	704.3	Santa Margarita	60-80
SVWD SV3-MW A	inactive	593.0	Santa Margarita	60-80
SVWD SV3-MW B	inactive	593.0	Santa Margarita	100-110
SVWD SV3-MW C	inactive	593.0	Lompico	150-160
SVWD SV4-MW	active	455.3	Santa Margarita	50-60
SVWD TW-18[1,2]	active	715.0	Santa Margarita	285-345
SVWD TW-19[1,2]	active	659.6	Lompico	960-1060

Notes:

[1] Groundwater elevation measurement data submitted to DWR CASGEM Program
[2] Equipped with electronic data transducer
feet msl = elevation in feet relative to mean sea level
feet bgs = depth in feet below ground surface

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2.2.7 Mount Hermon Association Groundwater Monitoring and Management

MHA has 2 active and 1 inactive supply well that are used to measure groundwater levels and extraction (Table 2-5). Also, MHA's exploration well, MHA-MW1, was converted to a monitoring well that supplements the groundwater level monitoring network.

Table 2-5. Wells Used for the Mount Hermon Association Groundwater Management & Monitoring Program

Well Name	Well Status	Reference Point Elevation (feet msl)	Primary Producing Formation	Screen Interval Depth (feet bgs)
MHA Production Wells – Measurements taken monthly for both static and dynamic levels				
MHA #1	inactive	727.1	Monterey, Lompico	255-265, 285-395, 435-495
MHA #2	active	746.8	Lompico	290-300, 400-415, 430-460, 490-590, 600-615, 625-725
MHA #3	active	584.0	Lompico	680-800, 860-980
MHA Monitoring Wells – Measurements taken monthly				
MHA-MW1	active	279.0	Lompico	120-300

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2.2.8 City of Santa Cruz Surface Water Monitoring and Environmental Management

As both an in-Basin user (Loch Lomond Reservoir, Felton diversion) and downstream user (Tait diversion) of San Lorenzo River watershed surface water, the City of Santa Cruz actively participates in surface water monitoring and management in the Basin. The key issues that have implications on the City of Santa Cruz water supply are nitrate impacts on surface water quality from the more than 13,000 septic systems in the San Lorenzo River watershed and groundwater use impacts on surface water baseflow supporting anadromous fisheries, particularly in Bean and Zayante Creeks. Reduced surface water baseflow in the Basin that may impact important coho salmon rearing streams increases the regulatory burden on the City, as any impact caused by the City's operations is evaluated within the context of overall habitat and population conditions. Finally, water resource management in the Basin also has impacts on the City of Santa Cruz's ability to fully exercise its water rights, which further complicates its ability to maintain supply reliability and improve habitat conditions for special status salmonids in the watershed.

2.2.8.1 Surface Water Monitoring and Management

The City of Santa Cruz monitors surface water stage and discharge in conjunction with their surface water supply diversions on the San Lorenzo River and Newell Creek. The City of Santa Cruz contributes financially to operation of the USGS flow gage on the San Lorenzo River at Big Trees, upstream of the City-operated diversion in Felton. The City monitors surface water

discharge on Newell Creek both upstream and downstream of the Loch Lomond Reservoir, at locations shown in Section 6.6.1.

2.2.8.2 Habitat Management

The City's Anadromous Salmonid Habitat Conservation Plan (HCP) was adopted by the Santa Cruz City Council in September 2025 (City of Santa Cruz, 2025). The HCP had been in development since 2001 and intends to restore habitats and populations of steelhead and coho salmon, which are priority species in the Basin, while minimizing the impacts of the City's water diversion to meet its long-term water supply needs. The City worked with the California Department of Fish and Wildlife (CDFW) and National Marine Fisheries Service (NMFS) to develop the HCP.

The City continues to monitor various attributes related to fish habitat in the San Lorenzo River watershed and is evaluating development of monitoring to support the 2025 HCP. Under the existing City of Santa Cruz Water Department Watershed Monitoring Program, the following are specifically monitored:

- Temperature monitoring in a variety of locations throughout the San Lorenzo River watershed
- Turbidity monitoring upstream of Loch Lomond
- Dissolved oxygen and pH monitoring below Loch Lomond
- Juvenile salmonid and habitat in a variety of locations throughout the San Lorenzo River watershed, as a part of a collaborative effort funded by the City of Santa Cruz, SLVWD, SVWD and the County

2.2.9 Environmental Monitoring Programs

There are currently no contamination sites undergoing groundwater extraction and treatment remediation within the Basin. Ongoing remediation and mitigation efforts taking place include soil vapor extraction, passive *in-situ* remediation using injection barriers, soil excavation, and land use controls, as described in the subsections below. SCEH is the local agency authorized by the CCRWQCB and California Department of Toxic Substances Control (DTSC) to oversee investigation and cleanup of waste releases in Santa Cruz County. To protect their potable water supplies and more effectively manage the Basin, SMGWA member agencies are informed about local environmental compliance sites where groundwater quality has been impacted by pollution or chemical spills. SMGWA has a management action in this GSP to coordinate annually with SCEH to share updates on groundwater quality cleanup sites and supply well monitoring, discussed further in Section 8.2.2.

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2.2.9.1 Groundwater Contamination Cleanup Sites

Historically, groundwater remediation of volatile organic compounds (VOCs) and gasoline-related chemicals in groundwater occurred at several Scotts Valley and Felton sites. The remediation efforts at these sites concluded after the concentrations of contaminants in groundwater decreased below the established water quality standards or no longer presented exposure risks. There is always a possibility that groundwater will be re-impacted in the future from these sites if the contaminant source is not completely addressed. Detailed information for all sites regardless of open or closed status is available from the SWRCB GeoTracker website: https://geotracker.waterboards.ca.gov/ and the DTSC Envirostor web site: www.envirostor.dtsc.ca.gov/public. One groundwater contamination cleanup site located 275 feet outside of the Basin at the former Valeteria Dry Cleaners in Felton is included in the summaries below since it impacted water quality in the San Lorenzo River located only 400 feet to the east of it and within the Basin.

Figure 2-4 shows the location of all SWRCB GeoTracker sites, and for reference, those sites described in more detail below are labeled on the map. Sites indicated on Figure 2-4 include cleanup program sites, land disposal sites, and leaking underground storage tank (LUST) sites. Organic and emerging contaminant threats to water quality in the Basin are discussed in more detail in Section 4.4.4. Descriptions of active and recently closed groundwater cleanup sites are included below.

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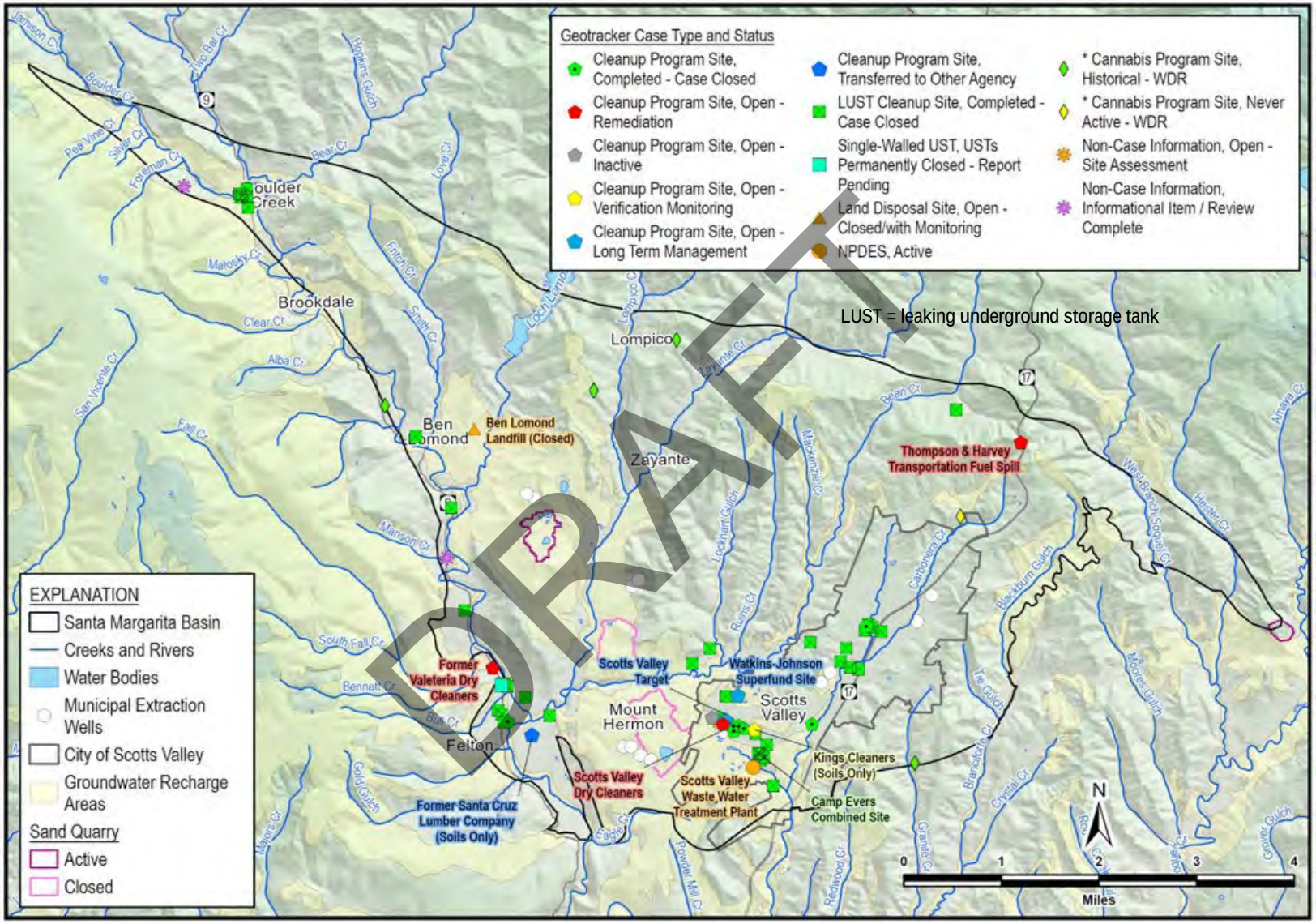

Figure 2-4. Location of Groundwater Contamination Cleanup Sites in the Santa Margarita Basin

2.2.9.1.1 Watkins-Johnson Superfund Site

The Watkins-Johnson site, located at 440 Kings Village Road in Scotts Valley, is a former semiconductor manufacturer where industrial processes included metal machining, degreasing operations, metal plating, glass cleaning, glass etching, welding, soldering, painting, and photo lab activities. A variety of organic chemicals, inorganic acids, and metals were used at the site. The site is a Federal Superfund Site listed on the National Priorities List, with remediation activities under the jurisdiction of USEPA Region 9 and the RWCQB.

The site's remedial investigation and feasibility study started in 1984 after organic chemicals were detected in the soil and groundwater at the site and in the surface water of Bean Creek near the site. Groundwater remediation began in October 1986. Key constituents detected in the groundwater include trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride (VC). In the soil, key constituents include TCE, methylene chloride, and chloroform. Of primary interest was the potential for contaminants in the soil to migrate into the underlying aquifers: the Santa Margarita Sandstone and Lompico Sandstone. SVWD Well #9, which is located approximately 400 feet south of the Watkins-Johnson site and screened in the lower Santa Margarita and Monterey Formations, has been impacted by TCE and cis-1,2-DCE at concentrations below drinking water standards. Although this well is no longer used by SVWD, when it was used, water pumped from it required filtration by a granular activated carbon (GAC) system prior to putting the water into the distribution system.

Groundwater remediation at the site consisted of pumping groundwater beneath the site with a series of extraction wells and treating it using a GAC adsorption system. Treated water was used onsite, recharged to the perched zone onsite, or discharged to Bean Creek. The groundwater remediation system was deactivated on July 5, 2016.

More than 3 decades after investigations began at the Watkins-Johnson site, its remediation is moving toward closure, but the current site owner still needs to complete the source control component of the remedial action to ensure protectiveness over the long-term. . The site is undergoing planning for residual contamination in soil and the vadose zone including a vapor intrusion monitoring and mitigation plan and evaluation of land use controls. Existing soil gas plumes containing benzene, TCE, and tetrachloroethene (PCE), and soil contamination with arsenic and cadmium are the remaining risk drivers preventing site closure.

2.2.9.1.2 Scotts Valley Dry Cleaners

Remediation of the Scotts Valley Dry Cleaners site, located at 272 Mount Hermon Road in Scotts Valley, is overseen by the CCRWQCB. PCE, which is used as a dry-cleaning solvent, was found in the soils and groundwater both on site and off site of the dry-cleaning operations in 1993. The site is classified as an open remediation cleanup site.

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Groundwater extraction remediation systems were used at the site from August 2005 to August 2015. The extracted water was treated by a GAC adsorption system and discharged under a National Pollution Discharge Elimination System Permit to the City of Scotts Valley storm water drain system. *In-situ* chemical oxidation via sodium permanganate injection was also used for remediation in 2009.

Cleanup at the Scotts Valley Dry Cleaners site currently involves operation of soil vapor extraction and air sparging systems. These remediation systems only extract soil vapor in the unsaturated soils above groundwater and thus no groundwater is extracted.

2.2.9.1.3 Scotts Valley Target

The Scotts Valley Target is an open, long-term management cleanup program site opened in 2022. The site is likely impacted by VOCs from the neighboring Scotts Valley Cleaners and is being remediation using soil vapor extraction.

2.2.9.1.4 Former Valeteria Dry Cleaners

The former Valeteria Dry Cleaners site, located at 6519-6539 Highway 9 in Felton, released PCE into groundwater just outside of the Basin. The site is now an open remediation cleanup site following its initial assessment and interim remedial action. The PCE in groundwater from the site is thought to have originated from dry cleaning solvent wastes being disposed into the onsite septic system (Integral Consulting Inc, 2020). In the 1980s, PCE was first detected in surface water samples from both the San Lorenzo River and springs on the river's western bank. Associated with PCE are lower concentrations of TCE, and limited detections of cis-1,2-DCE. PCE and TCE are the only VOCs consistently detected above their drinking water maximum contaminant levels (MCLs) of 0.005 mg/L.

Integral Consulting Inc. (2020) summarizes previous environmental assessments and remediation as:

> "Assessment activities in the 1990s and 2000s included a passive soil gas survey, additional surface water sampling, septic system sludge sampling, aquifer testing, and installation and sampling of numerous groundwater monitoring wells and soil borings. Initial remedial activities were conducted in 2002 with the removal of the historical septic tank and 325 cubic yards of surrounding soils from the onsite area. An on- and off-site area soil vapor assessment was conducted in 2008 followed by installation of a soil vapor extraction and sub-slab venting system in 2009 and sub-slab sampling in onsite area structures in 2010 and 2011. The onsite area soil vapor extraction system has since been operated periodically primarily for soil venting."

A July 21, 2020, Remedial Action Plan describes a VOC plume extending laterally 320 feet long by 180 feet wide downgradient from the former source area to Spring 1A at the San Lorenzo River. The vertical extent of the plume in groundwater generally follows the groundwater table

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at around 20 feet below ground and extends to an approximate depth of 60 feet below ground. The downgradient extent of the plume has been delineated to the extent practical at the springs near the San Lorenzo River. The authorized parties are in the process of permitting and installing a permeable reactive barrier between the site and the San Lorenzo River to prevent surface water contamination.

2.2.9.1.5 Camp Evers Combined Site (Closed)

The Camp Evers combined site is associated with 4 current and former gasoline stations (BP, Shell, Chevron, and Tosco), that were located at or near the intersection of Scotts Valley Drive and Mount Hermon Road. The primary constituents at this site are Methyl-tert-butyl ether (MTBE) and other fuel-related compounds. The Camp Evers combined site cleanup was overseen by the CCRWQCB. Historically, the plume extended at least 1,700 feet north of SLVWD's Mañana Woods Well #2. When this well was used, its pumped water was passed through a pre-treatment system to remove low MTBE concentrations. The well is no longer pumped by SLVWD.

Remediation at the sites consisted of underground storage tank (UST) removal and groundwater extraction and treatment before discharging to the City of Scotts Valley storm water drain system. Remedial efforts started in the early 2000s, and the Camp Evers Combined Site completed their remediation efforts and closed all cases as of November 21, 2017.

2.2.9.1.6 Ben Lomond Landfill (Closed)

The Ben Lomond Landfill, west of Newell Creek at 9835 Newell Creek Road in Ben Lomond, operated as a landfill until 2012 and is now a trash transfer station. Groundwater monitoring has been ongoing at the former landfill since 1980, as the site is associated with elevated levels of VOCs and heavy metals. Contamination associated with the was detected in SLVWD's Quail Hollow wellfield in the late 1990s, but concentrations of VOCs have been non-detectable since 2007 (Johnson, 2009).

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2.2.9.2 Soil Contamination Cleanup Sites

The following 2 non-LUST sites do not have groundwater contamination, only soil contamination and cleanup.

2.2.9.2.1 King's Cleaners

PCE was detected in soil and soil gas samples in 2020 at the King's Cleaners site, located at 222 Mount Hermon Road in Scotts Valley. No PCE was detected in groundwater in subsequent investigations. SCEH assumed oversight responsibility for this site from the CCRWQCB in April 2017 and it is an open verification monitoring site.

No remedial actions have occurred at the Kings Cleaners site over the past several years. However, in 2019/2020 there has been regulatory oversight for development of a Work Plan to

confirm current soil vapor concentrations and whether residual PCE concentrations detected in soil vapor investigations conducted during September 2000 and November 2009 pose a vapor intrusion health risk at the subject site and adjacent commercial businesses.

2.2.9.2.2 Former Santa Cruz Lumber Company

Santa Cruz Lumber Company, located at 5843 Graham Hill Road in Felton, operated from 1945 to 1986. Operations at the site included pressure treatment of a variety of wood products with the chemical Wood-Last, a water-based copper, chromium, and arsenic solution. Soil contamination was found during initial investigations in 1986. Remedial excavation and removal of over 2.6 thousand tons of contaminated soil took place in 1987. More recent soil sampling, in April 2018, found elevated levels of arsenic, hexavalent chromium, and formaldehyde, though hexavalent chromium may be naturally occurring. Contaminants have not been found in groundwater (Trinity Source Group, Inc., 2017). A Work Plan to remediate these remaining chemical constituents was requested by SCEH. The site has since been transferred to DTSC who approved a removal action work plan for additional excavation and a soil cap in 2022.

A privately owned well screened in the Lompico aquifer, 250 feet west of the site, has elevated arsenic concentrations in groundwater between 0.014 mg/L and 0.026 mg/L (the primary drinking water standard is 0.01 mg/L). Slightly elevated arsenic is also found in other wells in the vicinity, such as SLVWD Pasatiempo #6 and wells just outside the Basin, southeast of Felton. As described above, onsite investigations did not find groundwater contamination, and therefore given the information available, elevated arsenic in this area's groundwater is considered naturally occurring in the Lompico aquifer.

2.2.9.2.3 Thompson and Harvey Transportation Fuel Spill

The Thompson and Harvey Transportation Fuel is classified as an open remediation cleanup program site. A fuel tanker truck overturned on Highway 17 north of Scotts Valley on September 4, 2025. Emergency response actions included containment of the spill using vacuum recovery, absorbents, and excavation of contaminated soil under oversight of the CDFW Office of Spill Prevention and Response. The site is recommended for closure.

2.2.9.3 Migration of Contaminated Water Monitoring

Groundwater quality sampling of supply wells in the Basin allows for analysis of contaminated water migration. Historical supply well water quality data indicates that contaminated water migration is spatially and temporally limited to only a few locations over time. Detected contaminants in supply wells have mostly been from point source contaminant releases related to the regulated sites discussed above and contaminant concentrations were typically at or below relevant drinking water standards. Nitrate has also been detected in supply wells in some areas of the Basin at concentrations less than the drinking water standards, likely due to non-point source septic system releases. More information on groundwater quality is provided in Section 4.4.

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Contaminated groundwater detected in supply wells originated from 3 main areas in Scotts Valley: Camp Evers area gas stations, downtown dry cleaners, and the Watkins-Johnson Superfund Site. Contaminated groundwater has generally migrated down-hydraulic gradient from these sites within the Santa Margarita aquifer, but plume migration has also been influenced at various times by the operation of each of the sites' groundwater extraction and treatment systems, and cones of depression created by municipal extraction wells. Currently, all groundwater extraction and treatment systems have been decommissioned, and there is no municipal pumping in the Santa Margarita aquifer in the area where contamination originated.

There are 2 known locations where contamination has migrated down through the Santa Margarita aquifer into the underlying Monterey Formation or Lompico aquifer and impacted SLVWD and SVWD public supply wells.

- SLVWD Mañana Woods #2 is screened in both the Santa Margarita and Lompico aquifers in an area where the Monterey Formation is absent between the 2 aquifers. This well was impacted with MTBE and other gasoline breakdown products that were first detected in 2006. After discovering the impacts, groundwater pumped from this well was passed through a GAC treatment system to reduce VOCs below drinking water standards (Johnson, 2009). This well was destroyed in 2026.
- SVWD Well #9 is down-hydraulic gradient from Camp Evers and only 300 feet up-hydraulic gradient from onsite Watkins-Johnson monitoring wells impacted with VOCs. It is screened in the Monterey Formation. SVWD Well #9 is impacted with MTBE and several VOCs at concentrations below applicable drinking water standards. This well is no longer used by SVWD for extraction but continues to serve as a GSP groundwater level monitoring location.

Given that concentrations of contaminants in municipal extraction wells have not increased with time, it is assumed that contaminant sources have been addressed such that there is now limited migration of contaminant plumes. Regulating agencies provide impacted SMGWA member agencies with relevant information on monitoring and cleanup. This information combined with regular monitoring of groundwater quality at all municipal extraction wells provides the information the public water supply agencies need to protect their wells. In addition, a management action described in Section 8.2.2 establishes an annual meeting with SCEH to confirm that groundwater quality degradation is not occurring.

Nitrate concentrations in groundwater throughout the Basin associated with septic systems appear to have stabilized at a level that is well below drinking water standards. County standards now require that any new or replacement septic systems in sandy soils must incorporate enhanced treatment and denitrification to reduce nitrate discharge to groundwater.

2.3 Land Use Elements

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2.3.1 Existing Land Use Designations

Land use planning in the Basin is the responsibility of the County of Santa Cruz and the City of Scotts Valley. Boulder Creek, Felton, Lompico, and Ben Lomond are all census-designated areas within the county but are not incorporated towns. Current land use designations in the Basin are shown on Figure 2-5 and are summarized in Table 2-6 by major land use groups. The land use features on Figure 2-5 were developed by the County of Santa Cruz in collaboration with the Cities of Capitola, Santa Cruz, Scotts Valley, and Watsonville, to aggregate individual land use designation datasets into a summarized single dataset for use in the July 2015 Wasteload Allocation Attainment Program (WAAP) for Watersheds in Santa Cruz County (County of Santa Cruz, 2016).

Just under half the Basin is identified as open space/undeveloped (Table 2-6). Open space includes areas for outdoor recreation, preservation of natural resources, or vacant lands. Rural residential land use is the next largest land use covering 5,755 acres of the Basin (25.9% of the Basin, Table 2-6). This land use consists primarily of single-family residential housing located outside of the suburban centers and typically between the tributaries of the San Lorenzo River. Suburban residential housing (13.2% of the Basin) occurs within the San Lorenzo Valley and south of Bean Creek. It includes the City of Scotts Valley and the communities of Mount Hermon, Felton, Ben Lomond, Brookdale, Boulder Creek, Lompico, and Zayante (Figure 2-5). The Basin has several camps and conference centers that account for approximately 3.5% of land use.

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Table 2-6. Santa Margarita Basin Land Use Designation Summary

Land Use Category	Area in Acres	Area in Square Miles	Relative Percent
Open Space/Undeveloped	10,117	15.8	45.5%
Rural Residential	5,755	9.0	25.9%
Suburban Residential	2,930	4.6	13.2%
Roads/Parking Lots/Utilities	1,491	2.3	6.7%
Camps/Church/Institutions	772	1.2	3.5%
Industrial/Sand Quarries	741	1.2	3.3%
Commercial	425	0.7	1.9%
Agriculture	18	0.03	0.1%
Total	22,249	34.8	100%

Commercial land use is concentrated in the City of Scotts Valley and the community of Felton. Much of this development occurred during a period of population expansion between 1970 and 2000, which coincided with construction of commercial and industrial complexes. Three large

sand quarries exist within the Basin area: Hanson (also known as Kaiser) Quarry, Olympia (also known as Lone Star) Quarry, and Quail Hollow Quarry. Hanson and Olympia Quarries ceased operations in the early 2000s and are currently undergoing restoration. Quail Hollow is still active.

Most irrigated areas in the Basin are in or near Scotts Valley and consist of schools and large parks. Agriculture within the Basin is limited due to the steep and forested nature of the Basin, and relatively shallow soils. Currently, only approximately 0.1% of the Basin is zoned agricultural. There are a few very small wineries that cumulatively irrigate about 20 acres. Currently, there are no official records of cannabis cultivation and water use in the Basin although there is speculation that it is occurring.

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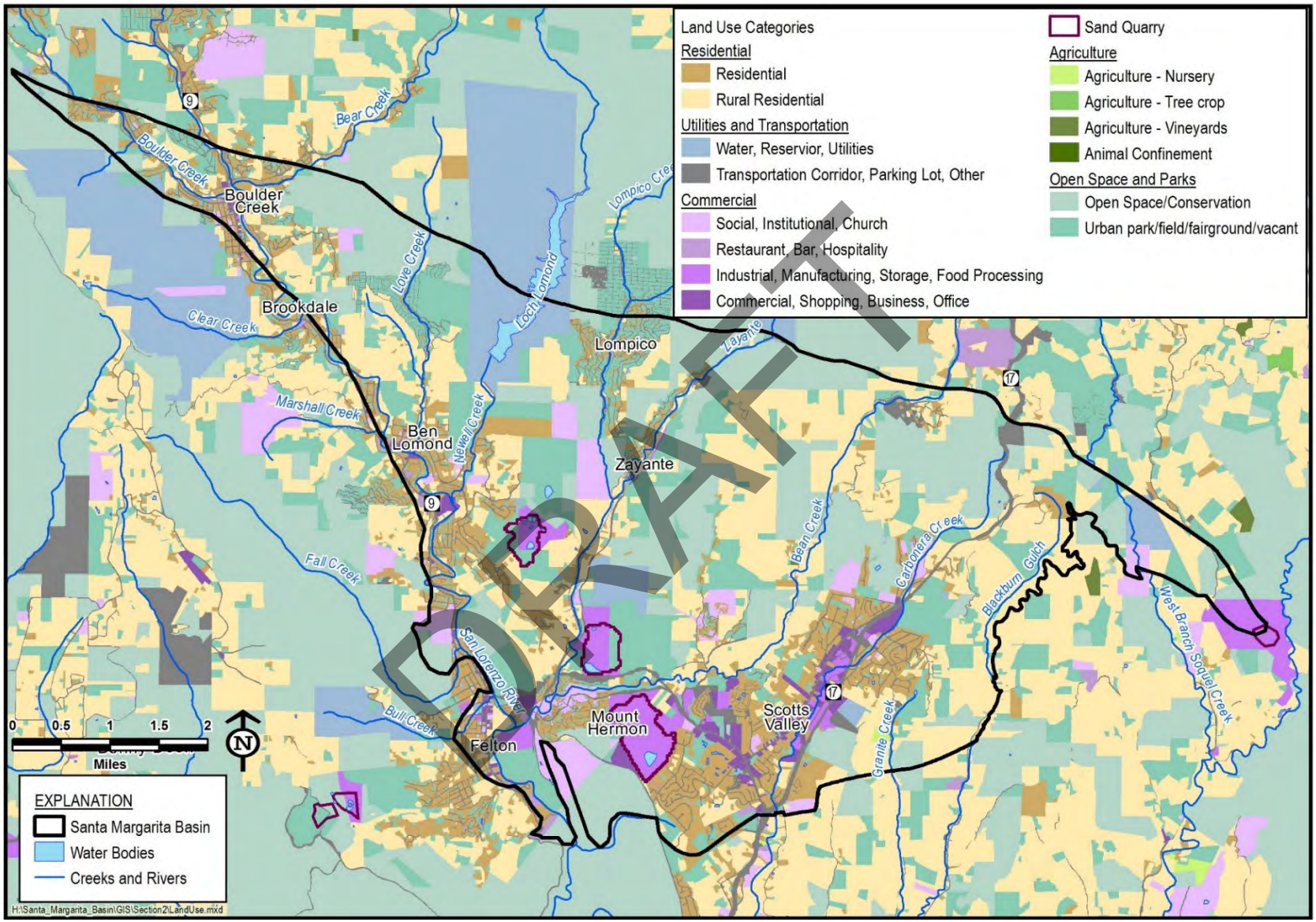

Figure 2-5. Land Use in the Santa Margarita Basin

2.3.2 General Plans

Land use authority in the Basin falls under the jurisdiction of the County of Santa Cruz and the City of Scotts Valley. These agencies have each adopted general plans with land use classifications that identify desired areas for development, open space, and conservation. The general plans also cover zoning regulations and development standards that determine the location, type, and density of growth allowed in the region, along with various policies for protection of watershed and groundwater resources. General plans are reviewed to understand the adverse environmental impacts they may have when implemented.

State general plan guidance was significantly revised in 2017 (Governor's Office of Planning and Research, 2017). Changes to planning laws triggered these revisions, including SGMA's requirement that general plans consider water supply at their next update. Any significant update to a general plan, including to its housing element, will trigger the SGMA mandate to consider potential development impacts on groundwater supply and consistency between the general plan and the GSP.

2.3.2.1 City of Scotts Valley General Plan

The City of Scotts Valley adopted its updated General Plan on November 29, 2023, replacing a plan that dated to 1994 and establishing a long-range policy framework to guide development and conservation for the next 20+ years. The plan serves as the city's fundamental governance document, embodying community values and setting direction across 7 elements: Land Use, Economic Development, Housing, Mobility, Open Space and Conservation, Community Services and Facilities, and Public Safety and Noise. Key updates include revised land use policies addressing compatibility and development intensities, new impact thresholds for future projects, and programs aimed at enabling sustainable growth while preserving community character and conserving natural resources.

2.3.2.2 County of Santa Cruz General Plan

The County of Santa Cruz originally adopted its General Plan in 1994 and completed a comprehensive update in November 2022. The 1994 plan had remained in place for nearly 3 decades and required updating to align with new state laws, new regional and local plans, and a community vision focused on sustainable growth. Prior to the 2022 update, the County adopted the Sustainable Santa Cruz County Plan in 2015 to promote sustainable land use, housing, economic development, and transportation objectives in the urban areas of the County, with a planning horizon through 2035. The 2022 update, known as the Sustainability Policy and Regulatory Update, amended General Plan goals, objectives, policies, and implementation strategies across 5 chapters; revised the County Code; adopted County Design Guidelines; and incorporated land use and zoning map amendments to identify opportunity sites and correct

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mapping inconsistencies. The California Coastal Commission approved the Sustainability Update amendments in March 2024, bringing the update fully into effect countywide.

Two components of the County General Plan significantly affect the management of water resources within the Basin: Measure J and the Conservation and Open Space Element of the County General Plan. Measure J was passed by voters in 1978, establishing a comprehensive growth management system with population growth limits, affordable housing provisions, preservation of agricultural lands and natural resources, and a defined distinction between urban and rural areas. This has resulted in greatly diminished development density and growth rates in areas that do not receive municipal water service. Each year when the Board of Supervisors adopts the growth goal and annual building permit allocation, limitations of water supply are taken into consideration.

The Conservation and Open Space Element of the County General Plan establishes goals, policies, and programs to conserve farmland, timber, biotic, and water resources, including policies for protection and management of groundwater resources, recharge areas, wetlands, streams, riparian corridors, and sensitive habitat areas — many of which are incorporated into the County Code. An example of such a program is the restriction on building disturbance in Santa Cruz Sandhills habitat. The Sandhills are a unique community of plants and animals found only on Zayante soils, which are derived from the Santa Margarita Sandstone and are mostly found in the Scotts Valley, Ben Lomond, and Bonny Doon areas. Due to their limited geographic range and narrow habitat specificity, the endemic communities and species of the Sandhills are naturally extraordinarily rare and are also associated with areas of high groundwater recharge potential. Estimated to have originally covered 6,000 acres, approximately 40% of Sandhills habitat has been lost, primarily due to sand quarrying and development. The County has developed a detailed process to identify whether parcels fall within the Sandhills, accessible at: https://www.sccoplanning.com/Portals/2/County/Planning/env/Permit%20Processing%20Chart.pdf.

These policies, programs, and code requirements were reviewed during development of GSP elements for depletion of surface waters and groundwater dependent ecosystems (GDEs). The County General Plan maps of recharge areas, sensitive habitats, and biotic resources were also used. The Conservation and Open Space Element was updated as part of the 2022 Sustainability Update, and language referencing the GSP has been incorporated into the updated General Plan. The County has also updated its well ordinance (County Code Chapters 7.70 and 7.73) to modernize well construction and individual water system management considering groundwater sustainability requirements, public trust impacts, drought risk for domestic wells, and drinking water quality concerns.

2.3.3 Potential Water Demand Changes due to GSP Implementation

GSP implementation is not expected to increase water demand over the next 20 years. The only anticipated changes in water demand are attributable to urban water use factors. A small decrease

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in municipal demand due to water use efficiency achieved through ongoing technological improvements, regulatory compliance, and customer conservation is expected to be offset by increased demand from population growth. Overall, water demands are projected to increase slightly during the GSP planning and implementation horizon (SLVWD, 2026; SVWD, 2026).

The small increase of projected municipal demand may be offset by water conservation, conjunctive use, or development of new water supplies in the Basin. These potential projects are described in more detail in Section 8.

There are no known water demand or land use changes in neighboring areas that would affect water demands in the Basin.

2.3.4 Replenishment of Groundwater Extractions

Managed replenishment of groundwater extractions has historically occurred or is currently taking place in the Basin using indirect methods. Groundwater recharge and demand reduction is achieved using conjunctive use, stormwater recharge, recycled water, and conservation.

2.3.4.1 Conjunctive Use and Underground Storage

Conjunctive use is the coordinated operation of multiple water sources to achieve improved supply reliability. Most conjunctive use concepts are based on storing groundwater supplies in times of surplus for use during dry periods when surface water supplies would likely be reduced. Opportunities exist to improve water supply reliability in the Basin using conjunctive use and underground storage.

While there are no formal conjunctive use programs between SMGWA members and other water agencies, conjunctive use practices have been studied and are implemented by SMGWA member agencies with access to surface water. For example, SLVWD meets demand through conjunctive use of surface water and groundwater sources. Since SLVWD has limited storage other than natural groundwater storage, they use surface water for water supply as much as possible to store groundwater for use during dry periods when surface water is not available.

There are bidirectional interties in the Basin that could be used to expand conjunctive use. SLVWD's water systems are connected by intertie that although only permitted for emergency use, could potentially be used to transfer water supplies within its service area (Exponent, 2019). SLVWD is pursuing routine conjunctive use of its emergency interties to improve water supply flexibility and system resiliency. Emergency operations of the interties after the 2020 CZU Lightning Complex wildfire demonstrated the operational benefits of these interconnections. An intertie also connects the SLVWD and SVWD systems to allow water transfers in emergency situations; however, no formal conjunctive use agreement between the 2 districts is currently in place.

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An intertie between the City of Santa Cruz and SVWD water systems was completed in 2026, enabling the 2 agencies to better coordinate and maximize the use of surface and groundwater supplies and support active and passive recharge of the Basin. The intertie project follows decades of discussion about regional cooperation, with a goal of storing surplus City of Santa Cruz surface water in the Basin for later recall when needed in dry years. Options for both passive and active groundwater recharge, along with potential water-banking strategies, will be evaluated. The intertie will also improve fire protection through increased fire-response flows and the addition of new fire hydrants along the alignment.

The project is part of a broader regional strategy for water supply resilience. The Santa Cruz water system has been connected by an intertie with the Soquel Creek Water District since 2018, and SVWD completed an intertie with SLVWD in 2016, though both connections have been used primarily for emergency purposes rather than routine conjunctive use. The new City of Santa Cruz–SVWD intertie allows for opportunities to move beyond emergency-only operations and enable substantive conjunctive use coordination between the 2 agencies.

2.3.4.2 Stormwater Recharge

There are intentional efforts to reduce stormwater runoff in the Basin by increasing on-site recharge. Stormwater retention and recharge is required by the City of Scotts Valley guidelines for new development projects (City of Scotts Valley, 2017). The City's guidelines are based on the CCRWQCB adopted Order R3-2013-0032 (July 2013). The Post-Construction Requirements mandate that development projects use Low Impact Development (LID) to detain, retain, and treat runoff. This has resulted and will continue to result in new on-site stormwater recharge in the Basin.

SVWD contributes to stormwater recharge via the implementation of LID projects in Scotts Valley. LID projects consist of applying stormwater BMPs—such as infiltration basins, vegetated swales, bio-retention and/or tree box filters—to retain and infiltrate stormwater currently being diverted into the storm drain system.

Infiltrated stormwater recharges the shallow aquifers in a manner similar to natural processes. The infiltration helps augment groundwater elevations and sustains groundwater contributions to stream baseflow that support local fish habitats. A complicating factor in implementing LID projects in the Scotts Valley area is that there is no centralized stormwater collection system, which limits the ability for large-scale projects to implement groundwater augmentation in the most beneficial areas.

All 3 LID facilities are located where Santa Margarita Sandstone overlies the Monterey Formation; therefore, there is less potential for the LID facilities to recharge the Lompico Sandstone. Figure 2-6 shows the location of the LID facilities relative to where the Monterey Formation is absent.

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Monitoring equipment is installed to assess the performance of the facilities. The total amount of stormwater infiltrated through WY2025 at the 3 LID facilities is summarized in Table 2-7. The annual infiltration volumes fluctuate with precipitation, averaging 25.7 acre-feet per year (AFY) since 2018.

Table 2-7. SVWD Low Impact Development Infiltration Volumes

Water Year	Transit Center (AFY)	Woodside HOA (AFY)	Scotts Valley Library (AFY)	Total (AFY)
2018	1.75	17.30	3.39	22.44
2019	3.08	31.17*	6.11*	40.38
2020	1.50*	14.97*	2.94*	19.42*
2021	1.40	13.86	1.41	16.67
2022	1.75	13.87	1.41*	17.03*
2023	2.39	28.79	6.26	37.44
2024	2.16	21.95	4.28	28.39
2025	3.06	17.34	3.42	23.82
Average	2.19	19.91	3.65	25.70
Total	15.34	141.95	25.83	183.15

* estimated because dataloggers were not recording correctly

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2.3.4.2.1 Transit Center LID

SVWD obtained grant funding through a County Prop 84 grant from the SWRCB for the planning, design, and construction of an LID retrofit at the Scotts Valley Transit Center site (Figure 2-6). The design included construction of a vegetated swale, a below-ground infiltration basin, and pervious pavement. Construction began in October 2016 and was completed in May 2017. SVWD completed an expansion of the Transit Center LID project in WY2025 that is expected to contribute approximately 7 AFY of additional stormwater recharge to the Santa Margarita aquifer. The expansion project was supported by a 2022 Urban Community Drought Relief grant from DWR. Average recharge is 2.19 AFY since 2018 (Table 2-7).

2.3.4.2.2 Woodside HOA LID

As part of the Prop 84 grant match, SVWD worked with a local developer to install a stormwater recharge facility at the Woodside HOA along Scotts Valley Drive (Figure 2-6). This facility includes a large below-ground infiltration basin. Stormwater is routed from the development to the basin where it can percolate down into the groundwater. Initial hydrology reports estimated recharge on the order of 20 to 40 AFY might be achieved (Ruggeri, Jensen, and Azar, 2010). Average recharge is 19.9 AFY since 2018 (Table 2-7).

2.3.4.2.3 Scotts Valley Library LID

This LID was an earlier grant-funded project that installed a below-ground infiltration basin at the Scotts Valley Library (Figure 2-6). Average recharge is 3.65 AFY since 2018 (Table 2-7).

In addition to the large LID projects described above, SVWD was part of the Strategic and Technical Resources Advisory Groups for Ecology Action's regional sponsorship of the Prop 84 LID Incentives Grant. SVWD staff provided input on rating criteria for the landscape certification program and the structure of the grant reporting. Through 2018, 32 SVWD customers were awarded grant incentives for making stormwater management improvements to their properties, with strategies such as rainwater harvesting, lawn and hardscape removal, and stormwater retention methods such as swales and rain gardens. According to SVWD staff records, the program provided 31,733 square feet (0.73 acres) of permeable recharge area.

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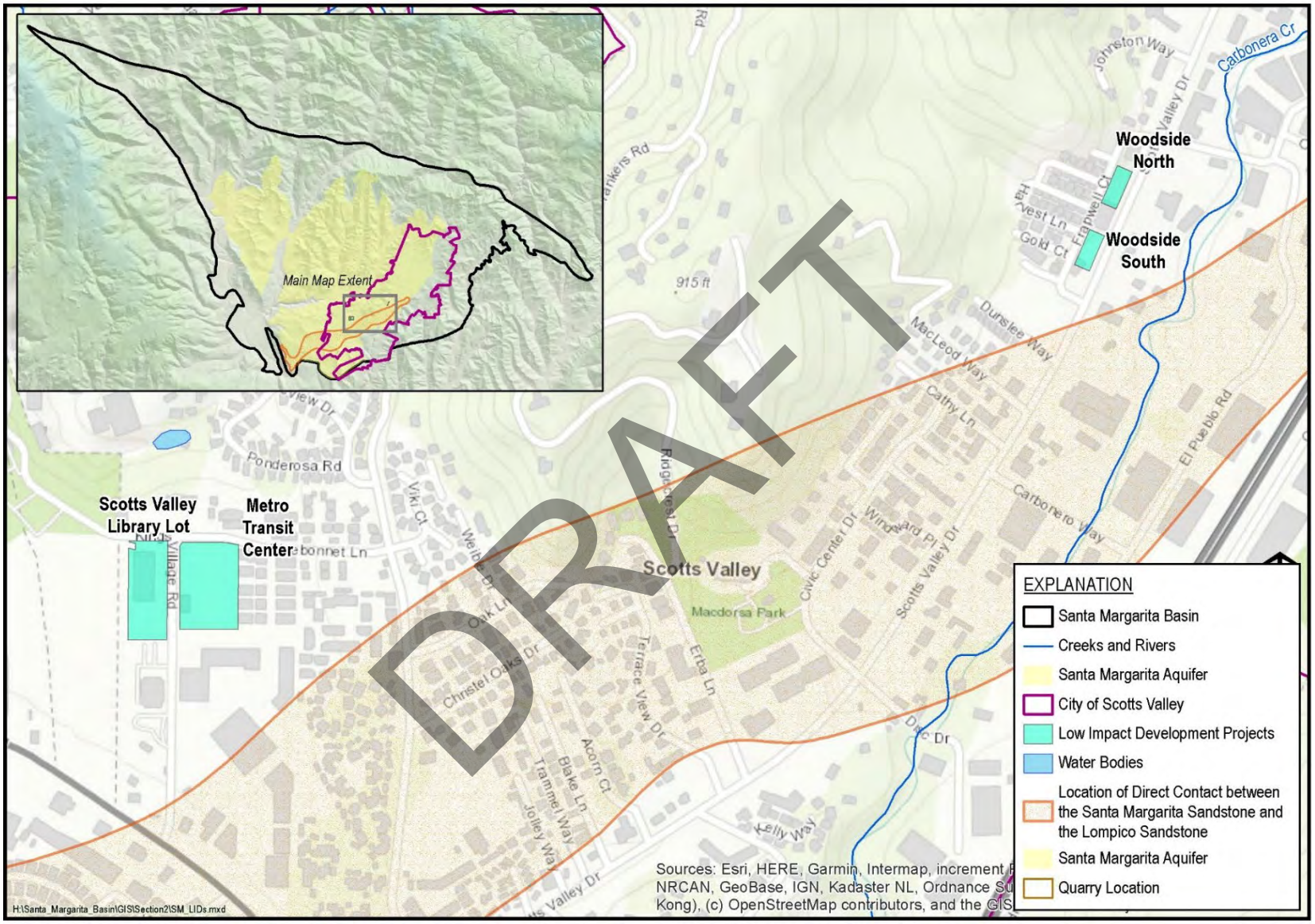

Figure 2-6. Location of SVWD Low Impact Development Projects

2.3.4.3 Diversions to Storage

SLVWD has limited storage capacity in their distribution system other than natural groundwater stored in the aquifers. In total it has 26 acre-feet (AF) of storage within its service area. Of that total storage capacity, 21.8 AF is in 33 tanks serving the North System, 1.3 AF in 5 tanks serving the South System, and 2.9 AF in 8 tanks serving the Felton System. Both pumped groundwater and diverted surface water are stored in these facilities. Bennett Spring is designated as a surface water source not permitted to be stored.

SVWD uses tanks to store up to 1.8 AF of recycled water and 13.3 AF of treated groundwater.

The City of Santa Cruz created the Loch Lomond Reservoir in the early 1960s by impounding Newell Creek with construction of the Newell Creek Dam. The reservoir is supplied by runoff from the Newell Creek watershed, as well as by flows diverted from the San Lorenzo River that are pumped up from the Felton Diversion Dam to the Loch Lomond Reservoir. It is the City's only reservoir and raw water storage facility. This makes it an integral part of their water system as it provides water supply for peak season demands and as a drought reserve. When full, the reservoir holds approximately 8,600 AF (or 2.8 billion gallons).

Private individuals who have riparian water rights for surface water diversion in the Basin are not permitted to store surface water.

2.3.4.4 Water Conservation and Use Efficiency

2.3.4.4.1 San Lorenzo Valley Water District Conservation Activities

SLVWD customers continue to demonstrate commitment to ongoing proactive conservation efforts. Currently, they are maintaining at least a 15-22% reduction in yearly water usage from 2013 consumption levels. According to SLVWD's 2020 Urban Water Management Plan (UWMP), its 2025 target water use is 85 gallons per capita per day (GPCD). The population served by SLVWD has met the 85 GPCD target during the latter part of the 2012-2015 drought and from 2018 to 2020. Since 1995, per capita water usage varied from a high of 104 GPCD in 2006 to a low of 70 GPCD in 2015.

SLVWD actively pursues incidents of water waste by investigating, recommending corrective action, and providing follow-up documentation of resolution. The water waste prevention ordinance (106) was most recently revised in May 2018 (Water Shortage Emergency Ordinance 106).

All SLVWD service connections are currently metered, and customers are billed by monthly volume of usage. As of July 2016, SLVWD's Board of Directors approved the Badger Meter project with the goal of installing the advanced metering technology at all meters. As of Water

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Year (WY) 2025, about 50% of the meters have been upgraded. The new meters, combined with the Badger Eye on Water engagement portal, allow customers to view hourly usage history, set up leak detection alerts, and receive high bill notifications. As of WY2025, 1,115 customers are participating.

The majority of SLVWD's customer accounts are residential; therefore, they target indoor and outdoor water savings programs toward these customers. Residential water conservation is promoted by disseminating technical information on methods to reduce indoor and outdoor water use and by offering credits on customer bills for installation and/or replacement of appliances and lawns with approved water saving appliances and plantings. In WY2025, SLVWD issued 27 rebates with an estimated water savings of 208,545 gallons.

SLVWD conducts a variety of public education activities such as a dedicated Water Use Efficiency Page on its website, e-Newsletters, billing inserts, and Instagram and Facebook postings.

In compliance with SB555, SLVWD has been conducting and submitting water loss audit reports to DWR. The SLVWD audit score was consistently between 49 and 51 in 2016 to 2019.

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2.3.4.4.2 Scotts Valley Water District Water Use Efficiency Activities

SVWD recognizes that using water efficiently is an integral component of a responsible water management strategy and is committed to providing education, tools, and incentives to help its customers understand and manage the amount of water they use. SVWD's water demand has already shown significant decline in recent years, which is attributed to SVWD's ongoing water use efficiency activities in conjunction with the expansion of recycled water use for landscape irrigation. Since 2010, SVWD's water demand has been lower than its SB X7-7 2020 target of 154 GPCD (WSC and M&A, 2021). In December 2015, with the continuance of the drought and the Governor's Emergency Drought Regulations, SVWD potable demand was reduced to 93 GPCD. SVWD's calculated GPCD for 2020 is 96 GPCD. Since 2015, SVWD's annual potable demand has averaged 96 GPCD, ranging between 93 and 100 GPCD.

SVWD actively pursues incidents of water waste by investigating, recommending corrective action, and providing follow-up documentation of resolution. A water waste prevention ordinance was first adopted in 1983 and most recently revised in June 2020 (Policy P500-15-1).

All potable and recycled water use in SVWD is metered, and customers are billed by volume of usage on a bimonthly basis. An increasing block rate structure for residential customers has been in place since 1992 incentivizing the efficient use of water.

In 2017, the SVWD Board of Directors approved the advanced metering infrastructure (AMI) project with a goal of installing advanced metering technology at all meters. As of April 2021, all

but less than 10 meters in the District have been upgraded. The new meters, combined with the WaterSmart customer engagement portal, allow customers to view hourly usage history, receive leak alerts and high-bill notifications, explore water saving actions and apply for rebates.

SVWD conducts a variety of public education activities such as a dedicated Water Use Efficiency Page on its website, regular ads in the local newspapers, e-newsletters, billing inserts, Instagram, and Facebook postings. SVWD's Water Use Efficiency Coordinator also makes presentations to the general public and professional organizations, conducts informational tours and is available for free water-wise house calls.

In response to the 2012-2015 Statewide drought, SVWD created a Think Twice Water Efficiency Campaign comprised of a customer scorecard, bumper stickers, lawn signs, 2-day per week watering schedule, enhanced rebates, hotel and food service placards, and a direct toilet replacement program. Customer response to the campaign was very positive and resulted in a 24% drop in potable water demand. The trend of efficient water use has continued with no significant bounce back in consumption since 2016.

SVWD currently uses the WaterSmart online platform to inform its customers on usage and water use efficiency. As of WY2025, 3,141 customers are participating.

The Rebate Program is reviewed annually, and components are changed to achieve optimal use of ratepayer dollars for incentivizing the efficient use of water. The 2020 Rebate Program includes 9 categories: lawn or impervious hardscape replacement, spray irrigation replacement, spray to rotator nozzle replacement, greywater irrigation, rainwater cistern, downspout diversion, pressure regulator, toilet replacement, and urinal replacement. An example of the benefit of this program is demonstrated in estimated water savings of 950,00 gallons from 133 rebates in WY2019 and 923,000 gallons from 133 rebates in WY2020. These are estimated annual savings which carry over into subsequent years and realize cumulative savings as more rebates are added every year. In WY2025, SVWD issued 17 rebates with an estimated savings of 144,127 gallons.

An additional conservation effort by SVWD, in compliance with SB555, involves conducting and submitting annual water loss audit reports to DWR. SVWD's audit score has improved every year: from 51 in 2016 to 53 in 2017 to 60 in 2019.

2.3.4.4.3 County of Santa Cruz Conservation Activities

The County of Santa Cruz is not a water purveyor and therefore does not have ratepayers that typically form the backbone of a water conservation rebate program. Despite this, they promote water conservation throughout the County in several ways. The County requires source metering and reporting of monthly usage on all public water systems with 5 or more connections. County staff offer well soundings to private well owners who want to see if their water levels have changed.

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The County's water conservation program includes the following elements:

- Enforcement of an ordinance on all residential users prohibiting wasteful uses of water
- Requirement for replacement of inefficient toilet and showerheads at time of property sale
- Implementing building code requirements for efficient fixtures for all new construction and remodels
- Requiring water conservation forms and meters to be installed as part of any new well permits for wells expected to use over 2 AFY

2.3.4.5 Recycled Water

The City of Scotts Valley owns and operates the Scotts Valley WRF and Tertiary Treatment Plant. Influent to the WRF is sourced entirely from within the City of Scotts Valley. The recycled water is used by SVWD to augment its water supply and to offset its groundwater extraction for non-potable uses. Recycled water has been used in the Basin since WY2002. Recycled water use increased quickly over the first 9 years of its use, and since 2011 use has been stable between 160 to 200 AFY in most years. From WY2002 through WY2025, approximately 3,500 AF of recycled water has been used in the Basin (Figure 2-7).

The following specific recycled water programs are implemented by the City of Scotts Valley and SVWD and discussed in more detail in Section 2.1.1.3:

- The City of Scotts Valley has an order mandating use of recycled water for irrigation for new construction when permissible and economically feasible.
- Recycled Water Fill Stations offer free recycled water to District customers and City residents for permitted uses since 2016.
- The City of Scotts Valley and Pasatiempo Golf Club, located outside of the Basin, reached an agreement in 2016 to provide treated wastewater to the golf course for irrigation. This allows Pasatiempo Golf Club to reduce its reliance on potable water from the City of Santa Cruz during peak-use months when irrigation demand is high. SVWD compensation for the water can be applied toward funding future projects. SVWD did not have a current identified use for the amount of recycled water that it supplied to the golf course.

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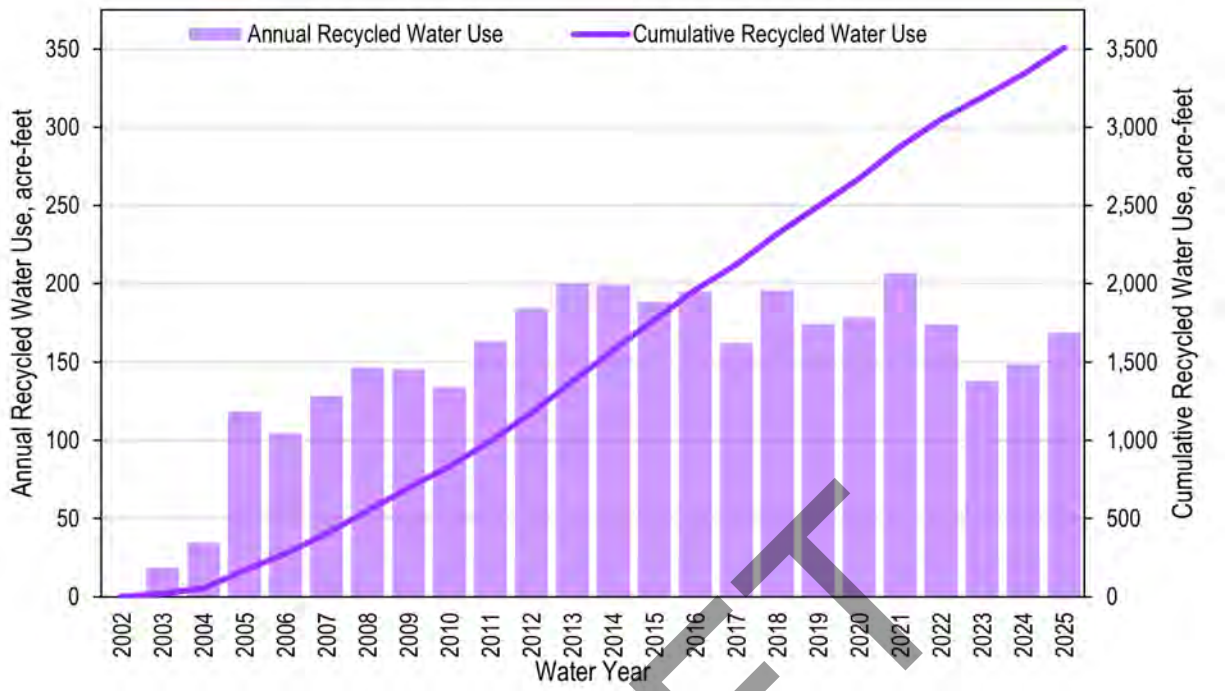

Figure 2-7. SVWD Recycled Water Deliveries, 2002-2020

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2.3.5 Additional GSP Elements

2.3.5.1 Process for Permitting New and Replacement Wells

The County of Santa Cruz regulates well siting, construction, repair, and destruction of wells to protect groundwater resources and ensure suitable water supply for the intended use through Santa Cruz County Code (SCCC) Chapters 7.70 (Water Wells). The County undertook a 2-year update process to modernize the Well Ordinance in response to evolving state and local policy. An updated Well Ordinance was adopted by the Board of Supervisors effective July 21, 2025, and subsequently approved by the California Coastal Commission.

The updated Well Ordinance introduces a tiered review system that scales the level of review and protective measures to the type of well, volume of pumping, and potential for impacts on streams, public trust resources, nearby wells, groundwater sustainability, and control zones. Wells meeting Tier 1, 2, or 3 requirements receive ministerial permits, while Tier 4 wells—those that cannot meet protective standards—are subject to discretionary CEQA review and may be denied if impacts cannot be mitigated.

Other significant changes to Chapter 7.70 include: increased setbacks from streams and deeper well seals for newly permitted wells to reduce streamflow depletion and protect salmonid habitat; mandatory metering of all newly installed non-domestic wells; required notification to

and comment from affected water agencies and groundwater sustainability agencies on well applications; new provisions regulating soil borings and stormwater infiltration devices, which were previously unregulated at the county level; designation of Groundwater Extraction Concern Areas where groundwater availability is limited or new wells may cause significant adverse impacts; and new penalties for code violations.

The update also adopted a new Resource Protection Policy to guide evaluation of well permit applications. The policy is grounded in analytical modeling of groundwater pumping impacts on streamflow and incorporates specific construction measures—including increased stream setbacks and deeper well seals—to reduce impacts from small domestic and replacement wells. For new non-domestic wells involving significant increases in water use, more extensive analysis is required, and denial is possible if impacts cannot be mitigated.

The updated ordinance defines a *de minimis* well as one serving up to 4 primary residences using less than 2 AFY total. Wells exceeding this threshold—whether serving additional domestic connections, agricultural uses, industrial/commercial uses, or new development—are classified as non-*de minimis* and subject to progressively more stringent review depending on the tier in which they fall. Non-*de minimis* well permit applications must be accompanied by supplemental water use efficiency information as specified by the Health Officer, demonstrating that groundwater will be put to beneficial use and not wasted.

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2.3.5.2 Wellhead Protection

The California Department of Health Services Division of Drinking Water and Environmental Management developed the Drinking Water Source Assessment and Protection (DWSAP) Program in January 1999. The program was developed in response to the 1996 reauthorization of the federal Safe Drinking Water Act, which included an amendment requiring states to develop a program to assess sources of drinking water and encourage protection measures. The DWSAP program enables partnership between local, state, and federal agencies to ensure that drinking water quality is maintained and protected.

Specific efforts related to wellhead protection in the Basin include the following:

- SLVWD and SVWD have met DWSAP requirements for all active water supply wells since 1999.
- The City of Santa Cruz and SLVWD have completed periodic watershed sanitary surveys of potential sources of contamination in the water supply watersheds, which encompass the entire Basin (Kennedy/Jenks Consultants, 2018a).
- The SWRCB 2012 Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems (OWTS) establishes additional

setback and design requirements for OWTS located within 600 feet of municipal wells. These requirements are incorporated into the County's August 2022 LAMP.

2.3.6 Relationships with State and Federal Regulatory Agencies

Section 2.1.3 includes a description of monitoring and management programs that involve coordination with state and federal agencies. The SMGWA coordinated with representatives from the DWR throughout the GSP development. The following state and federal agencies were consulted during the preparation of the 2022 GSP and 2027 GSP Amendment:

- California Department of Fish and Wildlife (CDFW)
- California Department of Water Resources (DWR)
- Central Coast Regional Water Quality Control Board (CCRWQCB)
- National Marine Fisheries Service (NMFS, formerly NOAA Fisheries)
- State Water Resources Control Board (SWRCB)
- U.S. Fish and Wildlife Service (USFWS)

As discussed in Section 2.4.3, the SMGWA established a Surface Water Technical Advisory Group (TAG) that included local resource area experts, non-governmental organizations with extensive resource management and protection experience, and state and federal resource and regulatory agencies. The purpose of this group was to gather experts to discuss the resources, agency mandates, and best available science to develop recommendations for the SMGWA Board to consider when developing its depletion of interconnected surface water policies for the 2022 GSP.

SMGWA member agencies have established long-term working relationships with the resource management agencies identified above. Ongoing coordination and collaboration with these agencies focus on planning for and resource protection programs, utility operations, and development and construction of capital improvement projects.

2.3.6.1 Land Use Planning Related to Potential Risks for Groundwater Quality or Quantity

Land use planning, development, and population growth influence groundwater quality and quantity. Current planning by SVWD, SLVWD, and the County does not anticipate a large increase in the Basin's population. SVWD population is projected to increase annually by 0.87% from 2020 to 2045, and SLVWD's population is projected to increase annually by 0.15% over the same time (WSC and M&A, 2021).

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Commercial and suburban residential land development can increase paved surfaces in the Basin, which potentially decrease recharge if not offset with onsite infiltration of runoff. Decreased recharge in areas underlain by the Santa Margarita aquifer could potentially cause reduced quantity and quality of groundwater in that aquifer. Current CCRWQCB stormwater policies require that all new development and redevelopment include measures to maintain runoff and infiltration rates at pre-development levels (City of Scotts Valley, 2017). Furthermore, PMAs to be implemented and included in Section 8 of this GSP increase water supply resiliency and achieve sustainability while considering anticipated future water demands related to population growth.

An increase in the Basin's rural population, most of whom are served by septic systems rather than by municipal wastewater systems, may also affect groundwater quantity and quality by increasing groundwater use and potentially leaching nitrate and other organic compounds to groundwater. There is no expected expansion of communities on septic systems according to the County. Any new rural development using septic systems in the sandy soils of the Basin requires use of enhanced treatment to reduce nitrogen and other constituents prior to wastewater dispersal. The Scotts Valley Waste Water Treatment Plant releases treated effluent to surface water under a National Pollution Discharge Elimination System permit.

There are several sand quarry sites in the Basin that are now either closed or not operating at full capacity. A land use change at these sites, either to a recurrence of mining or to another land use, has the potential to impact groundwater quality by mobilizing contaminants present on site. Permitting by SCEH should identify and mandate solutions to groundwater quality issues at these sites.

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2.3.6.2 Impacts on Groundwater Dependent Ecosystems

The SGMA legislation identified protection of GDEs as a goal of sustainable groundwater management. Per the definitions in the GSP Regulations § 351(m), GDEs refer to "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." Interconnected surface water is defined by § 351(o) as "surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted."

Impacts to GDEs within the Basin have yet to be identified. The groundwater model shows a Basin-wide reduction in streamflow from pumping. However, given the current condition of waterways that continue to support threatened and endangered species, these impacts are not thought to be significant and unreasonable. Ongoing programs such as Santa Cruz County's Juvenile Steelhead and Stream Habitat Monitoring Program have monitored steelhead density and stream habitat since 1994. No correlation between the amount of creek baseflow and fish density or habitat availability has been identified, perhaps because other factors, both

anthropogenic and naturally occurring, can affect habitat abundance. GDE health data collected through remote sensing methods demonstrate GDE habitat is healthy even during droughts like WY2020 to 2022. Additional GDE information is presented in Section 3.4.9.

2.4 Communication and Engagement

The SMGWA represents the beneficial users of groundwater in the Basin. The public agency maintains robust communication and engagement procedures to ensure that all stakeholders are considered in plan development and implementation.

2.4.1 Beneficial Users of Groundwater

As part of the GSP process, beneficial users of groundwater in the Basin are identified by the SMGWA based on categories described in the SGMA and codified in CWC §10723.2. Beneficial users of groundwater in the Basin include municipal well operators, agricultural users, private domestic well owners, small water systems, local land use planning agencies, surface water users, environmental users of groundwater, California Native American Tribes, disadvantaged communities (DACs), protected lands (including recreational areas), public trust uses (including wildlife, aquatic habitat, fisheries, recreation, and navigation), and entities engaged in monitoring and reporting groundwater elevations.

CWC §106.3 recognizes that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes." The Human Right to Water extends to all Californians, including disadvantaged individuals, groups, and communities in rural and urban areas. This GSP considers impacts on all beneficial uses and users, addressing California's Human Right to Water.

2.4.1.1 Municipal Water Agencies

The primary groundwater extractors in the Basin are the 2 municipal water agencies described earlier in this GSP for SLVWD (Section 2.1.1.2.1) and SVWD (Section 2.1.1.2.2). Figure 2-8 shows the locations of active municipal water supply wells used by the 2 water districts, and Figure 3-23 shows their historical annual extractions relative to other groundwater extractors. Where the municipal water agencies' source of water supply is groundwater, their customers are beneficial users of groundwater.

The City of Santa Cruz and its customers are indirect users of groundwater in the Basin. Since surface water is interconnected with groundwater in the Basin, the City of Santa Cruz indirectly uses groundwater that supports the San Lorenzo River for their municipal surface water diversions. The City also owns property, which is partly located in the Basin, associated with water supply use and storage in the Loch Lomond Reservoir.

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2.4.1.2 Mount Hermon Association

The MHA is located southwest of Scotts Valley near the confluence of Bean Creek and the San Lorenzo River (Figure 2-8). MHA is a year-round conference center and camp that serves more than 60,000 guests each year and a community of approximately 1,300 people living in 450 homes. Groundwater is the sole source of potable water supply for the conference center and surrounding homes. MHA's water supply is from 2 wells located on MHA property. Figure 3-23 shows MHA's historical annual extractions relative to other groundwater extractors. Average groundwater extracted since MHA started using groundwater in 1991 is 172 AFY. Over the past 5 years pumping has been reduced to around 140 AFY due to increased water conservation awareness in the community. The JPA provides that MHA has 1 representative on the Board.

2.4.1.3 Small Water Systems

There are 12 small water systems (SWS) supplying water to 5 or more residential connections within the Basin, serving a population of approximately 1,000 (Figure 2-8). Most SWS use groundwater, but some have water rights to divert surface water as their water source (Table 2-8).

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Table 2-8. Small Water Systems in the Santa Margarita Basin

Small Water System	Approximate Number of Connections	Water Source
Fern Grove Water Club	67	groundwater
Fernbrook Woods Mutual Water Company	10	groundwater
Forest Springs	126	supplied water from outside the Basin
Hidden Meadow Mutual Water Company	17	groundwater
Karls Dell	8	groundwater
Love Creek Heights Mutual Water Association	7	groundwater
Mission Springs Conference Center	118	groundwater
Moon Meadows Water Company	5	groundwater
Quail Hollow Circle Mutual Water Company	7	spring
Roaring Camp	non-community	groundwater
Vista Robles Association	21	groundwater
Zayante Acres Mutual Water Company	8	spring

Source: State Water Resources Control Board, Division of Drinking Water

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2.4.1.4 Private Domestic Pumpers

In areas with no municipal or small water system supply, private individuals extract groundwater for residential purposes from wells they own or share ownership with fewer than 5 other homes. An estimated 3,000 people in the Basin depends on private water supply. The approximate locations of private domestic pumpers are shown on Figure 2-8. Typically, these users extract less than 2 AFY. Under SGMA, domestic use less than 2 AFY is called *de minimis* use and is exempt from metering.

2.4.1.5 Disadvantaged Communities

There is a single DAC Census Block Group (DWR, 2025) partially located within the Basin (Figure 2-8). The entire DAC has an estimated population of 967, most of which is outside the Basin. Within the Basin, the DAC includes part of the Census Designated Places of Boulder Creek and Brookdale. These communities were severely impacted by the CZU Complex wildfires in August 2020. The majority of the DAC population residing in the Basin are supplied water by SLVWD (both surface water and groundwater). Based on the location of private domestic wells, the estimated DAC population within the Basin that rely on their own wells for domestic use is fewer than 10. All parcels within the DAC are on septic or a small community wastewater disposal system.

Unlike many DACs throughout California, the Block Groups are not a cohesive community. They are generally made up of small parts of several disparate larger communities that have been grouped together by the Census. The Block Group also provides an artificial boundary within which to focus special attention. In all of the communities located within the Basin, there are people who meet the income requirements to be considered "disadvantaged," but they are not concentrated together in a defined location. Communities within the Block Group are grouped into beneficial user types under their source of water supply, which is either municipal water or privately pumped (Figure 2-8).

2.4.1.6 Agricultural Irrigators

Approximately 18 acres of parcels in the Basin are zoned for agricultural groundwater use. There are some small vineyards are not zoned for agriculture.

2.4.1.7 Industrial Users

Groundwater pumping for industrial use in the Basin is currently minimal. Historically, more groundwater was pumped by the operators of the 3 sand quarries (Hanson Quarry, Olympia Quarry, and Quail Hollow Quarry) for process water and dewatering. Hanson and Olympia Quarries ceased operations in the early 2000s and are undergoing restoration, and Quail Hollow is still active.

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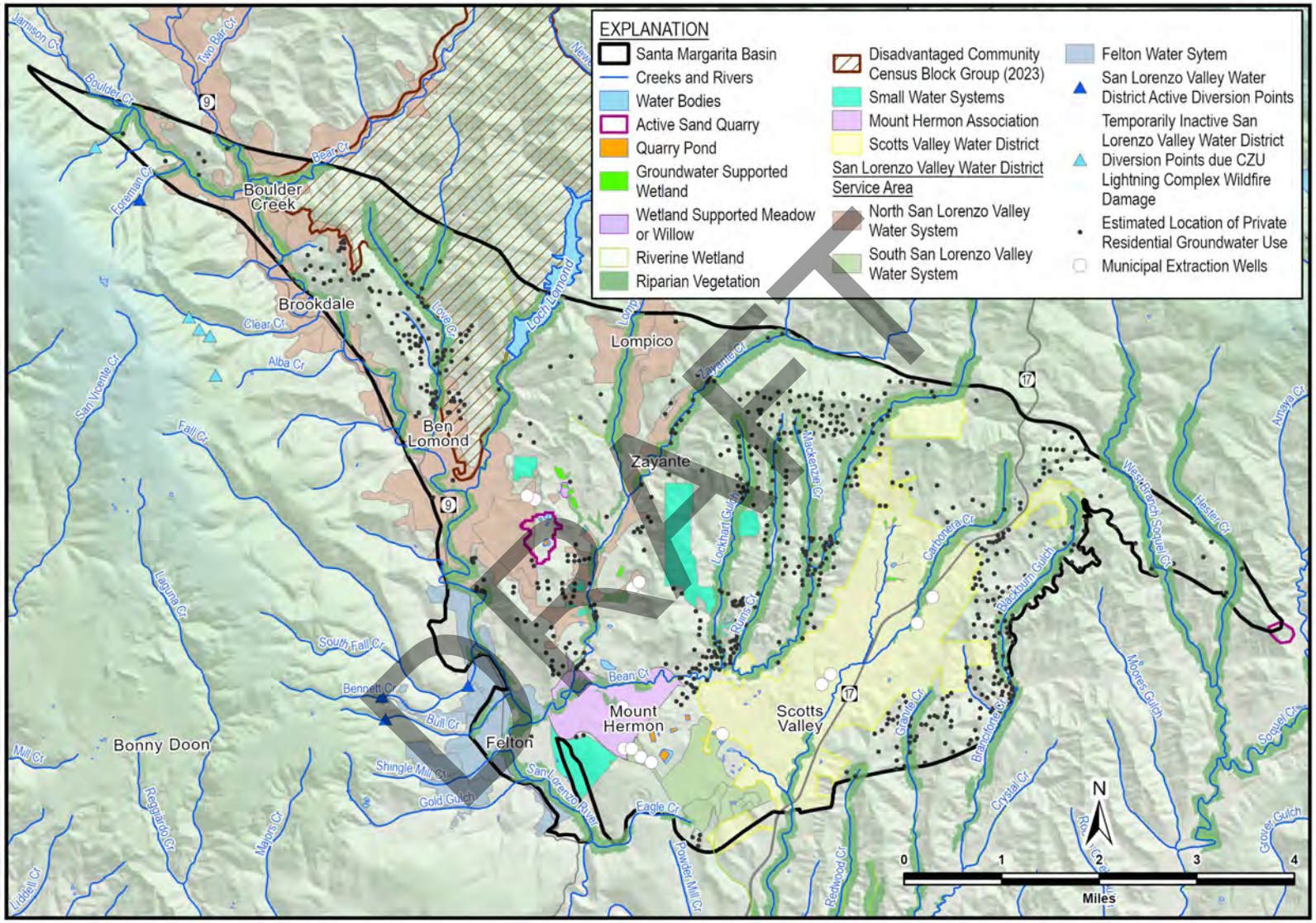

Figure 2-8. Beneficial Users of Groundwater in the Santa Margarita Basin

2.4.1.8 Ecological Users

GDEs in the Basin support many different species, some of which are listed as priority species by either the federal Endangered Species Act of 1973 (U.S.C. §1531 *et seq*.; USFWS, 2021) or the California Endangered Species Act of 1970 (Fish and Game Code § 2050 *et seq*.; CDFW, 2021). For example, Central California Coast coho salmon and Central California Coast steelhead trout are federally listed as endangered and threatened, respectively. Other priority species that depend on instream flows for sustenance including lamprey, California red-legged frog, western pond turtle, and California giant salamander.

The San Lorenzo River is an important river for local fisheries. Historically, the river supported the largest coho salmon and steelhead trout fishery south of San Francisco Bay. While coho salmon are critically endangered in the San Lorenzo Watershed (and Santa Cruz and San Mateo Counties, in general), the federal recovery plan identifies the San Lorenzo Watershed as an "independent watershed" and critical for recovery within the Central California Coast evolutionary significant unit. Coho salmon successfully reproduced in the San Lorenzo Watershed in 1981, 2005, and 2008 in limited areas. In addition, adult coho salmon have been observed in the lagoon and in Felton during other years. Coho salmon do have the capacity for recovery, as shown by their new intermittent (i.e., not every year) population in Laguna Creek. As required by SGMA, the GSP should conform with existing management plans such as federal recovery plans.

The San Lorenzo River has been designated as a fully appropriated stream during the summer months to maintain environmental flows in the river to support fish habitat. While these bypass flows produce important instream benefits in riverine environments, they produce equally important benefits for the San Lorenzo River estuary/lagoon that provides critical habitat for rearing of juvenile steelhead.

Critical species in the Basin that likely rely on GDEs are compiled from the California Natural Diversity Database and information available from the CDFW and The Nature Conservancy (TNC; CDFW, 2020a; TNC, 2021). The priority species, and their locations either known or thought to be found in the Basin are summarized in Table 2-9. GDEs in the Basin are discussed in more detail in Section 3.4.9. Additional species that should be considered but are not listed as priority species and are likely co-beneficiaries of the priority species, are presented in Table 2-10. If the habitat requirements of the priority species are met then the habitat requirements of the co-beneficiary species are also met. The co-beneficiaries are currently not listed as threatened or endangered species.

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Table 2-9. Groundwater Dependent Species Identified for Priority Management

Species Common Name	Type of Species	Occurrence Frequency	Location(s)
California Giant Salamander	Amphibian	Frequently present	Probably distributed widely in basin. Bean Creek, Lockhart Gulch, Ruins Creek, Zayante Creek, Lompico Creek, San Lorenzo River
California Red-Legged Frog	Amphibian	-	Bean Creek, Mountain Charlie
Coho Salmon	Fish	Rare	Bean Creek, Zayante Creek, San Lorenzo River
Lamprey	Fish	Occasional to Common	Bean Creek, Zayante Creek, Newell Creek, San Lorenzo River
Steelhead	Fish	Common	Bean Creek, Zayante Creek, Lompico, Mackenzie, San Lorenzo River, Newell Creek, Love Creek, Boulder Creek
Western Pond Turtle	Reptile	Rare	Zayante Creek, Newell Creek, San Lorenzo River

Species with no quantified frequency marked with "-"

Table 2-10. Groundwater Dependent Species Identified as Co-Beneficiaries of Priority Species

Species Common Name	Type of Species	Occurrence Frequency
Belted Kingfisher	Bird	Occasional
California Dipper	Bird	Rare; feeds in streams
California Newt	Amphibian	-
California Roach	Fish	Common
Coastrange Sculpin	Fish	Common
Common Merganser	Bird	Uncommon
Dace	Fish	Common
Deceiving Sedge/Santa Cruz Sedge	Plant	-
Downy Woodpecker	Bird	Common
Marsh Sandwort	Plant	-
Mount Hermon June Beetle	Insect	-
Prickly Sculpin	Fish	Common on Newell Creek
Rough Skinned Newt	Amphibian	-
Sacramento Sucker	Fish	Common
Santa Cruz Black Salamander	Amphibian	-
Slender Salamander	Amphibian	-
Swamp Harebell	Plant	-
Tidewater Goby	Fish	Rare
Warbling Vireo	Bird	Uncommon
Western Bumble Bee	Insect	-
Western Pearshell	Bivalve (Mussel)	-
Western Red Bat	Mammal	CA species of special concern
Western Sycamore	Plant	-
Western Wood-Pewee	Bird	Uncommon

Species with no quantified frequency marked with "-"

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Current regulatory instream flow requirements exist on Fall Creek upstream of its confluence with the San Lorenzo River, Newell Creek below Loch Lomond Reservoir, and the San Lorenzo River at Felton. For Fall Creek, the minimum November through March bypass flow is 0.75 cubic feet per second (cfs) for dry years, and 1.5 cfs for other years; April through October bypass flow is 0.5 cfs for dry years, and 1.0 cfs for other years. Dry years are defined based on cumulative flow volume in the San Lorenzo River at Big Trees from the beginning of the water year. On Newell Creek below Loch Lomond Reservoir, a flow of 1.0 cfs must be maintained year-round to provide adequate depths for fish passage and spawning. On the San Lorenzo River at Big Trees, if flows fall below monthly minimum rates of 10.0 cfs in September, 25.0 cfs in October, or 20.0 cfs November through May, diversions from Fall and Bull Creeks must be terminated (Exponent, 2019).

While these are currently the only locations with mandated flows in the Basin, there are many resources available to evaluate instream flows if a basin-wide approach is warranted. North Coast Instream Flow Policy (R2 Resource Consultants, Inc and Stetson Engineers, 2008) provides guidelines for maintaining instream flows to protect anadromous salmonids. In general, summer rearing flows are just as critical, if not more so than spawning and passage flows. Summer rearing flows when the creek flow mostly comprises baseflows fed by groundwater are more impacted by groundwater extraction than spawning and migration flows, which are primarily influenced by rainfall and runoff. Table 2-11 lists minimum stream depth and dates for passage, and Table 2-12 lists dates, minimum stream depths, favorable velocities, and useable substrate for spawning.

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Table 2-11. Steelhead and Coho Minimum Passage Criteria

Species	Dates	Minimum Passage Depth Criterion (feet)
Steelhead	November 1 to March 31	0.7
Coho	October 1 to February 28	0.6

Source: R2 Resource Consultants, Inc and Stetson Engineers, 2008

Table 2-12. Steelhead and Coho Spawning Criteria

Species	Dates	Minimum Depth (feet)	Favorable Velocities (feet/second)	Useable Substrate D_{50} (millimeter)
Steelhead	December 1 to March 31	0.8	1.0-3.0	12-46
Coho	November 1 to February 28	0.8	1.0-2.6	5.4-35

Source: R2 Resource Consultants, Inc and Stetson Engineers, 2008

A variety of other methods and models can be used to estimate instream flow requirements that provide the minimum depths required for fish passage or spawning:

- 1-D and 2-D hydraulic models to assess flow depths and velocities for streams with available topographic data.
- Physical Habitat Simulation developed by the USGS combines both biologic and hydraulic inputs to simulate the relationship between streamflow and physical habitat to establish instream flow requirements (USGS, 2012).
- Regression equations are another option when site-specific topographic data are absent, but streamflow data are available (R2 Resource Consultants, Inc and Stetson Engineers, 2008). These equations were developed by establishing a relationship between cross-sectional data with mean annual flow for unimpaired gaged.
- Field-based approaches such as the Wetted Perimeter Method can also be used by performing repeat transects at various flow rates at known hydraulic bed controls (CDFW, 2020b).

Understanding the biological response of priority species to available habitat is an important consideration. Santa Cruz County's Juvenile Steelhead and Stream Habitat Monitoring Program measures the density of juvenile steelhead and assesses habitat conditions for steelhead and coho salmon in 4 watersheds in Santa Cruz County including the San Lorenzo River watershed. Presence/absence data are collected for select species of fish, amphibian, and reptiles including all the priority species listed in Table 2-9. Habitat data are also collected in select stream reaches. The species and habitat data are compiled into an annual report and a geodatabase for spatially referenced information. This work is ongoing and has occurred in every fall since 1994 (Beck *et al*., 2019), and can be used to establish links between streamflow, groundwater conditions, GDE habitat, and presence or absence of priority aquatic species.

The City of Santa Cruz is implementing 3 different HCPs that will help protect environmental beneficial users of groundwater (City of Santa Cruz, 2011 and 2025). An HCP is a planning document required as part of an Incidental Take Permit under the Endangered Species Act. The HCP describes effects of City activities that may result in any harm or damage to threatened and endangered species (incidental take), and how those effects will be tracked, avoided, minimized, and mitigated.

Multiple species are covered by 3 different HCPs for City activities:

- Anadromous Salmonid HCP adopted in 2025
- Administrative draft USFWS HCP for 10 species that are state or federally listed as threatened, endangered, or species of special concern is currently in final review
- Low Effect Mount Hermon June beetle HCP currently being implemented

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2.4.2 SMGWA Board of Directors

The JPA between SVWD, SLVWD, and the County of Santa Cruz (included as Appendix 1B) that created the SMGWA requires the GSA to hold public meetings at least quarterly. The meetings are required to be noticed and meet all of the requirements of the Ralph M. Brown Act for transparency in California government. To hold a valid meeting, the SMGWA must have a quorum of the Board of Directors, which consists of an absolute majority of directors plus 1 director or designated alternates. With these requirements in mind, the SMGWA:

- Holds board meetings on a regular schedule
- Provides written notice of meetings with meeting agenda and meeting materials available at least 72-hours prior to the meeting time
- Sends email meeting reminders to SMGWA's contact lists that includes approximately 824 unique email addresses
- Posts meeting agenda at the meeting location prior to the meeting as required

Under SGMA, the SMGWA Board of Directors is responsible for approving and submitting a GSP and subsequent amendment(s), if needed. Once a quorum is present, most SMGWA decisions require a simple majority of all appointed directors participating in the vote. If a director is disqualified from voting on a matter before the Board because of a conflict of interest, that director shall be excluded from the calculation of the total number of directors that constitute a majority.

Certain matters presented before the SMGWA Board of Directors require a unanimous vote of all participating directors. These include approval of any of the following:

- Capital expenditures estimated to cost $50,000 or more
- Annual budget
- GSP for the Basin or any future amendments
- Levying of assessments or fees
- Issuance of indebtedness
- Stipulations to resolve litigation concerning groundwater rights within or groundwater management for the Basin

The SMGWA Board of Directors directs agency staff to fulfill the various requirements of SGMA. To do this, SMGWA staff provides the Board with research and recommendation staff reports, work plans, technical summaries, budgets, and other work products as required to support Board decision-making.

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2.4.3 Surface Water Technical Advisory Group

Representatives from the following organizations and agencies participated in 2 technical Surface Water TAG meetings to assist with 2022 GSP development:

- California Department of Fish and Wildlife
- California Department of Water Resources
- City of Santa Cruz Water Department
- County of Santa Cruz Environmental Health (SCEH)
- Environmental Defense Fund
- Land Trust of Santa Cruz County
- National Marine Fisheries Service (formerly NOAA Fisheries)
- Resource Conservation District of Santa Cruz County
- San Lorenzo Valley Water District
- Santa Margarita Groundwater Agency
- Scotts Valley Water District
- The Nature Conservancy
- U.S. Fish and Wildlife Service

The 2 meetings held on August 14, 2020, and February 24, 2021, provided the TAG background information on the hydrogeological setting of the Basin, City of Santa Cruz habitat conservation planning, Santa Cruz County fish monitoring, potential conjunctive use opportunities for SLVWD, water budget, and current understanding of the relationship between surface water and groundwater. Based on the background information available, the technical team shared potential approaches for developing SMC for the depletion of interconnected surface water and plans for GDE monitoring. The TAG's expert input was taken into account in the development of SMC and the GDE monitoring plan for the 2022 GSP. SMGWA did not reconvene a TAG for the 2027 GSP Amendment, but input received while developing the 2022 GSP informed the revised approach to SMC related to depletion of interconnected surface water.

2.4.4 Consideration of Public Input and GSP Review Process

During SMGWA Board meetings, a meeting facilitator regularly provides opportunities for public comments on topics being discussed. Consistent with and expanding on Brown Act requirements, each Board meeting included the following periods of public comment on the agenda:

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- Introductory public comment period at the beginning of the meeting for topics not included in the agenda
- Public comment periods for each agenda item
- Public comment periods prior to any formal action taken by the Board

A table-based comment tracking system was adopted for 2022 GSP development to record beneficial user input. The public comment tracking table is included as an appendix to the Communication and Engagement Plan (C&E Plan) summarized in Section 2.4.5 below. The full C&E Plan is included as Appendix 2A. All public comments provided at Board meetings were heard by directors and staff, and considered before formal action were made or direction to staff provided.

During 2022 GSP development, draft sections of the GSP were developed by consultants and member agency staff, presented to the Board for initial feedback, refined, and then provided as a draft for Board and public review on the SMGWA's website. The Board provided written comments on each section and significant comments were discussed at the subsequent Board meeting. During Board meetings covering specific draft sections of the GSP, the public was encouraged to provide verbal feedback on the topics being discussed.

All comments provided by the Board and public were reviewed by GSP consultants and staff, and revisions made to relevant sections of the GSP as applicable. A complete draft of the 2022 GSP was compiled and uploaded to the SMGWA website on July 26, 2021 for a 60-day public review period. The GSP was finalized considering public comments received. Comments received on the public draft GSP and responses are documented in Appendix 2B.

The 2027 GSP Amendment was developed consistent with the requirements of preparing and adopting a GSP. Following public notices published in the San Lorenzo Valley Press Banner and Scotts Valley Press Banner on February 13, 2026 and February 20, 2026, the SMGWA Board adopting a notice of intent to prepare a GSP Amendment at its February 26, 2026 meeting. On July 24, 2026, SMGWA notified the City of Scotts Valley and the County of Santa Cruz of its intent to adopt a GSP Amendment at least 90 days after providing notice. *[GSP Review Draft Note – additional information on the adoption process and public comment on the draft GSP will be included in the final GSP Amendment as Appendix 2C.]*

2.4.5 Communication and Engagement Plan

A Stakeholder C&E Plan was prepared to assist the SMGWA in its efforts to disseminate and receive feedback on relevant information and to engage the public, including groundwater beneficial users, regarding the development and implementation of SMGWA's GSP with a particular focus on fulfilling and exceeding the requirements of § 354.10 Notice and Communication of the SGMA. The C&E Plan covers a 4-phase approach that includes ongoing

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communication efforts, GSP development, GSP rollout, and future efforts following GSP submission and beyond as the GSP is implemented. The C&E Plan is included as Appendix 2A.

The C&E Plan provides SMGWA board members and staff a guide to ensure consistent messaging about SGMA requirements and other related information. It established a roadmap for GSP development that identifies how and when beneficial users and other stakeholders can provide timely and meaningful input into GSA decision-making. Additionally, the C&E Plan ensures beneficial users and other stakeholders in the SMGB are informed of milestones and offered opportunities to participate in GSP development and implementation.

Stakeholder involvement and public outreach is critical to GSP development and implementation because it helps promote the plan development based on input and broad support. Some essential elements of public outreach are providing timely and accurate public reporting of planning milestones through the distribution of outreach materials and posting of materials on the SMGWA website, securing quality media coverage, and using social media.

The phased approach to outreach allows opportunities to assess the program and evaluate how the C&E Plan is performing against its goals and objectives. Assessment is conducted by the cooperating agency staff and reviewed by Board members during quarterly communications updates to the Board.

Ongoing activities in the GSP implementation phase starting in 2022 include: maintenance of the SMGWA website; continued social media presence through Facebook and Instagram; email newsletter; youth engagement efforts; promoting and conducting community meetings, workshops and events; coordination with member agencies to share information; and developing print materials, as necessary.

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3 BASIN SETTING

3.1 Overview

The Santa Margarita Groundwater Basin lies in the north central portion of Santa Cruz County (Figure 2-1) in the Santa Cruz Mountains. The Basin is a geologically complex area that was formed by the same tectonic forces along the San Andreas fault zone that created uplift of the Santa Cruz Mountains and the rest of the California Coast Range.

The Basin consists of a section of sandstone, siltstone, and shale/mudstone overlying a basement of granitic and metamorphic rocks, all of which have been folded into a geologic trough called the Scotts Valley Syncline. The sedimentary rocks are divided into numerous formations based on the types of rock and their relative ages, as determined by field mapping and paleontological studies performed by the United States Geological Survey (Clark, 1981; Brabb *et al.*, 1997; McLaughlin *et al.*, 2001). The sandstone formations make the best aquifers due to their large porosity and permeability. Three sandstone formations—the Santa Margarita, Lompico, and Butano Sandstones—are the principal aquifers that supply much of the Basin's water demand.

3.2 Topography

Surface topography is varied in the Basin, increasing in elevation to the north and east. Elevations within the Basin range from approximately 300 feet above mean sea level (amsl) in the vicinity of the San Lorenzo River at the southern end of the Basin, to more than 1,500 feet amsl along the northern boundary of the Basin at the peak of Mount Roberta.

Figure 3-1 is a topographic map for the Basin.

At its northern margin, the Basin is characterized by a series of ridges and peaks running roughly parallel to the Zayante-Vergeles Fault. Named peaks include Mount Roberta (~1,500 ft amsl) and Eagle Dell Peak (~1,400 ft amsl). The rugged terrain of the northern part of the Basin includes several north-south trending, steep ridges separated by V-shaped valleys formed by Newell Creek, Zayante Creek, and Bean Creek and their branches and tributaries. The topography is gentler and rolling in the southern and central parts of the Basin where the Santa Margarita Sandstone occurs at the surface. At the south end of the Basin a relatively low-lying area stretches from Scotts Valley to Felton, where it joins the San Lorenzo River Valley. The San Lorenzo River Valley crosses the entire Basin near its western margin. The varied topography in the Basin is illustrated in a 3D rendering on Figure 3-2.

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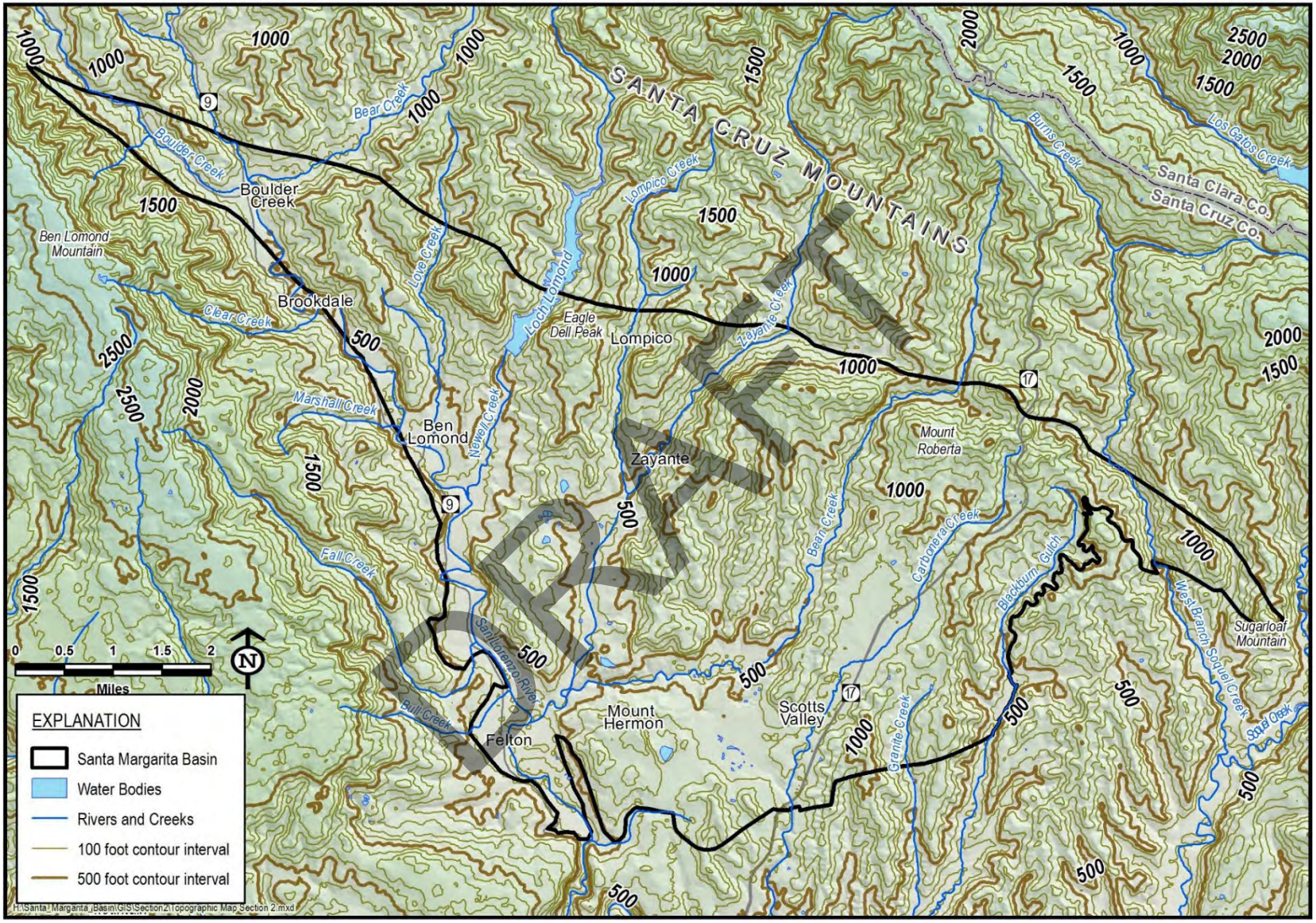

Figure 3-1. Santa Margarita Basin Topography

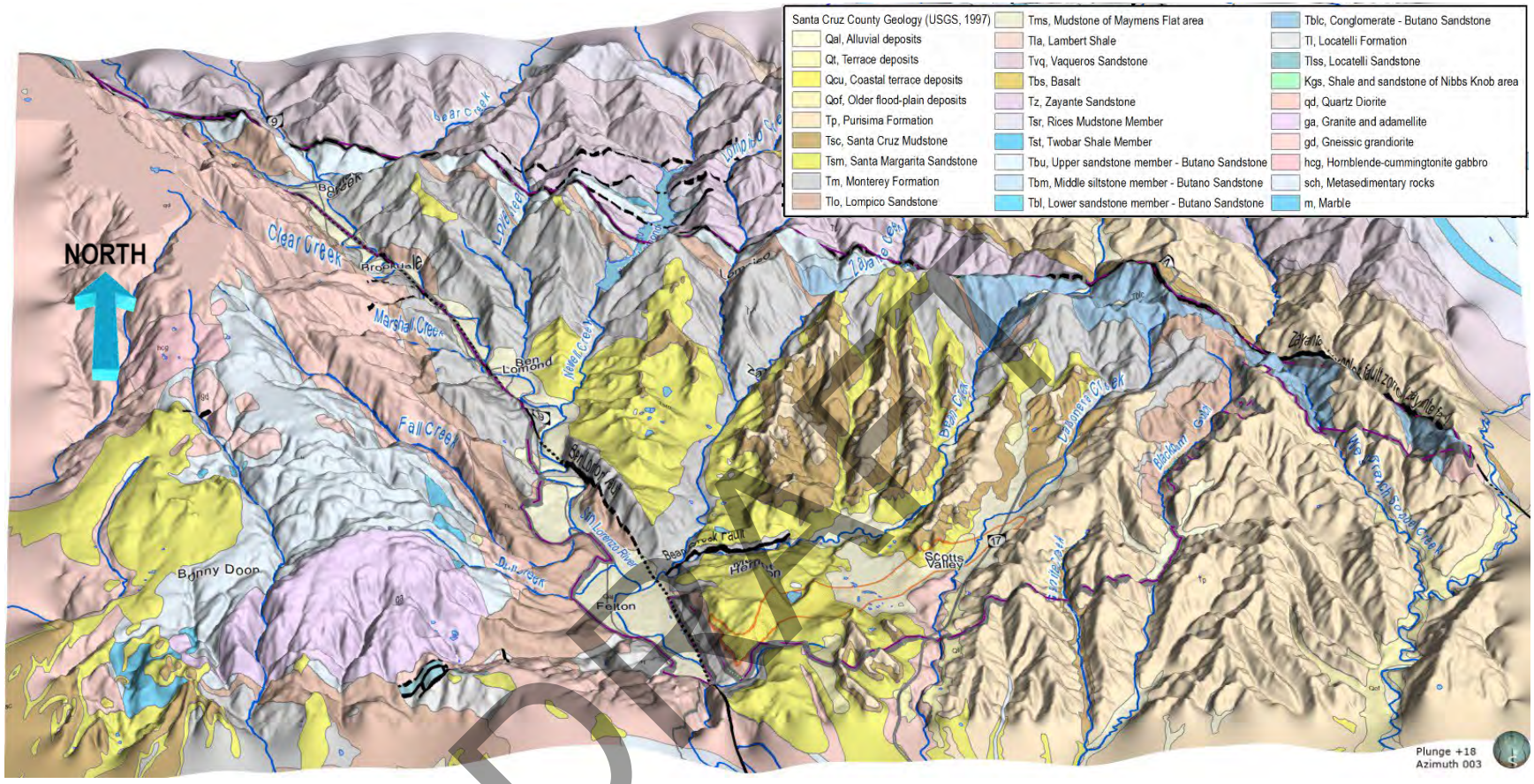

Figure 3-2. 3D Topography of the Santa Margarita Basin with Surface Geology (3x exaggeration)

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3.3 Climate

The climate in Santa Margarita Basin is classified as Mediterranean, characterized by distinct rainy and dry seasons, warm summers, and mild winters (Kennedy/Jenks Consultants, 2015). In an average year, almost all the Basin's precipitation occurs from November through April. Almost all precipitation is rainfall, though occasionally snow falls at higher elevations.

3.3.1 Historical Climate

Historically, precipitation increases across the Basin east to west from about 40 inches per year to 50 inches per year due to increased elevation and the orographic effect of Ben Lomond Mountain west of the Basin. The distribution of precipitation across the Basin from 1981 to 2010 is displayed on Figure 3-3.

Precipitation and temperature are measured at the El Pueblo Yard weather station in Scotts Valley (elevation ~580 feet amsl) and at the Boulder Creek weather station in downtown Boulder Creek (elevation ~508 feet amsl). Station-specific precipitation range, average, and annual departure from the average for the full period of record (1947 through WY2025) are provided on Figure 3-4. Consistent with the WY2025 Annual Report and standard climatological practice, the most recent 30-year period (1995–2024) is used to define long-term average conditions in the Basin. The 30-year average annual precipitation is approximately 41.1 inches at the El Pueblo Yard station (Table 3-1) and approximately 50.1 inches at the Boulder Creek station. (Table 3-1). The temperature record is similar at the 2 stations. The average minimum and maximum temperatures are about 32ºF and 77ºF, respectively. In the warmer dry season, from May to October, average minimum and maximum monthly temperatures are approximately 41ºF and 95ºF, respectively.

Water year type is determined using the City of Santa Cruz water year classification that is no longer used by the city, but is used in the GSP for consistency with past classification practices. This classification is based on total annual runoff in the San Lorenzo River measured at the USGS Big Trees gage, just south of its confluence with Bean and Zayante Creeks. Water year types are defined as Wet when annual runoff exceeds 119 AF, Normal when runoff ranges from 49 to 119 AF, Dry when runoff ranges from 29 to 48 AF, and Critically Dry when runoff is less than 29 AF. The water year types are displayed on most of the hydrographs in this GSP.

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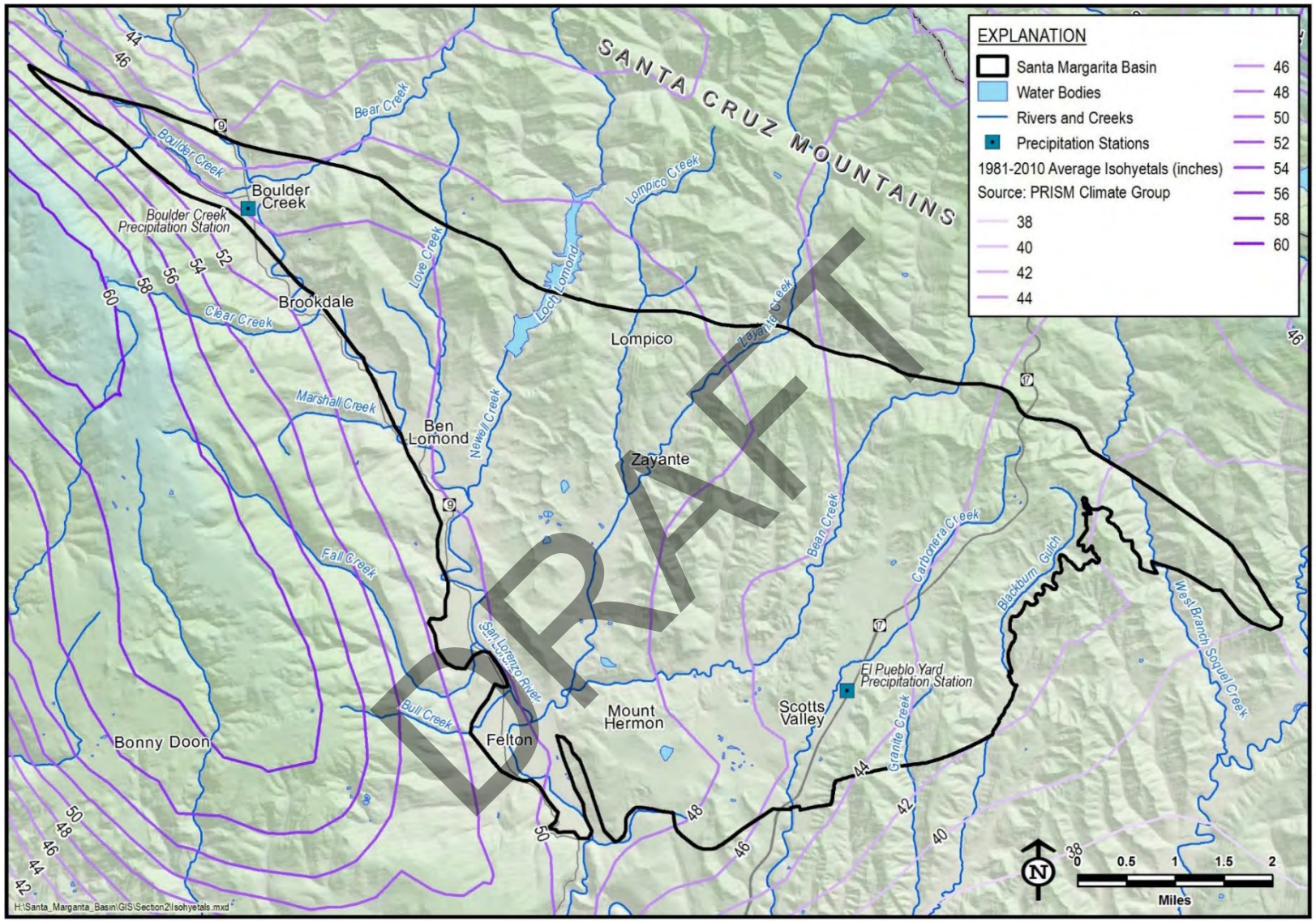

Figure 3-3. Distribution of Precipitation Across the Santa Margarita Basin

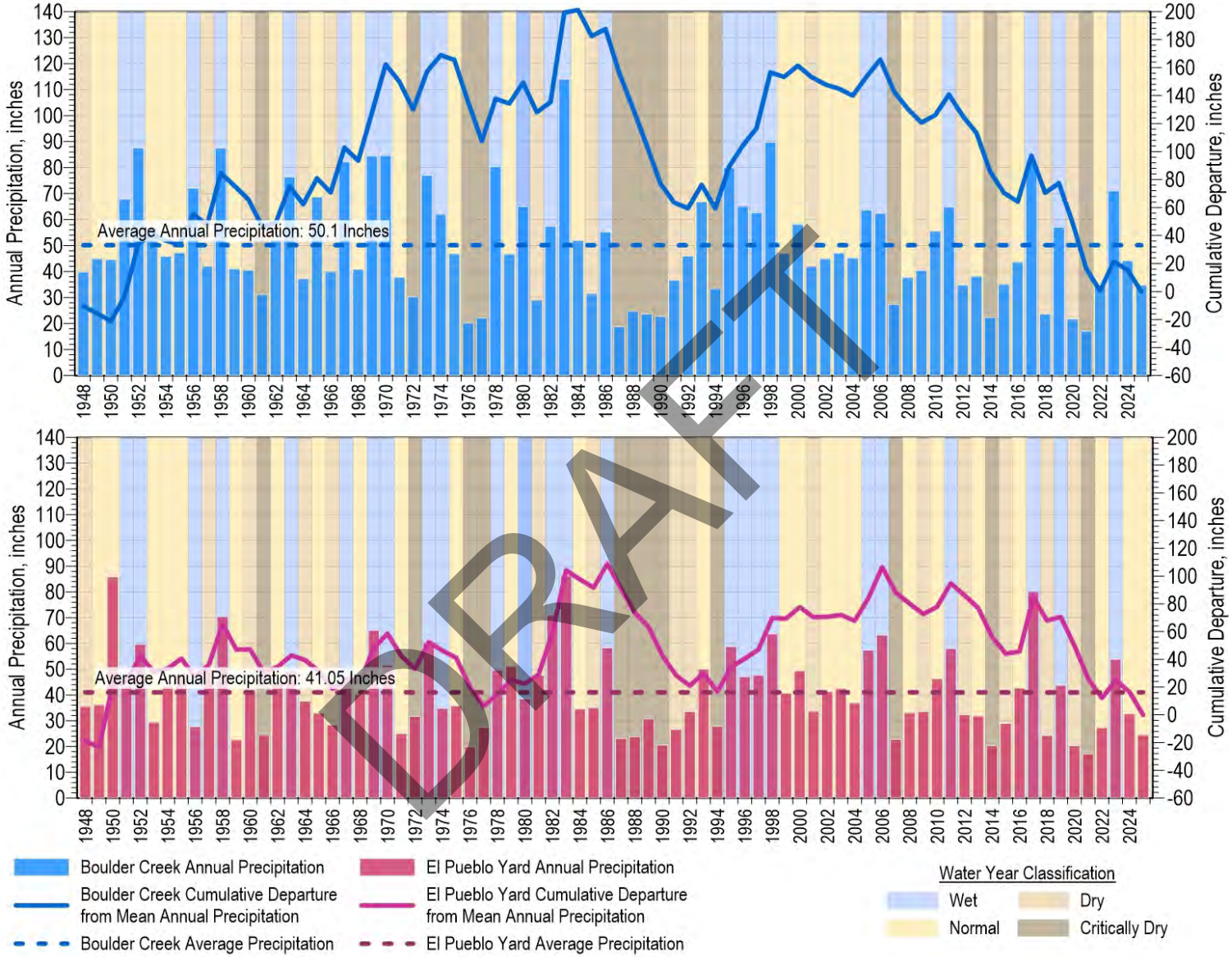

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Figure 3-4. Annual Precipitation and Cumulative Departure from Mean Annual Precipitation in the Santa Margarita Basin

Table 3-1. Santa Margarita Basin Monthly Climate Summary (30-Year Average, updated through WY2025)

	Boulder Creek (SLVWD)			El Pueblo Yard (SVWD)		
Month	Average Precipitation (inches)	Average Monthly Minimum Temperature (ºF)	Average Monthly Maximum Temperature (ºF)	Average Precipitation (inches)	Average Monthly Minimum Temperature (ºF)	Average Monthly Maximum Temperature (ºF)
January	11.3	29.3	71.6	8.8	31.3	73.4
February	9.9	32.2	71.5	7.5	30.2	72.9
March	6.3	32.3	81.6	5.7	34.3	80.6
April	3.1	37.6	85.6	2.4	37.9	85.7
May	1.3	40.2	85.5	1	41.3	85.9
June	0.2	42.2	97.3	0.2	45.2	96.9
July	0	47.7	101.9	0	14.4	96.5
August	0.1	48.3	100.8	0	50.1	94.6
September	0.1	40.7	102.1	0.2	44.2	100.0
October	2.1	37.6	87.0	2	41.5	89.8
November	4.7	31.8	82.4	4.1	34.3	83.2
December	10.8	30.4	66.2	9	30.4	69.0

Notes: Precipitation values represent average monthly precipitation based on the most recent 30-year period (WY1996–2025). The full period of record (WY1947–2025) is shown on Figure 3-4 to characterize long-term variability

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3.3.2 Projected Climate

Climate change is expected to impact the Basin in the future because of a rise in atmospheric greenhouse gases such as carbon dioxide and methane. Projecting climate change is a challenging task that has inherent uncertainty regardless of the method selected. DWR provides a set of assumptions that can be used for GSP development, but the SMGWA elected to use a slightly different approach that better suited the groundwater model already developed for the Basin. The method described below was selected for use in the GSP projected scenario because it is based on the best available science, is consistent with other regional planning efforts, and provides a conservative estimate of future conditions in the Basin.

DWR's projected climate change data sets for use in GSP development incorporate a single set of assumptions about future temperature, evapotranspiration, precipitation, and hydrology in 2 future years (2030 and 2070). Generally, DWR anticipates future regional climate conditions to be warmer than current conditions, with greater evapotranspiration and more variable precipitation and streamflow (DWR, 2018). In part because this steady-state approach is not directly applicable to transient groundwater models where model inputs vary over time (i.e. the

Santa Margarita Basin Numerical Groundwater Flow Model, or "Basin Model"), the DWR guidance document on climate change states that other climate change approaches can be used for developing projected water budgets in the GSP:

> *Local considerations and decisions may lead GSAs to use different approaches and methods than the ones provided by DWR for evaluating climate change. For example, the use of a transient climate change analysis approach may be appropriate where local models and data have been developed that include the best available science in that watershed or groundwater basin.*

The transient climate projection approach used for the Basin Model, is described generally below and in more detail in Appendix 3A: Section 7.1. The climate projection is developed based on an ensemble of 4 commonly used and scientifically defensible global climate models. The approach is similar to that being used by the City of Santa Cruz to develop their recent HCPs. Similar to DWR's dataset, the climate projection generally results in more variable precipitation (i.e., longer and more extreme droughts with fewer but more extreme rainfall events), slightly lower total precipitation, and warmer temperatures in the future in comparison to current conditions.

Projected trends for the 4-model ensemble projection are compared against historical data and other climate models to demonstrate how the climate projections compare to conditions observed historically and projected in the future by others.

Streamflow and evapotranspiration are simulated in the Basin Model based on the precipitation and temperature projections.

Figure 3-5 shows projected precipitation and Figure 3-6 shows projected reference evapotranspiration controlled by temperature. The set of assumptions used in the climate projection is a single scenario selected to be representative of the region, is consistent with other regional planning efforts, and is conservative about future climate change. There are many other equally likely climate scenarios that could also occur.

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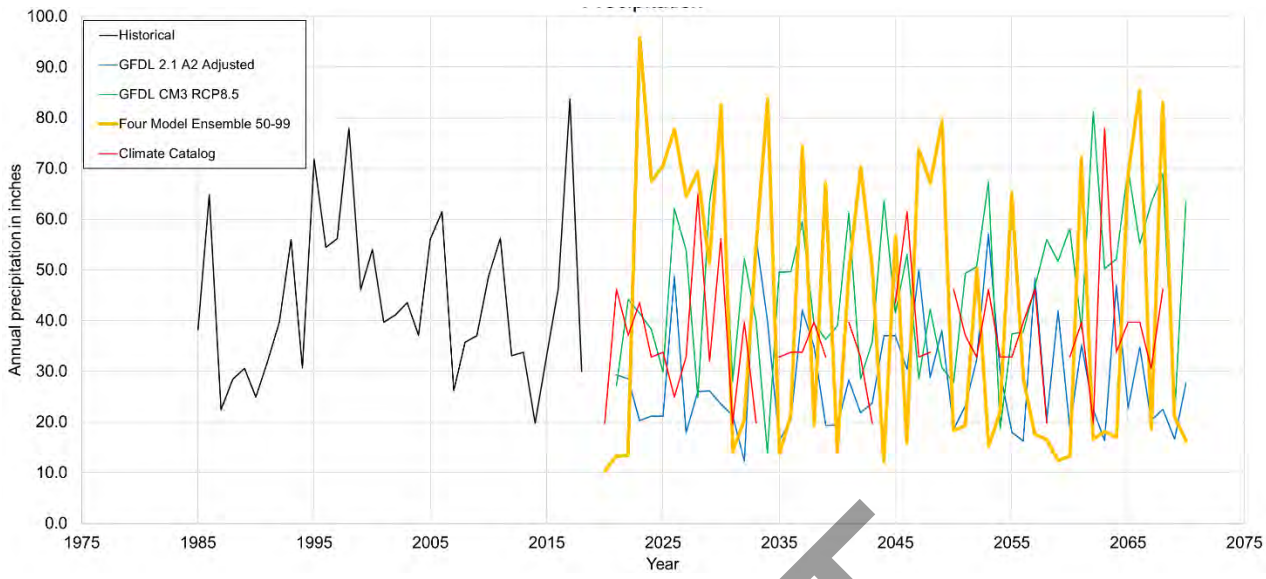

Figure 3-5. Precipitation Variability Between Climate Models

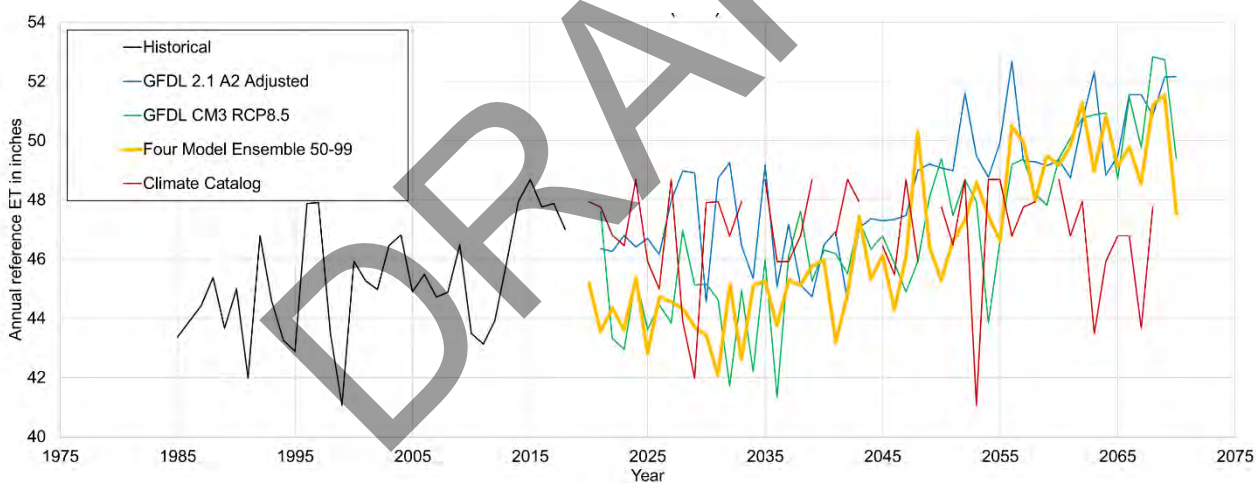

Figure 3-6. Annual Reference Evapotranspiration Variability Between Climate Models

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3.4 Hydrogeologic Conceptual Model

This subsection describes the Hydrogeologic Conceptual Model (HCM) of the Basin, including its boundaries, geologic formations and structures, and principal aquifer units. Also described is general Basin groundwater quality, interactions between groundwater and surface water, and generalized groundwater recharge and discharge areas. The HCM primarily relies upon previously published studies, including the following:

- Nicholas M. Johnson (2009) San Lorenzo Valley Water District Water Supply Master Plan
- Kennedy/Jenks Consultants (2015) Santa Margarita Basin Groundwater Modeling Technical Study
- SVWD annual groundwater management program reports (2008 – 2019)

3.4.1 Basin Boundaries

The Basin forms a roughly triangular area that extends from Scotts Valley in the east, to Boulder Creek in the northwest, to Felton in the southwest (Figure 3-7). Sedimentary rocks within the Basin include, from oldest to youngest, the Tertiary-aged Butano Sandstone, Lompico Sandstone, Monterey Formation, and Santa Margarita Sandstone. The sandstone formations form the Basin's principal aquifers. The Basin is bounded on the north by the Zayante trace of the active, strike-slip Zayante-Vergeles fault zone, on the east by a buried granitic high that separates the Basin from Santa Cruz Mid-County Basin, and on the west by the Ben Lomond fault except where areas of alluvium (previously designated as the Felton Basin lie west of the fault). The southern boundary of the Basin with the West Santa Cruz Terrace Basin is located where the Tertiary sedimentary formations thin over a granitic high and give way to young river and coastal terrace deposits.

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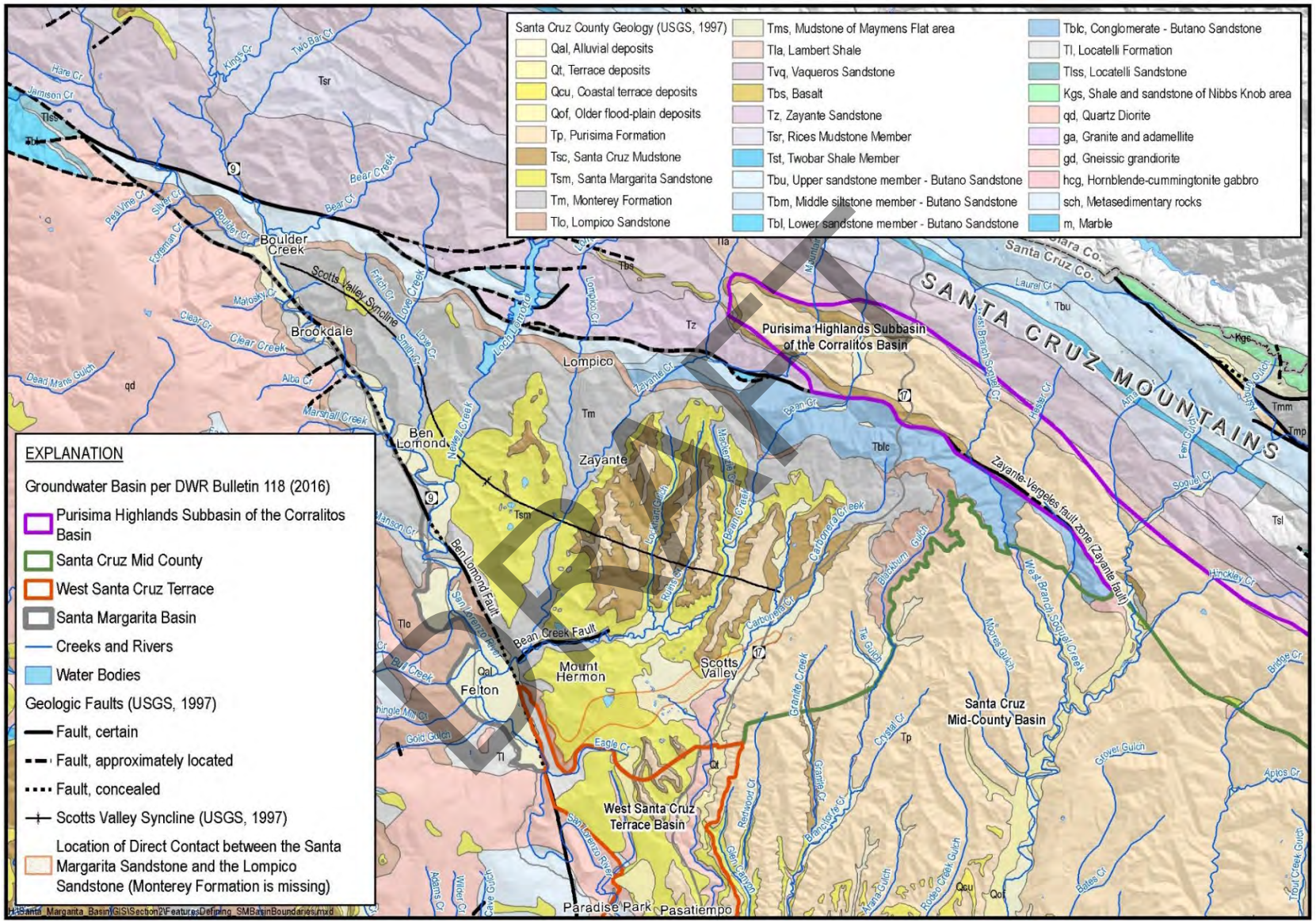

Figure 3-7. Features Defining the Santa Margarita Basin Boundaries

3.4.2 Basin Stratigraphy

Figure 3-8 is a generalized stratigraphic column for the Basin that shows the age relationships and thickness of geologic units. The thick section of Tertiary-age sedimentary formations does not represent a continuous marine depositional sequence. Episodes of deformation and uplift combined with changes in global sea level led to erosion that resulted in 4 unconformities, or gaps, in the geological record represented by wavy lines on the stratigraphic column. These episodes of folding and uplift followed by erosion account for the thickness variations across the Basin of the sedimentary layers or their local absence, with important consequences for the HCM. The subsections below describe the stratigraphic units from oldest to youngest and indicate where they occur in the Basin as depicted in the geologic map shown on Figure 3-9.

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Era	Period	Series	Geologic Formation		Lithology	Maximum Thickness in Basin (feet)
Cenozoic	Quaternary	Pleistocene-Holocene	Alluvium (Qal) and		Alluvium – unconsilidated, moderately sorted silt, sand and gravel	40
			Terrace Deposits (Qt)		Terrace Deposits – weakly consolidated, poorly sorted sandy gravel to medium-grained sands	60
	Tertiary	Pliocene	Purisima Formation (Tp)		Very thickly bedded tuffaceious and diatomaceous siltstone with thick interbeds of semi-friable andestic sandstone	200
		Miocene	Santa Cruz Mudstone (Tsc)		Medium- to thick-bedded and faintly laminated pale siliceous mudstone with scattered speriodal dolomite concretions; locally graded to sandy siltsone	250
			Santa Margarita Sandstone (Tsm)		Very thick bedded and thickly crossbedded friable arkosic sandstone	450
			Lompico Sandstone (Tlo)	Monterey Formation (Tm)	Medium- to thick-bedded and laminated subsiliceous organic mudstone and sandy siltstone with few thick dolomite interbeds	2,000
					Thick-bedded to massive arkosic sandstone	400
		Eocene	Butano Sandstone	Upper (Tbu)	Thin- to very thick-bedded medium arkosic sandstone with thin interbeds of siltstone	3,000
				Middle (Tbm)	Thin- to medium-bedded nodular pyritic siltstone	250 – 750
				Lower (Tbl)	Very thick bedded to massive arkosic sandstone with thick to very thick interbeds of sandy pebble conglomerate in lower part	1,500
		Paleocene	Locatelli Formation (Tl)		Nodular micaceous siltstone; micaceous arlosic sandstone locally at base	800
Mesozoic	Cretaceous		Crystalline Basement		Metasedimentary rocks intruded by granodiorite and quartz diorite	

unconformity

principal aquifer

Modified after Johnson (2009) and Kennedy/Jenks Consultants (2015)

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Figure 3-8. Santa Margarita Basin Stratigraphic Column

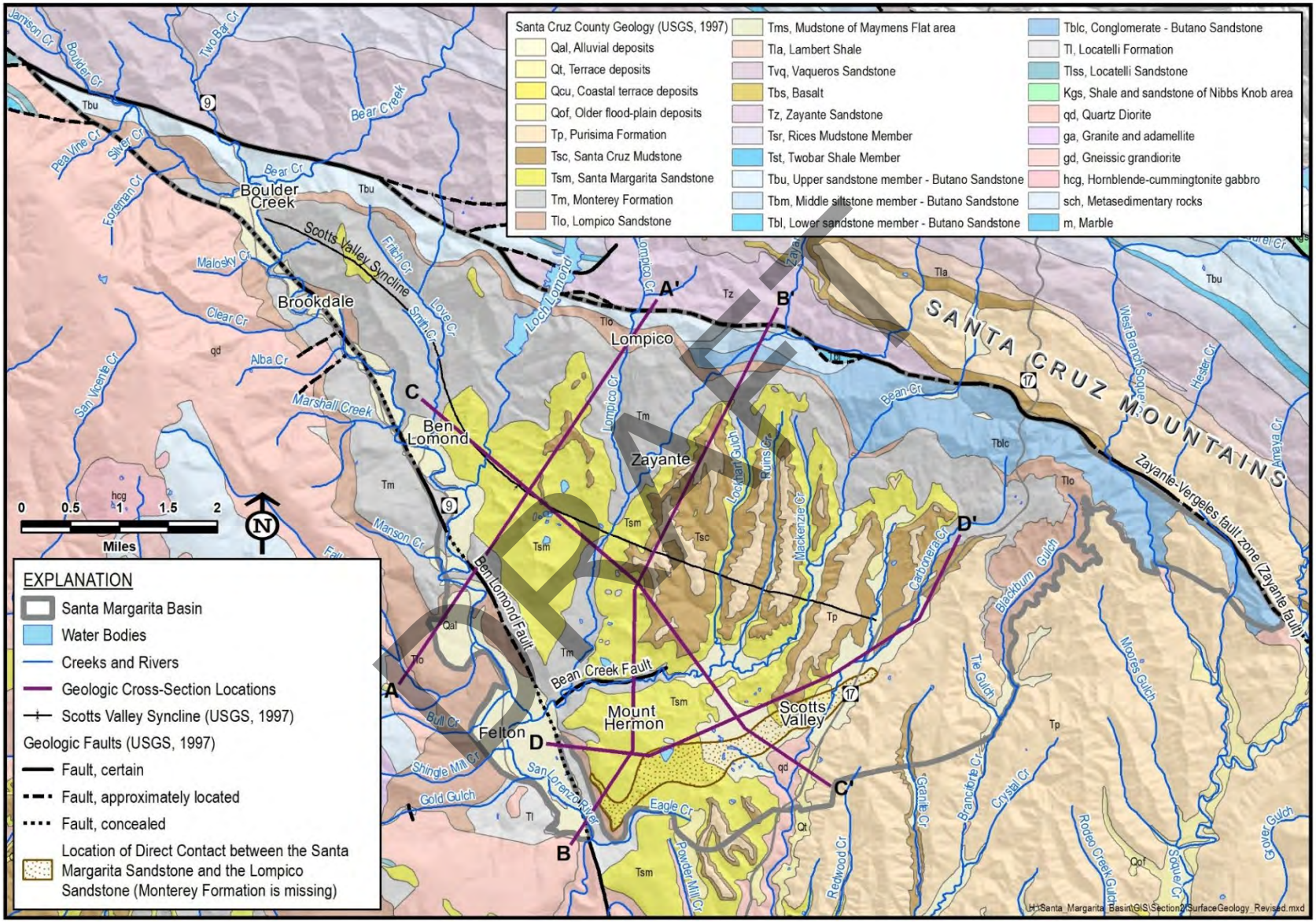

Figure 3-9. Surface Geology of the Santa Margarita Basin

3.4.2.1 Metasedimentary/Granitic Basement

The local basement for the Basin consists of metasedimentary rocks (including marble) that have been intruded by quartz diorite and granodiorite of Cretaceous age. The basement rocks are exposed only at the southernmost margin of the Basin, along Carbonera Creek; however, they underlie the southern part of the Basin at shallow depths. A buried high of basement rocks is defined by DWR as the boundary that separates the Basin from the Santa Cruz Mid-County Basin to the east.

The basement rocks are part of the Salinian Block, which constitutes a continental terrain that originated more than 1,200 miles south of its present location and collided with the North American plate prior to Eocene time. Since about 20 million years ago, the Salinian Block has been transported northward along the San Andreas Fault Zone as a part of the Pacific Plate. It was profoundly eroded prior to the Eocene, accounting for the limited occurrence of Paleocene sediments like the Locatelli Sandstone. It also means that sedimentary units Eocene and younger in age were deposited on an irregular erosional surface, which results in some of the near-shore sedimentary units like the Lompico Sandstone and the Santa Margarita Sandstone showing a range of original depositional thicknesses across the Basin.

3.4.2.2 Locatelli Sandstone

The Paleocene Locatelli Sandstone (Tl on Figure 3-9) is primarily a grey sandy siltstone with a thin basal sandstone. It is exposed at the southern margin of the Basin, on both sides of the San Lorenzo River, where it is lapping onto the basement. It is, however, present widely in the subsurface, with a thickness as great as 800 feet thick (Kennedy/Jenks Consultants, 2015).

3.4.2.3 Butano Sandstone

The Eocene Butano Sandstone is a thick sedimentary unit that was deposited in deep water (Clark, 1991) in an environment analogous to where modern-day shelf sediments are swept down submarine Monterey Canyon to be deposited off the continental shelf in the Monterey submarine fan. It has 3 defined members shown on Figure 3-9: an upper sandstone member (Tbu), a middle siltstone member (Tbm), and a lower massive sandstone with conglomerate near its base (Tbl) (Clark, 1981). The middle member is more fine-grained and contains pyrite, making it unsuitable as an aquifer, but the upper and lower sandstone units are important aquifers in the Basin.

The Butano Sandstone is exposed in the south-dipping limb of the Scotts Valley syncline at the northern margin of the Basin in a band parallel to the Zayante-Vergeles fault (Figure 3-9). The upper, middle, and lower members outcrop from northwest to southeast across this band, respectively. The thickness of the Butano Sandstone varies across the Basin, from several

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hundred to as much as 5,000 feet thick (Clark, 1982; Kennedy/Jenks Consultants, 2015). The upper 2 members of the Butano Sandstone form part of one of the principal aquifers in the Basin.

3.4.2.4 Lompico Sandstone

The Miocene Lompico Sandstone (Tlo on Figure 3-9) is a thick-bedded to massive, fine- to medium-grained arkosic sandstone that was deposited on the continental shelf at moderate depths (Clark, 1991). The Lompico Sandstone has a relatively uniform thickness of up to 400 feet, though it is slightly thinner and finer grained in the northern and eastern areas of the Basin (Kennedy/Jenks Consultants, 2015). As is the case for the underlying Butano Sandstone, the Lompico Sandstone outcrops as a strip parallel to the Basin's northern boundary (Figure 3-9). The width of this outcropping strip ranges from approximately 2,000 feet in the northwest near Boulder Creek to 100 feet in the southeast, where it joins up with another significant outcrop alongside the headwaters of Blackburn Gulch near the Basin's boundary with the Santa Cruz Mid-County Basin (Figure 3-9). The Lompico Sandstone is a principal aquifer in the Basin.

3.4.2.5 Monterey Formation

The Miocene Monterey Formation (Tm on Figure 3-9) is composed mostly of medium- to thick-bedded and organic mudstone and shale with sandy siltstone interbeds. It represents deposition in a deeper-water continental-shelf environment as sea level rose following deposition of the Lompico Formation (Clark, 1991). The Monterey Formation is thickest near the center of the Basin, where it is more than 2,000 feet thick. It is absent near the southeastern margin of the Basin (see the brown stippled area on Figure 3-9). The absence of Monterey Formation in this area has important consequences for the HCM, as the Lompico aquifer and the overlying Santa Margarita aquifer are in direct contact, allowing for direct recharge of the Lompico aquifer through the Santa Margarita aquifer.

The Monterey Formation is not a principal aquifer, but because it is exposed widely in the Basin, it is used by many private wells. These wells generally tap sandy intervals in the lower part of the formation for relatively small volumes of water.

3.4.2.6 Santa Margarita Sandstone

The Miocene Santa Margarita Sandstone (Tsm on Figure 3-9) is a massive, fine- to coarse-grained, moderately sorted arkosic sandstone containing lenses of gravel and cobbles. It formed in a near-shore, high-energy environment as indicated by fossils of shallow marine organisms as well as fossils of terrestrial animals swept in by rivers (Clark, 1991). This poorly consolidated and easily erodible formation can be observed in natural and quarried cliffs around Scotts Valley and forms the basis of the distinctive Sand Hills ecosystem. It is often referred to as "white sand" in driller logs. In areas where the Santa Margarita Sandstone directly overlies the Lompico

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Sandstone, the 2 sandstones can be difficult to distinguish from one other, although the Lompico Sandstone is typically finer grained and more cemented (Johnson, 2009).

The Santa Margarita Sandstone—a principal aquifer in the Basin—is thickest along the axis of the Scotts Valley Syncline between the community of Ben Lomond and City of Scotts Valley; it thins and becomes more fine-grained to the northeast (Clark, 1981). In the Quail Hollow and Olympia areas, it is as much as 450 feet thick, though much has been removed by quarrying (Johnson, 2009). In the Scotts Valley area, it is up to about 350 feet thick. In some areas, the relatively easily eroded sandstone is incised through its entire thickness by overlying creeks, forming several isolated areas within the Basin.

3.4.2.7 Santa Cruz Mudstone

The Miocene Santa Cruz Mudstone lies conformably atop the Santa Margarita Sandstone, indicating a deepening of the marine depositional environment (Clark, 1991). The Santa Cruz Mudstone makes up the upper slope of the ridges between Zayante Creek and Carbonera Creek (Tsc in Figure 3-9) and can be up to 250 feet thick (Johnson, 2009). The medium- to thick-bedded, siliceous mudstone restricts surface recharge where present.

3.4.2.8 Purisima Formation

East of Zayante Creek, the shallow marine sediments of the Purisima Formation are discontinuously exposed along ridge tops separated by streams (Tp on Figure 3-9). It has a maximum thickness of about 200 feet within the Basin but thickens considerably west of Carbonera Creek and into the Santa Cruz Mid-County Basin, where it is identified as one of the principal aquifers by this neighboring basin (Johnson, 2009).

3.4.2.9 Coastal Terrace Deposits

There are small outcrops of marine coastal terrace deposits in the southernmost part of the Basin along Carbonera Creek and Powder Mill Creek (Qt on Figure 3-9). Present as isolated outcrops no thicker than 50 feet, these superficial deposits are not considered an aquifer and contain no known water supply wells.

3.4.2.10 Alluvium

Quaternary alluvium consisting of unconsolidated sands and silts occur locally in river and creek valleys within the Basin, including along the San Lorenzo River, portions of Bean and Carbonera Creeks, and in an ancestral drainage near Camp Evers (Qal on Figure 3-9). Ranging in thickness from less than 10 to 40 feet thick, these alluvial deposits are generally too thin to constitute a major aquifer; however, they may play a part in the connection between surface water in the river and creeks with underlying Santa Margarita and Lompico Sandstones (Johnson, 2009).

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3.4.3 Geologic Structure

3.4.3.1 Tectonic Setting

The geologic structure of the Basin is a reflection of its location along the boundary between the North American and Pacific tectonic plates. The Pacific plate is moving northward with respect to the North American plate an average of about 2 inches per year, with much of this motion distributed over a number of fault strands within the greater San Andreas fault zone. The Basin is bound on the north by one of these: the Zayante-Vergeles fault which has active seismicity.

Although the overall motion along the plate boundary is right-lateral, the local details are more complicated. There is a slight bend in the San Andreas fault east of the Santa Cruz Mountains. This bend interferes with the plates slipping past one another; this so-called restraining bend causes local compression in the rocks that causes them to fold or to break along high-angle fault planes in which one side of the fault moves up and over the rocks on the other side of the fault. The M7.1 1989 Loma Prieta earthquake occurred along the restraining bend and exhibited this type of behavior: there was 4.3 feet of vertical motion along the fault as well as 6.2 feet of right-lateral motion (Plafker and Galloway, 1989). Analysis of global positioning system data along with geochronological studies show that there is currently a component of compression along the San Andreas fault in the Santa Cruz Mountains, and that the contraction that causes folding and uplift along faults in an otherwise strike-slip setting (Burgmann *et al.*, 2006; Gudmundsdottir *et al.*, 2013) are the cause of the complicated fault geometries in the region, including the Zayante-Vergeles and Ben Lomond Mountain fault zones.

This tectonic regime may have started when there was a reorganization of Pacific Plate motion about 5 million years ago (Engebretson *et al.*, 1985). Since that time, folding and faulting have resulted in the uplift that created the California Coast Range.

3.4.3.2 Faults

Faults can be barriers to groundwater flow in 2 ways:

(1) As rocks on either side of a fault slide past each other, mineral grains along the fault are ground and transformed into a fine-grained, clay-rich, impermeable material referred to as gouge. Zones of gouge impede the lateral flow of groundwater, and may deflect the water upward, where it can emerge at the surface as springs.

(2) Translation of rock layers along a fault can juxtapose a rock layer that is an aquifer against one that is an aquiclude, blocking groundwater flow.

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The Basin is bounded by 2 regional faults, the Zayante-Vergeles fault zone to the north and the Ben Lomond Fault to the west. Figure 3-9 shows the location of these faults with respect to the Basin.

The Zayante-Vergeles fault zone, which forms the northern Basin boundary, is a major northwest-striking structural element of the Santa Cruz Mountains restraining bend of the larger San Andreas fault zone. It is a major right-lateral reverse-oblique-slip fault with late Pleistocene and possible Holocene displacement with an estimated vertical slip rate of 0.2 millimeters per year (Bryant, 2000). The easternmost end of the fault is currently seismically active; the section that is the northern boundary of the Basin is not.

Areas south of the Zayante-Vergeles fault zone are underlain primarily by granitic and metasedimentary basement rock, while in contrast, areas north of the fault zone are underlain by gabbroic basement rock and overlain by sedimentary formations not present within the Basin. The juxtaposition of these continental (90-million years ago) and oceanic (165-million years ago) crustal formations illustrates the significant displacement associated with the movement of the fault zone, reflects the long-term right-lateral translation of the Salinian block along the San Andreas fault system, and marks the fault zone as a major feature of this system.

In contrast, the Ben Lomond Fault, which is the western boundary of the Basin, has more limited, largely vertical motion. It extends from northwest of the community of Boulder Creek, where it merges with the Zayante-Vergeles fault zone, through the communities of Ben Lomond and Felton, and south to the coast, where it continues for a further 2.5 miles offshore (Johnson *et al*., 2016). The steep eastern face of Ben Lomond Mountain reflects the presence of the fault, as does the course of the San Lorenzo River, which exploited shattered, easily eroded rocks in the fault zone in making its way southward to the coast.

Movement along the near-vertical Ben Lomond fault has uplifted the basement rocks of Ben Lomond Mountain with respect to the sedimentary formations of the Basin by about 600 feet (Stanley and McCaffery, 1983). Evidence for lateral motion is lacking. This steep reverse fault is best interpreted as a minor fault in the complex fault geometry that results from the restraining bend in the San Andreas fault zone in the Santa Cruz Mountains.

The Ben Lomond fault is not currently seismically active. Stanley and McCaffery (1981) argued that most of the movement on the fault took place during the deposition of the Santa Margarita Sandstone, as this unit thickens against it. Small offsets of the Purisima Formation and uplift in marine terraces suggest that at least some slip occurred in Pleistocene time. A minor fault called the Bean Creek Fault is aligned along the lower reach of Bean Creek where the Monterey Formation outcrops in the Bean Creek valley (Figure 3-9). It is unknown if this fault impacts the movement of groundwater in the Basin (Johnson, 2009).

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3.4.3.3 Folding and Geologic Structure

Caught between faults of the Santa Cruz Mountain restraining bend of the San Andreas fault zone, the sediments of the Santa Margarita Basin have been folded and uplifted several times, resulting in synclines and anticlines in and around the Basin. The dominant feature defining the Basin is the Scotts Valley syncline, a geologic trough whose northwest-southeast-trending axis roughly bisects the Basin (Figure 3-9). This folding of the sedimentary rocks is illustrated in 4 geologic cross sections (Figure 3-10 through Figure 3-13) constructed along lines of section shown on the geologic map (Figure 3-9). The cross sections were developed as part of SLVWD's water supply master plan (Johnson, 2009).

The southwest-northeast trending cross sections in section A-A' (Figure 3-10) and section B-B' (Figure 3-11) cross through the area of the Quail Hollow and Olympia well fields, respectively. Constructed approximately perpendicular to the axis of the Scotts Valley syncline, these cross sections illustrate the syncline and the location of the deepest part of the Basin beneath the wellfields, some 4,000 feet deep (Figure 3-11). They also show the prominent influence of the Ben Lomond fault as a boundary to the Basin, displacing the Lompico Sandstone by just under 400 feet, and juxtaposing aquicludes against aquifers. These cross sections also illustrate the steep dips of the Butano Sandstone, Lompico Sandstone, and Monterey Formation at the northern end of the basin, due to deformation near the Zayante-Vergeles fault zone. It is these steep dips that result in the relatively narrow strips of surface exposure of the Butano Sandstone and Lompico Sandstone (Figure 3-10 and Figure 3-11), the only places where they can receive direct recharge from infiltrating precipitation and percolation through creek beds, thereby limiting the amount of direct recharge these aquifers can receive.

The northwest-southeast-trending cross-section C-C' (Figure 3-12) is constructed approximately parallel to the axis of the Scotts Valley syncline. This cross section illustrates how the Basin's sedimentary rocks were folded against a basement highland forming the eastern margin of the Basin. Thus, the sedimentary rocks constitute a structural "bowl" across much of the Basin, making it hydrologically isolated from other basins. It also illustrates the shallowing of the granitic basement that forms the eastern margin of the Basin.

The southwest-northeast-trending cross section D-D' (Figure 3-13) is constructed to pass through the Mount Hermon, Pasatiempo, Camp Evers, and the southern and northern Scotts Valley well areas. The deepest wells in the Basin are shown on this section in the northern Scotts Valley area, where they tap down to the deepest aquifer, the Butano Sandstone.

The Monterey Formation is present widely in the Basin and in most places forms a thick aquitard between the Santa Margarita aquifer and the Lompico aquifer as shown in section A-A' (Figure 3-10). There is a narrow, southwest-northeast-trending area running from Pasatiempo to Scotts Valley (shown as a stipple pattern on the geologic map on Figure 3-9) in which the Monterey Formation is absent, so that the Santa Margarita Sandstone and the Lompico

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Sandstone are in direct contact. The cross section on Figure 3-13 illustrates the Monterey Formation's absence near Camp Evers. The hydrogeologic connection between these 2 sandstone units in this area affects the quantity and quality of groundwater recharge to the Lompico Sandstone, and so is an important feature in the HCM.

Most of the folding to form the Scotts Valley syncline must have occurred in the time between deposition of the Monterey Formation and the Santa Margarita Sandstone, as the Santa Margarita Sandstone and younger formations are only weakly affected by the folding, as can be seen on Figure 3-10, Figure 3-11, and Figure 3-13.

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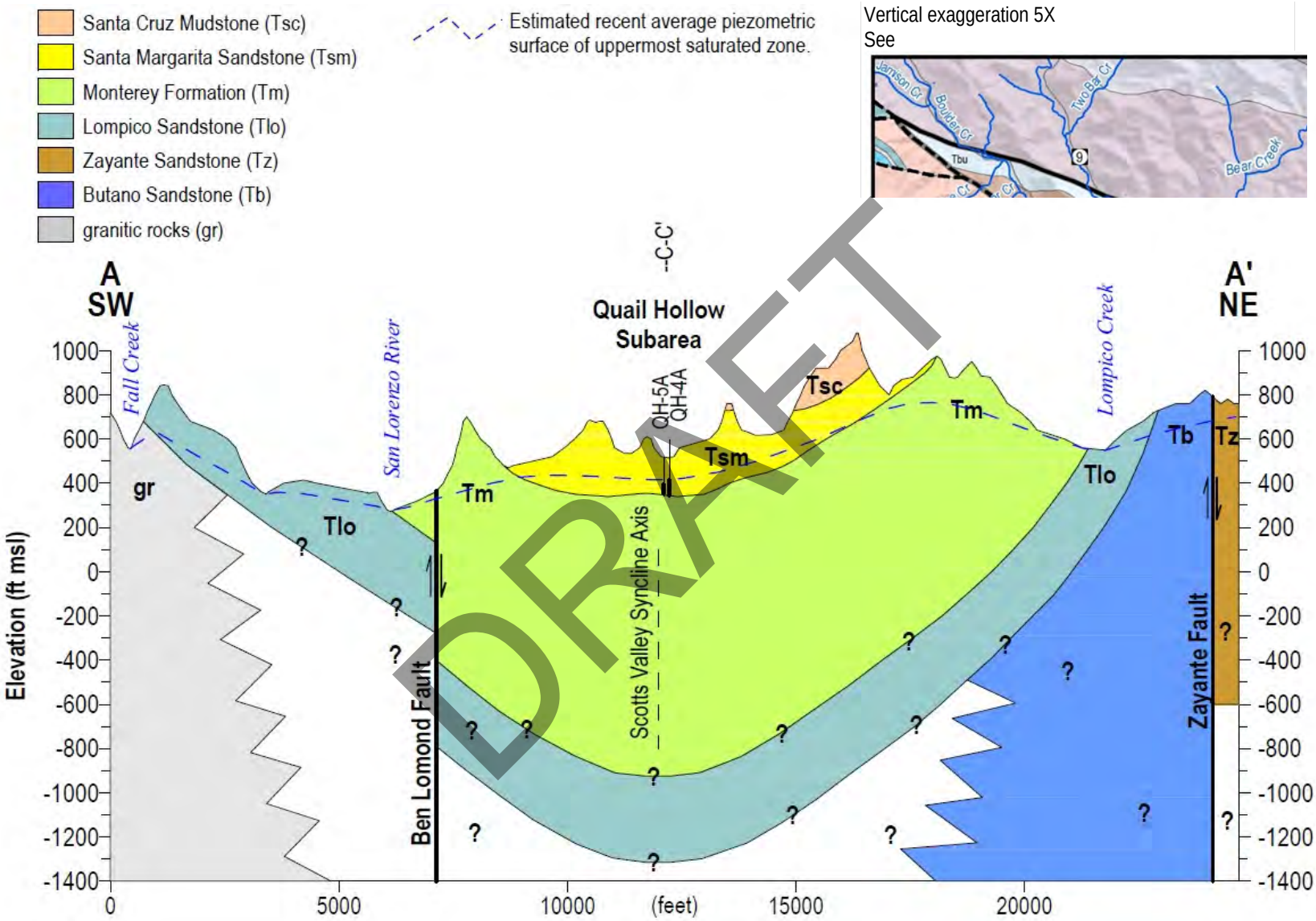

Figure 3-10. A-A' Geologic Cross Section through the Santa Margarita Basin (Johnson, 2009)

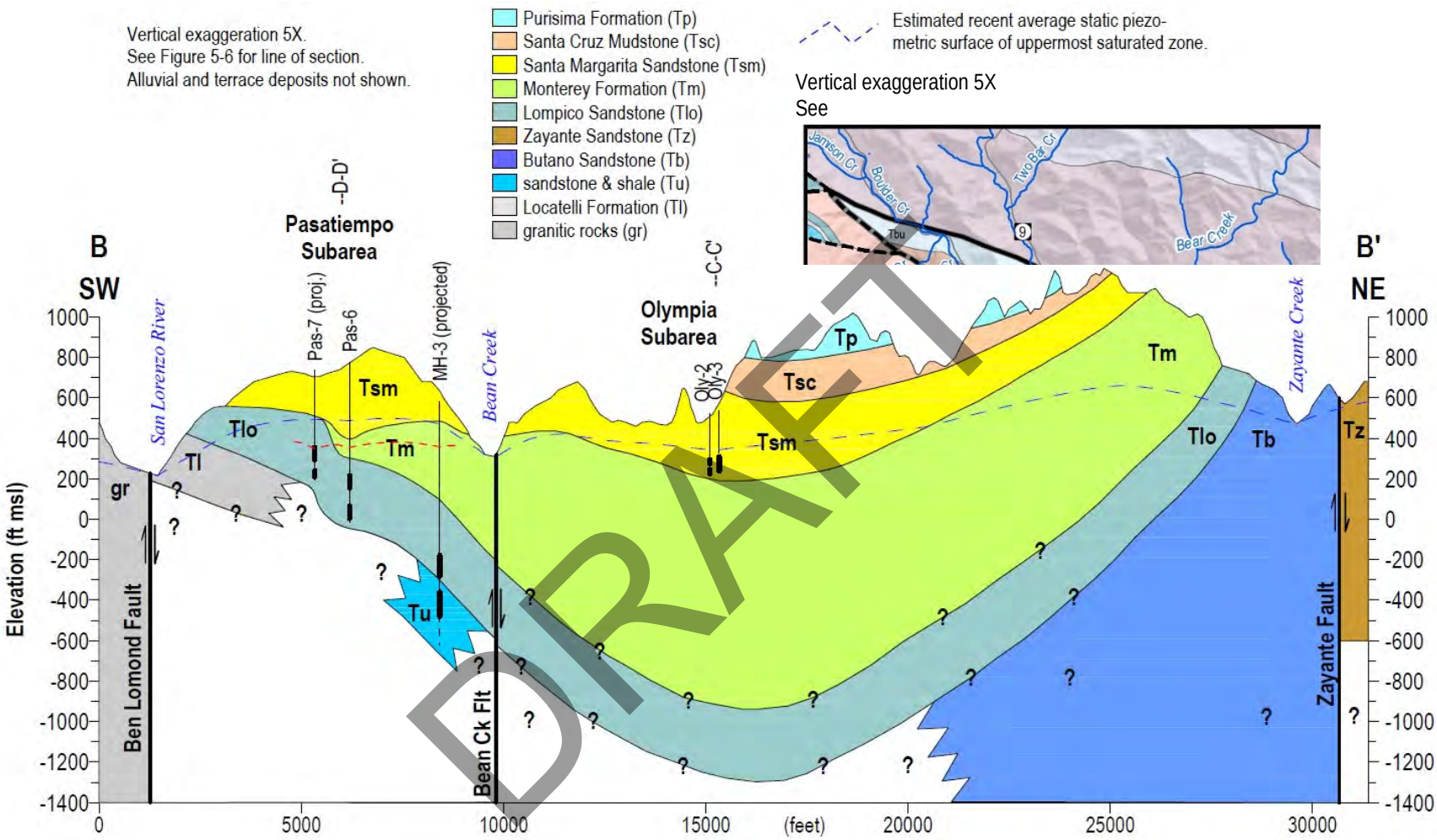

Figure 3-11. B-B' Geologic Cross Section through the Santa Margarita Basin (Johnson, 2009)

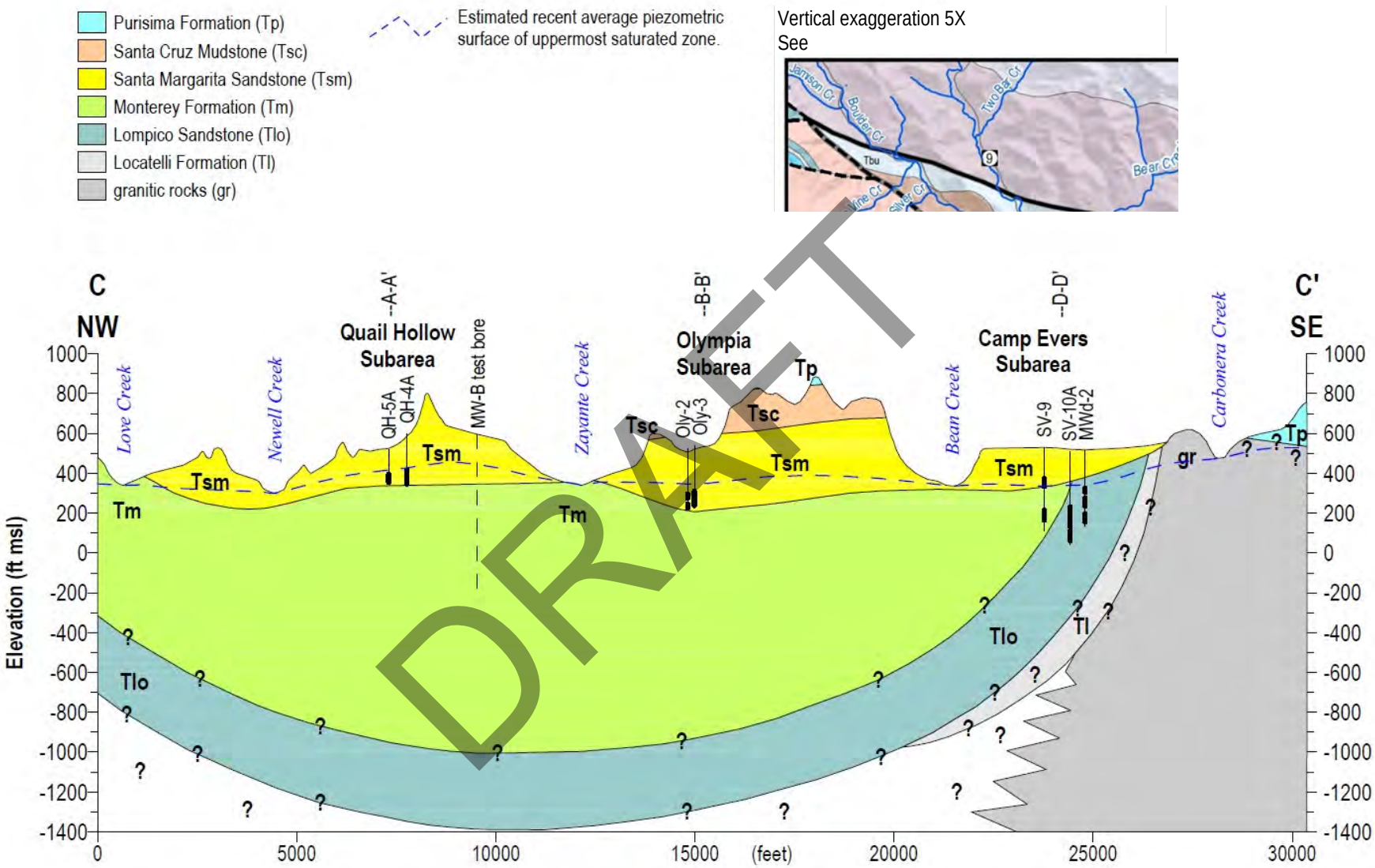

Figure 3-12. C-C' Geologic Cross Section through the Santa Margarita Basin (Johnson, 2009)

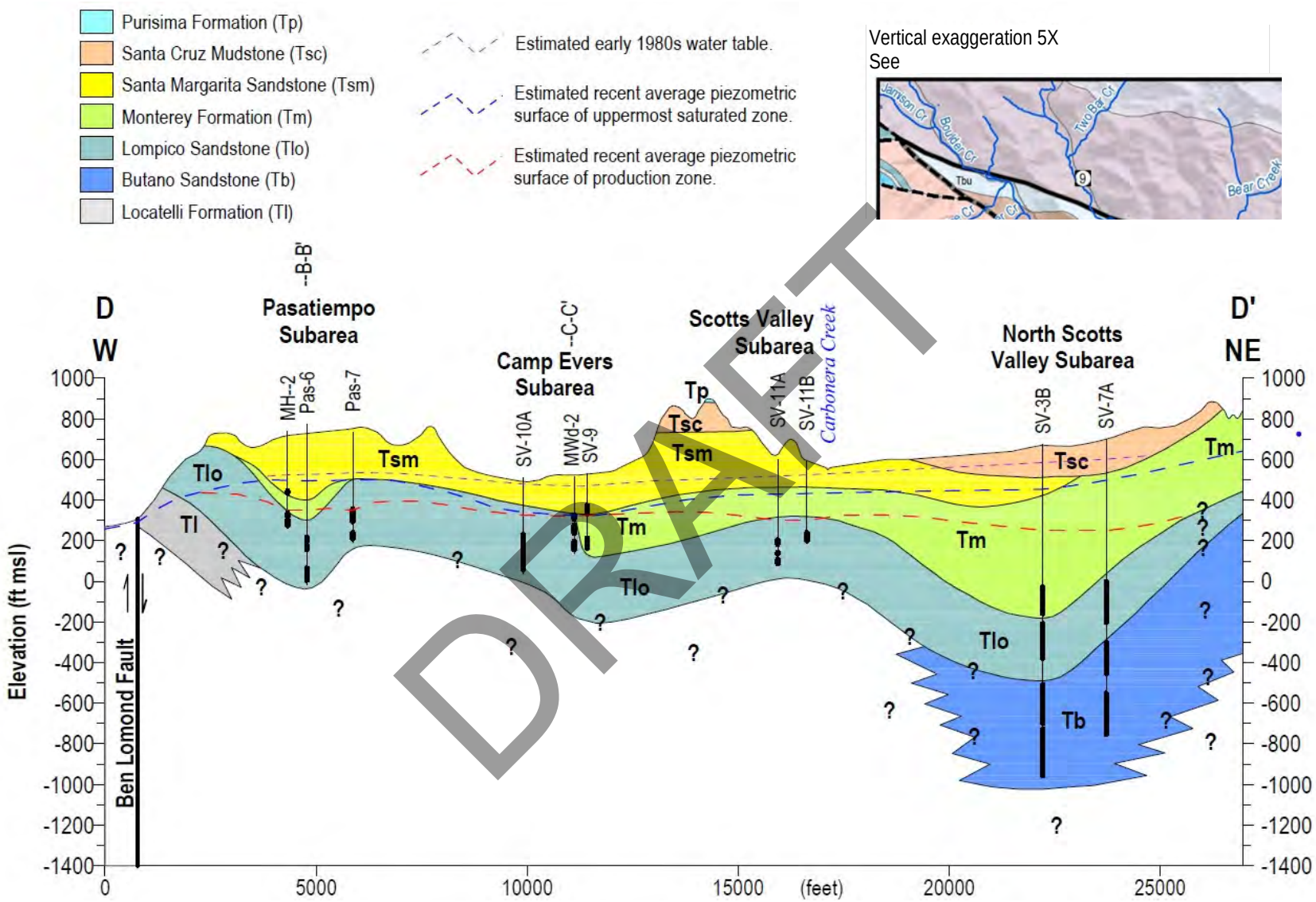

Figure 3-13. D-D' Geologic Cross Section through the Santa Margarita Basin (Johnson, 2009)

3.4.4 Principal Hydrogeologic Units

Sandstone units within the sedimentary rocks of the Scotts Valley syncline supply nearly all the groundwater extracted in the Basin. The Santa Margarita, Lompico, and Butano Sandstones are the principal aquifers used by municipal suppliers. Silty and sandy intervals within the otherwise fine-grained Monterey Formation provide smaller volumes of groundwater to domestic pumpers. More importantly, the Monterey Formation serves as a confining layer that separates the overlying unconfined Santa Margarita from the underlying generally confined Lompico and Butano aquifers in the central portion of the Basin. This has a bearing on the groundwater elevation subareas described in subsection 4.2 and the groundwater level and interconnected surface water monitoring networks described in subsections 6.2 and 6.5.

The Santa Margarita Sandstone, which is the shallowest of the 3 sandstone units, has a long history as a source of water in the Basin, with many water supply wells extracting groundwater from this unit. The Lompico and Butano Sandstones are currently the principal groundwater producing units in the Scotts Valley area. SVWD is increasing reliance on the Butano Aquifer with inclusion of new Sucinto and Grace Way extraction wells screened across the Lompico and Butano aquifers. The subsections below describe these aquifers.

Table 3-2 summarizes representative aquifer hydraulic parameters for these units obtained from aquifer testing and included in reports by Johnson (2009) and Kennedy/Jenks Consultants (2015). Definitions of the aquifer parameter terminology used in this section are provided below.

Hydraulic Conductivity: Property of geologic materials that controls the ease with which groundwater flows through pore spaces or fractures. Higher hydraulic conductivity allows water to travel faster through geologic media. Units with very low hydraulic conductivity slow or may prevent groundwater flow. Hydraulic conductivity has units with dimensions of length per time (e.g., feet per day).

Transmissivity: A measure of how much water can be transmitted horizontally. It is derived from the hydraulic conductivity of an aquifer unit multiplied by its total thickness. High transmissivity units are very conducive to groundwater flow and/or very thick. Transmissivity is usually expressed in units of length^2 per time, or occasionally as volume per length per time.

Storativity (or storage coefficient): The volume of water (e.g., cubic feet) released from aquifer storage per unit decline in hydraulic head in the aquifer (e.g., foot), per unit area of the aquifer (e.g., square feet). Storativity is a volumetric ratio and therefore unitless. A large value for storativity implies a highly productive aquifer. Storativity is applied only to aquifers under local or regional confinement; specific yield is a roughly equivalent measure of aquifer productivity in an unconfined aquifer.

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Specific Yield: The volume of water released from storage by an unconfined aquifer per unit surface area of aquifer per unit decline of the water table. Specific yield is a volumetric ratio and therefore unitless. Specific yield is used to characterize unconfined aquifers; high specific yield indicates a productive aquifer unit.

Table 3-2. Principal Hydrogeologic Units Hydraulic Properties

Principal Hydrogeologic Unit	Hydraulic Conductivity (feet/day)	Transmissivity (feet^2/day)	Storativity[1]	Specific Yield[2]
Santa Margarita Aquifer Entire Basin	2 – 130	430-7,700	0.008 – 0.02	0.02 – 0.25
Santa Margarita Aquifer Quail Hollow/ Olympia	2 – 50	430 – 6,200	0.008 – 0.02	0.12 – 0.25
Santa Margarita Aquifer Central Portion of Basin	3 – 130	2,000 – 7,700	NA	0.02 – 0.13
Santa Margarita Aquifer Scotts Valley Area	12 – 35	1,000 – 1,700	NA	0.02 – 0.13
Monterey Aquifer [3]	0.05 – 6	170 – 1,000	0.00001 – 0.001	0.01 – 0.03
Lompico Aquifer	0.5 – 7	500 – 3,200	0.000001 – 0.001	0.02 – 0.07
Butano Aquifer	0.1 – 6	100 – 1,070	0.000001 – 0.0007	

Adapted from Kennedy/Jenks Consultants (2015); NA = non-applicable given unconfined conditions

[1] Storativity is the volume of water released from confined aquifer storage per unit decline in hydraulic head in the aquifer per unit area of the aquifer.

[2] Specific yield is the amount of water released from an unconfined aquifer if allowed to drain completely under force of gravity.

[3] The Monterey Formation is not a principal aquifer but is included here as there are aquifer test data available for it, and because its occurrence between 2 principal aquifers plays an important role in the hydrogeology of the Basin.

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3.4.4.1 Santa Margarita Aquifer

The Santa Margarita Sandstone or Santa Margarita aquifer is the shallowest principal aquifer in the Basin, with widespread surface exposures in the southern and central portions of the Basin. Due to its shallow depth and highly productive lithology, it was the first formation to be developed for municipal and private domestic use (Kennedy/Jenks Consultants, 2015). The Santa Margarita aquifer is capped in some areas by the Santa Cruz Mudstone and lies unconformably over the Monterey Formation in the north and northwest portions of the Basin. In the Pasatiempo and Camp Evers areas of the southeastern portion of the Basin, the Monterey Formation has been completely removed by erosion so that the Santa Margarita Sandstone rests unconformably on the Lompico Sandstone, creating a direct groundwater connection between the 2 principal aquifers.

The Santa Margarita aquifer is unconfined, apart from areas in northern Scotts Valley where it is confined by a few hundred feet of overlying Santa Cruz Mudstone. Due to its wide exposure and

high conductivity, the Santa Margarita aquifer responds rapidly to changes in precipitation and recharges quickly, but because it also drains to creeks relatively fast, it has little long-term groundwater storage (Kennedy/Jenks Consultants, 2015). The hydrogeologic properties of the Santa Margarita Sandstone as a highly transmissive unconfined aquifer reflect its coarse grain size and weak cementing. Estimated hydraulic conductivity ranges from 2 to more than 100 feet/day (Kennedy/Jenks Consultants, 2015) depending on location within the Basin and specific yield ranges from 0.02 to 0.25, and transmissivity ranges from 430 to 7,700 feet^2/day (Table 3-2; Kennedy/Jenks Consultants, 2015). Johnson (2009) and Kennedy/Jenks Consultants (2015) report variations in Santa Margarita aquifer parameters across the Basin that indicate the aquifer is spatially variable in its properties. Aquifer test results from the Camp Evers area indicate the occurrence of highly conductive zones near the base of the aquifer where intervals of conglomerate (gravel-sized particles) occur (Johnson, 2009; Kennedy/Jenks Consultants, 2015).

3.4.4.2 Lompico Aquifer

The Lompico Sandstone is a productive arkosic sandstone aquifer that provides a large proportion of the Basin's municipal supply (Johnson, 2009; Kennedy/Jenks Consultants, 2015). The Lompico Sandstone is generally uniform, although slightly more fine-grained and cemented toward its base. The restricted exposure of the Lompico Sandstone at the surface, at the northern and northeast margin of the Basin, limits the amount of surficial recharge by precipitation. The Lompico aquifer is primarily recharged via water that percolates through the highly transmissive Santa Margarita Sandstone, where the Santa Margarita and Lompico Sandstones are in direct contact due to the absence of intervening Monterey Formation. The limited exposure of the Lompico Sandstone at the surface and the confined to semi-confined nature of the aquifer makes it relatively slow to respond to rainfall-driven recharge events (Kennedy/Jenks Consultants, 2015). The Lompico aquifer discharges to the San Lorenzo River at several locations where it is exposed in the riverbed, such as in cross section B-B' (Figure 3-11). The vertical gradient between the Lompico and Butano aquifers is not known; therefore, it is not known whether there is significant flow between these 2 deeper aquifers.

Available aquifer testing results in the Lompico aquifer reflect a moderately permeable, semi-confined to confined sandstone aquifer. Hydraulic conductivity ranges from 0.5 to 7 feet/day, transmissivity ranges from 500-3,200 feet^2/day, and storativity ranges from 0.000001 to 0.02 (Table 3-2; Kennedy/Jenks Consultants, 2015). Where the Lompico aquifer is unconfined, specific yield ranges from 0.04 to 0.08. Although generally less conductive than the Santa Margarita aquifer, the transmissivity of the Lompico aquifer, i.e., the amount of groundwater it can produce, is larger due to its much greater thickness (Johnson, 2009).

3.4.4.3 Butano Aquifer

The Butano Sandstone or Butano aquifer is composed primarily of arkosic sandstone similar in consistency to the Lompico Sandstone, though with significant mudstone, shale, and siltstone

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interbeds. The Butano aquifer is recharged primarily by direct infiltration of precipitation and streamflow in the extreme northern portions of the Basin where it outcrops (Figure 3-9). Review of limited groundwater elevation data indicates that the Butano aquifer groundwater elevations recover more quickly than the Lompico aquifer, suggesting the Butano aquifer is a more actively recharged aquifer likely because of its greater surface exposure area (Kennedy/ Jenks Consultants, 2015). Since the available Butano groundwater elevation data is collected in wells installed close to where the formation outcrops, and the aquifer is not used extensively as a water supply in the Basin due to its greater depth and lower hydraulic conductivity than the other 2 aquifers, the more stable groundwater elevations in the Butano aquifer may also be related to the location of wells used to characterize the aquifer or a general lack of pumping influence on the aquifer.

Interpretation of limited aquifer tests in the Butano aquifer indicate confined or semi-confined aquifer conditions with moderate hydraulic conductivity. Estimated hydraulic conductivity ranges from 0.01 to 6 feet/day, transmissivity ranges from 100 to 1,070 feet^2/day, and storativity ranges from 0.000001 to 0.0007 (Table 3-2; Kennedy/Jenks Consultants, 2015).

3.4.5 Other Hydrogeologic Units

3.4.5.1 Purisima Formation

The Purisima Formation comprises siltstone and sandstone up to 200 feet thick that forms the tops of some of the hills in the Scotts Valley area but is absent over most of the Basin. The more permeable units of the Purisima Formation are principal aquifers in the neighboring Santa Cruz Mid-County Basin to the east. However, in the Santa Margarita Basin, it is not considered a principal aquifer due to its limited thickness and occurrence on ridgetops. No hydraulic property data are available for this formation in the Basin.

3.4.5.2 Santa Cruz Mudstone

The Santa Cruz Mudstone is an impermeable layer that locally caps the Santa Margarita Sandstone, limiting recharge to the underlying aquifers where it is present. Slightly higher than normal salinity in Santa Margarita Sandstone groundwater near the Santa Cruz Mudstone indicates that runoff from the mudstone may percolate and recharge adjacent exposures of Santa Margarita Sandstone. No hydraulic property data are available for this formation.

3.4.5.3 Monterey Formation

The Monterey Formation is composed primarily of thick mudstone and siliceous shale that form a hydraulic barrier between the Santa Margarita Sandstone and Lompico Sandstone, except where it is missing in the southern portion of the Basin, as discussed above. The Monterey Formation contains sandstone interbeds, especially closer to the base of the formation, that are

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used for water supply. These interbeds are especially prominent in the southern Scotts Valley area (Kennedy/Jenks Consultants, 2015). In general, the sandstone interbeds of the Monterey Formation are more hydrogeologically connected to the underlying Lompico Sandstone than to the overlying Santa Margarita Sandstone (Kennedy/Jenks Consultants, 2015).

Although the Monterey Formation is generally considered an aquitard, the sandstone interbeds and fractured siliceous shales, along with the widespread surface exposure, make the Monterey Formation a locally important aquifer for shallow private domestic wells. Historically, municipal and small water systems pumped from the Monterey Formation, but those wells were not reliable because of low transmissivity.

Similar to the principal aquifers in the Basin, available aquifer test results in the Monterey Formation indicate a relatively large degree of heterogeneity. Reported hydraulic conductivity ranges from 0.05 to 6 feet/day, transmissivity ranges from 170 to 1,000 feet^2/day, storativity ranges from 0.00005 to 0.005, and specific yield ranges from 0.01 to 0.03 (Table 3-2; Kennedy/ Jenks Consultants, 2015).

3.4.5.4 Locatelli Sandstone

The Locatelli Sandstone is primarily a sandy siltstone that acts as a local aquitard in the Scotts Valley area; however, it contains a thin basal sandstone that provides water for some wells in the Scotts Valley area. In the northern Scotts Valley area, the Locatelli Sandstone is overlain by 600 feet of Butano Sandstone, whereas in southern Scotts Valley it is unconformably overlain by the Lompico Sandstone. The Locatelli Sandstone is not exposed at the surface within the Basin, and only has a limited outcrop south of the Basin (Figure 3-9). Most recharge to this unit is likely from the overlying Lompico and Butano Sandstones. No hydraulic property data are available for this formation.

3.4.5.5 Igneous and Metamorphic Basement Formations

The sedimentary rocks of the Santa Margarita Basin lie unconformably over a basement of igneous and metamorphic rocks. Exposed locally in the southern part of the Basin (e.g., along Carbonara Creek and the San Lorenzo River), the crystalline basement rocks have very low porosities and conductivities so typically behave as aquitards. Where sufficiently decomposed due to long surface weathering or fractured due to proximity to faults, granitic rocks can provide limited volumes of groundwater suitable for private domestic wells (Kennedy/Jenks Consultants, 2015).

3.4.6 Soil Characteristics

The nature of soil and vegetation affect how much precipitation can infiltrate into the soil to recharge the regional groundwater aquifers. The Basin’s soils are derived from the exposed

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geologic formations and also influenced by other factors such as climate, vegetation, and local relief.

The saturated hydraulic conductivity of surficial soils is a good indicator of its infiltration potential. The map on Figure 3-14 presents the distribution in the Basin of the 4 hydrologic groups defined in the USDA Natural Resources Conservation Service, Soil Survey Geographic Database (USDA, 2007). The soil hydrologic groups are characterized by the water-transmitting properties, which include hydraulic conductivity and percentage of clay relative to sand and gravel. The groups are defined as:

- Group A – High Infiltration Rate: water is transmitted freely through the soil; soils typically less than 10% clay and more than 90% sand or gravel.
- Group B – Moderate Infiltration Rate: water transmission through the soil is unimpeded; soils typically have between 10 and 20% clay and 50 to 90% sand.
- Group C – Slow Infiltration Rate: water transmission through the soil is somewhat restricted; soils typically have between 20 and 40% clay and less than 50% sand.
- Group D – Very Slow Infiltration Rate: water movement through the soil is restricted or very restricted; soils typically have greater than 40% clay, less than 50% sand.

The soil hydrologic group generally correlates with the hydraulic conductivity of underlying geologic formations. Soil zones with greater hydraulic conductivity occur in areas where the Santa Margarita Sandstone outcrop, and lower hydraulic conductivity are found where siltstones and mudstones outcrop.

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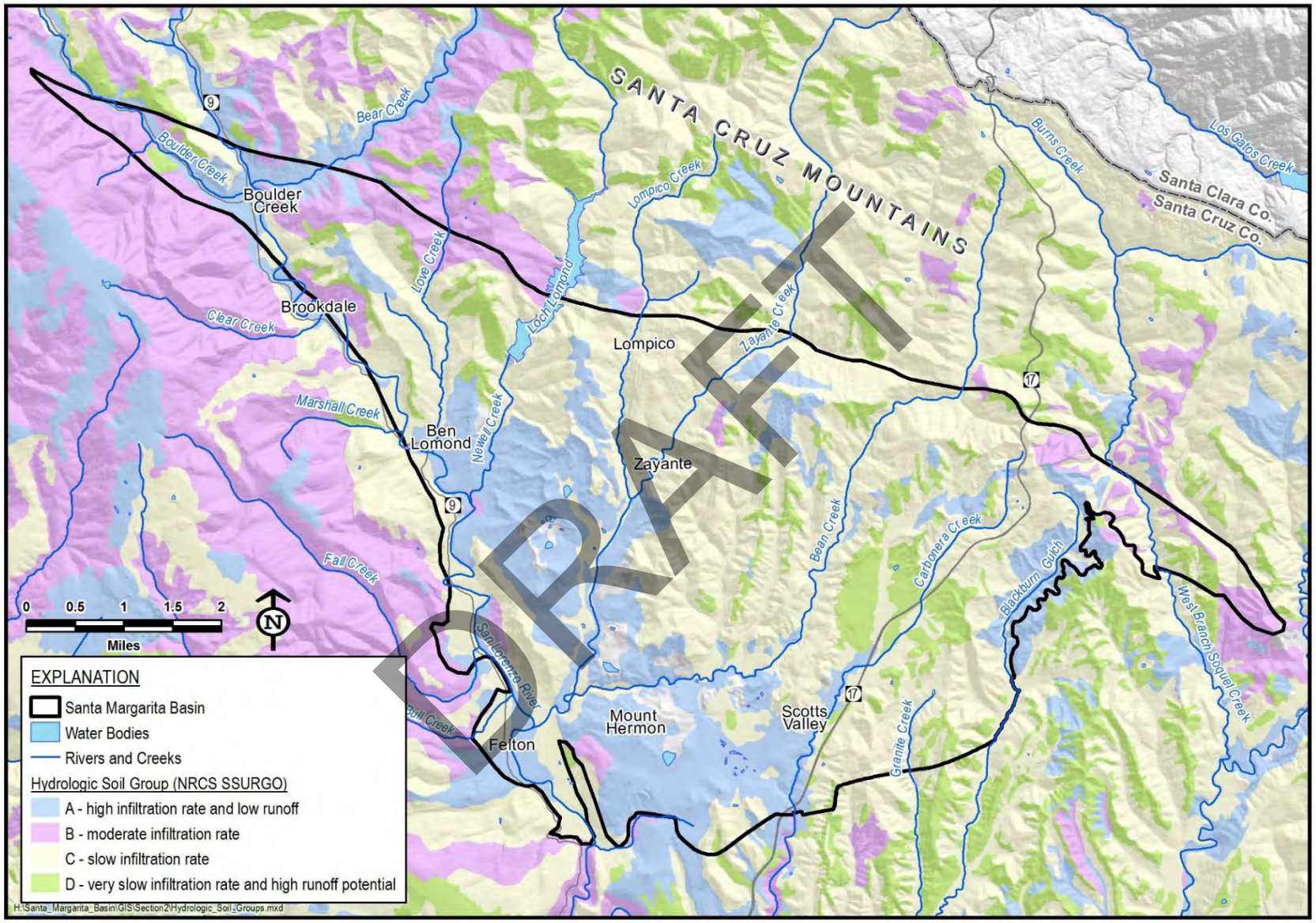

Figure 3-14. Soil Characteristics of the Santa Margarita Basin

3.4.7 Recharge Areas

Precipitation is the main source of natural groundwater recharge in the Basin. It enters shallow aquifers either directly by infiltration through the soil or indirectly from streamflow that infiltrates through stream and creek beds. As discussed in Section 3.4.9.1, most streams are fed by groundwater that is recharged by precipitation. Reductions in groundwater recharge can occur either naturally or anthropogenically. Natural reduction to groundwater recharge is caused by reduced precipitation or increased evapotranspiration due to changes in climate. Anthropogenic reduction to groundwater recharge is caused by land use changes such as increasing paved impermeable surfaces or changing vegetative cover that increase runoff and evapotranspiration.

Figure 3-15 shows County-mapped recharge areas (brown stipples). Most are areas with soils of high to moderate infiltration capacity developed on productive aquifer units. Areas of higher recharge capacity correspond closely with soils developed on the Santa Margarita Sandstone. Areas of lower recharge capacity are clay-rich soils with slower infiltration rates developed on geologic units with less productive potential: the Monterey Formation and the Santa Cruz Mudstone.

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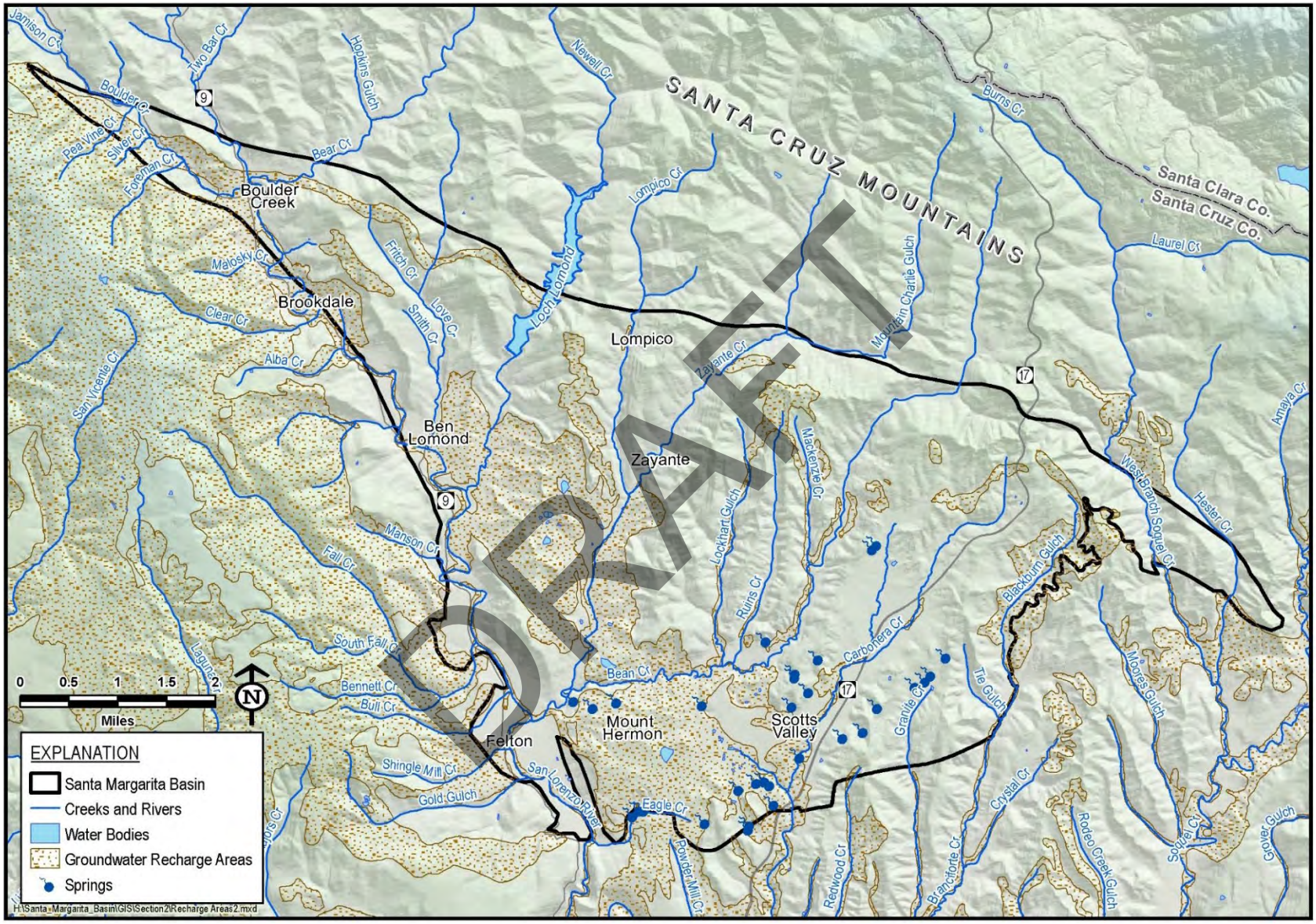

Figure 3-15. Recharge Areas in the Santa Margarita Basin

3.4.8 Surface Water

3.4.8.1 Rivers and Creeks

Figure 3-16 shows the location of rivers and creeks throughout the Basin. Significant rivers and creeks in the Basin include the San Lorenzo River, Boulder Creek, Love Creek, Newell Creek, Lompico Creek, Zayante Creek, Bean Creek, and Carbonera Creek. Many of these rivers and creeks are home to protected species such as coho salmon and steelhead, as described in Section 3.4.9.1.

Previous studies examining streamflow in the Basin concluded that streamflow is sustained by stormflow (i.e., stormwater runoff) and groundwater (i.e., baseflow). From November to May, streamflow comprises both baseflow and stormflow. Streamflow peaks around April, at the tail end of the Basin's rainy season. The contribution from baseflow increases through the wet season because of rising groundwater elevations. In the dry season, from roughly late May through October, essentially all water flowing in the Basin's streams and creeks is derived from groundwater (Johnson, 2009). This pattern is illustrated on Figure 3-17, originally presented by Johnson in 2009.

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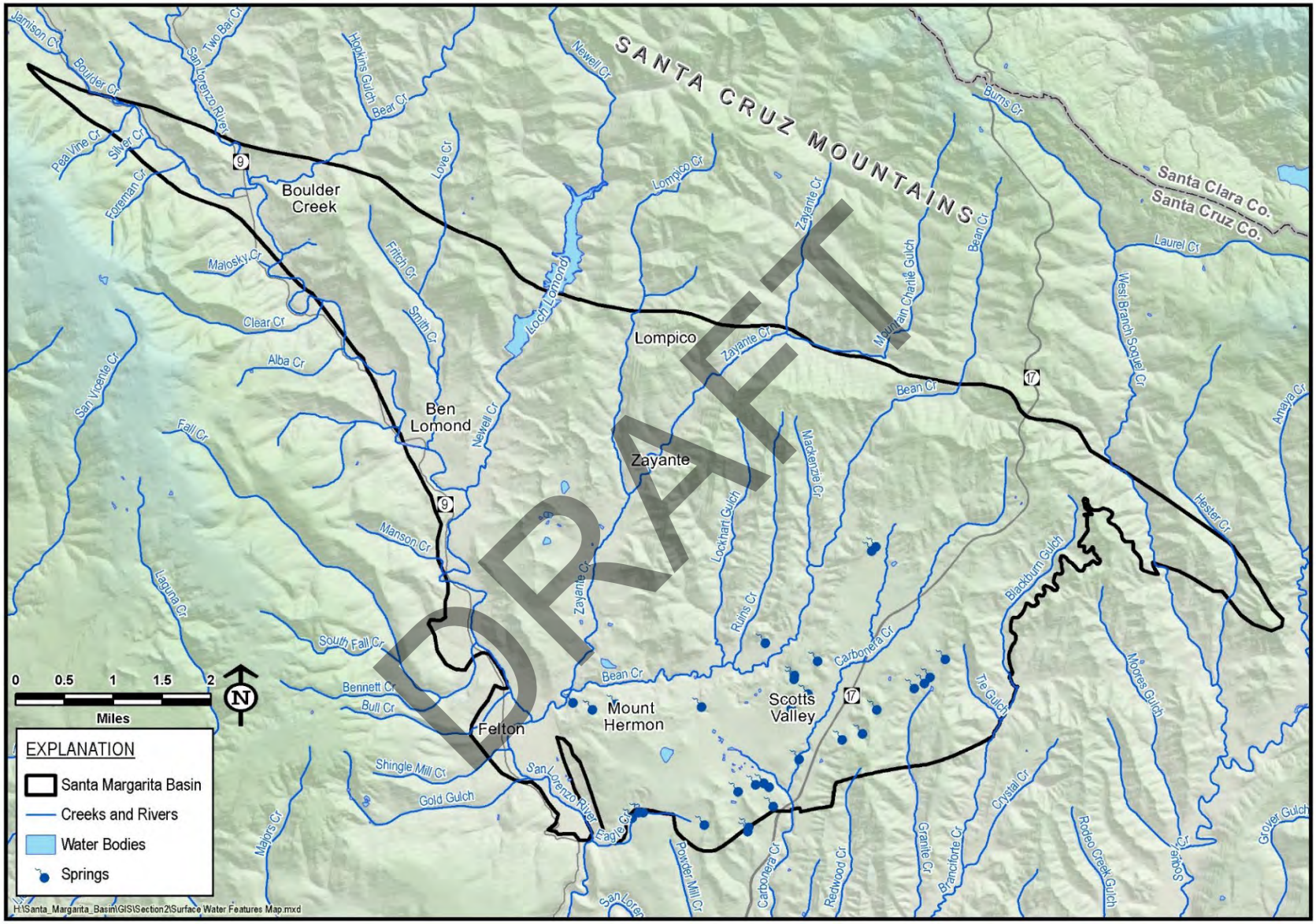

Figure 3-16. Surface Water Features

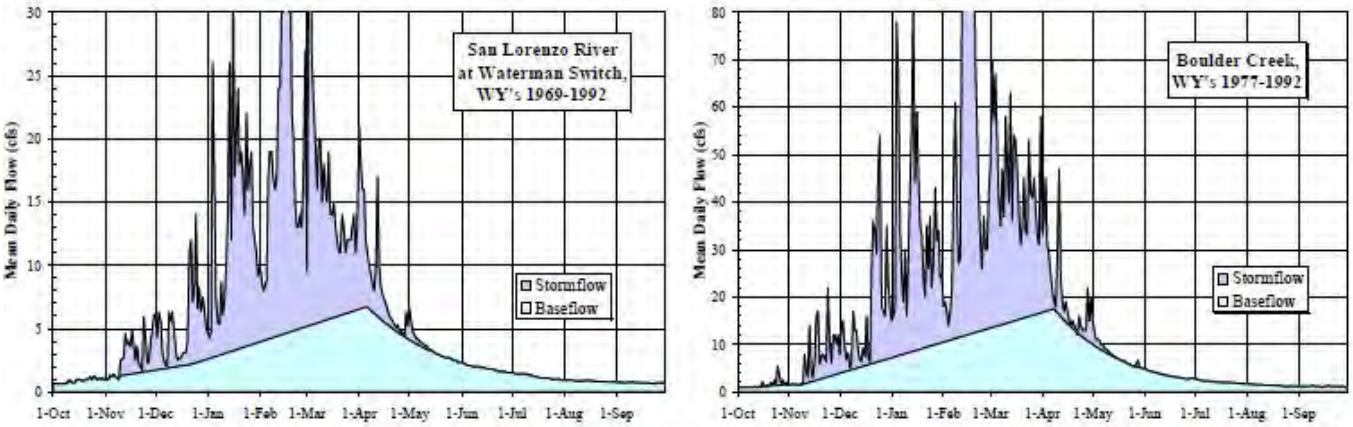

Figure 3-17. Stormflow and Baseflow in San Lorenzo River and Boulder Creek (from Johnson, 2009)

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3.4.8.2 Water Impoundments

There is 1 permanent surface water impoundment within the Basin operated by the City of Santa Cruz Water Department. The Newell Creek Dam constructed in the early 1960s impounded Newell Creek and formed the Loch Lomond Reservoir (Figure 3-16). The Loch Lomond Reservoir is 2.5 miles long, no more than 1,500 feet wide, and has a maximum storage capacity of approximately 8,600 AF. Water stored in the reservoir is a major supply source for the City of Santa Cruz in summer and during droughts when surface water availability declines.

One temporary surface water impoundment in the Basin is operated, though rarely, by the City of Santa Cruz Water Department. The diversion consists of an inflatable diversion dam on the San Lorenzo River in Felton that allows the City to impound and divert a portion of the streamflow by conveyance pipeline to the Loch Lomond Reservoir for storage. This dam can be inflated during the wet season as minimum bypass flow requirements, water rights, and storage capacity in Loch Lomond allow. If used, the dam is deflated in the dry season when stream flow is low.

3.4.8.3 Springs

Springs in the Basin—both basal and non-basal—are often important and reliable sources of cold water during summer, support adjacent wetlands, and by definition indicate groundwater levels are at the ground surface. Basal springs emanate from the base of the Santa Margarita Sandstone, where the underlying and much less permeable Monterey Formation consolidated shales redirects water percolating through the Santa Margarita Sandstone to the surface through springs, seeps, or other points of discharge. Non-basal springs are groundwater discharge features that are not controlled by lateral flow along an aquifer–aquitard contact, but instead result from local controls such as water table intersection, perched conditions, or structural features like faults.

3.4.8.4 Open Water

Lakes and ponds in the Basin are typically man-made or are modifications of natural springs and seeps. Although not usually natural features in this Basin, lakes and ponds support unique wetland habitats and may be useful indicators of depth to groundwater and nearby rates of groundwater-to-surface water exchange. All open surface water features are included on Figure 3-16.

3.4.9 Groundwater Dependent Ecosystems

The GDE analysis in this GSP includes assessment of the extent of GDE indicator vegetation, groundwater elevations in shallow aquifers, and impacts of seasonal surface water and groundwater interaction or accretion. Where groundwater level data are unavailable, the groundwater model is used to identify where surface water and groundwater are likely connected.

Identification of GDEs in the Basin is based primarily on the database of mapping assembled by Natural Communities Commonly Associated with Groundwater (NCCAG) dataset [https://gis.water.ca.gov/app/NCDatasetViewer/#]. This database from sources such as the National Wetland Inventory, National Hydrography Dataset, and Classification and Assessment with Landsat of Visible Ecological Groupings includes GDE indicators such as mapped springs, wetlands, and ponds, as well as vegetation types that may rely on shallow groundwater. All of the GDEs from the NCCAG dataset were retained and considered GDEs in the Basin. In addition, several known springs, seeps, or other groundwater-dependent wetlands were identified as likely GDEs by local experts and were added to the GDE dataset.

Types of identified GDEs include springs, open water, riverine/riparian, and other groundwater-supported wetlands. Springs and open water were described in Sections 3.4.8.3 and 3.4.8.2, respectively. Riverine/riparian and other groundwater supported wetlands are discussed in more detail in the following subsections. Table 3-3 summarizes the 4 different GDE classifications in the Basin. Figure 3-18 through Figure 3-20 show the locations of the Basin's mapped GDEs.

Table 3-3. Santa Margarita Basin Groundwater Dependent Ecosystem Classification

GDE Classification	GDE Types	Mapped GDEs
Springs	Basal springs and non-basal springs	42 sites
Open Water	Lakes and ponds	35 sites
Riverine/ Riparian	Perennial and ephemeral streams, riparian corridors, on-channel ponds, palustrine wetlands	Sites throughout the basin
Other Groundwater-Supported Wetlands	Seep, seep complex, quarry floor, willow vegetation, terrace	4 sites: Quail Hollow, Lompico (also mapped as a pond), Graham Hill Rd (also mapped as a pond), Olympia Quarry floor

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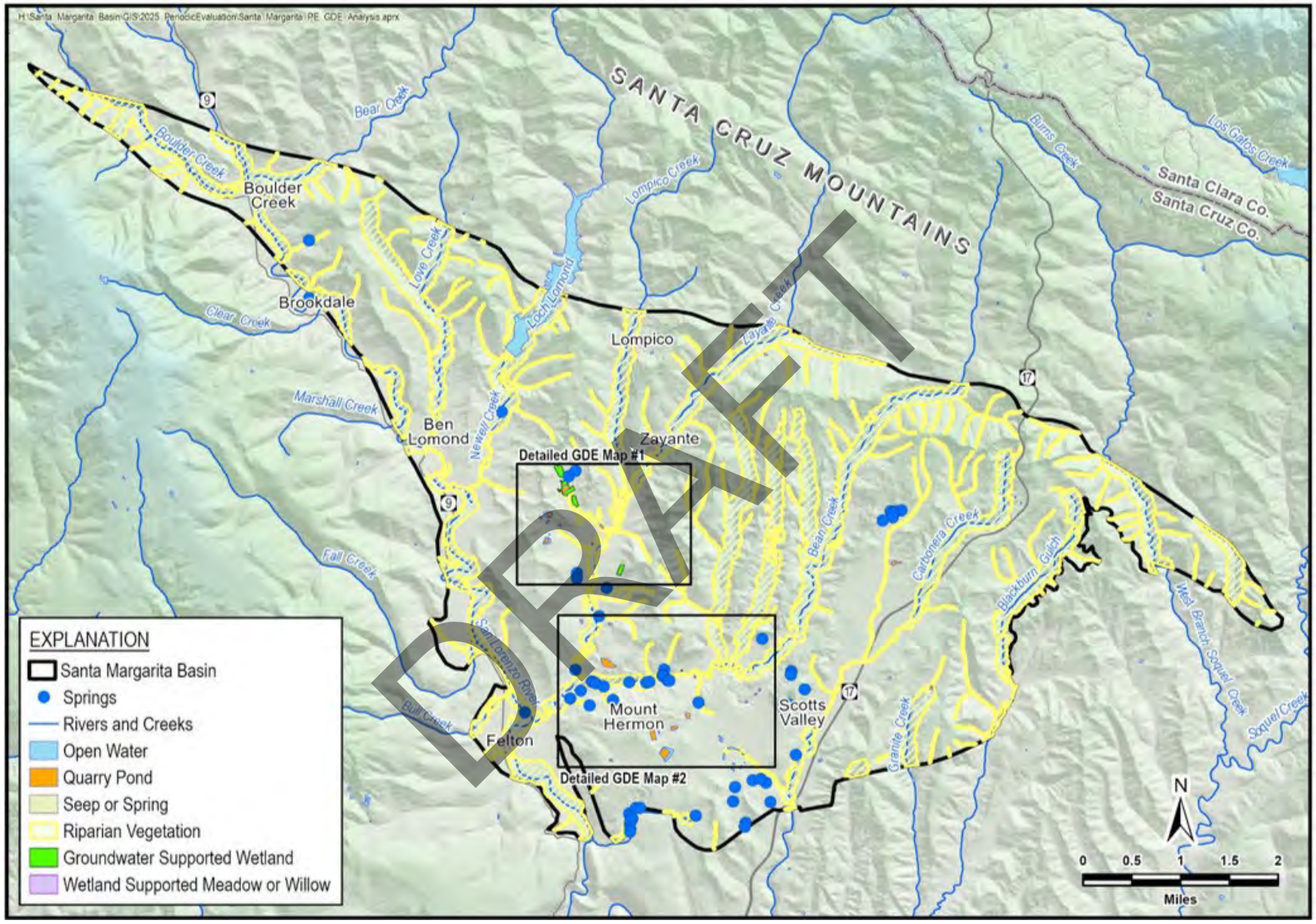

Figure 3-18. Identified Groundwater Dependent Ecosystems in the Santa Margarita Basin

Figure 3-19. Detailed Map #1 of Identified Groundwater Dependent Ecosystems

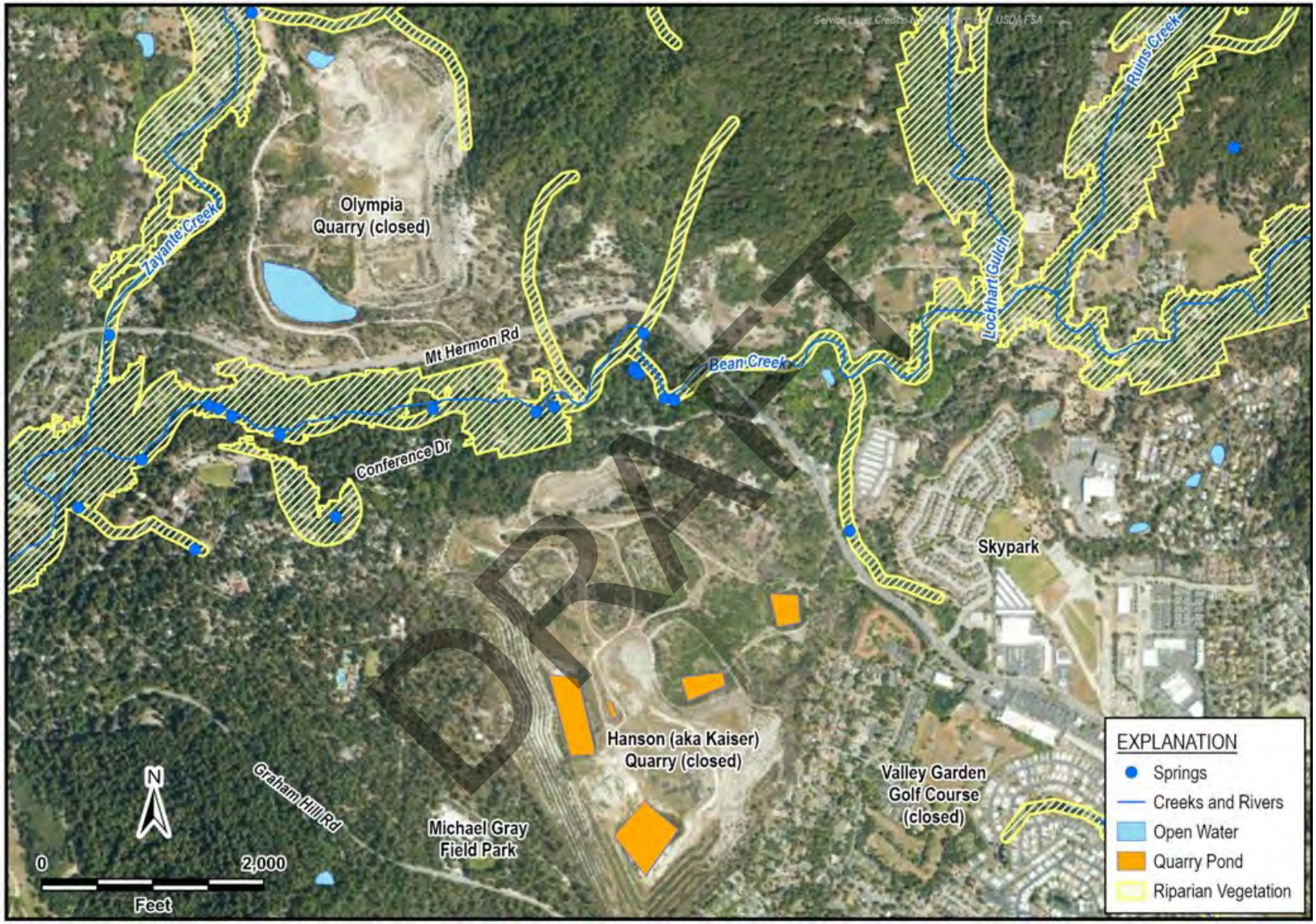

Figure 3-20. Detailed Map #2 of Identified Groundwater Dependent Ecosystems

3.4.9.1 Riverine and Riparian GDEs

Riverine and riparian GDEs (including riverine wetlands, on-channel ponds, or other wetland types that occur within the riverine corridor) are distinguished from other GDE types because they have complex interactions with both surface water and groundwater. Riparian vegetation responds to changes in groundwater as well as streamflow, both of which can be influenced by fire, sudden oak death or other infestations, land use changes, and climate change. Further, riparian and watershed vegetation development stage can influence the water budget as more mature plants have deeper root systems that might access groundwater more efficiently. These complicating factors make correlation of vegetation in riverine and riparian GDEs with groundwater management challenging.

3.4.9.2 Other Groundwater-Supported Wetlands

Groundwater supported wetlands in the Basin are a variety of ecologically unique systems. These include spring/seep complexes and quarry floor sites where shallow or emerging groundwater support a variety of wetland vegetation types. Additional investigation is required, but several of these sites are likely supported by local shallow perched groundwater conditions on lower permeability sedimentary deposits as opposed to being supported wholly by baseflow from the high permeability Santa Margarita aquifer.

3.4.10 Sources and Points of Water Supply

Almost all water supply within the Basin is derived from local sources. Local water sources in the Basin include groundwater, surface water, and recycled water. Figure 3-21 shows the location of all municipal supply wells, points of surface water diversions, and current service areas of the public suppliers in the Basin. The communities of Forest Springs (128 connections) and Bracken Brae (24 connections) located in the northwesternmost part of the Basin are supplied water from sources within the Boulder Creek watershed but northwest of the Basin.

Figure 3-21 shows the rural areas of the Basin that have no municipal water supply and thus rely on private groundwater wells for domestic and non-domestic water supply. Figure 3-22 well density maps show the number of all water supply wells, including municipal, small water systems, private domestic, and industrial, within 1 square mile cells across the Basin.

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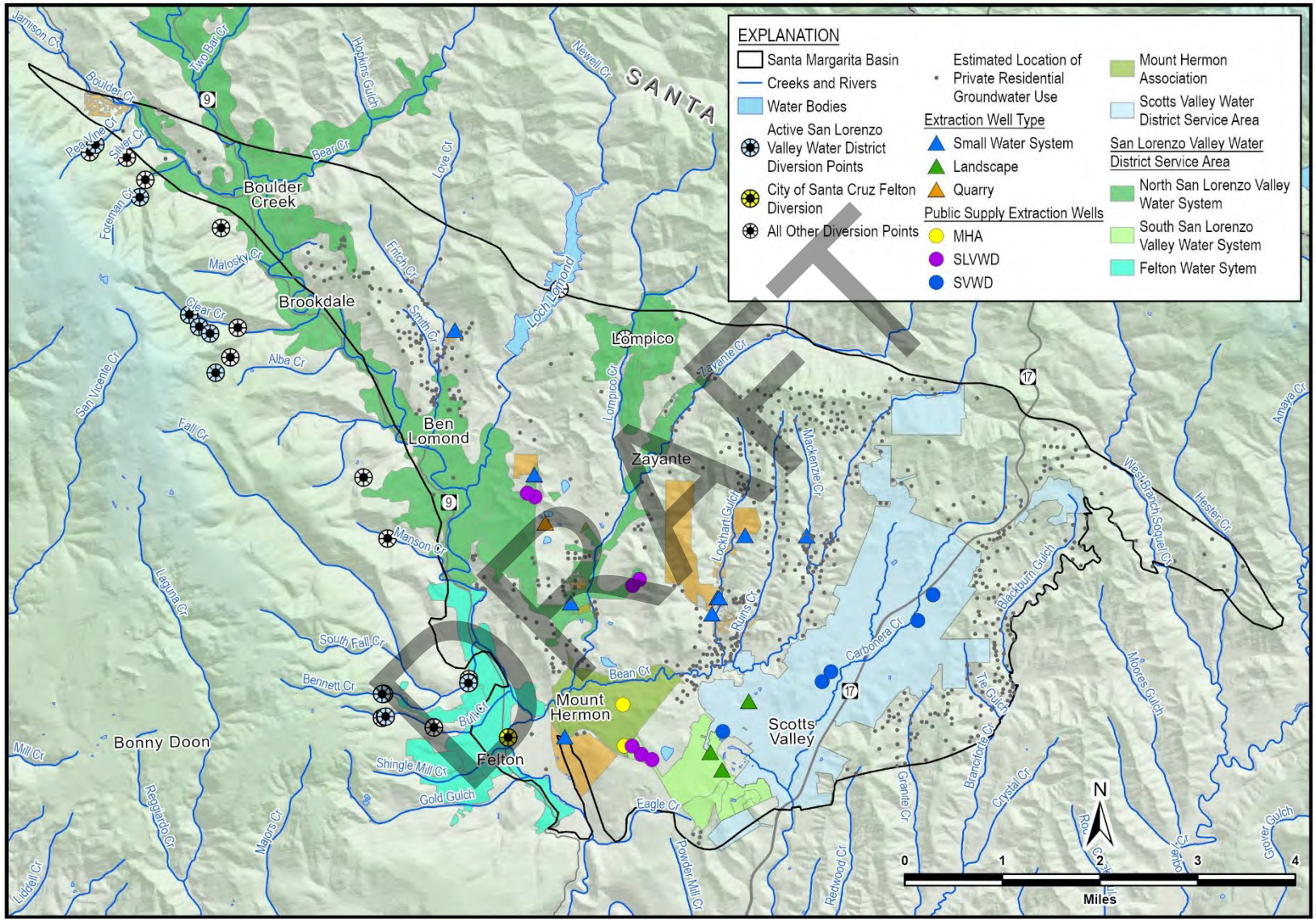

Figure 3-21. Current Water Supply Sources and Service Areas

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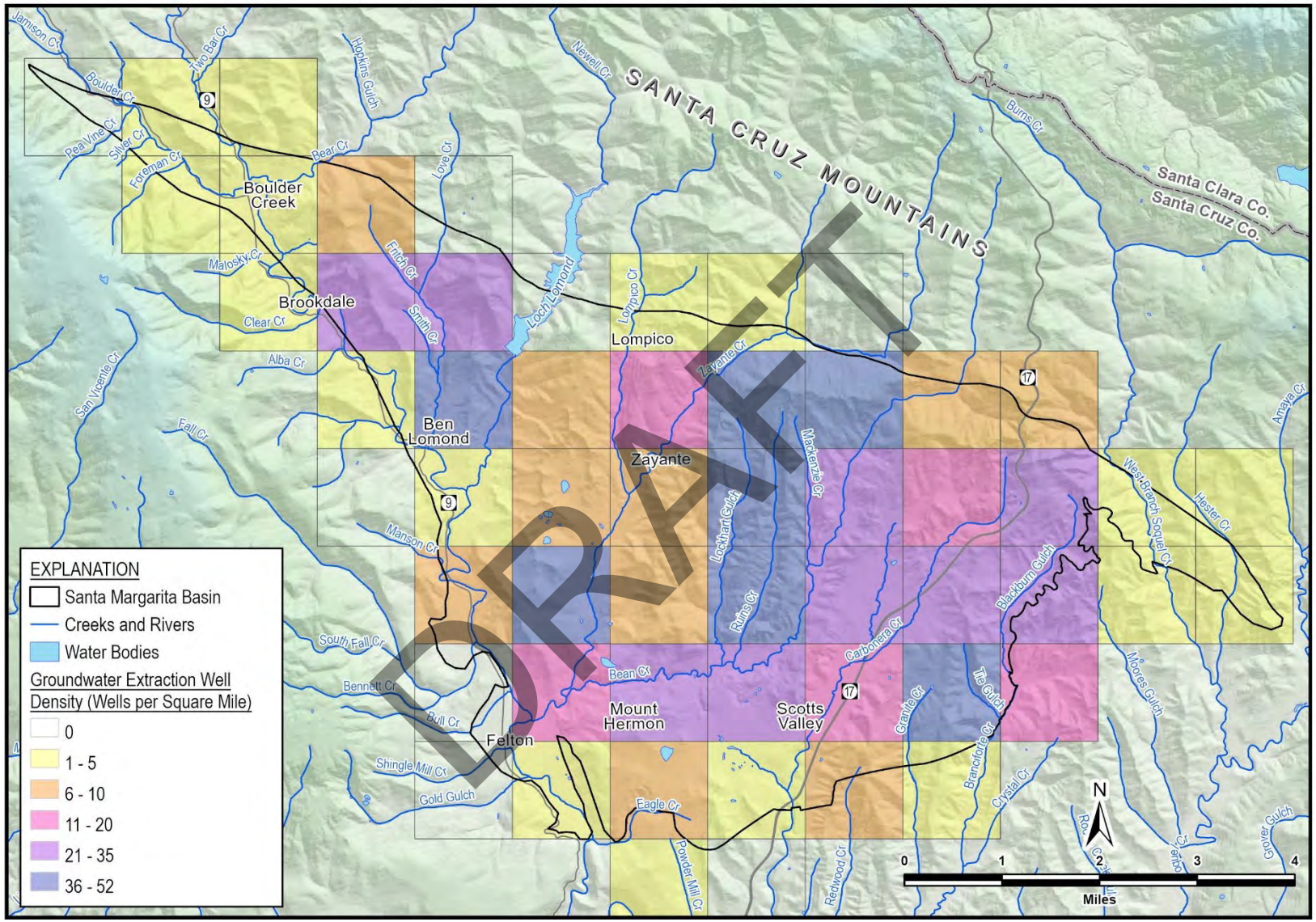

Figure 3-22. Supply Well Density Map

SLVWD uses both surface water and groundwater for its water supply. SLVWD operates 9 surface water diversions—all located on tributaries of the San Lorenzo River outside of the Basin—which are shown on Figure 3-21 and listed in Table 3-4. Following the 2020 CZU Lightning Complex wildfire, which destroyed about 50% of SLVWD's facilities, the District has worked steadily to restore its water infrastructure; 4 of the 9 diversion points remain unrestored. Water not diverted flows into the San Lorenzo River and is considered a Basin water source. SLVWD holds appropriative water rights, including pre-1914 rights, on all streams in the San Lorenzo Valley System, exercised through its active diversions.

Table 3-4. SLVWD Surface Water Diversions

SLVWD System	Points of Diversion	Diversion Status
San Lorenzo Valley System		
Peavine Creek	1	Temporarily inactive
Foreman Creek	1	Active
Clear Creek	3	Temporarily inactive
Sweetwater Creek	1	Temporarily inactive
Felton System		
Fall Creek	1	Active
Bennett Spring	1	Active
Bull Creek	1	Active

Note: gages that are temporarily inactive were damaged during the CZU Lightning Complex wildfire damage in the summer of 2020

Additionally, SLVWD holds entitlement to a portion of surface water storage in Loch Lomond Reservoir or an equivalent water transfer from the City Santa Cruz Water. SLVWD has not recently exercised its entitlement due mostly to the costly upgrade that would be needed to its Kirby WTP to address relatively high concentrations of organic carbon in Loch Lomond raw water.

SLVWD produces stored groundwater from 3 wellfields (Table 2-3 and Figure 3-21). The Quail Hollow and Olympia wellfields extract groundwater from the Santa Margarita aquifer, and the Pasatiempo wellfield extracts from the Lompico aquifer. The 7 active wells are grouped as shown in Table 2-3.

SVWD relies on 6 active groundwater extraction wells for the entirety of its potable water supply (Figure 3-21). These wells extract from the Basin's confined Lompico and Butano aquifers. SVWD augments its water supply and offsets its groundwater extraction for non-potable uses with between 160 to 200 AFY of recycled water. This is less than the total available recycled water supply. The City of Scotts Valley's WRF treats around 2.9 AF of water daily (or about 1,060 AFY). Influent to the WRF is sourced entirely from within the City of Scotts Valley.

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Recycled water produced at a Scotts Valley WRF Tertiary Treatment Plant is used mainly within the city limits but is also available to bulk users outside of city limits such as the Pasatiempo Golf Club.

Groundwater is pumped by private pumpers within the Basin for residential use, and there are some private water rights holders for surface water diversions for non-potable uses. The approximate location of wells used for private use are shown on Figure 3-21.

Other water systems that use groundwater pumped from the Basin as a source of potable water include MHA and 9 small water systems. MHA used springs as their sole water source prior to 1991 (Johnson, 2009) but have since extracted groundwater to meet their full demand. Small water systems primarily use groundwater with several also diverting local surface water to supplement their demand. Section 2.4.1.3 provides more information on small water systems.

Table 3-5 summarizes WY2025 water use within the Basin and Figure 3-23 provides annual water use in the Basin from WY1985 through 2025 categorized by water source and user; water year type is shown on the chart (wet, normal, dry, and critically dry; the classification system is described in Section 3.3).

The City of Santa Cruz is included in Table 3-5 as it has rights to store and divert surface water in the Basin. The City of Santa Cruz operates the Loch Lomond storage reservoir that impounds water in the Newell Creek watershed that would naturally flow into the Basin. It also operates a diversion on the San Lorenzo River in Felton that conveys water upstream for storage in Loch Lomond. Water diverted and stored in the Basin by the City of Santa Cruz is conveyed out of the Basin by the Newell Creek Pipeline to the City of Santa Cruz WTP. The City of Santa Cruz's primary surface water diversion occurs on the San Lorenzo River at Tait Street, which is 5 miles downstream of the Basin in the City of Santa Cruz.

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Table 3-5. Water Year 2025 Santa Margarita Basin Water Use by Source

Water Supplier	Groundwater Use (Acre-Feet)	Surface Water Use (Acre-Feet)	Recycled Water Use (Acre-Feet)	Imported Water Use (Acre-Feet)	Total 2025 Water Use (Acre-Feet)
San Lorenzo Valley Water District (SLVWD)[1]	612	1,155[4]	0	0	1,767
Scotts Valley Water District (SVWD)	1,128	0	169	0	1,297
Mount Hermon Association	167	0	0	0	167167
City of Santa Cruz	0	0[5] 5,307[6]	0	0	5,307
Private Domestic Wells[2]	234	0	0	0	234
Other Non-Domestic Private Groundwater Users[3]	122	0	0	0	122
Small Water Systems	88	2	0	48	138
Quail Hollow Quarry	32	0	0	0	32
Total	2,383	6,464	169	21	9,016

Note: The City of Santa Cruz Water Department stores surface water diverted from both the San Lorenzo River and Newell Creek in Loch Lomond Reservoir which is partially within the Basin. Water from Loch Lomond is treated at the City's surface water treatment plant and served to its customers. While SLVWD has a right to a portion of Loch Lomond water to serve to customers within the Basin, this water is currently delivered only to City customers outside the Basin.

[1] includes springs
[2] estimated
[3] other private non-domestic uses include landscape irrigation and water for landscape ponds.
[4] SLVWD surface water is sourced outside of the Basin in tributaries to the San Lorenzo River
[5] City of Santa Cruz Valley's San Lorenzo River diversion from Felton to Loch Lomond
[6] City of Santa Cruz Valley's San Lorenzo River diversion at Tait Street (5 miles downstream of the Basin) to the City treatment plant

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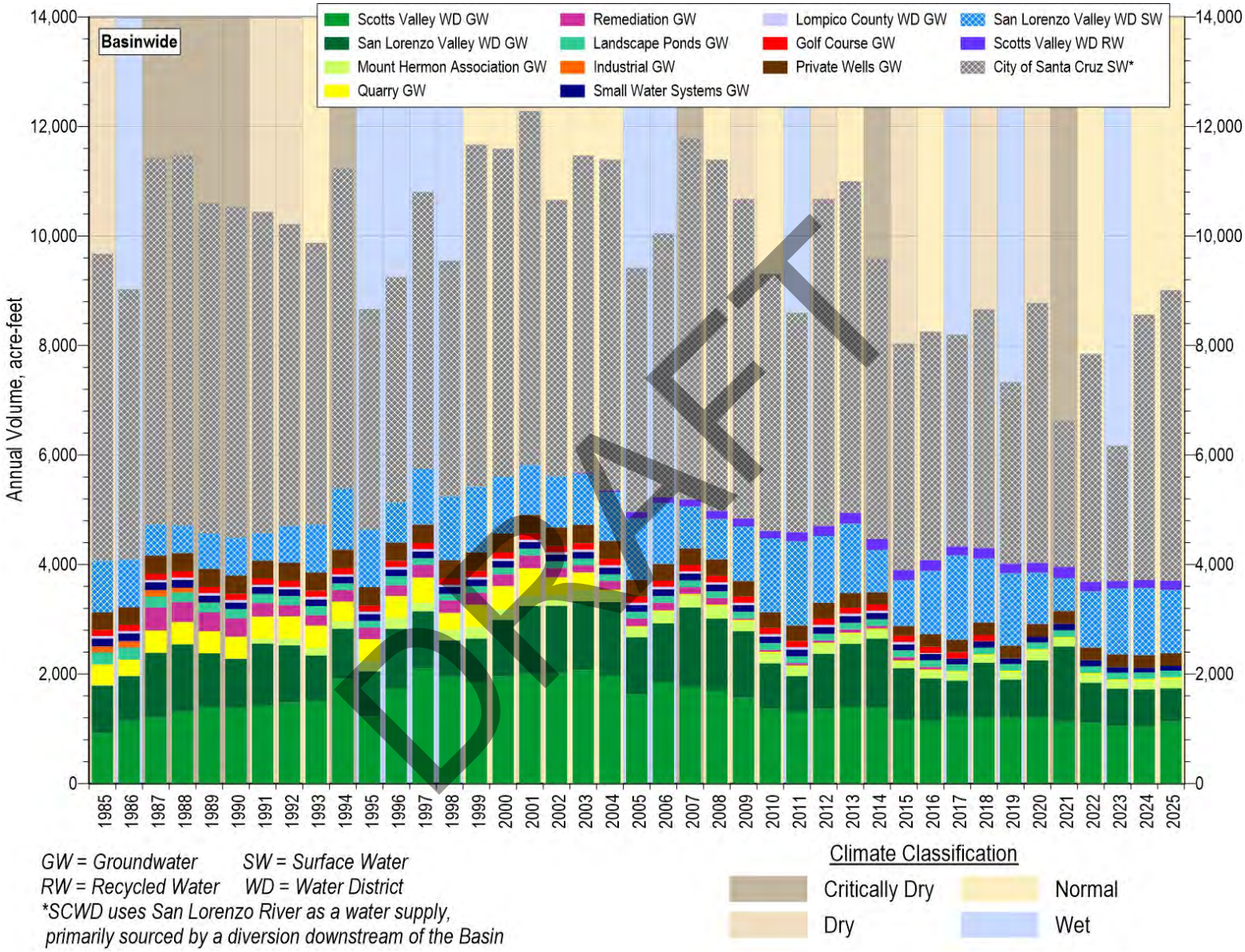

Figure 3-23. Historical Annual Water Use in the Santa Margarita Basin by Source and User

3.4.11 Description of Surface Water Supply for Groundwater Recharge or In-Lieu Supply

Almost all water supply within the Basin is derived from surface water and groundwater, which is fed by precipitation in the Basin and the surrounding watershed. A very small amount (between 160 to 200 AFY) of recycled water is used by SVWD to supplement their water supply.

SLVWD has rights to divert water from tributaries of the San Lorenzo River located outside of the Basin. When surface water is available, SLVWD uses it in lieu of pumping its wells. This conjunctive use of surface water and groundwater is described in Section 2.3.4.1. If SLVWD's water rights and place of use restrictions are amended in the future, there will be more surface water available for conjunctive use by SLVWD and potentially SVWD.

The City of Santa Cruz has water rights to divert water from the San Lorenzo River. Between October 1 and May 31, the San Lorenzo River and its tributaries are not fully appropriated, and at times have streamflow in excess of minimum bypass flows; these excess flows could be used for groundwater recharge and conjunctive use projects. This potential source and volume of water is potentially available for expanded conjunctive use projects.

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4 GROUNDWATER CONDITIONS

Groundwater conditions in the Basin reflect more than a century of groundwater use together with the management and conservation measures implemented since the early 2000s. This section characterizes the current and historical groundwater conditions that provide the technical basis for the sustainable management criteria presented in Section 7, drawing on data from the Basin's monitoring network and supporting technical analyses. Conditions are described for each sustainability indicator: groundwater elevations and the vertical hydraulic gradients between the principal aquifers, the change of groundwater in storage, groundwater quality, land subsidence, and the depletion of interconnected surface water. Each subsection summarizes historical trends, present-day conditions, and the data used to evaluate them.

4.1 Historical Groundwater Demands

Groundwater has been the primary source of water in the Basin for domestic, municipal, and sand mining users since the early part of the 20th century. The rate of parcel development in the San Lorenzo River watershed between the 1950s and 1980s increased (Figure 4-1) to meet the housing, commercial, and industrial needs of a growing population (Figure 4-2). The parcel development led to increased groundwater demands. Much of the development in this timeframe was in the City of Scotts Valley and the communities of the San Lorenzo Valley (County of Santa Cruz, 2002). Since historical population estimates for all communities within the Basin are not available, Figure 4-2 shows County of Santa Cruz population estimates that can be used as an indication of population growth within the Basin.

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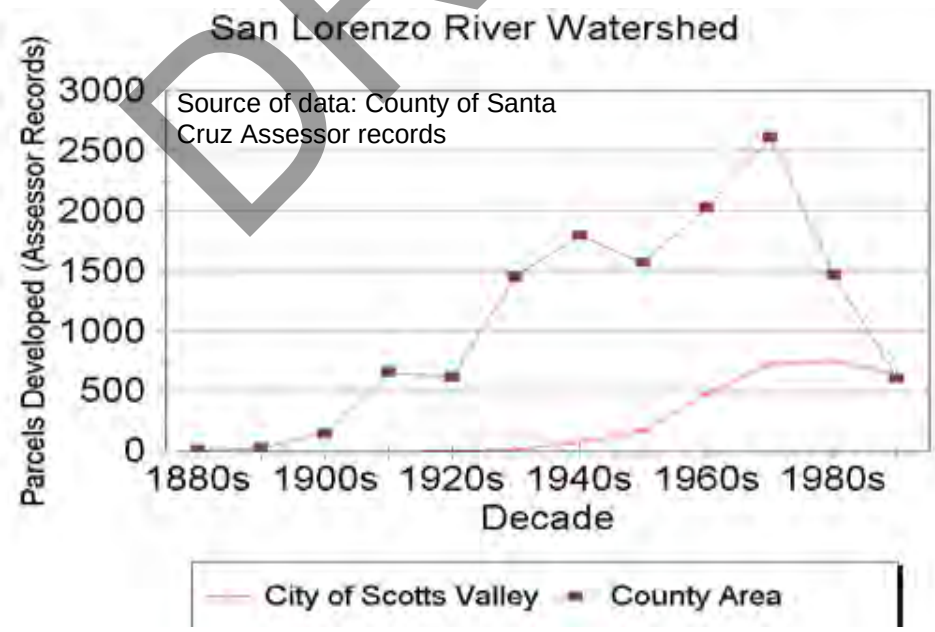

Figure 4-1. County of Santa Cruz Parcel Development in the San Lorenzo River Watershed

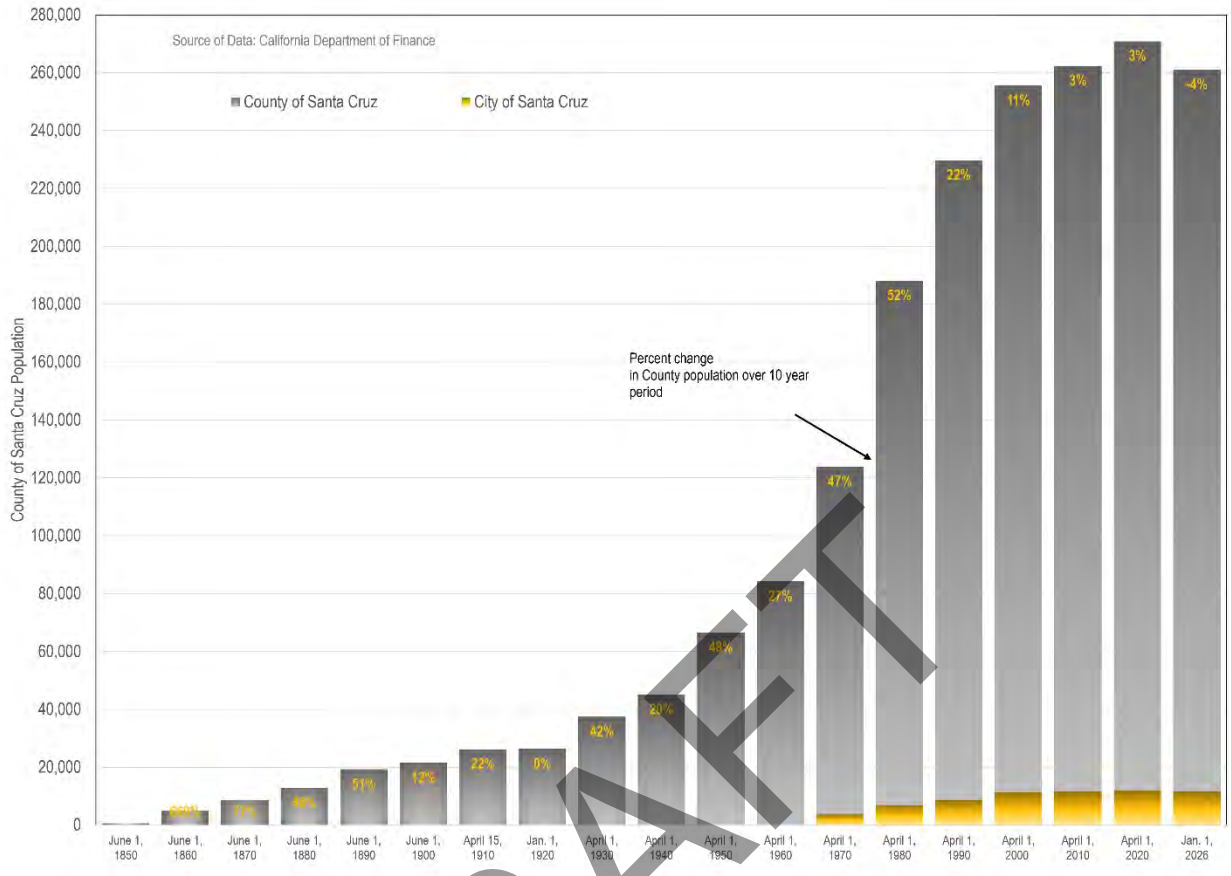

Figure 4-2. County of Santa Cruz Historical Population

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Starting in the 2000s, focused groundwater management and conservation programs by the water districts, reduced environmental remediation pumping, decommissioning of the Hanson and Olympia quarries, closure of the Valley Gardens Golf Course, and heightened water use efficiency practices. Water use within the Basin is discussed in detail in Section 3.4.10. Reduced groundwater extraction in the Basin, particularly in the confined aquifers south of Bean Creek (Figure 4-3), helped stabilize declining groundwater levels in the Basin, as discussed in the sections below.

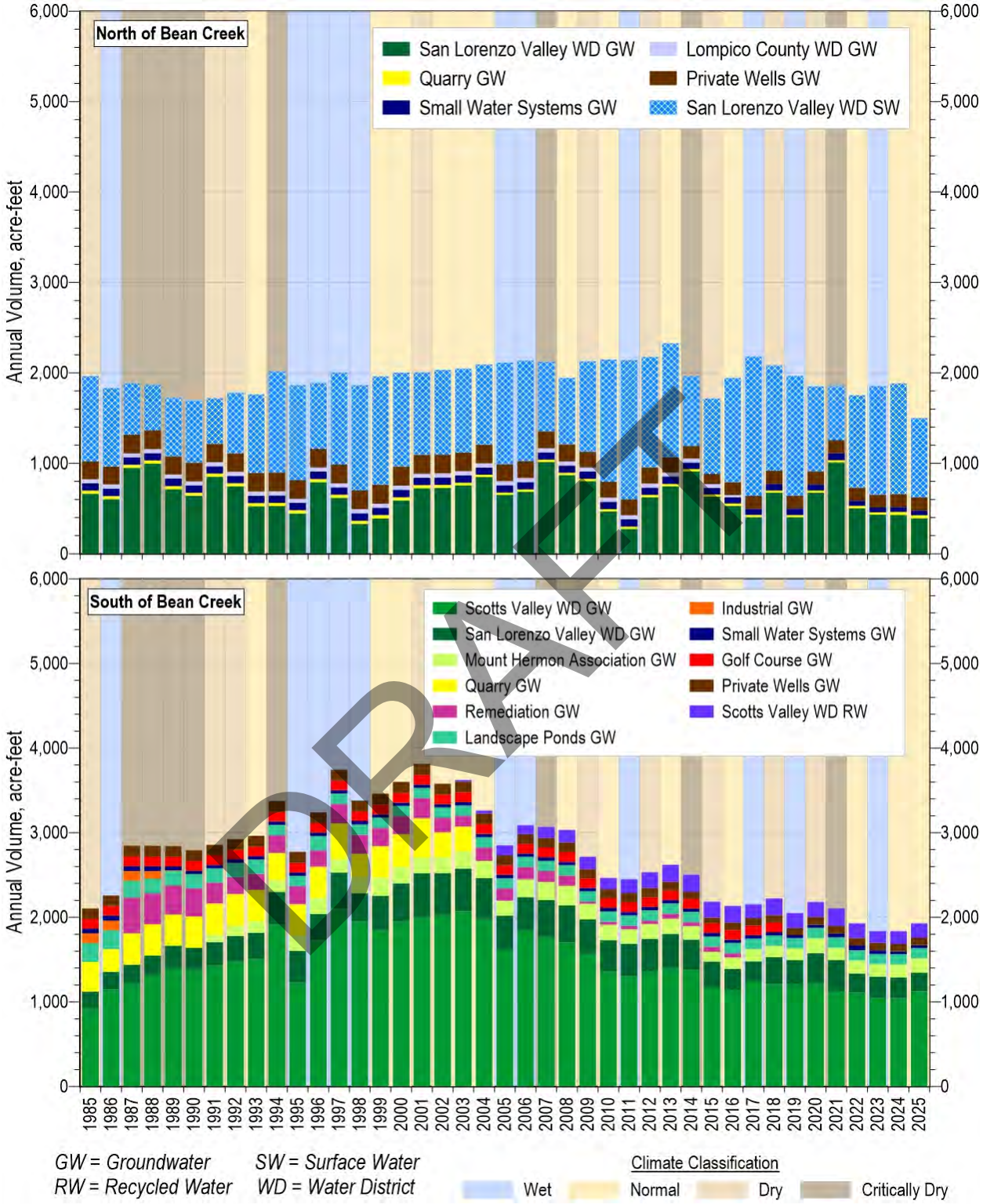

Figure 4-3. Groundwater Extraction by User Type Relative to Bean Creek

4.2 Groundwater Elevations

Groundwater elevations in the Basin have generally been stable to improving over the past 20 years. One notable area that exhibited unsustainable groundwater conditions is the Mount Hermon/South Scotts Valley area. Groundwater levels in both Santa Margarita and Lompico aquifers in the Mount Hermon/South Scotts Valley area started to decline as early as the 1970s when the area underwent extensive development. The groundwater level declines were exacerbated by a 10-year drought starting in 1984 eventually resulting in the dewatering of the Santa Margarita aquifer in that area. Groundwater levels have generally stabilized and are increasing in some areas since Basin-wide groundwater extraction peaked in the early 2000s, but the Santa Margarita aquifer remains dewatered in the area southeast of Mount Hermon.

4.2.1 Groundwater Elevation Subareas and Monitoring Wells

The subsections below describe groundwater elevations and gradients by principal aquifers in the Basin. The Monterey Formation is generally an aquitard to flow between the Santa Margarita and Lompico aquifers so is not considered a principal aquifer. To guide discussion in the GSP, the principal aquifers and Monterey Formation are divided into subareas with distinct characteristics.

Figure 4-4 shows the following Santa Margarita aquifer subareas:

1. Quail Hollow
2. Olympia/Mission Springs
3. Mount Hermon/South Scotts Valley
4. North Scotts Valley

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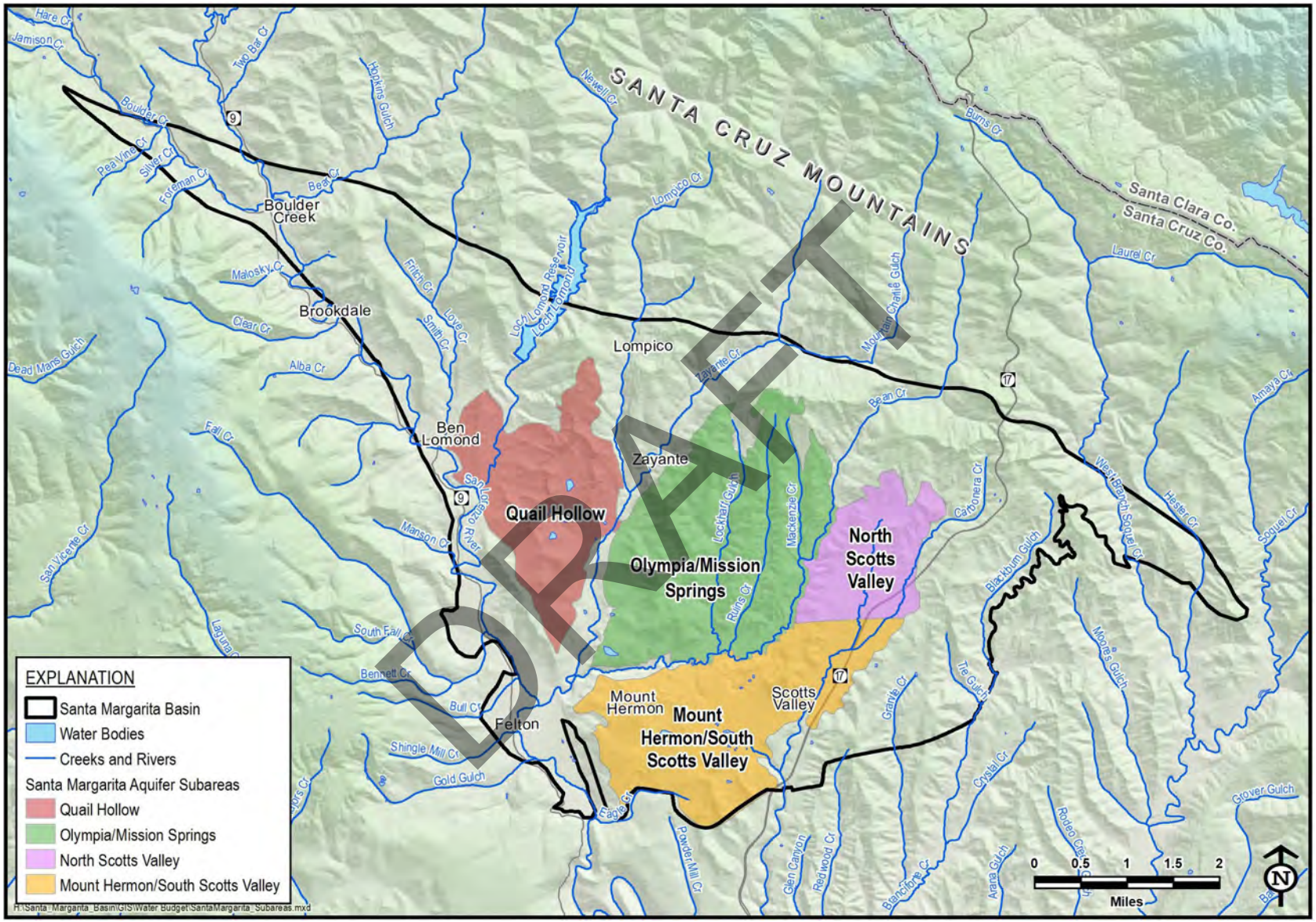

Figure 4-4. Santa Margarita Aquifer Subareas

The Quail Hollow area, a roughly 3 square mile hillslope area south of Loch Lomond is largely hydrogeologically separated from other areas of Santa Margarita Sandstone due to erosion and its position on the limb of the Scotts Valley syncline topographically above other outcrops (Johnson, 2009). The only major groundwater pathway between Quail Hollow and the greater Basin is through a narrow bridge of sandstone and stream alluvium beneath Zayante Creek (Figure 3-9). The isolated nature of the Quail Hollow area means that PMAs undertaken in other parts of the Basin are unlikely to influence groundwater conditions in the Quail Hollow area. The other Santa Margarita aquifer subareas are connected more than Quail Hollow, but still demonstrate unique characteristics due to erosion by creeks.

Subareas are also identified for discussion in the GSP in each of the deeper, more laterally continuous geologic units used for water supply in the Basin. The 3 subareas for the Monterey Formation, Lompico aquifer, and Butano aquifer shown on Figure 4-5 are:

1. North of Bean Creek
2. Mount Hermon/South Scotts Valley
3. North Scotts Valley

The subareas are defined loosely based on the overlying Santa Margarita aquifer subareas, with the subareas south of Bean Creek having identical names and boundaries. Since nearly all of the Lompico and Butano aquifer extractions occur in the southern portions of the Basin, there are no monitoring wells in the aquifers and formations in the deeper geologic units in the North of Bean Creek subarea. MHA-MW1, the only Lompico aquifer well north of Bean Creek, is a pilot well that was not completed for extraction.

The sections below describe the groundwater conditions measured historically in monitoring wells in the Basin and simulated by the Basin Model. Well locations and the aquifer or formation they are screened in are shown on Figure 4-6. The groundwater elevation contour maps are generated using groundwater level measurements supplemented with simulated groundwater model results. The Basin Model is calibrated to measured groundwater levels in wells and streamflow in creeks where data are available and is based on inferences where data are not available.

Appendix 4A contains hydrographs for all wells with current records in the Basin. Note that all hydrographs included in this GSP identify the climatic year type of each water year by different background colors on the graphs (wet, normal, dry, and critically dry) using the classification system described in Section 3.3.

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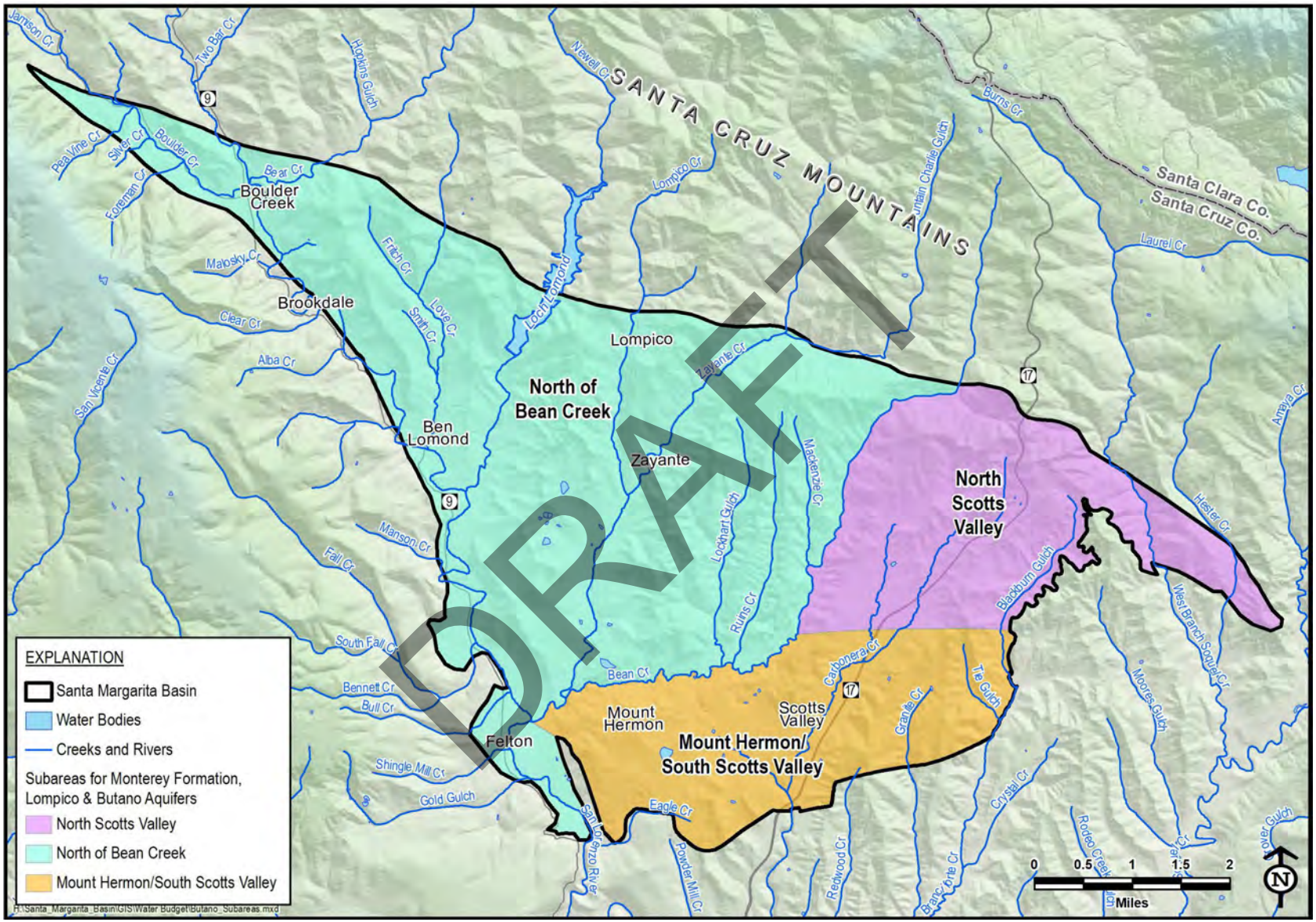

Figure 4-5. Monterey Formation, Lompico Aquifer, and Butano Aquifer Subareas

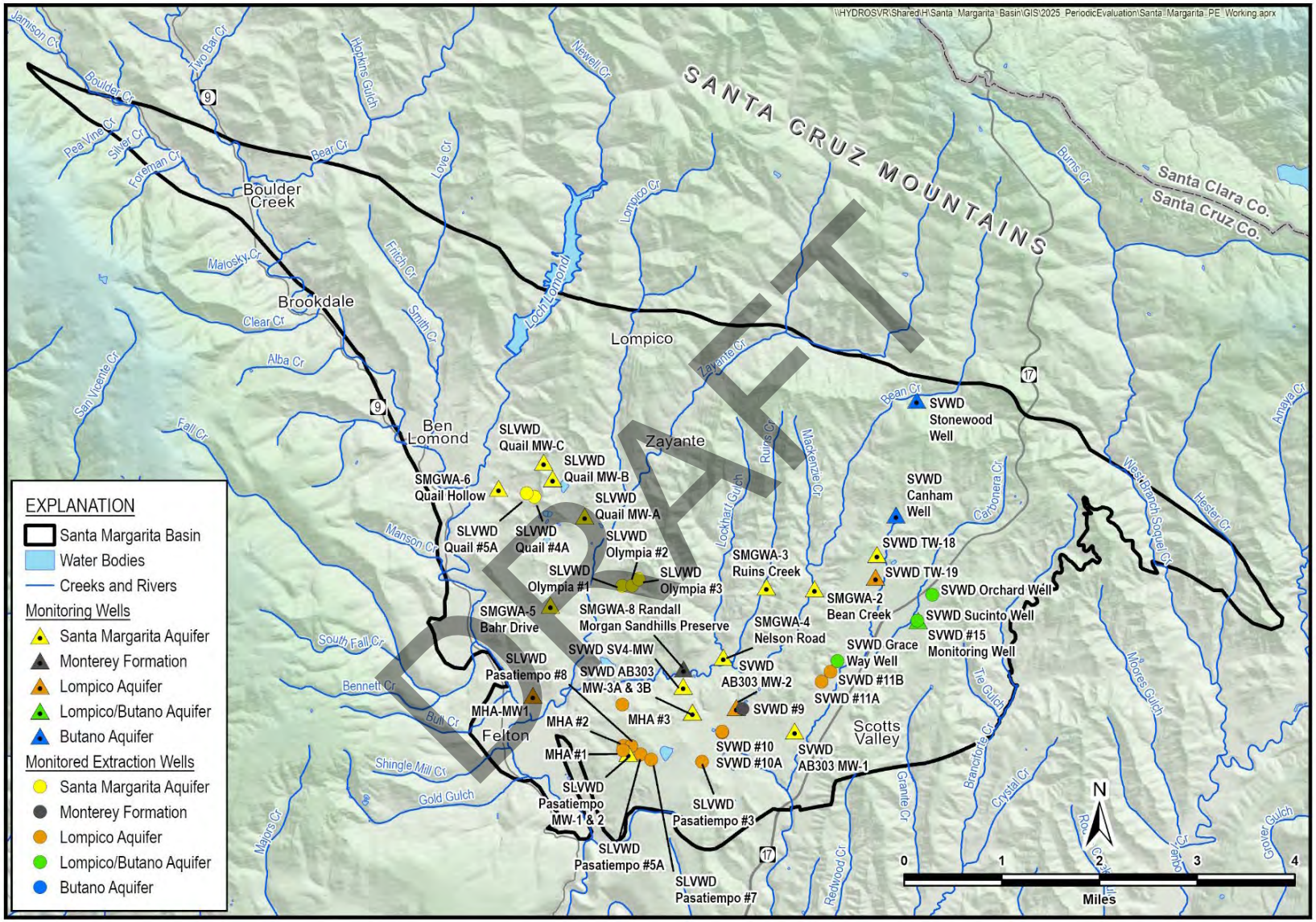

Figure 4-6. Groundwater Level Monitoring Locations

4.2.2 Santa Margarita Aquifer Groundwater Elevations

4.2.2.1 Santa Margarita Aquifer Groundwater Elevations over Time

The Basin's primary unconfined aquifer is the Santa Margarita aquifer as described in Section 3.4.4.1. Relatively high hydraulic conductivities and widespread surface exposure result in the Santa Margarita aquifer being one of the most important hydrogeologic units within the Basin for water supply, recharge, and as a source of baseflow for creeks and rivers. The Santa Margarita aquifer's high hydraulic conductivity and extensive surface exposure allow it to recharge quickly after rainfall resulting in relatively stable long-term levels as demonstrated on hydrographs on Figure 4-7.

As discussed in Section 4.2, the Santa Margarita aquifer has isolated subareas with distinct groundwater level trends. The groundwater elevations in the Quail Hollow and Olympia/Mission Springs subareas north of Bean Creek demonstrate greater seasonal variability related to groundwater pumping. The Santa Margarita aquifer in the Mount Hermon/South Scotts Valley south of Bean Creek near Pasatiempo and Camp Evers was dewatered in the 1980s by overpumping in the Santa Margarita and underlying Lompico aquifer in an area where the Monterey Formation aquitard is absent. Groundwater elevations have not recovered and as a result, there is no longer groundwater pumping in most of the Santa Margarita aquifer in this portion of the subarea. There is very little pumping in the Santa Margarita aquifer in the North Scotts Valley subarea, resulting in long-term stable groundwater elevations.

This section describes groundwater level fluctuations in representative hydrographs in each subarea. The following section describes the overall groundwater elevations and flow directions for the aquifer in each subarea as simulated by the groundwater model in WY2018.

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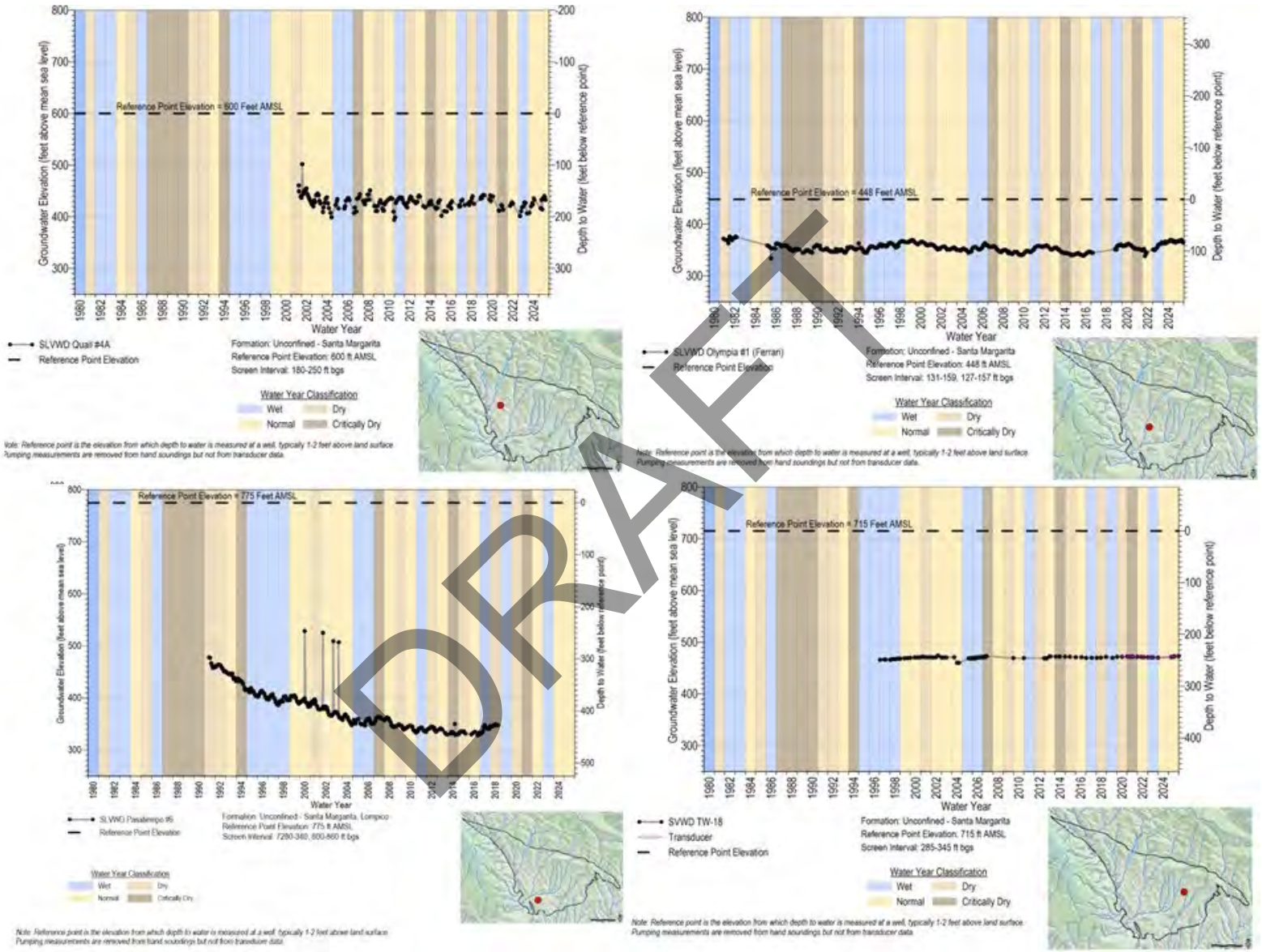

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Figure 4-7. Santa Margarita Aquifer Hydrographs

Quail Hollow and Olympia/Mission Springs Subareas

Groundwater elevations in the Santa Margarita aquifer in the Quail Hollow and Olympia/Mission Springs subareas are similar and have remained consistent over time. Groundwater elevations exhibit seasonal fluctuations from pumping and annual responses to dry and wet periods (Figure 4-7).

The severity of the long-term groundwater level decline that took place in the Basin's deeper confined aquifers over the extended drought in the late 1980s through mid-1990s is not observed in the Santa Margarita aquifer in the Quail Hollow and Olympia areas. The hydrograph for SLVWD's Quail Hollow Well #4A on Figure 4-7 shows that, based on seasonal low elevations, there was a decline of only about 10 feet over that period. Groundwater elevations then recovered 40 feet above pre-drought levels by the end of 4 consecutive wet years that followed the drought. Rapid groundwater elevation recovery is observed during every wet period, as is typical in aquifers that have a high hydraulic conductivity and direct exposure to recharge from rainfall. The 30-foot decline in the Santa Margarita aquifer's Olympia area during the 1987 through 1994 drought was greater than in the Quail Hollow area, as shown on the SLVWD Olympia #1 hydrograph on Figure 4-7. This is probably because there was more pumping from the Olympia well field during this time, especially toward the latter part of the drought.

Mount Hermon South Scotts Valley Subarea

The hydrograph for Santa Margarita/Lompico aquifer SLVWD Pasatiempo #6 in the Mount Hermon/South Scotts Valley subarea demonstrates greater groundwater level decline (Figure 4-7). In the Pasatiempo and Camp Evers area, dewatering of the Santa Margarita aquifer was induced by historical overpumping (Johnson, 2009). Dewatering took place because of unsustainable pumping by a combination of users: nearby sand quarry, environmental remediation to clean up contaminated groundwater, and municipal water suppliers. Declining groundwater elevations of up to 200 feet in the deeper Lompico aquifer caused the Santa Margarita aquifer to become unsaturated and eventually completely dewatered in the vicinity of where the Santa Margarita aquifer and Lompico aquifer are in direct contact (Figure 3-9). The hydrograph for SLVWD Pasatiempo #6 on Figure 4-7 shows groundwater elevations declining in this well screened in the Lompico and Santa Margarita aquifer to levels below the Santa Margarita screen interval (280-340 feet bgs) in the mid-1980s.

In the early 1990s, municipal water supply wells screened in the dewatered Santa Margarita aquifer in this subarea were replaced with deeper wells screened entirely in the Lompico aquifer. As a result of this change in groundwater source, along with reduced environmental remediation and quarry pumping in the Santa Margarita aquifer, by the end of 4 years of above average rainfall ending in 1998, groundwater elevations recovered approximately 25 feet (Figure 4-7). Other than an almost 20-foot increase during the very wet year in 2017, groundwater elevations are stable since 1999. The Pasatiempo and Camp Evers areas currently remain mostly dewatered even though municipal water agencies no longer pump from the Santa Margarita aquifer.

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Induced recharge through the aquifer is likely the main reason it has not completely recovered in dewatered areas. Induced recharge through the dewatered portions of the aquifer generally follows 1 of 2 pathways depending on the underlying formation: 1) infiltration to the top of the underlying low permeability Monterey Formation from where it flows until it emerges as seeps to Bean Creek, and 2) into the Lompico aquifer where it directly underlies the Santa Margarita aquifer. A secondary factor may be reduced local recharge. In the mid-1980s, most septic systems in the Scotts Valley area were converted to a sewer system. Moreover, development over time created increased impervious surfaces. These changes have resulted in less recharge and return flows to the Santa Margarita aquifer in the Scotts Valley area than prior to the 1980s.

North Scotts Valley Subarea

The Santa Margarita aquifer in the North Scotts Valley subarea is not pumped by SVWD. Because this part of the City of Scotts Valley is supplied water by SVWD, there are very few private wells. SVWD TW-18 is the only Santa Margarita monitoring well in the subarea and its groundwater elevations have fluctuated slightly since the start of the monitoring record in 1996 (Figure 4-7). Its trends are notably different than the Quail Hollow and Olympia/Mission Springs subareas, which demonstrate seasonal fluctuations related to groundwater pumping. Since the Monterey Formation underlies the aquifer in the North Scotts Valley subarea, groundwater levels are not influenced by pumping occurring in the deeper Butano and Lompico aquifers in the subarea.

4.2.2.2 Santa Margarita Aquifer Groundwater Elevation Contours and Flow Directions

Groundwater flow in the Santa Margarita aquifer generally mimics the surface topography. Groundwater flows from areas of higher elevation where the Santa Margarita aquifer is exposed at the surface and can be directly recharged toward areas of lower elevations where groundwater is discharged. Groundwater discharge occurs in seeps at the contact between the Santa Margarita aquifer and underlying Monterey Formation, in springs, or as baseflow in Bean Creek, Zayante Creek, Newell Creek, and the San Lorenzo River in the Glen Arbor area.

As required per the GSP regulations, spring seasonal high and fall seasonal low contour maps are provided in this subsection. Figure 4-8 and Figure 4-9 show Santa Margarita aquifer groundwater elevations and flow directions for the spring and fall of WY2025, respectively. The groundwater elevations included on the Santa Margarita aquifer and all other aquifer contour maps are both a combination of interpreted contours from measured elevations at wells, and Basin Model-simulated elevations in areas where there are no measured data. The contour maps are produced for this and other following sections to show that seasonal groundwater flow patterns are similar at the regional scale despite local groundwater elevation fluctuation during wet and dry seasons. The subsections below describe groundwater elevations and flow for each of the subareas.

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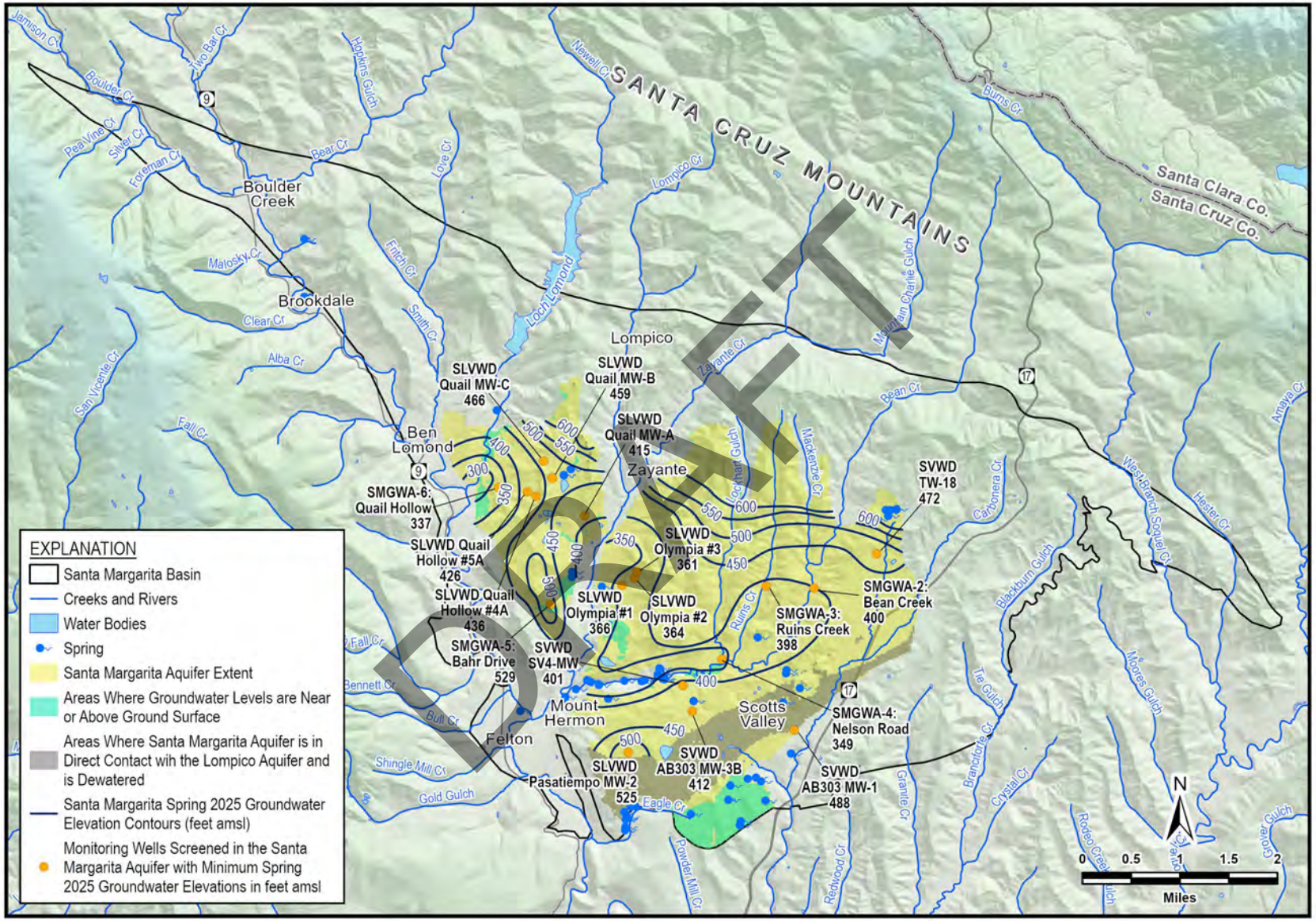

Figure 4-8. Santa Margarita Aquifer Groundwater Elevations and Contours, Spring 2025

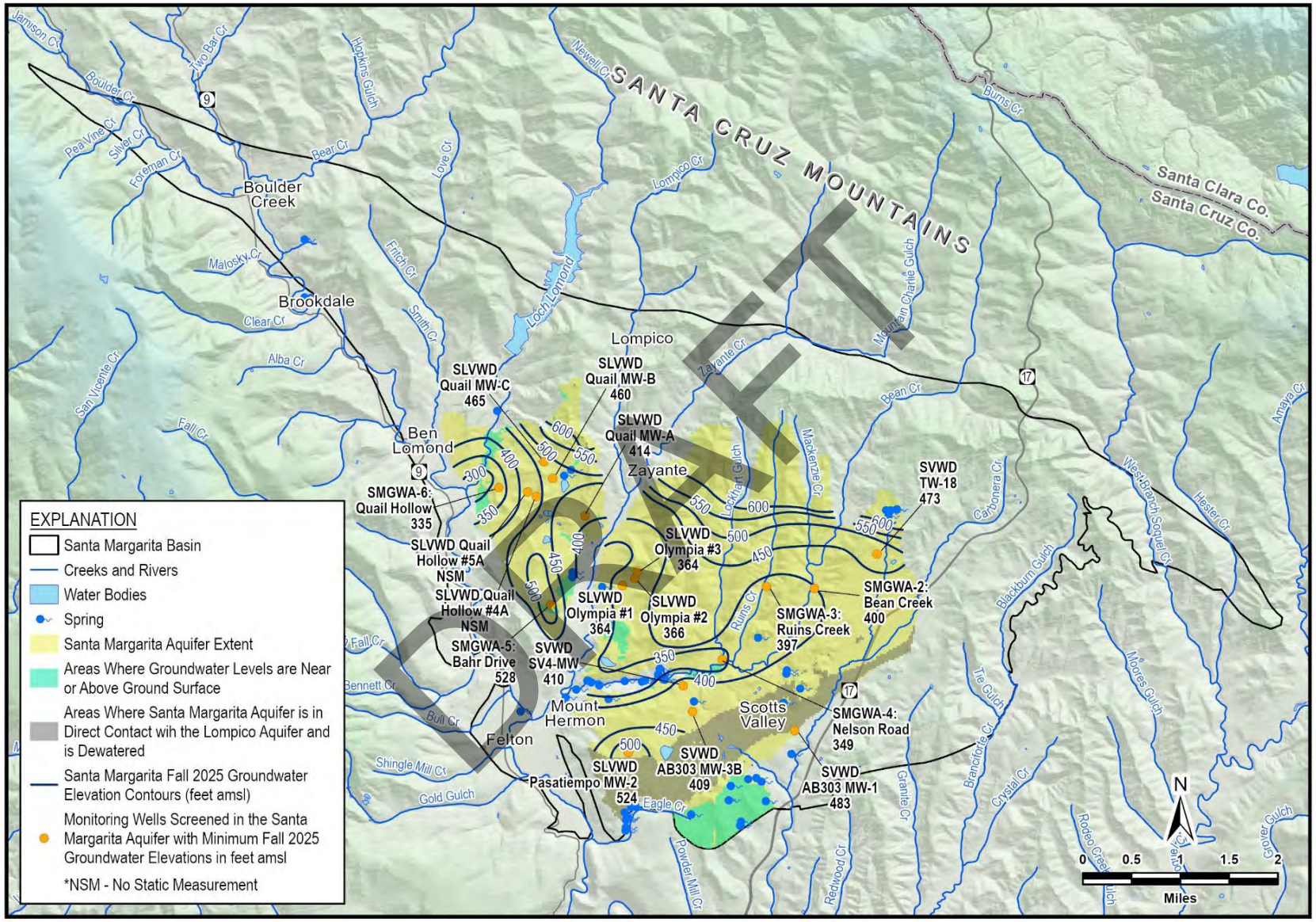

Figure 4-9. Santa Margarita Aquifer Groundwater Elevations and Contours, Fall 2025

4.2.2.2.1 Quail Hollow Subarea

The Quail Hollow subarea is located in the central portion of the Basin, between the communities of Ben Lomond, Glen Arbor, Felton, Zayante, and Lompico (Figure 4-4). It lies between Love Creek and Lompico/Zayante Creek and is intersected by Newell Creek. Almost the entire subarea has Santa Margarita aquifer exposed at the surface. Groundwater in this subarea is pumped by SLVWD's Quail Hollow wellfield, the Quail Hollow sand quarry, and private domestic pumpers.

Johnson (2009) and Kennedy/Jenks Consultants (2015) describe the subarea groundwater elevations as generally mimicking the topography as a result of mounded recharge beneath hills and ridges and groundwater discharge to eroded stream channels. Perennial streams and springs are generally an expression of the groundwater table. Under high groundwater table conditions in wet years, the saturated thickness of the Santa Margarita sandstone reaches 130 feet thick. During drought conditions, the groundwater surface partially flattens but maintains a similar shape. Groundwater flows toward the center of Quail Hollow from the north and south, east toward Zayante Creek, west toward the Quail Hollow wellfield where there is a localized pumping depression and then toward Newell Creek. Under drought conditions, some groundwater flows west under Newell Creek toward the San Lorenzo River. Springs occur where the groundwater table intersects the ground surface. Most springs in the subarea occur on the northern flank of the lower Zayante Creek valley where the contact between Santa Margarita Sandstone and Monterey Formation outcrops at the surface, forcing groundwater perched above the Monterey Formation to emerge as springs and seeps.

4.2.2.2.2 Olympia/Mission Springs Subarea

The Olympia/Mission Springs subarea is north of Bean Creek and lies between the communities of Mount Hermon, Zayante, and Scotts Valley (Figure 4-4). The subarea is a hillslope area where hilltop ridges are capped by Santa Cruz Mudstone and Purisima Formation, which limits recharge to the Santa Margarita aquifer below. Private domestic pumpers and small water systems provide the majority of water to the residents in the subarea. The only municipal pumping occurs in the western portion of the subarea where SLVWD has its Olympia wellfield.

The highest groundwater elevations are in upland areas in the northern portion of the subarea (Figure 4-8 and Figure 4-9) where recharge to the exposed portions of the aquifer occurs by direct percolation of precipitation and streambed percolation in the upper reaches of creeks. Groundwater flows from the upland areas to lower elevations discharging at: 1) Zayante Creek, west of the Olympia wellfield; 2) near the confluence of Lockhart Gulch and Ruins Creek with Bean Creek; and 3) in springs that occur at the contact of the Santa Margarita aquifer and Monterey Formation along the sides of Zayante and Bean creeks. A localized pumping depression is associated with the Olympia wellfield.

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The Olympia/Mission Springs subarea is separated from the Pasatiempo/Camp Evers/Scotts Valley subarea by Bean Creek, which is a groundwater discharge location in the Santa Margarita aquifer, as shown on the groundwater elevation contour maps (Figure 4-8 and Figure 4-9). Groundwater level declines north of Bean Creek are unlikely to influence groundwater elevations south of Bean Creek, and vice versa.

4.2.2.2.3 North Scotts Valley and Mount Hermon/South Scotts Valley Subareas

The Santa Margarita aquifer south of Bean Creek is divided into 2 subareas: North Scotts Valley and Mount Hermon/South Scotts Valley (Figure 4-4). Most of the Santa Margarita aquifer in the North Scotts Valley subarea is overlain by the Santa Cruz Mudstone. There has not been municipal pumping in the subarea, and there is limited private domestic pumping.

The Mount Hermon/South Scotts Valley subarea lies south of the lower to mid-reach of Bean Creek (Figure 4-4), both where it is exposed at the surface and locally overlain by the Santa Cruz Mudstone. It includes most of the City of Scotts Valley, the communities of Camp Evers and Mount Hermon, and the former Hanson Quarry (Figure 4-4). It is considered separately from the Northern Scotts Valley subarea because it contains the dewatered portion of the aquifer.

Most of the groundwater pumping in the Mount Hermon/South Scotts Valley subarea is by municipal suppliers, SVWD, SLVWD, and MHA, who pump from the deeper Lompico aquifer and not from the Santa Margarita aquifer. Historically, municipal, environmental remedial, and sand quarry pumping from the Santa Margarita aquifer took place in the subarea, but that use no longer occurs, as described in Section 4.2. There is also limited pumping by private domestic pumpers in the subarea.

The highest groundwater elevations are in the upland areas in the North Scotts Valley subarea (Figure 4-8 and Figure 4-9). Groundwater recharge is mostly from precipitation and streambed percolation where the Santa Margarita aquifer is exposed at the surface. Santa Cruz Mudstone overlying much of the Santa Margarita aquifer limits the amount of precipitation and return flows reaching the aquifer. Groundwater recharge also occurs along Carbonera Creek where it flows in the Santa Margarita aquifer or the alluvium directly overlying the Santa Margarita aquifer (Kennedy/Jenks Consultants, 2015).

Groundwater flows south from the northern upland area and north from Mount Hermon to the central part of the subarea. Groundwater flow converges toward Bean Creek where the lowest groundwater elevations are found along the subarea's boundary with the Olympia/Mission Springs subarea. Bean Creek is the primary groundwater discharge area for groundwater in the subareas south of Bean Creek. In the western portion of the Mount Hermon/South Scotts Valley subarea, groundwater discharges at numerous springs along the Santa Margarita Sandstone outcrop areas bordering Bean, Eagle, and Camp Evers Creeks. Figure 4-8 and Figure 4-9 indicate areas where groundwater elevations simulated in the groundwater model lie above the land surface. These areas correlate with known springs, which are indicated on the contour maps.

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Historically, some of MHA's water supply was from the Ferndell and Redwood springs. Water discharged by these springs is now sourced from the upland areas of the Santa Margarita aquifer adjacent to the springs.

In the past, when there was environmental remediation, quarry, and municipal pumping in the Santa Margarita aquifer, there were localized pumping depressions in the aquifer, but those have dissipated since that pumping ceased.

Figure 4-8 and Figure 4-9 show the location where the Santa Margarita aquifer is unsaturated or dewatered for its entire thickness. Even with portions of the aquifer dewatered, groundwater flow in this area is still toward Bean Creek.

4.2.3 Monterey Formation Groundwater Elevations

As described in Section 3.4.5.3, the Monterey Formation is not a high yielding aquifer and is not considered a principal aquifer, but its groundwater is pumped by some Basin residents because there is no alternative water source. Groundwater elevation data for wells screened in the Monterey Formation in the Basin are very limited. The only long-term record is from SVWD Well #9 previously thought to be screened in the Santa Margarita aquifer (Kennedy/Jenks Consultants, 2015). The lack of monitoring data in the Monterey Formation was addressed by adding 1 private well to the County's private well monitoring network described in Section 2.2.4.1 and installing 2 new dedicated monitoring wells described in Section 6.9.1.

The single hydrograph for the Monterey Formation on Figure 4-10 shows that groundwater elevations have a much more pronounced response to drought and increased water usage than the Santa Margarita aquifer, presumably because recharge to sandy layers tapped in the Monterey Formation is impeded by the low conductance of the surrounding mudstone and shale layers. A decline in groundwater elevations of about 150 feet corresponds with an extended dry period that started in the mid-1980s (Figure 4-10) and population growth in the Basin. It is notable that the SVWD Well #9 was pumped more between 1983 and 1988 than in the years before and after. Groundwater elevations stabilized in 1994 during a period of 4 consecutive wet years. A more typical rainfall pattern and significantly reduced extraction from SVWD Well #9 has allowed groundwater elevations to recover by about 75 feet (Figure 4-10). Its pump was removed in early 2026 and the well is now only used for monitoring.

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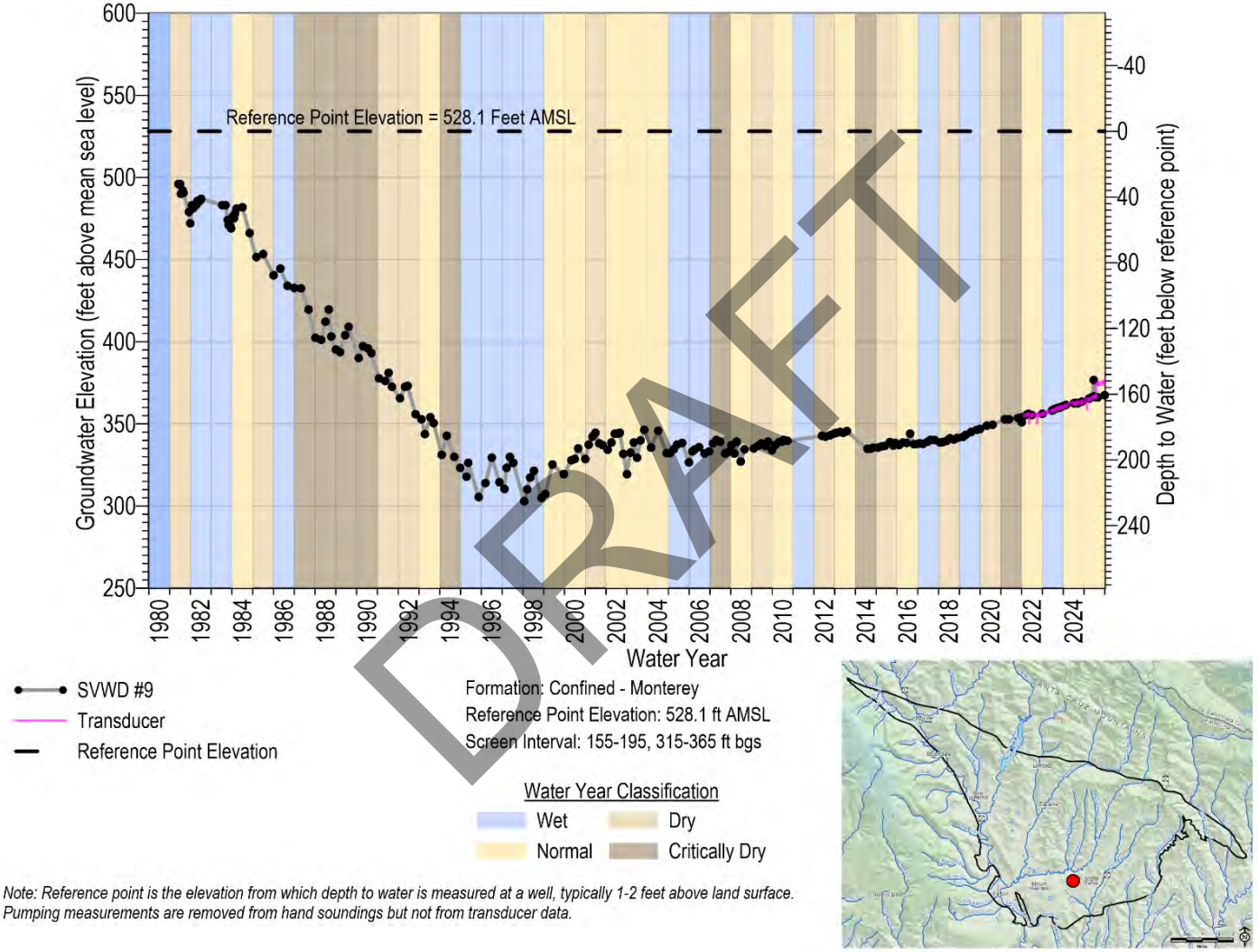

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Figure 4-10. Monterey Formation Hydrograph

4.2.4 Lompico Aquifer Groundwater Elevations

4.2.4.1 Lompico Aquifer Groundwater Elevations over Time

Most of the groundwater pumped from the Lompico aquifer in the Basin is extracted in the Scotts Valley area by SVWD. The Lompico aquifer is also pumped by the SLVWD Pasatiempo and MHA wellfields to the south of Scotts Valley. There is little to no Lompico aquifer pumping north of Bean Creek and therefore there has been no historical groundwater level monitoring conducted in the North of Bean Creek subarea (Figure 4-6).

In the Mount Hermon/South Scotts Valley subarea of the Basin, which includes central Scotts Valley south of Bean Creek, Camp Evers, and Pasatiempo, groundwater elevations in the Lompico aquifer declined as much as 200 feet in well SVWD #10 during the drought period between 1985 and 1994 (Figure 4-11). Other nearby wells have a shorter measurement record but display similar trends. The groundwater elevation declined more in this subarea than in other parts of the Basin during the drought due to population growth, remediation pumping at 2 cleanup sites, and pumping at the Hanson Quarry that led to overextraction of groundwater.

Subsequent groundwater management efforts and reduced pumping due to water conservation have slowed the decline in groundwater levels. Groundwater levels stabilized in the early 2000s and, since 2017, increased in the subarea by about 25 to 50 feet (Figure 4-11). Part of this recovery is attributed to the emergency use of SLVWD interties for wildfire recovery, allowing for additional surface water diversion from the Felton System to offset groundwater pumping from the Pasatiempo wellfield.

The North Scotts Valley subarea demonstrates similar overall trends, though the record only starts in 1996 and has a short-term groundwater level increase between 1996 and 2000 not observed in the other hydrographs. Groundwater elevations at SVWD TW-19 have also increased by about 50 feet since 2017 (Figure 4-11).

Groundwater elevation data for wells in the Lompico aquifer indicate that sometime around 2012, pumping volumes ceased to be unsustainable. Most wells exhibited more or less constant seasonal lows in groundwater elevation during the 2012-2015 drought. Moreover, it appears that groundwater elevations have been recovering since 2017. These facts suggest that over-pumping is no longer occurring in the Lompico aquifer.

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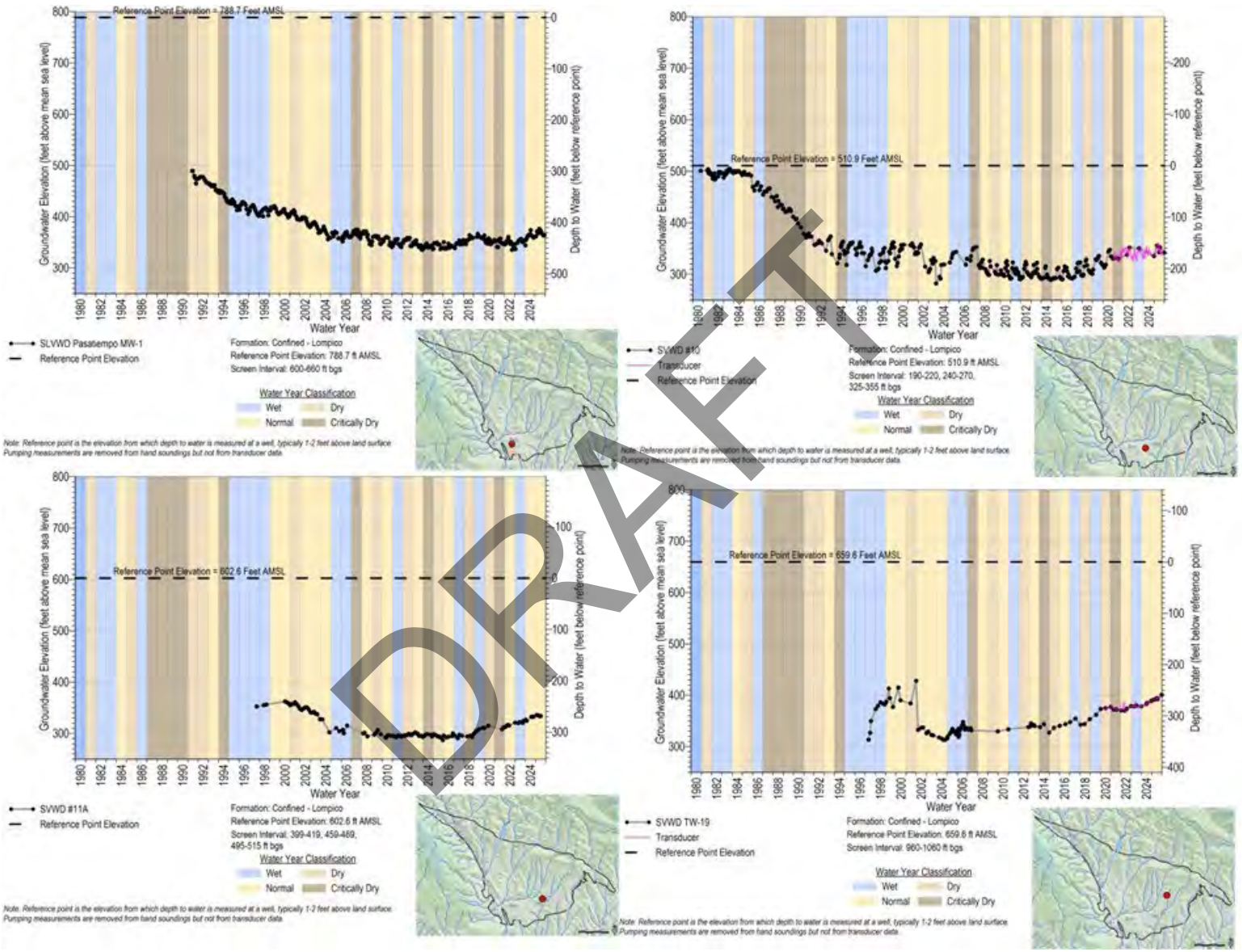

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Figure 4-11. Lompico Aquifer Hydrographs

4.2.4.2 Lompico Aquifer Groundwater Elevation Contours and Flow Directions

The highest groundwater elevations in the Lompico aquifer occur at the northern boundary of the Basin, where the Lompico Sandstone is exposed at the surface in a narrow strip parallel to the Zayante-Vergeles fault. This is the only area in which the Lompico aquifer can be recharged directly by percolation of precipitation or streamflow; elsewhere it is covered by younger geologic units that prevent direct recharge. Groundwater flow in the southern portion of the Lompico aquifer is primarily controlled by municipal pumping in the Scotts Valley area by SVWD and in the Pasatiempo area by SLVWD and MHA. Extraction of water causes depression of groundwater levels around the wells, such that groundwater flows downgradient from the north and south toward the pumping wells. Groundwater elevation contours for Spring and Fall of WY2025 are shown on Figure 4-12 and Figure 4-13, respectively.

Measured groundwater elevation data are only available in the Pasatiempo, Camp Evers, and Scotts Valley areas. Consequently, the contour maps (Figure 4-12 and Figure 4-13) do not include contours north of Bean Creek. Basin Model simulations identify 3 primary discharge points along the San Lorenzo River where the Lompico Sandstone outcrops. These discharge points, shown in teal on the figures, are found on the west side of the Ben Lomond fault near Felton and further upstream near the communities of Ben Lomond and Boulder Creek. These locations are where the Lompico aquifer contributes to San Lorenzo River baseflow.

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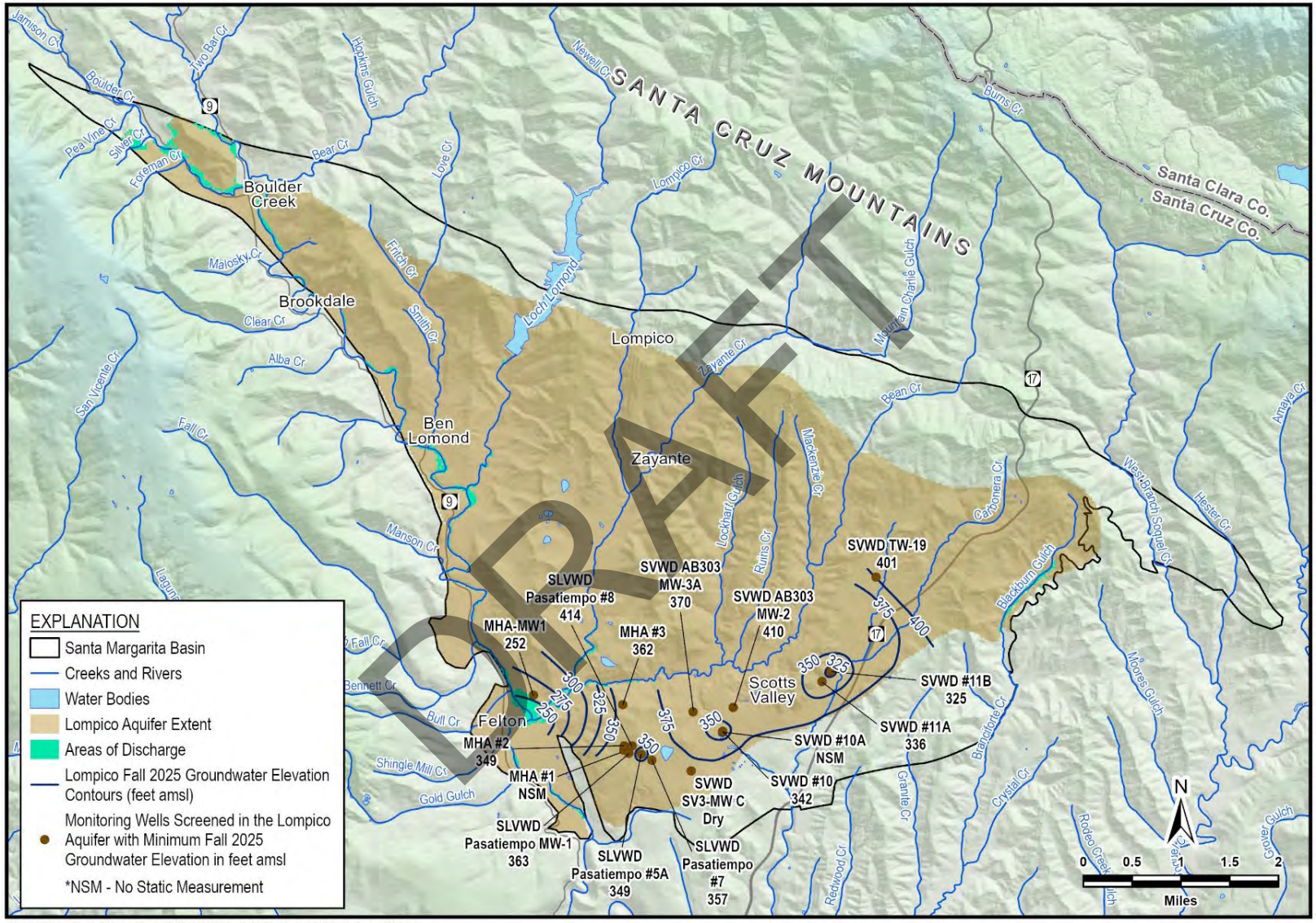

Figure 4-12. Lompico Aquifer Groundwater Elevations and Contours, Spring 2025

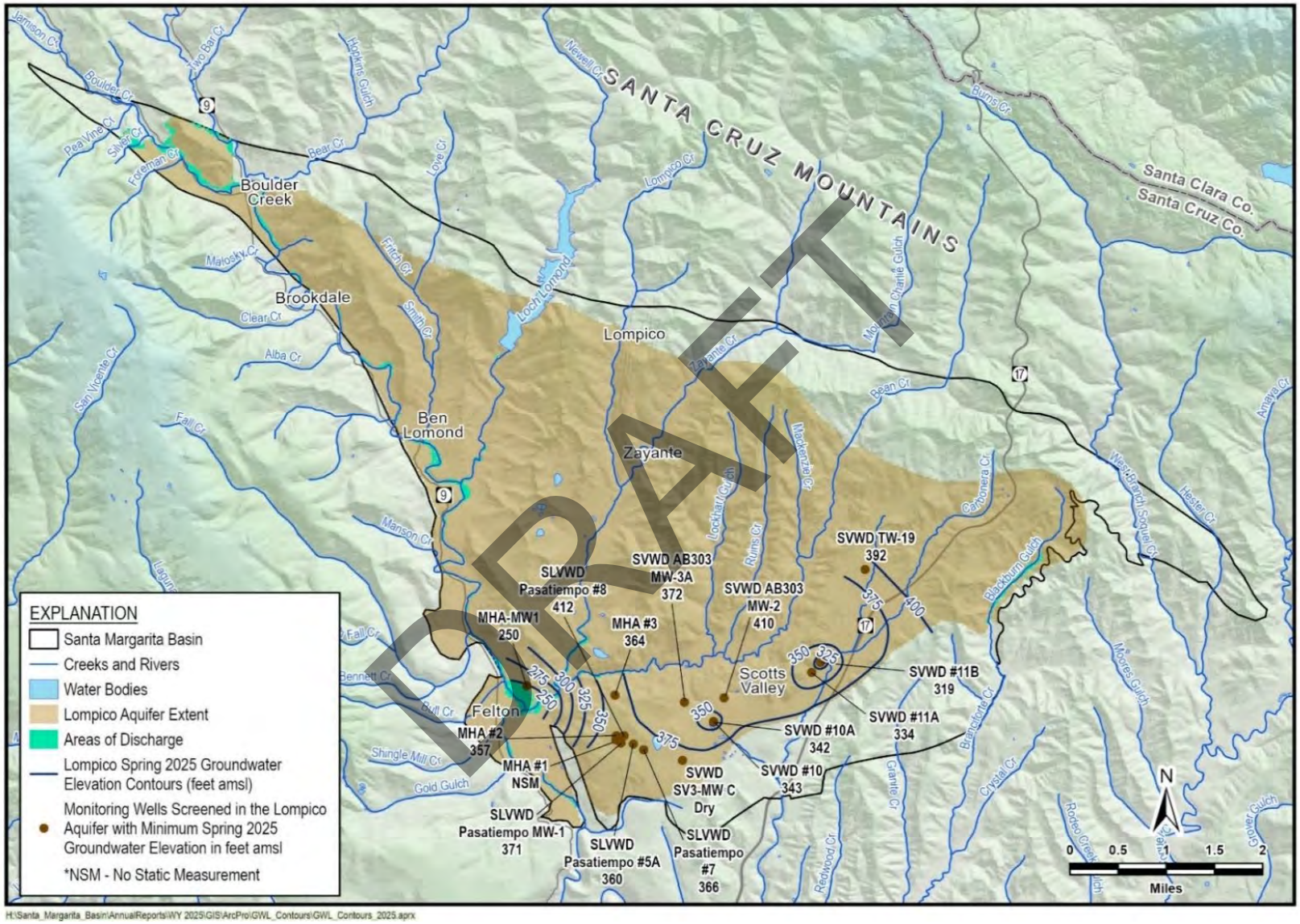

Figure 4-13. Lompico Aquifer Groundwater Elevations and Contours, Fall 2025

4.2.5 Butano Aquifer Groundwater Elevations

4.2.5.1 Butano Aquifer Groundwater Elevations over Time

The Butano aquifer is the deepest of the productive aquifers in the Basin. Due to its great depth, there are few wells completed in it, and limited groundwater elevation data available for analysis. SVWD's water supply wells in the aquifer are SVWD Sucinto (#3B replacement), Grace Way, and Orchard Well (#7A replacement). The SVWD supply wells are screened in both the Butano Formation, at depths greater than 1,000 feet, and the overlying Lompico Formation; hence groundwater elevations measured in these supply wells are a composite elevation from both aquifers. As such, the groundwater elevations are not specific to the Butano aquifer making them difficult to interpret. The SVWD Canham and Stonewood monitoring wells are installed entirely within the Butano aquifer though not close to the SVWD supply wells (Figure 4-6).

Hydrographs shown on Figure 4-14 reflect long-term stable groundwater elevation trends since 1994, especially in the Butano-specific monitoring wells. The monitoring wells do not have seasonal groundwater elevation fluctuations. The supply wells show seasonal groundwater elevation fluctuations of greater than 50 feet, due to pumping during high-demand summer months, and the influence of flow to the supply wells from multiple aquifers.

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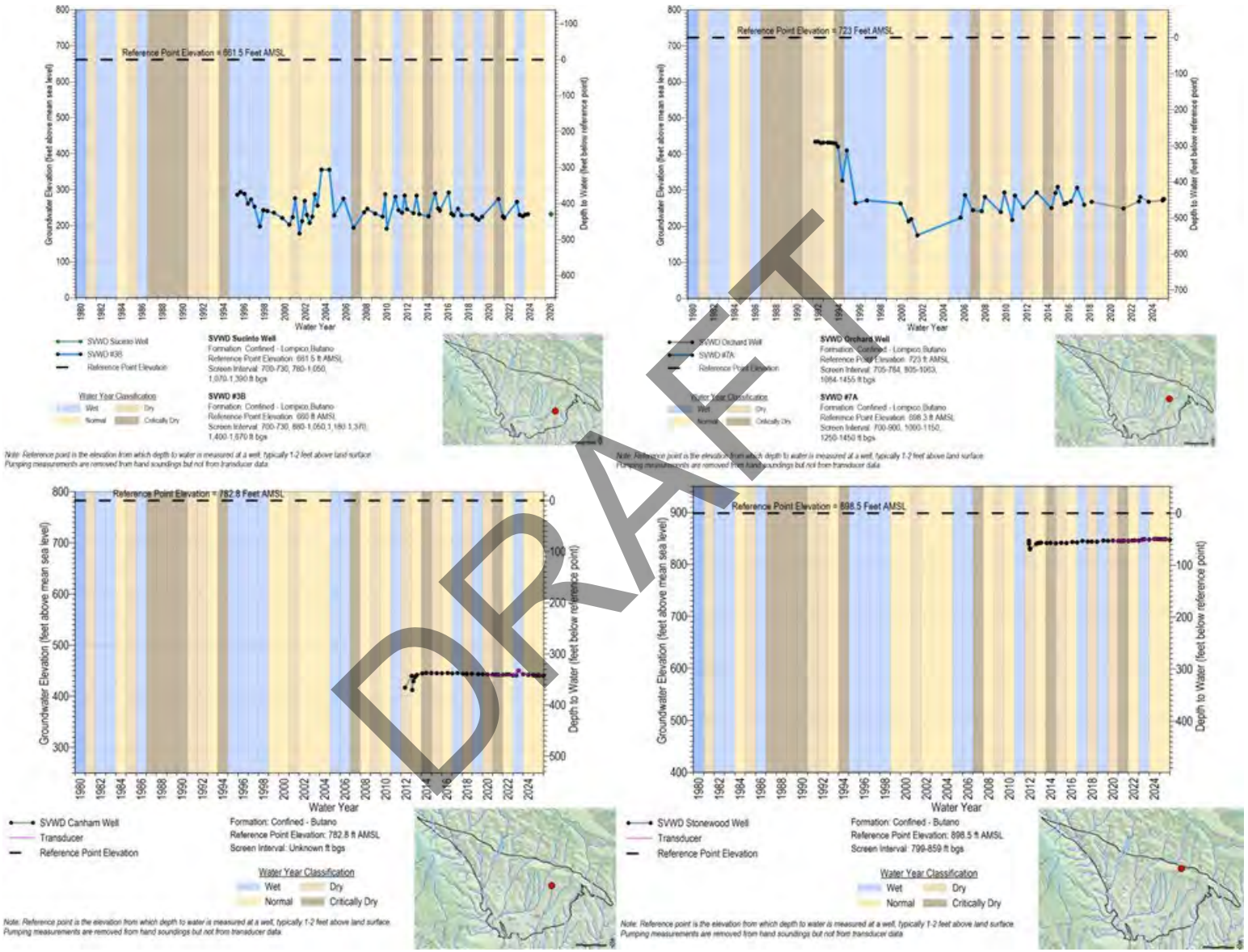

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Figure 4-14. Butano Aquifer Hydrographs

4.2.5.2 Butano Aquifer Groundwater Elevation Contours and Flow Directions

The limited wells available to contour groundwater elevations in the Butano aquifer are shown on Figure 4-6:

- SVWD's Canham and Stonewood monitoring wells are screened solely in the Butano aquifer
- Monitoring well SVWD #15 is screened roughly in equal lengths in the Lompico and Butano aquifers and is at times highly influenced by pumping at Orchard and Sucinto wells. It is still useful for groundwater elevation contour maps, but only with strict quality control of the data to ensure that groundwater levels are not influenced by active pumping;
- SVWD's active Butano aquifer supply wells, Grace Way, Sucinto (#3B replacement), and Orchard (#7A replacement), are screened in the Lompico and Butano aquifers and are not suitable for contouring because 1) they do not consistently have static levels unless they are offline for an extended period of time, and 2) although in the past it has been assumed their groundwater levels are more representative of the Butano aquifer than the Lompico aquifer because a greater percentage of their screened interval is within the Butano aquifer (Kennedy/Jenks Consultants, 2015), this has not been confirmed with downhole flow surveys. Recent flow surveys for Sucinto and Grace Way well installations suggest that the aquifers contribute about equal volumes to the supply wells.

Groundwater elevation contour maps for spring and fall of WY2025, are shown on Figure 4-15 and Figure 4-16, respectively. The extent of the Butano aquifer contours is limited to just the area of available control points. Since these are the same points used for model calibration there is greater uncertainty in the simulated contours with distance from the control points. Also, complicating the simulated elevations is that each of the 3 Butano Sandstone members (upper, middle, and lower) are assigned their own model layers and thus each has its own simulated groundwater elevations which makes it difficult to produce a realistic combined contour map.

Like groundwater elevations in the Lompico aquifer, the Butano aquifer's highest groundwater elevations are where it is exposed at the surface along the Basin's northern boundary parallel to the Zayante-Vergeles fault. This is an important recharge area for the aquifer as it can only be recharged directly by percolation of precipitation and streamflow where it is exposed at the surface. The drawdown caused by pumping SVWD's Lompico/Butano extraction wells forms local pumping depressions. The Canham and Stonewood monitoring wells have higher groundwater elevations than the water supply wells, which indicates that groundwater flow is mostly north to south toward the pumping center caused by the Lompico/Butano aquifer water supply wells. Model-simulated groundwater elevations indicate that south of the pumping depression there is south to north flow toward the depression.

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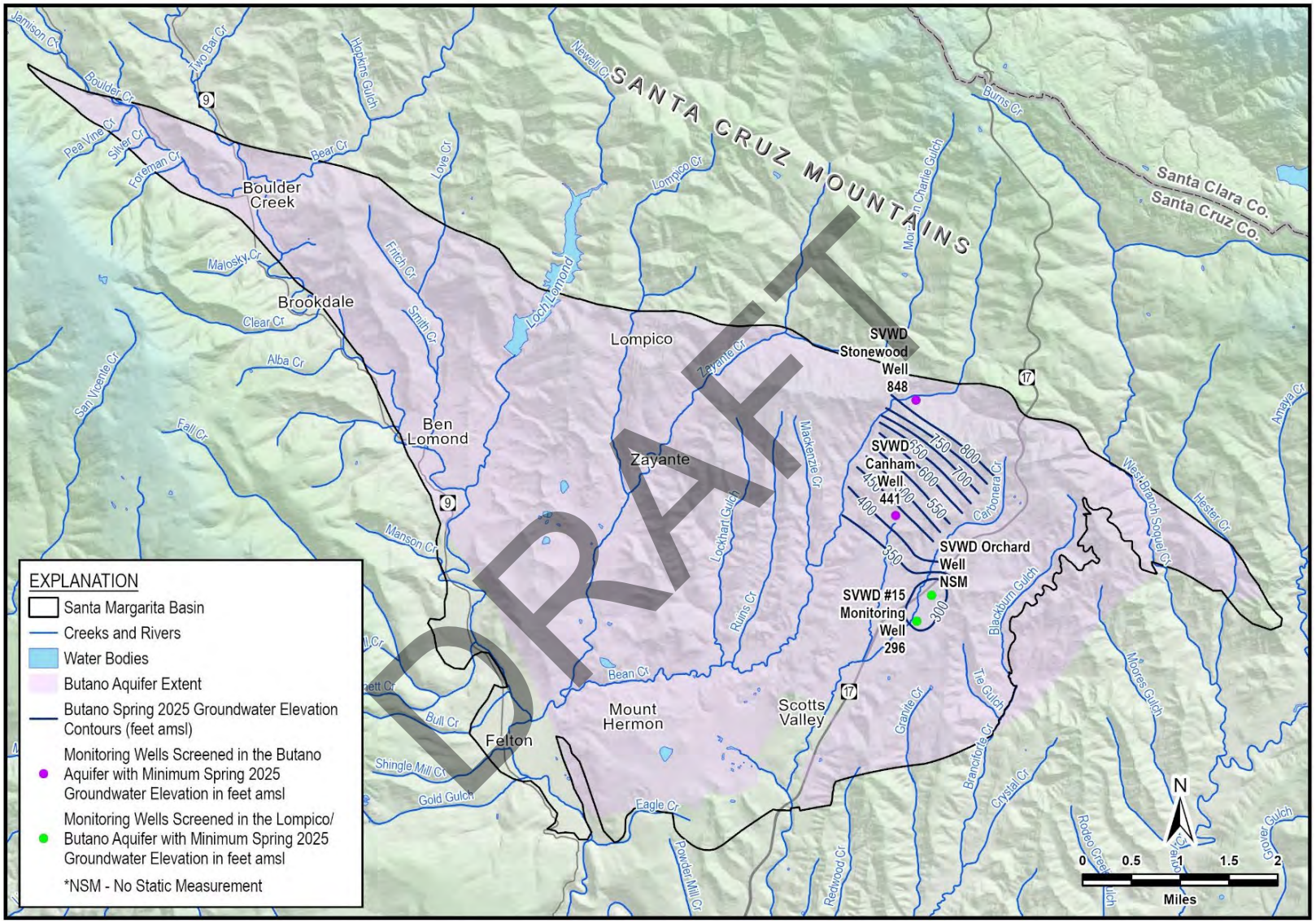

Figure 4-15. Butano Aquifer Groundwater Elevations and Contours, Spring 2025

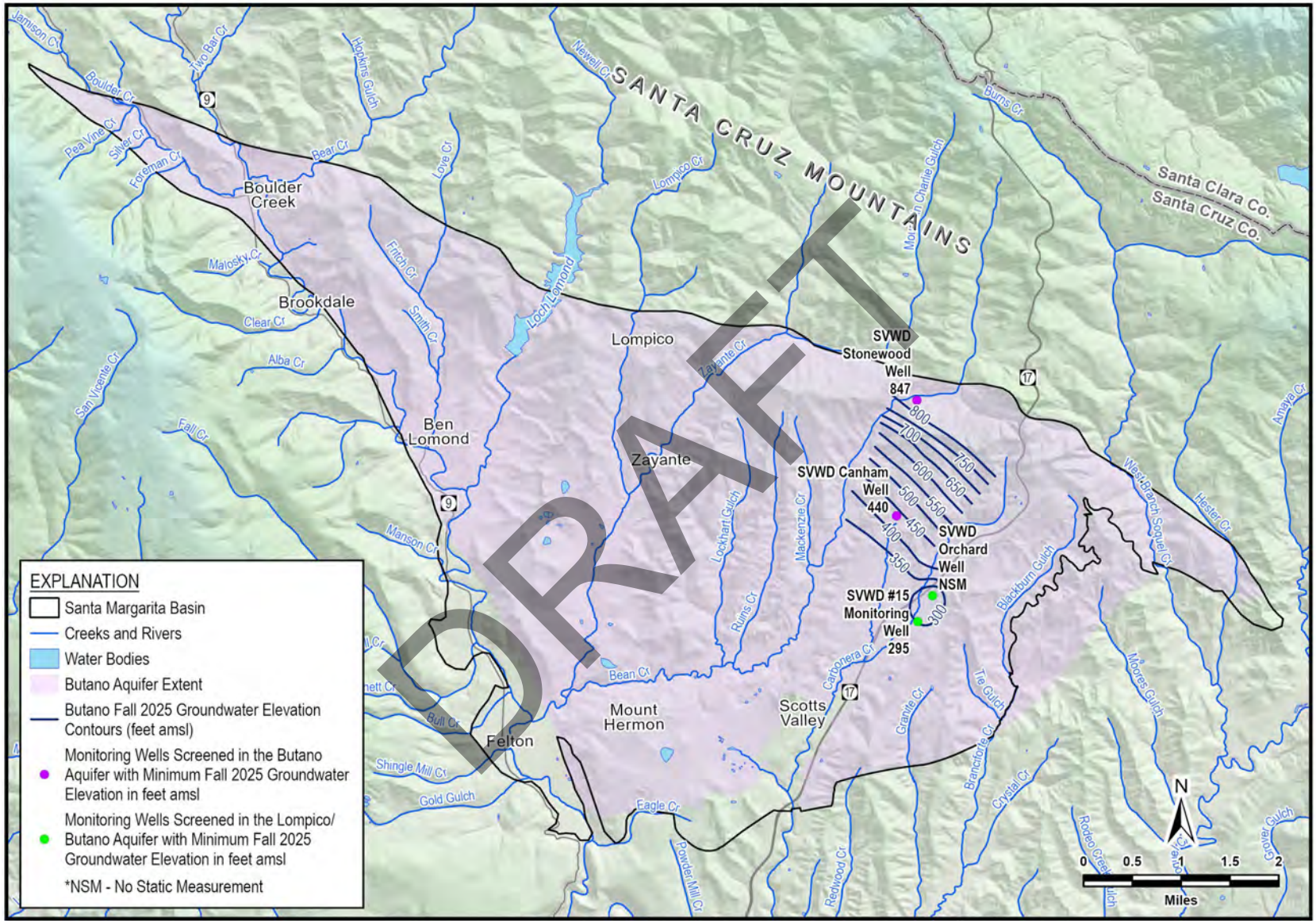

Figure 4-16. Butano Aquifer Groundwater Elevations and Contours, Fall 2025

4.2.6 Vertical Hydraulic Gradients

Differences in groundwater elevations between the Basin's aquifers and within some of the thicker aquifer units create vertical hydraulic gradients. Vertical gradients produce upward or downward flow within aquifers, or flow between overlying or underlying aquifers. Previous studies have identified substantial vertical gradients in the Pasatiempo, Camp Evers, and Scotts Valley areas, where overpumping in the Lompico aquifer has created local pumping depressions that cause groundwater to flow downward (Johnson, 2009; Kennedy/Jenks Consultants 2015).

In the relatively small area of the Basin where the Santa Margarita and Lompico aquifers are in direct contact with each other (Figure 3-9), the vertical hydraulic gradient induces recharge from the unconfined Santa Margarita aquifer into the deeper Lompico aquifer (Kennedy/Jenks Consultants 2015). For most of the Basin where the fine-grained Monterey Formation separates the Santa Margarita and Lompico aquifers, downward vertical flow is significantly reduced. Figure 4-17 and Figure 4-18 show groundwater elevation hydrographs for 2 sets of multi-level monitoring wells located in the Pasatiempo / Camp Evers area. Groundwater elevations in the Santa Margarita aquifer at these locations are currently at least 50 feet to 150 feet higher than in the confined Lompico aquifer that is separated from the Santa Margarita aquifer by the Monterey Formation. The hydrographs on Figure 4-18 for the Pasatiempo monitoring wells illustrate how continually lowered groundwater elevations in the Lompico aquifer progressively increased the downward vertical gradient over time. At the start of the hydrograph record, groundwater elevation differences are around 10 feet and increase to roughly 150 feet. It is possible that prior to 1990, the vertical hydraulic gradient may have been upward, with the Lompico aquifer elevations being higher than those in the Santa Margarita aquifer.

Vertical hydraulic gradient information is only available in the Pasatiempo/Camp Evers/southern Scotts Valley area because this is the only area where groundwater elevation data from nested or multi-level monitoring wells are available. Not enough information is available to assess vertical gradient between the Lompico and Butano aquifers.

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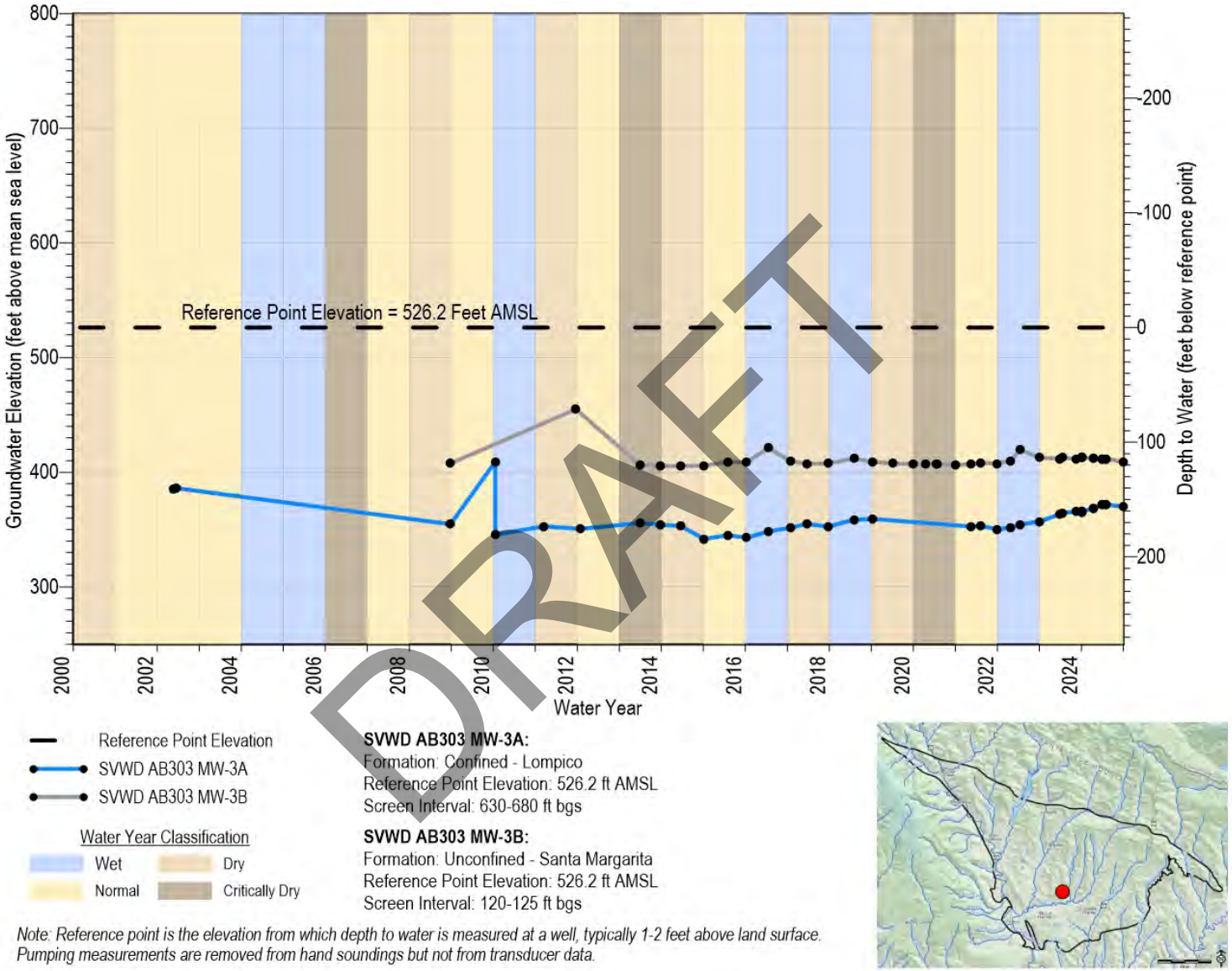

Figure 4-17. Monitoring Well AB303 MW-3A and AB303 MW-3B Hydrographs Illustrating Vertical Gradients Over Time

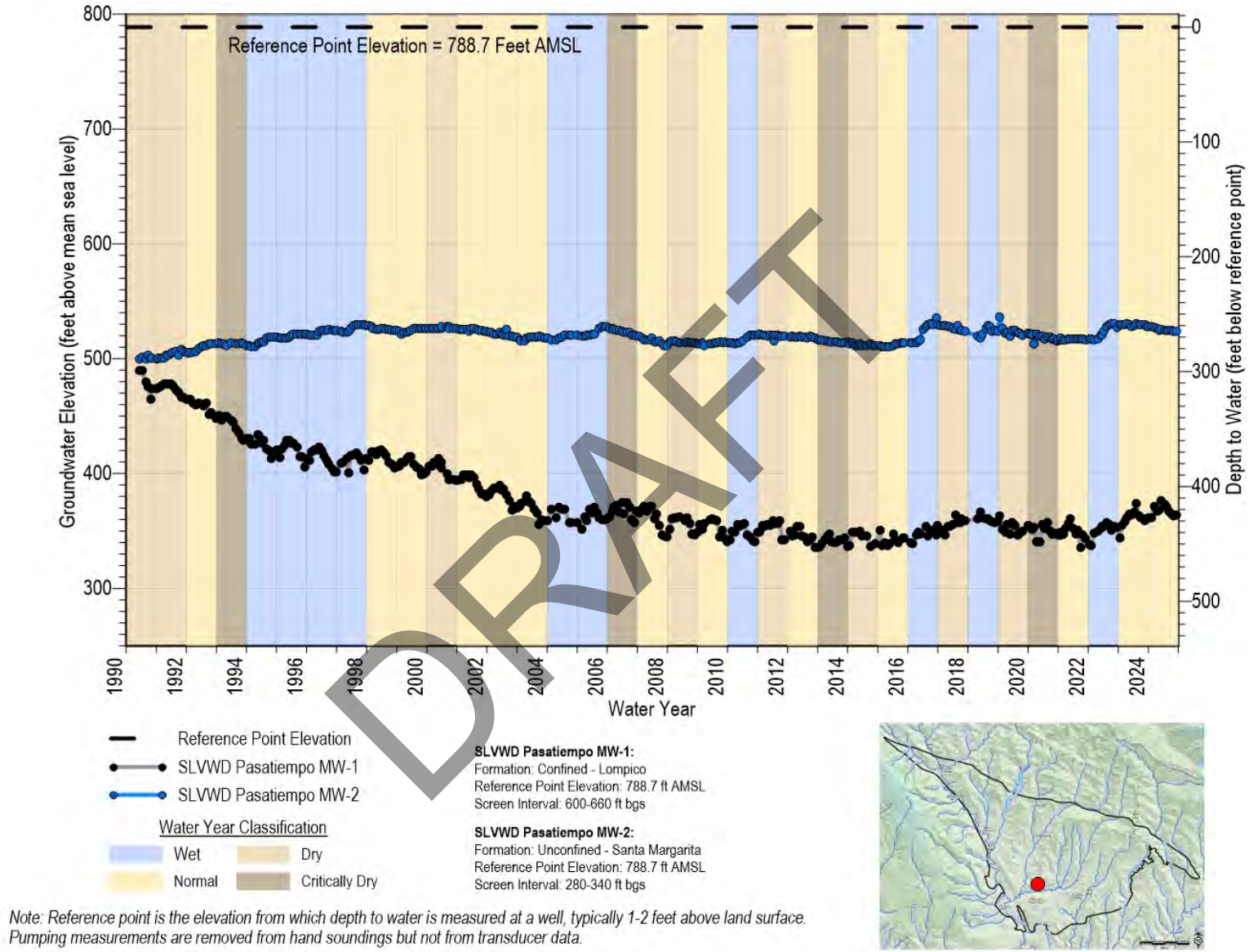

Figure 4-18. Monitoring Well SLVWD Pasatiempo MW-1 and SLVWD Pasatiempo MW-2 Hydrographs Illustrating Vertical Gradients Over Time

4.3 Change of Groundwater in Storage

Since the 1970s, and even possibly starting in the 1960s, there has been a consistent loss of groundwater stored in the Basin due primarily to over-pumping of the Lompico aquifer in the south Scotts Valley area. Figure 4-19 shows the Basin Model simulated annual change in storage with the color of the bars correlating with the water year type, and the solid line reflecting the cumulative change in storage.

Individual annual increases of groundwater stored in the Basin correlate with wet years and normal years if they precede a dry year. Historically, normal or drier water year types generally result in groundwater lost from storage. This is reflected on Figure 4-19 where cumulative storage change shows a consistent decline through about WY2014. After that, cumulative change in storage has stabilized with annual increases in wet years, little to no change in normal years, and decreases in dry years.

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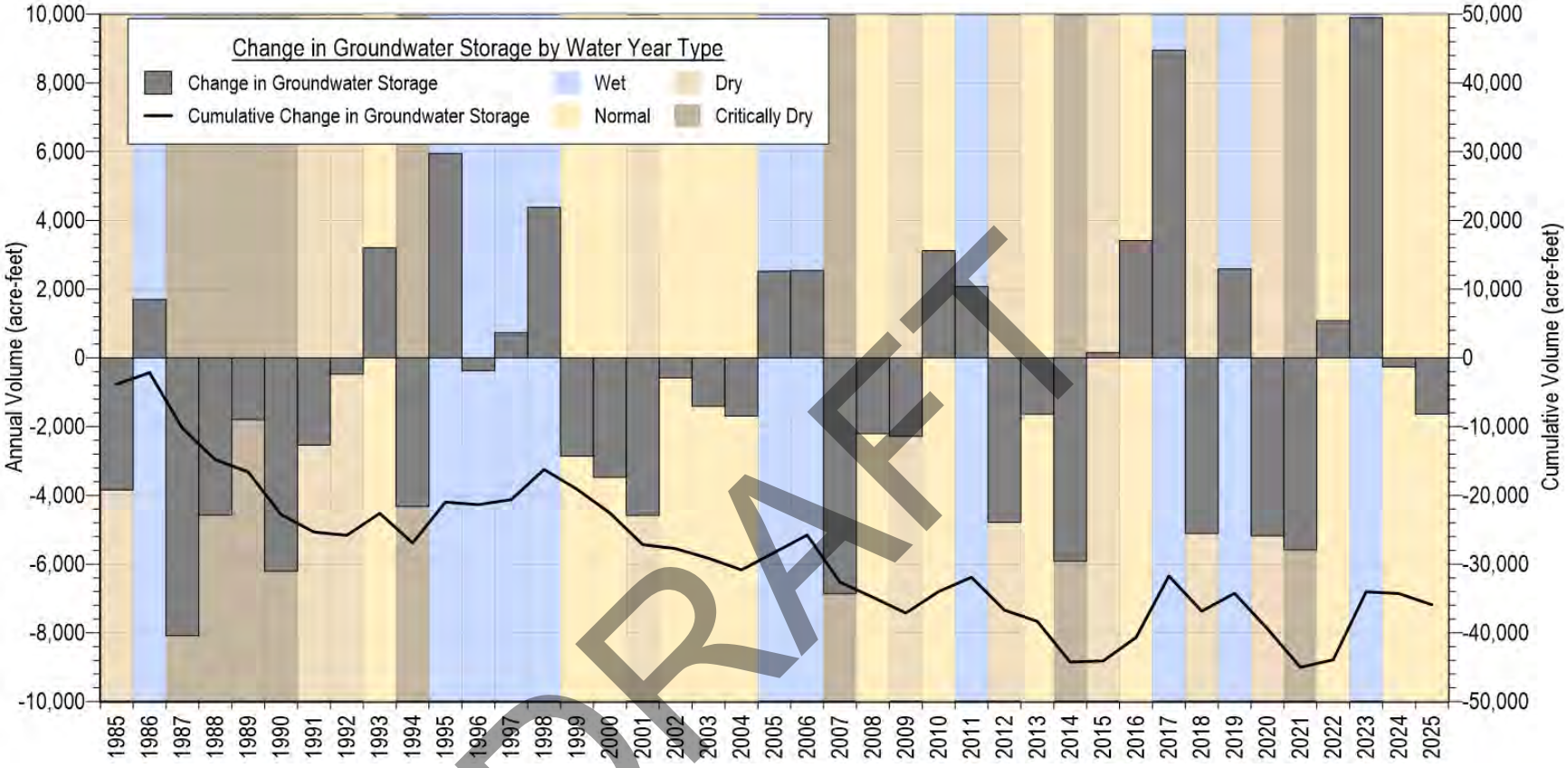

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Figure 4-19. Santa Margarita Basin Annual and Cumulative Change of Groundwater in Storage

4.4 Groundwater Quality

Groundwater in the Basin is generally of good quality and meets primary drinking water standards. However, both naturally occurring and anthropogenic groundwater quality concerns are present in some aquifers and areas. The following subsections discuss general groundwater quality with a focus on constituents that have concentrations above state drinking water standards. The chemical constituents included in this section were considered and evaluated for inclusion in the Basin COC for which SMC are developed in Section 3. Appendix 4B contains chemographs for wells with groundwater quality data in the Basin at the time of development of the 2022 GSP.

4.4.1 Groundwater Quality Standards

As a relative measure of groundwater quality, this section compares groundwater quality in the Basin's different aquifers to primary and secondary drinking water standards. These standards are established by the USEPA and the California SWRCB DDW. Standards for contaminants in drinking water established by the USEPA represent the legal maximum allowable concentration for a constituent in public water systems. The maximum limits, referred to as MCLs, have been developed under the Safe Drinking Water Act. Some states, including California, have state laws or regulations that set MCL values consistent with or lower than federal MCLs, or for chemicals for which no federal MCL has been established. For example, the federal MCL for benzene is 0.005 mg/L but the state MCL is 0.001 mg/L. MTBE does not have a federal MCL but California established an MCL of 0.013 mg/L.

California MCLs are in accordance with CCR, Title 22 and are categorized as either primary or secondary. Primary MCLs are those which address health concerns, whereas secondary MCLs address aesthetics such as taste and odor. Not all constituents with an established primary MCL have a secondary MCL, and not all constituents with a secondary MCL have a primary MCL. Using the example of MTBE above, the primary MCL is 0.013 mg/L whereas the secondary MCL is 0.005 mg/L. Manganese, on the other hand, only has a secondary MCL of 0.05 mg/L. The California Office of Environmental Health Hazard Assessment establishes public health goals based on lifetime exposure risk for constituents with an established MCL or those for which an MCL will be established in the future. MCL values may be revised based on any changes to the public health goal.

In addition to regulated constituents, California DDW has established notification levels and response levels for some constituents that do not have an established MCL. Recommended actions for constituents exceeding these levels are established by DDW.

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4.4.2 Groundwater Quality Testing

Municipal water suppliers regularly sample and test both raw and treated water sources per state requirements contained in the CCR, Title 22. Groundwater quality parameters typically tested for include general minerals, general physical parameters, and organic/inorganic compounds. All municipal water sources are treated to state drinking water standards.

The Code of Regulations requires that public water systems annually provide their customers with an annual water quality report called a Consumer Confidence Report. This includes information on source water, levels of any detected contaminants, and compliance with drinking water regulations (including monitoring requirements), along with some educational information. Consumer Confidence Reports for SLVWD and SVWD are available at the following websites: https://www.slvwd.com/233/Consumer-Confidence-Reports and https://www.svwd.org/water-quality, respectively.

Groundwater quality is not regularly tested at SLVWD and SVWD monitoring wells. There have been some one-off samples collected and tested over the years, but there is no long-term groundwater quality record in any municipal monitoring well. There are longer groundwater quality records in monitoring wells associated with contamination cleanup sites. These only provide data for the period during active site assessment and remediation. Many of these monitoring wells are destroyed once clean up goals have been achieved.

Private domestic use wells are not subject to DDW drinking water regulations. However, before any newly constructed domestic well can be used the County requires testing of nitrate and bacteria (Total Coliform and E. Coli) to demonstrate the water is a safe drinking water source. As of September 1, 2025, the County has specific testing requirements at property sale. This requires sellers of properties served by domestic wells to complete water quality testing and well flow testing before closing the sale. Results must be provided to the buyer and SCEH.

Small water systems that supply groundwater to 15–199 service connections also report water quality to the County. These water quality constituents include inorganics, nitrates, arsenic, perchlorate, chromium, radiation, synthetic organic compounds, VOCs, and fuel oxygenates, which include MTBE. The frequency of monitoring ranges between 1 year and 9 years depending on the constituents. Smaller water systems with between 5 and 14 service connections have limited one-time testing requirements for inorganics and report quarterly bacteriologic water quality to the County.

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4.4.3 Naturally Occurring Groundwater Quality

4.4.3.1 Salinity

Elevated salinity in groundwater can occur from both natural geologic sources and as a result of anthropogenic groundwater contamination. Salinity in groundwater is often measured using TDS and chloride concentrations. There are no primary drinking water standards for TDS and chloride, but rather secondary drinking water standards that are set at 1,000 and 250 mg/L, respectively.

Natural waters contain some dissolved solids (salinity) from contact with soils, rocks, and other natural materials. Geologic formations can influence groundwater quality, and formations often have their own unique groundwater salinity signature. Surface activities by humans can artificially introduce salts into groundwater through the natural recharge process where infiltrating rainfall dissolves anthropogenic salts on the land surface allowing salts to enter the underlying aquifers. Slight differences in salinity occur across the Basin due to its geology. Improperly constructed wells can also allow salts to migrate from 1 aquifer to another.

4.4.3.1.1 Total Dissolved Solids

The regulatory drinking water limit for TDS is a SWRCB secondary MCL, which differs from a primary MCL because it is based on aesthetics rather than health risk. Santa Cruz County enforces the 1,000 mg/L upper limit of the secondary MCL. TDS concentrations in portions of the Santa Margarita aquifer are generally low as a result of its high permeability, exposure at the surface, and associated high rate of aquifer "flushing" (Johnson, 2006; Johnson, 2009). In areas where wells pump from the Santa Margarita aquifer and data on TDS concentrations are available, the following observations on Santa Margarita aquifer TDS are made:

- Quail Hollow has relatively low TDS concentrations typically below 150 mg/L (Figure 4-20)
- The Olympia area has higher TDS concentrations typically ranging between 200 and 800 mg/L (Figure 4-20)
- Historical TDS concentrations in Santa Margarita aquifer wells in the Pasatiempo/Camp Evers/southern Scotts Valley area were lower and more stable than TDS concentrations in the Olympia wells (Johnson, 2009). Since the Santa Margarita aquifer is no longer pumped by municipal suppliers in the Pasatiempo/Camp Evers/southern Scotts Valley area there is no current testing of groundwater quality to determine if this is still the case.

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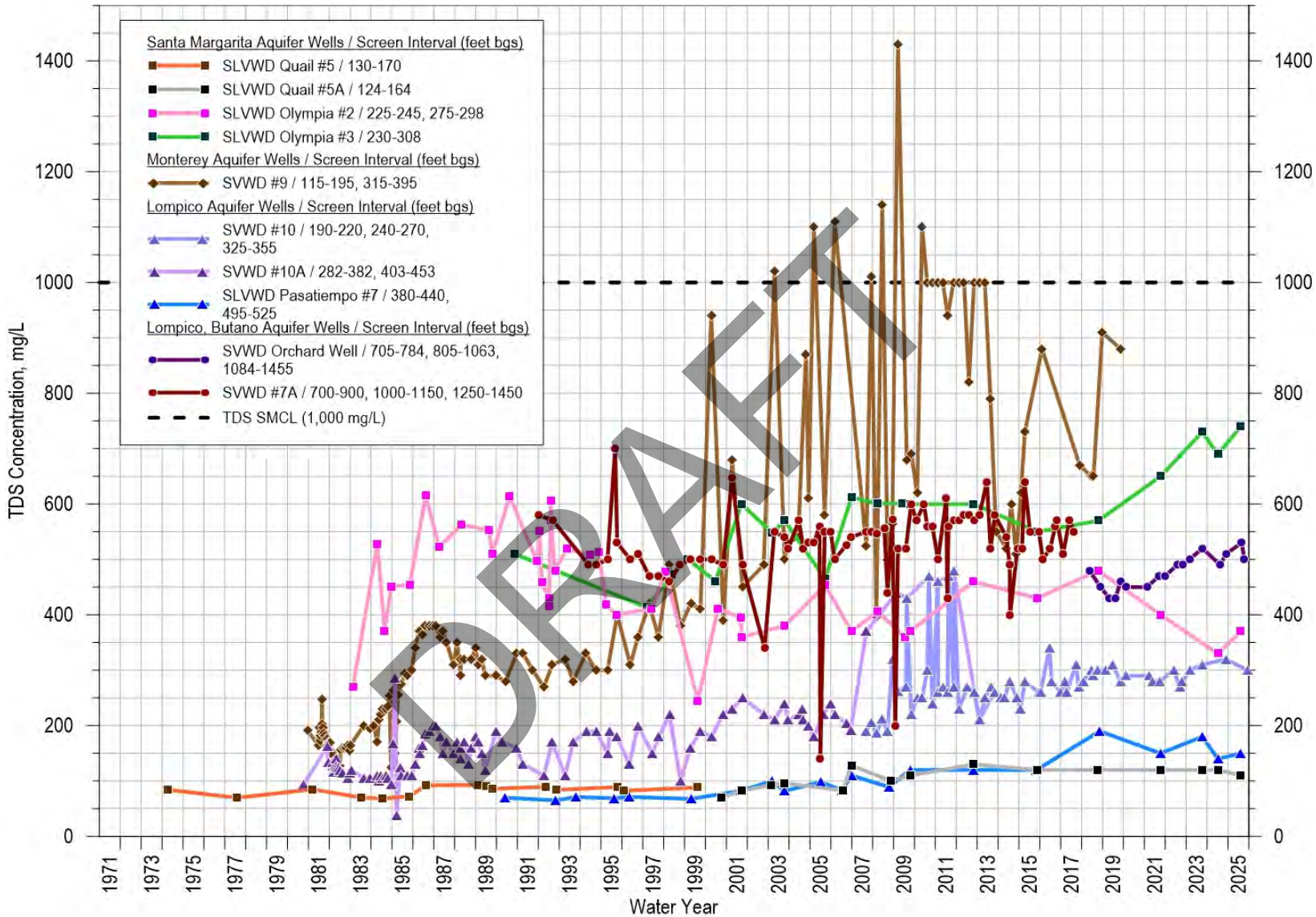

Figure 4-20. Total Dissolved Solids Concentrations in Select Wells from 1970 to 2025

Very few wells screened in the Monterey Formation have groundwater quality data. SVWD's Well #9, the only Monterey Formation well in the Basin with long-term and recent groundwater quality data, has TDS concentrations ranging from 300 to 1,430 mg/L (Figure 4-21). SVWD's Well #9 had an increasing TDS trend while it was being used for extraction prior to 2008. It is thought its increased TDS concentration is linked to the dewatered Santa Margarita aquifer in the area that has caused reduced leakage of good quality water to the underlying aquifers (Johnson, 2009). High TDS concentrations appear to correspond to periods when the well was being pumped more and thereby extracting a greater proportion of its groundwater from deeper in the Monterey Formation which is known to have elevated TDS because of its marine origin and more limited flushing. This well is no longer used by SVWD for water supply because of its low yield and poor water quality. Elevated TDS concentrations were also reported for Monterey Formation monitoring wells SMGWA-7 (1,300 mg/L) and SMGWA-8 (1,000 mg/L) installed in 2023 (M&A, 2023).

Wells screened in the Lompico aquifer do not exceed the TDS secondary drinking water standard and concentrations typically range from 200 to 700 mg/L (Figure 4-20). Among municipal extraction wells, SVWD #10A and SLVWD Pasatiempo #7 show overall increasing TDS trends over the sampling record, whereas SVWD #11A/#11B remain stable. At SVWD #10, TDS concentrations have generally stabilized in the 200 to 300 mg/L range since the early 2010s, following earlier increases observed in the late 1990s through mid-2000s. Increases in TDS generally correlate to declines in groundwater elevation (Figure 4-21). This relationship does not hold uniformly across the Lompico aquifer, however, as shown on Figure 4-22 where groundwater elevation declines at SVWD #11A and #11B do not drive TDS increases. TDS at these 2 wells has remained relatively stable over time, generally ranging from about 280 to 350 mg/L at #11B and about 450 to 550 mg/L at #11A, with only minor variability and no persistent trend despite groundwater level fluctuations. SVWD #11A and #11B are pumped less than #10A and SLVWD Pasatiempo #7, so perhaps concentration fluctuation is related to pumping more than groundwater levels in these wells.

Wells screened in the Butano aquifer appear to have higher TDS concentrations than the Lompico aquifer. SVWD extraction wells screened across both aquifers in North Scotts Valley, #3B and its replacement Sucinto, #7A and its replacement Orchard, and Grace Way, do not exceed TDS secondary drinking water standards, but concentrations are slightly higher than wells further south only installed in the Lompico aquifer. Concentrations in Lompico/Butano supply wells typically range from about 400 to 800 mg/L (Figure 4-20) and have slight increasing trends that do not appear to be related to groundwater level changes (Figure 4-23). Samples collected after installation of dedicated Butano aquifer exploration wells north of Scotts Valley exceeded the secondary MCL at SVWD Canham (1,500 mg/L) and approached the MCL at SVWD Stonewood (950 mg/L), as shown in chemographs in Appendix 4B.

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A known area of elevated salinity north of the Basin between Kings and Bear Creeks is likely associated with connate water, which is saltwater trapped in the pore spaces of marine sediments when it was deposited and subsequently buried by younger sediments. A USGS water resource investigation in 1977 indicated that this area has some saline groundwater and surface water that may be degraded by connate water leaking upward from depth through improperly sealed, abandoned oil test wells (USGS, 1977). Although the source of saline water is outside of the Basin, higher salinity water does impact streams upgradient of the Basin that then flow into it, thereby slightly impacting its surface water quality. Figure 4-24 summarizes the spatial distribution of TDS and chloride across the Basin by aquifer.

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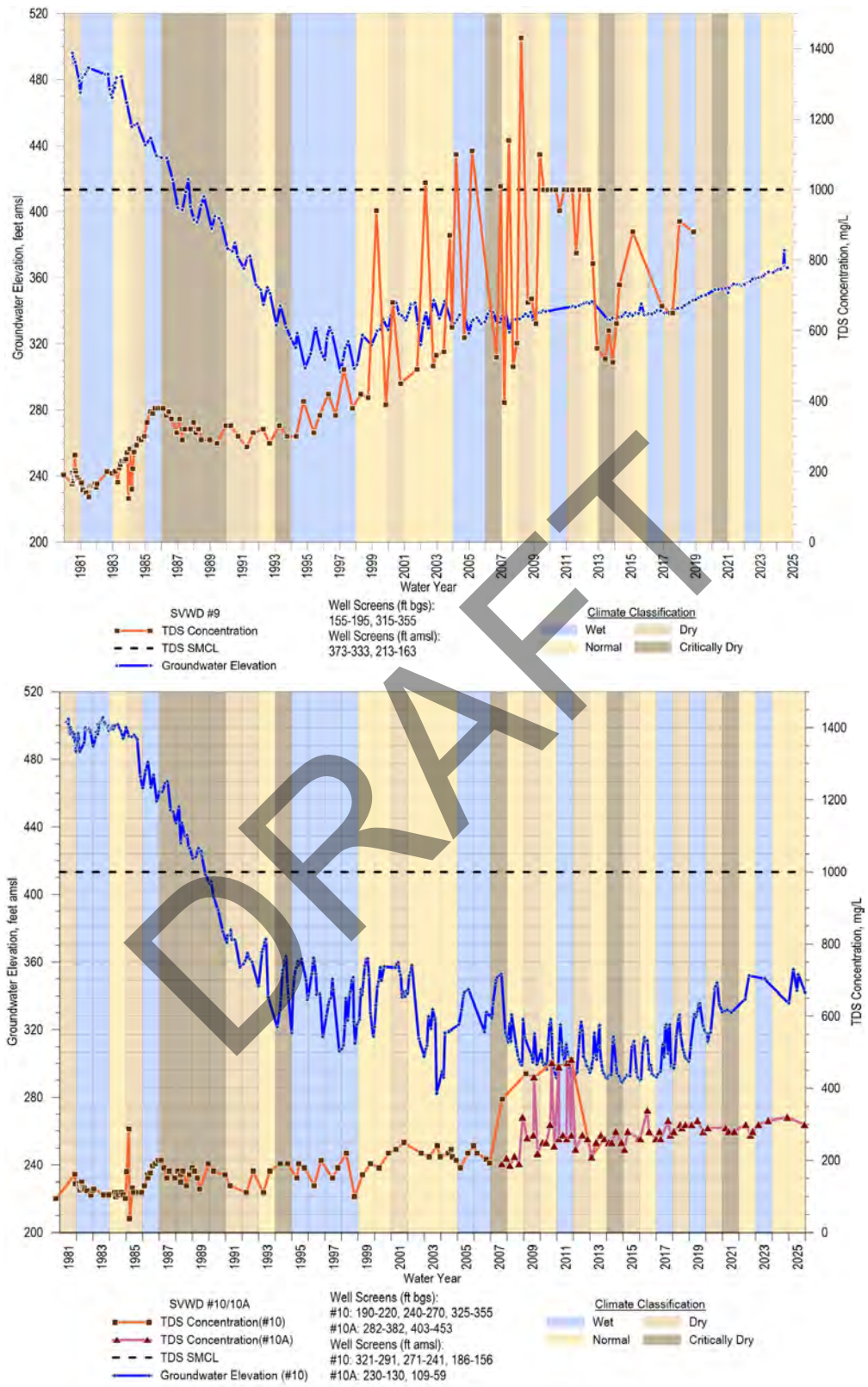

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Figure 4-21. Total Dissolved Solids Concentrations and Groundwater Elevations in SVWD Well #9 (Monterey Formation) and SVWD #10/10A (Lompico Aquifer)

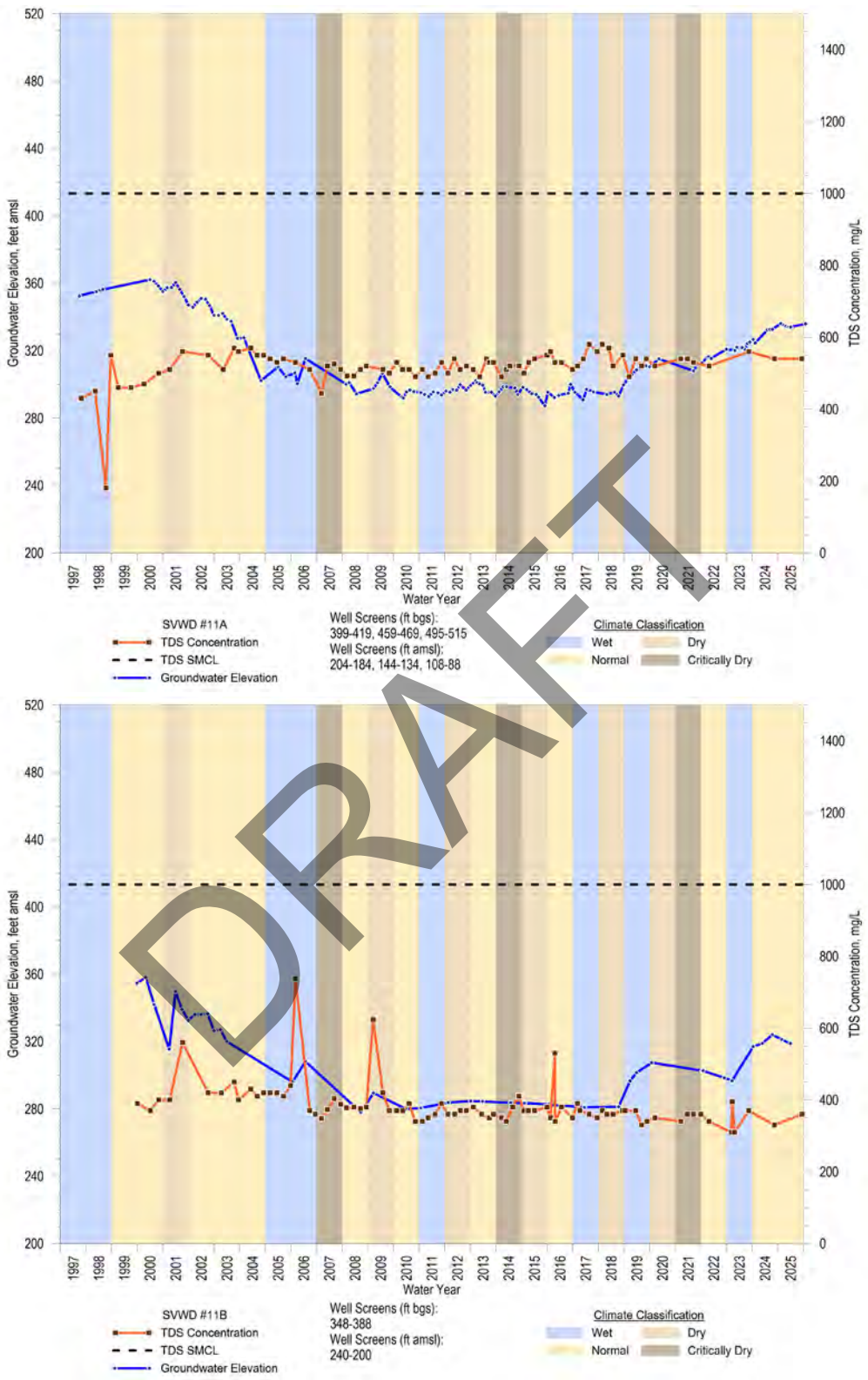

Figure 4-22. Total Dissolved Solids Concentrations and Groundwater Elevations in SVWD Well #11A and SVWD #11B (Lompico Aquifer)

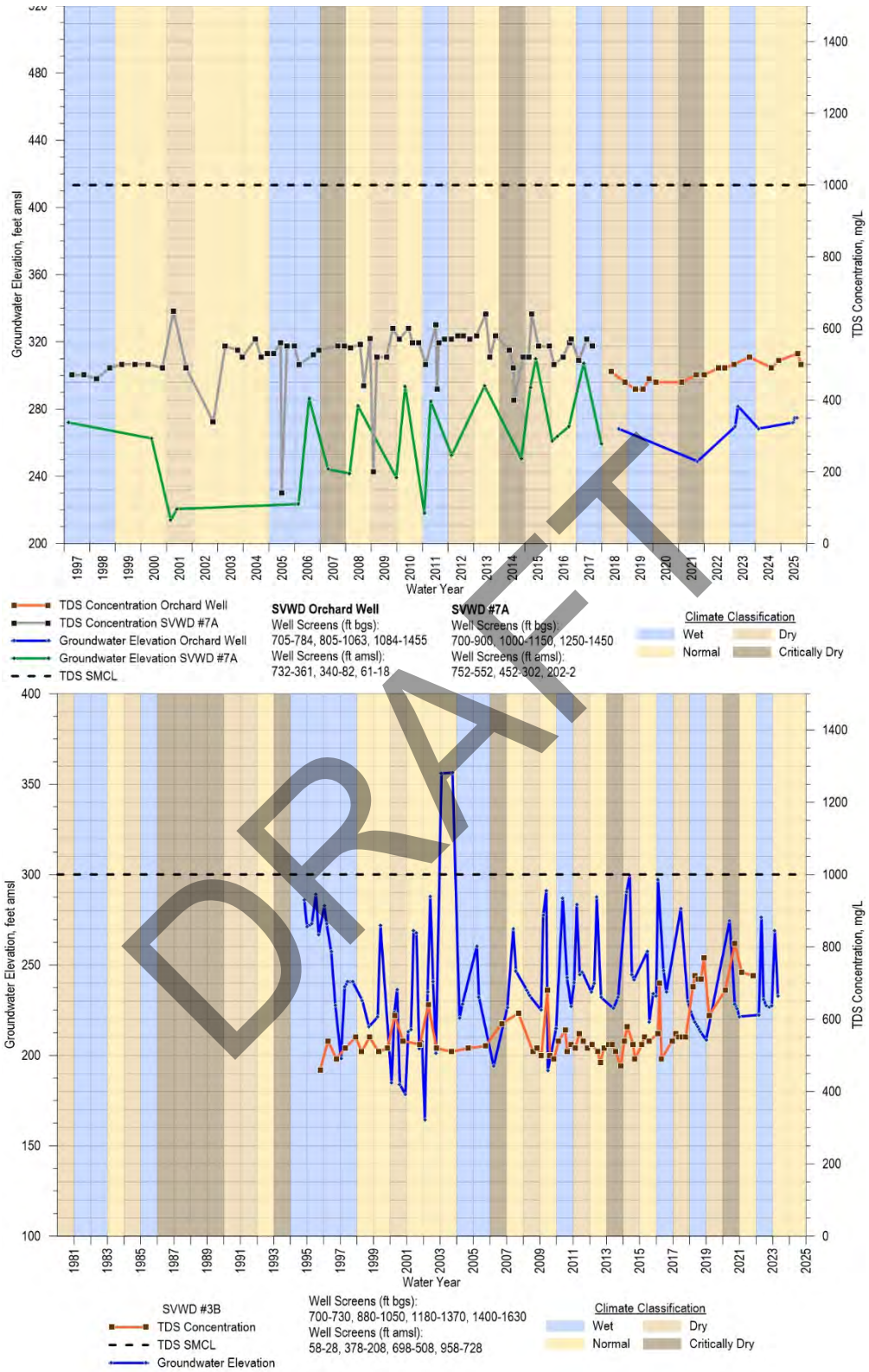

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Figure 4-23. Total Dissolved Solids Concentrations and Groundwater Elevations in SVWD Wells #7A, Orchard, and #3B (Lompico/Butano Aquifer)

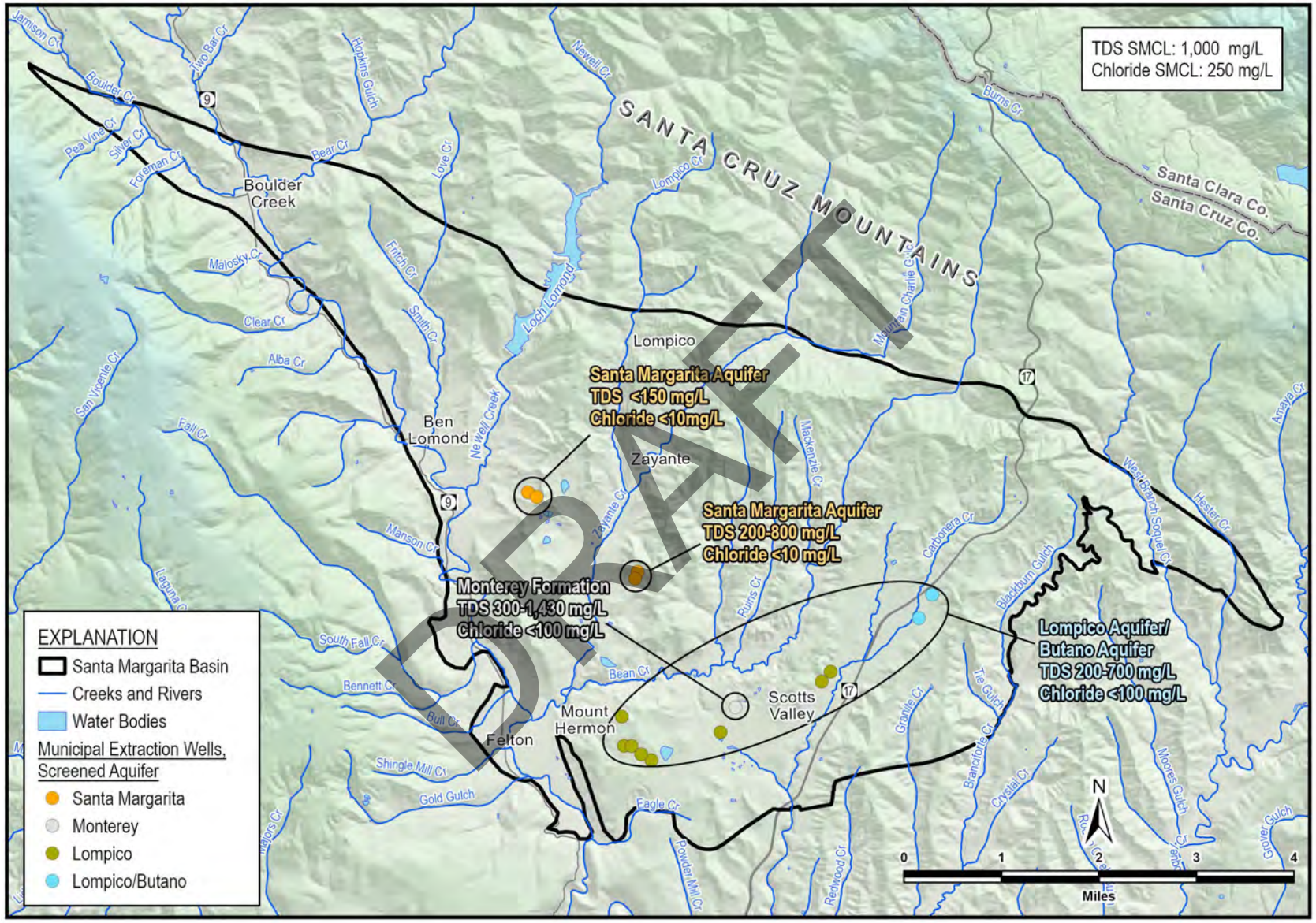

Figure 4-24. Distribution of Total Dissolved Solids and Chloride Across the Santa Margarita Basin

4.4.3.1.2 Chloride

Chloride can be a major component of TDS and is used to determine salinity in groundwater. Chloride concentrations in the Basin are well below chloride's secondary MCL of 250 mg/L and are typically below 100 mg/L. Apart from increasing chloride in the Monterey Formation and Lompico aquifer in the Pasatiempo/Camp Evers/southern Scotts Valley area that mirror TDS trends, chloride concentrations do not have increasing (or decreasing) trends over time. Appendix 4B contains plots of chloride over time for wells with recent groundwater quality data.

4.4.3.2 Iron and Manganese

Although iron and manganese are required nutrients in the human diet, concentrations above secondary drinking water standards can create aesthetic problems including metallic taste, staining, accumulation of oxides in pipes, and eventually toxicity. Iron and manganese occur naturally in much of the world's groundwater and surface water but can also originate from anthropogenic sources including automobile exhaust and manufacturing (WHO, 2011). The state secondary MCLs for iron and manganese are 0.3 and 0.05 mg/L, respectively.

Iron and manganese concentrations are detected above state secondary MCL in all Basin aquifers, but not in all wells. The widespread occurrence of iron and manganese detections have a naturally occurring origin associated with the dissolution of metals present in the Basin's geologic formations. There have been no trends in iron or manganese concentrations associated with contaminating activities. Monitoring data through 2025 continue to show elevated concentrations occur intermittently and are characterized by short-duration spikes rather than persistent increases, supporting a natural geochemical origin rather than anthropogenic influence. All groundwater extracted for municipal purposes with elevated iron and manganese is treated to reduce concentrations below secondary MCLs prior to distribution. Small water systems report iron and manganese concentrations to the County to ensure public health.

As with TDS, previous analysis has noted generally lower iron and manganese in some areas of the Santa Margarita aquifer because of high rates of aquifer "flushing" (Johnson, 2009; Johnson, 2016). Areas where iron and manganese concentrations are higher in the Santa Margarita aquifer (i.e. the Olympic subarea) are found to be directly correlated with groundwater residence time, and therefore inversely correlated with the rate of aquifer flushing driven by rainfall (Johnson, 2009). Furthermore, the Santa Margarita aquifer interaction with the overlying Santa Cruz Mudstone, where present, and underlying Monterey Formation, are related to higher iron and manganese concentrations in some areas (Johnson, 2009).

Iron and manganese concentrations are consistently below state secondary MCLs including frequent non-detects in the Quail Hollow subarea and are at higher concentrations and occasionally above the secondary MCLs in the Olympia subarea (Figure 4-25 and Figure 4-26).

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In the Santa Margarita aquifer, concentrations of iron and manganese can be as high as 1.5 mg/L and 0.2 mg/L, respectively (Figure 4-25 and Figure 4-26). Basin-wide data also show occasional higher outliers, including iron concentrations exceeding 5 mg/L and manganese concentrations exceeding 0.6 mg/L at select wells, although these values are infrequent and not sustained (Figure 4-25 and Figure 4-26). Figure 4-27 shows variability in iron and manganese concentrations that do not appear to be closely tied to groundwater levels trends.

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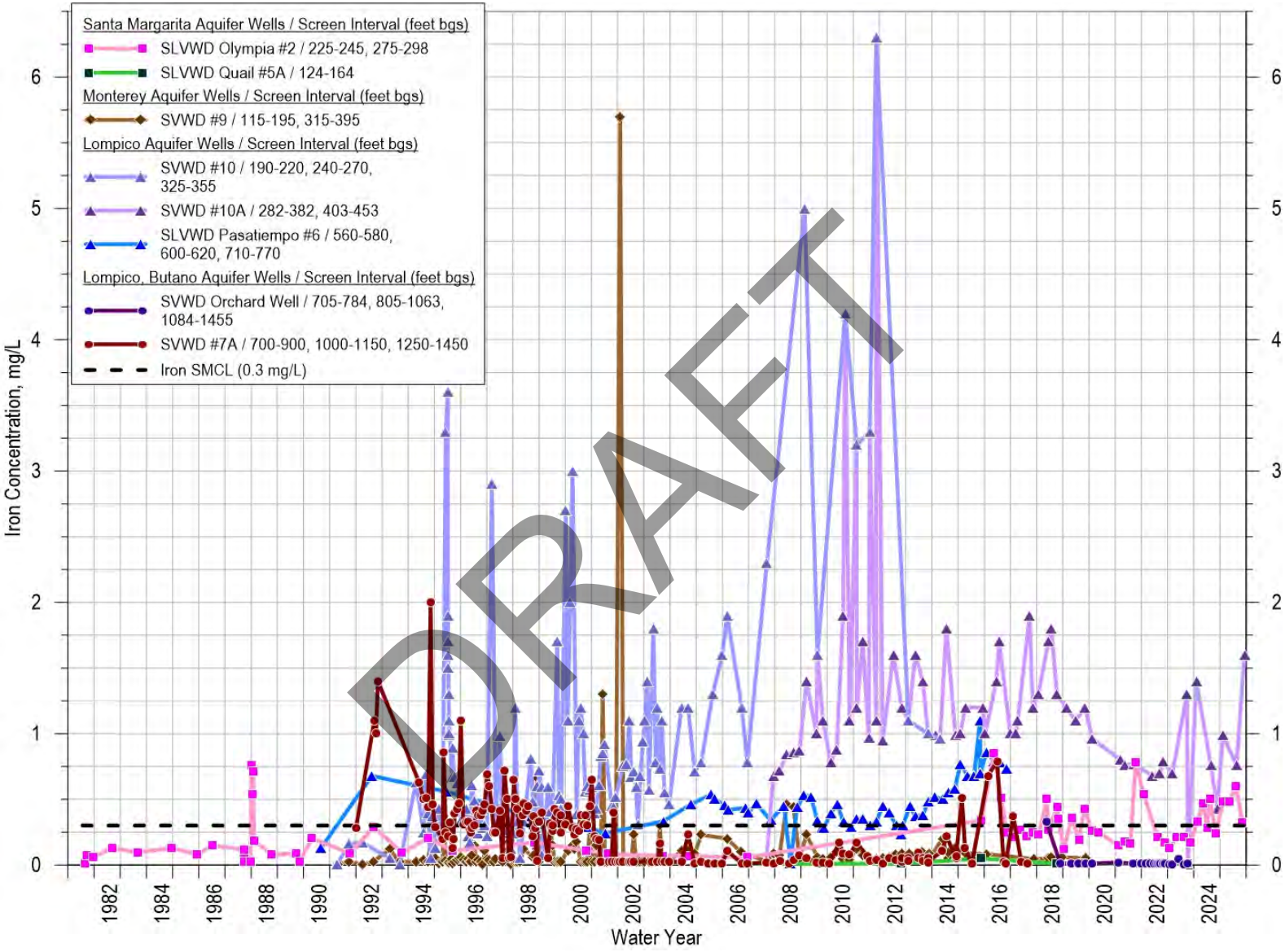

Figure 4-25. Iron Concentrations in Select Wells from 1980 to 2025

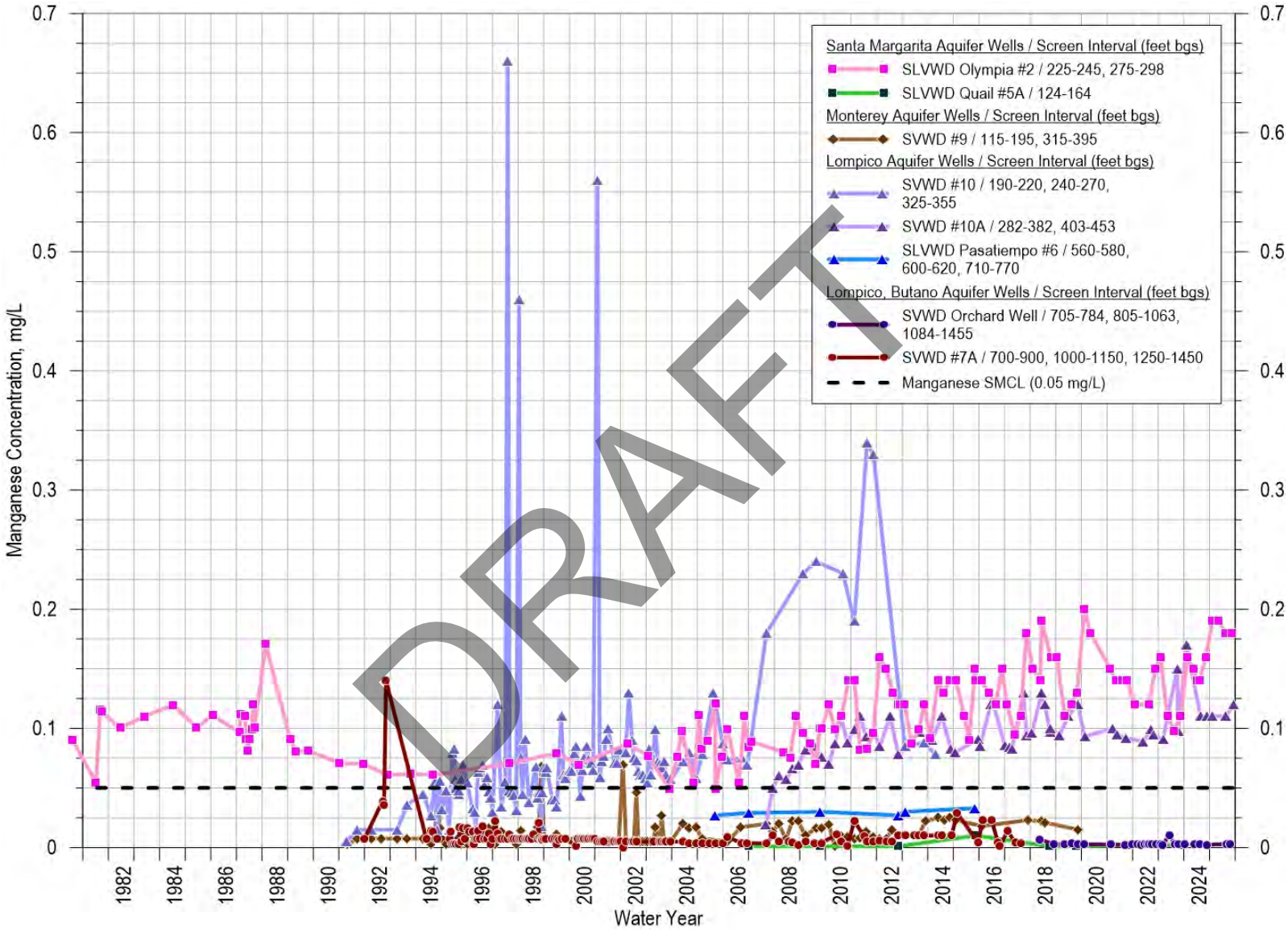

Figure 4-26. Manganese Concentrations in Select Wells from 1980 to 2025

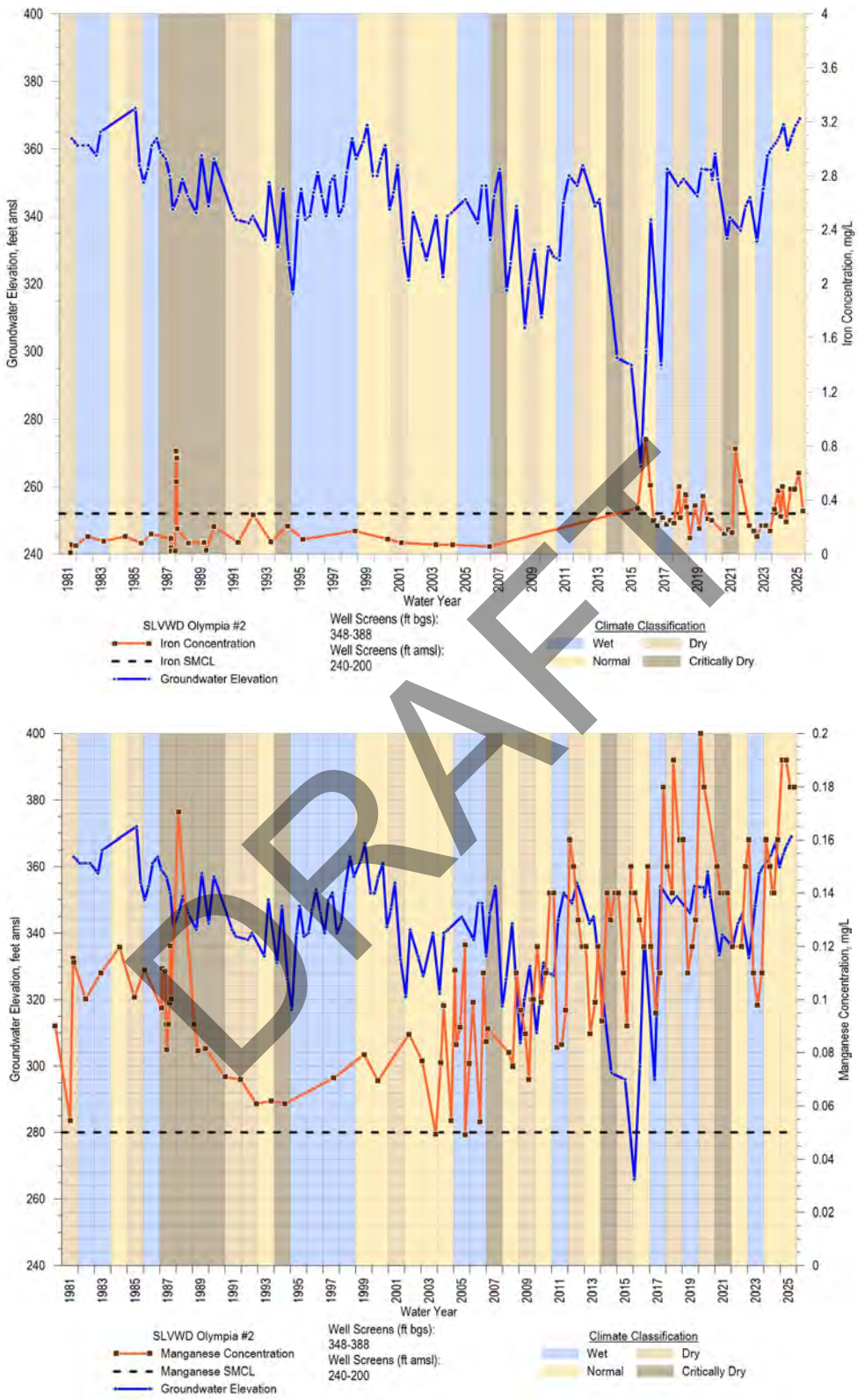

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Figure 4-27. Historical Iron and Manganese Concentrations and Groundwater Elevations in SLVWD Olympia #2 (Santa Margarita Aquifer)

Groundwater in SVWD #9, which is screened in the Monterey Formation, generally has iron and manganese concentrations below secondary MCLs that occasionally spike higher (Figure 4-25 and Figure 4-26). There are no groundwater quality data for other Monterey Formation screened wells.

Iron and manganese concentrations in the Lompico aquifer are highly variable by well and typically above state secondary MCLs, with maximum concentrations of 6 mg/L and 0.66 mg/L, respectively (Figure 4-25 and Figure 4-26):

- A historical increasing trend in iron and manganese was observed in SVWD Well #10/10A corresponding to a period of groundwater level decline prior to 2014 (Figure 4-28). More recent data indicate that concentrations have generally stabilized or declined from earlier peak values, as groundwater elevations recover (Figure 4-28).
- Extraction well SVWD #11B has different trends in iron and manganese even though it is only 1-mile northeast of SVWD Well #10/10A. It has highly variable iron concentrations and declining manganese concentrations with declining groundwater elevations (Figure 4-29). Iron concentrations have pronounced spikes in the late 1990s and early 2000s (up to approximately 9 mg/L), followed by a substantial decline to generally near or below the secondary MCL in recent years; manganese concentrations show a modest decreasing trend with most recent values typically near or slightly above the secondary MCL.
- Extraction well SVWD #11A near SVWD #11B has a decreasing iron trend and no manganese trend (Figure 4-30). Recent data confirm that iron concentrations at SVWD #11A have declined from elevated values in the late 1990s and early 2000s to generally at or below the secondary MCL in recent years, while manganese concentrations remain relatively stable with moderate variability and no clear trend. SVWD #11A and 11B have not been pumped much in recent years so concentration trends could also be related to well inactivity.

These differences within the same aquifer suggest that differences in how each well is operated and from where in the Lompico aquifer it pumps has an influence on its iron and manganese concentrations.

SVWD wells screened within both the Lompico and Butano aquifers, such as extraction well SVWD Sucinto (Well #3B replacement) and SVWD Orchard (#7A replacement) generally have iron and manganese concentrations below secondary MCLs with occasional temporary spikes above their secondary MCLs (Figure 4-25 and Figure 4-26). Historical data from these wells are consistent with the broader pattern of predominantly low concentrations with intermittent exceedances reflecting localized geochemical conditions (Figure 4-31 and Figure 4-32). There does not appear to be any iron or manganese concentration correlation with water year type or groundwater elevation.

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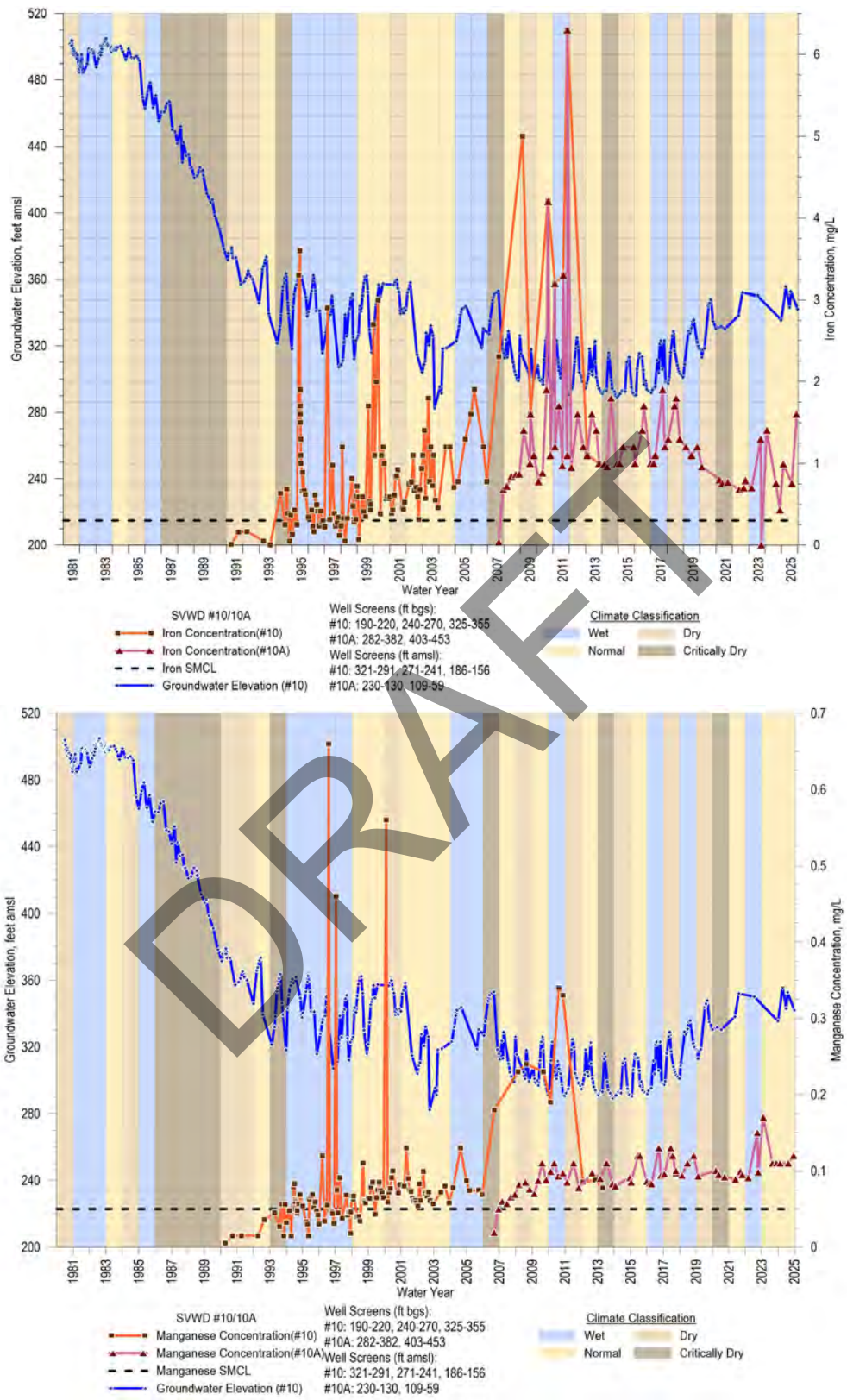

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Figure 4-28. Historical Iron and Manganese Concentrations and Groundwater Elevations in SVWD Well #10/10A (Lompico Aquifer)

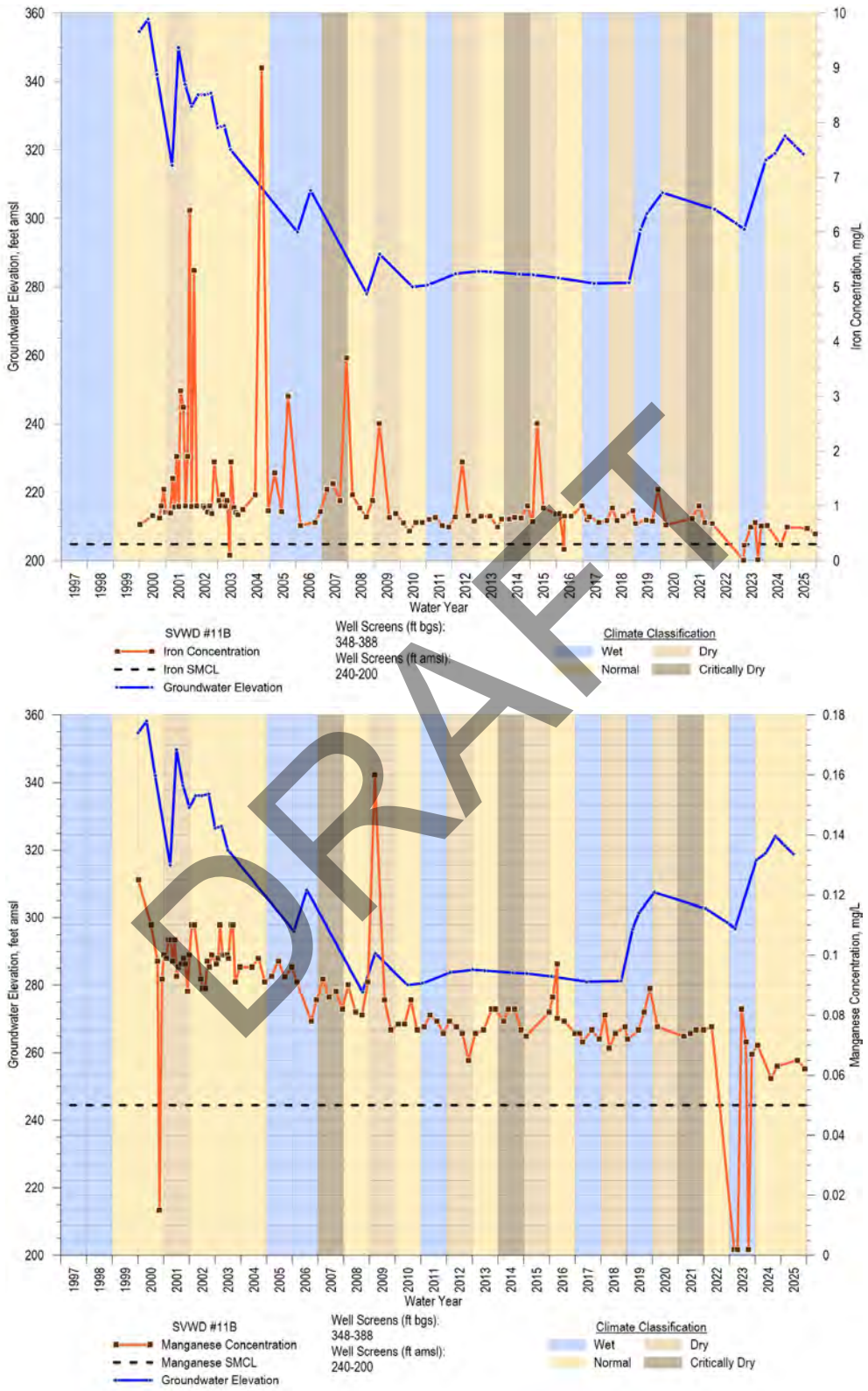

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Figure 4-29. Historical Iron and Manganese Concentrations and Groundwater Elevations in SVWD Well #11B (Lompico Aquifer)

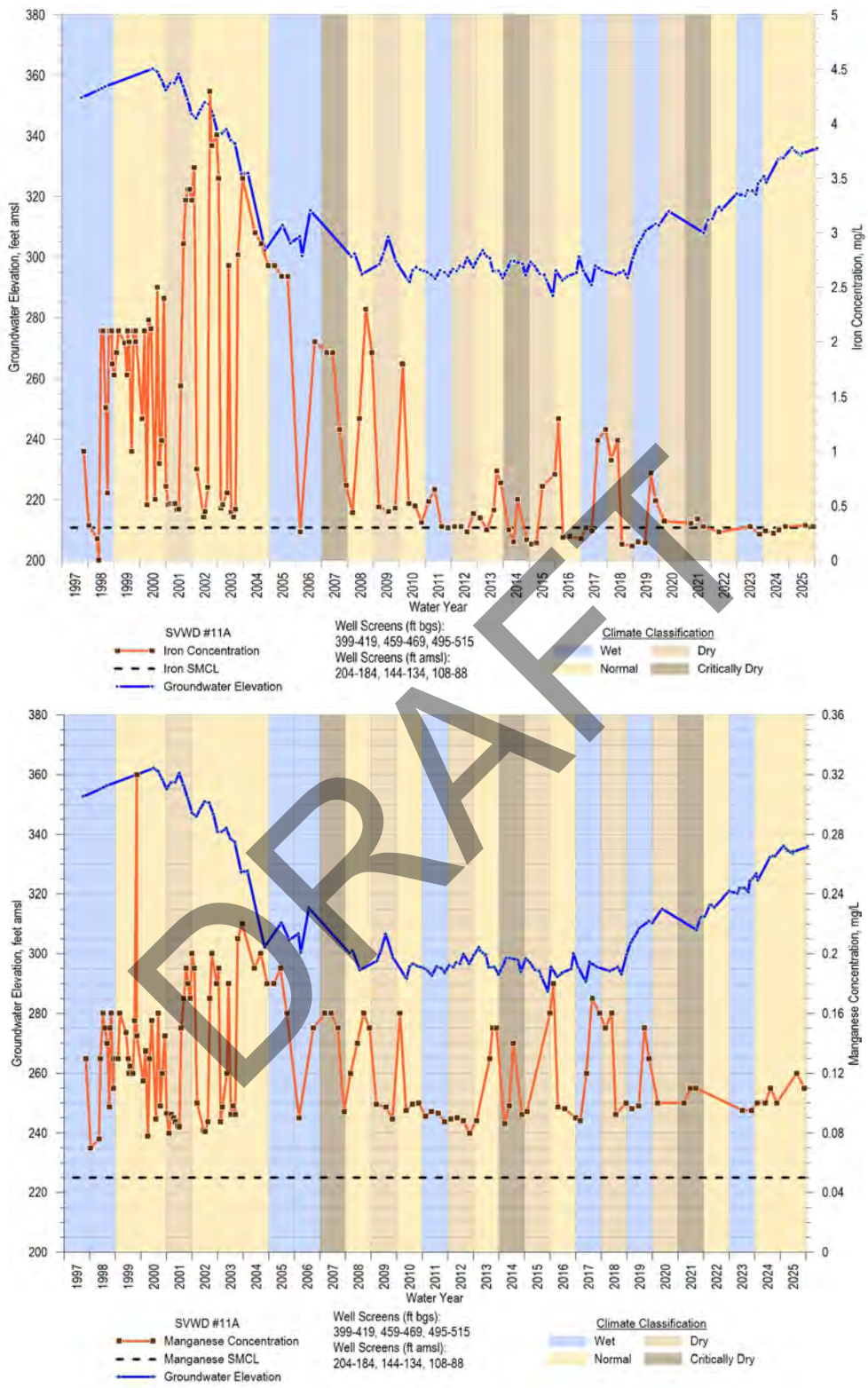

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Figure 4-30. Historical Iron and Manganese Concentrations and Groundwater Elevations in SVWD Well #11A (Lompico Aquifer)

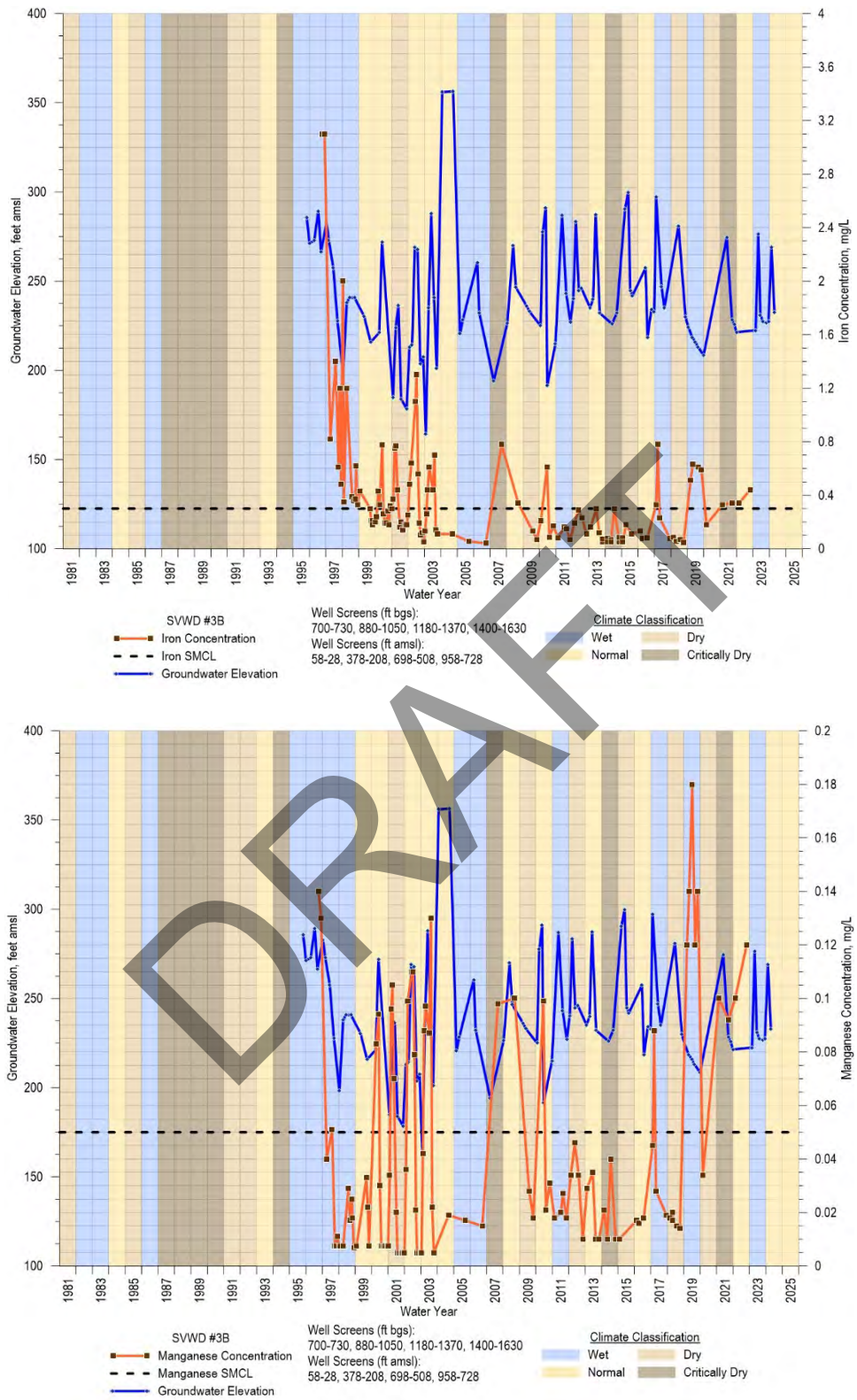

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Figure 4-31. Historical Iron and Manganese Concentrations and Groundwater Elevations in SVWD Well #3B (Lompico/Butano Aquifer)

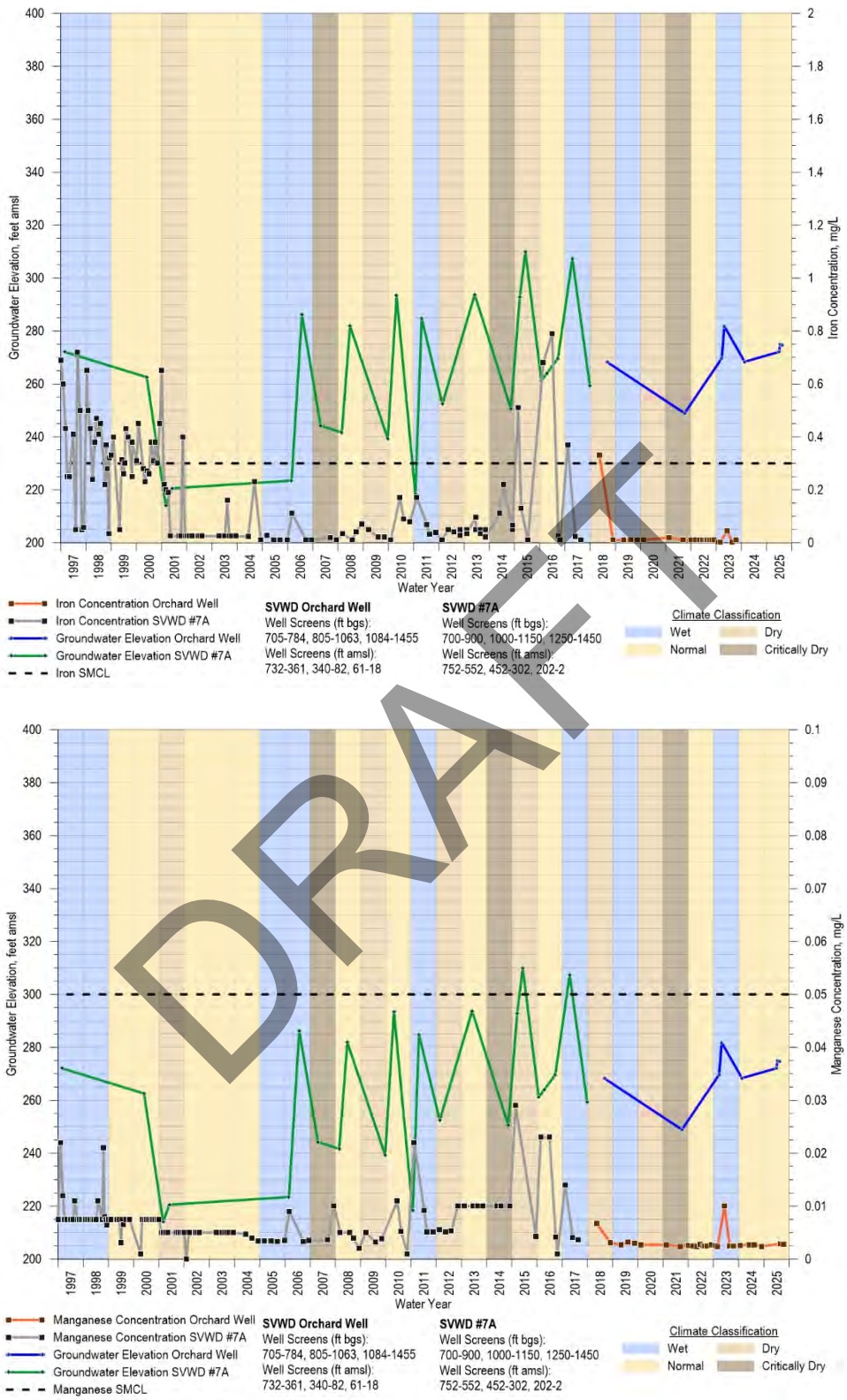

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Figure 4-32. Historical Iron and Manganese Concentrations and Groundwater Elevations in SVWD Well #7A and Orchard (Lompico/Butano Aquifer)

4.4.3.3 Arsenic

Arsenic is a trace element often naturally present in groundwater that can negatively impact human health when consumed. Arsenic occurs naturally and is ubiquitous in the environment. It is found in many drinking water sources in California and is commonly associated with deeper portions of sedimentary fill-basins throughout the western United States (Anning *et al*., 2012). The primary MCL for arsenic is 0.010 mg/L.

Arsenic concentrations exceeding the MCL with a recent maximum of 0.016 mg/L, are found periodically in several wells extracting from the Lompico aquifer (Figure 4-33). Lompico aquifer groundwater quality monitoring is limited to wells in the Pasatiempo and Scotts Valley portions of the Basin (Figure 4-36), so the extent of arsenic in the Lompico aquifer in other portions of the Basin is unknown. Non-detect or low detections of arsenic in the Basin's other aquifers (Appendix 4B), including the Butano aquifer, support the observation that naturally elevated arsenic is limited to the Lompico aquifer.

Arsenic is occasionally detected above its MCL in surface waters in the northern and western portions of the Basin, such as near Boulder Creek and south Felton where the Lompico aquifer is exposed at the surface in this area. The iron and manganese treatment and blending process used for distributed public supply water coincidentally treats arsenic to below MCLs prior to distribution.

Lompico aquifer extraction wells SVWD #11B and SLVWD Pasatiempo #8 are the only active extraction wells with arsenic concentrations greater than the MCL. Arsenic concentration increases in SVWD #11B appear to be correlated with groundwater elevation declines prior to 2018, and may reflect the well drawing groundwater from a different portion of the aquifer than nearby SVWD #11A, which has low to non-detectable arsenic concentrations (Figure 4-34). There are insufficient data to make conclusions about the arsenic concentration and groundwater level relationship at SLVWD Pasatiempo #8. This well, installed in 2019, has a maximum arsenic concentration of 0.011 mg/L, which is just above the MCL (Figure 4-35).

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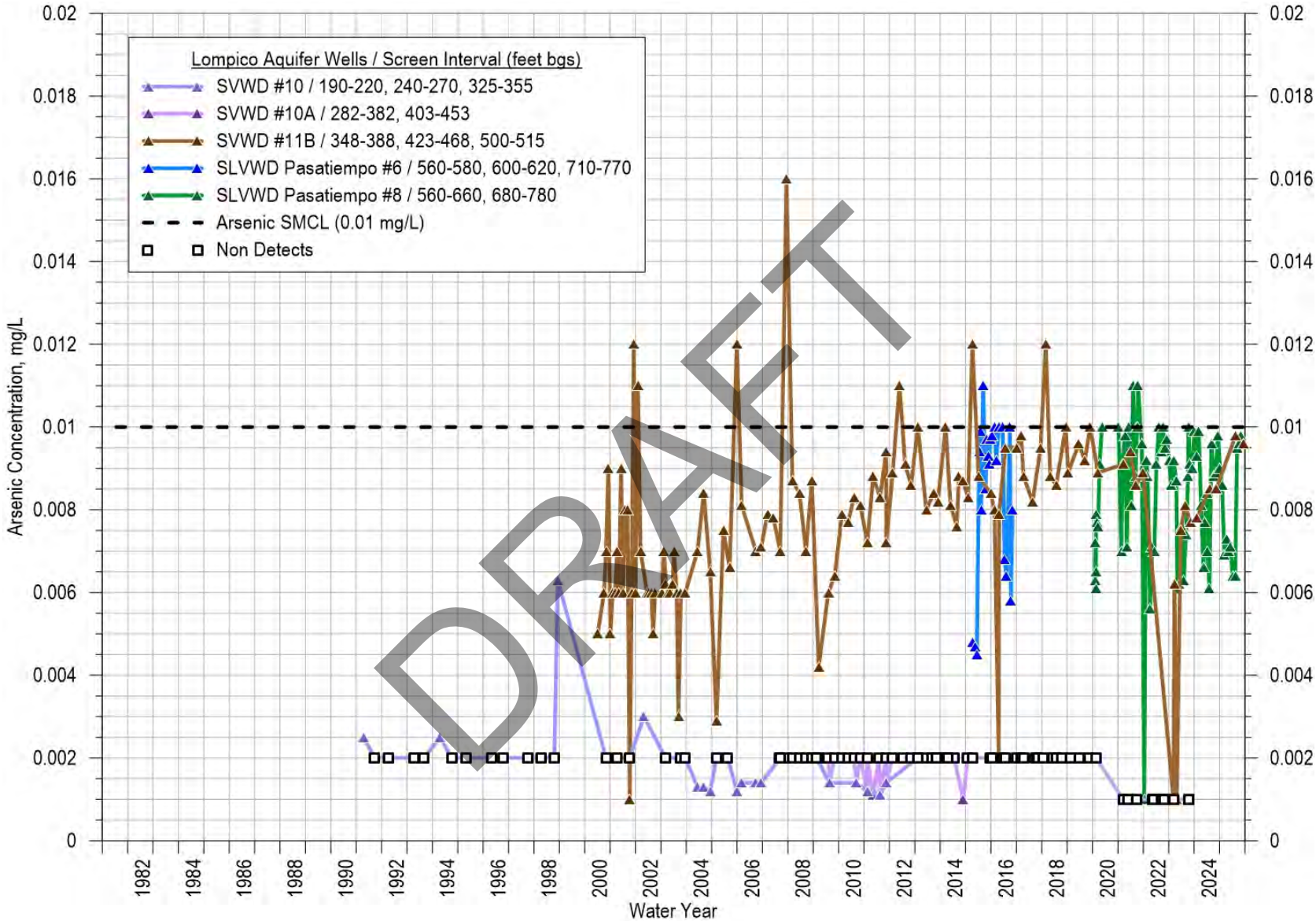

Figure 4-33. Arsenic Concentrations in Select Lompico Aquifer Wells from 1990-2025

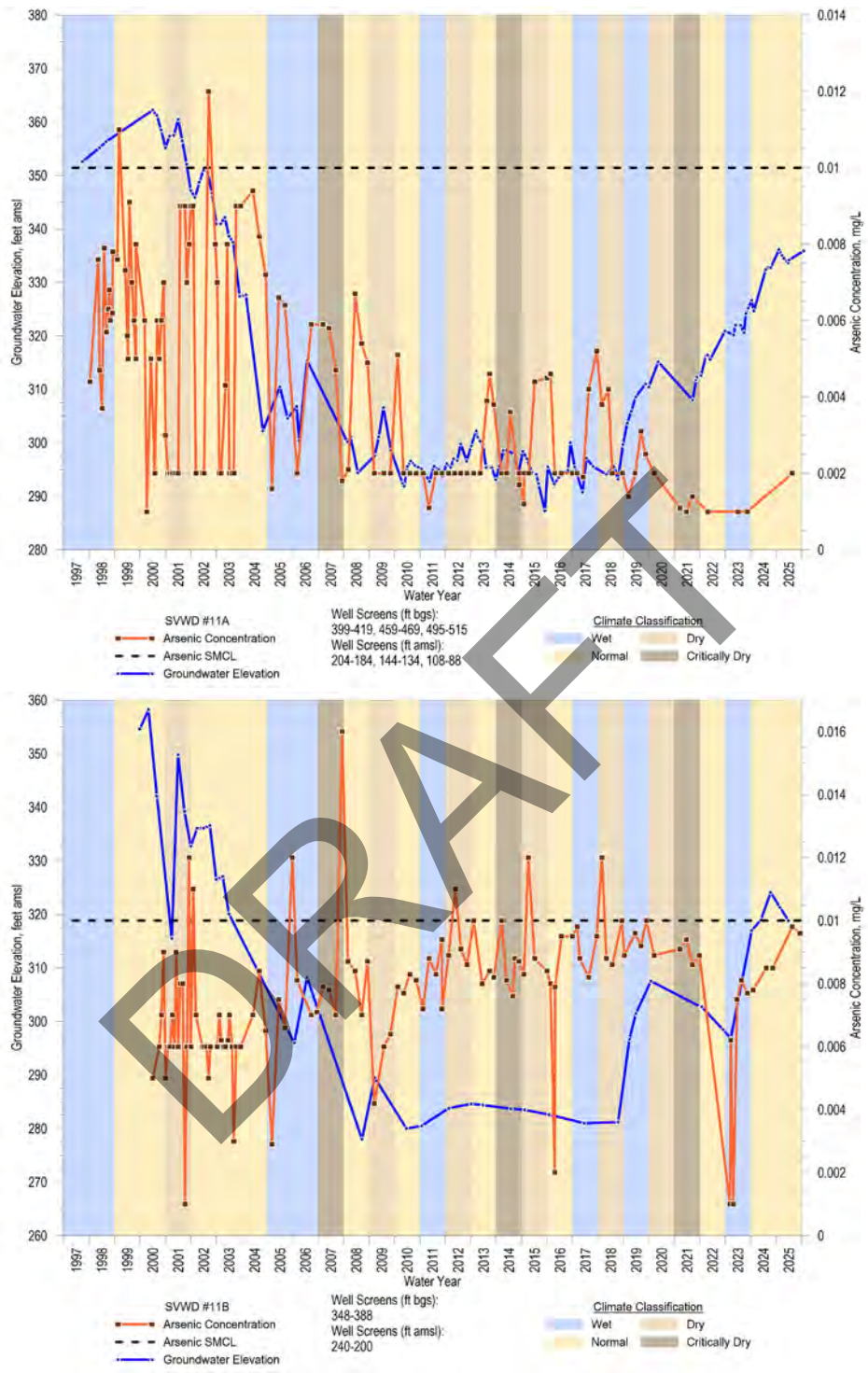

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Figure 4-34. Historical Arsenic Concentrations and Groundwater Elevations in SVWD #11A and SVWD #11B

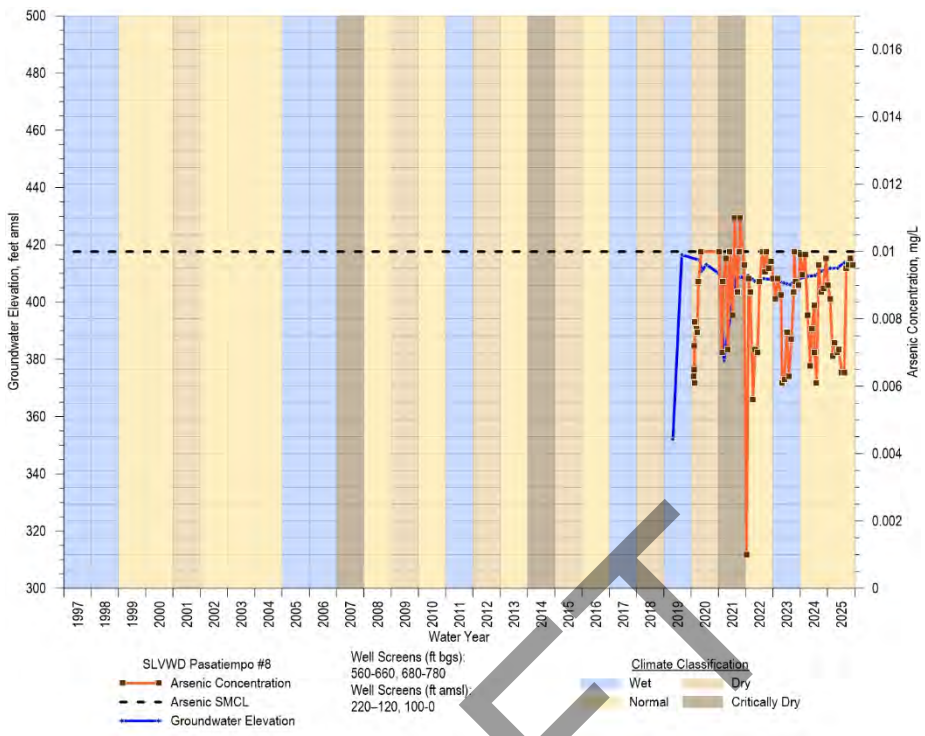

Figure 4-35. Historical Arsenic Concentrations and Groundwater Elevations in SLVWD Pasatiempo #8

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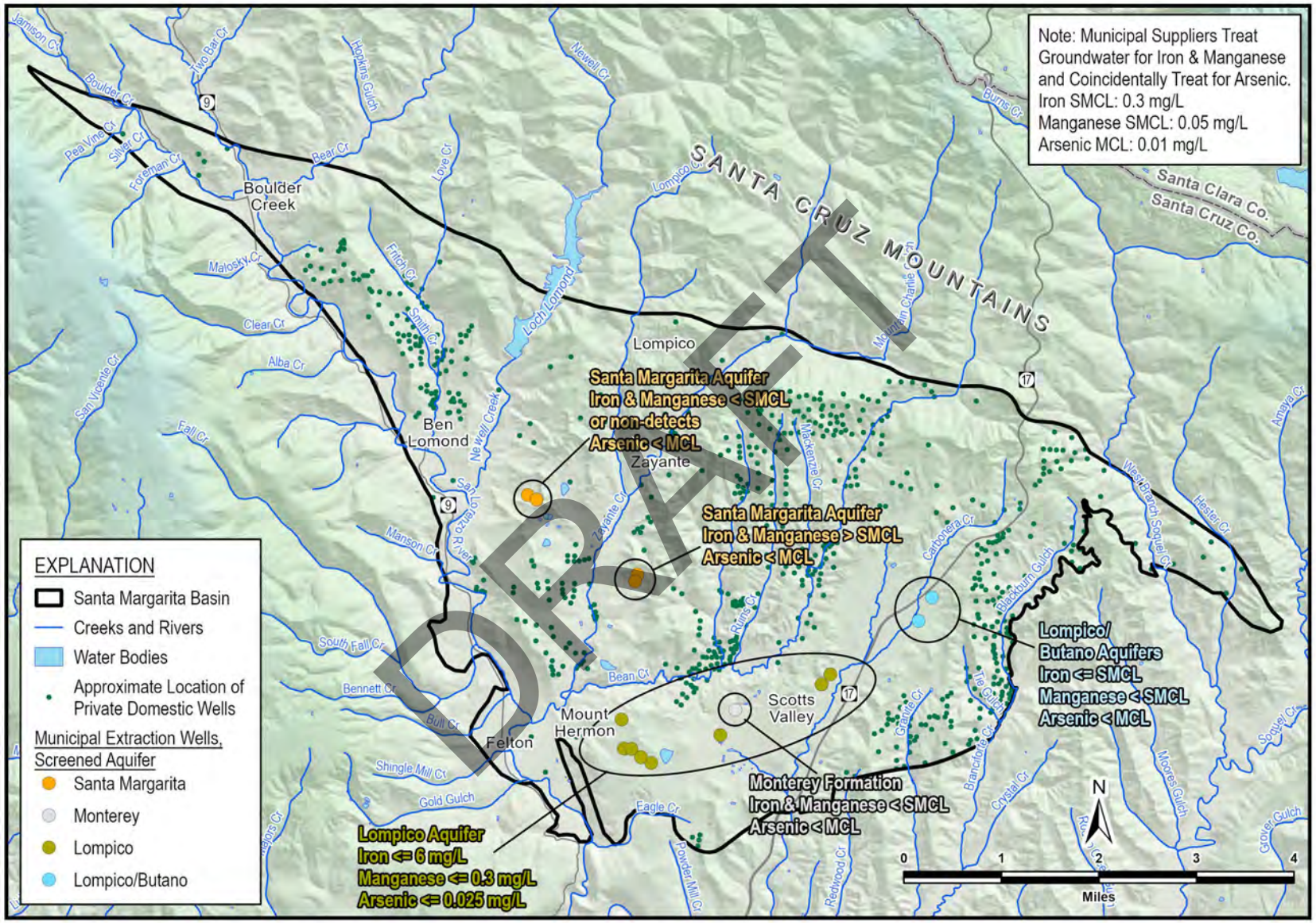

Figure 4-36. Areas of Elevated Naturally Occurring Groundwater Quality

4.4.4 Anthropogenic Constituents in Groundwater

4.4.4.1 Nitrate

Nitrate is a regional water quality concern due to its prevalence in the environment and potential health impacts if ingested. Consumption of nitrates can cause methemoglobinemia (blue baby syndrome) in infants, which reduces the ability of the blood to carry oxygen. If left untreated, methemoglobinemia can be fatal for affected infants. Due to this health risk, a drinking water standard of 10 mg/L is set for nitrate measured as nitrogen (N) or 45 mg/L for nitrate as nitrate (NO_3).

4.4.4.1.1 Nitrate Sources

Elevated nitrate in groundwater is typically derived from anthropogenic sources such as fertilizer applied to crops and turf, animal operations, such as livestock/stables, and human sources such as wastewater treatment plant effluent and septic tanks. In response to observed increased nitrate concentrations in the San Lorenzo River in the 1980s and 1990s, the County prepared a San Lorenzo Nitrate Management Plan to evaluate the impacts of nitrogen release from septic systems and other sources, and to develop recommendations for reduction of nitrate levels in groundwater and surface water (County of Santa Cruz, 1995). The 1995 Nitrate Management Plan found that 76% of the nitrate load in the San Lorenzo River originated from human waste including septic systems and sewer discharges. The remaining 24% was associated with natural (animal and plant) sources (16%), livestock and stables (6%), and fertilizer use (2%). The Nitrate Management Plan also found that the nitrate concentrations occurring in the San Lorenzo River at that time did not appear to have any adverse impacts on fishery resources, and that impacts on recreation were low.

Septic return flows and historical wastewater are the largest source of nitrate in the Basin. The City of Scotts Valley is the only area of the Basin that is sewered although there are still approximately 445 operating septic systems (6% of systems in the Basin) within City limits (Figure 4-37). The vast majority of the Basin's residents, as shown on Figure 4-37, use septic systems to treat and dispose of sanitary waste. Using land use data and County septic system inspection records, it is estimated that there are approximately 7,789 septic systems in the Basin. Table 4-1 summarizes the estimated distribution of septic systems, with a major proportion of the Basin's septic systems in areas supplied water by SLVWD. Historically, primary effluent from the Scotts Valley WRF was discharged to the Hanson Quarry (USGS, 1977).

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Table 4-1. Santa Margarita Basin Septic System Distribution

Water Supplier	Estimated Number of Septic Systems (2018)	Percent
SLVWD	5,275	68%
Private domestic wells	784	10%
SVWD	747	10%
Mount Hermon Association	586	7%
Small Water Systems	397	5%
Total	7,789	

Nitrogen, primarily from urine, feces, food waste, and cleaning compounds, is present in sanitary wastewater. If sited or operated incorrectly, septic systems can be a significant source of groundwater contamination. Even properly functioning conventional septic systems may contribute nitrogen to groundwater exceeding this standard (USEPA, 2001).

The CCRWQCB has historically delegated authority to oversee and regulate the installation of septic systems to SCEH through a memorandum of understanding. The County must comply with the minimum standards contained in the Basin Plan in order to keep the authority to permit septic systems. The County Board of Supervisors has adopted Section 7.38 of the County Code (the Sewage Disposal Ordinance) which specifies the standards for septic system installation in Santa Cruz County. The County's current LAMP which is in compliance with the California Water Board's 2012 Water Quality Control Policy for Siting, Design, Operation and Maintenance of Onsite Wastewater Treatment Systems was adopted by the Santa Cruz County Board of Supervisors on August 23, 2022.

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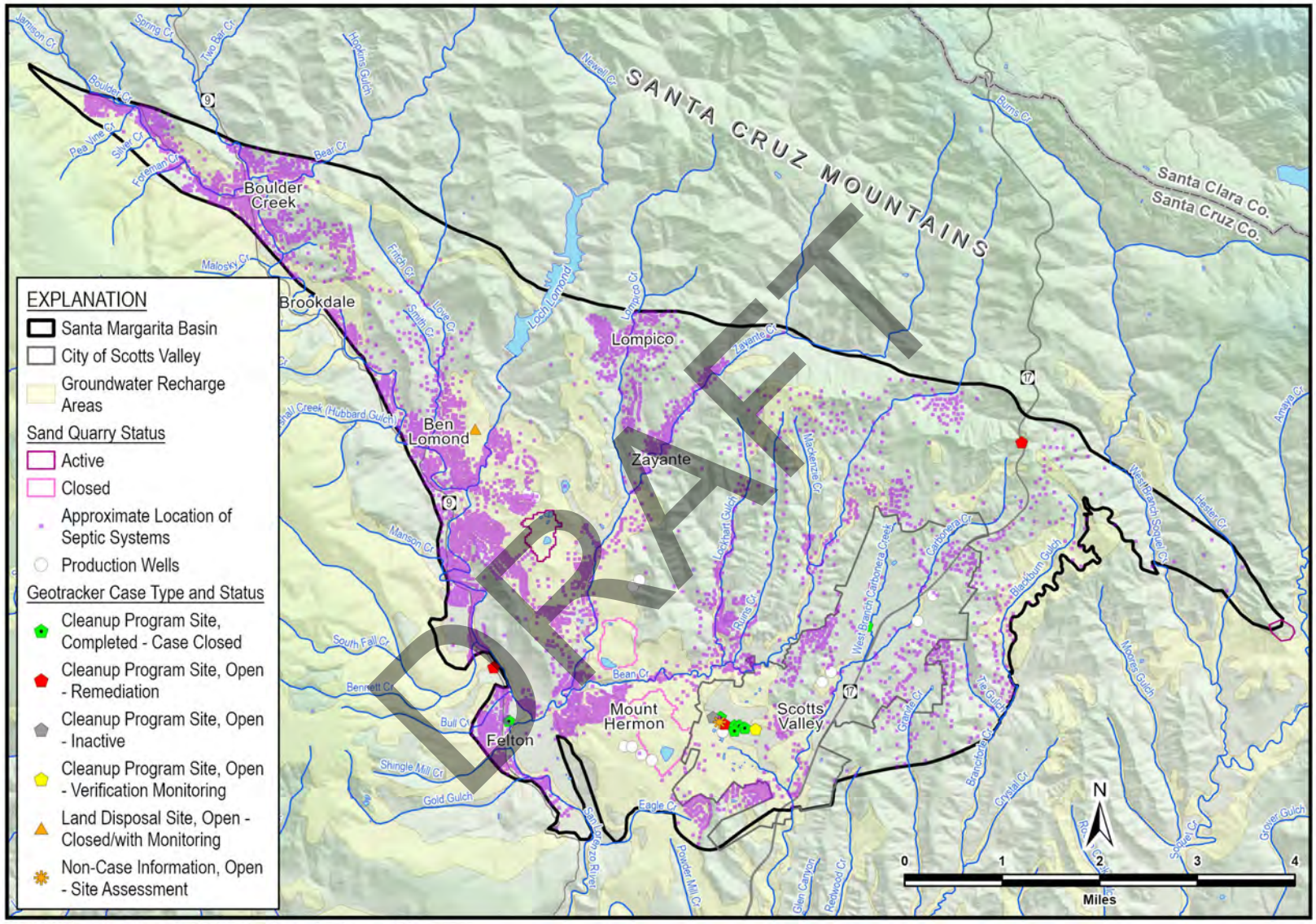

Figure 4-37. Potential Groundwater Contamination Sources

4.4.4.1.2 Nitrate Concentrations in Groundwater

Nitrate concentrations in the Santa Margarita and Lompico aquifers are well below the nitrate (as N) MCL of 10 mg/L Maximum nitrate (as N) detections in municipal wells from 2010 to 2025 are approximately 3.6 mg/L in the Santa Margarita aquifer, and less than 1 mg/L in the Lompico aquifer. Nitrate in the permeable Santa Margarita aquifer has relatively higher concentrations due to its widespread exposure at the surface and proximity to potential nitrate contamination sources such as septic tanks and livestock/stables. The description of nitrate concentrations below is limited to areas where groundwater quality data are available.

During the 1970s to the 1990s—the period of the County's greatest population growth—(Figure 4-2), nitrate concentrations increased in the Santa Margarita aquifer, particularly in the Quail Hollow area. Figure 4-38 plots nitrate (as N) concentrations in various wells screened at different depths from 1970-2025. Near-surface sources of nitrate have a greater impact on shallower wells (Quail Hollow #5 and #5A) compared to the deeper screened Quail Hollow #4 and #4A wells. There are also more septic systems potentially impacting Quail Hollow #5/5A than Quail Hollow #4/4A due to their different locations.

Historically nitrate concentrations peak in the impacted Santa Margarita aquifer wells during drought periods when groundwater levels are lower. Peak concentrations are observed at 3.5 mg/L in WY1987, which was during the 6-year statewide drought that extended from WY1986 through WY1991, and WY2016, which was at the end of the WY2012-2016 drought (Figure 4-38). Johnson (1988) demonstrated with a groundwater model that the nitrate peak at Quail Hollow was associated with late-season, drought-year pumping and the number of septic systems within the wells' capture zones.

Johnson forewarned that nitrate concentrations had the potential to increase again in the future as the source remained. Updated data through 2025 indicate that nitrate concentration increases during droughts are short-lived, with concentrations returning to typical levels (generally 2 to 3 mg/L or less) following the drought. Comparison of long-term groundwater level and nitrate concentration trends in Quail Hollow on Figure 4-39 does not demonstrate a significant correlation between nitrate concentrations and groundwater levels. It should be noted, however, that the nitrate data are collected every 1 to 3 years per DDW requirements, so may not be collected frequently enough to fully analyze the interrelationship with seasonal groundwater level fluctuation.

Historically, the Santa Margarita aquifer in the Pasatiempo/southern Scotts Valley area was impacted by nitrate with concentrations (as N) up to 6 mg/L. The source of nitrate in this area is also septic and sewer waste disposal (Johnson, 2009). Recent nitrate concentration data are not available in this area since the Santa Margarita aquifer is no longer pumped for municipal use.

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Lompico aquifer wells in the area shown on Figure 4-38 generally have lower nitrate concentrations than the Santa Margarita aquifer because nitrate released at the ground surface undergoes greater attenuation before reaching this deeper aquifer. The extraction well SVWD #10/10A is screened in the Lompico aquifer below the Monterey Formation, which forms a barrier to downward recharge and has mostly non-detectable nitrate concentrations. The SLVWD Pasatiempo wells, by contrast, are in an area where the Monterey Formation is absent or very thin. Without this barrier between the Santa Margarita and Lompico aquifers, nitrate concentrations there are slightly higher than in areas overlain by the fine-grained Monterey Formation, though still lower than in the Santa Margarita aquifer (Figure 4-38). The few public water supply wells screened in the Butano aquifer mostly have no detectable nitrate, reflecting the great depth of that aquifer.

The County's efforts starting in 1986 to manage nitrate loading from septic systems has likely contributed to stabilizing nitrate concentration trends observed in the Santa Margarita and Lompico aquifers. The County works with property owners to prevent failing septic systems, enforces new requirements for the construction and performance of new and existing septic systems, and requires enhanced treatment for effluent nitrogen reduction for new and replacement systems in sandy soils. Groundwater monitoring since 2015 demonstrates that nitrate concentrations are stable to slightly decreasing in both shallow and deeper wells, with no evidence of wells with long-term concentration increases.

As described in Section 4.4.2, County well permitting code requires new private domestic well owners to submit a single groundwater quality test result following well installation. Private domestic wells are more vulnerable to nitrate contamination than municipal wells because private wells are typically shallower and are closer to septic systems. From 2010 to 2019, only 1 well had an elevated nitrate (as N) concentration of 4.9 mg/L and the remainder of the nitrate concentrations were less than 1 mg/L.

Figure 4-40 summarizes the Basin's spatial distribution of nitrate concentrations for different aquifers described above.

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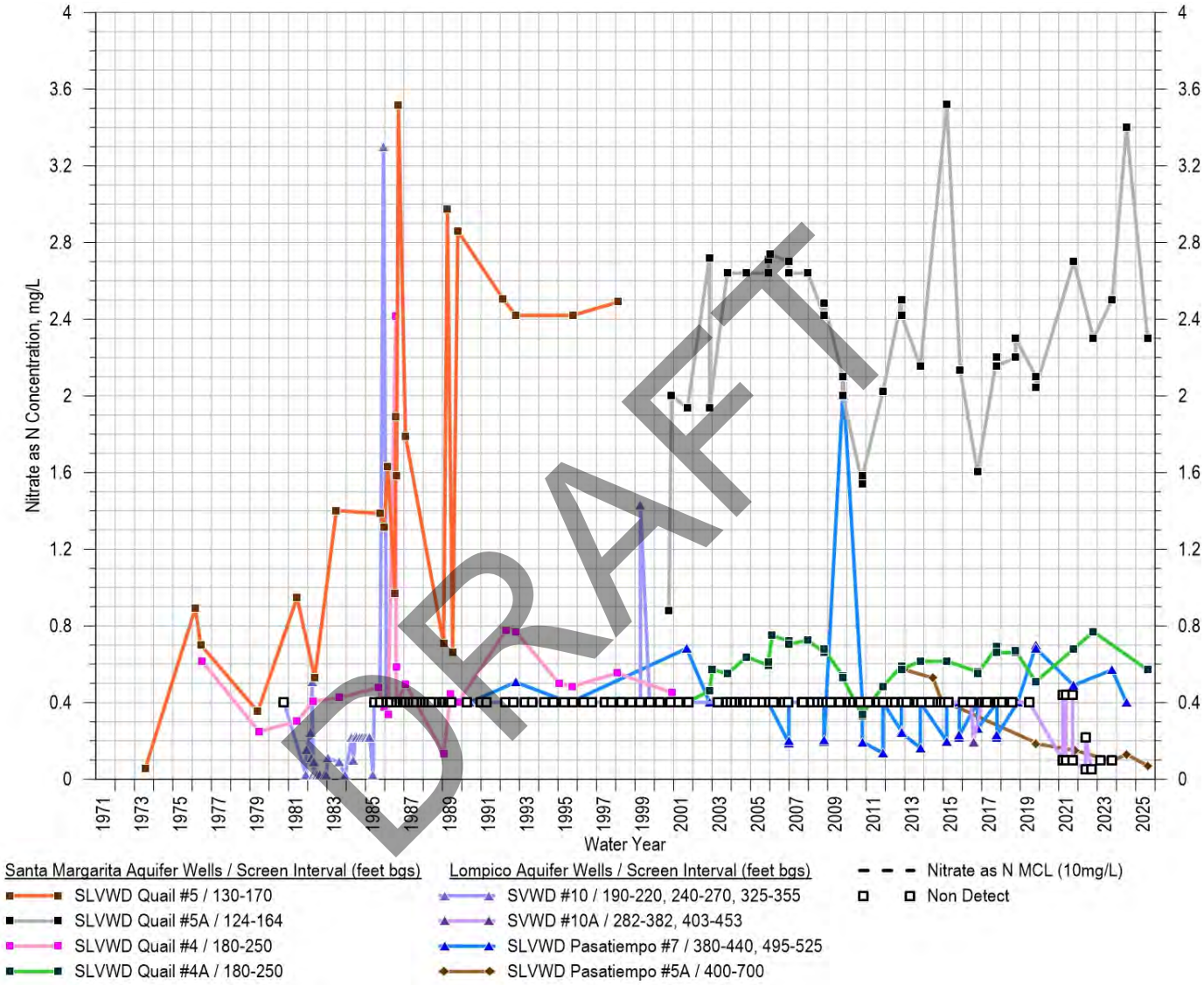

Figure 4-38. Historical Nitrate (as N) Concentrations, 1970-2025

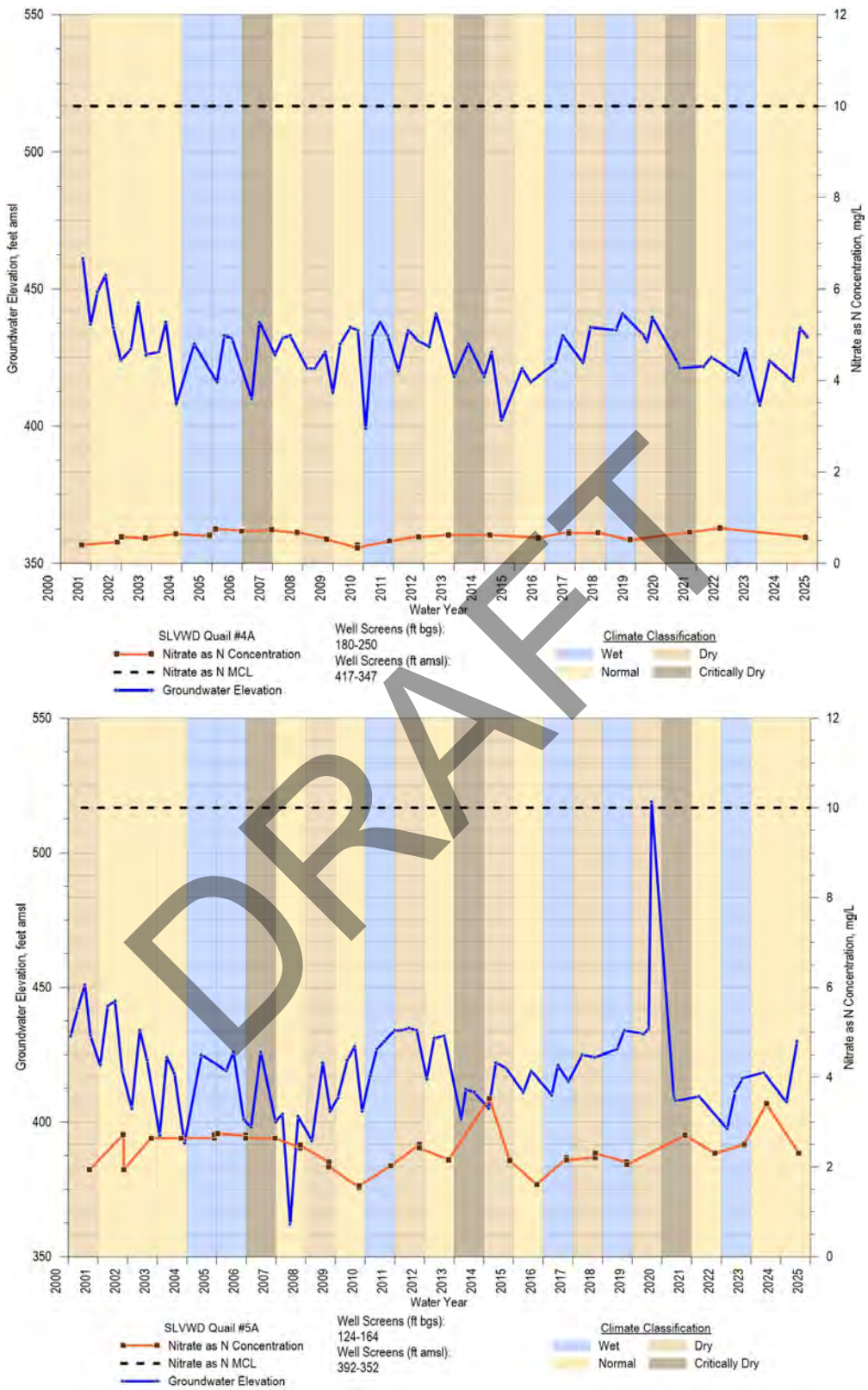

Figure 4-39. Historical Nitrate Concentrations and Groundwater Elevations in SLVWD Quail Hollow #4A and #5A (Santa Margarita Aquifer)

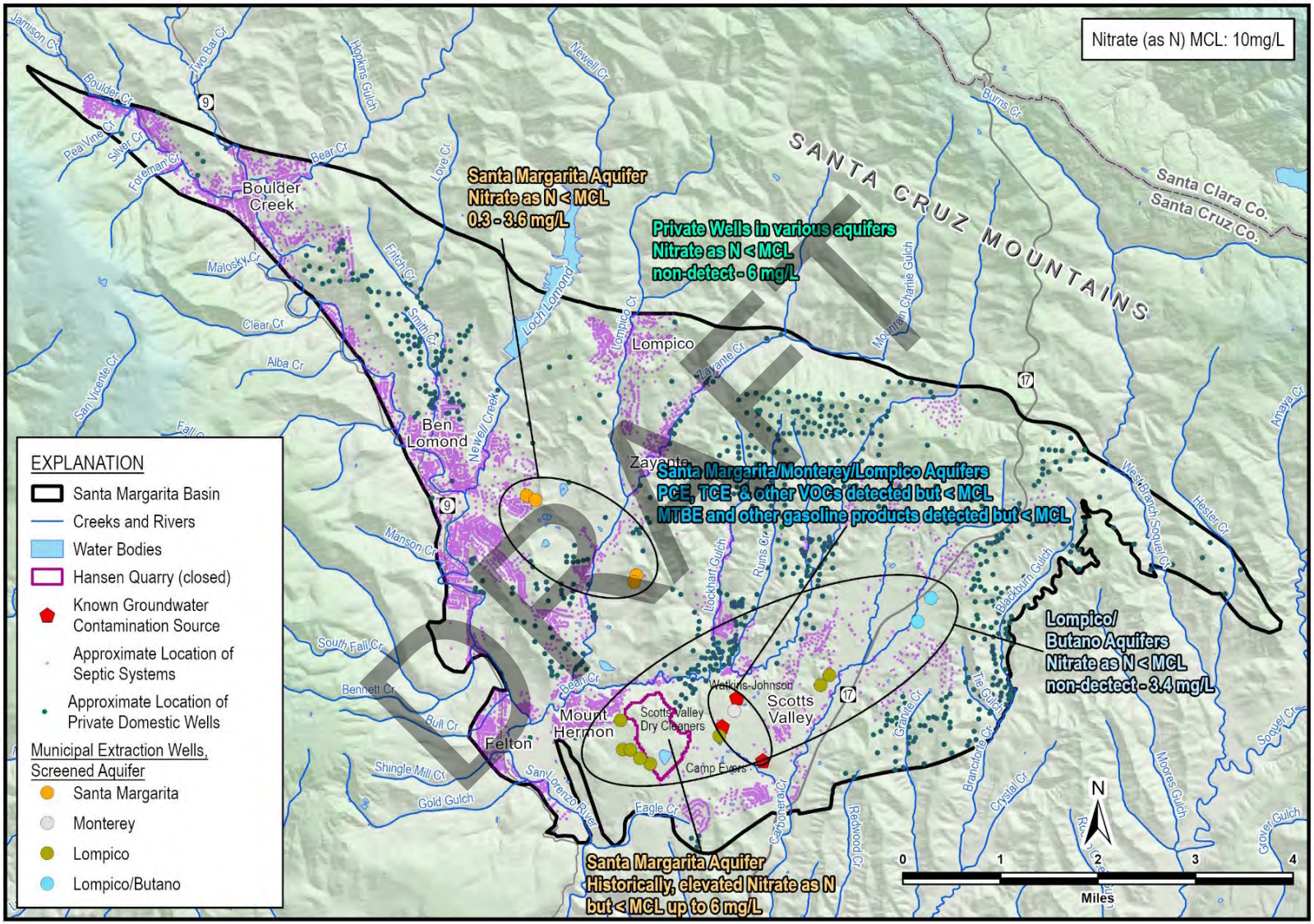

Figure 4-40. Areas of Known Anthropogenic Groundwater Quality Impacts

4.4.4.1.3 Nitrate Concentrations in the San Lorenzo River

Due to the high degree of groundwater and surface water interconnection, groundwater quality has a strong influence on water quality in the San Lorenzo River. Nitrate released from septic systems, livestock, fertilizer use, and other sources passes readily through the sandy soil, into the basin groundwater, and eventually into tributary streams and the San Lorenzo River. Summer average nitrate (as N) concentrations at the San Lorenzo River at Felton from 1976 to 1993 was 0.42 mg/L (County of Santa Cruz, 1995). More recently, nitrate (as N) concentrations at this same location averaged 0.47 mg/L between September 2011 and September 2018 (Trussell Technologies Inc., 2019). This indicates that nitrate concentrations in the San Lorenzo River at Felton increased approximately 11% over the 30 year period.

The San Lorenzo River has been designated as impaired by the State and the USEPA due to elevated levels of nitrate, which stimulates increased algal growth and release of compounds that degrade the quality of drinking water and require increased cost for treatment. Increased nitrate and algal growth also causes impacts in the San Lorenzo lagoon, degrading salmonid habitat and potentially creating harmful algal blooms. It's estimated that 65% of the River's nitrate load originates in the Basin, the majority of which comes from septic systems.

In order to reduce nitrate levels in the San Lorenzo River, the County developed the San Lorenzo Nitrate Management Plan in 1995, and the CCRWQCB adopted a Nitrate TMDL of 0.33 mg/L (as N). These plans call for various measures to prevent any increased nitrate discharge and to reduce existing sources, particularly requiring individual enhanced treatment systems as existing septic systems in sandy soils are replaced or upgraded. Additionally, the use of recycled water in the Basin requires additional treatment for denitrification before the water can be used.

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4.4.4.2 Constituents of Emerging Concern

Constituents of emerging concern (CECs), including pharmaceuticals and personal care products, are detected at low levels in the Basin's surface water and groundwater. CEC pathways to surface and groundwater resources are similar to nitrate since these constituents are typically found in wastewater. New and emerging contaminants are currently unregulated but may be subject to future regulation. Examples of new and emerging contaminants are N-Nitrosodimethylamine, and 1,4-dioxane, disinfection byproducts, and per- and polyfluoroalkyl substances (PFAS).

The Unregulated Contaminant Monitoring Rule (UCMR) is part of the federal Safe Drinking Water Act Amendments of 1996 and administered by the U.S. Environmental Protection Agency (USEPA). SVWD and SLVWD have had CECs tested in their source waters and treated water in 3 separate UCMR testing cycles: 2009/2010 (UCMR 2), 2014/2015 (UCMR 3), and 2018/2019 (UCMR 4). Apart from very low levels of brominated haloacetic acid disinfection byproducts in treated water, there were no CECs detected in groundwater or surface water during these events.

More recently, SVWD and SLVWD were required to sample for 29 different PFAS in 2025/2026 as part of UCMR 5 released in 2021. While there were PFAS detections, no concentrations exceeded any notification levels associated with health-based concerns. UCMR data can be accessed from the USEPA (https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule).

The San Lorenzo River, which is a primary source of water for the City of Santa Cruz, has detections of CECs at both the Tait and Felton diversions. The Tait diversion is south of the Basin and the Felton diversion is within the Basin. The City's CEC testing was initially undertaken to inform planning for upcoming improvements to the Graham Hill WTP (City of Santa Cruz, 2016b); it is now conducted annually and includes CEC testing of influent and effluent from the treatment plant. The most common CECs detected in raw San Lorenzo River water samples are 2 types of artificial sweeteners, Sucralose (i.e., Splenda) and Acesulfame-K, (i.e. Sunett and Sweet One). Sampling conducted over time and during different seasons found that the most diverse set of CECs were found in the first flush sample that reflects the influence of the first significant rainfall of the season on river flows and is intended to capture the impacts on water quality of both surface runoff and rewetting of the streambed.

Table 4-2 summarizes 1 year of monthly samples tested for CECs, including frequency of detections in either the raw source water blend and/or the treated drinking water at the Graham Hill WTP. In this 1-year WTP study, there were 59 total detections out of 2,304 CECs measured, which equals a 2.6% rate of CEC detection. Blending of the City's raw water sources prior to treatment was documented to decrease the higher CEC concentrations measured in the San Lorenzo River. Samples collected during the drier months of May through September measured lower concentrations of artificial sweeteners (universal indictors of wastewater) and a dissimilar variety of CEC compounds compared to those CECs detected during the wetter periods. This occurs because of CECs entering the San Lorenzo River as either surface water runoff or septic system effluent through groundwater baseflow, which are both less prevalent during dry-season conditions. Increased pharmaceutical and personal care products are detected in and around the San Lorenzo River during these warmest months of the year, probably due to recreational activities such as swimming and wading.

While there are few regulations for CECs at this time, more are expected in the future. There is a high likelihood that additional treatment techniques will be used to remove or reduce CECs from the treated drinking water, which will be more costly and likely require upgrades to existing WTPs.

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Table 4-2. Constituents of Emerging Concern Detections in Raw Source Water Blend and/or Treated Drinking Water at the Graham Hill Water Treatment Plant (2016/2017)

CEC Type	Chemical Type or Use with Common Name if Applicable	Number of CECs detected in the raw source water blend and/or treated drinking water in 2016/2017	Number of Detections
Artificial sweeteners and caffeine	Artificial sweetener (Sunett and Sweet One)	Acesulfame- K (16)	23 detections ranging from 6-320 ng/L, average detection of 70 ng/L
	Artificial sweetener (Splenda)	Sucralose (5)	
	Stimulant (coffee, tea, some energy drinks)	Caffeine (2)	
Pharmaceuticals	Antibiotic	Erythomycin (6)	22 detections ranging from 6-130 ng/L, average detection of 34 ng/L
	Contrast media used for x-ray imaging	Iohexal (4)	
	Organic chemical used in the manufacture of a variety of other products such as dyes, some pharmaceuticals, and niacin (vitamin B3)	Quineline (3)	
	Pain relief medicine	Acetaminophen (2)	
	Veterinary drug for swine	Carbadox (2)	
	Antacid and antihistamine	Cimetidine (2)	
	Anti-inflammatory medicine	Meclofenamic acid (2)	
	High blood pressure medicine	Diltiazem (1)	
Herbicides and insecticides	Insect repellent	DEET (5)	8 detections ranging from 5-60 ng/L, average detection of 23 ng/L
	Herbicide	Chloridazon (2)	
	Herbicide	Chlorotoluron (1)	
Personal care products	Alkylphenols used in manufacturing of antioxidants, lubricating oil additives, and laundry and dish detergents	4-nonylphenol (4)	5 detections ranging from 8-240 ng/L, average detection of 150 ng/L
	Paraben family of preservatives in personal care products found in cosmetics, pharmaceuticals and foods	Propylparaben (1)	
Flame retardant	Flame retardant	Tris(1,3-dichloro-2-propyl) phosphate (1)	1 detection at 1,300 ng/L

ng/L – nanograms per Liter

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4.4.4.3 Organic Compounds

Organic compounds are those that include VOCs and pesticides. VOCs are chemicals that are carbon-containing and evaporate or vaporize easily into air at normal air temperatures. VOCs are found in a variety of commercial, industrial, and residential products including gasoline, solvents, cleaners, degreasers, paints, inks, dyes, and pesticides. VOCs in the environment are typically the result of human activity, such as a spill or inappropriate disposal where the chemical has been allowed to infiltrate into the ground. Once released into the environment, VOCs may infiltrate into the ground and migrate into the underlying production aquifers.

Figure 4-37 shows the locations of all historical and current cleanup sites in the Basin sourced from the SWRCB GeoTracker database. GeoTracker is a database and geographic information system that provides online access to environmental data. It tracks regulatory data about leaking underground fuel tanks, Department of Defense, Spills-Leaks-Investigations-Cleanups, and landfill sites. Most the Basin's cleanup sites are in the Scotts Valley area and along the San Lorenzo Valley corridor are impacted with VOCs. While closed-case cleanup sites (green) are present across a wide range of this area, current open-site cleanup cases are clustered near Felton and the Scotts Valley/Camp Evers area. These areas correspond with the Basin's developed areas and to detections of anthropogenic contaminants in wells (Figure 4-36 and Figure 4-40). Section 2.2.9 summarizes the status of the Basin's groundwater cleanup cases based on information available from GeoTracker.

There are other cleanup sites in the Basin which are now closed, indicated in green on Figure 4-37. These include numerous LUST sites, such as the now closed (since November 21, 2017) Camp Evers Combined Site associated with 4 current and former gasoline stations located at the intersection of Scotts Valley Drive and Mount Hermon Road. Although the Camp Evers site cleanup is complete as described in Section 2.2.9.1, there are remaining gasoline related chemicals in groundwater below their relevant MCLs.

Several SVWD municipal water supply wells have been impacted by organic compounds originating from some of the sites described above (Montgomery & Associates, 2020). SLVWD's Quail Hollow wells have historically been impacted by organics thought to have originated from spills or septic system disposal of cleaning products by 1 or more of the local residences (Johnson, 2009). Table 4-3 identifies those wells with detections. SVWD and SLVWD use on-site treatment plants to remove certain constituents that are above or approaching primary or secondary drinking water standards.

Similar to the fate of nitrate, organic constituents readily migrate through the Santa Margarita Sandstone to the water table. The Lompico aquifer is more protected from contaminants migrating downward through the Santa Margarita aquifer by the Monterey Formation if it is present above the Lompico aquifer.

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Table 4-3. Summary of Municipal Water Supply Wells Historical Detections of Organic Compounds

Well	PCE MCL = 0.005 mg/L	TCE MCL = 0.005 mg/L	cis-1,2-DCE MCL = 0.07 mg/L	Chloro-benzene MCL = 0.1 mg/L	MTBE MCL = 0.013 mg/L
Santa Margarita Aquifer					
SLVWD Quail Hollow #4A	ND	ND	ND	ND	ND
SLVWD Quail Hollow #5A	ND	Below MCL	ND	ND	Below MCL
SLVWD Olympia #2	ND	ND	ND	ND	ND
SLVWD Olympia #3	ND	ND	ND	ND	ND
Monterey Formation					
SVWD #9*	ND	Below MCL	Below MCL	ND	Below MCL
Lompico Aquifer					
SLVWD Pasatiempo #5A	ND	ND	ND	ND	ND
SLVWD Pasatiempo #7	ND	ND	ND	ND	ND
SLVWD Pasatiempo #8	ND	ND	ND	ND	ND
SLVWD Mañana Woods #2*	ND	ND	ND	ND	Above MCL
SVWD #10A	ND	ND	ND	ND	ND
SVWD #11A	ND	ND	ND	Below MCL	ND
SVWD #11B	ND	ND	ND	ND	ND
Lompico/Butano Aquifer					
SVWD #3B*	ND	ND	ND	ND	ND
SVWD Orchard	ND	ND	ND	ND	ND
SVWD Sucinto	ND	ND	ND	ND	ND
SVWD Grace Way	ND	ND	ND	ND	ND

MCL = maximum contaminant level or primary drinking water standard
* Well no longer used for water supply

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4.5 Land Subsidence

Land subsidence is the gradual or sudden lowering of the land surface. Subsidence can be inelastic or elastic. Elastic subsidence includes short-term land surface elevation changes that are reversible; inelastic subsidence is irreversible. Only inelastic subsidence caused by groundwater pumping is subject to SGMA and GSP Regulations (DWR, 2026). Besides groundwater pumping, inelastic subsidence can also be caused by the following processes:

- Drainage and decomposition of organic soils
- Underground mining, oil and gas extraction, hydro compaction, natural compaction, sinkholes, and thawing permafrost
- Aquifer-system compaction
- Tectonic forces such as fault uplift and land sliding

There is no known evidence of land subsidence in the Basin. Potential evidence of land subsidence related to lowered groundwater elevations might include damage to roads, bridges, and well casings. None of these conditions have been prevalent in the Basin or attributed to subsidence.

Pumping-induced subsidence is generally restricted to unconsolidated deposits of clay and fine silt, in which extraction of pore water results in the grains of sediment no longer being subjected to the buoyant support of fluid-saturated pore space. The collapse is inelastic in that, even if pumping were to cease, the deposit has less pore space to hold water and reduced conductivity.

Monterey Formation and Lompico aquifer have experienced up to 200 feet in groundwater decline in the Scotts Valley area but no known subsidence has been observed. This is because the Basin's aquifers are sandstones that are, to varying degrees, consolidated and cemented. When groundwater is extracted from the pores, the pores do not collapse as they would in unconsolidated deposits or clay-rich rocks because the framework of sand and silt grains remains due to lithologic cement that holds the grains in place. The Monterey Formation, though consisting mostly of siltstone and siliceous shale, has not undergone pumping-induced compaction because the formation is well consolidated and well-cemented. Moreover, the horizons tapped by the pumping are sandy interbeds that are coarser than the bulk of the formation.

As no reports or observations have been made regarding land subsidence due to lowered groundwater elevations in the basin, no local land-based subsidence monitoring has taken place. There is a continuous global positioning station (CGPS) near Felton about 2.4 miles west of the Basin that is part of the University NAVSTAR Consortium Plate Boundary Observatory network; however, it is located outside the sedimentary basin on granitic basement rock, making

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it useful for tracking movement of the land surface due to tectonic deformation but of no use for monitoring pumping-induced subsidence in the nearby sedimentary rocks of the Basin.

DWR has made vertical displacement data available as part of its SGMA technical assistance for GSP development and implementation. Vertical displacement estimates are derived from Interferometric Synthetic Aperture Radar (InSAR) data that are collected by the European Space Agency Sentinel-1A and 1B satellites and processed by TRE ALTAMIRA Inc. The InSAR dataset is available for public use and has been calibrated to best available independent data prior to release by DWR. The statewide dataset starts in mid-June 2015.

InSAR monitoring is subject to potential errors of approximately 0.059 feet (0.7 inch) from discrepancies between InSAR data and CGPS data (Towill Inc., 2020) and measurement accuracy when converting from the raw InSAR data to the maps provided by DWR of 0.048 feet (personal communication with Benjamin Breezing at DWR, 2019). A land surface change of less than 0.1 foot (1.2 inches) which is less than the combined error of the dataset is within the noise of the data and is not dispositive of subsidence in the Basin. Additionally, InSAR data provided by DWR reflects both elastic and inelastic subsidence.

Figure 4-41 shows changes in total vertical ground surface displacement measured by InSAR between June 2015 and April 2026. During this timeframe, the satellite data showed generally minimum vertical displacement, with most of the basin exhibiting between approximately –0.02 and 0.02 inches and limited localized areas showing up to slightly greater than 0.02 inches of uplift or subsidence within the basin. Most areas with estimated subsidence on Figure 4-41 are regional and not co-located with groundwater pumping. It is unlikely these relatively minor changes in ground surface elevation reflect ongoing inelastic subsidence trends. Rather, they may be attributed to expected measurement error inherent in the methodology, seasonal fluctuations in soil and vadose zone moisture that cause swelling and recession of the ground surface, or tectonic forces.

The lack of land subsidence related to historical declines in groundwater levels combined with the consolidated nature of Basin sediments support the inapplicability of land subsidence as an indicator of sustainability.

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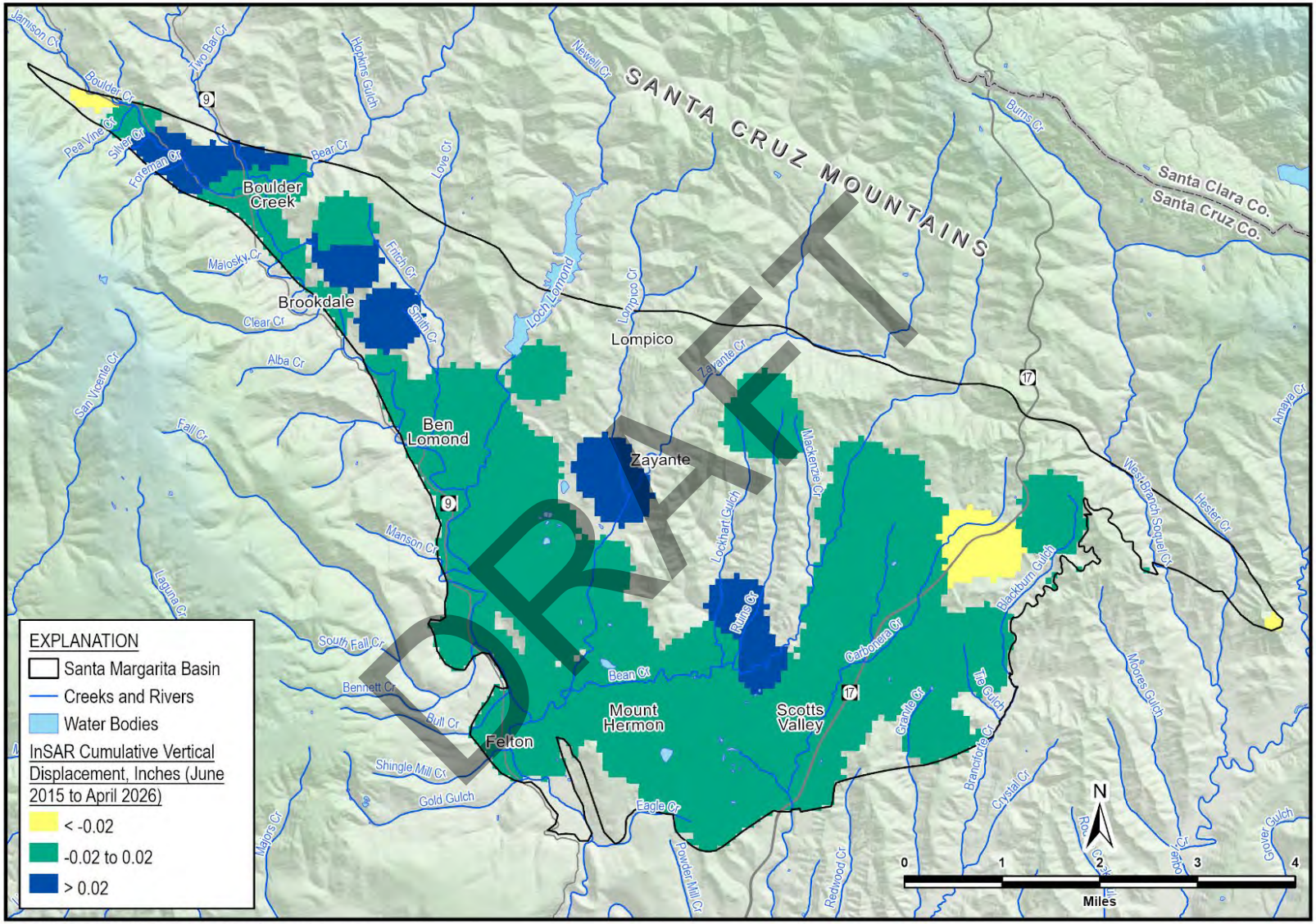

Figure 4-41. Total Vertical Land Surface Displacement in Santa Margarita Basin from June 2015 – June 2026 (based on TRE ALTAMIRA Inc. InSAR)

4.6 Interconnected Surface Water

Surface water is largely connected to groundwater throughout the Basin. As discussed in Section 3.4.8, essentially all flow in the Basin's streams and creeks is derived from groundwater during the dry season from late May through October (Johnson, 2009). The SMGWA, member agencies, and local partners have collected a vast quantity of data to evaluate interconnection of surface water and groundwater, including stream gaging, accretion studies, groundwater level monitoring, stream topography surveys, field habitat reconnaissance, and groundwater modeling. This information helps inform the correlation between groundwater levels as a proxy for evaluating depletion of interconnected surface water. The analysis for the 2027 GSP Amendment considers recent guidance from DWR on technical aspects of managing depletion of interconnected surface water (DWR, 2024a, b, and c).

4.6.1 Locations of Interconnected Surface Water

The highly permeable nature of the Santa Margarita aquifer and its proximity to surface water features lends it to being the primary source of baseflows to the Basin's creeks and the San Lorenzo River. Groundwater in other aquifers is also connected to surface water, but the Santa Margarita aquifer is the greatest overall contributor. The historical groundwater budget in Section 5.4.3 estimates that net groundwater contributions to surface water (i.e., groundwater discharge to creeks less groundwater recharge from creeks) averaged about 12,600 AFY. The Santa Margarita aquifer contributes 40%, the Butano aquifer contributes 32%, and the other formations connected to creeks contribute a combined 28% of net groundwater discharge to creeks. The Butano aquifer contributes a relatively larger amount than expected because it is intersected by numerous creeks along the Basin's northern boundary where these interactions occur. The other formations and aquifers that discharge groundwater to creeks in the Basin include the small portion of alluvium near Felton, the Monterey Formation, and the Lompico aquifer.

Accretion studies provide field observations that demonstrate where groundwater is contributing to streamflow and where streams are replenishing groundwater. In 2017, Balance Hydrologics began evaluating interconnected surface water by conducting annual late-season stream observation walks ("accretion runs"), where flow and specific conductance were measured with high precision at select locations along the San Lorenzo River and its tributaries[2]. The accretion runs also include habitat-oriented measurements of localized changes in water temperature, temperature stratification, and the presence and height of recent high-water marks, all of which also inform assessments of surface/groundwater exchange.

[2] This work grew out of detailed hydrologic studies conducted for the SLVWD during 2 very dry summers (2014 and 2015), coupled with the effects of a recovery year (2016), and the recommendations of the technical advisory committee reviewing that work.

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Additionally, measurements of nitrate and sometimes other major ions or forms or organic carbon (Richardson *et al*., 2020) are also included in many of the accretion runs. Sites along the San Lorenzo River are measured from upstream of downtown Boulder Creek to below the USGS at Big Trees gage (Section 6.6.1). Much of the emphasis is on areas within the outcrop of the Santa Margarita Sandstone, which contributes water to the river and its tributaries, most notably from below Love Creek to downstream of the USGS Big Trees gage, beneath the Henry Cowell State Park entrance road.

As part of GSP development and implementation, sites along Zayante, Lompico, and Bean Creeks were added to the accretion runs in the summer of 2019 and 2020, with most of the additional sites along Bean Creek and its tributaries. During the summer and fall of 2019, three separate accretion runs (May, July, and September) were conducted on the San Lorenzo River, Lompico, Zayante, Bean, and Eagle Creeks, where measurements were collected at all sites over 1 to 2 days for each run. During the summer and fall of 2020, two separate accretion runs were conducted (July and September) at the same locations as in 2019.

Accretion sampling results show flow increases downstream along the San Lorenzo River, Bean, and Zayante Creeks, except for 1 dry reach along Bean Creek. The flow increases are independent of surface contributions from other small tributaries along the reaches. These findings suggest that the creek baseflow is supported by groundwater discharge (Parke and Hecht, 2020a; Neill and Hecht, 2020; Neill *et al*., 2021). Previous studies have shown that streams flowing through the Santa Margarita aquifer in the San Lorenzo Valley all share common characteristics of elevated baseflows, low solute loads (measured as specific conductance), very low chloride contributions and elevated nitrate loads (Ricker, 1979; Ricker *et al*., 1994; Sylvester and Covay, 1978; Hecht *et al*., 1991; Parke and Hecht, 2020a). These characteristics were observed in the accretion runs where streams pass through portions of the Basin influenced by the Santa Margarita aquifer.

Along Bean Creek, the findings of the accretion runs are consistent with previous observations: the upper Bean Creek watershed and its tributaries are typically losing reaches that recharge the groundwater, whereas streamflow in the lower watershed is enhanced by groundwater discharge from the Santa Margarita aquifer (Kennedy/Jenks Consultants, 2015; Neill and Hecht, 2020). It has been noted that Bean Creek, beginning about one-quarter mile downstream of Mackenzie Creek, typically goes dry in the summer and has done so since the 1960s, although the extents vary between years (Kennedy/Jenks Consultants, 2015; personal communication with John Ricker, March 2020). Balance Hydrologics conducted a stream walk along the dry reach to document the conditions and extent during October 2019 and July 2020 (Neill and Hecht, 2020, Neill *et al*., 2021). The greatest increases in flows were observed downstream of the confluence of Ruins Creek with Bean Creek. This reach, in particular, is the primary gaining reach within the Basin and is characterized by areas where the stream has cut through the Santa Margarita sandstone and into the top of underlying Monterey shale, such that springs in the streambed and along the sides of the stream are contributing groundwater

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discharge (Figure 4-42). Balance Hydrologics conducted a stream walk along the lower Bean Creek reach in September of 2020 to document the numerous seeps and springs contributing groundwater from the Santa Margarita aquifer (Neill *et al*., 2021). Similar observations of seeps and springs contributing groundwater along streams within the Basin have been documented along the San Lorenzo River, Zayante Creek, and Eagle Creek (Parke and Hecht, 2020a; Parke and Hecht, 2020b).

In addition to accretion studies and field observations, analysis of groundwater elevations in monitoring wells compared to nearby streambed elevations shows groundwater levels consistently higher than the streambed, indicates that groundwater is contributing to streamflow in these locations year-round. Additional details on this analysis are provided in Section 4.6.2.

Findings from the above-mentioned studies and observations are combined with model-simulated groundwater elevations in relation to creeks and land surface to produce a map showing where surface water and groundwater are connected (Figure 4-42). The map includes creek connections together with non-riparian areas where depth to groundwater is on average less than 30 feet. A depth of 30 feet is selected because it is generally accepted as the maximum rooting depth for most plants supported by groundwater that are mapped in the Natural Communities Commonly Associated with Groundwater Dataset (TNC, 2019). The map shows that many of the creeks in the Basin are likely interconnected with groundwater most of the time.

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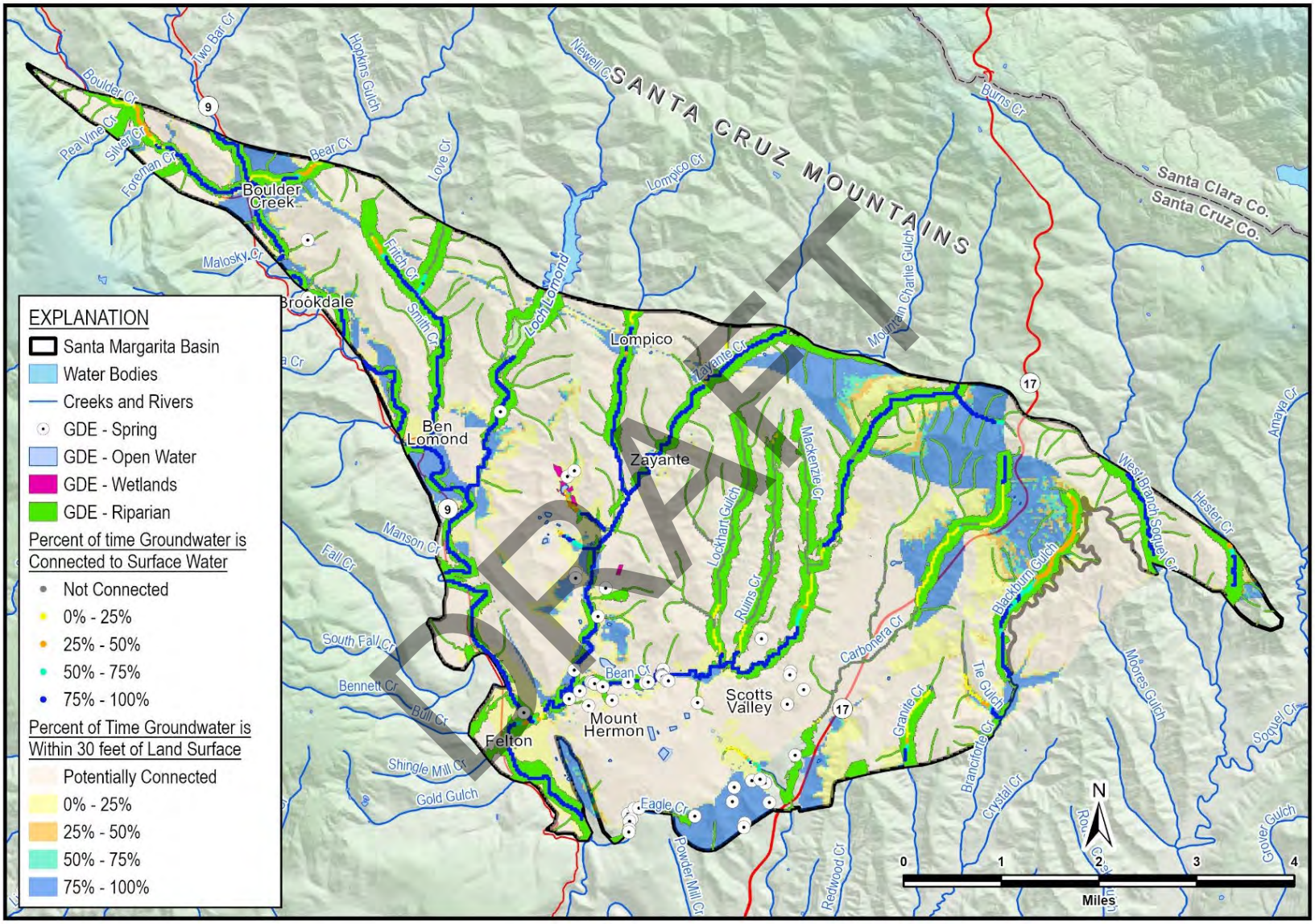

Figure 4-42. Interconnected Surface Water in the Santa Margarita Basin

4.6.2 Relationship of Interconnected Surface Water Baseflow to Groundwater Extraction and Precipitation

To assess the relationship between interconnected surface water, groundwater extraction, and water year precipitation, data for 25 water years (2001 through 2025) were compiled and reviewed. As described in Section 4.6.1 above, past accretion studies have established the relationship between surface water flow entering the Basin, tributaries from within and outside of the Basin, and the role of groundwater discharge to baseflow. The result of these relationships can be observed in daily flow as gaged on the San Lorenzo River at Big Trees.

Figure 4-43 shows the daily flow in cfs plotted on a logarithmic scale throughout the water year averaged over 25 years. The flow data shows the high variability in mean daily flow that starts in mid-October and continues until mid-April associated with the wet season. After mid-April, flow becomes more consistent as it is dominated by groundwater discharge. The lowest flow of the season generally occurs throughout the month of September.

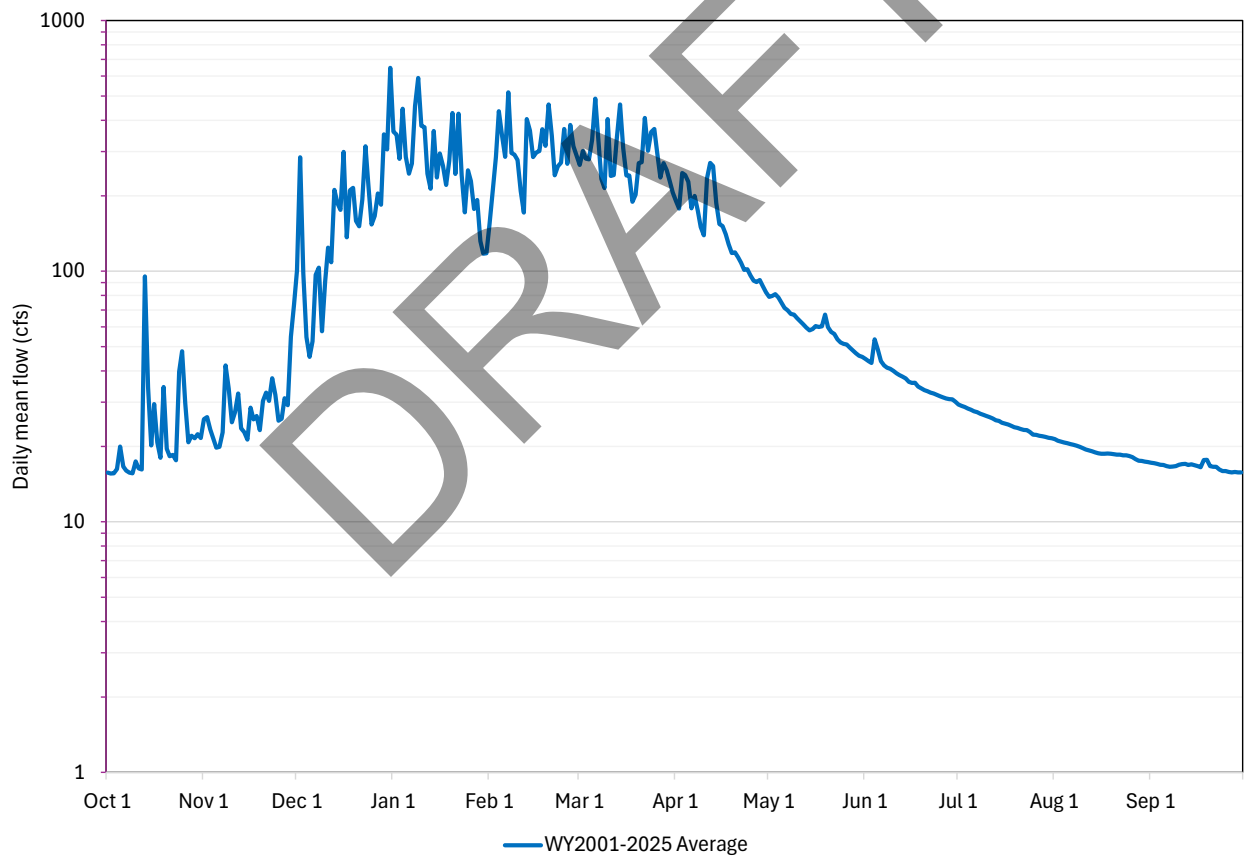

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Figure 4-43. Daily Mean Flow on San Lorenzo River at Big Trees

As described in Sections 3.4.3, 3.4.4, and 4.2.2, the Basin has a unique geologic structure as a fault bounded syncline with the Santa Margarita Sandstone acting as a highly transmissive

unconfined aquifer that rapidly recharges and subsequently discharges baseflow to streams. Discharge to streams is accentuated by the Santa Margarita Sandstone being situated above the Monterey Formation, which serves as a barrier to vertical groundwater flow (see Section 3.4.5.3). Figure 4-8 and Figure 4-9 show that the Santa Margarita Sandstone is present throughout much of the Basin with groundwater contours that largely mimic topography with groundwater elevations higher than adjacent streams that receive its discharge through baseflow and basal springs. Because this formation contributes so significantly to baseflow, a comparison of groundwater extraction from the Santa Margarita aquifer is appropriate to compare to the minimum daily flow measured in each year to evaluate the potential impact associated with groundwater extraction.

Figure 4-44 shows the low measured daily flow on the San Lorenzo River at the Big Trees gage in September from 2001 through 2025 compared to water year total groundwater extraction from the Santa Margarita aquifer. The data show a relatively weak positive linear relationship, indicating that groundwater extraction has some influence on minimum flows at the end of the water year. However, some years combine very low groundwater extraction with lower than average flow, while other years have high extraction with above average flow.

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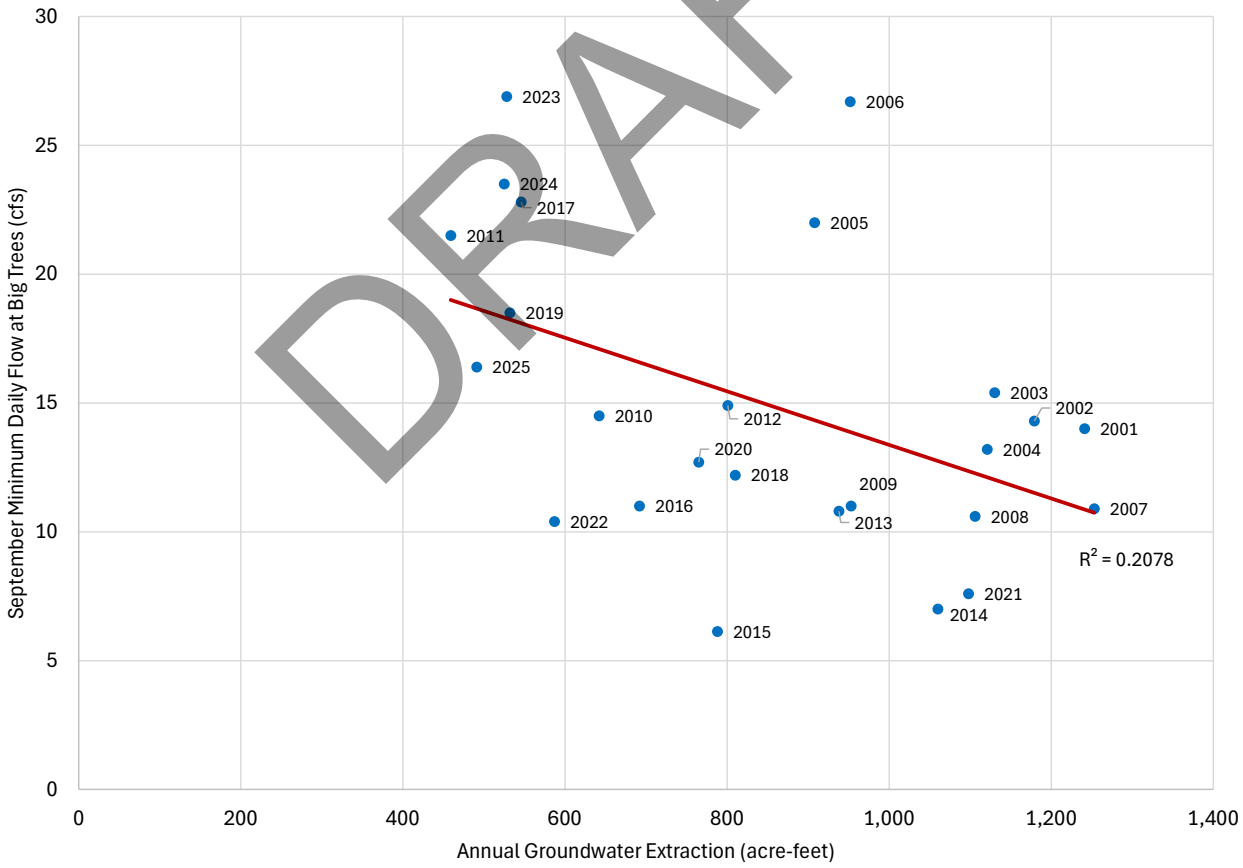

Figure 4-44. Relationship Between Minimum Flow at Big Trees Gage and Water Year Extraction in the Santa Margarita Aquifer

Figure 4-45 shows the low measured daily flow in September from 2001 through 2025 compared to water year total precipitation as measured on the San Lorenzo River at the Big Trees gage. The data show a relatively strong linear relationship, indicating that annual rainfall likely has a stronger influence on dry-season baseflow than groundwater extraction does.

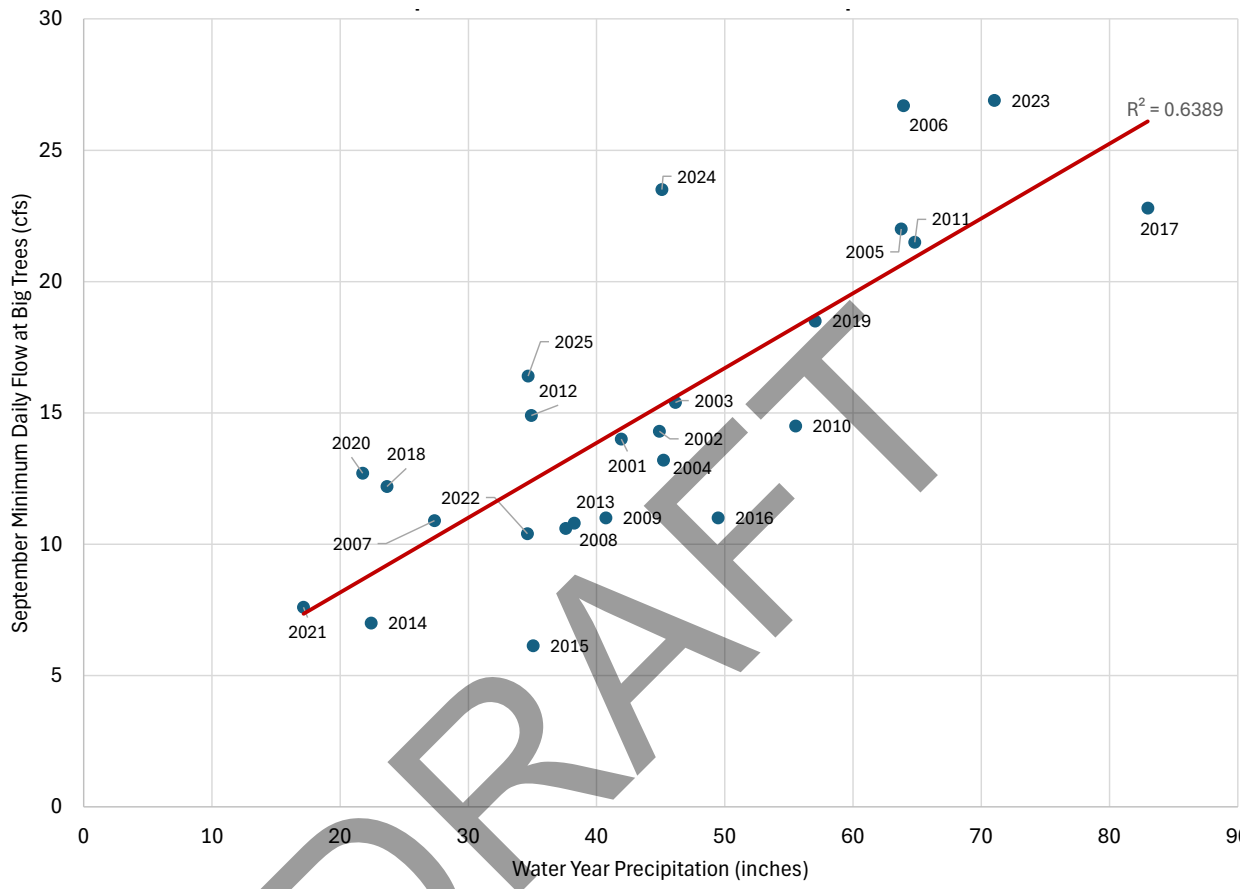

Figure 4-45. Relationship Between Minimum Flow at Big Trees Gage and Water Year Precipitation

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4.6.3 Relationship Between Depletion of Interconnected Surface Water and Groundwater Elevation Based on Measured Data

Section §354.28(c)(6) of the GSP Regulations requires that minimum thresholds for depletion of interconnected surface water be based on a rate or volume of surface water depletions. However, Section §354.28(d) allows the use of groundwater elevations as a proxy for multiple SMC when supported by adequate evidence of a relationship. This section provides the rationale for the relationship. The data below indicate that despite a relatively weak correlation between groundwater extraction and baseflow, groundwater elevations are still a good indicator of what baseflow to expect under varying hydrologic conditions.

4.6.3.1 Comparison of Long-Term Water Groundwater Levels to Flow on the San Lorenzo River at Big Trees

To evaluate the relationship between groundwater elevations and streamflow, SMGWA identified 4 Santa Margarita aquifer representative monitoring points (RMPs) with fall (September to early October) groundwater level data collected between 2012 and 2025. Fall groundwater levels are used because they are at the end of the dry season, so they limit the effect of precipitation on streamflow while isolating groundwater's contribution to baseflow. The 4 Santa Margarita aquifer RMPs (SLVWD Quail Hollow MW-B, SLVWD Olympia #1, SLVWD Pasatiempo MW-2, and SVWD SV4-MW) are broadly distributed across the Basin (Figure 4-46) in areas where the Santa Margarita aquifer discharges groundwater to the San Lorenzo River or one of its tributaries. Annual fall groundwater elevations at these 4 RMPs were averaged and compared to the lowest daily flow measured during September in the San Lorenzo River at Big Trees, which represents the cumulative outflow from the Basin and includes tributary contributions fed by groundwater within the Basin. Figure 4-47 shows that there is a strong correlation between annual average groundwater levels for the 4 RMPs in the Santa Margarita aquifer and the resulting low daily flow in the San Lorenzo River.

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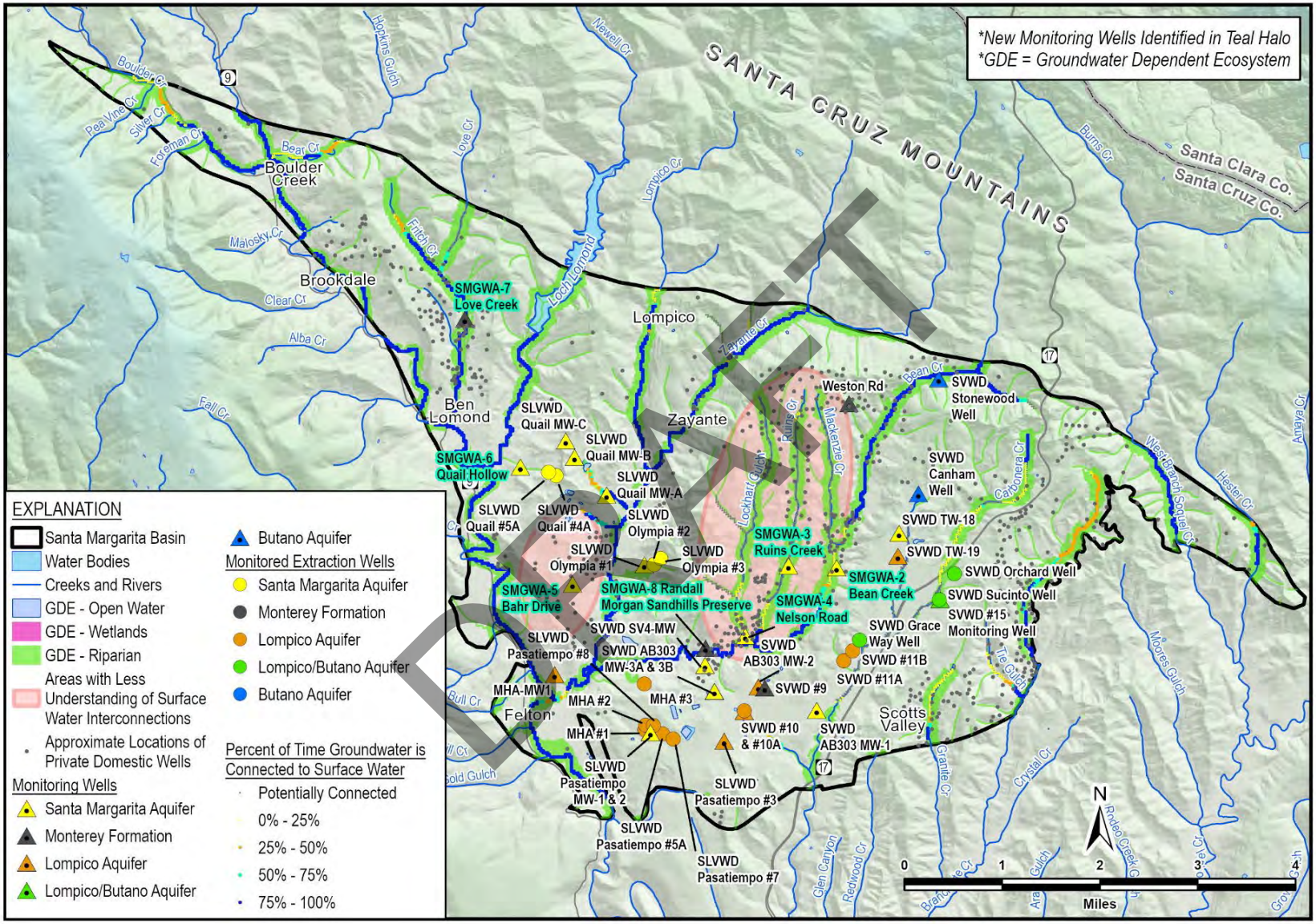

Figure 4-46. Interconnected Surface Water Modeled Results and Monitoring Locations

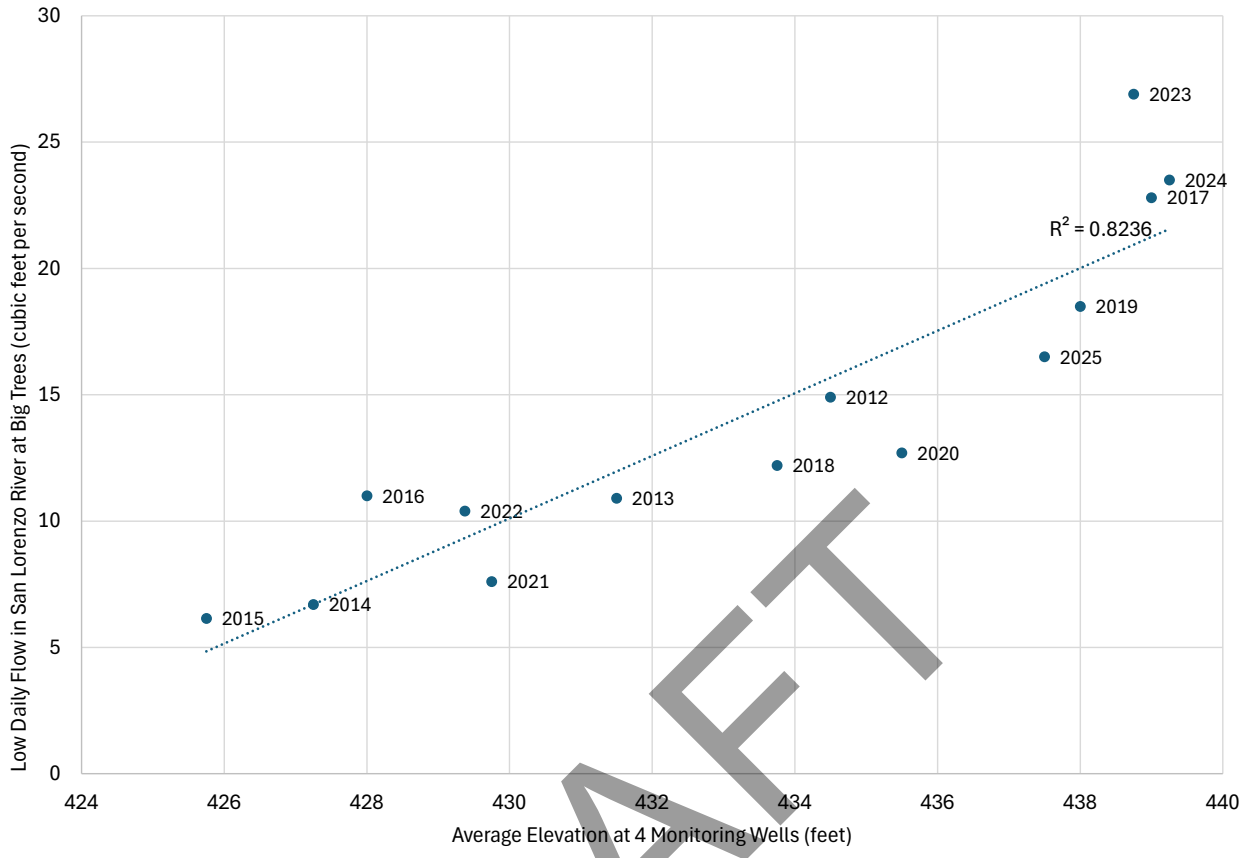

Figure 4-47. Average Annual Fall Santa Margarita Aquifer Groundwater Elevations Compared to Low Daily Flow, 2012 through 2025

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4.6.3.2 Comparison of Short-Term Groundwater Levels to Flow at Multiple Locations

A total of 7 new monitoring wells were installed in 2023 (labeled in teal on Figure 4-46), expanding the shallow monitoring network and improving spatial coverage near streams. Some of the new shallow wells are paired with nearby streamflow or stage monitoring gages to improve evaluation of groundwater-surface water interactions. The new monitoring wells are described in more detail in Section 6.9.1.

Figure 4-46 shows the current understanding from the Basin Model of where interconnected surface water occurs in relation to GDE's, private domestic wells, all wells that have groundwater levels monitored as part of the GSP monitoring network, and the 7 monitoring wells installed in 2023 to improve monitoring coverage near streams. Figure 4-46 also indicates areas where groundwater extraction occurs near creeks and where, prior to recent monitoring improvements groundwater level monitoring locations were insufficient to indicate whether the creeks are gaining or losing.

As shown on Figure 4-46 much of the San Lorenzo River and its tributaries are connected to groundwater. Love Creek, Newell Creek, Zayante Creek, and Bean Creek are the primary tributaries within the Basin from north to south along the San Lorenzo River. Above the confluence of Newell Creek as shown on Figure 2-8, only 1 small water system serving 7 customers and an estimated 115 domestic wells extract a combined 37 AFY of groundwater (less than 2% of total basin extraction). This nominal extraction does not appreciably influence surface water depletion. Evidence of this lack of depletion is the fact that Monterey Formation monitoring well SMGWA-7 installed in 2023 to monitor levels in that portion of the Basin has continued to exhibit artesian conditions since its installation. As the intent of SGMA is to manage the effects of groundwater extraction on depletions of interconnected surface water, SMGWA has excluded Love Creek from the analysis. Comparisons of surface water flow and groundwater elevations are included below for Newell Creek, Zayante Creek, and Bean Creek. The analysis uses 5 years of dry-season streamflow data for each location and between 2 and 5 years of groundwater data for nearby wells that are equipped with year-round pressure transducers and dataloggers.

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4.6.3.2.1 Newell Creek Flows Compared to Groundwater Elevations

As shown on Figure 6-6, the Newell Creek gage is just above the confluence with the San Lorenzo River. Newell Creek flow is regulated because Loch Lomond Reservoir is located on the creek near the northeastern boundary of the Basin. With limited exceptions, the City of Santa Cruz is required to maintain a year-round baseflow of 1.0 cfs below the reservoir to provide adequate depths for fish passage and spawning. In 2023, SMGWA constructed monitoring well SMGWA-6 just under 0.25 miles east of the Newell Creek stream gage. The well was equipped with a transducer and datalogger in late September 2023. Figure 4-48 shows the relationship between dry-season flow on the creek and groundwater elevations in SMGWA-6.

Although managed releases from the reservoir for flow requirements somewhat affect the relationship on Newell Creek, declining groundwater levels correspond clearly with declining average flow over the period. Starting with the very wet year in 2023, 2024, and 2025 were successively drier. The September 30 groundwater level in SMGWA-6 declined from 341.7 feet in 2023, to 338.7 feet in 2024, to 334.7 feet in 2025. Through much of that period, the City of Santa Cruz maintained a release of 1.0 cfs with minor exceptions. Measured flow above 1 cfs indicates that the stream is gaining baseflow as it travels from the reservoir to the confluence with the San Lorenzo River. Each successive year gained less baseflow, which is consistent with the declining groundwater elevations that are feeding the creek. Streamflow also increased through the summer of 2023. This increase likely reflects a time lag in which water recharged into the Santa Margarita aquifer during the exceptionally wet winter continued to discharge into the creek over the summer. This behavior further supports the Basin HCM, in which the Santa Margarita aquifer quickly accepts recharge and then releases it from storage by discharging to local creeks.

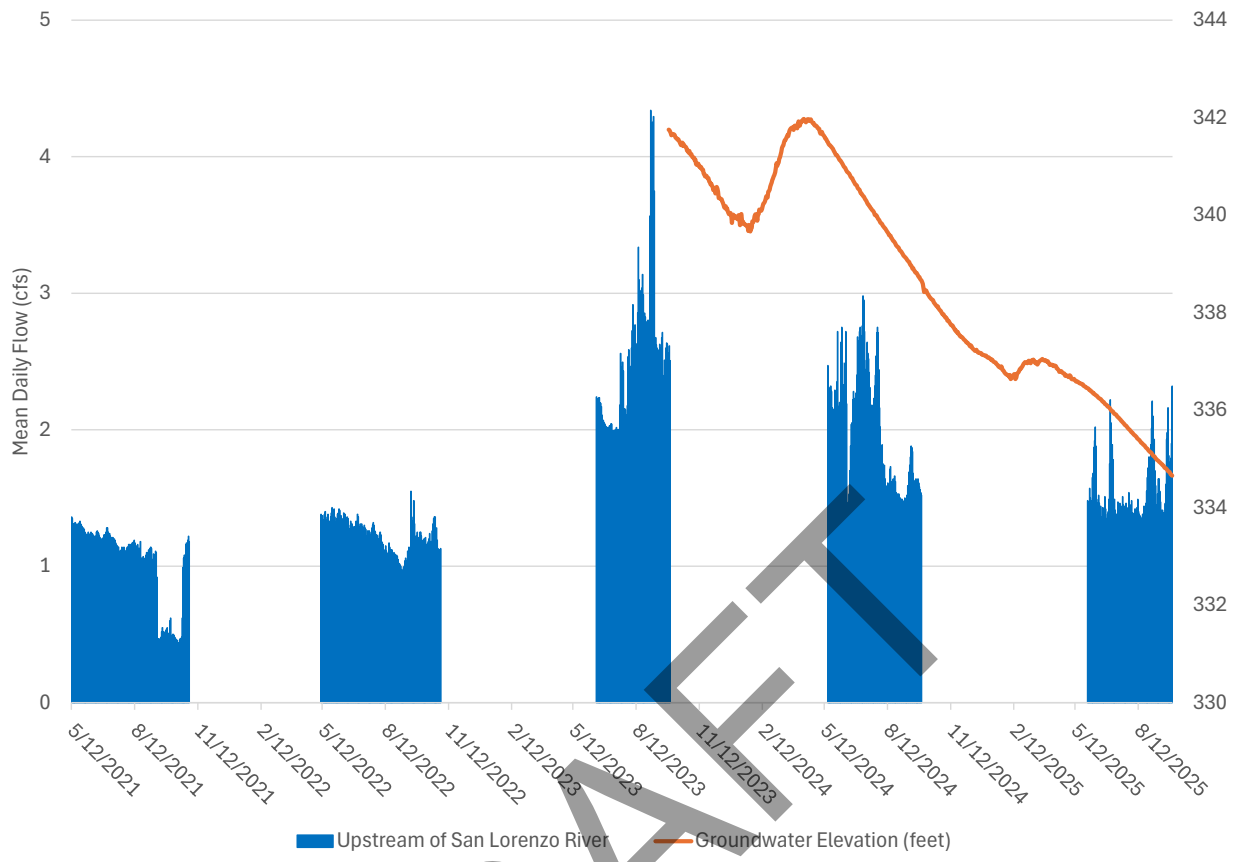

Figure 4-48. Dry-Season Flow on Newell Creek vs. Groundwater Elevations at SMGWA-6

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4.6.3.2.2 Zayante Creek Flows Compared to Groundwater Elevations

As shown on Figure 6-6, the Zayante Creek gage at Woodwardia is just over 0.25 miles upstream from the confluence with Bean Creek. In May 2024, a pressure transducer and datalogger were installed in an existing monitoring well, SLVWD Olympia #1, which is located just over 1 mile northeast of the Zayante gage. Figure 4-49 shows the relationship between dry-season flow on the creek and groundwater elevations in Olympia #1. While the highs and lows measured in Olympia #1 are very subtle, the pattern of seasonality closely matches that of the creek during the dry season.

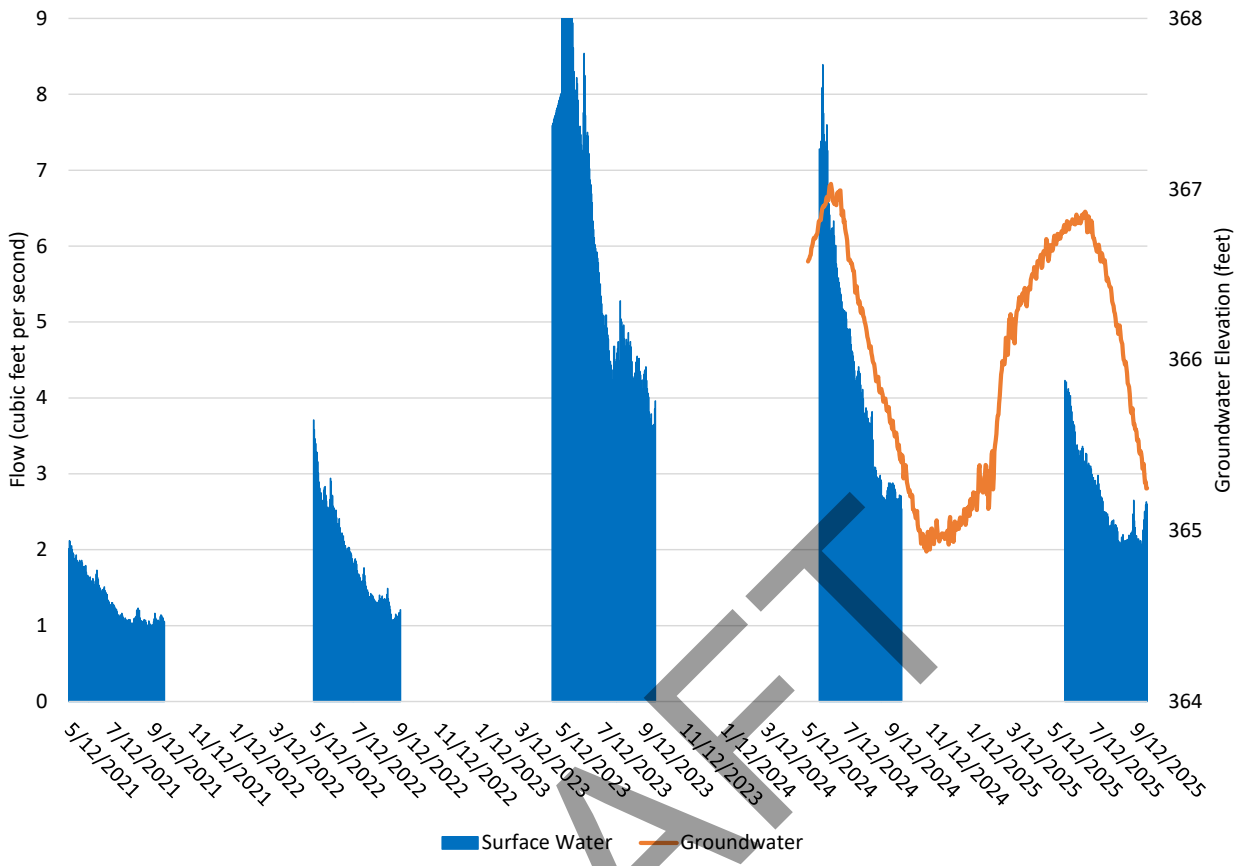

Figure 4-49. Dry-Season Flow on Zayante Creek vs. Groundwater Elevations at SLVWD Olympia #1

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Also near Zayante Creek, SMGWA installed a monitoring well, SMGWA-5, about 0.75 miles north of the creek gage. A pressure transducer and datalogger were installed on the well in late September 2023. As shown on Figure 4-50, the data shows a unique but clear relationship where the timing of peak groundwater levels is in early spring rather than early summer. This behavior is expected because the well was drilled where a highly permeable section of Santa Margarita Sandstone less than 60 feet thick sits on top of impermeable Monterey Formation. Groundwater in this thin section was expected to move relatively quickly into the creek at a lower elevation. The groundwater level behavior in this location indicates that groundwater moves through the aquifer as a pulse earlier in the season. The peak groundwater level declined by nearly 2 feet from 2024 to 2025, consistent with lower precipitation. The seasonal low, however, did not decline similarly, which supports the concept that the Monterey Formation serves as a base of groundwater flow. This is consistent with SMGWA's understanding of the Basin's HCM.

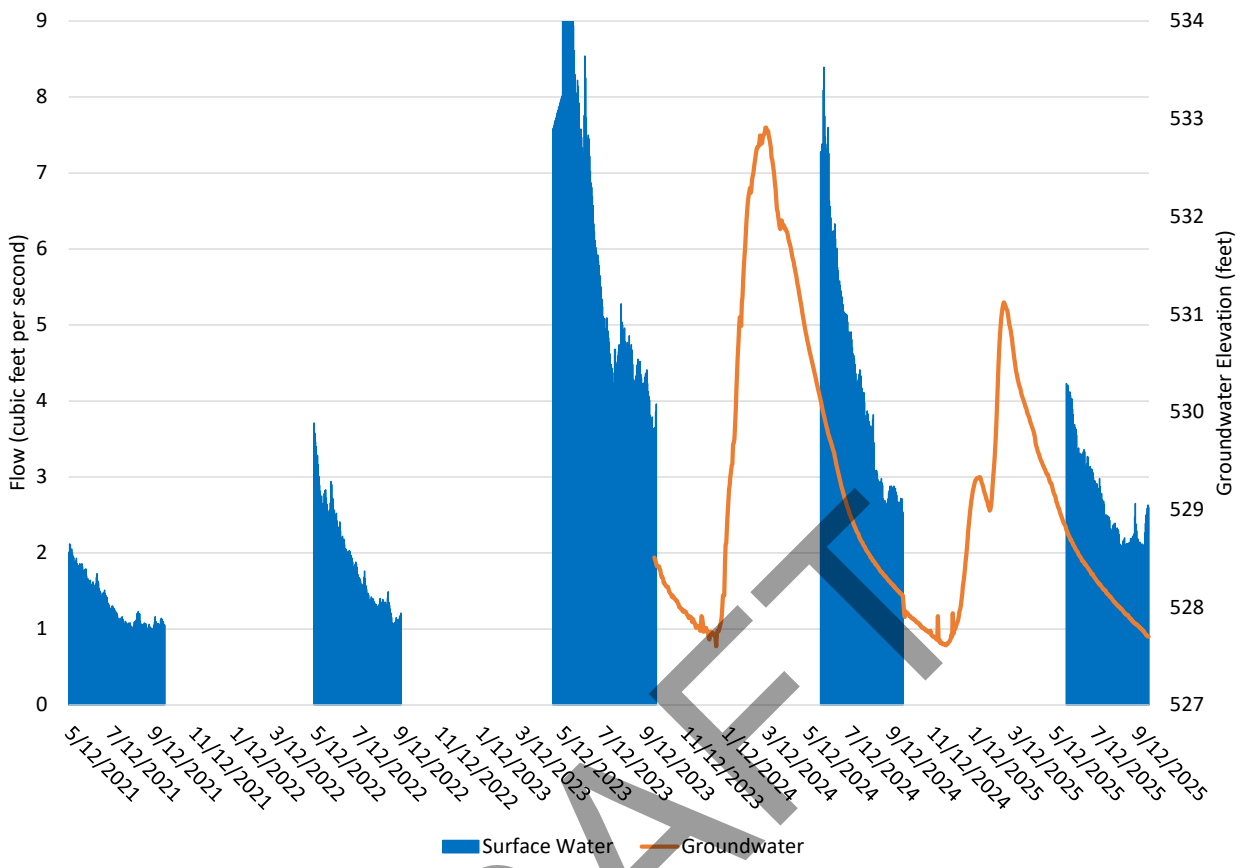

Figure 4-50. Dry-Season Flow on Zayante Creek vs. Groundwater Elevations at SMGWA-5

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4.6.3.2.3 Bean Creek Flows Compared to Groundwater Elevations

As shown on Figure 6-6, the Bean Creek gage at Mount Hermon Camp is just under 0.2 miles upstream from the confluence with Zayante Creek. Since October 2020, a pressure transducer and datalogger have been installed in an existing monitoring well, SVWD SV4-MW, which is located just over 1 mile east of the Mount Hermon Camp gage. Figure 4-51 shows the relationship between dry-season flow on the creek and groundwater elevations in SVWD SV4-MW. Groundwater levels closely match the pattern of seasonality that the creek exhibits during the dry-season as well as the year-to-year creek flow trends (e.g., 2021 critically dry and 2023 wet).

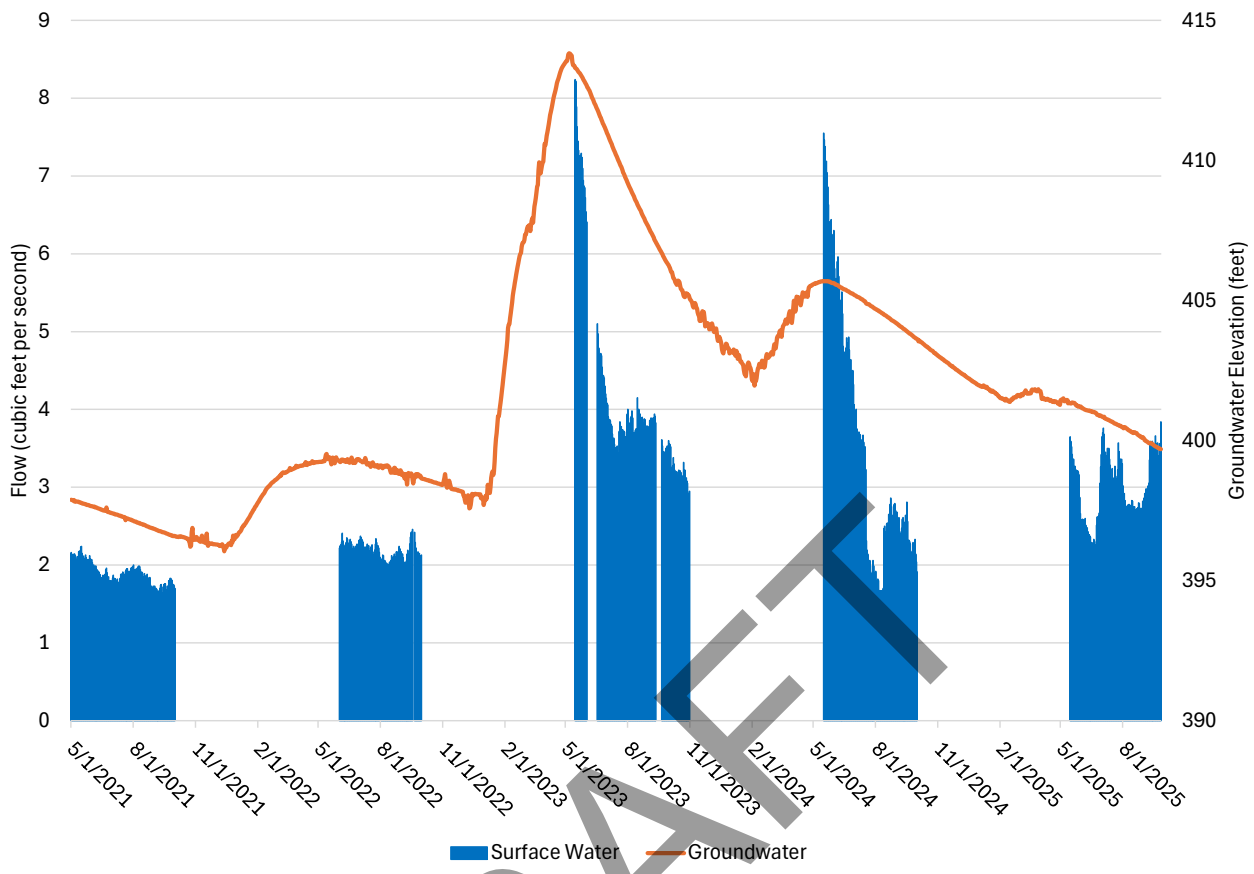

Figure 4-51. Dry-Season Flow on Bean Creek vs. Groundwater Elevations at SVWD MW-SV4

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4.6.4 Modeled Information on Depletion of Interconnected Surface Water

For the 2022 GSP, the Basin Model was used to estimate the influence of groundwater extraction on stream depletion. Removing extraction from the Basin Model results in a 5.6% increase (about 1,200 AFY) of groundwater discharge to creeks (Table 4-4). This is about 5.3% of the average historical annual groundwater discharge to streams (21,300 AFY) and 3.0% of the streamflow gained (40,600 AF) within the Basin (69,600 AFY entering Basin to 110,200 AFY exiting Basin). The Santa Margarita aquifer contributes more than half of the discharge.

Table 4-4. Annual Average Model Simulated Discharge to Creeks With and Without Groundwater Extraction, WY1985-2018

Discharge to Creeks	Basin-Wide	Santa Margarita Aquifer
With Pumping, AFY	21,300	6,780
Without Pumping, AFY	22,500	7,390
Increase in Discharge to Creeks, AFY	1,200	610
% Change	5.6%	9.0%

On a smaller watershed scale, eliminating extraction in the Bean Creek watershed increases the groundwater contribution to creeks by 0.33 to 0.55 cfs during low-flow periods (the difference between the 2 dashed lines on Figure 4-52). On average, this equates to 15% greater low flows without extraction. Groundwater discharge to creeks during low-flow months contributes substantially to streamflow but is highly dependent on rainfall, represented by water year type on Figure 4-52. This result is consistent with the strong relationship between interconnected surface water baseflow and precipitation described in Section 4.6.2.

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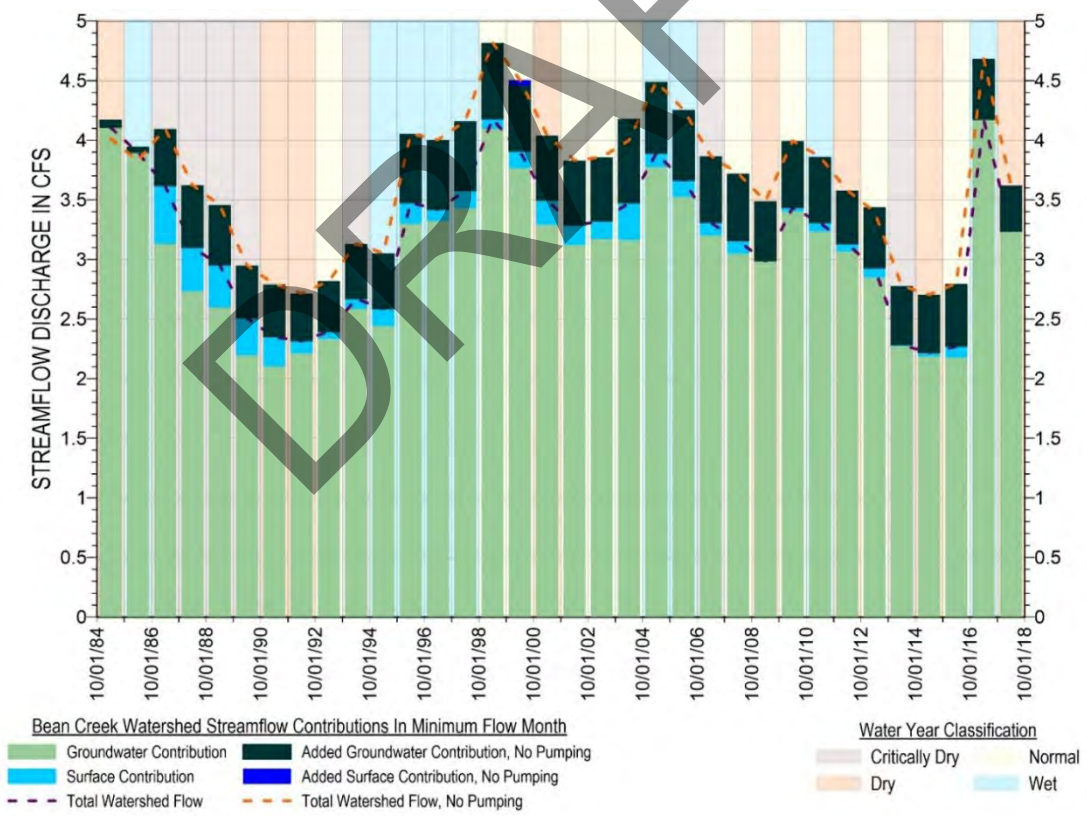

Figure 4-52. Model Simulated Effects of Groundwater Extractions on Groundwater Discharge to Bean Creek in Minimum Flow Month

4.6.5 Sufficiency of Groundwater Elevation as a Proxy for Depletion of Interconnected Surface Water

Section §354.28(d) of the GSP Regulations allows groundwater elevation to serve as a proxy for other sustainability indicators where a GSP demonstrates a significant correlation between groundwater elevation and the indicator being represented. The preceding subsections present 5 independent lines of evidence supporting the use of Santa Margarita aquifer groundwater elevations as a proxy for the timing and rate of depletion of interconnected surface water in the Basin. This subsection summarizes those lines of evidence, states the quantitative relationship on which the proxy relies, and identifies the limitations of that relationship.

First, field observation establishes that the Basin's creeks and the San Lorenzo River are sustained by groundwater discharge during the dry season. Annual late-season accretion runs conducted since 2017 document downstream flow gains along the San Lorenzo River, Bean Creek, and Zayante Creek that are independent of tributary inflow, together with the seeps and springs that produce those gains where streams have incised the Santa Margarita Sandstone to the top of the Monterey Formation (Section 4.6.1). The elevated baseflow, low specific conductance, low chloride, and elevated nitrate measured along these reaches match the geochemical signature of Santa Margarita aquifer groundwater reported in earlier studies, which independently confirms groundwater as the source of dry-season flow.

Second, groundwater elevations measured at wells adjacent to interconnected reaches remain above the elevation of the adjacent streambed throughout the year, which is the defining condition for a gaining stream. Because the vertical gradient is directed from the aquifer toward the stream in all seasons, a change in groundwater elevation translates directly into a change in the head difference that drives groundwater discharge to the stream.

Third, the relationship between groundwater elevation and dry-season flow is significant at the Basin scale. Average fall groundwater elevation at the 4 Santa Margarita aquifer RMPs explains the variance in September low flow on the San Lorenzo River at Big Trees. Groundwater elevation correlates more closely with September low flow than groundwater extraction does because it is a measured state variable that integrates both drivers: it rises in response to recharge from precipitation and falls in response to extraction, and it therefore reflects the net aquifer condition that governs discharge to streams. This integration is the central basis for adopting groundwater elevations as the proxy.

Fourth, reach-scale monitoring demonstrates that groundwater elevation tracks streamflow in time as well as in magnitude. At Newell Creek, Zayante Creek, and Bean Creek, continuous groundwater elevation records from adjacent monitoring wells reproduce both the within-season recession and the year-to-year sequence of wet and dry conditions recorded at the corresponding stream gages (Sections 4.6.3.2.1 through 4.6.3.2.3). The Newell Creek record is particularly

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informative because managed reservoir releases hold the upstream boundary condition near 1.0 cfs, so the progressive decline in flow gained between the reservoir and the confluence from 2023 through 2025 can be observed with the concurrent decline in groundwater elevation at SMGWA-6.

Fifth, numerical modeling corroborates the measured relationships. Simulations run with and without groundwater extraction indicate that extraction reduces groundwater discharge to streams by about 1,200 AFY Basin-wide, or 5.6% of average annual discharge. In the Bean Creek watershed, simulated discharge during low-flow periods is 0.33 to 0.55 cfs lower with extraction, with the magnitude dependent on water year precipitation (Section 4.6.4).

On the basis of the field observations, the measured relationships between groundwater elevation and streamflow, SMGWA concludes that Santa Margarita aquifer groundwater elevations are a reliable indicator of both the timing and the rate of depletion of interconnected surface water in the Basin, and are therefore appropriate for use as a proxy in establishing sustainable management criteria for the depletion of interconnected surface water sustainability indicator.

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5 WATER BUDGET

A water budget is an accounting of the total annual volume of precipitation, surface water, and groundwater entering and leaving the Basin. This section provides an assessment of the historical, current, and projected Santa Margarita Basin water budgets in accordance with the GSP Regulations §354.18 and the Water Budget BMP (DWR, 2016a). Per the GSP Regulations, water budgets are presented in both graphical and tabular formats. Water budgets are developed using groundwater model inputs and outputs described in a groundwater model report (Appendix 3A).

5.1 Water Budget Development

Water budgets are developed for the area and depth bounded by the lateral and vertical boundaries of the Basin. The lateral boundaries are the Basin boundaries described in Section 3.2. The water budgets were bounded vertically by the deepest principal aquifer, which in most places is the Butano aquifer. The lateral and vertical boundaries of the aquifers in the groundwater model are discussed in more detail in Appendix 3A: Section 5.2.1.

The water budgets are developed from an inventory of precipitation, surface water, and groundwater inflows (supplies) and outflows (demands) to and from the Basin. Some water budget components are measured, such as streamflow at a gaging station or municipal groundwater pumping from a metered well. Other components of the water budget are simulated by the model, such as recharge from precipitation and change in groundwater storage. The difference between groundwater inflows and outflows equals the change of groundwater in storage. The water budget inputs and outputs from the groundwater model are rounded to the nearest 100 for consistency across all summary tables and text. The larger values are not certain to this precision, but this approach helps summarize the data without introducing rounding errors into summation calculations such as total inflows, outflows, and change in storage.

The change over time in groundwater levels, groundwater and surface water interaction, and groundwater in storage derived from the water budgets will be used to assess Basin sustainability. Water movement in the Basin is driven by precipitation as surface runoff to creeks and groundwater recharge after accounting for evapotranspiration. Creeks flow into and out of the Basin, while interacting with groundwater. Water flows from creeks to groundwater and vice versa, depending on the gradient between creek stage and groundwater levels. Groundwater pumping removes groundwater from aquifers, though a small fraction of pumped water enters the groundwater system as return flows from septic systems, quarry usage, landscape irrigation, and sewer and water distribution system losses. Specific details on these components are described in the groundwater model report contained in Appendix 3A: Section 5.1.4. Figure 5-1 presents a schematic hydrologic cycle that is included in the Water Budget BMP (DWR, 2016a). This is a generalized graphic and not all the components pictured apply to the Basin.

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Although not required by GSP Regulations, the groundwater budgets of individual principal aquifers are analyzed to better understand and manage the various sources of groundwater in the Basin. The principal aquifers in the Basin are the Santa Margarita, Lompico, and Butano Sandstones. The Monterey Formation is not considered a principal aquifer but is included in the water budget because there are many private well owners that rely on it as their only source of water. The following describes the general characteristics of the aquifers relevant to water budgets:

- The Santa Margarita aquifer is the primary groundwater source for SLVWD and is also pumped by private well owners. It is the most significant aquifer in terms of groundwater's interactions with surface water.
- The Monterey Formation is primarily pumped to supply shallow private wells where more productive aquifers are not present at or near the surface. It is not currently pumped for municipal supply. Where it is present in the stratigraphic sequence, its low permeability retards recharge of the aquifers in the Lompico and Butano Sandstones below it. The Monterey Formation interacts with surface water where it outcrops in the streambed.
- The Lompico aquifer is pumped extensively for municipal supply in the Scotts Valley area where the formation is thickest. This aquifer has significantly less direct recharge from precipitation than the Santa Margarita aquifer as it outcrops over a much smaller area in the Basin. The area where the Monterey Formation is absent beneath the Santa Margarita aquifer is important for groundwater recharge of the Lompico aquifer in the south Scotts Valley area.
- The Butano aquifer is the deepest of the productive aquifers and is only pumped in northern Scotts Valley. It is recharged by surface water and precipitation where it outcrops along the northern margin of the Basin. In this area, private well owners also pump from it. SVWD pumps water from deep wells that are screened in both the Butano aquifer and the overlying Lompico aquifer.
- Other geologic formations having less of an impact on the water budget still contribute to overall inflows and outflows. The main formation not included in the water budget is the Quaternary alluvium, small deposits that occur widely throughout the Basin, but the most significant are deposits west of the Ben Lomond fault (Figure 3-9 and Figure 3-12).

Additional descriptions of hydrogeologic properties and extents of all aquifer units are provided in Section 3.4.4. The modeled aquifer extents are shown in Appendix 3A: Figure 23 for the Santa Margarita aquifer, Monterey Formation, and Lompico aquifer and in Appendix 3A: Figure 24 for the Butano aquifer.

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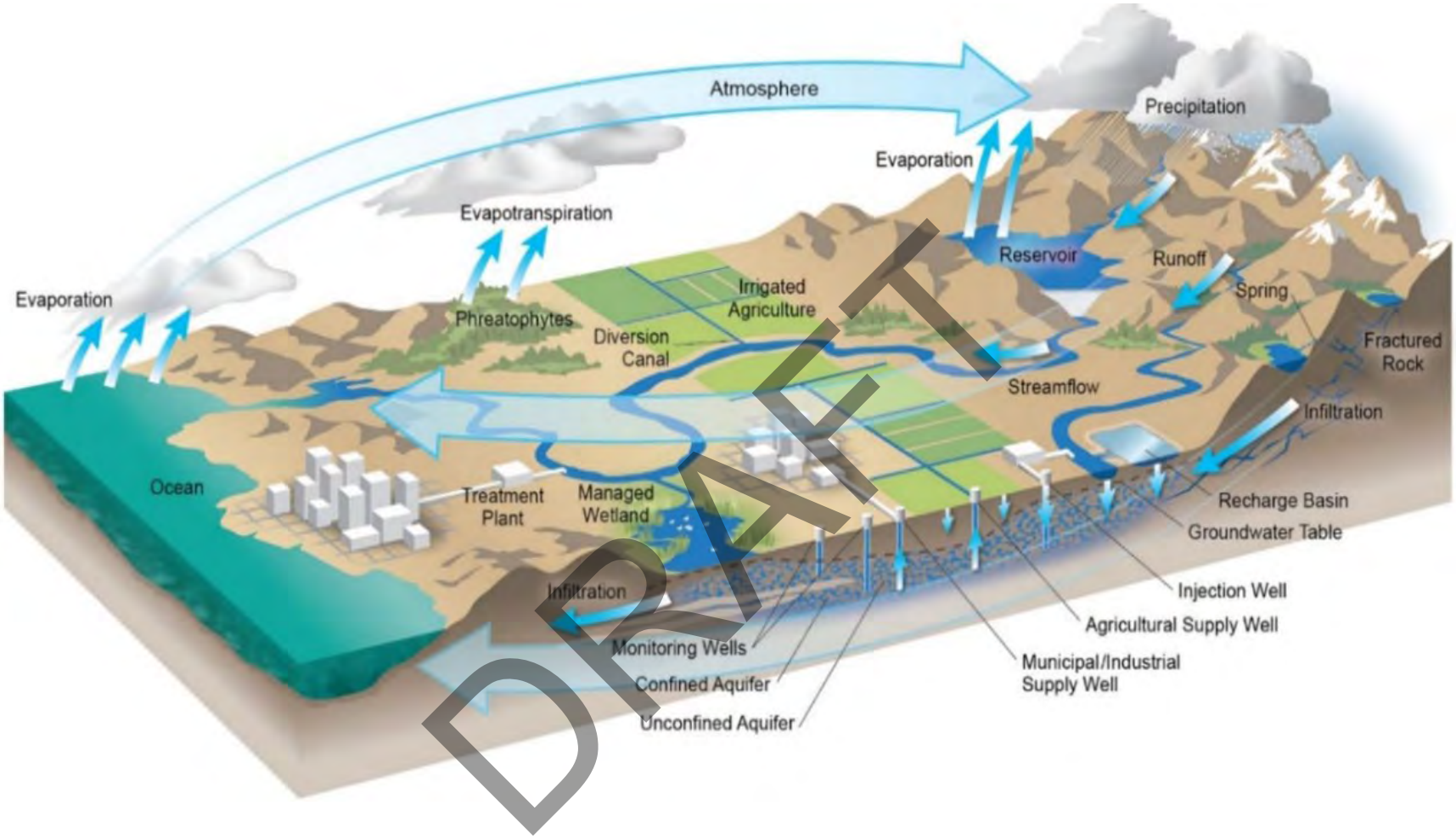

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Figure 5-1. Generalized Hydrologic Cycle from Water Budget BMP (DWR, 2016a)

5.1.1 Precipitation Budget Components

The precipitation budget is an accounting of how much rain falls on the Basin, and where it is eventually allocated. A simplified schematic showing the precipitation budget components is provided on Figure 5-2. Precipitation budget components and associated data sources and uncertainties are described in the bullets below and in Table 5-1.

Precipitation Budget Inflow

- **Precipitation:** Rain that falls within the Basin.

Precipitation Budget Outflows

- **Evapotranspiration:** Water that evaporates from the land surface and soil or is transpired by plants.
- **Runoff:** Flow that traverses over the land surface into surface water bodies. Also referred to as overland flow.
- **Groundwater Recharge**: Water that percolates through the unsaturated zone and passes through the water table into the saturated zone, becoming groundwater.

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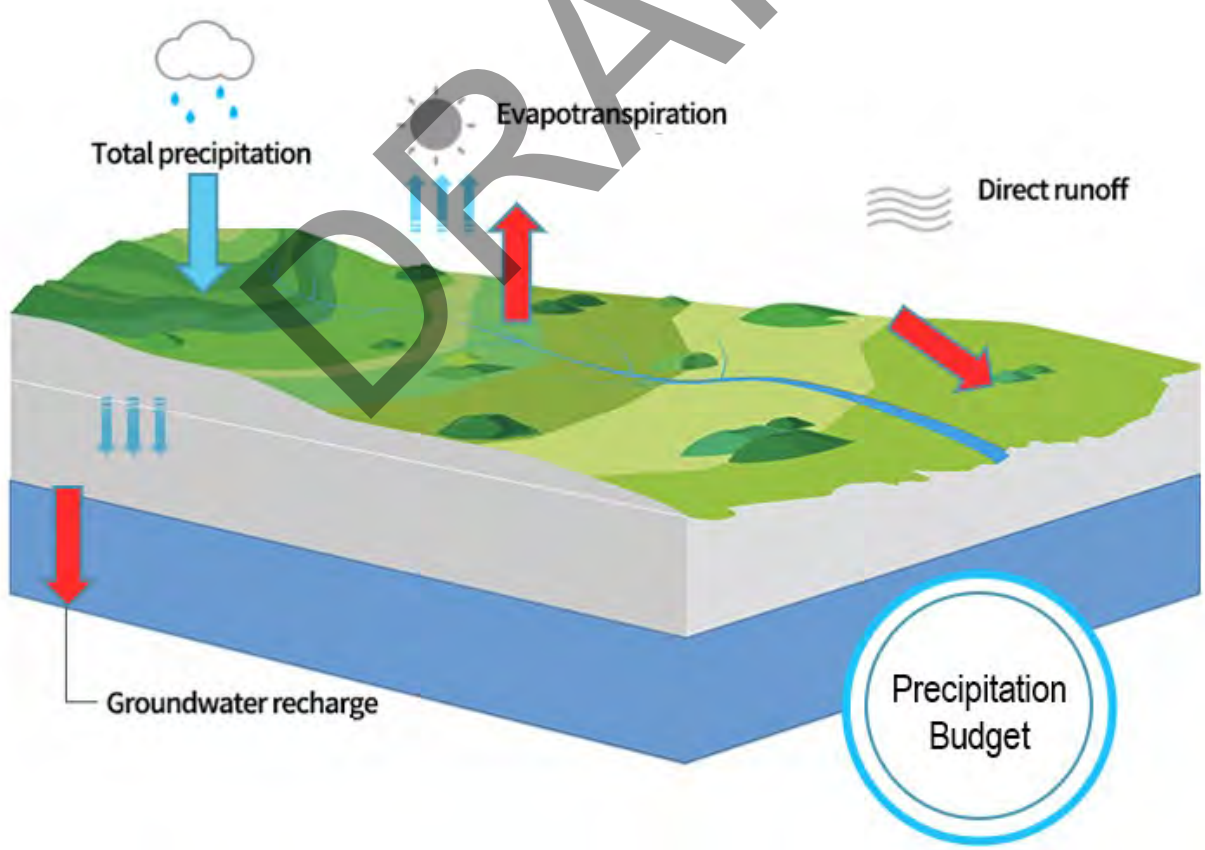

Figure 5-2. Precipitation Budget Components

Table 5-1. Precipitation Budget Components Data Sources and Uncertainty

Budget Component	Source of Model Input Data	Limitations
Inflows		
Precipitation	Monthly precipitation data from PRISM for historical model and Four-model Ensemble for future predictions (Figure 3-3).	Regional precipitation model used to develop model input may not account for local variability
Outflows		
Evapotranspiration	Calculated using the Blaney-Criddle (1962) method with adjusted factors from the Santa Cruz Water Balance Model. Temperature was sourced by PRISM for the historical and the Four-model Ensemble for future predictions. This is discussed in more detail in Appendix 3A: Section 5.1.3.	Regional temperature model used to calculate model input may not account for local variability in temperature
Direct Runoff	Calculated based on land use and geology which controls perviousness of land surface	Estimated, limited data for calibration
Groundwater Recharge	Calculated from precipitation less evapotranspiration and runoff	Estimated, limited data for calibration

5.1.2 Surface Water Budget Components

The surface water budget describes flows into and out of the Basin's surface water system. Evaluation of the surface water budget is important for understanding the groundwater-surface water connection, surface water use, and the responsiveness of the surface water system to historical climatic variation. A simplified schematic showing the surface water budget components is provided on Figure 5-3. Surface water budget components and associated data sources and uncertainties are described in the bullets below and in Table 5-2.

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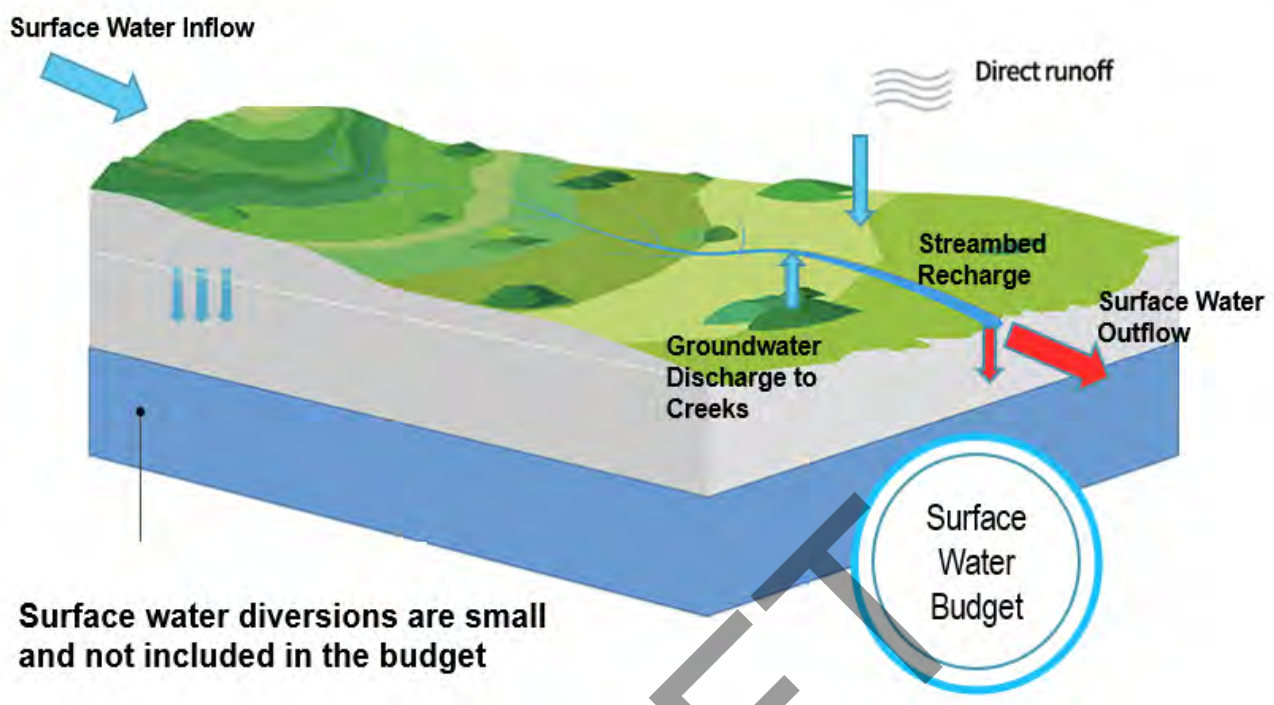

Figure 5-3. Surface Water Budget Components

Surface water diversions within the Basin are small relative to other components of the surface water budget. The only surface water diversion within the Basin is the rarely used City of Santa Cruz San Lorenzo River diversion at Felton that is used to divert to storage at Loch Lomond. SLVWD diversions are all outside of the Basin on upstream tributaries of the San Lorenzo River. The City of Santa Cruz primary surface water diversion occurs on the San Lorenzo River at Tait Street, which is in Santa Cruz and about 5 miles downstream of the Basin.

Despite not being included in the groundwater model simulations, surface water diversions outside of the Basin by SLVWD and the City of Santa Cruz are an important component of the regional water supply system. These diversions made outside of the Basin totaled about 2,300 AF in WY2018 (Table 3-5). In WY2018, SLVWD surface water diversions upstream of the Basin to the west totaled about 1,170 AF, which is about 2.2% of the surface water flow into the Basin that year. That same year, the City of Santa Cruz diverted about 1,230 AF at Tait Street and nothing at the Felton diversion, which is about 1.3% of the surface water budget flowing out of the Basin that year.

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Table 5-2. Surface Water Budget Components Data Sources and Uncertainty

Budget Component	Source of Model Input Data	Limitations
Inflows		
Surface Water Inflow	Calculated from runoff in areas upstream of the basin	Estimated, limited data for calibration
Direct Runoff	Calculated based on land use and geology which control perviousness of land surface	Estimated, limited data for calibration
Groundwater Discharge to Creeks	Simulated by model using stream stage and groundwater head.	Calibrated parameter using limited historical stream accretion data; data are not available for every time period or every creek and tributary in the Basin
Outflows		
Surface Water Outflow	Simulated by model.	Calibrated parameter using available historical stream stage and discharge measurements; however, data are not available for every creek and tributary in the Basin
Streambed Recharge	Simulated by model using stream stage and groundwater head.	Calibrated parameter using limited historical stream accretion data; data are not available for every time period or every creek and tributary in the Basin

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Surface Water Budget Inflows

- **Surface Water Inflow:** Streamflow that enters the Basin's surface water system from areas upstream of the Basin. Surface water inflow includes inflow on the San Lorenzo River, Newell Creek (downstream of Loch Lomond Reservoir situated on the northern Basin boundary), Bean Creek, and other smaller tributaries of the San Lorenzo River.
- **Direct Runoff**: Water that runs off the land surface into surface water bodies.
- **Groundwater Discharge to Creeks**: Groundwater that discharges into creeks, also known as gaining stream conditions. This is the component of groundwater-surface water interactions where surface water stage is lower than nearby groundwater levels, allowing groundwater to discharge to surface water.

Surface Water Budget Outflows

- **Surface Water Outflow:** Streamflow that leaves the Basin's surface water system to areas downstream of the Basin.
- **Streambed Recharge:** Water that percolates to groundwater from stream channels, also known as streambed seepage, or losing stream conditions. This is the component of groundwater-surface water interactions where surface water stage is higher than nearby groundwater levels, allowing surface water to recharge the groundwater system.

5.1.3 Groundwater Budget Components

The groundwater budget describes flows into and out of the Basin's groundwater system. Evaluation of the groundwater budget is important for understanding trends in climate, groundwater use, and groundwater-surface water interaction. A simplified schematic showing the groundwater budget components is provided on Figure 5-4. Groundwater budget components and associated data sources and uncertainty are described in the bullets below and in Table 5-3. Change in storage is calculated from model inputs and outputs for all surface water and groundwater budget components. However, change in storage is discussed in the groundwater budget subsections as the majority of storage changes in the Basin occur in groundwater.

Groundwater Budget Inflows

- **Groundwater Recharge:** Water that infiltrates the land surface, percolates through the unsaturated zone, passes through the water table into the saturated zone, thereby becoming groundwater. The term "precipitation recharge" is used interchangeably with groundwater recharge in the water budget section of this GSP.
- **Subsurface Inflow**: Subsurface flow that enters the Basin's aquifers from neighboring areas.
- **Streambed Recharge**: Water that percolates to groundwater from stream channels, also known as streambed seepage, or losing stream conditions. This is the component of groundwater-surface water interactions where surface water stage is higher than nearby groundwater levels, allowing surface water to recharge the groundwater system.
- **Septic Return Flows**: Water originating in domestic septic systems that percolates to groundwater.
- **System Losses:** Water originating from leakage in sewer and water distribution systems that percolates to groundwater.
- **Quarry Return Flows**: Water that originates from usage at quarry sites that percolates to groundwater.
- **Irrigation Return Flows**: Water originating from the inefficient portion of landscape irrigation that percolates to groundwater.

Groundwater Budget Outflows

- **Subsurface Outflow:** Subsurface groundwater that flows out of the Basin's aquifers into adjacent basins or areas.
- **Groundwater Pumping:** Groundwater extracted by wells for municipal, agricultural, domestic, and industrial uses.

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- **Discharge to Creeks:** Flow that discharges from groundwater into stream channels, also known as gaining stream conditions. This is the component of groundwater-surface water interactions where surface water stage is lower than nearby groundwater levels, allowing groundwater to discharge to surface water.

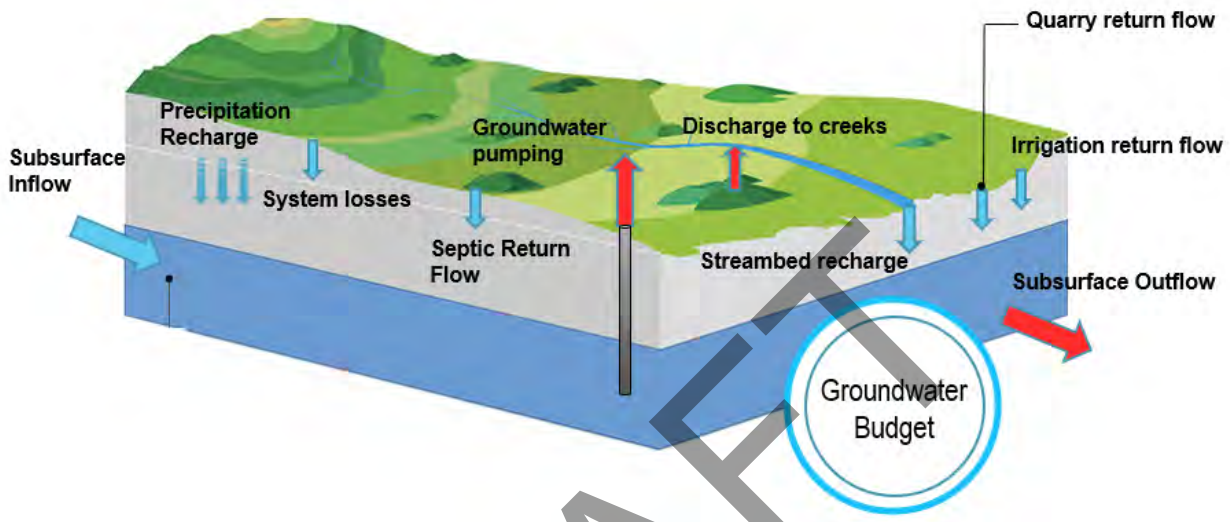

Figure 5-4. Groundwater Budget Components

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Table 5-3. Groundwater Budget Components Data Sources and Uncertainty

Budget Component	Source of Model Input Data	Limitations
Inflows		
Precipitation (Groundwater) Recharge	Calculated from precipitation less evapotranspiration and runoff depending on land use and geology	Estimated, limited data for calibration
Subsurface Inflow	Simulated by model.	Subject to uncertainty in simulated heads and aquifer hydraulic properties
Streambed Recharge	Simulated by model using stream stage and groundwater head.	Calibrated parameter using limited historical stream accretion data; data are not available for every time period or every creek and tributary in the Basin
System Losses	Estimated based on reported water demand or pumping and loss assumptions	Estimated, limited data for calibration
Quarry Return Flows	Estimated based on reported pumping and loss assumptions	Estimated, limited data for calibration
Irrigation Return Flows	Estimated based on assumed outdoor portion of reported water use for municipal users, and estimated for private domestic users and loss assumptions	Estimated, limited data for calibration
Outflows		
Subsurface Outflow	Simulated by model.	Estimated, limited data for calibration
Groundwater Pumping	Reported by providers for public supply use. Estimated for private well owner domestic use using number of domestic parcels and local estimate of water use coefficients. Estimated for industrial, pond-filling, and landscape uses.	Unmetered data subject to estimation errors
Discharge to Creeks	Simulated by model using stream stage and groundwater head.	Calibrated parameter using limited historical stream accretion data; data are not available for every time period or every creek and tributary in the Basin

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5.2 Historical Water Budget

Per GSP Regulations (§ 354.18), the historical water budget is developed to show past water supplies and demands. The historical water budget timeframe for this GSP starts in WY1985 and ends in WY2014 to coincide the end of the budget analysis with the passage of SGMA. This period encompasses multiple droughts and wet periods to represent historical variation in water budget components. The model period starts in 1985 because groundwater pumping and level data are only available for the majority of the Basin starting around 1985.

5.2.1 Historical Precipitation Budget

The historical precipitation budget provides an accounting of how much precipitation fell in the Basin and how much of it was lost to evapotranspiration, became surface water, or recharged groundwater. The historical precipitation budget is summarized in Table 5-4 and presented in a timeseries chart on Figure 5-5.

Table 5-4. Summary of Historical Precipitation Budget

Water Budget Components		Historical Water Budget WY1985-2014		Annual Average by Water Year type (Acre-Feet)			
Average Total for Historical Water Budget (Acre-Feet)		Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow	Critically Dry	Dry	Normal	Wet
Inflows (81,600)*	Precipitation	81,600	100%	49,400	68,200	83,300	117,900
Outflows (81,600)*	Evapotranspiration	37,700	46%	25,500	34,200	37,200	51,600
	Direct Runoff	30,400	37%	16,600	24,100	31,500	46,000
	Groundwater Recharge	13,500	17%	7,300	10,000	14,600	20,300

*Small discrepancies between total inflow and outflow may occur due to rounding.

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On average, about 81,600 AFY of precipitation falls within the Basin boundaries, with critically dry years averaging about 49,400 AF and wet years averaging about 117,900 AF. On average, about 46% of precipitation is evaporated or transpired by plants, 37% runs off the land surface into creeks, and 17% percolates through the soil vadose zone and recharges groundwater.

Total outflow in the precipitation budget to evaporation, groundwater, and surface water is dependent on climate and land use/cover. As expected, evapotranspiration, runoff, and groundwater recharge are greater during wet years than dry years. In general, runoff and recharge are more responsive to climate variation than evapotranspiration because vegetation cover is relatively constant, dry soil in dry years absorbs soil moisture, and saturated soil moisture in wet years promotes runoff and infiltration. During critically dry years, a greater percentage of precipitation (about 52%) is lost from the system due to evapotranspiration than in wet years when only about 44% of precipitation is lost to evapotranspiration. As a result, a smaller percentage of precipitation enters the surface water and groundwater systems during critically dry years, and a greater percentage of precipitation enters the surface water and groundwater systems in wet years.

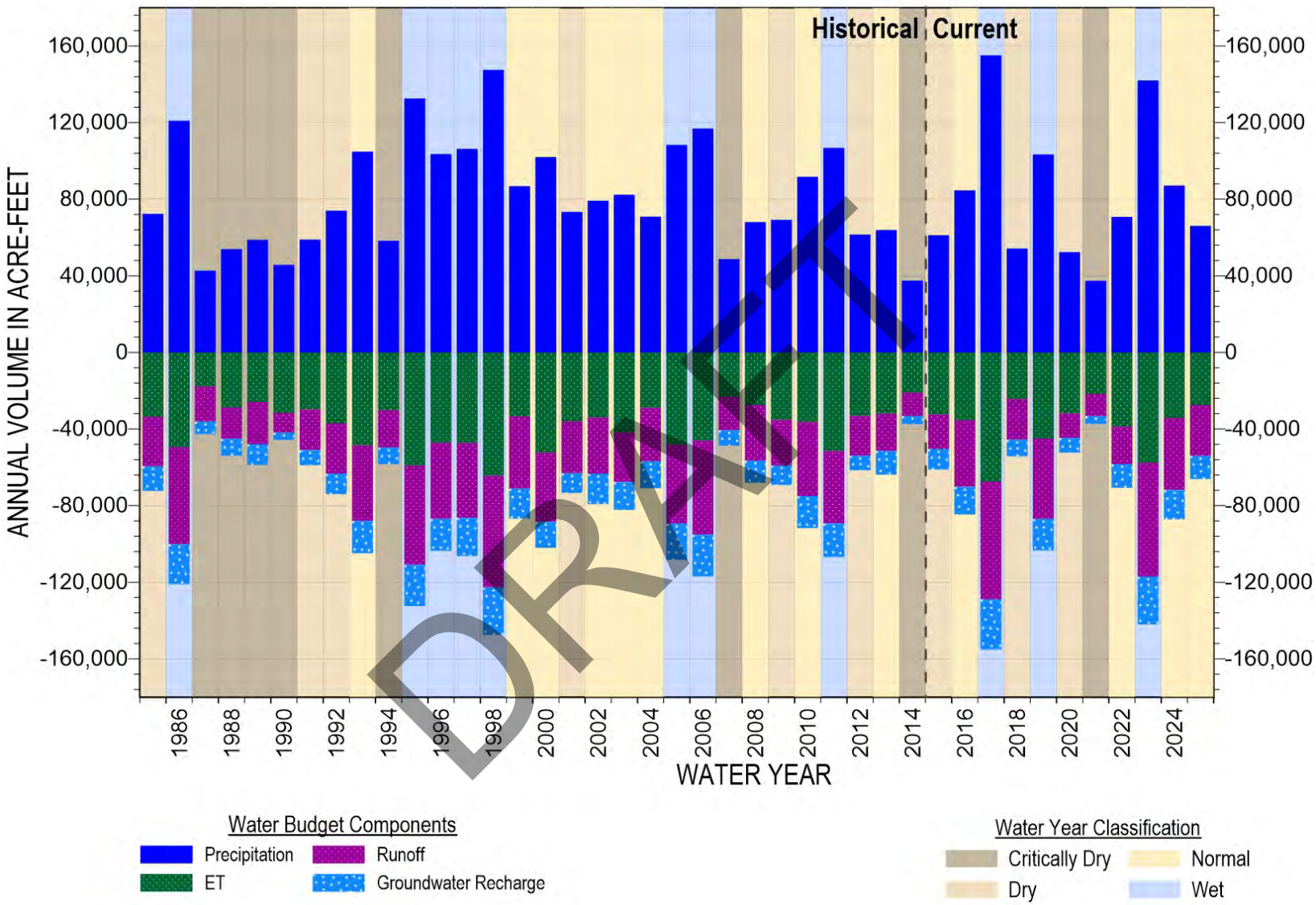

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Figure 5-5. Historical and Current Precipitation Budget

5.2.2 Historical Surface Water Budget

The historical surface water budget provides information on historical surface water and groundwater interactions, and how much surface water has flowed through the Basin. The historical surface water budget is summarized in Table 5-5, and is presented in a timeseries chart on Figure 5-6.

Table 5-5. Summary of Historical Surface Water Budget

Water Budget Components		Historical Water Budget WY1985-2014		Annual Average by Water Year Type (Acre-Feet)			
Average Total for Historical Water Budget (Acre-Feet)		Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow	Critically Dry	Dry	Normal	Wet
Inflows (118,800)	Surface Water Inflow	69,600	59%	37,900	56,800	71,300	104,900
	Runoff	27,900	23%	15,200	22,100	28,900	42,200
	Groundwater Discharge to Creeks	21,300	18%	17,800	19,600	21,700	25,300
Outflows (118,900)	Surface Water Outflow	110,200	93%	63,400	90,300	113,300	162,600
	Streambed Recharge	8,700	7%	7,700	8,500	8,700	9,600

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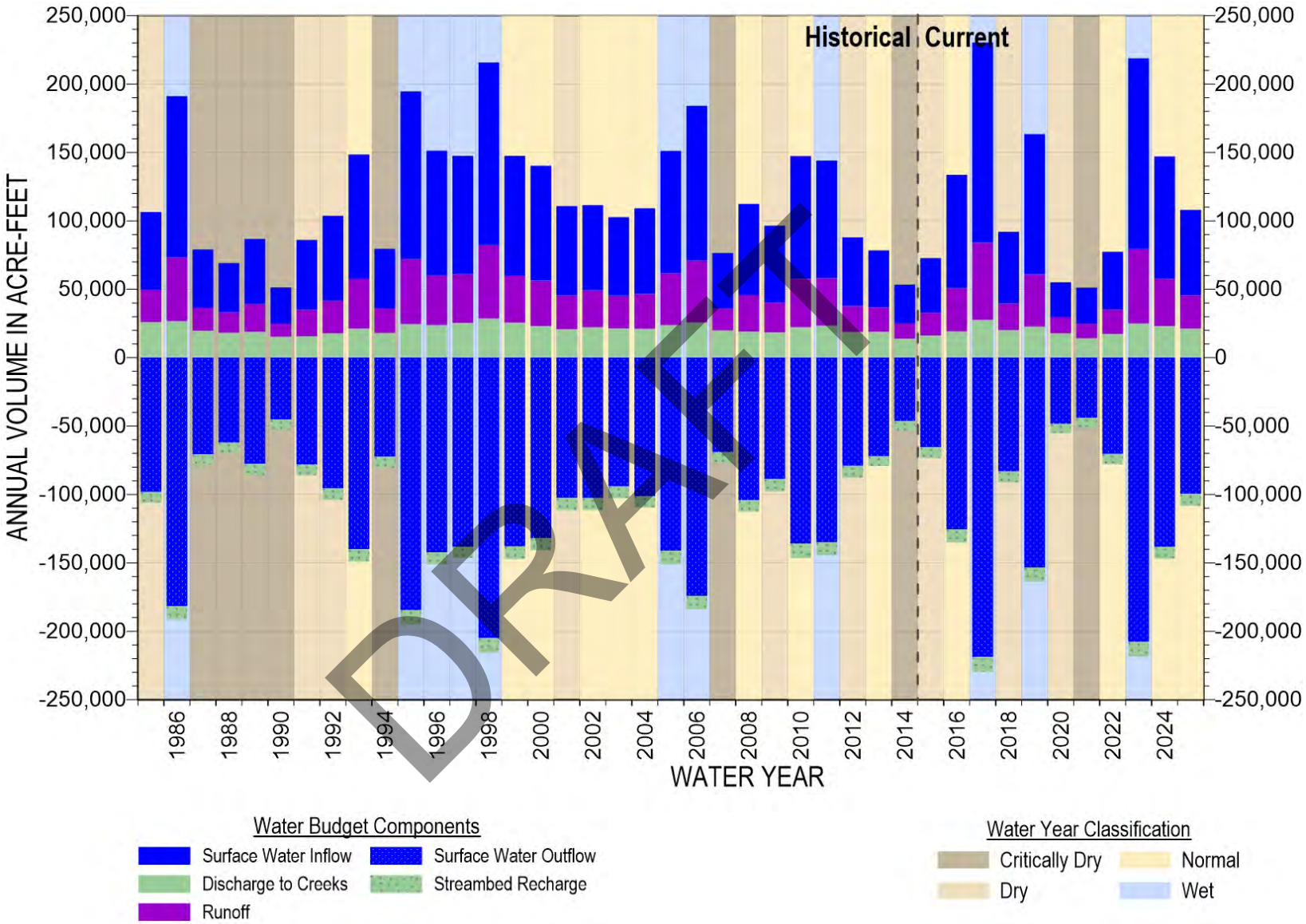

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Figure 5-6. Historical and Current Surface Water Budget

Average historical surface water inflow in the Basin is about 118,800 AFY. Water year type strongly influences the surface water inflows, averaging about 70,900 AF in critically dry years and 172,400 AF in wet years. Surface water inflows are mostly from the San Lorenzo River, Newell Creek, Bean Creek, and a few other smaller streams and tributaries originating outside of the Basin. Creeks originating outside the Basin make up 59% of the surface water inflow to the Basin during an average year. Runoff from precipitation to surface water comprises 34% of total precipitation during an average year. Groundwater discharge to creeks makes the smallest contribution to surface water budget inflow, with an average of only 18% of the total inflow.

Outflow from the surface water system is approximately balanced with inflow over time across all water year types. Like inflow, surface water outflow is strongly correlated with water year type. Nearly all (93%) of surface water flows out of the Basin, mostly in the San Lorenzo River and Carbonera Creek. Recharge of aquifers underlying the surface water system accounts for only 7% of surface water outflow from the system.

Although groundwater discharge to creeks and streambed recharge to groundwater make up the smallest percentages of the surface water inflow and outflow budgets, surface water and groundwater interaction is important for maintaining volumes of surface water baseflows in the summer and fall months and for providing some groundwater recharge. Although there are months where there are losing reaches, creeks in the Basin consistently have a net annual gain from groundwater contributions regardless of water year type. Overall, there is about 2.5 times more groundwater discharge to creeks than creek recharge of groundwater. This results in widespread gaining stream conditions and contributes to greater surface water outflow than inflow. Annual precipitation and lowered groundwater levels influence groundwater and surface water interactions. Groundwater discharge to creeks during average wet years is about 7,500 AF more than in average critically dry years. Similarly, streambed groundwater recharge is about 1,900 AF more in average wet years than critically dry years. The impact of surface water interaction and precipitation on groundwater is discussed further in Sections 5.2.3 and 5.2.4.

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5.2.3 Historical Groundwater Budget

The historical groundwater budget provides information on how groundwater is replenished and used. Groundwater pumping, groundwater and surface water interaction, and changes of groundwater in storage are particularly relevant to groundwater management. The historical groundwater budget is summarized in Table 5-6 and presented in a time series chart on Figure 5-7.

Table 5-6. Historical Groundwater Budget

Water Budget Components		Historical Water Budget WY1985-2014		Annual Average by Water Year Type (Acre-Feet)			
Average Total for Historical Water Budget (Acre-Feet)		Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow	Critically Dry	Dry	Normal	Wet
Inflows (24,100)*	Precipitation Recharge	13,600	56%	7,400	10,400	14,700	20,100
	Subsurface Inflow	200	1%	200	200	200	200
	System Losses	200	1%	200	200	200	200
	Septic Return Flow	1,100	5%	1,100	1,100	1,200	1,200
	Quarry Return Flow	200	1%	300	300	200	200
	Streambed Recharge	8,700	36%	7,700	8,500	8,700	9,600
	Irrigation Return Flow	100	<1%	100	100	100	100
Outflows (25,300)*	Groundwater Pumping	3,900	15%	3,900	3,800	4,100	3,800
	Subsurface Outflow	100	<1%	100	100	100	100
	Discharge to Creeks	21,300	84%	17,800	19,600	21,700	25,300
Storage*	Average Annual Change in Storage	-1,300	--	-4,900	-2,800	-800	2,200
	Cumulative Change in Storage	-40,300	--	--	--	--	--

*Small discrepancies between total inflow and outflow may occur due to rounding.

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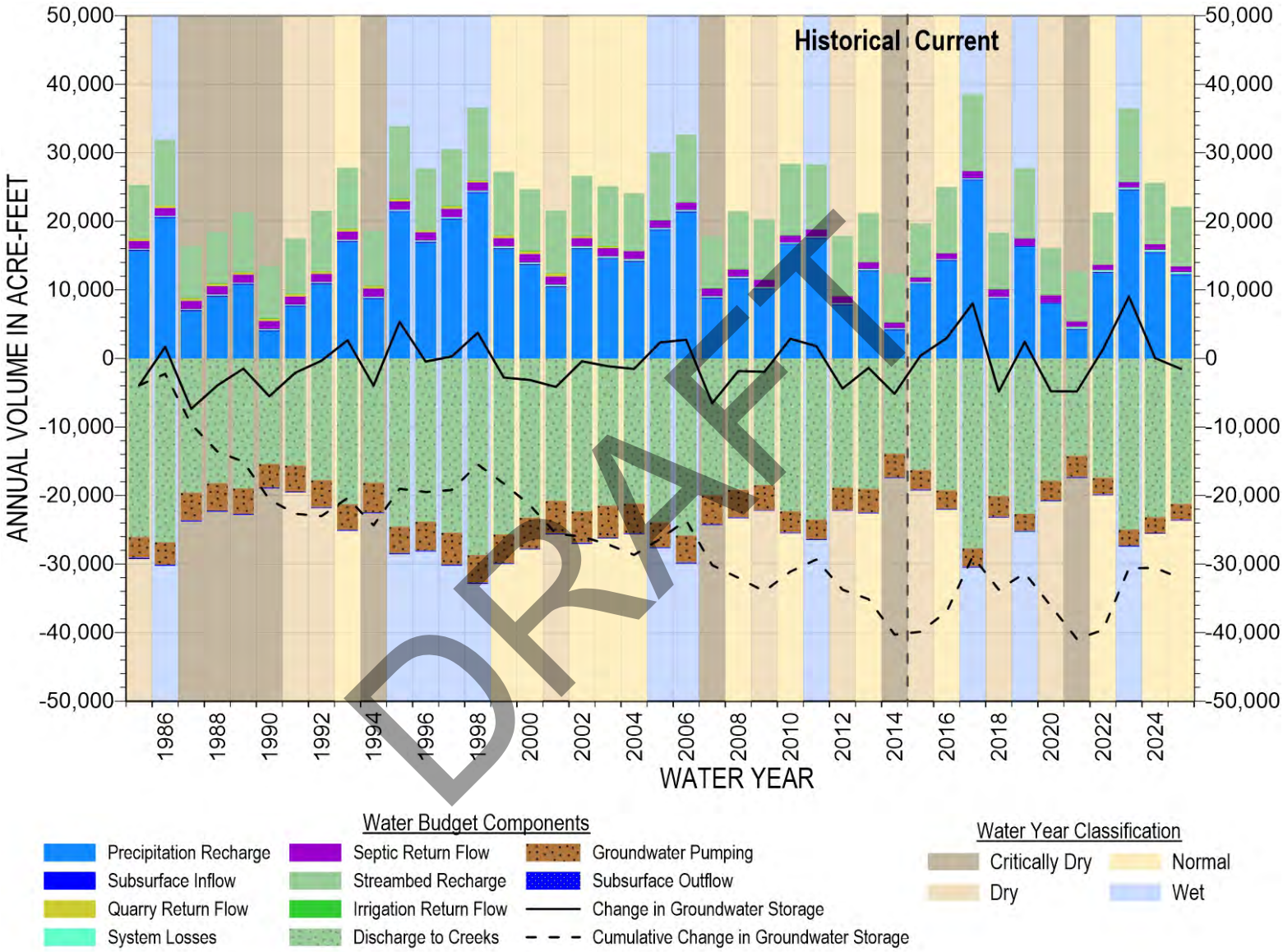

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Figure 5-7. Historical and Current Groundwater Budget

Groundwater inflow totals about 24,100 AFY on average and range from about 17,000 AF in average critically dry years to 31,600 AF in average wet years. Inflow to the groundwater system is dominated by precipitation and streambed recharge, which on average comprise 56% and 36% of total groundwater inflow, respectively. These 2 inflow components vary with climate, with significantly larger recharge volumes from both precipitation and creeks occurring during wet periods. Groundwater recharge from precipitation and streams combined ranges from about 15,100 AF in average critically dry years to 29,700 AF in average wet years.

Recharge to groundwater from septic systems, quarries, landscape irrigation, and other system losses make up only 8% of total annual inflow to groundwater. Groundwater return flows do not vary substantially with water year type but are correlated to population growth because more than half of the return flows are from septic systems. Septic return flows increased with population growth during the 1980s and early 1990s but decreased since the 2000s due to expansion of wastewater treatment systems, and replacement of older septic systems with systems that have less discharge in part to mitigate increasing nitrate concentrations due to septic impacts.

The Basin is hydrogeologically isolated by the bounding faults and relatively impermeable basement rock beneath the Basin; therefore, subsurface inflow and outflow constitute only a very small fraction of the total groundwater budget.

Total outflow from the Basin's groundwater system is approximately 25,300 AFY on average and ranges between 21,800 AF in average critically dry years to 29,200 AF in average wet years. Outflow is dominated by groundwater discharge to creeks and groundwater pumping, which comprise roughly 84% and 15% of total groundwater outflow, respectively.

As discussed in the historical surface water budget section, groundwater discharge to creeks is controlled by climate. Average groundwater discharge to creeks in critically dry years was 17,800 AF and average discharge in wet years was 25,300 AF. In contrast to predominantly agricultural groundwater basins in the state, groundwater pumping in the Basin does not increase greatly in dry years as groundwater is mainly for municipal and private domestic purposes, which have more consistent year-round demands than agriculture. Municipal pumping in the Basin reached a high during a period of relatively rapid population growth in the 1980s and 1990s. Groundwater management adjustments particularly from around 2010 on have reduced total groundwater pumping. More details on changes in groundwater pumping and its impact on groundwater levels are provided in Section 4.2.

Given that the Basin is a relatively closed groundwater system, groundwater discharge to creeks comprises a major component of groundwater outflow, and the Basin's creeks are dependent on groundwater discharge to maintain baseflows in the summer and early fall months. As discussed in the surface water budget section, creeks consistently gain more water from groundwater than

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they lose to groundwater from streambed recharge, regardless of climate or anthropogenic factors.

The historical groundwater budget is indicative of a Basin not operating within its sustainable groundwater yield. Overall, historical groundwater outflow has been greater than inflow, resulting in a cumulative net decrease in groundwater in storage, which translates to falling groundwater levels. Between 1985 and 2014 the Basin cumulatively lost about 40,300 AF of groundwater in storage, or on average 1,300 AFY. While cumulative change in storage historically recovered during extended wet periods (notably WY1995 to WY1998 and WY2005 to WY2006), dry and normal years have historically resulted in large decreases in storage (notably WY1987 to WY1992 and the recent drought from WY2012 to WY2015). Improvements in groundwater supply management from 2010 on appear to have slowed the decline in groundwater storage.

5.2.4 Historical Groundwater Budget by Aquifer

The historical groundwater budget was analyzed by aquifer to demonstrate how groundwater was used and recharged in the various formations. The historical groundwater budget by aquifer is summarized in Table 5-7.

In general, groundwater inflows are mostly into the Santa Margarita and Butano aquifers as they are conductive sandstones with large outcrop areas in the Basin. They are recharged by direct percolation of precipitation and streambed recharge. The Quaternary alluvium also receives substantial streambed recharge where it is thickest along the Basin's southern boundary, west of the Ben Lomond Fault near Felton. The alluvium is generally shallow across most of the Basin, but it is highly permeable and located in an area with relatively high streamflow where the San Lorenzo River flows out of the Basin.

In contrast to the other primary aquifers, the Lompico aquifer is recharged primarily from flow from overlying aquifers as it has limited surface outcrop in the Basin. It is readily recharged where Santa Margarita Sandstone directly overlies Lompico Formation in the Pasatiempo and Camp Evers areas. Elsewhere in the Basin, however, the presence of intervening Monterey Formation, an aquitard, limits the recharge of the Lompico aquifer.

Like the basin-wide groundwater inflow budget, groundwater outflow by aquifer is dominated by groundwater discharge to creeks, primarily from the Santa Margarita and Butano aquifers. There is also substantial flow between aquifers, with most of it from the Santa Margarita aquifer to the deeper aquifers. The Lompico aquifer has smaller inflows than other aquifers, yet it supports almost half of the groundwater pumping in the Basin; the result is that about half the decline in storage in the Basin is in the Lompico aquifer.

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Table 5-7. Summary of Historical Groundwater Budget by Aquifer

Groundwater Budget Components		Historical Water Budget WY1985-2014 Annual Average (Acre-Feet)				
		Santa Margarita Aquifer	Monterey Formation	Lompico Aquifer	Butano Aquifer	Other Formations
Inflows	Precipitation Recharge	6,400	1,500	1000	4,000	700
	Subsurface Inflow	0	0	0	100	<100
	Return Flows	900	200	200	200	200
	Streambed Recharge	1,700	800	300	3,400	2,500
	Flow from Other Aquifers	<100	400	1,900	700	200
	*Total Inflow**	*9,000*	*2,900*	*3,300*	*8,400*	*3,600*
Outflows	Groundwater Pumping	1,100	400	1,800	600	<100
	Subsurface Outflow	0	0	0	100	<100
	Discharge to Creeks	6,800	2,200	1,500	7,400	3,400
	Flow to Other Aquifers	1,300	400	700	600	200
	*Total Outflow**	*9,100*	*3,000*	*4,000*	*8,700*	*3,600*
Storage	Average Annual Change in Storage*	-200	-100	-700	-300	-100
	Cumulative Change in Storage*	-4,900	-4,300	-20,400	-8,400	-2,200

*Small discrepancies between total inflow and outflow may occur due to rounding

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5.2.5 Historical Groundwater Change in Storage by Subarea

To evaluate historical changes of groundwater in storage in different areas of the Basin and identify specific areas and aquifers that require PMAs, the Basin is divided into subareas as depicted on Figure 4-4 and Figure 4-5. The subareas do not represent management areas and are only used in this GSP to describe aquifer conditions for different parts of the Basin.

Santa Margarita aquifer subareas are 1) Quail Hollow, 2) Olympia/Mission Springs, 3) Mount Hermon/South Scotts Valley, and 4) North Scotts Valley (Figure 4-4). These subareas are described in Section 4.2.2.2. Unlike the Santa Margarita aquifer, the Basin's confined aquifers are more continuous throughout the Basin. The Monterey Formation and Lompico and Butano aquifers share the same subareas: 1) North of Bean Creek, 2) Mount Hermon/South Scotts Valley, and 3) North Scotts Valley (Figure 4-5).

Plots of change in aquifer storage by subarea on Figure 5-8 through Figure 5-11 show that the largest loss of groundwater storage is in the Lompico aquifer in the Mount Hermon/South Scotts

Valley subarea. The Monterey Formation and Butano aquifers in the Mount Hermon/South Scotts Valley subarea also have storage losses, but they are an order of magnitude smaller than in the Lompico aquifer. Losses of Lompico aquifer groundwater in storage in the in the Mount Hermon/South Scotts Valley subarea correspond to lowered groundwater levels measured in wells screened in the Monterey Formation and Lompico aquifer as described in Sections 4.2.3 and 4.2.4. The Butano aquifer has storage losses in subareas where it outcrops along the Basin's northern boundary in the North of Bean Creek and North Scotts Valley subareas. In comparison, the Lompico aquifer in those same subareas has smaller storage losses than the Butano aquifer. Storage losses in the Butano aquifer appear due to groundwater discharge to creeks since pumping is much smaller than creek discharges (Table 5-7). Conclusions regarding the Butano aquifer cannot be made with confidence because there are only 2 Butano aquifer specific monitoring wells in the Basin. The Butano aquifer is not as well-calibrated in the groundwater model as the shallower aquifers for which there are more data, as described in Section 3.4.11 on HCM data gaps.

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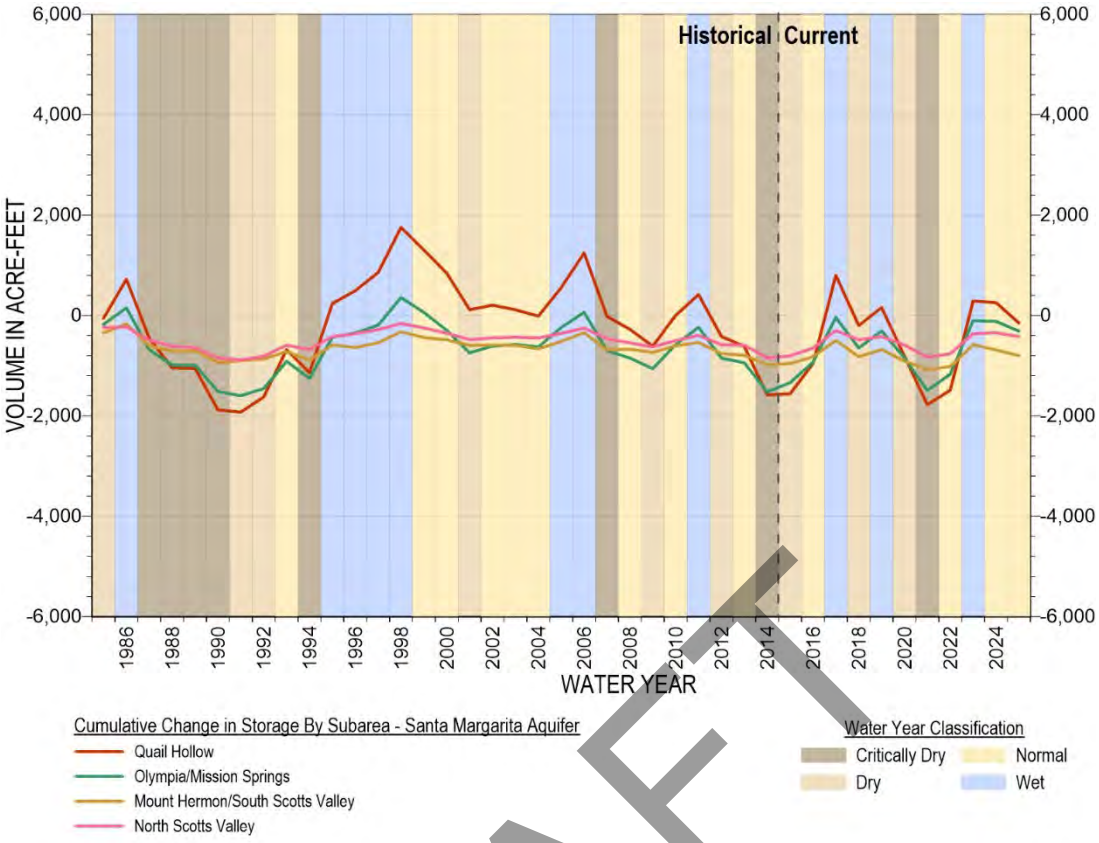

Figure 5-8. Historical Cumulative Change of Groundwater in Storage in the Santa Margarita Aquifer

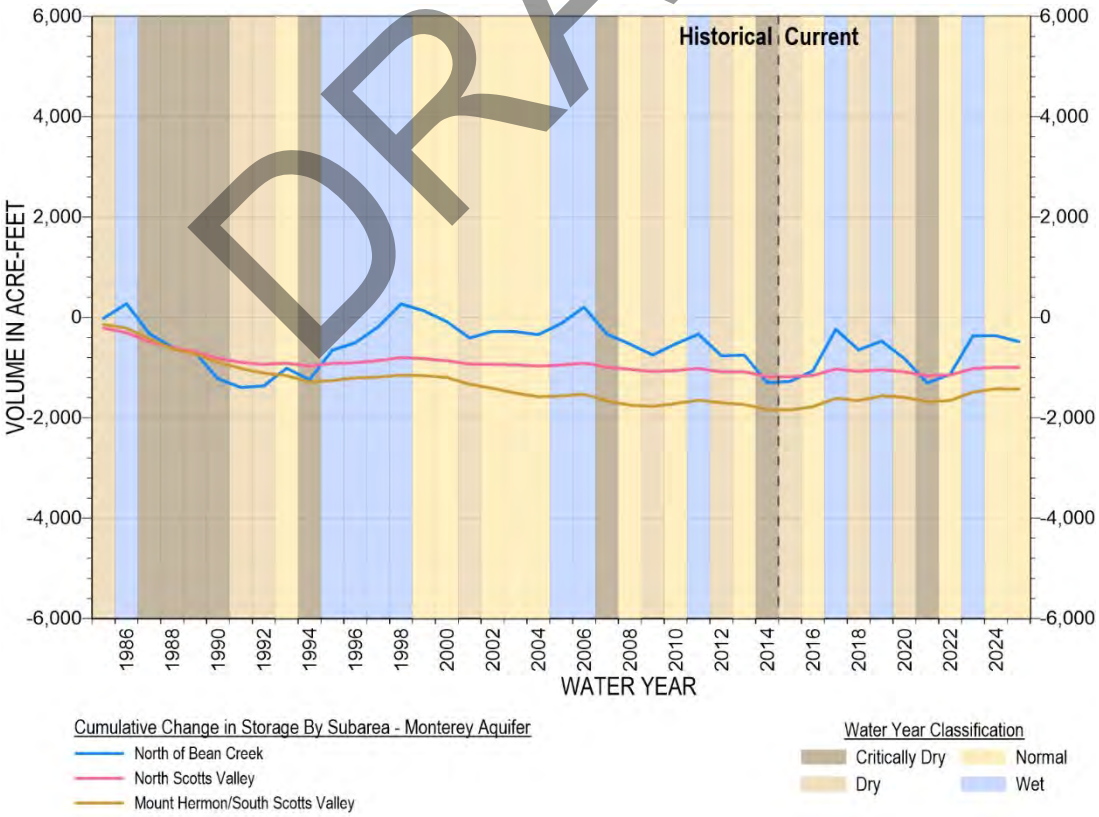

Figure 5-9. Historical Cumulative Change of Groundwater in Storage in the Monterey Formation

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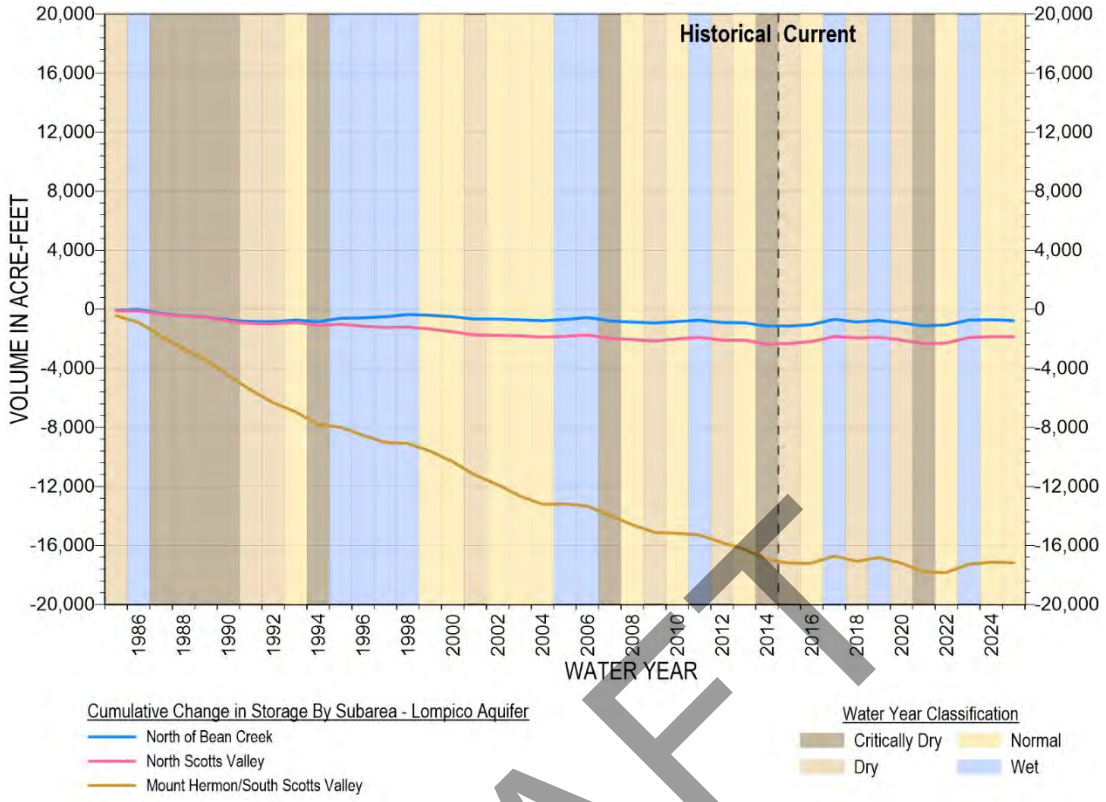

Figure 5-10. Historical Cumulative Change of Groundwater in Storage in the Lompico Aquifer

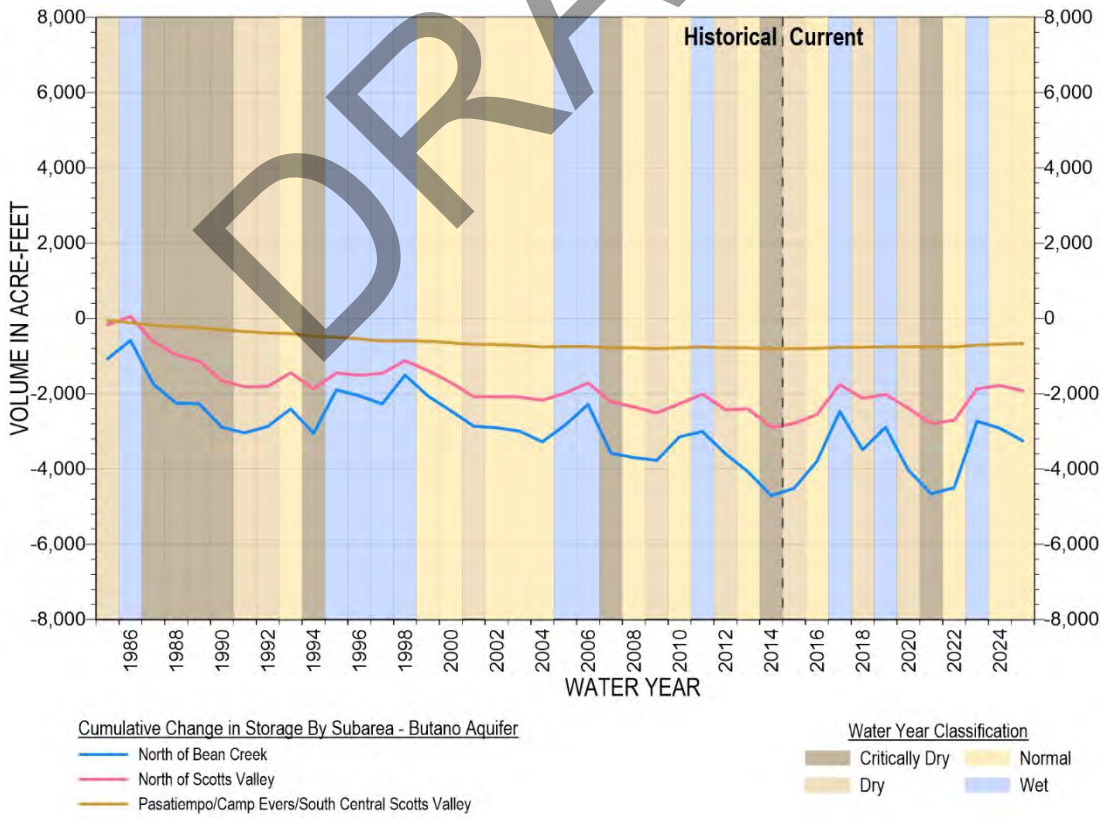

Figure 5-11. Historical Cumulative Change of Groundwater in Storage in the Butano Aquifer

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5.3 Current Water Budget

Per GSP Regulations (§ 354.18), a current water budget is developed for the Basin based on the most recent land use, water use, and hydrologic conditions. The current water budget allows the SMGWA to assess the most recent water supply, demand, groundwater and surface water interaction, and aquifer conditions for implementing the GSP. What constitutes current conditions is not prescribed by DWR in the GSP Regulations. For this Basin's GSP, the current water budget period from WY2015 to WY2025 is selected as it includes years after the passage of SGMA and encompasses some extreme climatic conditions that are anticipated to become more typical in the future due to climate change. The period includes extended dry conditions from WY2020 to WY2022, and historically wet conditions in WY2017 and WY2023.

5.3.1 Current Precipitation Budget

The current precipitation budget provides a recent record of precipitation inflow and outflow in the Basin. The current precipitation budget is summarized in Table 5-8 and presented as part of the timeseries chart on Figure 5-5.

Table 5-8. Summary of Current Precipitation Budget

Water Budget Components		Current Water Budget WY2015-2025		Historical Water Budget WY1985-2014	
Average Total for Current Water Budget (Acre-Feet)		Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow	Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow
Inflows (83,100)*	Precipitation	83,100	100%	81,600	100%
Outflows (83,100)*	Evapotranspiration	37,900	46%	37,700	46%
	Direct Runoff	31,300	38%	30,400	37%
	Groundwater Recharge	13,900	16%	13,500	17%

*Small discrepancies between total inflow and outflow may occur due to rounding

Overall, total precipitation during the current period is slightly more than during the historical period and is more variable. On average, approximately 83,100 AFY of precipitation fell in the Basin during the current timeframe, which is about 1,500 AF more per year than the historical period. During the current period, average evapotranspiration, runoff, and groundwater recharge has similar modest overall increases due to slightly higher precipitation and greater variability compared to the historical period. As with the historical period, evapotranspiration during the current period is relatively less responsive to extremes in climate than runoff and groundwater recharge. As a result, proportionally less precipitation enters the surface water and groundwater systems during critically dry years, and proportionally more precipitation enters the surface water and groundwater systems in wet years.

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5.3.2 Current Surface Water Budget

The current surface water budget provides a recent record of surface water inflow and outflow in the Basin. The current surface water budget is summarized in Table 5-9 and presented as part of the timeseries chart on Figure 5-6.

Table 5-9.Summary of Current Surface Water Budget

Water Budget Components		Current Water Budget WY2015-2025		Historical Water Budget WY1985-2014	
Average Total for Current Water Budget (Acre-Feet)		Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow	Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow
Inflows (122,800)*	Surface Water Inflow	73,600	60%	69,600	59%
	Runoff	28,700	23%	27,900	23%
	Groundwater Discharge to Creeks	20,500	17%	21,300	18%
Outflows (122,900)*	Surface Water Outflow	114,100	93%	110,200	93%
	Streambed Recharge	8,800	7%	8,700	7%

*Small discrepancies between total inflow and outflow may occur due to rounding

During the current period, average overall inflow and outflow is approximately 122,800 AFY, which is about 4,000 AF more per year than the historical period. Overall wetter conditions during the current period compared to the historical period result in more surface water inflow and outflow. Groundwater discharge to creeks decreased and streambed recharge to groundwater increased compared to the historical period.

5.3.3 Current Groundwater Budget

The current groundwater budget provides a recent record of groundwater inflow and outflow in the Basin. The current groundwater budget is summarized in Table 5-10 and presented as part of the timeseries chart on Figure 5-7.

The inflows and outflows to the groundwater budget are similar in the historical and current periods. The total inflow is about 24,000 AF, which is about 100 AFY less than the historical period. The total outflow is about 23,200 AF, which is about 2,100 AFY less than the historical period.

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Table 5-10. Current Groundwater Budget

Water Budget Components		Current Water Budget 2015-2025		Historical Water Budget 1985-2014	
Average Total for Current Water Budget (Acre-Feet)		Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow	Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow
Inflows (24,000)*	Precipitation Recharge	13,900	58%	13,600	56%
	Subsurface Inflow	100	1%	200	1%
	System Losses	200	1%	200	1%
	Septic Return Flow	900	4%	1,100	5%
	Quarry Return Flow	<100	<1%	200	1%
	Streambed Recharge	8,800	37%	8,700	36%
	Irrigation Return Flow	100	<1%	100	<1%
Outflows * (23,200)	Groundwater Pumping	2,700	11%	3,900	15%
	Subsurface Outflow	100	<1%	100	<1%
	Discharge to Creeks	20,500	88%	21,300	84%
Storage*	Average Annual Change in Storage	700	--	-1,300	--
	Cumulative Change in Storage	8,200	--	-40,300	--

*Small discrepancies between total inflow and outflow may occur due to rounding

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The main difference between the current and historical periods is that municipal pumping decreased. During the current period, outflow from groundwater pumping is 2,700 AFY on average, which is about 1,200 AF less than during the historical period. This reflects a reduction of average annual groundwater pumping of about 30% between the historical and current period.

During the current period, groundwater discharge to streams decreased by about 800 AFY from the historical period. Less net groundwater discharge to streams is likely related to lower groundwater levels in the Santa Margarita aquifer following the WY 2012-2015 drought and during WY 2020-2022 drought than in the early historical period, particularly in 4 consecutive wet years from WY 1995-1998.

Change of groundwater in storage fluctuated over the current period, from -4,800 AFY to 9,000 AFY, with a cumulative gain of 8,200 AF and an average annual gain of 700 AF. The overall increase in storage during the current period indicates that groundwater inflow and outflow is balanced since 2015. This is an improvement from the historical period during which average annual storage losses are about 1,300 AF. Groundwater in storage declines in dry and critically dry water years suggest that net groundwater recharge of the Basin's aquifers only occurs in normal and wet years.

5.3.4 Current Groundwater Budget by Aquifer/Formation

The current groundwater budget is analyzed by aquifer/formation to demonstrate changes in groundwater flows in the various aquifers relative to the historical period. The current groundwater budget by aquifer is summarized in Table 5-11.

Table 5-11. Summary of Current Groundwater Budget by Aquifer

Groundwater Budget Components		Current Water Budget: WY2015-2025 Annual Average (Acre-Feet)				
		Santa Margarita Aquifer	Monterey Formation	Lompico Aquifer	Butano Aquifer	Other Formations
Inflows	Precipitation Recharge	6,500	1,500	1,000	4,200	700
	Subsurface Inflow	0	0	0	100	<100
	Return Flows	600	200	200	100	100
	Streambed Recharge	1,700	800	400	3,300	2,600
	Flow from Other Aquifers	<100	300	1,700	600	100
	Inflow*	8,700	2,800	3,200	8,400	3,600
Outflows	Groundwater Pumping	700	200	1,200	500	<100
	Subsurface Outflow	0	0	0	100	<100
	Discharge to Creeks	6,500	2,100	1,300	7,200	3,300
	Flow to Other Aquifers	1,200	400	600	400	200
	Total Outflow*	8,400	2,700	3,100	8,200	3,500
Storage	Average Annual Change in Storage*	300	100	100	200	<100
	Cumulative Change in Storage*	3,300	1,400	600	2,600	300

*Small discrepancies between total inflow and outflow may occur due to rounding

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Groundwater inflows to each aquifer changed little between the historical and current periods. Precipitation recharge in the current period is within 200 AFY of its historical average in every aquifer, streambed recharge is within 100 AFY, and total inflow to each aquifer is within 300 AFY, indicating that the distribution of recharge among the aquifers is controlled by Basin geology rather than by changes in groundwater extraction. The one exception is flow into the Lompico aquifer from overlying aquifers, which decreased from 1,900 to 1,700 AFY, consistent with reduced vertical gradients as Lompico aquifer pumping declined and groundwater elevations recovered. Reduced pumping is the main difference between the 2 periods, and pumping decreased in every aquifer, from 1,800 to 1,200 AFY in the Lompico aquifer and from 1,100 to 700 AFY in the Santa Margarita aquifer, which together account for about 75% of the Basin-wide reduction.

The most substantial change between the historical and current periods is in groundwater storage, which shifted from losses to gains in all 5 hydrogeologic units. Average annual change in storage in the Lompico aquifer improved from a loss of 700 AFY in the historical period to a gain of 100 AFY in the current period. Current period cumulative storage gains are largest in the Santa Margarita aquifer, about 3,300 AF, and the Butano aquifer, about 2,600 AF. The reversal in the Lompico aquifer is the most notable of these changes because that aquifer accounted for about half of the historical Basin-wide storage loss.

5.3.5 Current Groundwater Change in Storage by Subarea

The current groundwater change in storage is analyzed by aquifer and subarea to assess where storage changes have been occurring since WY 2015. Figure 5-8 through Figure 5-11 illustrate that cumulative change in storage is balanced overall in the current period.

Historical declines in groundwater in storage in the deeper, semi-confined, and confined aquifers stabilized after slight declining trends in the historical period. The Lompico aquifer in the Mount Hermon/South Scotts Valley subarea, which had the greatest storage losses during the historical timeframe, saw a slight average gain of 100 AFY over the current period (Figure 5-10).

5.4 Baseline Projected Water Budget

The GSP Regulations (CWC § 354.18) require the development of a projected water budget baseline to assess how water supply, surface water and groundwater interactions, and aquifer conditions will be impacted by future changes in climate and water demands if PMAs are not implemented. The projected baseline water budgets presented in this and the next subsection fulfill those requirements of the GSP. The projected water budgets are developed for the period WY2026 to WY2072 per the GSP Regulations requirement that the projected period include a 50-year planning and implementation horizon over which the GSP and measures will be implemented to ensure that the Basin is operated within its sustainable yield.

The climate projections used by the groundwater model were designed to replicate historical climate conditions. The historical climate parameters from WY1985 to WY2025 are used as the projected climate parameters for WY2026 to WY2066, and the climate parameters from WY2007 to WY2012 (a period with variable climate but lower than average precipitation) are repeated again as the projected climate parameters for WY2067 to WY2072. A projected water budget under alternate climate conditions, developed to account for the potential impacts of climate change, is presented in Section 5.5.

In both climate scenarios, the projected simulation assumes a small increase in urban growth. Water demands are projected to increase 0.18% per year for SLVWD (SLVWD, 2026) and 0.14% per year for SVWD (SVWD, 2026) through the projected model period from 2026 to

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2072. Although it is not simulated in the projected groundwater model, the urban footprint in the service areas is projected to expand slightly, resulting in slightly more runoff and less recharge.

5.4.1 Baseline Projected Precipitation Budget

The projected precipitation budget provides a simulated outlook of precipitation inflow and outflow. The projected precipitation budget is summarized in Table 5-16 and presented on a timeseries chart on Figure 5-12.

Table 5-12. Summary of Baseline Projected Precipitation Budget

Water Budget Components		Baseline Projected WY2026-2072		Current WY2015-2025	Historical WY1985-2014
Average Total for Projected Water Budget (Acre-Feet)		Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow	Annual Average (Acre-Feet)	Annual Average (Acre-Feet)
Inflows (81,000)*	Precipitation	81,000	100%	83,100	81,600
Outflows (81,000)*	Evapotranspiration	37,300	46%	37,900	37,700
	Direct Runoff	30,300	37%	31,300	30,400
	Groundwater Recharge	13,400	15%	13,900	13,500

*Small discrepancies between total inflow and outflow may occur due to rounding

Projected precipitation in the Basin is on average about 3% less than the current period and 1% less than the historical period. This discrepancy occurs because the climate conditions of 2007 to 2012, which collectively include below average precipitation, are repeated in the projected model period. Evapotranspiration over the projected period is also a repeat of historical conditions and is also 1% lower than the historical period.

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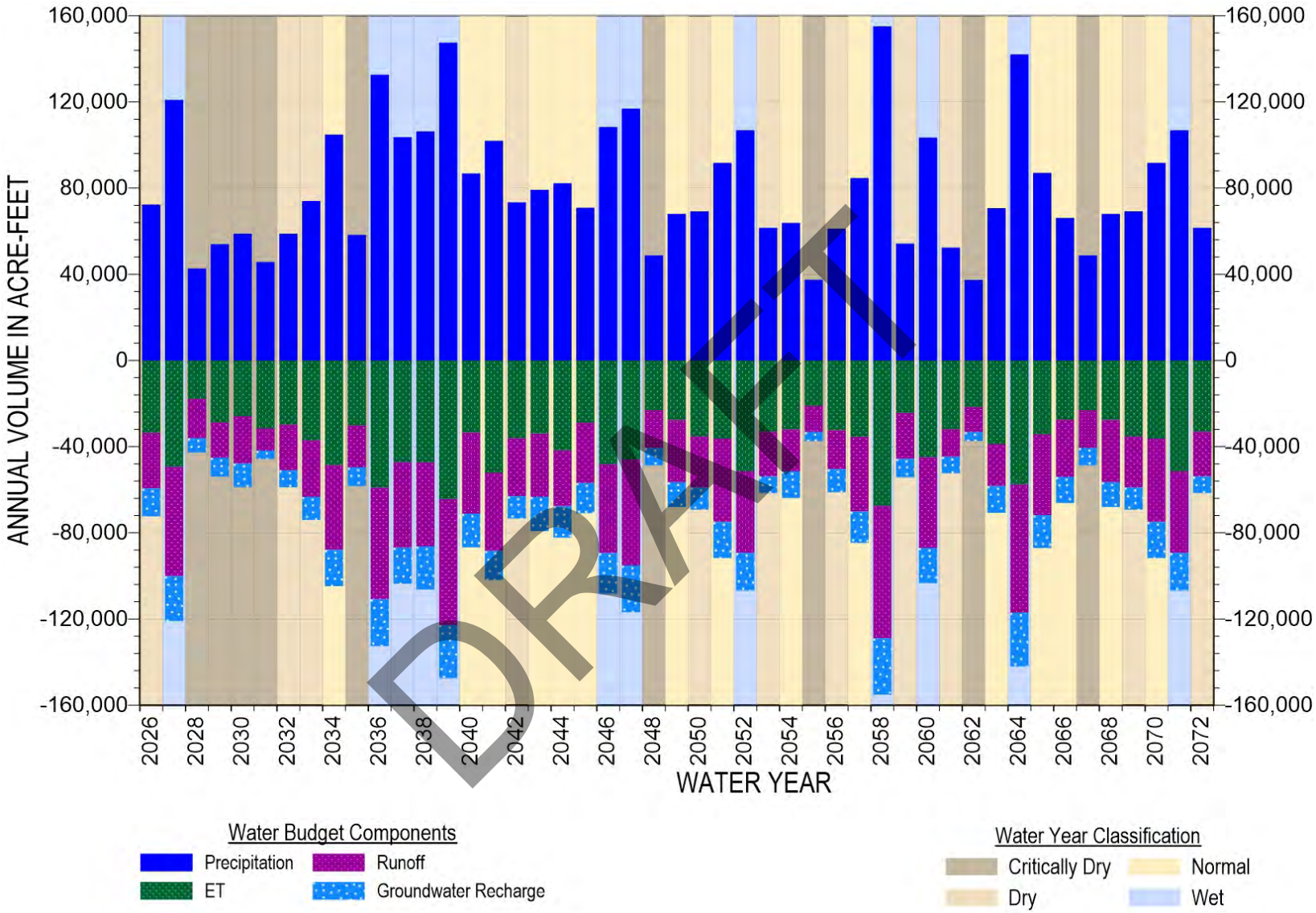

Figure 5-12. Baseline Projected Precipitation Budget

5.4.2 Baseline Projected Surface Water Budget

The projected surface water budget provides a simulated outlook for surface water inflow and outflow. The projected surface water budget is summarized in Table 5-17 and presented in a timeseries chart on Figure 5-20.

Table 5-13. Summary of Baseline Projected Surface Water Budget

Water Budget Components		Baseline Projected WY2026-2072		Current WY2015-2025	Historical WY1985-2014
Average Total for Projected Water Budget (Acre-Feet)		Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow	Annual Average (Acre-Feet)	Annual Average (Acre-Feet)
Inflows (118,500)	Surface Water Inflow	69,600	59%	73,600	69,600
	Runoff	27,800	23%	28,700	27,900
	Groundwater Discharge to Creeks	20,800	18%	20,500	21,300
Outflows (118,600)	Surface Water Outflow	109,900	93%	114,100	110,200
	Streambed Recharge	8,700	7%	8,800	8,700

During the baseline projected period, average groundwater total inflow and outflow are both approximately 118,600 AFY, which is about 3% less than the historical period. Surface water and groundwater interaction reflected as discharge to creeks and streambed recharge to groundwater fluctuates proportionally with precipitation and surface water inflow, especially during periods of extended drought. Consequently, the amount of surface water and groundwater interaction decreases slightly during the projected period.

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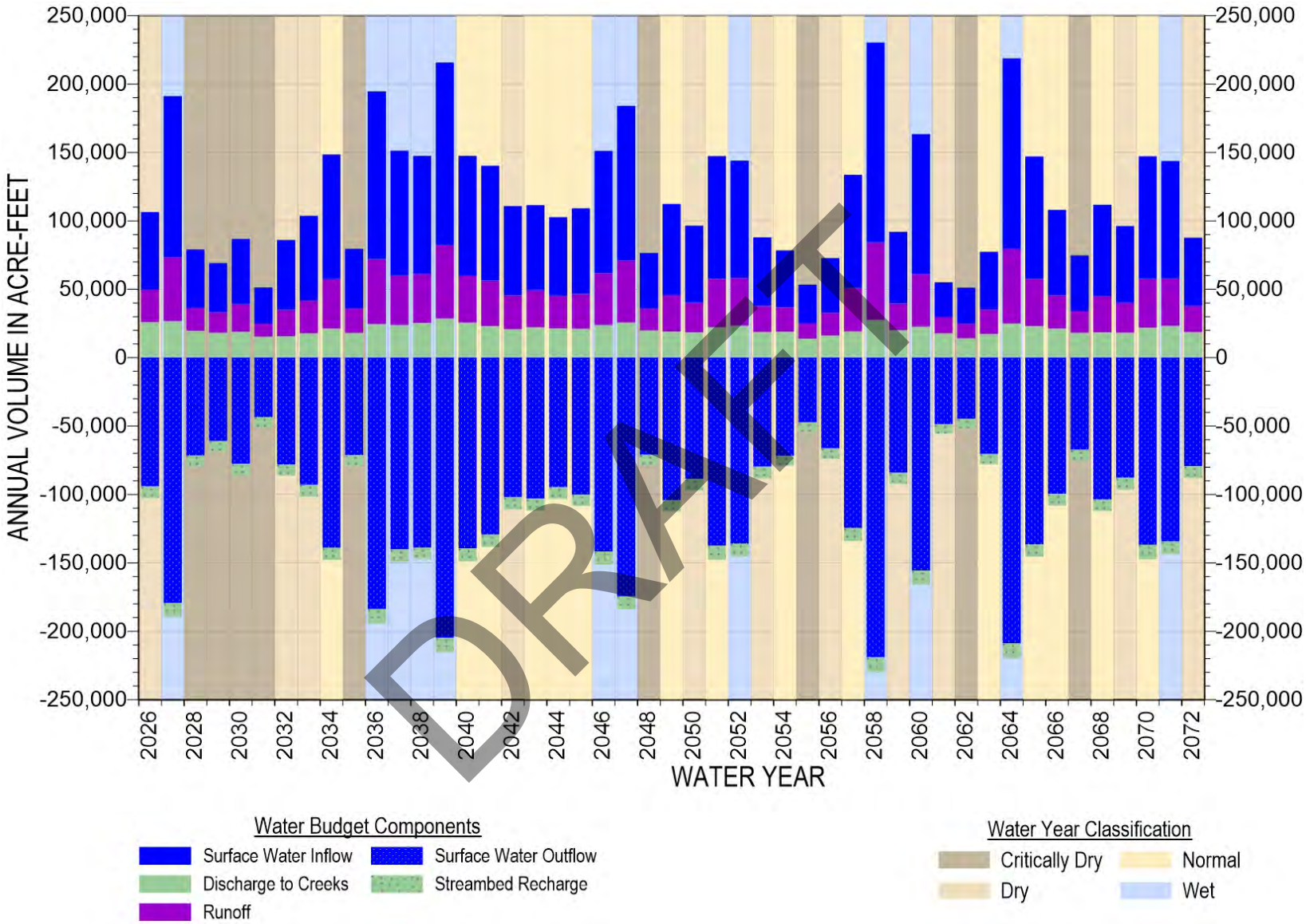

Figure 5-13. Baseline Projected Surface Water Budget

5.4.3 Baseline Projected Groundwater Budget

The projected groundwater budget provides a simulated outlook for groundwater inflow and outflow. The projected groundwater budget is summarized in Table 5-18 and presented in a timeseries chart on Figure 5-21.

Table 5-14. Summary of Baseline Projected Groundwater Budget

Water Budget Components		Baseline Projected WY2026-2072		Current WY2015-2025	Historical WY1985-2014
Average Total for Projected Water Budget (AF)		Annual Average (AF)	Percent of Total Inflow or Outflow	Annual Average (AF)	Annual Average (AF)
Inflows (23,400)*	Precipitation Recharge	13,400	57%	13,900	13,600
	Subsurface Inflow	200	<1%	100	200
	System Losses	300	1%	200	200
	Septic Return Flow	800	3%	900	1,100
	Quarry Return Flow	<100	<1%	<100	200
	Streambed Recharge	8,700	37%	8,800	8,700
	Irrigation Return Flow	<100	<1%	100	100
Outflows (23,500)*	Groundwater Pumping	2,600	11%	2,700	3,900
	Subsurface Outflow	100	1%	100	100
	Discharge to Creeks	20,800	88%	20,500	21,300
Storage*	Average Annual Change in Storage	-100	-	700	-1,300
	Cumulative Change in Storage	-3,400	-	8,200	-40,300

*Small discrepancies between total inflow and outflow may occur due to rounding

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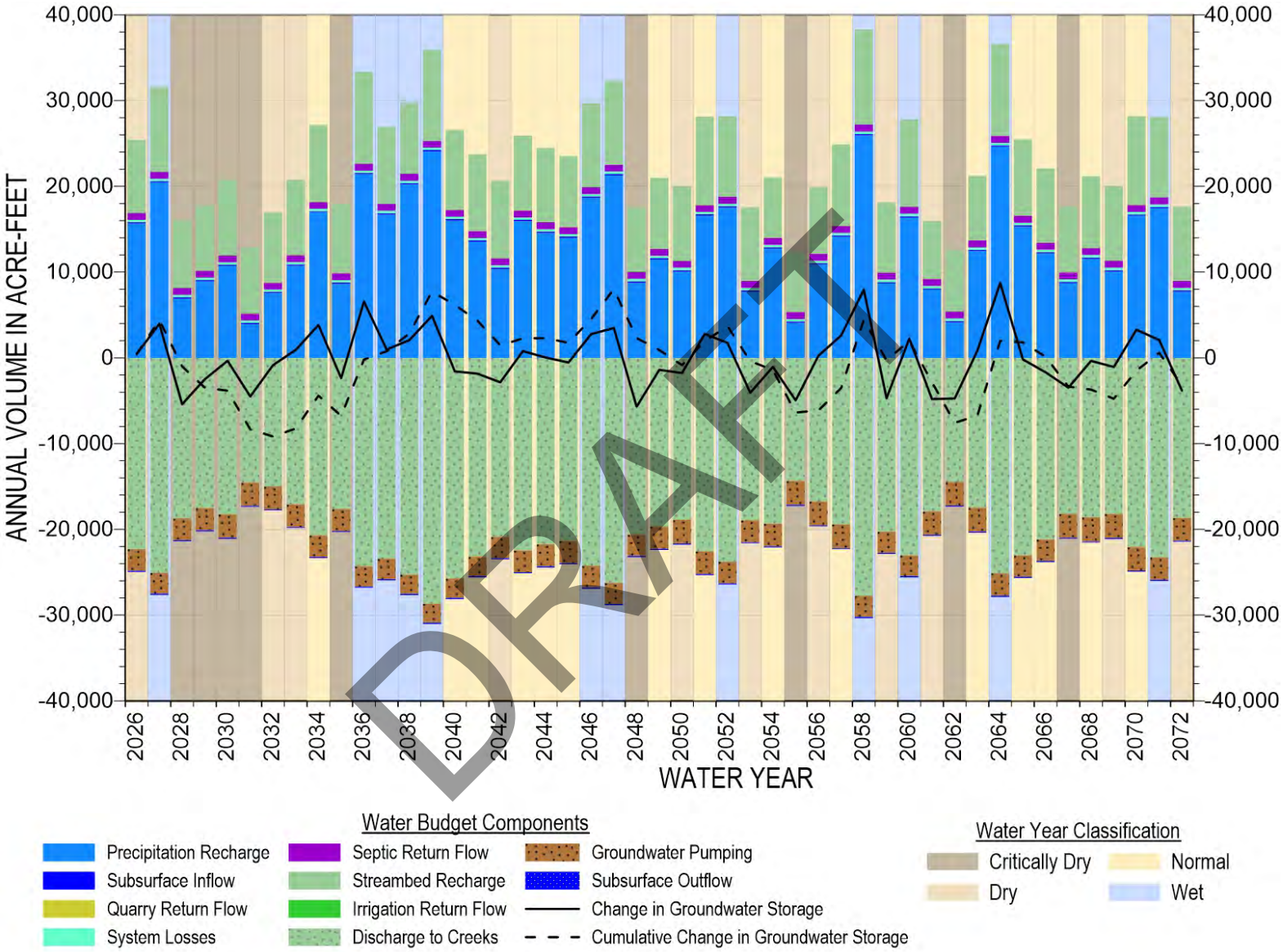

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Figure 5-14. Baseline Projected Groundwater Budget

Total inflows and outflows to the groundwater budget are both smaller in the projected period than in the historical and current periods. Compared to the historical period, predicted total inflows and outflows are approximately 700 AFY and 1,800 AFY less, respectively.

Direct groundwater recharge from precipitation is projected to be about 200 AF less per year than the historical period; in comparison, streambed recharge is predicted to be about 300 AF less. Septic return flows to groundwater are expected to decrease about 28% with improved water efficiency as water fixtures are replaced, resulting in about 800 AFY of septic return flows compared to about 1,100 AFY over the historical period. Other components of projected groundwater inflow are expected to be similar to historical inflows.

Reduced projected groundwater outflow is mostly a result of less groundwater pumping and groundwater discharge to creeks. In the projection, groundwater pumping is estimated to average about 2,600 AFY, which is 100 AFY less than average current conditions and about 1,300 AFY less than average historical conditions. Future population growth is expected to be small and therefore the slight increase in water use is expected to be offset with continued water efficiency improvements. It is projected that groundwater discharge to creeks will be about 20,800 AFY on average, which is 500 AF less than the historical annual average and 300 AF more than the current annual average.

Under the repeated WY2007 to WY2012 climate projection, the Basin will experience slightly less precipitation and groundwater pumping compared to historical conditions. This results in a slightly negative, though nearly balanced, average change in groundwater in storage and groundwater levels. Periods of prolonged drought stress the water supply in the Basin and require greater groundwater recharge and/or conjunctive use strategies to increase groundwater in storage in wetter years when water is available. The projected baseline simulation without implementing new projects or management actions results in a cumulative loss of groundwater in storage of about 3,200 AF between 2026 and 2072. The annual average decline in storage in this timeframe is about 100 AFY, which is the rounding error for the simulated values.

Given these results, additional PMAs will not be needed to achieve sustainability under a slightly drier climate than the past 50 years. It is, however, important to recognize that the model projections are highly dependent on estimates of future precipitation. To the degree that actual future precipitation deviates from that predicted by this projection, groundwater conditions could be better or worse than simulated. An alternate climate change projection water budget is provided in Section 5.5.

5.4.4 Baseline Projected Groundwater Budget by Aquifer

The projected groundwater budget is analyzed by aquifer to demonstrate changes in groundwater flows in the various aquifers if no additional projects or management actions are implemented. The projected groundwater budget by aquifer is summarized in Table 5-19.

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Table 5-15. Baseline Projected Groundwater Budget by Aquifer

Groundwater Budget Components		Baseline Projected Water Budget: WY2026-2072 Annual Average (Acre-Feet)				
		Santa Margarita Aquifer	Monterey Formation	Lompico Aquifer	Butano Aquifer	Other Formations
Inflows	Precipitation Recharge	6,300	1,400	900	4,000	700
	Subsurface Inflow	0	0	0	100	<100
	Return Flows	500	200	200	100	100
	Streambed Recharge	1,700	800	400	3,400	2,500
	Flow from Other Aquifers	<100	300	1,700	700	100
	*Total Inflow**	*8,500*	*2,700*	*3,100*	*8,300*	*3,400*
Outflows	Groundwater Pumping	700	100	1,200	600	<100
	Subsurface Outflow	0	0	0	100	<100
	Discharge to Creeks	6,700	2,200	1,400	7,200	3,300
	Flow to Other Aquifers	1,200	400	600	400	100
	*Total Outflow**	*8,600*	*2,700*	*3,200*	*8,300*	*3,040*
Storage	Average Annual Change in Storage*	>-100	>-100	>-100	>-100	>-100
	Cumulative Change in Storage*	-1,500	-200	-1,000	-600	-2,000

*Small discrepancies between total inflow and outflow may occur due to rounding

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The baseline projected groundwater budget assumes pumping will be on average 100 AFY less than current pumping (Table 5-11). This is because in the projection's very wet years, there will be more surface water available for municipal water supply. A slight increase in pumping is projected in the Butano aquifer, while slight decreases in groundwater pumping are projected in the Monterey and Lompico aquifers in comparison to current pumping. The decrease in Lompico aquifer pumping is due to SVWD shifting pumping from Lompico aquifer wells (SVWD #10A, #11A, and #11B) to wells screened in both the Lompico and Butano aquifers (SVWD Grace Way, Orchard, and Sucinto).

The average long-term annual change in storage is projected to be slightly negative for each of the principal aquifers. The greatest amounts of storage loss are projected for the Santa Margarita aquifer. Storage is lost during dry periods and gained during wet periods. Since more dry and critically dry years are projected than wet years, the result is a net overall loss of groundwater in storage.

5.4.5 Baseline Projected Groundwater Change in Storage by Subarea

Figure 5-22 through Figure 5-25 show each aquifer's baseline projected cumulative change of groundwater in storage. The Santa Margarita aquifer is the most sensitive to climatic changes and loses almost 2,800 AF from storage in the Quail Hollow subarea during the 5-year projected drought period from 2028 to 2032 (Figure 5-22). However, it recovers quickly after several wet years. The same pattern of groundwater depletion and recovery occurs in other subareas, but at a lesser scale. The Quail Hollow and Olympia/Mission Springs subareas have the greatest losses and gains in storage because they support municipal supply wells that pump most of the groundwater extracted from the Santa Margarita aquifer in the Basin.

Monterey Formation projected change of groundwater in storage is shown on Figure 5-23. The Monterey Formation has very limited extraction in the area south of Bean Creek (North Scotts Valley and Mount Hermon/South Scotts Valley subareas) and even in the driest years, little change in storage is predicted.

Figure 5-23 shows there is more change in groundwater in storage in the subarea north of Bean Creek where only *de minimis* users pump from the Monterey Formation.

Except in periods of consecutive dry or wet years, groundwater in storage in the Lompico aquifer is generally consistent (Figure 5-24). This indicates that pumping from the Lompico aquifer is roughly in balance with its recharge. The largest fluctuations in storage are seen in the Mount Hermon/South Scotts Valley subarea where the majority of Lompico aquifer extraction occurs by MHA, SLVWD, and SVWD. Section 8 describes potential projects targeting the Lompico aquifer to both provide for some recovery from past losses of storage and to provide regional water supply resiliency against prolonged future droughts.

The Butano aquifer is pumped only in the northern portions of the Basin, where it outcrops south of the Zayante-Vergeles fault and slightly farther south from the boundary where SVWD has 3 water supply wells in Scotts Valley that are more than 1,000 feet deep. The projected modeled changes in storage depicted on

Figure 5-25 reflect effects of recharge in wet years. This pattern is more like the Santa Margarita aquifer response to recharge events and less like the similarly confined Lompico aquifer response. The 2 Butano aquifer monitoring wells in northern Scotts Valley do not respond to wet years in the same way the model predicts (hydrographs are included on Figure 4-14). It is acknowledged in Section 4.2.5 that because of so few monitoring wells in the Butano aquifer, current understanding of it is limited and assumptions made in the model may not be correct. Existing plans to install a new Butano monitoring well may increase hydrogeologic understanding, in turn informing the groundwater model.

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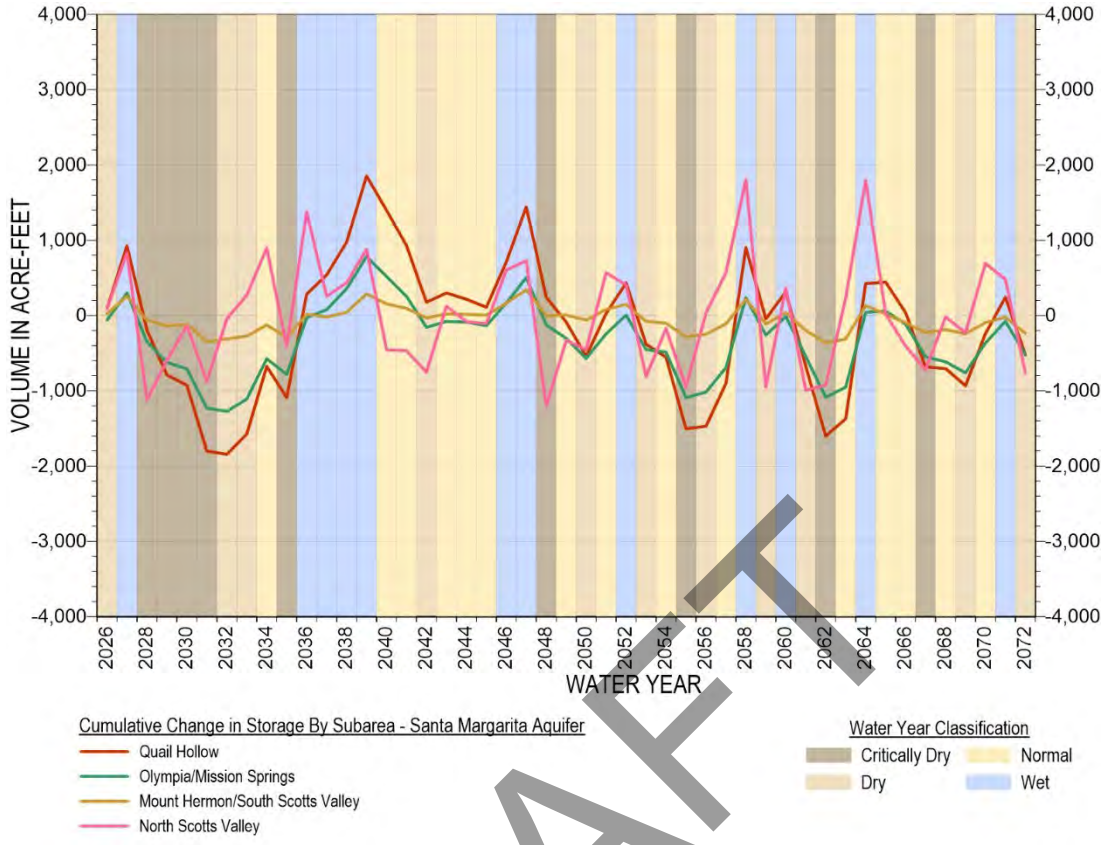

Figure 5-15. Baseline Projected Cumulative Change of Groundwater in Storage in the Santa Margarita Aquifer

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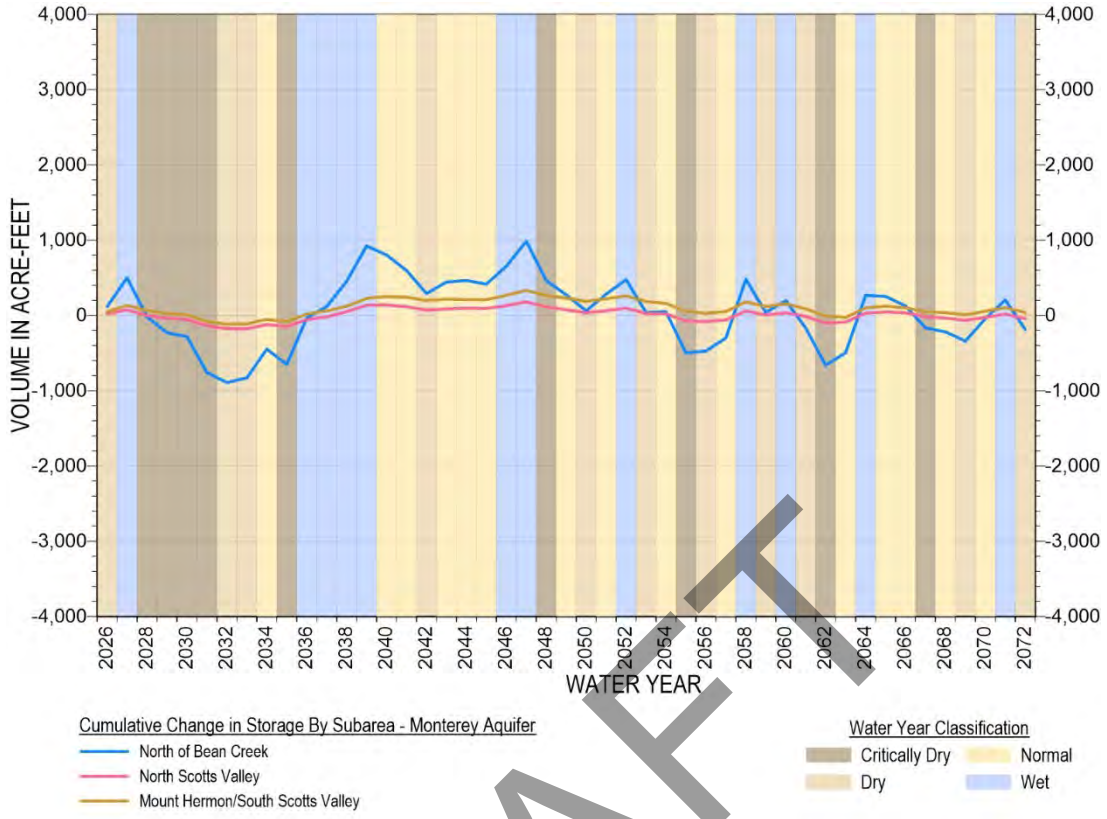

Figure 5-16. Baseline Projected Cumulative Change of Groundwater in Storage in the Monterey Formation

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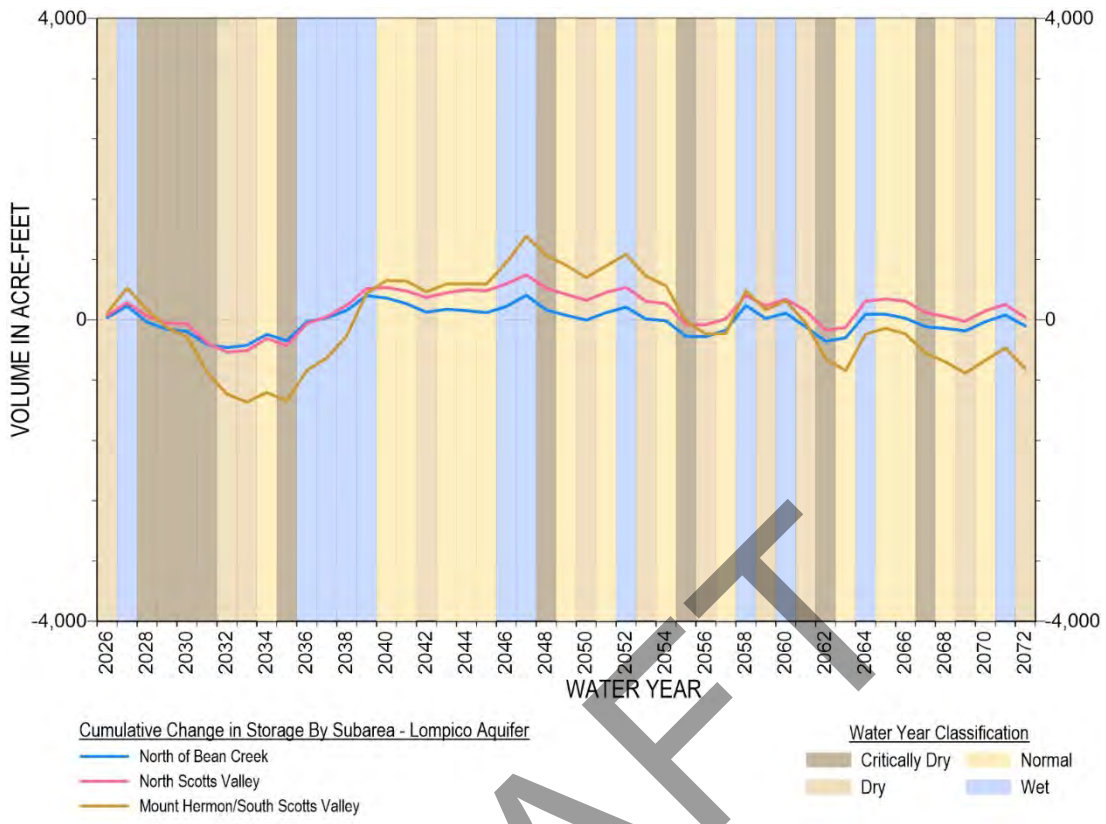

Figure 5-17. Baseline Projected Cumulative Change of Groundwater in Storage in the Lompico Aquifer

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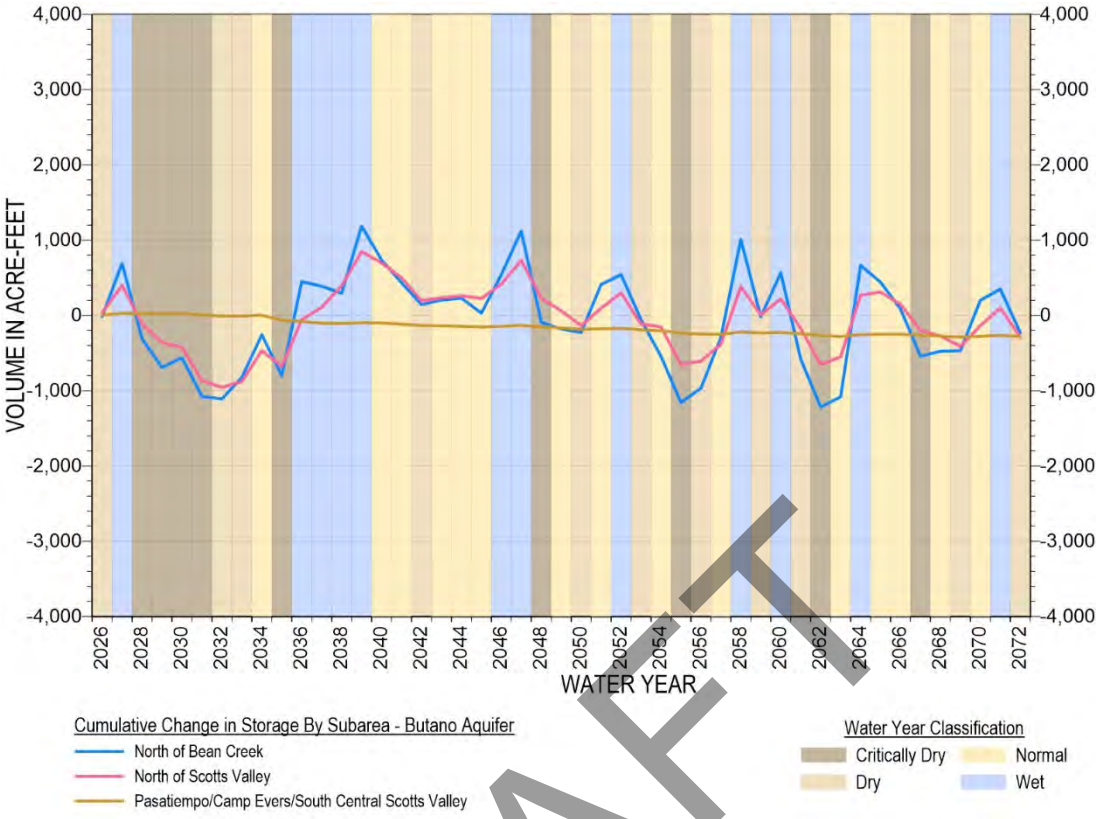

Figure 5-18. Baseline Projected Cumulative Change of Groundwater in Storage in the Butano Aquifer

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5.5 Projected Water Budget with Climate Change—

The projected water budget presented in this subsection uses climate parameters—described in Section 3.3.2—which account for potential impacts of climate change, including more extreme wet years and critically dry years, and overall less precipitation over the model period. All other model input parameters are the same as the baseline projected water budget in Section 5.4. Climate change is predicted to have a larger impact on the projected water budget than changes in water demand and runoff due to urban and residential development. Because all non-climate inputs are unchanged, the discussion below reports only the components that differ substantially from the baseline projected budget; components that are essentially unchanged are given in the summary tables and are not discussed again.

5.5.1 Projected Precipitation Budget with Climate Change

The projected precipitation budget with climate change is summarized in Table 5-16 and presented in a timeseries chart on Figure 5-19.

Table 5-16. Summary of Projected Precipitation Budget with Climate Change

Water Budget Components		Projected with Climate Change WY2026-2072		Current WY2015-2025	Historical WY1985-2014
Average Total for Projected Water Budget with Climate Change (Acre-Feet)		Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow	Annual Average (Acre-Feet)	Annual Average (Acre-Feet)
Inflows (76,500)*	Precipitation	76,500	100%	83,100	81,600
Outflows (76,500)*	Evapotranspiration	37,200	49%	37,900	37,700
	Direct Runoff	27,300	36%	31,300	30,400
	Groundwater Recharge	12,000	15%	13,900	13,500

*Small discrepancies between total inflow and outflow may occur due to rounding

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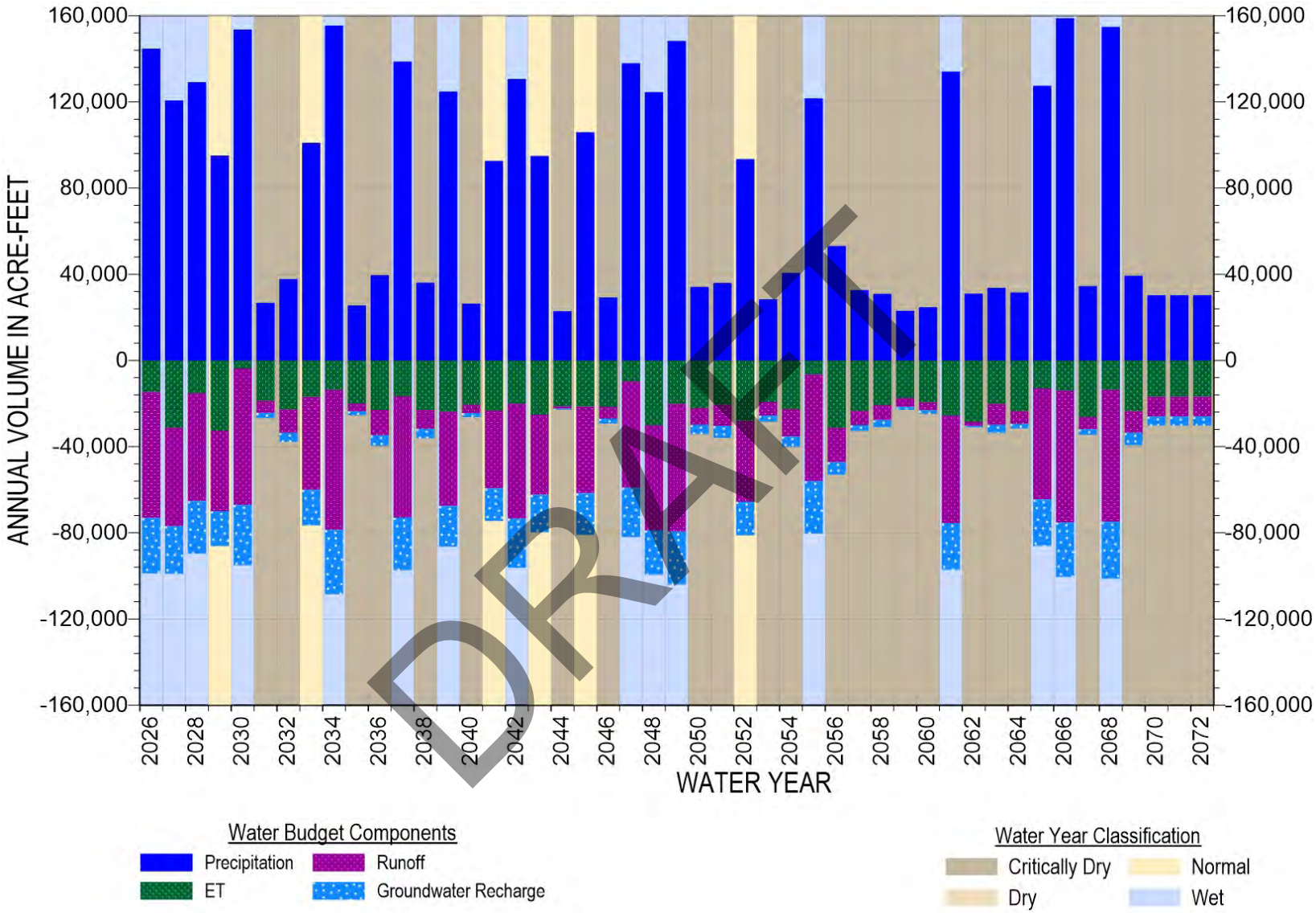

Figure 5-19. Projected Precipitation Budget with Climate Change

Projected precipitation averages 76,500 AFY with climate change, about 4,500 AFY (6%) less than the baseline projected budget (Section 5.4.1), 8% less than the current period, and 6% less than the historical period. The more consequential difference is variability rather than volume: the 4-model ensemble classifies 53% of projected water years as critically dry, 34% as wet, and 13% as normal, with no dry years, compared with 17% critically dry and 30% wet historically.

Evapotranspiration is essentially unchanged from the baseline projected budget because higher projected temperatures sustain vegetative growth and evaporation despite lower precipitation. Constant evapotranspiration combined with less precipitation reduces groundwater recharge to 12,000 AFY, down from 13,400 AFY in the baseline projected budget and about 10% below the historical period.

5.5.2 Projected Surface Water Budget with Climate Change

The projected surface water budget provides a simulated outlook for surface water inflow and outflow in the Basin in the future. The projected surface water budget with climate change is summarized in Table 5-17 and presented in a timeseries chart on Figure 5-20.

Table 5-17. Summary of Projected Surface Water Budget with Climate Change

Water Budget Components		Projected with Climate Change WY2026-2072		Current WY2015-2025	Historical WY1985-2014
Average Total for Projected Water Budget with Climate Change (Acre-Feet)		Annual Average (Acre-Feet)	Percent of Total Inflow or Outflow	Annual Average (Acre-Feet)	Annual Average (Acre-Feet)
Inflows (106,200)	Surface Water Inflow	62,400	59%	73,600	69,600
	Runoff	24,500	23%	28,700	27,900
	Groundwater Discharge to Creeks	19,300	18%	20,500	21,300
Outflows (106,100)	Surface Water Outflow	97,900	92%	114,000	110,200
	Streambed Recharge	8,200	8%	8,800	8,700

During the projected period with climate change, total surface water inflow and outflow average about 106,200 AFY, roughly 12,400 AFY (10%) less than the 118,600 AFY baseline projected budget. Surface water inflow falls from 69,600 AFY to about 62,400 AFY and runoff from 27,800 to 24,500 AFY. Surface water and groundwater interaction reflected as discharge to creeks and streambed recharge to groundwater fluctuates proportionally with precipitation and surface water inflow, especially during periods of extended drought.

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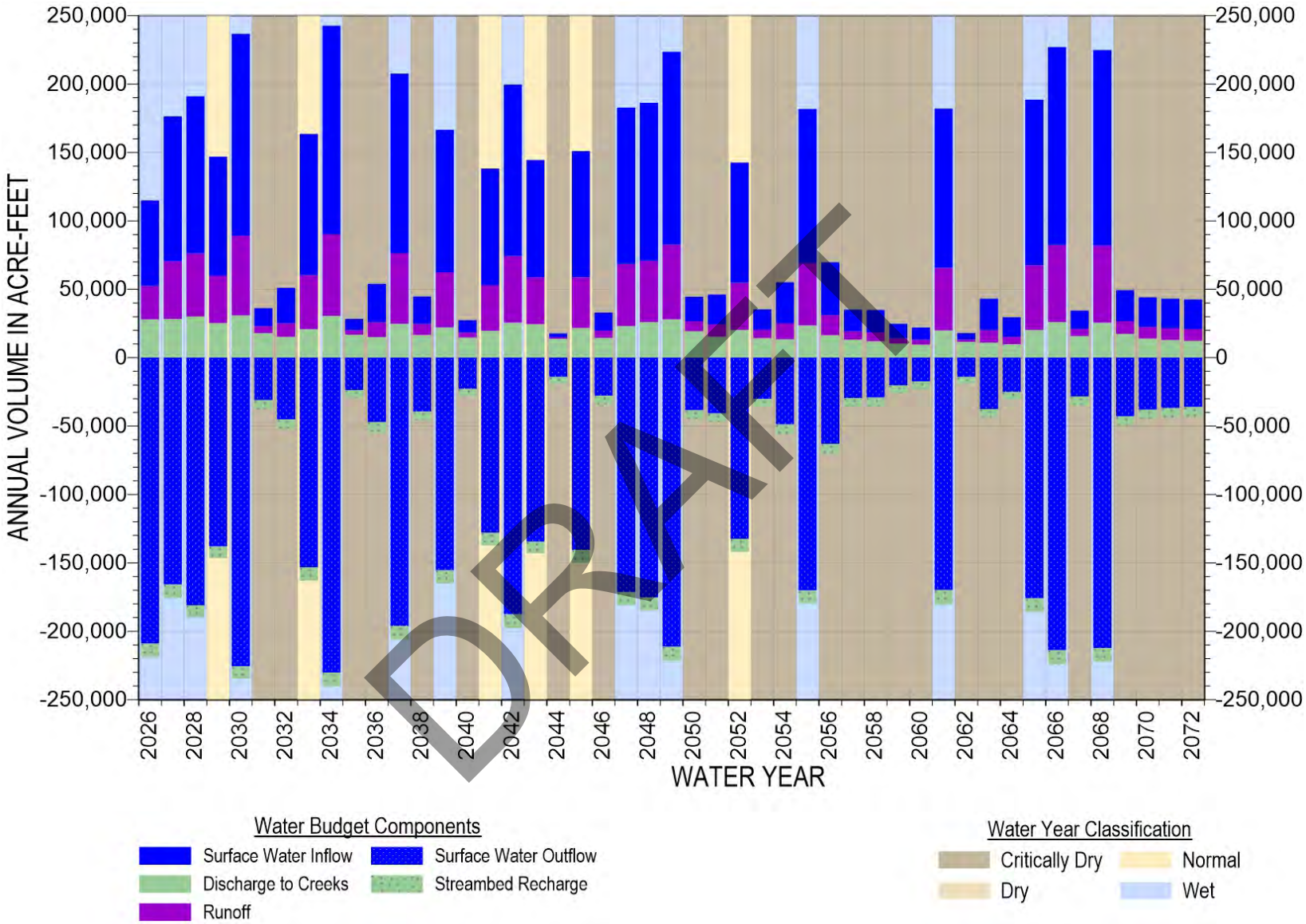

Figure 5-20. Projected Surface Water Budget with Climate Change

5.5.3 Projected Groundwater Budget with Climate Change

The projected groundwater budget provides a simulated outlook for groundwater inflow and outflow. The projected groundwater budget with climate change is summarized in Table 5-18 and presented in a timeseries chart on Figure 5-21.

Table 5-18. Summary of Projected Groundwater Budget with Climate Change

Water Budget Components		Projected with Climate Change WY2026-2072		Current WY2015-2025	Historical WY1985-2014
Average Total for Projected Water Budget with Climate Change (AF)		Annual Average (AF)	Percent of Total Inflow or Outflow	Annual Average (AF)	Annual Average (AF)
Inflows (21,400)*	Precipitation Recharge	12,000	56%	13,900	13,600
	Subsurface Inflow	100	<1%	100	200
	System Losses	300	1%	200	200
	Septic Return Flow	800	4%	900	1,100
	Quarry Return Flow	<100	<1%	<100	200
	Streambed Recharge	8,200	38%	8,800	8,700
	Irrigation Return Flow	<100	<1%	100	100
Outflows (22,000)*	Groundwater Pumping	2,600	12%	2,700	3,900
	Subsurface Outflow	100	1%	100	100
	Discharge to Creeks	19,300	88%	20,500	21,300
Storage*	Average Annual Change in Storage	-400	-	700	-1,300
	Cumulative Change in Storage	-19,500	-	8,200	-40,300

*Small discrepancies between total inflow and outflow may occur due to rounding

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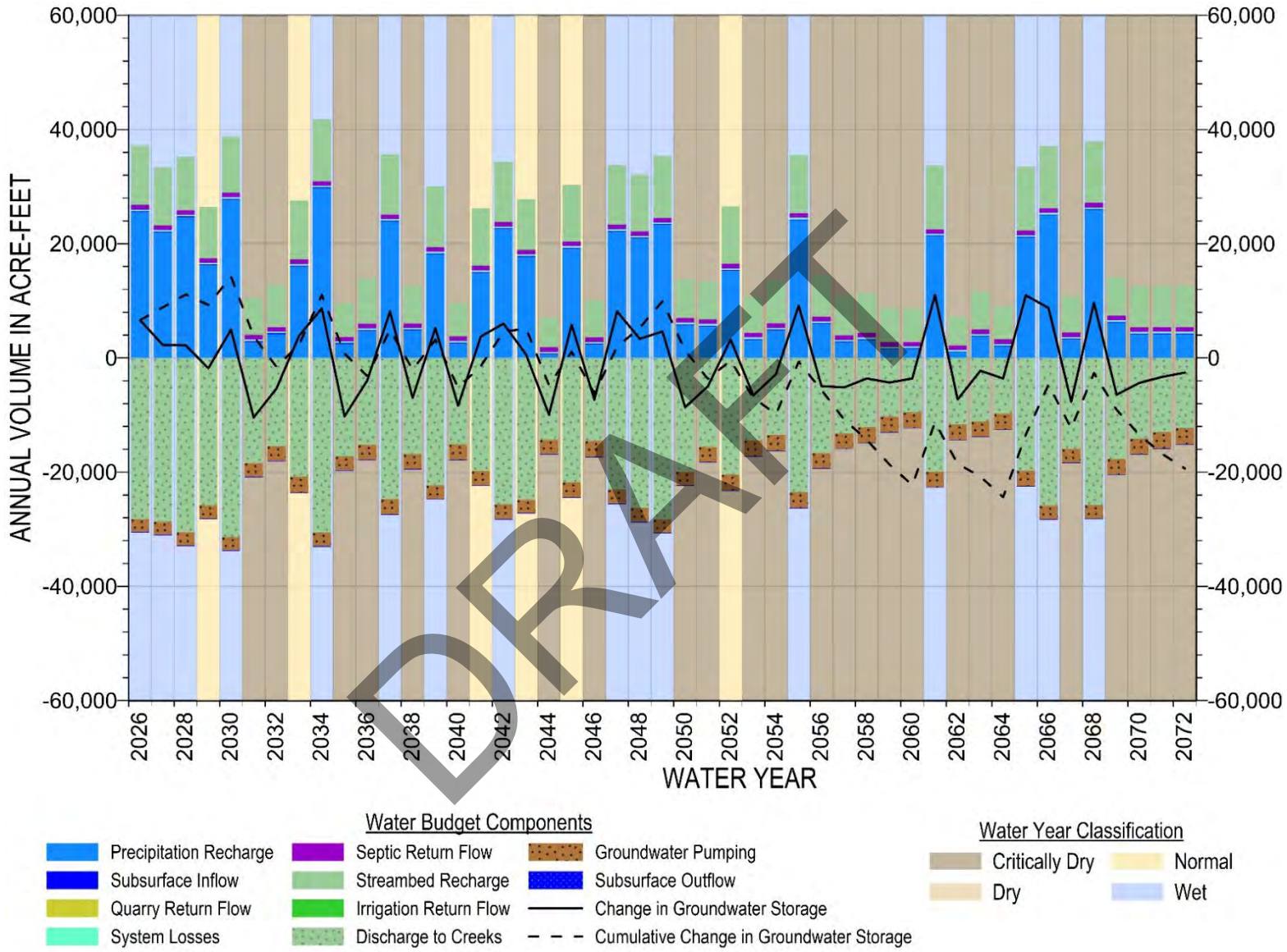

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Figure 5-21. Projected Groundwater Budget with Climate Change

Total projected groundwater inflow and outflow with climate change average about 21,400 AFY and 22,000 AFY, compared with 23,400 AFY and 23,500 AFY, respectively, in the baseline projected budget. Reduced precipitation recharge accounts for most of the difference, at 12,000 AFY against 13,400 AFY in the baseline projected budget. Direct groundwater recharge from precipitation is projected to be about 1,900 AFY and 1,600 AFY less than the current and historical periods, respectively. Streambed recharge is 8,200 AFY, about 500 AFY less than the baseline projection. Other components of projected groundwater inflow with climate change are expected to be similar to historical inflows.

Reduced projected groundwater outflow with climate change is almost entirely a result of less groundwater discharge to creeks. Groundwater pumping is a consistent model input for both projections at about 2,600 AFY and about 1,300 AFY less than average historical conditions. In the future, SLVWD and SVWD pumping is expected to increase very slightly, as described in Section 5.4, with all other pumping remaining consistent. Groundwater discharge to creeks with climate change averages about 19,300 AFY, roughly 1,500 AFY less than the baseline projected budget. The reduction reflects drier conditions, which reduce streamflow and lower groundwater levels.

The most substantial difference between the 2 projections is the loss of groundwater in storage. Less overall precipitation and greater variability result in longer droughts and lower groundwater levels. Prolonged drought stresses the water supply in the Basin and requires greater groundwater recharge and/or conjunctive use strategies to increase groundwater in storage in wetter years when water is available. The projected simulation under the climate change scenario, without new projects or management actions, results in a cumulative storage loss of about 19,500 AF between WY2026 and WY2072—which is 16,300 AF more storage loss than the baseline projected budget. The average annual decline is about 400 AFY, against about 100 AFY in the baseline projection. Cumulative storage remains balanced until WY2050, when a substantially drier climate begins, resulting in 17 critically dry years out of the 23 years to end the projected simulation (Figure 5-21).

Given these results and as discussed in Sections 7 and 8, PMAs may be needed to achieve groundwater sustainability, a conclusion the baseline projected budget does not support. Model projections depend heavily on estimates of future precipitation, however, so groundwater conditions could be better or worse than simulated if actual precipitation deviates from the 4-model ensemble.

5.5.4 Projected Groundwater Budget by Aquifer with Climate Change

The projected groundwater budget with climate change is analyzed by aquifer to show how groundwater flows change if no additional projects or management actions are implemented. The groundwater budget by aquifer is summarized in Table 5-19.

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Table 5-19. Projected Groundwater Budget by Aquifer with Climate Change

Groundwater Budget Components		Projected Water Budget with Climate Change WY2026-2072 Annual Average (Acre-Feet)				
		Santa Margarita Aquifer	Monterey Formation	Lompico Aquifer	Butano Aquifer	Other Formations
Inflows	Precipitation Recharge	5,700	1,300	800	3,600	600
	Subsurface Inflow	0	0	0	100	<100
	Return Flows	500	200	200	100	100
	Streambed Recharge	1,500	800	400	3,300	2,200
	Flow from Other Aquifers	<100	300	1,600	600	Not calculated
	*Total Inflow**	*7,700*	*2,600*	*3,000*	*7,700*	*3,100*
Outflows	Groundwater Pumping	700	100	1,200	600	<100
	Subsurface Outflow	0	0	0	100	<100
	Discharge to Creeks	6,100	2,100	1,300	6,800	3,000
	Flow to Other Aquifers	1,100	400	600	400	Not calculated
	*Total Outflow**	*7,900*	*2,600*	*3,100*	*7,800*	*3,100*
Storage	Average Annual Change in Storage*	-100	-100	-100	-100	>-100
	Cumulative Change in Storage*	-6,100	-2,400	-6,100	-4,300	-2,400

*Small discrepancies between total inflow and outflow may occur due to rounding

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Groundwater in storage is projected to decrease with climate change in every principal aquifer and in the Monterey Formation, with a long-term average annual change in each aquifer of about -100 AFY, whereas the baseline projected budget shows only minor losses. Groundwater storage is in relative balance under projected climate change until WY2050, after which the concentration of critically dry years produces a net loss toward the end of the simulation. Cumulative losses over the projected period are about 6,100 AF each in the Santa Margarita and Lompico aquifers, 4,300 AF in the Butano aquifer, and 2,400 AF each in the Monterey Formation and other formations, compared with 1,500, 700, 800, 200, and 2,000 AF, respectively, in the baseline projected budget.

The Santa Margarita and Butano aquifers are the most sensitive to the drier climate because they are recharged directly by precipitation and streambeds, which together supply 7,200 AFY of the Santa Margarita aquifer's 7,700 AFY total inflow and 6,900 AFY of the Butano aquifer's 7,700 AFY total inflow. The Lompico aquifer response is muted because recharge must percolate through the overlying Santa Margarita aquifer, the Monterey Formation, or both,

except in the Camp Evers area of south Scotts Valley where Monterey Formation shale is absent between the permeable Santa Margarita and Lompico aquifers.

5.5.5 Projected Groundwater Change in Storage by Subarea with Climate Change

In the climate change projection, all principal aquifers are affected by the drier climate simulated by the 4-model ensemble, particularly during the multiple critically dry years toward the end of the projected period. Figure 5-22 through Figure 5-25 show each aquifer's projected cumulative change of groundwater in storage within each of the 4 subareas.

The Santa Margarita aquifer is the most sensitive to climate, and the divergence between the 2 projections is pronounced there. During the longest projected drought period from WY2050 to 2064 (Figure 5-22, it loses about 8,400 AF from storage in the North of Bean Creek subareas (Quail Hollow and Olympia/Mission Springs) and about 2,800 AF from storage in the South of Bean Creek subareas (Mount Hermon/South Scotts Valley and North Scotts Valley). Storage still recovers quickly during and after wet years. The Quail Hollow and Olympia/Mission Springs subareas have the greatest losses and gains in storage because they contain SLVWD supply wells that extract the most groundwater from the Santa Margarita aquifer. These SLVWD supply wells are rested in wet years when surface water is available.

Monterey Formation projected change of groundwater in storage is shown on Figure 5-23. The Monterey Formation is not pumped by many wells in the area south of Bean Creek (North Scotts Valley and Mount Hermon/South Scotts Valley subareas) and even in the driest years, little change in storage is predicted. Figure 5-23 shows that there is more change in stored groundwater in the subarea north of Bean Creek where only *de minimis* users pump from the Monterey Formation. The very low rainfall predicted from WY2050 on results in an overall loss of about 1,500 AF north of Bean Creek, where the baseline projected budget predicts little net change, by the end of the projected period.

Up until WY2050, groundwater in storage in the Lompico aquifer is generally consistent with about 2,300 AF of cumulative storage gain (Figure 5-24). This indicates that pumping from the Lompico aquifer is roughly in balance with its recharge. The extended drought projected after this period causes a cumulative loss of groundwater in storage of about 8,700 AF, mainly in the Mount Hermon/South Scotts Valley subarea where the majority of Lompico aquifer pumping occurs by MHA, SLVWD, and SVWD. Because of the aquifer's limited recharge area and confined nature, recovery from an extended drought may require projects or management actions. Section 8 describes potential projects that target the Lompico aquifer to both provide for some recovery from past storage losses and to provide resiliency against prolonged future droughts.

The Butano aquifer behaves similarly to the Lompico aquifer in the subareas south of Bean Creek and like the Santa Margarita aquifer north of Bean Creek. Most of the Butano groundwater

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pumping is from 3 deep SVWD extraction wells in North Scotts Valley subarea. North of Bean Creek, the Butano is shallower, outcropping and being recharged in the model simulations by interconnected streams and pumped by private well owners. The projected changes in storage depicted on Figure 5-25 reflect effects of recharge in wet years where it outcrops near interconnected streams. The 2 Butano aquifer monitoring wells in northern Scotts Valley do not appear to respond to wet years in the same way the model predicts (Figure 4-14). It is acknowledged in Section 4.2.5 that because of so few monitoring wells in the Butano aquifer, our current understanding of it is limited and assumptions made in the model may not be correct. Existing plans to install a new Butano monitoring well may increase hydrogeologic understanding, in turn informing the groundwater model.

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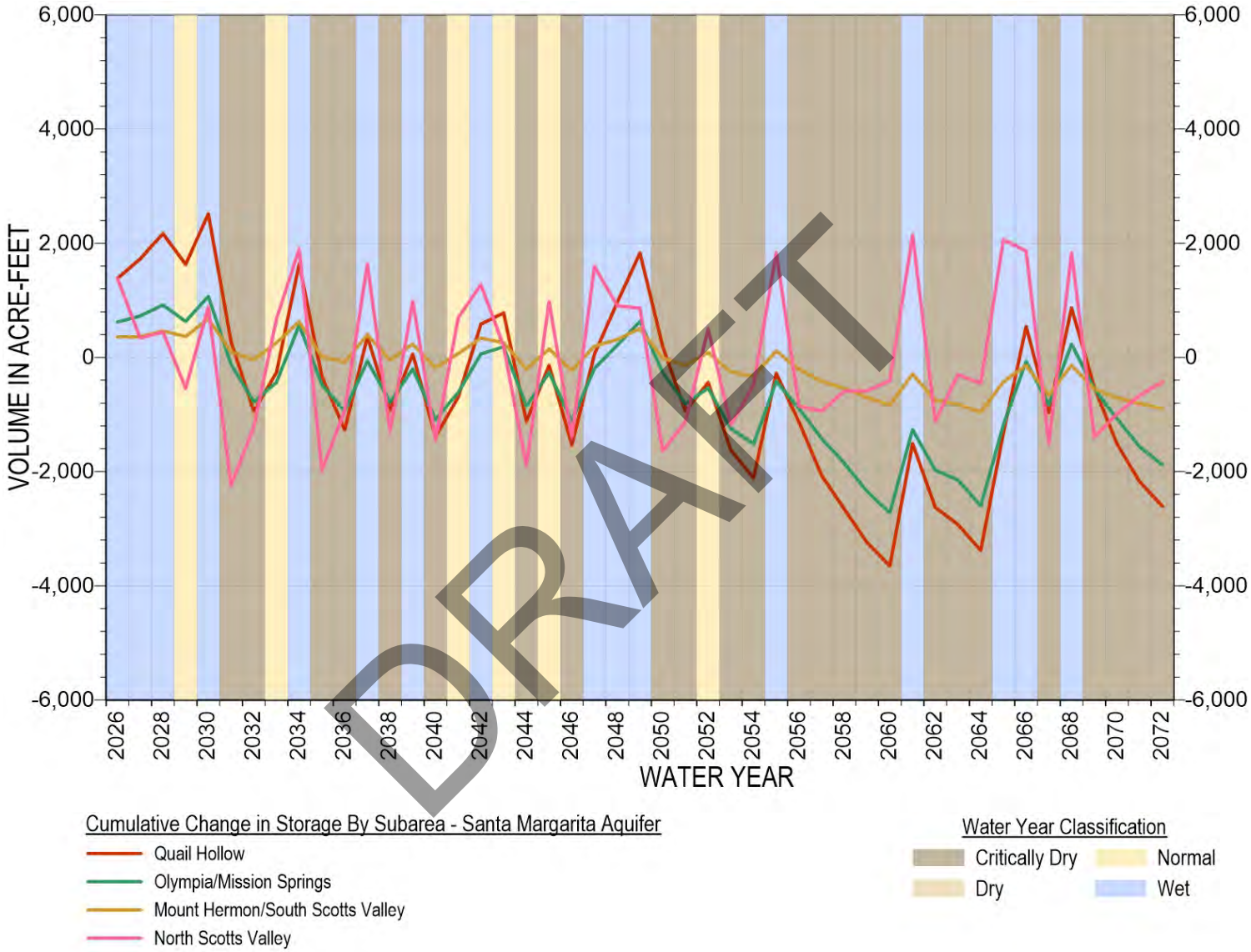

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Figure 5-22. Projected Cumulative Change of Groundwater in Storage in the Santa Margarita Aquifer with Climate Change

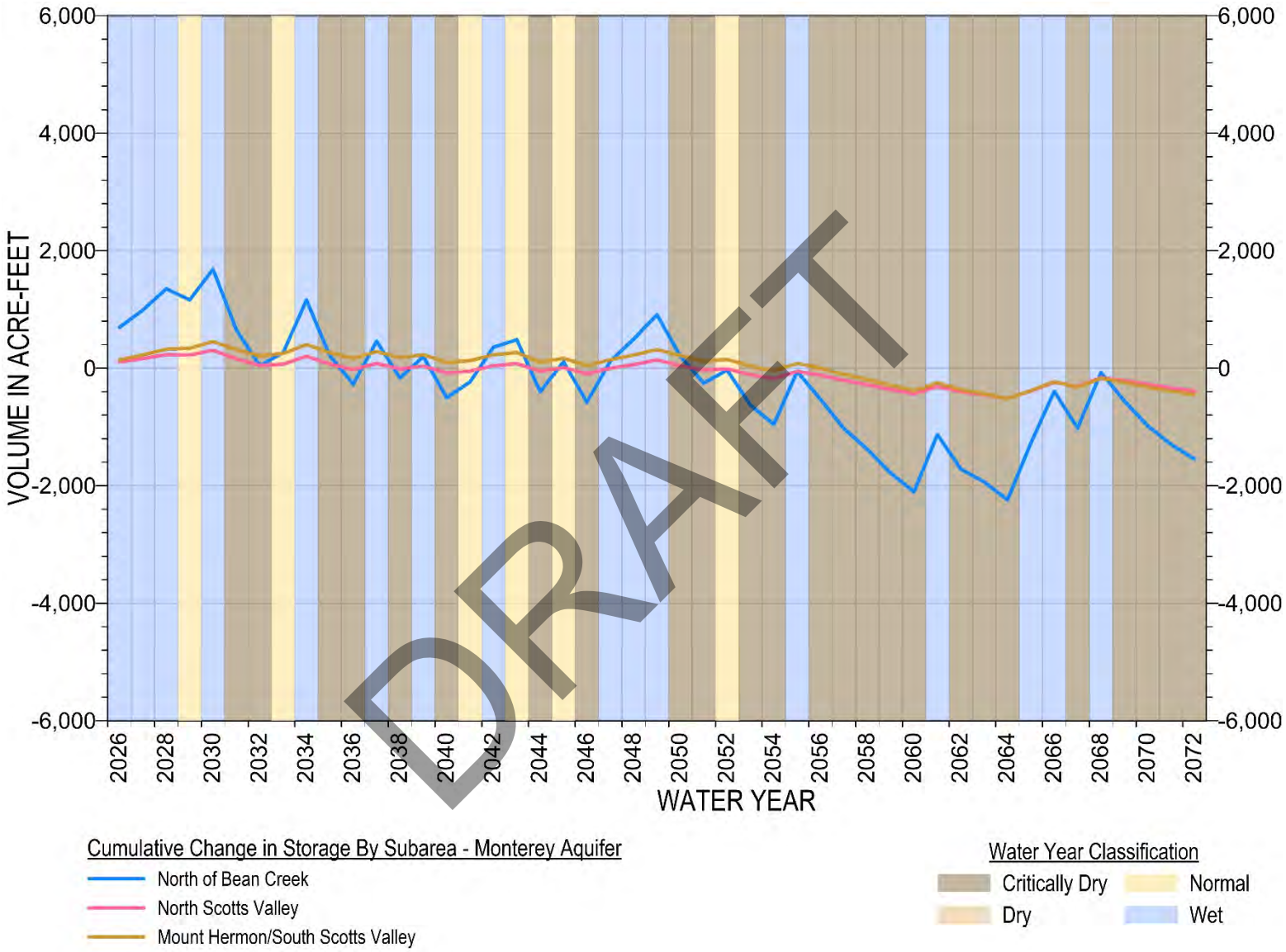

Figure 5-23. Projected Cumulative Change of Groundwater in Storage in the Monterey Formation with Climate Change

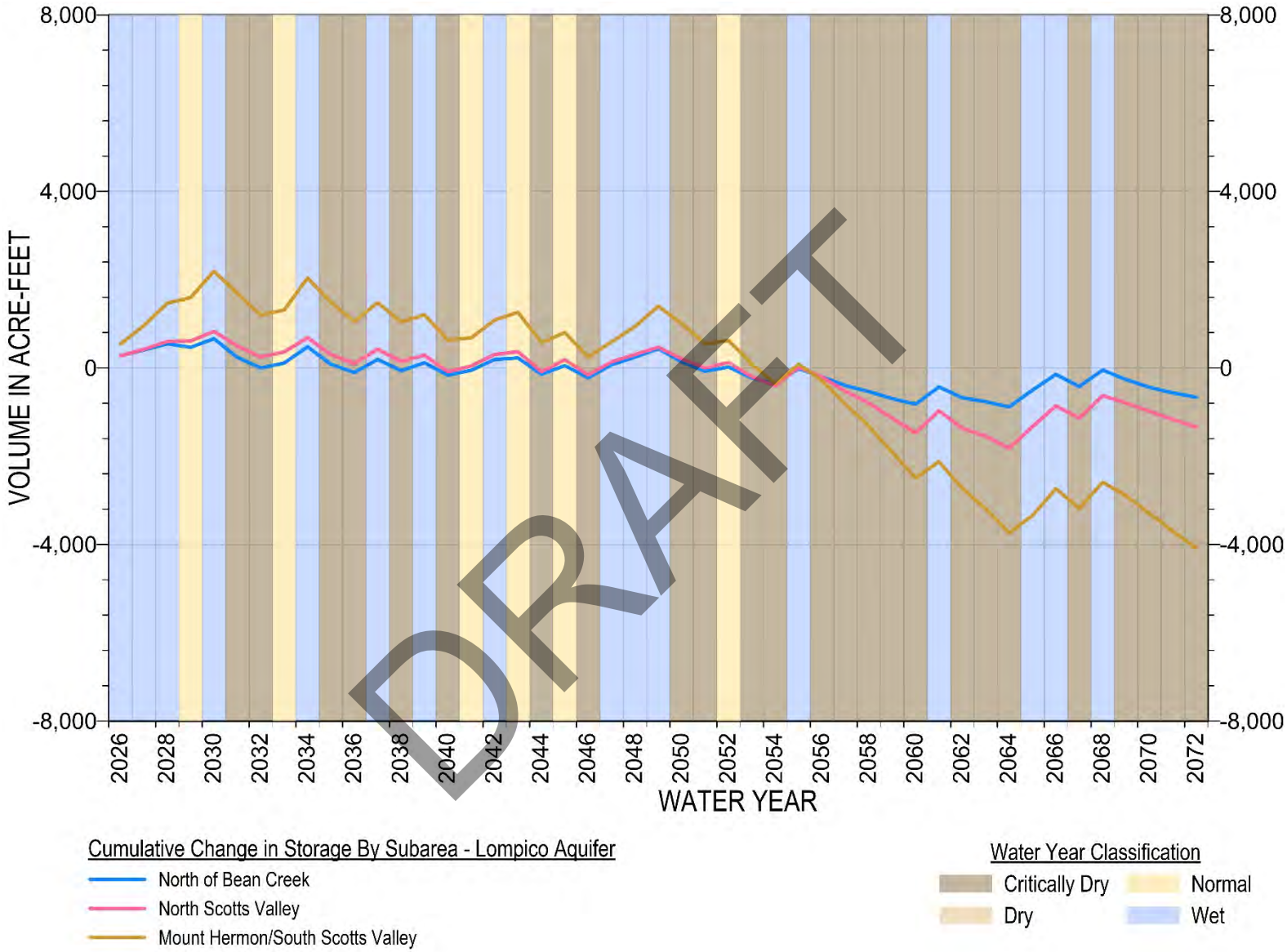

Figure 5-24. Projected Cumulative Change of Groundwater in Storage in the Lompico Aquifer with Climate Change

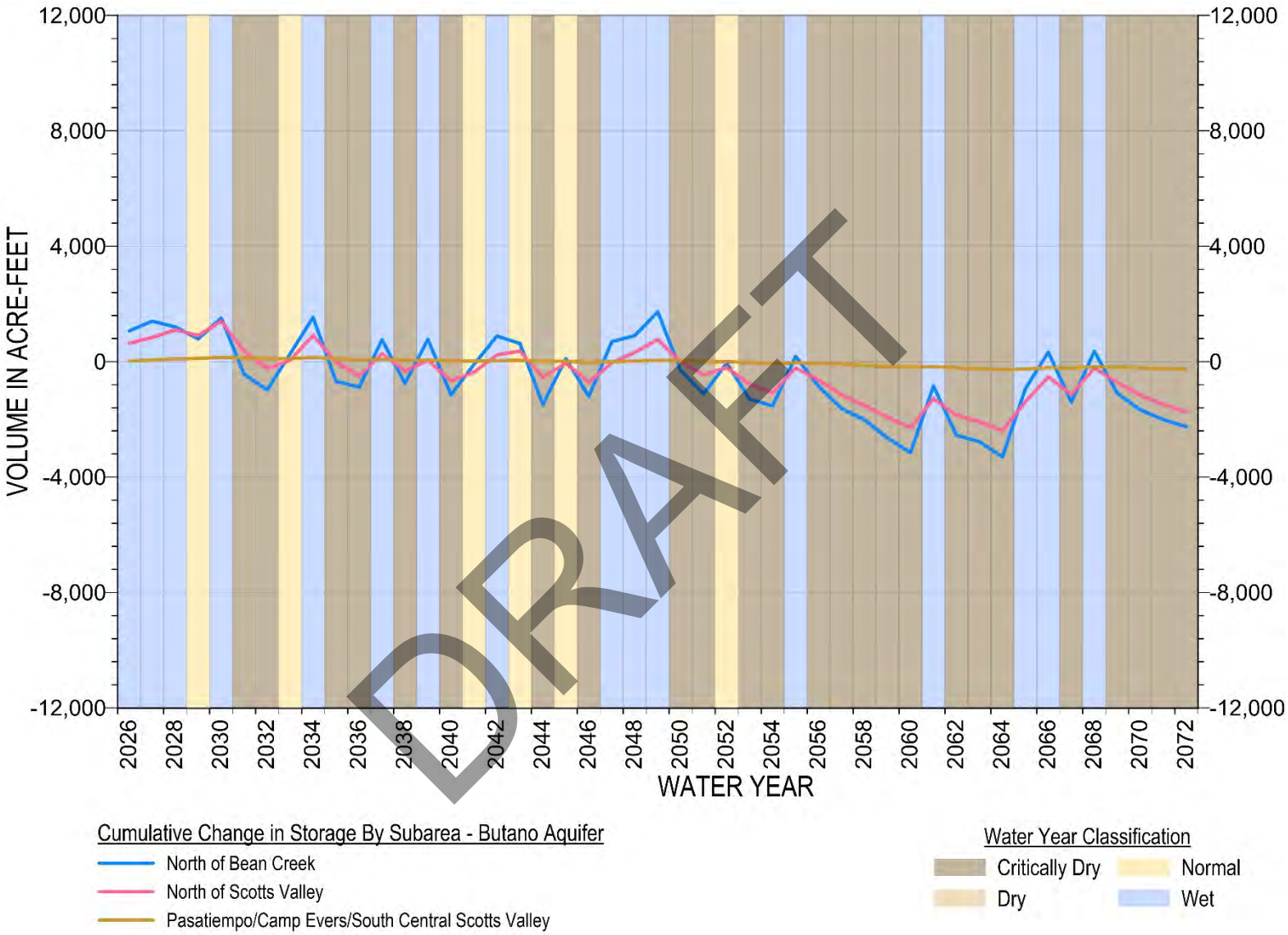

Figure 5-25. Projected Cumulative Change of Groundwater in Storage in the Butano Aquifer with Climate Change

5.6 Sustainable Yield

The Basin's sustainable yield is an estimated volume of groundwater that can be extracted on a long-term average annual basis without causing undesirable results. The role of sustainable yield estimates in SGMA as described in the SMC BMP (DWR, 2016a) are as follows:

> *"In general, the sustainable yield of a basin is the amount of groundwater that can be withdrawn annually without causing undesirable results. Sustainable yield is referenced in SGMA as part of the estimated basinwide water budget and as the outcome of avoiding undesirable results.*
>
> *Sustainable yield estimates are part of SGMA's required basinwide water budget. Section 354.18(b)(7) of the GSP Regulations requires that an estimate of the basin's sustainable yield be provided in the GSP (or in the coordination agreement for basins with multiple GSPs). A single value of sustainable yield must be calculated basinwide. This sustainable yield estimate can be helpful for estimating the projects and programs needed to achieve sustainability."*

Basin-wide groundwater extraction within the sustainable yield does not constitute proof of sustainability. Sustainability under SGMA is only demonstrated by avoiding undesirable results for the sustainability indicators applicable to the Basin. Specific undesirable results for the chronic lowering of groundwater levels, reduction in groundwater storage, and depletion of interconnected surface water sustainability indicators are presented in Section 7.

Groundwater conditions in the Basin have been generally sustainable since SGMA was enacted in 2015, as reflected by stable to increasing groundwater level trends (Section 4.2) and balanced aquifer storage (Section 4.3), which create conditions that help limit groundwater quality degradation (Section 4.4) and maintain interconnected groundwater and surface water (Section 4.6). The Basin Model simulation results are generally aligned with observed conditions and also reflect a balanced current groundwater budget since SGMA was enacted in 2015 (Figure 5-7; Figure 5-14), except for an extreme drought in the climate change scenario simulated after WY2050 (Figure 5-21). Similarly, stable to increasing groundwater levels are observed and simulated at RMPs after 2015 in the projected baseline simulation (Appendix 5A) and until WY2050 in the projected simulation with climate change (Appendix 5B). SMGWA is prepared to adaptively manage the Basin with planned PMAs described in Section 8 to achieve or maintain sustainability during extreme future droughts should they occur.

Current and projected extraction volumes that prevent undesirable results are the estimated sustainable yield for the Basin. Current and projected scenarios show that the average groundwater extraction volumes over the past 10 years are similar to projected average volumes between 2026 and 2072. The sustainable yield for the unconfined Santa Margarita aquifer is

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700 AFY and confined aquifer is 1,900 AFY, totaling 2,600 AFY for the Basin, as summarized in Table 5-20.

Table 5-20. Sustainable Yield by Aquifer Compared to Historical, Current Extraction

Aquifer	Historical Pumping 1985 – 2014 (AFY)	Current Pumping 2015 – 2025 (AFY)	Sustainable Yield Projected Pumping 2026-2072 (AFY)
Santa Margarita (Unconfined Aquifer Total)	1,100	700	700
Monterey	*400*	*200*	*100*
Lompico	*1,800*	*1,200*	*1,200*
Butano	*600*	*500*	*600*
Confined Aquifer Total	2,800	1,900	1,900
Total Extraction	3,900	2,600	2,600

The projected confined aquifer extraction is similar every year, but the unconfined Santa Margarita aquifer extraction fluctuates with climate due to SLVWD's conjunctive use practices. Therefore, a 5-year running average extraction volume is appropriate to smooth out annual differences in volumes to understand the longer-term effects that groundwater extraction has on groundwater conditions. Annual and 5-year running average groundwater extraction in the historical, current, and projected baseline model timeframes are shown on Figure 5-26 for the Santa Margarita / unconfined aquifer and Figure 5-27 for the confined aquifer. The 5-year running average extraction only exceeds the sustainable yield for the unconfined aquifer in a few drought years, which is offset by increased recharge and reduced extraction in wetter periods. The sustainable yield estimates are incorporated into the reduction of groundwater storage sustainability indicator evaluation, described further in Section 7.4.2.

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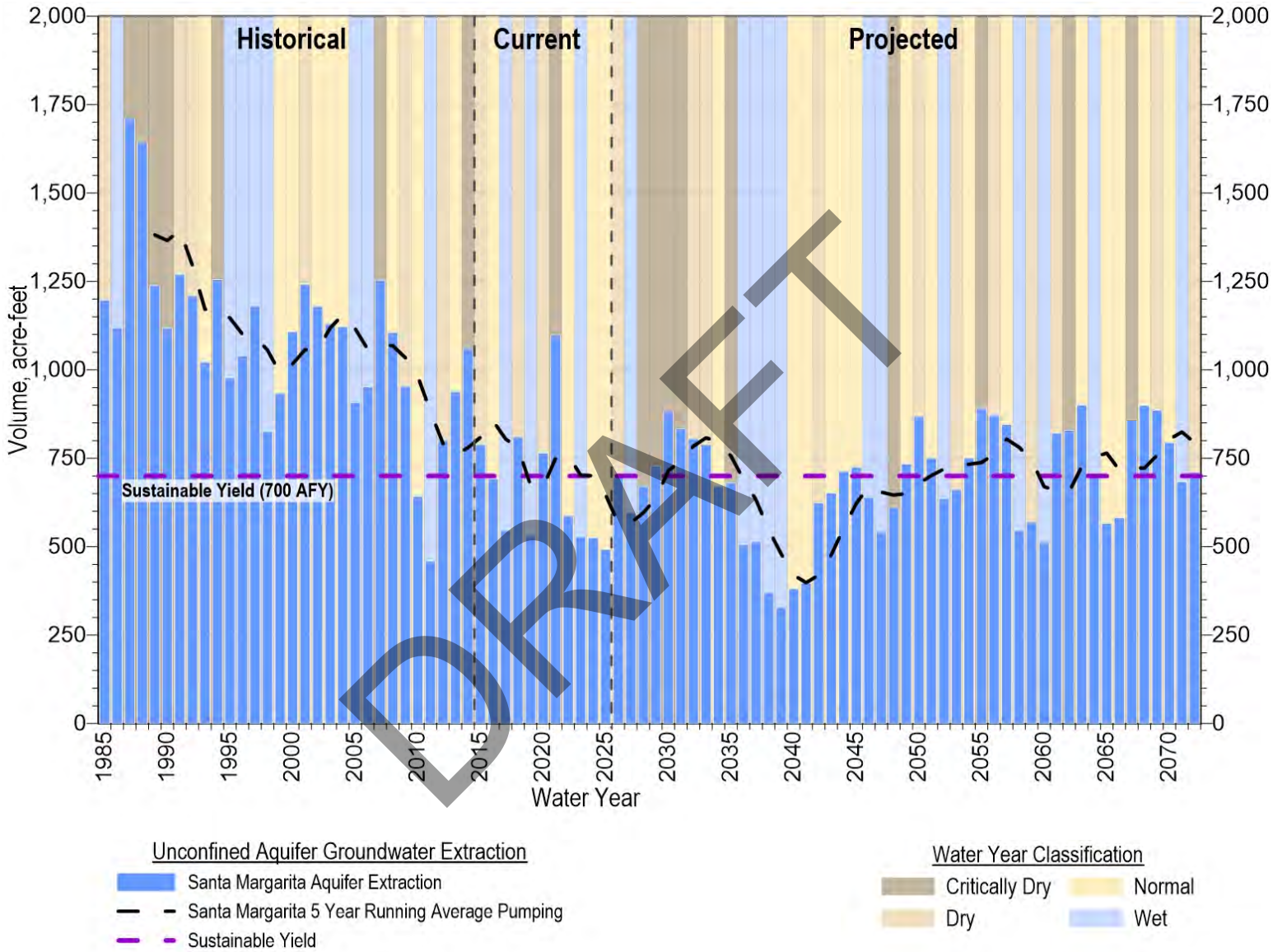

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Figure 5-26. Historical and Projected Groundwater Extraction in the Unconfined Aquifer

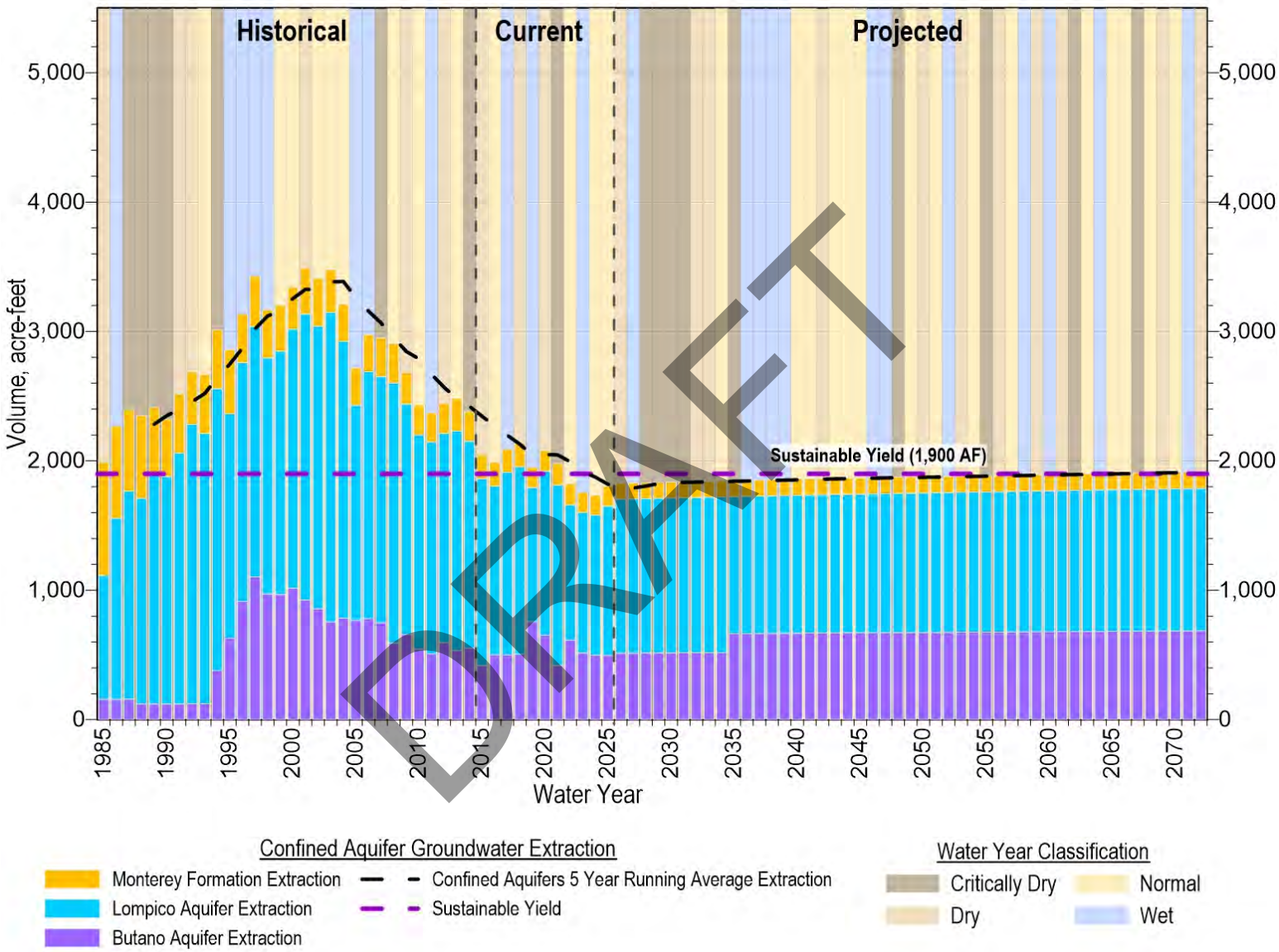

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Figure 5-27. Historical, Current, and Projected Groundwater Extraction in the Confined Aquifer

6 MONITORING NETWORKS

This section describes the monitoring networks and protocols that the SMGWA will use to assess groundwater conditions and the Basin's sustainability during GSP implementation. The monitoring networks included in this subsection are based, to the extent possible, on existing monitoring networks described in Section 2.1.3. The subsections below describe how the existing networks are adapted to meet the SGMA requirements for each applicable sustainability indicator. A subset of monitoring wells from the existing monitoring network are selected as RMPs for measuring progress toward sustainability metrics. Finally, this section identifies monitoring network data gaps and proposed improvements for networks that are insufficient for assessing current and future conditions.

6.1 Purpose of Monitoring Networks

The GSP Regulations require that monitoring networks be developed to promote the collection of data of sufficient quality, frequency, and spatial distribution to characterize groundwater and related surface water conditions, and to evaluate changing conditions that occur during GSP implementation. Monitoring networks should accomplish the following:

- Demonstrate progress toward achieving SMC described in the GSP
- Monitor impacts to beneficial uses and users of groundwater
- Quantify annual changes in water budget components

The Basin's existing monitoring networks have been used for decades to collect information to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface water conditions. The existing networks are used to collect data relevant to the Basin's applicable groundwater sustainability indicators including chronic lowering of groundwater levels, depletion of interconnected surface water, reduction of groundwater in storage, and degraded groundwater quality (Table 6-1).

Representative monitoring points are a subset of the Basin's overall monitoring network where numeric values for SMC, including minimum thresholds (MTs), measurable objectives (MOs), and interim milestones (IMs), are set. Per GSP regulations, designation of RMPs is supported by adequate evidence demonstrating that the site reflects general aquifer conditions in the area. The depletion of interconnected surface water sustainability indicator is monitored using groundwater levels and extraction volume as a proxy, because they are correlated to surface water depletion because of widespread interconnection between the principal aquifers and streams throughout the Basin.

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Table 6-1. Applicable Sustainability Indicators in the Santa Margarita Basin

Sustainability Indicator	Metric	Proxy
Chronic Lowering of Groundwater Levels	Groundwater elevation	---
Reduction of Groundwater in Storage	Groundwater extraction volume	---
Degraded Groundwater Quality	Concentration	---
Depletion of Interconnected Surface Water	Volume or rate of streamflow	Groundwater elevation and extraction volume

6.2 Groundwater Level Monitoring Network

Groundwater levels are measured to evaluate the chronic lowering of groundwater levels SMC and as a proxy for monitoring depletion of interconnected surface water. The groundwater level monitoring network comprises municipal production wells, dedicated monitoring wells, and select private and small water system wells in each of the Basin's principal aquifers and the Monterey Formation. Table 6-2 summarizes the wells in the existing monitoring network by aquifer. Figure 6-1 shows the basin-wide distribution of groundwater level monitoring wells.

The monitoring network is grouped into 2 different hydrogeologic units for SMC evaluation – the Unconfined Monitoring Network and Confined Monitoring Network. The 2 consolidated network designations are used to evaluate groundwater level URs as described in Section 7.3.1. The Unconfined and Confined aquifer terminology is a generalization. The shallow Santa Margarita aquifer is unconfined throughout the Basin and the deeper aquifers group (Monterey, Lompico and Butano formations) are generally confined, particularly in the areas where they used for water supply. However, each of the "Confined" geologic units outcrop in a relatively thin band within the Basin at the margins where they represent the outer limbs of the syncline, so shallow zones in those locations could exhibit unconfined behavior. There is also direct contact between the Lompico and Santa Margarita aquifers in the South Scotts Valley area where the Monterey Formation is not present, so the Lompico aquifer can exhibit semi-confined behavior. Regardless, groundwater tends to recharge and discharge more quickly in the Unconfined aquifer than it does in the Confined aquifer, so tracking these as 2 distinct aquifer systems is warranted.

A subset of the groundwater level monitoring network was designated as RMPs to assess conditions relative to SMC. Most of the groundwater level monitoring wells in the Basin are RMPs. Groundwater level monitoring locations that are not RMPs include wells also used as active extraction wells, monitoring wells highly influenced by extraction (i.e. SVWD #15 Monitoring Well), and a few monitoring locations that provide redundant data compared to other nearby locations (i.e., Quail MW-C, MHA-MW1, and AB303-MW-3B). RMPs are summarized in Table 6-2 and shown on Figure 6-2.

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Table 6-2. Summary of Groundwater Level Monitoring Network Wells

Aquifer Type	Aquifer Unit	Well Name	Well Type	RMP
Unconfined	Santa Margarita	SLVWD Olympia #1	Monitoring	X
		SLVWD Olympia #2	Extraction	
		SLVWD Olympia #3	Extraction	
		SLVWD Pasatiempo MW-2	Monitoring	X
		SLVWD Quail #4A	Extraction	
		SLVWD Quail #5A	Extraction	
		SLVWD Quail MW-A	Monitoring	X
		SLVWD Quail MW-B	Monitoring	X
		SLVWD Quail MW-C	Monitoring	
		SMGWA-2 Bean Creek	Monitoring	X
		SMGWA-3 Ruins Creek	Monitoring	X
		SMGWA-4 Nelson Road	Monitoring	X
		SMGWA-5 Bahr Drive	Monitoring	X
		SMGWA-6 Quail Hollow	Monitoring	X
		SVWD AB303 MW-1	Monitoring	X
		SVWD AB303 MW-3B	Monitoring	
		SVWD SV4-MW	Monitoring	X
		SVWD TW-18	Monitoring	X
Confined	Monterey	SMGWA-8 Sandhills Preserve	Monitoring	X
		SVWD #9	Monitoring	X
		Weston Rd	Extraction	
	Lompico	MHA #1	Extraction	
		MHA #2	Extraction	
		MHA #3	Extraction	
		MHA-MW1	Monitoring	
		SLVWD Pasatiempo #3	Monitoring	X
		SLVWD Pasatiempo #5A	Extraction	
		SLVWD Pasatiempo #7	Extraction	
		SLVWD Pasatiempo #8	Extraction	
		SLVWD Pasatiempo MW-1	Monitoring	X
		SVWD #10	Monitoring	X
		SVWD #10A	Extraction	
		SVWD #11A	Extraction	X
		SVWD #11B	Extraction	
		SVWD AB303 MW-2	Monitoring	X
		SVWD AB303 MW-3A	Monitoring	X
		SVWD TW-19	Monitoring	X
	Lompico, Butano	SVWD #15 Monitoring Well	Monitoring	
		SVWD Grace Way	Extraction	
		SVWD Orchard	Extraction	
		SVWD Sucinto	Extraction	
	Butano	SVWD Canham	Monitoring	X
		SVWD Stonewood	Monitoring	X

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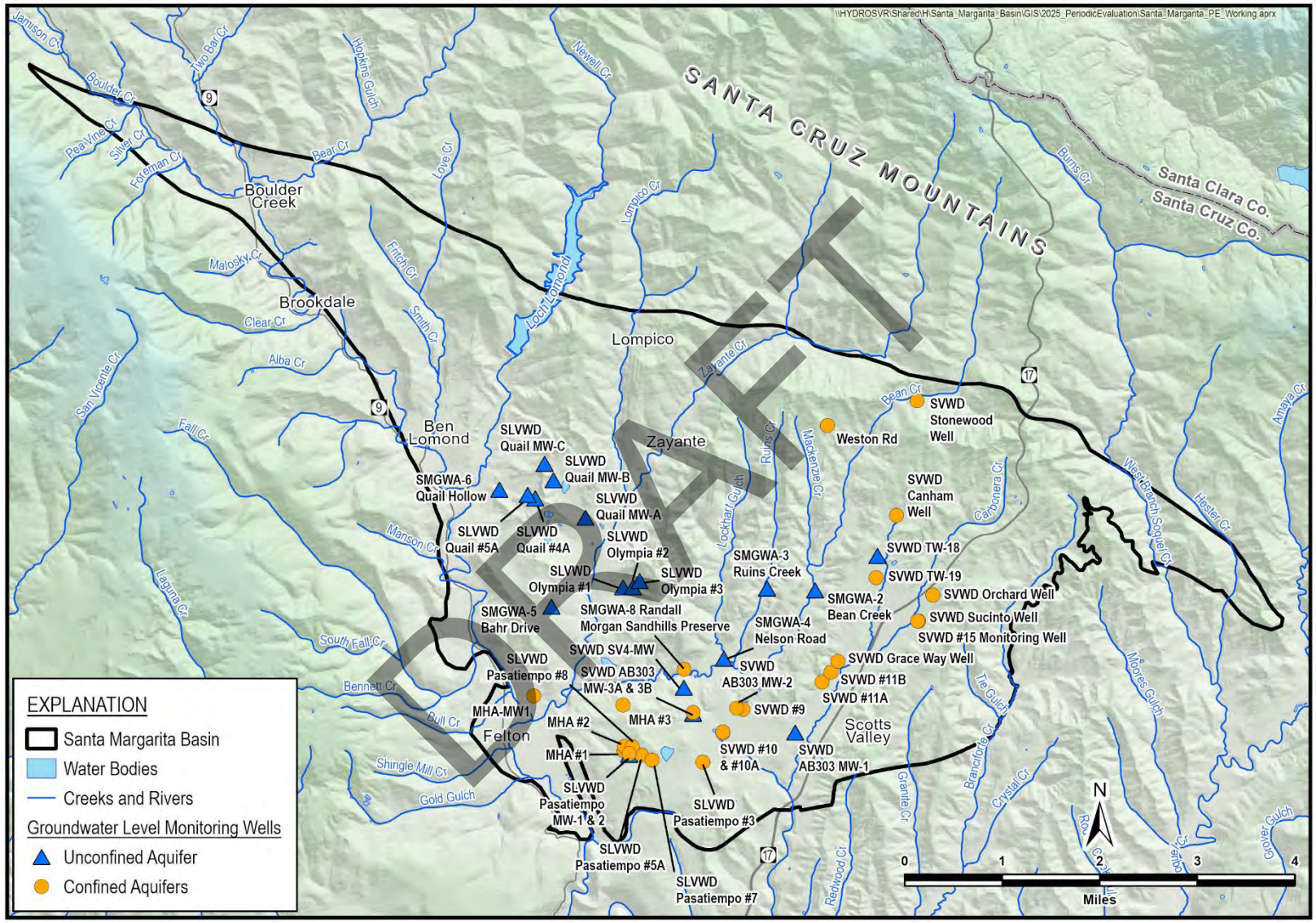

Figure 6-1. Groundwater Level Monitoring Network

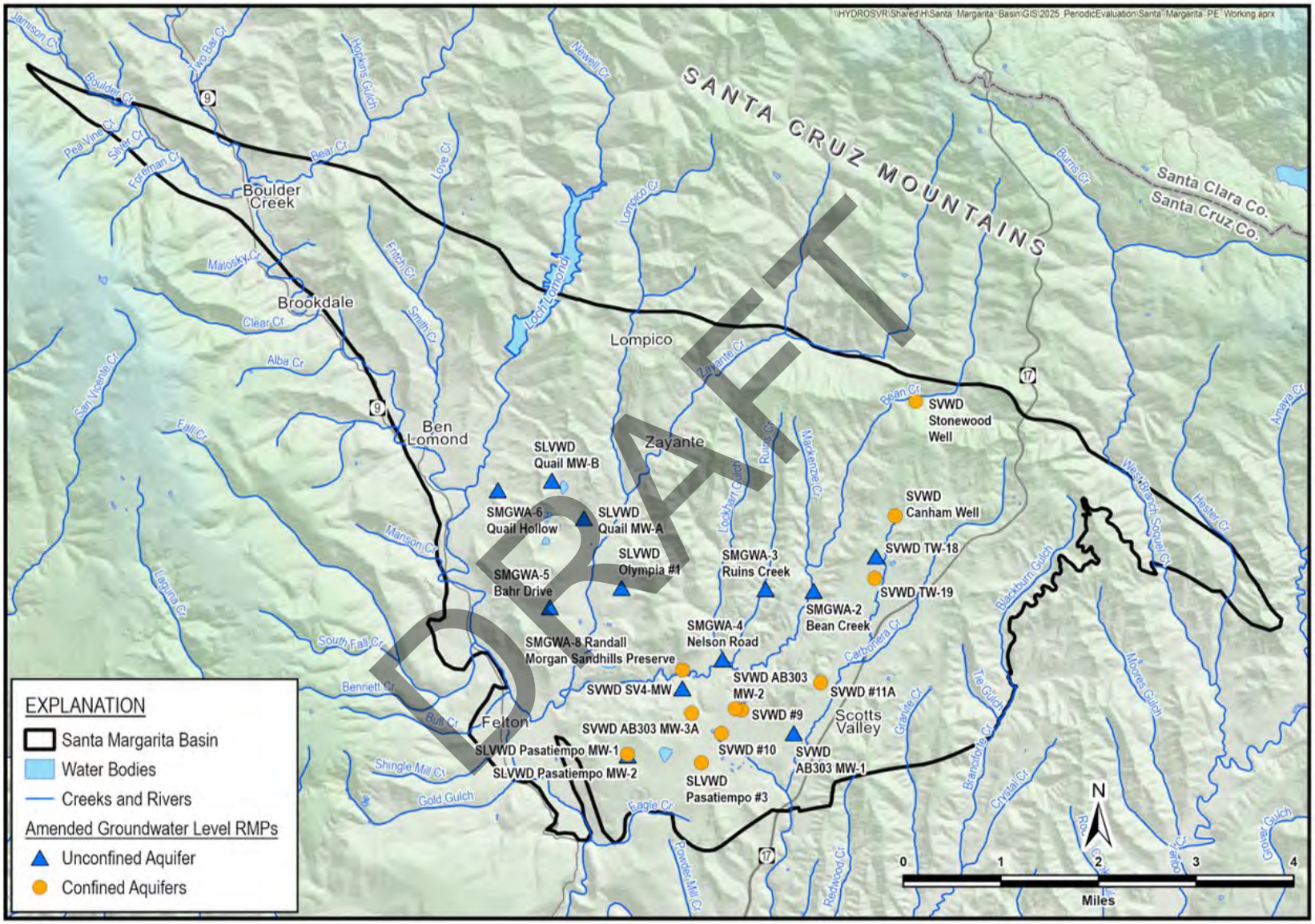

Figure 6-2. Groundwater Level Representative Monitoring Network

6.3 Groundwater Extraction Monitoring

Per GSP regulations, the quantitative metric for reduction of groundwater in storage is an annual volume of groundwater extracted. The volume of groundwater extracted is measured using flow meters where available and estimated where direct measurements are not available. Lower volume private and industrial extraction wells generally do not have flow meters, so assumptions are made about water demand to estimate groundwater extraction. The SMC for reduction of groundwater in storage are an annual extraction volume and the RMPs are all metered and estimated supply wells in the Basin's principal aquifers. The location of the groundwater extraction well monitoring network is shown on Figure 6-3.

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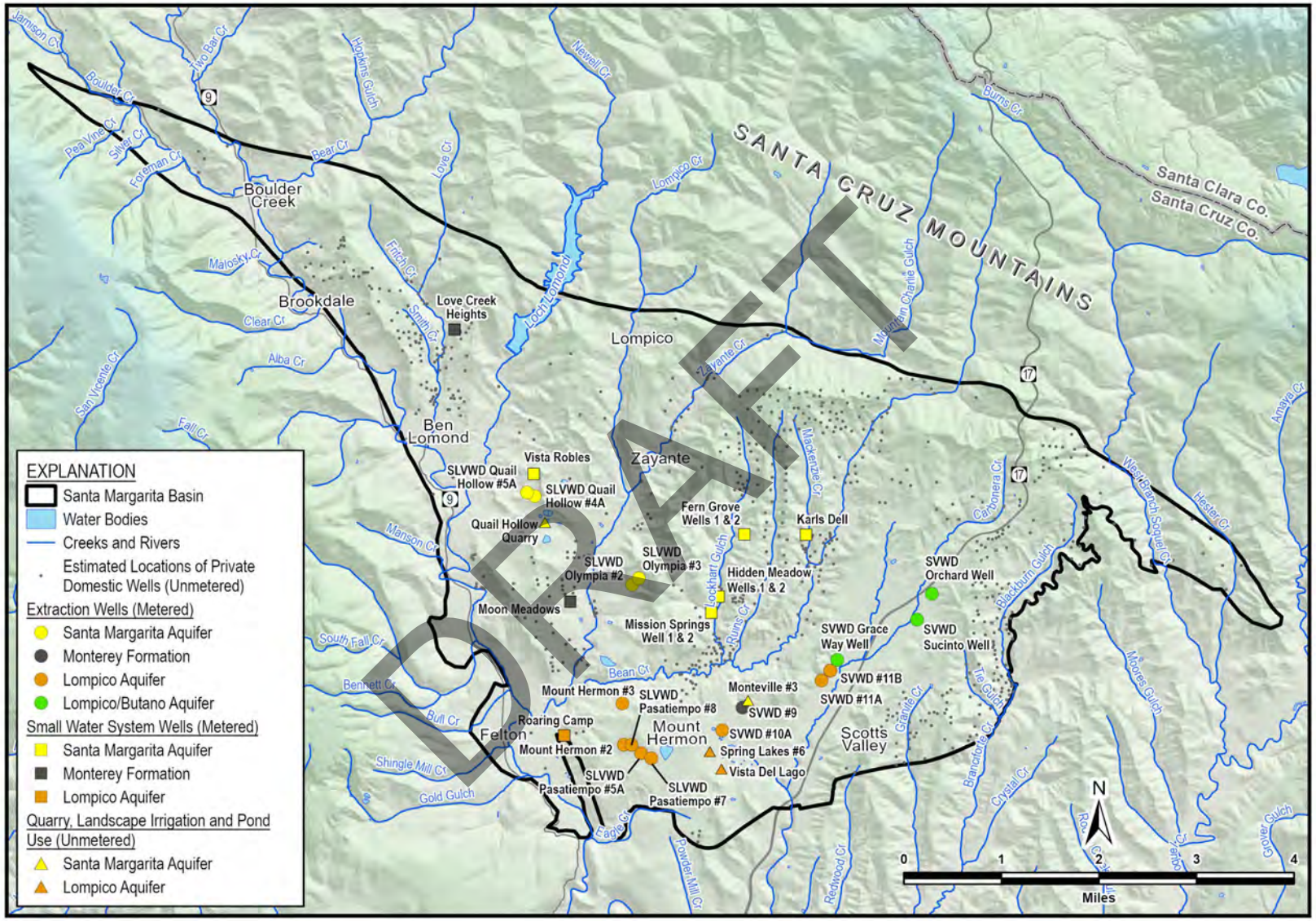

Figure 6-3. Groundwater Extraction Wells in the Reduction in Storage Representative Monitoring Network

6.3.1 Metered Groundwater Extraction

The SLVWD, SVWD, and MHA measure monthly extraction by individual well using totalizer meter readings. Public SWS with between 5 and 199 connections are required to measure and report monthly extraction data to SCEH. Annual metered extraction is about 2,100 AF between WY2021 and 2025. Table 6-3 lists the extraction wells that are metered. All monthly metered extraction data is stored in the DMS.

Table 6-3. Metered Extraction Wells

Aquifer	Well Name
Santa Margarita	SLVWD Quail Hollow #4A
	SLVWD Quail Hollow #5A
	SLVWD Olympia #2
	SLVWD Olympia #3
	Fernbrook Woods Mutual Water Company
	Fern Grove Water Club
	Hidden Meadows Mutual Water Company
	Karl's Dell
	Mission Springs Conference Center Well
	Vista Robles Association
Monterey	Love Creek Heights Mutual Water Association
	Moon Meadows Water Company
Lompico	SLVWD Pasatiempo #5A
	SLVWD Pasatiempo #7
	SLVWD Pasatiempo #8
	SVWD #10A
	SVWD #11A
	SVWD #11B
	Mount Hermon #2
	Mount Hermon #3
	Roaring Camp
Lompico/Butano	SVWD Grace Way (added since 2022 GSP)
	SVWD Orchard Well
	SVWD Sucinto (added since 2022 GSP)

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6.3.2 Unmetered Groundwater Extraction

Unmetered groundwater extraction includes private domestic, irrigation, landscaping, and industrial water uses. Estimated groundwater extraction volumes are not included in the DMS as

the data are not measured. Instead, estimated extraction data are compiled and reported in water use tables as part of annual reporting.

Private pumping is dispersed throughout the Basin in residential areas not served by public water systems. Approximately 777 residences in the Basin are considered *de minimis* users, a term the SGMA legislation defines as "a person who extracts, for domestic purposes, 2 AF or less per year." Under SGMA, *de minimis* groundwater pumping (less than 2 AFY) is exempt from metering. This exemption, however, does not relieve *de minimis* pumpers of responsibility for addressing the impacts they may have on the Basin, including cumulative impacts. The volume of water extracted for domestic use is estimated based on the number of rural parcels with domestic wells, approximate population counts for people using domestic wells for water supply, and per connection water use estimates from small water systems and individual households that are metered. Collective pumping from *de minimis* wells for domestic supply is estimated to be around 233 AFY, which is approximately 8% of extraction from the Basin.

Similar to domestic pumping, industrial groundwater extraction at Quail Hollow Quarry and irrigation by several non-*de minimis* private pumpers is currently unmetered and estimated based on SMGWA staff outreach and communication with well owners. Unmetered non-*de minimis* pumping is approximately 92 AFY. SMGWA has not established a metering program for non-*de minimis* users who pump more than 2 AFY. The number, location, and volume of industrial, pond filling, agricultural, and landscape irrigation by non-*de minimis* pumpers is relatively well understood.

6.4 Groundwater Quality Monitoring Network

Routine groundwater quality monitoring is performed by public water agencies and SWS with 15 or more connections to comply with drinking water regulations. There are 21 GSP monitoring network wells summarized in Table 6-4 and shown on Figure 6-4. Groundwater quality RMPs are SLVWD and SVWD extraction wells, which extract about 75% of the groundwater in the Basin. These wells are representative as they are distributed throughout the Basin and principal aquifers where most groundwater is extracted and are routinely sampled for groundwater quality COCs to comply with state drinking water regulations. The 13 RMP wells are listed in Table 6-5 and shown on Figure 6-5. SWS with 15 or more connections are not RMPs as they extract a relatively small volume of groundwater compared to SLVWD and SVWD wells and are not required to annually test drinking water quality. Available data from these SWS monitoring network wells are publicly available and will be reviewed as part of Annual Reports to ensure that groundwater quality degradation is not occurring.

Private domestic wells and SWS with 5 to 14 connections are not included in the GSP monitoring network because they are not sampled routinely. For all newly constructed domestic wells, SCEH requires testing of nitrate and bacteria (Total Coliform and E. Coli) to demonstrate

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the water is a safe drinking water source, as described in Section 4.4.2. After initial sampling, there are no sampling requirements for domestic wells and limited and sporadic requirements for SWS with fewer than 15 connections. Data for domestic and SWS wells are reported to SCEH. Domestic wells and SWS with fewer than 15 connections are not included in the groundwater quality monitoring network, though the SMGWA has options for incorporating these limited data, if available and needed to expand spatial coverage. For example, the SMGWA could partner with SCEH on the following 2 county domestic well programs to obtain groundwater quality data:

- Free well water testing program for private well owners
- Required point-of-sale well testing required when a property relying on a domestic well is sold

Table 6-4. Groundwater Quality Monitoring Network Wells by System

Public Water Supply System	Extraction Wells	RMPs
San Lorenzo Valley Water District	7	7
Scotts Valley Water District	6	6
Mount Hermon Association	2	0
Fern Grove Club	2	0
Hidden Meadows Mutual Water Co.	1	0
Mission Springs Conference Center	2	0
Vista Robles Association	1	0
Total	*21*	*13*

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Table 6-5. Summary of Groundwater Quality Monitoring Network RMPs

Aquifer Group	Aquifer	Well Name
Unconfined	Santa Margarita	SLVWD Quail #4A
	Santa Margarita	SLVWD Quail #5A
	Santa Margarita	SLVWD Olympia #2
	Santa Margarita	SLVWD Olympia #3
Confined	Lompico	SLVWD Pasatiempo #5A
	Lompico	SLVWD Pasatiempo #7
	Lompico	SLVWD Pasatiempo #8
	Lompico	SVWD #10A
	Lompico	SVWD #11A
	Lompico	SVWD #11B
	Lompico/ Butano	SVWD Orchard
	Lompico/ Butano	SVWD Sucinto
	Lompico/ Butano	SVWD Grace Way

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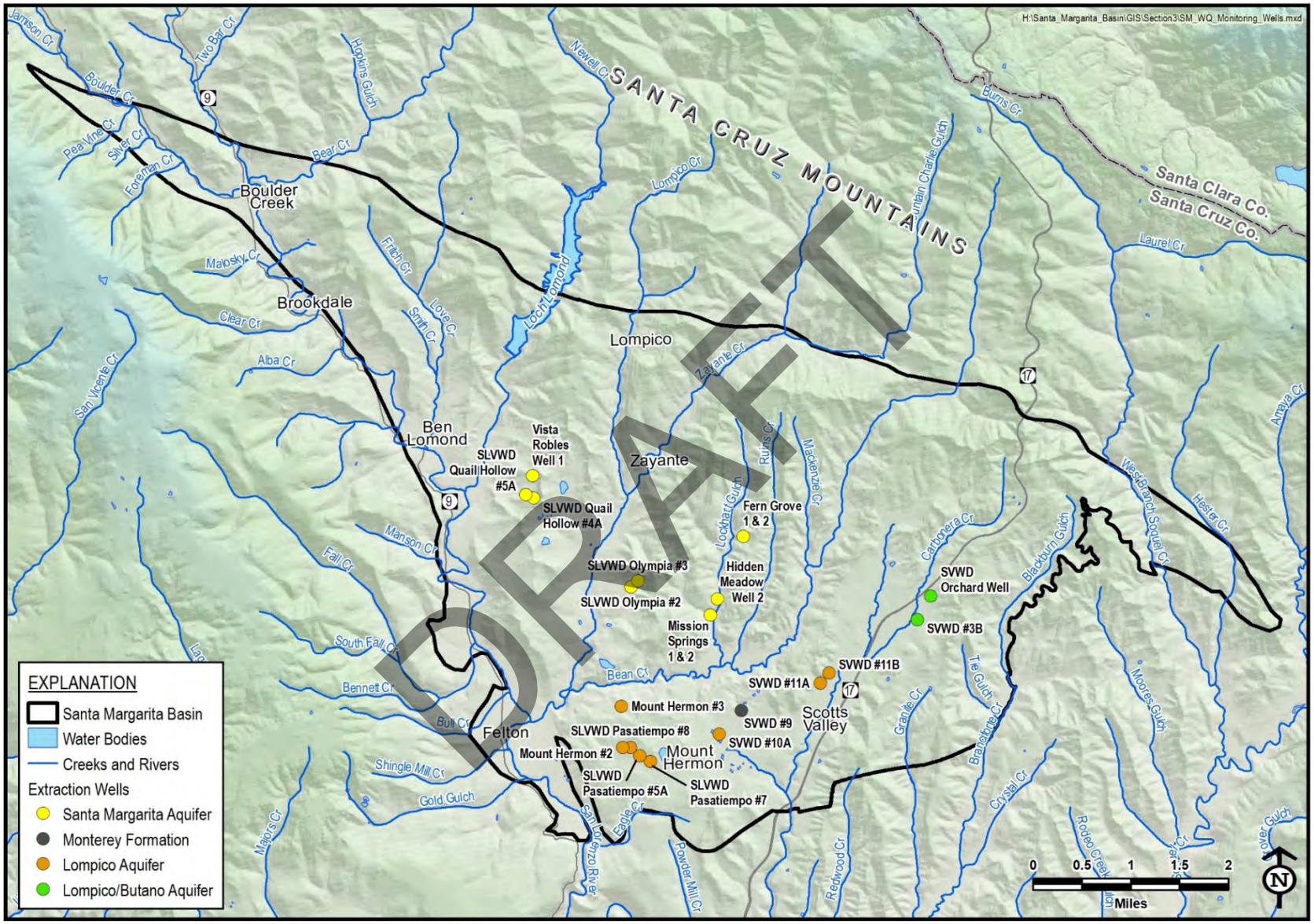

Figure 6-4. Groundwater Quality Monitoring Network

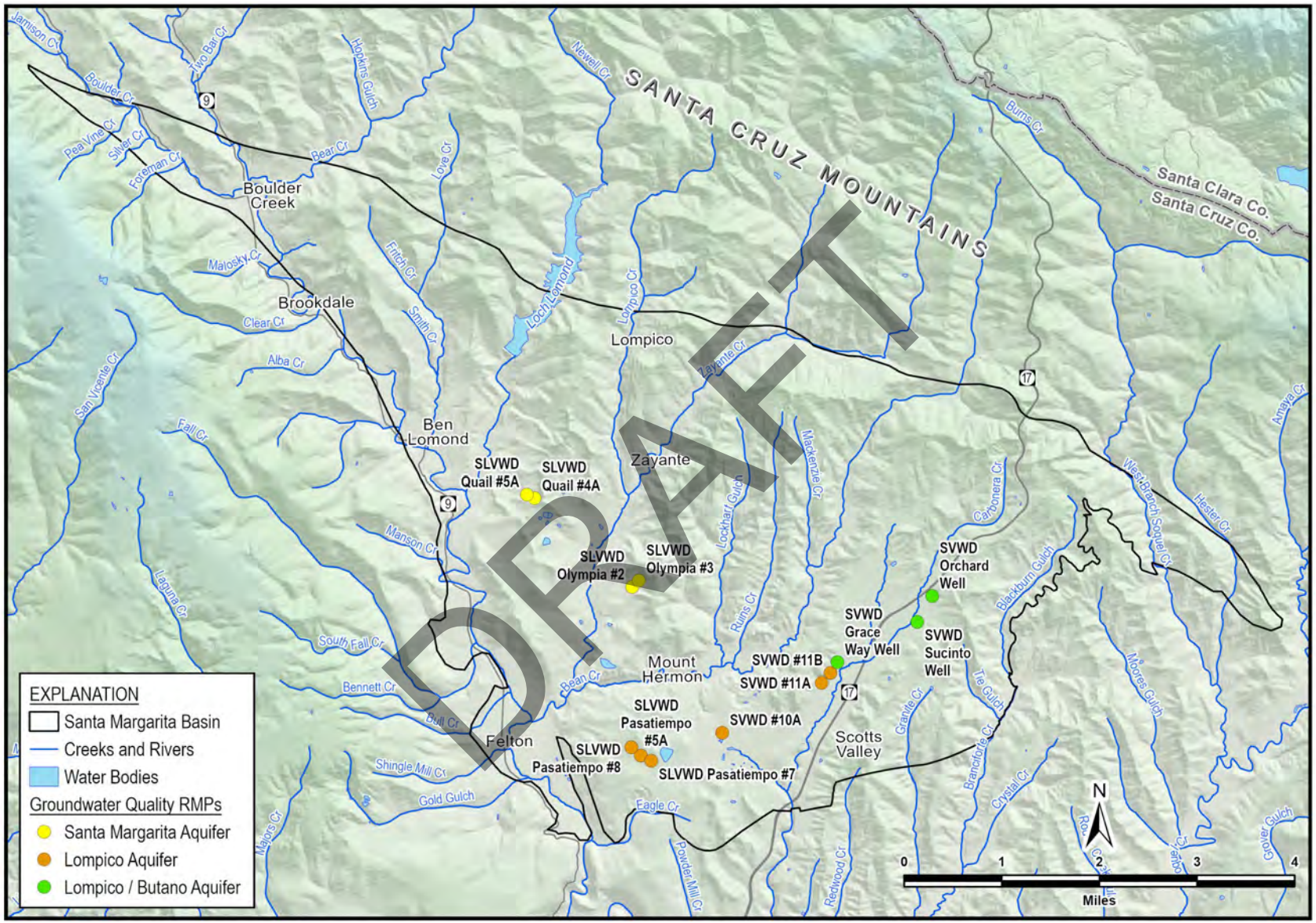

Figure 6-5. Groundwater Quality Representative Monitoring Network

6.5 Depletion of Interconnected Surface Water Monitoring

Depletion of interconnected surface water is monitored using groundwater levels as a proxy, so the same RMP monitoring network described in Section 6.2 above is being used. Streamflow measurements cannot be used to directly monitor depletion due to groundwater extraction because extraction accounts for a fraction of all other factors influencing streamflow, such as precipitation, runoff, evapotranspiration, diversions, and other natural groundwater and surface water interactions that are unrelated to groundwater extraction. The GSP regulations allow for the use of groundwater elevations as a proxy for assessing the volume or rate of surface water depletion SMC if there is significant correlation between these conditions in the Basin. The correlation is demonstrated in Section 4.6.5.

In addition to using groundwater levels as a proxy, SMGWA will use the groundwater extraction SMC network for monitoring of interconnected surface water. This will help isolate the potential effects from groundwater extraction on depletion of interconnected surface water despite the many other factors influencing streamflow described above. By maintaining groundwater extraction below what it was prior to SGMA, the effects on stream depletions would be less than in the pre-SGMA period.

6.6 Other Monitoring Networks

Other monitoring networks support groundwater conditions analysis and GSP reporting but are not directly tied to SMC. Monitoring networks that collect streamflow, vegetation health, land surface elevation, and climate data supplement the sustainability indicator representative monitoring networks used to evaluate sustainability.

6.6.1 Streamflow Monitoring Network

Stream stage and discharge monitoring supplements the depletion of interconnected surface water monitoring performed using groundwater levels and extraction as a proxy. Stream discharge data is also used to calibrate the Basin Model. Streamflow monitoring gages are located throughout the Basin, especially in the southern portion, where tributaries consolidate into the larger stream reaches and groundwater and surface water interactions occur due to aquifers exposed at the ground surface. The stream gage network is summarized in Table 6-6 and shown on Figure 6-6. Recently inactivated gages are included on Figure 6-6 and Table 6-6 for reference.

The primary streamflow monitoring point in the Basin is the Big Trees Gage on the San Lorenzo River (streamflow gage No. 11160500, San Lorenzo River at Big Trees). This gage is maintained and operated by the USGS with funding from the City of Santa Cruz. The gage measures San Lorenzo River stage and discharge leaving the Basin and thus captures surface water flow in the

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tributaries throughout the Basin that feed into the San Lorenzo River. Annual discharge at the gage is used to classify the water year type for GSP reporting using a local water year classification system originally developed by the City of Santa Cruz. The classification system is no longer used by the city, but it is used in the GSP for consistency with past classification practices.

There are 7 other stream gages in the Basin that are funded and maintained by the City of Santa Cruz and the County. These gages measure stage and discharge on various tributaries and upstream reaches of Big Trees on the San Lorenzo River. The USGS and City of Santa Cruz stream gages are measured throughout the year and the County stream gages are typically operational during the seasonal baseflow period (approximately May to November) to record flow during the driest time of year.

Past accretion studies were instrumental in understanding the surface water-groundwater relationship in the Basin. Beginning in 2017, Balance Hydrologics conducted annual late-season stream observation walks ("accretion runs"), where flow, nitrate, and specific conductance were measured at locations shown on

Figure 6-6 along the San Lorenzo River and its tributaries. Measurements were collected along the reach from Felton up through Boulder Creek. The goal of the accretion study was to improve understanding of the surface water and groundwater interactions within the Basin. As part of the GSP process, sites along Zayante Creek, Lompico Creek, and Bean Creek were added to the accretion runs in the summer of 2019. Most of the added sites were focused along Bean Creek and its tributaries. During the summer and fall of 2019, 3 separate accretion runs (May, July, and September) were conducted on the San Lorenzo River, Lompico Creek, Zayante Creek, Bean Creek, and Eagle Creek. Measurements were collected at all sites over a period of 1 to 2 days for each run. The number of accretion runs was increased during 2019 to capture the changes in flow during the dry-season recession and to aid in understanding the surface-water groundwater interactions within the Basin.

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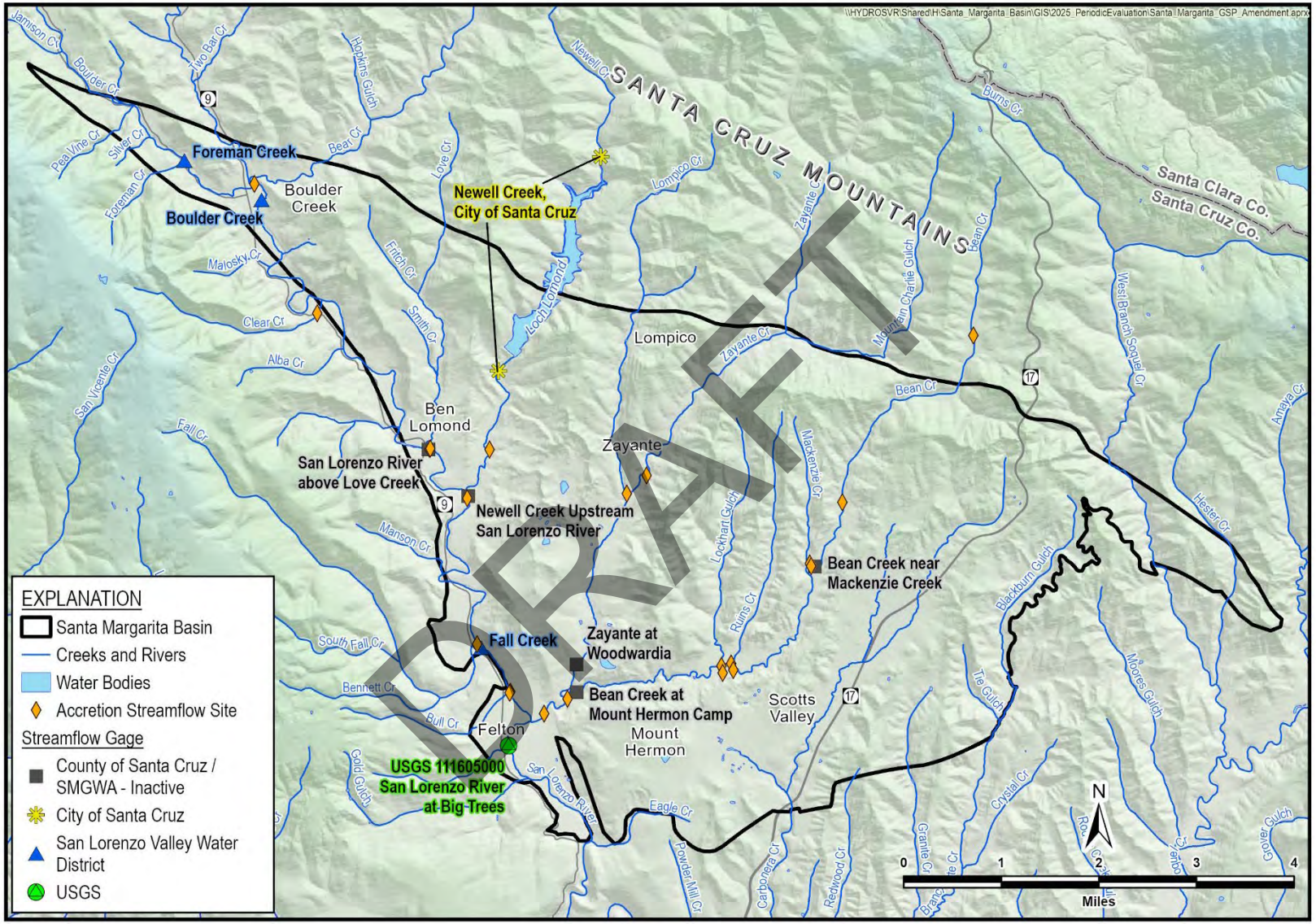

Figure 6-6. Location of Streamflow Gages and Surface Water Quality Monitoring Sites

Table 6-6. Streamflow Gages, Status, and Use

Monitoring Agency	Streamflow Gage Name	Status	Parameters Measured	Frequency Measured
USGS	USGS 11160500 San Lorenzo River at Big Trees	Active	Streamflow	15 minutes
City of Santa Cruz	Newell Creek below Loch Lomond	Active	Streamflow	Daily
	Newell Creek above Loch Lomond	Active	Streamflow	Daily
San Lorenzo Valley Water District	Fall Creek	Active	Streamflow, Temperature	Approximately monthly year-round
	Boulder Creek	Active	Streamflow, Temperature	Approximately monthly during seasonal baseflow
	Foreman Creek	Active	Streamflow, Temperature	Approximately monthly during seasonal baseflow
County of Santa Cruz through 2021 SMGWA 2022 through 2025	San Lorenzo River above Love Creek	Inactive	Streamflow, Specific Conductance, Temperature	Approximately monthly during seasonal baseflow
	Newell Creek upstream of San Lorenzo River	Inactive	Streamflow, Specific Conductance, Temperature	Approximately monthly during seasonal baseflow
	Zayante at Woodwardia	Inactive	Streamflow, Specific Conductance, Temperature	Approximately monthly during seasonal baseflow
	Bean Creek at Mount Hermon Camp	Inactive	Streamflow, Specific Conductance, Temperature	Approximately monthly during seasonal baseflow
	Bean Creek near Mackenzie Creek	Inactive	Streamflow, Specific Conductance, Temperature	Approximately monthly during seasonal baseflow

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6.6.2 Groundwater Dependent Ecosystem Monitoring

SMGWA uses GDE monitoring to collect information on changes to GDE health during GSP implementation. GDE health is evaluated at least every 5 years using satellite-derived vegetation index mapping. GDEs in the Basin support many different species, some of which are listed as priority species by the federal Endangered Species Act. Section 2.4.1.8 describes ecological beneficial users of groundwater including other priority species that may be found within the Basin. GDE health is evaluated alongside data collected by groundwater level, interconnected surface water (ISW) depletion, streamflow, and climate monitoring networks described in Sections 6.2, 6.5, 6.6.1, and 6.6.4, respectively, to determine if groundwater use is impacting GDEs.

Representative GDE monitoring sites are selected based on their proximity to pumping areas, the underlying geology, and inferred or modeled stream connectivity with groundwater (Table 6-7 and Figure 6-7).

Table 6-7. Groundwater Dependent Ecosystem Representative Monitoring Sites

Site	GDE Types	Selection Rationale
Quail Hollow	Springs, Open Water, and Other Groundwater-Supported Wetlands	Near SLVWD pumping in Santa Margarita aquifer
Zayante Creek south of Quail Hollow	Springs, Riverine and Riparian	Near SLVWD and private pumping, near contact between Santa Margarita aquifer and Monterey Formation
Redwood and Ferndell Springs	Springs	Near Mount Hermon Association pumping, springs are in the Santa Margarita aquifer
Eagle Creek Springs	Springs	At southern extent of Basin, springs are in the Santa Margarita aquifer
San Lorenzo River, Zayante Creek, and Bean Creek	Riverine and Riparian	Primary streams connected to groundwater, with nearby municipal and private pumping wells

The vegetation index mapping uses publicly available datasets such as The Nature Conservancy's GDE Pulse Webmap and open access processing tools such as Google Earth Engine, thereby making it a cost-effective indicator to monitor. The common vegetation health indices include Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), and Normalized Difference Moisture Index (NDMI)[3,4].

[3]https://www.usgs.gov/core-science-systems/nli/landsat/landsat-enhanced-vegetation-index?qt-science_support_page_related_con=0#qt-science_support_page_related_con
[4] https://gde.codefornature.org/#/methodology

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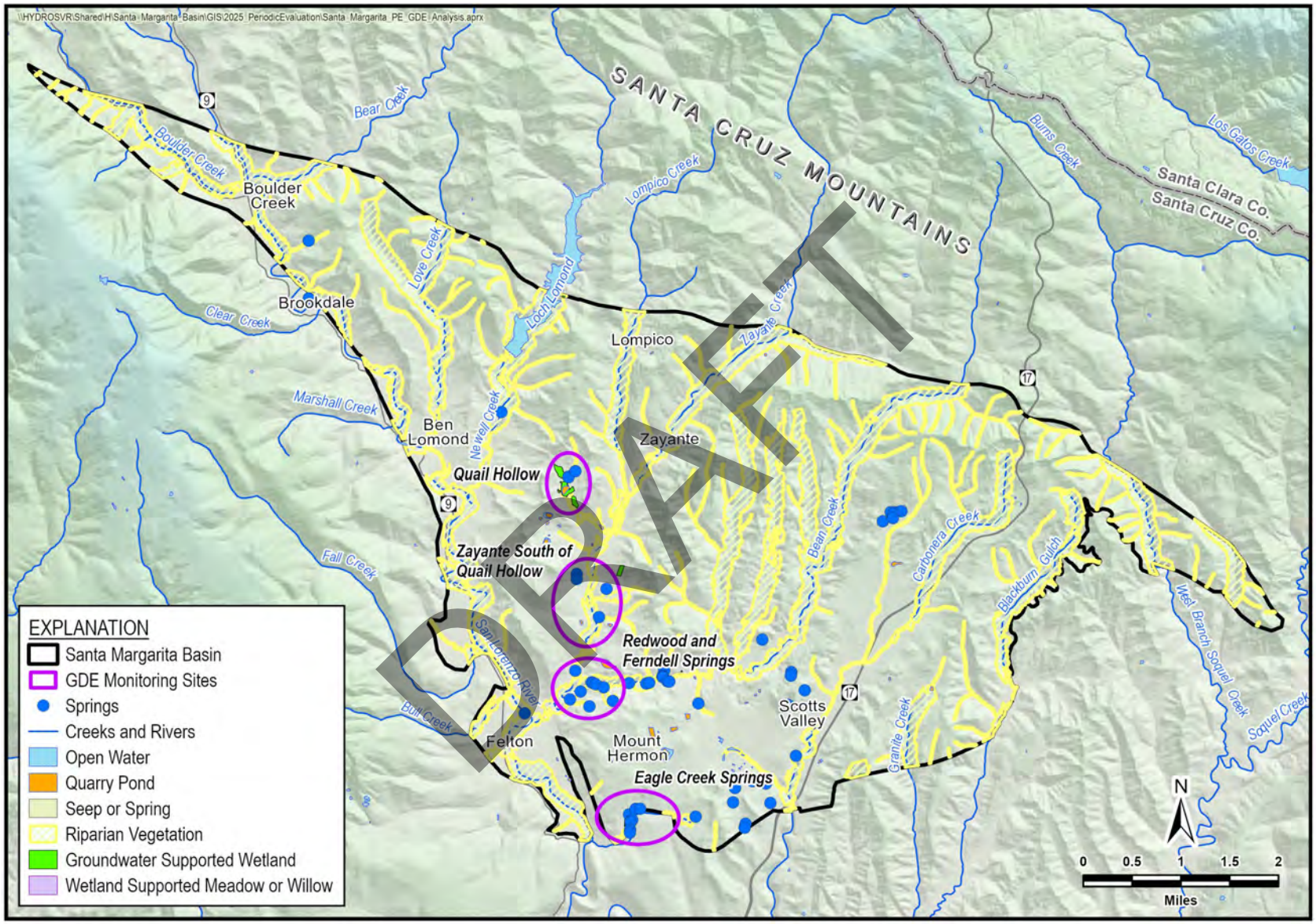

Figure 6-7. Location of Groundwater Dependent Ecosystem Monitoring Sites

Ongoing habitat studies, conducted by the County, SLVWD, and the City of Santa Cruz, will assist in GDE data interpretation by providing additional information on the anticipated biological responses to surface water fluctuations and variability in GDE conditions. The Santa Cruz County Juvenile Steelhead and Stream Habitat Monitoring Program, a multi-agency partnership, has measured steelhead population density at more than 40 sites throughout the San Lorenzo, Soquel, Aptos, and Pajaro watersheds since 1989. Additionally, the County occasionally monitors riparian vegetation using the Riparian Rapid Assessment Method, a monitoring method developed by the Central Coast Wetlands Group to assess physical and biological complexity, and to infer ecological functioning and benefits (City of Santa Cruz Water Department *et al*., 2018). Data from these monitoring programs are anticipated to generally inform the SMGWA's ongoing consideration of potential groundwater management impacts to GDEs.

6.6.3 Subsidence Monitoring

Land subsidence is not an applicable indicator of sustainability in the Basin and land surface elevations within the Basin have not been historically monitored nor are there plans to conduct such monitoring in the future. The DWR-funded vertical displacement spatial data from InSAR, described in Section 2.2.5.5, will be reviewed as part of each GSP Periodic Evaluation to confirm that subsidence is not occurring. In the analysis of the InSAR dataset, it will be important to distinguish between land elevation changes resulting from tectonic deformation due to the proximity of active faults and land elevation changes from land subsidence caused by groundwater extraction. It will also be important to take into account small seasonal elevation changes that can result from changing moisture levels in expanding soils, and to acknowledge the intrinsic precision of the measurements can result in small calculated changes that do not reflect actual surface movement. If inelastic or permanent land subsidence from groundwater extraction is found to be occurring, it will trigger the need for dedicated subsidence monitoring.

6.6.4 Climate Monitoring

Precipitation and temperature data are collected by the Basin's 2 municipal water agencies using their own weather stations. SLVWD has a weather station in Boulder Creek and SVWD has a weather station in Scotts Valley. Climate stations are summarized in Table 6-8 and their locations are provided on Figure 3-3.

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Table 6-8. Climate Stations in the Santa Margarita Basin

Monitoring Entity	Station Name	Parameters
San Lorenzo Valley Water District	Boulder Creek	Daily precipitation, daily minimum, maximum, and average temperature
Scotts Valley Water District	El Pueblo Yard	Daily precipitation, daily minimum, maximum, and average temperature

6.7 Monitoring Protocols

County and SMGWA member agency staff collect groundwater data in the Basin using reliable and effective data collection protocols. Use of standard monitoring protocols ensures data are consistently collected, thereby increasing the reliability of data used to evaluate GSP implementation. There are 5 types of data collected for GSP implementation: groundwater level, groundwater quality, streamflow, groundwater extraction volume, and climate conditions.

6.7.1 Groundwater Level Measurement Protocols

Groundwater level monitoring is conducted to evaluate Basin conditions relative to the SMC for chronic lowering of groundwater levels and depletion of interconnected surface water, as shown in Table 6-1. SMGWA member agencies collect both hand soundings and pressure transducer records, which are stored in a regional DMS managed by the County. All monitoring data uploaded to the DMS is analyzed, compared to SMC, and included on hydrographs in the GSP Annual Reports. The DMS is described in more detail in Section 6.8. Groundwater levels in some wells are measured and recorded at least daily using pressure transducers with dataloggers. Groundwater level measurement in wells without dataloggers are collected monthly in most wells and at least semi-annually as required by GSP Regulations.

All groundwater level measurements are referenced to a consistent elevation datum, known as the Reference Point (RP). For monitoring wells, the RP is typically a mark on the top of the well casing. For extraction wells, the RP is typically the top of the well's concrete pedestal. Per GSP regulations, the elevation of the RP of each well is to be surveyed to the North American Vertical Datum of 1988 (NAVD 88). Currently, the elevation of the monitoring well RPs is accurate to at least 0.5 foot.

Groundwater level measurements are taken to the nearest 0.01 foot relative to the RP using procedures appropriate for the measuring device. Groundwater elevation is calculated using the following equation:

$$GWE = RPE - DTW$$

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where:

GWE = groundwater elevation

RPE = reference point elevation

DTW = depth to water

In cases where the official RPE is a concrete pedestal, but the hand soundings are referenced off the top of a sounding tube, the measured DTW is adjusted by subtracting the sounding tube offset from the top of the pedestal.

All groundwater level measurements include a record of the date, well identifier, time (in 24-hour format), RPE, DTW, GWE, and comments regarding factors which may influence the recorded measurement such as nearby extraction wells pumping, weather, flooding, or well condition.

6.7.1.1 Manual Groundwater Level Measurement

All manual groundwater level measurements are collected using the following protocols:

- Measurements will be collected using an electronic sounder or steel tape. Electronic sounders consist of a graduated wire equipped with a weighted electric sensor. When the sensor is lowered into water, a circuit is completed and an audible beep is produced, at which point the sampler will record the depth to groundwater. This is the preferred method for monitoring groundwater levels, but other methods may be used. For instance, some extraction wells may have lubricating oil floating on top of the groundwater column; oil and groundwater levels in these wells will be gaged with an oil water interface probe or steel tape with oil and water indicator paste. Equipment usage will follow manufacturer specifications for procedure and maintenance.
- In wells that have been subject to recent pumping, a measurement will be taken after pumping has ceased and the water level has recovered to a stable level. If a well pump cannot be turned off during the scheduled monitoring event, then a measurement will be collected if possible, and accompanied by an explanatory note.
- For each well, multiple measurements will be collected to ensure the well has reached equilibrium such that no significant changes in groundwater level are observed.
- Equipment will be thoroughly cleaned after measurements at each well location in order to prevent cross-contamination among wells.
- The groundwater level measurement will be collected from a permanent reference mark. If a well is found to not have a permanent reference mark, one will be made on the north side of the casing to ensure subsequent measurements reference the same point.

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6.7.1.2 Groundwater Level Measurement with Continuous Recording Devices

In addition to manual groundwater level measurements, some wells in the Basin are equipped with pressure transducers to collect more frequent data. These include SVWD extraction wells and most monitoring wells. Installation and use of pressure transducers abide by the following protocols:

- In order to calibrate the transducer data, the sampler will use a water level measurement device to measure the current groundwater level prior to installation of the probe. The groundwater level will be measured following the protocols listed above.
- All transducer installations will follow manufacturer specifications for installation and calibration. The time on the transducer internal clock will be synchronized with the computer satellite time.
- The well name, transducer name, transducer range, transducer accuracy, and cable serial number will be recorded in any log or datasheet used to document measurements.
- The sampler will note whether the pressure transducer uses a vented or non-vented cable for barometric compensation. If non-vented units are used, data will be corrected for natural barometric pressure changes using a barometric pressure logger or if unavailable, weather station data.
- All transducer cables will be secured to the well head with a well dock or another reliable method. This cable will be marked at the elevation of the reference point to allow estimates of future cable slippage as needed.
- Transducer data will be periodically checked against manually measured groundwater levels to identify electronic drift, cable movement, and transducer failure. These checks will occur at least annually, typically during routine site visits.
- Transducer data will be downloaded when water levels are measured. Transducer data will be entered into the regional DMS as soon as possible. Once the transducer data has been successfully downloaded and stored, the data will be deleted or overwritten to ensure adequate datalogger memory.
- Desiccant for vented transducers will be replaced as needed, or at least annually, in order to prevent failure of the transducers. Non-vented transducers are preferred for this reason as they do not require routine maintenance.

6.7.2 Groundwater Quality Monitoring Protocols

Groundwater quality monitoring in the Basin relies on existing sampling programs. All public water supply agencies and SWS are responsible by California regulations for sampling and testing groundwater used for drinking water supply. While specific groundwater sampling

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protocols vary depending on the constituent and the hydrogeologic context, the protocols contained herein provide guidance which is applied to all groundwater quality sampling:

- All groundwater quality analyses will be performed by laboratories certified under the State Environmental Laboratory Accreditation Program.
- Prior to sampling, the sampler will contact the laboratory(s) to schedule sample analysis, obtain appropriate sample containers, and clarify any sample holding times or sample preservation requirements. Laboratory(s) must be able to provide a calibration curve for the desired analyte and are instructed to use reporting limits equal to or less than the applicable data quality objectives, regional water quality objectives, or screening levels.
- Each well used for groundwater quality monitoring will have a unique identifier (ID). This ID will be written on the well housing or the well casing (if not there already) to avoid confusion.
- Sample containers will be labeled prior to sample collection if possible. The sample label will include the sample ID, sample date and time, sample personnel, sample location, preservative used, analyte, and analytical method.
- Prior to any sampling, the sampler will clean the sampling port and/or sampling equipment so that it is free of any contaminants and also decontaminate sampling equipment between sampling locations to avoid cross-contamination between samples. Cleaning should be conducted using a phosphate-free detergent, such as Alconox® or Liquinox®, followed by a rinse with distilled, deionized, or purified water.
- In the case of wells with dedicated pumps, samples will be collected at or near the wellhead. Samples will not be collected from storage tanks, at the end of long pipe runs, or after any water treatment. Samples from active extraction wells that are continuously purging may be collected after flushing the sample tap.
- Should monitoring well or inactive extraction well sampling be required, sampling should follow either low-flow or 3 well casing volume sampling methods. Low-flow sampling consists of purging at a low rate less than 0.13 gallons per minute and measuring water quality parameters until they stabilize within a specific range. Low-flow sampling is best suited for wells with short well screens less than 20 feet in length. Three well casing volume sampling will consist of purging 3 standing volumes of water from the well to ensure that the groundwater sample is representative of ambient groundwater and not stagnant water in the well casing. If pumping causes a well to go dry, the condition will be documented, and the well will be allowed to recover to within 90% of the original level prior to sampling. For deep and large casing diameter wells, purging 3 well volumes may not always be applicable, so professional judgment will be practiced for purging and sampling.

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- For low-flow and 3 well casing volume sampling protocols, field parameters including dissolved oxygen, electrical conductivity, temperature, oxidation reduction potential and pH may be collected during well purging. Samples should not be collected until these parameters stabilize. Parameters will be considered stabilized at the following ranges for 10 to 15 minutes: dissolved oxygen and oxidation reduction potential, ±10%; temperature and electrical conductivity, ±3%; and pH ±0.2%.
- All field instruments will be calibrated each day of use, cleaned between samples, and evaluated for drift throughout the day of use.
- Samples will be collected under laminar flow conditions if possible (i.e., without turbulence and bubbles). This may require reducing pumping rates prior to sample collection. For extraction wells, purging at laminar flow rates is not always an option, so professional judgment will be practiced.
- All samples requiring preservation will be preserved as soon as practically possible and filtered appropriately as recommended for the specific constituent.
- Samples will be chilled and maintained at 4 °C to prevent degradation of the sample prior to analysis.
- Samples must be promptly shipped or delivered in person to the appropriate laboratory to avoid exceeding holding times. The sampler will be responsible for providing proper chain of custody documentation for sample delivery.

6.7.3 Groundwater Extraction Measurement Protocols

Groundwater extraction volumes are collected to provide data for water demand operations, wellfield management, and estimate extraction relative to the groundwater in storage SMC. Municipal SMGWA member agencies measure discharge from their individual extraction wells with calibrated flow meters and totalizers. SVWD and SLVWD also use SCADA systems to monitor and control extraction from individual wells in close to real time. Small water systems report monthly extractions to the County of Santa Cruz on an annual basis. The volume of water extracted for private use is estimated as discussed in Section 6.3.1.

6.7.4 Other Monitoring Protocols

Other monitoring protocols only apply to streamflow measurements, as monitoring of GDEs and subsidence are satellite-based methods and the climate monitoring is performed by SVWD and SLVWD using established weather stations.

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6.7.4.1 Stream Gage Measurements

Stream stage and discharge measurements are collected by SMGWA cooperating agencies to monitor streamflow interaction related to groundwater extractions, monitor stream conditions related to fish habitat, and help preserve other beneficial uses of surface water. The Big Trees gage on the San Lorenzo is operated and monitored by the USGS according to procedures outlined by USGS (1982).

Surface water is most easily measured using a stream gage and stilling well system, which requires development of a ratings curve between stream stage and total discharge. Several measurements of discharge at a variety of stream stages are taken to develop an accurate ratings curve. This relationship is sometimes developed with assistance from Acoustic Doppler Current Profilers. Following development of an accurate ratings curve, streamflow is evaluated on a frequent basis using a stilling well and pressure transducer.

The following stream gage monitoring protocols will be followed:

- Streamflow gages within the basin are equipped with a staff plate and pressure transducer(s), housed in a stilling well.
- Most of the gages are equipped with non-vented pressure transducers, which measure pressure, temperature, and specific conductance and are usually set to log at 15-minute intervals. All transducer installations follow manufacturer specifications for installation, calibration, data logging intervals, battery life, and anticipated life expectancy. Non-vented pressure transducers are properly corrected for natural barometric pressure changes. See Section 6.7.1.2 for pressure transducer installation protocol.
- Streamflow measurements are regularly made at gaging locations following the methods established by the Federal Interagency Sedimentation Program. All field measurements are documented by date in station observers' logs, which are included with data submittals.
- Streamflow velocities are measured using a bucket-wheel meter, either a full-size Type AA ("Price"), bucket-wheel current meters, or a 60% scale smaller meter ("pygmy meter"). Flow meters must meet and exceed the required calibration test of that type of meter prior to measuring flow.
- Measurements of streamflow are taken at a variety of stream stages to develop an accurate rating curve, which establishes the relationship between stream stage and total discharge. The rating curve is used to create a continuous record of flow from the record of water depth collected by the pressure transducers.

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6.7.4.2 Stream Accretion

Additional stream accretion monitoring is not currently planned in the Basin; however to ensure consistency with previous accretion studies, any future studies will follow the general protocol described below:

- Streamflow measurements and velocities will be collected per the protocols described in the Section above. To increase accuracy for the accretion studies, 30 or more "verticals," or discrete velocity measurements are typically collected across each stream transect.
- Streamflow velocities are measured using a bucket-wheel meter, either a full-size Type AA ("Price"), bucket-wheel current meters, or a 60% scale smaller meter ("pygmy meter"). For low flow stream discharge (less than 50 gallons per minute), measurements are taken using a bag with graduated cylinder or bucket. Flow from seeps is measured with a bucket and stopwatch or Ziploc bag and graduated cylinder where appropriate.
- Specific conductance is measured in the center of flow in the stream profile with a calibrated specific conductance meter at field temperature and at 25°C.
- Water quality samples, such as nitrate and phosphate, are collected in Polyethylene bottles. Each bottle and cap are triple rinsed at the site before sample collection. Each sampling team will collect at least 1 field duplicate per day. Samples are stored in a cooler with ice and kept at or below 4° C. Samples and the chain-of-custody forms are delivered to a state-certified laboratory at the end of the sampling day.
- All field measurements are documented by date in station observer logs, which are included with data submittals.

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6.8 Data Management System

A regional DMS has been developed to compile and manage the large quantities of data required collected by the SMGWA. The regional DMS is used jointly by the member agencies of the SMGWA and Santa Cruz Mid-County Groundwater Agency (MGA). The DMS platform is WISKI (Water Information Systems by Kisters) developed by KISTERS North America. The costs for development of the DMS were funded with assistance from a Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Sustainable Groundwater Planning Grant Program), administered by DWR. Ongoing maintenance costs will be shared by both GSAs.

Cooperating agencies are required to upload groundwater level data to the DMS twice a year using tools developed by KISTERS for that purpose. These data are required for reporting to the SGMA portal and are also used to report on basin conditions for the Annual Reports required to be submitted to DWR by April 1 of each year following the SMGWA's adoption of the GSP. Each of the submitting agencies are responsible for QA/QC of their data, and barometric compensation and correction of datalogger records prior to upload to the DMS.

6.9 Assessment and Improvement of Monitoring Network

The monitoring networks will continue to be evaluated and refined as conditions change during GSP implementation. The following sections describe recent monitoring network improvements, remaining data gaps, and how networks may be improved in the future.

6.9.1 Groundwater Level Monitoring Improvements

The 2022 GSP identified 9 groundwater level monitoring data gap areas. Eight locations in the Santa Margarita aquifer and Monterey Formation were identified that either support private domestic wells or potential interconnected streams. In addition, because there are only 2 dedicated Butano monitoring wells in the Basin, a ninth well location to be drilled more than 1,000 feet down to the Butano aquifer was identified.

SMGWA received Proposition 68 funding from DWR to address the data gaps. Nine sites were chosen in WY2021, shortly after the 2022 GSP was submitted. In WY2022, SMGWA secured site access and permits for 8 of the sites. SMGWA was unable to find a suitable location for a Monterey Formation monitoring well on Weston Road in the northern concentrated domestic well use portion of the Basin. A Butano aquifer monitoring site was selected but the well could not be drilled due to the cost of drilling to that depth.

In WY2023, SMGWA installed 7 monitoring wells in the Santa Margarita aquifer and Monterey Formation (i.e., SMGWA-2 through -8 shown on Figure 4-46; M&A, 2023). The wells are equipped with dataloggers for frequent groundwater level measurement.

In WY2024, the County of Santa Cruz identified a private domestic well owner in the Weston Road area that will allow County staff to collect semi-annual groundwater level measurements to fill that data gap.

Additional existing monitoring wells were incorporated into the RMP monitoring network that were either not identified or underutilized in the 2022 GSP. SLVWD Pasatiempo #3, SVWD AB303 MW-2 and SVWD AB303 MW-3A were promoted to RMPs because they are completed in principal aquifers, have long-term, reliable groundwater level records, and are representative of Basin groundwater conditions.

The RMP network was also updated to reduce influences from extraction well operations on groundwater level measurements. SLVWD Olympia #3, which was identified as an RMP in the GSP, is an active municipal supply well and is replaced as an RMP with nearby inactive SLVWD Olympia #1, screened in the same aquifer. The Lompico/Butano SVWD #15 monitoring well is too close to 2 SVWD supply wells: the new SVWD Sucinto supply well on the same property and nearby SVWD Orchard well. The monitoring well is no longer an RMP

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because it cannot provide static groundwater data as the nearby supply wells are almost always in service.

SMGWA and/or SVWD still plans to install a deeper Butano aquifer monitoring well to address a data gap identified in the 2022 GSP. On September 26, 2023, SMGWA requested direct assistance from the DWR's TSS program to install this well, but has yet to receive a response on whether this request will be fulfilled.

6.9.2 Groundwater Extraction Monitoring Improvements

During GSP implementation, the SMGWA performed targeted outreach to estimate annual pumping volumes for non-metered non-*de minimis* pumpers, filling a data gap identified in the 2022 GSP. New SVWD water supply wells Grace Way and Sucinto were added for groundwater extraction monitoring. No other improvements were made.

6.9.3 Groundwater Quality Monitoring Improvements

Groundwater quality monitoring only includes public drinking water supply wells that are routinely sampled to comply with state regulations. New SVWD water supply wells Grace Way and Sucinto were added for groundwater quality monitoring. No other improvements were made.

6.9.4 Other Monitoring Improvements

A new gage on Carbonera Creek was installed to fill a data gap identified in the 2022 GSP. This area was identified as likely GDE habitat due to a cluster of springs and wetland habitat. Through additional data collection, SMGWA determined that this area is not likely groundwater dependent as the saturated groundwater level is deep below the root zone in the closest monitoring wells. The springs on this reach of Carbonera Creek are likely supported by the stream as recharge pools and daylights on the surface of the impermeable Monterey Formation. No other streamflow monitoring improvements were made or needed in the Basin.

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7 SUSTAINABLE MANAGEMENT CRITERIA

This section defines the groundwater conditions that constitute sustainable groundwater management, discusses the process by which the SMGWA characterizes undesirable results (URs), identifies the monitoring networks used to assess conditions, and establishes MTs and MOs for each applicable sustainability indicator.

Defining SMC requires significant analysis and scrutiny. This section presents the data and methods used to develop SMC and demonstrates how they influence beneficial uses and users. The SMC are based on currently available data and the application of best available science. As noted in the 2022 GSP, data gaps existed in the HCM related to interconnected surface water that have been partially addressed and are incorporated in the 2027 GSP Amendment.

This section is organized to address all the GSP Regulations regarding SMC. The Sustainability Goal guides development of the SMC and the monitoring networks identified in Section 6 describe the monitoring features used to track progress toward meeting MOs and IMs. To retain an organized approach, the description of the SMCs are grouped by each individual sustainability indicator. Each subsection follows a consistent format that contains the information required by Section §354.22 *et. seq* of the GSP Regulations and outlined in the SMC BMP (DWR, 2017). Each SMC subsection includes a description of how the following SMC were developed:

- Qualitative, locally defined significant and unreasonable conditions
- Quantitative description of undesirable results, including:
    - The criteria defining when and where the effects of the groundwater conditions cause undesirable results based on a quantitative description of the combination of minimum threshold exceedances (§354.26 (b)(2))
    - The potential causes of undesirable results (§354.26 (b)(1))
    - The effects of these undesirable results on the beneficial users and uses (§354.26 (b)(3))
- Quantitative minimum thresholds, including:
    - The information and methodology used to develop minimum thresholds (§354.28 (b)(1))
    - The relationship between minimum thresholds and the relationship of these minimum thresholds to other sustainability indicators (§354.28 (b)(2))
    - The effect of minimum thresholds on neighboring basins (§354.28 (b)(3))
    - The effect of minimum thresholds on beneficial uses and users (§354.28 (b)(4))

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    - How minimum thresholds relate to relevant Federal, State, or local standards (§354.28 (b)(5))
    - The method for quantitatively measuring minimum thresholds (§354.28 (b)(6))
- Quantitative measurable objectives, including:
    - The methodology for setting measurable objectives (§354.30)
    - Interim milestones (§354.30 (a), §354.30 (e), §354.34 (g)(3))

7.1 Sustainability Goal

SMGWA's sustainability goal is to achieve and maintain groundwater conditions that support beneficial uses and users and sustain the long-term health of the Basin's community, economy, and environment.

The sustainability goal will be achieved by the following:

- Monitoring and managing groundwater conditions to meet established sustainable management criteria and striving to achieve measurable objectives to enhance Basin conditions.
- Maintaining groundwater levels sufficient to protect domestic, municipal, agricultural, and industrial supply wells.
- Maintaining groundwater levels that support streamflow and groundwater dependent ecosystems, where applicable.
- Maintaining groundwater quality for current and future beneficial uses.

  Implementing cost-effective adaptive management strategies, including expanding conjunctive use and drought response measures, to enhance drought resilience and long-term supply reliability.

7.2 Process of Developing Sustainable Management Criteria

To evaluate progress toward sustainability, SMC were established for each sustainability indicator in accordance with SGMA requirements. The SMC were selected and approved by the SMGWA Board through an iterative and public process, starting with the 2022 GSP and being reevaluated for the 2027 GSP Amendment. The SMC consist of RMPs, minimum thresholds (MTs), measurable objectives (MOs), interim milestones (IMs), and undesirable results (URs):

- Minimum Threshold (MT): Condition at which significant and unreasonable impacts may occur

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- Measurable Objective (MO): Desired condition that provides operational flexibility above the MT
- Interim Milestones (IM): Incremental targets to achieve the MO by the sustainability horizon
- Undesirable Results (UR): Significant and unreasonable adverse impacts, defined qualitatively and quantified through exceedance of MTs

SMC refinements included in the 2027 GSP Amendment address recommended improvements identified by DWR and SMGWA through implementation of the 2022 GSP. The amended SMC address data gaps, improve representative monitoring, and align indicators within an integrated SMC framework. The integrated SMC framework establishes fall 2013, pre-SGMA conditions, as a benchmark for basin management. This is a period with historical low groundwater levels in some wells, higher groundwater extraction than post-SGMA timeframe, and therefore likely higher volumes of ISW depletion. Using 2013 as a benchmark is conservative since annual pumping volumes were higher than 2013 in the late 1990s and early 2000s and groundwater levels have been lower pre-2013 in different wells and areas of the Basin.

With the 2027 GSP Amendment, groundwater levels continue to serve as a primary indicator of aquifer response to pumping and recharge, groundwater extraction and storage conditions provide a basin-scale constraint on water use, and ISW depletion is evaluated as a function of broader groundwater conditions rather than localized measurements alone. This integrated framework reflects the conceptual understanding that changes in groundwater levels and storage ultimately control the magnitude and timing of groundwater contributions to surface water systems in the Basin.

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7.3 Chronic Lowering of Groundwater Levels Sustainable Management Criteria

Groundwater levels in the Basin fluctuate seasonally and over the long-term. Groundwater level change in the Unconfined aquifer (Santa Margarita Formation) is driven mainly by variations in precipitation, as the aquifer drains quickly during extended dry periods, but is able to recover during a wet year. The Confined aquifers (Monterey, Lompico, and Butano formations) in the Basin also respond to changes in climate, but the response is muted and slower in comparison to the unconfined Santa Margarita aquifer. These aquifer groups are further described in Section 6.2.

7.3.1 Undesirable Results - Chronic Lowering of Groundwater Levels

Chronic lowering of groundwater levels is considered significant and unreasonable when:

- Fall groundwater elevations in 3 or more RMPs are below the MT for 2 consecutive years in the Unconfined aquifer.
- Fall groundwater elevations in 3 or more RMPs are below the MT for 2 consecutive years in the Confined aquifers.

7.3.1.1 Criteria for Defining Chronic Lowering of Groundwater Levels Undesirable Results

Chronic lowering of groundwater levels undesirable results are quantified as a number and length of time for MT exceedances that would likely cause significant and unreasonable effects in the Basin.

Undesirable results are developed using the following criteria and information:

- Knowing impacts to groundwater beneficial users during periods when groundwater levels were lowest in the Basin
- Understanding how the Basin's aquifers respond to hydrologic conditions in any given year and over multiple years
- Understanding the relationship between groundwater levels and surface water baseflow
- Maintaining flexibility for adaptive management of groundwater levels should impacts occur in a single year

When Santa Margarita and Lompico aquifer groundwater levels declined in the Mount Hermon/South Scotts Valley subareas from 1985 through 1994 due to a combination of a 10-year extended drought and increased groundwater use in the area, there were known impacts to human groundwater beneficial users. In the early 1990s, municipal water supply wells screened in the dewatered Santa Margarita aquifer were replaced with wells screened deeper in the Lompico aquifer. Since the South Scotts Valley is supplied municipal water, there were no known significant impacts to individual domestic users of groundwater in this portion of the Basin. Chronically lowered groundwater levels have not occurred in any other areas of the Basin.

The County has records that many shallow private wells less than 100 feet in depth outside of the Scotts Valley area were deepened or replaced in response to declining groundwater levels toward the end of the WY 1987-1994 drought. Since that extended drought there have not been many wells deepened or replaced with deeper wells, including during the WY2012-2015 and WY2020-2022 droughts.

7.3.1.2 Potential Causes of Undesirable Results

Undesirable results may be caused by unsustainable groundwater use resulting in chronic lowering of groundwater levels such as the following conditions:

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1. **Changes to Basin Pumping.** If the location and rates of groundwater pumping change as a result of new high-capacity wells, or PMAs implemented to improve sustainability and water supply reliability, these changes could result in localized lowering of groundwater levels and changes in groundwater flow directions. Average total Basin extraction more than the sustainable yield is another potential cause of undesirable results for groundwater levels.
2. **Drought.** Groundwater levels could exceed the MT for extended periods of time during a prolonged drought. The Santa Margarita aquifer is particularly sensitive to climate and most at risk of experiencing undesirable results during drought. However, the historical groundwater level records show that this unconfined and highly permeable aquifer typically recovers in wet years to pre-drought conditions.
3. **Surface Water Diversions**. Diversion of surface water may result in reduced recharge to groundwater in the upper reaches of the Basin's creeks where losing creek conditions occur. Most creeks in the Basin are currently gaining year-round and surface water diversions are currently small, making this a highly unlikely cause of undesirable results if current groundwater conditions and management practices continue.

7.3.1.3 Effects on Beneficial Users and Land Use

Currently, there are no undesirable results for human beneficial users of groundwater occurring due to chronic lowering of groundwater levels. As described earlier, deeper wells replaced impacted shallow wells in the 1990's. Those municipal, industrial, agricultural, and domestic users of groundwater have adjusted to the lowered groundwater levels during pre-2012 droughts. Impacts of historical chronic lowering of groundwater levels on environmental groundwater users, such as GDEs and aquatic species is less understood.

If undesirable results from chronic lowering of groundwater levels occur in the future, it will impact beneficial users of groundwater as described in the bullets below. Lowering of groundwater levels will reduce the thickness of saturated aquifer from which wells can pump and may prevent a significant number of water supply wells from pumping the amount of groundwater they have typically used to meet their water needs.

Undesirable results from chronic lowering of groundwater levels can have the following general impacts on beneficial users and land uses:

- **Urban land uses and users**. If groundwater levels fall below municipal supply well pumps, the pump can only be lowered to the point where it reaches the bottom of the well, and then a deeper replacement well needs to be drilled. Lowering the pump or drilling a deeper well in the same location is not a solution as the levels will only continue to drop. Another solution is to move pumping to an unimpacted part of the Basin to meet demands. It is possible that changing extraction to a different location may

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stress unimpacted parts of the Basin. Other effects on municipal users from lowered groundwater levels is the increased pumping costs due to greater lift required to bring the water to the surface.

Lowered groundwater levels in both Santa Margarita and Lompico aquifers result in reduced contributions to streamflow and can impact the San Lorenzo Valley Water District, which has flow requirements for surface water diversions on its Felton system. Reduced streamflow could also impact the City of Santa Cruz, a downstream surface water user, especially in light of their efforts to support enhanced streamflow to protect and restore runs of endangered coho salmon and threatened steelhead trout though an HCP adopted in 2025.

- **Rural residential land uses and users**. Typically, rural residential users have the shallowest wells which makes them more vulnerable to lowered groundwater levels. If groundwater levels decline below the top of well screens or below pump intakes, landowners may lose access to groundwater and be forced to lower their pumps or drill their well deeper. Additionally, when groundwater levels fall below the top of well screens, this has the potential to cause cascading water in the well. Cascading or falling water is water flowing through preferential pathways above the groundwater table that falls into the well. As it pours into the well it introduces air into the water being pumped thereby causing pump cavitation. This condition may increase the cost to pump, cause physical damage to the well and pump, and potentially degrade groundwater quality within the well due to microbial biofouling. Property values may decline if low groundwater levels cause undesirable results that require residential pumping restrictions, deepening of wells, or connection to a public water system. Some small water systems rely on springs and lowered groundwater levels may dry the springs out.
- **Industrial land uses and users**. Industrial use of groundwater in the Basin is limited to process and dust suppression water at a single remaining sand quarry at Quail Hollow. Chronic lowering of groundwater elevations has the potential to increase pumping costs or reduce access to groundwater for similar reasons listed above for rural residential users.
- **Agricultural land uses and users**. For the very limited agriculture in the Basin, chronic lowering of groundwater elevations has the potential to increase irrigation costs or reduce access to groundwater for similar reasons listed above for rural residential users.
- **Ecological land uses and users**. GDEs have the potential to be impacted directly if groundwater depths decrease below the accessible level for GDE vegetation. Surface water bodies connected to groundwater may also incur reductions in baseflow caused by lowering of groundwater levels. Reduced baseflow may negatively impact portions of the lifecycle of aquatic species. Potential impacts to GDEs and priority species from decreased groundwater levels and interconnected surface water are further described in Section 7.6.1.3.

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7.3.2 Minimum Thresholds - Chronic Lowering of Groundwater Levels

Section §354.28(c)(1) of the GSP Regulations states that "The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results."

7.3.2.1 Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

The MTs and MOs were established based on evaluation of historical groundwater elevation data from the 2022 GSP RMP wells and estimated groundwater levels based on nearby well data or model simulations for more recently completed RMP wells. Additional information considered included baseflow to support beneficial uses and users given the very positive correlation between groundwater elevations and surface water discussed in Section 4.6.3. Baseflow was represented by the mean daily flow measured on the San Lorenzo River at Big Trees; this was reviewed over a 25-year period from 2001 through 2025. Finally, the restrictions related to the beneficial uses and users described above were considered, including whether diversion restrictions would be triggered based on surface water flows.

The information reviewed revealed that the month of September is on average the lowest flow month and the most restrictive requirement is that SLVWD cannot divert surface water in its Felton system under Permit #20123 if flows at Big Trees are less than 10 cfs in the month of September. Based on the review of 25 years of baseflow, WY 2013 was identified as a relatively dry year that supported a minimum baseflow greater than 10 cfs through the month of September. Because the diversion restriction below 10 cfs impacts a beneficial user of surface water in the Basin, groundwater elevations from fall 2013, which supported more than the minimum baseflow, were used as the basis for establishing the MT values described below.

7.3.2.2 Chronic Lowering of Groundwater Level Minimum Thresholds

The amended MT is the fall 2013 groundwater level at each RMP. If a measured value is not available for an RMP in 2013, then the level is selected based on a similar nearby well or from the historical Basin Model simulation. MTs for each RMP are summarized in Table 7-1. Hydrographs showing MTs and MOs for each RMP are included in Appendix 7A.

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Table 7-1. Minimum Thresholds, Measurable Objectives, and Interim Milestones for Chronic Lowering of Groundwater Levels

Aquifer Group	Aquifer	Well Name	MT (ft amsl)	MO (ft amsl)	2027 IM (ft amsl)	2032 IM (ft amsl)	2037 IM (ft amsl)
Unconfined	Santa Margarita	SLVWD Olympia #1	349	359	--	--	--
	Santa Margarita	SLVWD Pasatiempo MW-2	516	528	--	--	--
	Santa Margarita	SLVWD Quail MW-A	413	417	--	--	--
	Santa Margarita	SLVWD Quail MW-B	457	470	459	464	468
	Santa Margarita	SMGWA-2 Bean Creek	392	396	--	--	--
	Santa Margarita	SMGWA-3 Ruins Creek	387	393	--	--	--
	Santa Margarita	SMGWA-4 Nelson Road	345	349	--	--	--
	Santa Margarita	SMGWA-5 Bahr Drive	515	528	--	--	--
	Santa Margarita	SMGWA-6 Quail Hollow	325	360	338	345	352
	Santa Margarita	SVWD AB303 MW-1	478	488	--	--	--
	Santa Margarita	SVWD SV4-MW	399	408	--	--	--
	Santa Margarita	SVWD TW-18	469	474	--	--	--
Confined	Monterey	SMGWA-8 Randall Morgan Sandhills Preserve	320	325	--	--	--
	Monterey	SVWD #9	340	346	--	--	--
	Lompico	SLVWD Pasatiempo #3	337	359	--	--	--
	Lompico	SLVWD Pasatiempo MW-1	337	372	--	--	--
	Lompico	SVWD #10	286	335	--	--	--
	Lompico	SVWD #11A	294	317	--	--	--
	Lompico	SVWD AB303 MW-2	387	400	--	--	--
	Lompico	SVWD AB303 MW-3A	354	361	--	--	--
	Lompico	SVWD TW-19	337	348	--	--	--
	Butano	SVWD Canham Well	433	451	442	445	448
	Butano	SVWD Stonewood Well	841	845	--	--	--

--: Interim milestones are the same as the MO

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7.3.2.3 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

Groundwater level MTs are unique to every RMP. As they are based on historical data or simulation of historical data in newer constructed monitoring wells, they represent actual achievable conditions that will not conflict other RMP MTs.

Chronic lowering of groundwater level MTs are integrated with and avoid undesirable results for other sustainability indicators, as described below.

- **Reduction of groundwater in storage**. Chronic lowering of groundwater level MTs do not promote pumping more than the sustainable yield or cause long-term declines of groundwater in storage because they are not lower than historical groundwater elevations. Therefore, chronic lowering of groundwater level MTs will not result in an exceedance of the reduction of groundwater in storage MT.
- **Degraded groundwater quality**. Declines in groundwater elevation may cause wells to draw from different aquifers or hydrogeologic subunits, potentially impacting groundwater quality. Degradation of groundwater quality was not apparent at the fall 2013 groundwater level, and thus chronic lowering of groundwater level MTs should not result in exceedances of groundwater quality MTs.
- **Depletion of interconnected surface water**. Chronic lowering of groundwater level MTs do not promote additional pumping or lower groundwater elevations adjacent to interconnected surface water than has historically occurred. Therefore, the chronic lowering of groundwater elevation MTs will not result in a significant or unreasonable depletion of interconnected surface water.
- **Seawater intrusion**. Not applicable.
- **Subsidence**. Not applicable.

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7.3.2.4 Effect of Minimum Thresholds on Neighboring Basins

The anticipated effect chronic lowering of groundwater level MTs on each of the neighboring basins is addressed below.

- **Santa Cruz Mid-County Basin** (critically-overdrafted). There is a relatively impermeable geologic basement high that separates the 2 basins and very limited areas where the Purisima Formation, the largest supply aquifer for Santa Cruz Mid-County Basin, is in direct contact with the principal aquifers of the Santa Margarita Basin. As a result, it is very unlikely that changes in groundwater levels due to PMAs in either basin could change hydraulic gradients near the shared basin boundary or affect groundwater level MTs in the neighboring basin.

- **Purisima Highlands Subbasin of the Corralitos Basin** (very low priority). The Santa Margarita Basin is hydraulically downgradient from the Purisima Highlands Subbasin, but is separated from it by the Zayante-Vergeles fault zone, which acts as a barrier to groundwater flow. Hence, it is unlikely that groundwater elevations in the Santa Margarita Basin can have an influence on groundwater in the Purisima Highlands Subbasin.
- **West Santa Cruz Terrace Basin** (very low priority). The boundary between the Santa Margarita Basin and West Santa Cruz Terrace Basin is located where Tertiary sedimentary rocks that are the principal aquifers in Santa Margarita Basin thin abruptly against basement rocks exposed at the surface or are at shallow depth in the subsurface. Groundwater pumping in West Santa Cruz Terrace Basin is mostly from private wells tapping low-yielding Quaternary alluvium and terrace deposits. These Quaternary deposits are not hydrologically connected to similar deposits scattered in small patches in Santa Margarita Basin. The lack of continuity in the Quaternary deposits and thinning of the Santa Margarita Basin aquifers makes it unlikely that groundwater elevations in the Santa Margarita Basin at MTs would cause chronic lowering of groundwater levels in the West Santa Cruz Terrace Basin.

7.3.2.5 Effects of Minimum Thresholds on Beneficial Users and Land Uses

Chronic lowering of groundwater level MTs are set at the fall 2013 groundwater elevation in each RMP. Figure 4-47shows that average groundwater levels were higher than the average levels in WY 2014, 2015, and 2016. Because lower groundwater levels have not appeared to cause significant and unreasonable conditions when they were lowest late in the 2012-2015 drought, these levels should continue to support similar beneficial use of groundwater users in the future. The MTs generally benefit beneficial users and land uses in the Basin as outlined in the bullets below.

- **Urban land uses and users**[5]. Maintaining groundwater elevations at or above historical levels will benefit municipal groundwater pumpers by protecting their ability to pump groundwater from existing municipal wells to meet public water supply demands. These elevations support the ability of SLVWD to divert surface water for its Felton system. Additionally, these elevations support a baseflow that will allow the City of Santa Cruz to divert some surface water from its Tait Street diversion outside the Basin under its 2025 HCP as described in Section 2.2.8.
- **Rural residential land uses and users**[6]. Maintaining groundwater elevations at or above historical levels during the 2012-2015 drought will benefit most domestic users of groundwater by protecting their ability to pump groundwater from their wells. There

[5] Urban land users include a small area of a DAC supplied water by SLVWD.
[6] Rural land users include an estimated fewer than 10 DAC residents who depend on private wells for domestic use.

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were very few reports of dry wells during the 2012-2015 drought and so not allowing levels to fall below those historical low levels will protect a vast majority of private domestic wells. If groundwater levels fall below MTs in RMPs, shallow private domestic wells may be at risk of being dewatered.

- **Industrial land uses and users**. Maintaining groundwater elevations at or above historical low levels should benefit industrial land uses and beneficial users by protecting their ability to pump groundwater from industrial wells.
- **Agricultural land uses and users**. For the very limited agriculture in the Basin, maintaining groundwater elevations at or above historical low levels will benefit agricultural users and land use by protecting their ability to pump groundwater from irrigation wells.
- **Ecological land uses and users**. Maintaining groundwater elevations at or above fall 2013 will maintain the very connected nature of groundwater and surface water in parts of the Basin. Baseflows associated with the fall 2013 groundwater elevations would support greater than 10 cfs flow in September. This is greater than the 8 cfs minimum flow required on the San Lorenzo River (measured at Santa Cruz) for rearing of priority species in the City of Santa Cruz 2025 HCP.

7.3.2.6 Relevant Federal, State, or Local Standards

No federal, state, or currently enforced local standards exist for chronic lowering of groundwater elevations.

7.3.2.7 Method for Quantitative Measurement of Minimum Thresholds

Fall groundwater elevations at each RMP are compared to MTs in GSP Annual Reports to evaluate progress toward achieving sustainability.

7.3.3 Measurable Objectives - Chronic Lowering of Groundwater Levels

MOs are set for each RMP at groundwater elevations that allow for operational flexibility to manage drought or other operational changes and keep groundwater levels above the MTs.

7.3.3.1 Measurable Objectives

The MOs are established at the fall 2006 groundwater elevations at each RMP. Fall 2006 was the second of 2 consecutive wet years, which followed 3 consecutive normal water years. Groundwater elevations were at a relatively high level similar to recent wet years like WY 2017, 2018, and 2023. In 2006, San Lorenzo River streamflow supported downstream diversions and met the City of Santa Cruz HCP in-stream flow requirements for a very wet year of 13.3 cfs, further making this year a good target for Basin groundwater level management. Some MOs are

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estimated using measured fall groundwater elevations from a similar year if the 2006 measured values were not taken or the GSP Model did not provide reasonable estimated targets for that year. The MOs are summarized in Table 7-1 and shown on hydrographs for each RMP in Appendix 7A.

7.3.3.2 Interim Milestones

IMs provide a managed trajectory from current conditions to sustainability at each RMP. If the spring 2025 groundwater level is above the MO, the IMs are set equal to the MO. If the spring 2025 groundwater level is below the MO the following IMs are calculated:

- 2027 IM is the fall 2025 groundwater level.
- 2032 IM is 1/3 of the difference between the 2027 IM and the MO.
- 2037 IM is 2/3 of the difference between the 2027 IM and MO.
- The IMs are included in Table 7-1.

7.4 Reduction of Groundwater in Storage Sustainable Management Criteria

Historically, there was a consistent loss of groundwater stored in the Basin primarily due to overpumping of the Lompico aquifer in the South Scotts Valley area prior to SGMA. However, since SGMA passed in 2015, groundwater in storage has been balanced with losses in dry years offset by gains in wet years (Section 5.3.3).

7.4.1 Undesirable Results - Reduction of Groundwater in Storage

The reduction of groundwater in storage is considered significant and unreasonable when either of the following occurs:

- Groundwater extraction volumes exceed the MT in the Unconfined aquifer.
- Groundwater extraction volumes exceed the MT in the Confined aquifers.

7.4.1.1 Criteria for Defining Undesirable Results

Per GSP Regulations the reduction in storage sustainability indicator is measured by “a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results.” (§354.28 (c)(2)). This definition intersects with the definition of sustainable yield described in Section 5.6. As described there, Basin-wide groundwater pumping within the sustainable yield does not constitute proof of sustainability. Sustainability under SGMA is only demonstrated by avoiding undesirable results for all sustainability indicators

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applicable to the Basin. Undesirable results for the storage indicator are based on predictive model simulations that demonstrate undesirable results for applicable sustainability indicators are avoided. For example, the projected groundwater extraction in specific aquifers does not cause MT exceedances that would create an undesirable result for chronic lowering of groundwater levels.

7.4.1.2 Potential Causes of Undesirable Results

Increased groundwater extraction may result from urban or agricultural land use expansion or a failure to implement PMAs that supplement groundwater supply through conjunctive use with surface water. GSP implementation will improve resiliency by storing groundwater supply in wet years to offset increased groundwater demands in dry years when surface water availability is limited.

7.4.1.3 Effects on Beneficial Users and Land Use

A reduction of groundwater in storage would impact beneficial users of groundwater by causing undesirable results for one or more applicable sustainability indicators. Undesirable results may have the following general impacts on beneficial users and land uses:

- **Urban land uses and users**. Continual reduction of groundwater in storage leads to groundwater elevation decline that may reduce well efficiency, increase associated pumping costs, cause mechanical damage to the well by cavitation, and may lead to groundwater levels falling below pump intakes or even the bottom of wells. Reduced groundwater in storage decreases contributions to streamflow, which may impact GDEs and surface water users including SLVWD as an in-basin user of surface water and the City of Santa Cruz as a downstream user of surface water.
- **Rural residential land uses and users**. Groundwater elevation declines associated with reduction of groundwater in storage may prevent rural residential access to groundwater due to the same urban impacts described above. Losing access to groundwater would have cost ramifications for the individual property owner who may need to repair their pump or drill their well deeper, and to the community at large which may see a decline in property value or require connecting to public water service.
- **Industrial land uses and users**. Industrial use of groundwater in the Basin is limited to process and dust suppression water at 1 remaining sand quarry at Quail Hollow. Groundwater elevation declines associated with reduction of groundwater in storage have the potential to increase pumping costs or reduce access to groundwater for similar reasons listed above for urban and rural residential users.
- **Agricultural land uses and users**. Groundwater elevation declines associated with reduction of groundwater in storage have the potential to increase irrigation costs or

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reduce access to groundwater for similar reasons listed above for urban and rural residential users.

- **Ecological land uses and users**. GDEs have the potential to be impacted directly if extraction causes groundwater depths to fall below the accessible level for GDE vegetation. Surface water bodies connected to groundwater may also incur reductions in baseflow caused by falling groundwater levels due to reduced groundwater in storage. This may negatively impact portions of aquatic species lifecycles.

7.4.2 Minimum Thresholds - Reduction of Groundwater in Storage

The reduction of storage sustainability indicator is not measured by a change in groundwater in storage. Rather, per the GSP Regulations, the reduction in groundwater in storage sustainability indicator is measured by "a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results." (§354.28 (c)(2)).

7.4.2.1 Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

Information used in establishing MTs and MOs for the reduction of groundwater in storage indicator included: review of results from the Basin Model and discussed in Section 5.6; review of water year types encountered in the region from WY 1985 through WY 2025; review of actual groundwater extraction and trends in the Basin; and consideration of conjunction use expansion from implementing PMAs. Based on the review of water years types, a 5-year rolling average will be used to evaluate extraction relative to the MT and MO to allow for annual variability in extraction to allow for 5-year drought periods that have been experienced and support implementation of ongoing and planned conjunctive use practices.

7.4.2.2 Reduction of Groundwater in Storage Minimum Thresholds

The MT for reduction of groundwater in storage is set as a 5-year rolling average not-to-exceed 750 AFY in the Unconfined aquifer and 2,250 AFY in the Confined aquifers. In the Unconfined aquifer, this value is consistent with current use and existing conjunctive use practices. Conjunctive use is not expected to change significantly in the Unconfined aquifer, so the average 5-year extraction of 750 AFY is consistent with current and projected operations that result in recent average annual extraction of 700 AFY. The MT of 750 allows for additional extraction over a prolonged period of 5 years that can be offset by reduced extraction in wet and normal years.

In the Confined aquifers, conjunctive use programs will be defined as part of GSP implementation, so the maximum amount of groundwater usage in dry years is yet to be determined. As an estimate for high groundwater usage under future conjunctive use operations, SMGWA reviewed groundwater usage in the last 5 years, which resulted in average extraction

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from the Confined aquifers of approximately 1,750 AFY. Based on an estimate of the scale of implementing expanded conjunctive use by SLVWD (Section 8.2.1) and SVWD/City of Santa Cruz (Section 8.3.1), groundwater extraction in dry years could increase by about 500 AF. That would result in an MT of 2,250 AFY to accommodate these projects in the future. As these projects are developed, project proponents will demonstrate how reductions in groundwater extraction in non-dry years would allow the Confined aquifers to operate within their sustainable yield estimate of 1,900 AFY.

Reduction of groundwater in storage historical, current, and projected groundwater extraction from the Basin Model, MT, and MO are summarized in Table 5-20, Figure 7-1, and Figure 7-2.

Table 7-2. Reduction of Groundwater in Storage Minimum Thresholds by Aquifer Compared to Historical and Current Pumping

Aquifer	Extraction Volume (AFY)				
	Historical (1985 to 2014)	Current (2015 to 2025)	Projected (2026 to 2072)	Minimum Threshold	Measurable Objective
Unconfined Aquifer System Total (Santa Margarita Aquifer))	1,100	700	700	750	700
Monterey	*400*	*200*	*100*	--	--
Lompico	*1,800*	*1,200*	*1,200*	--	--
Butano	*600*	*500*	*600*	--	--
Confined Aquifer System Total	2,800	1,900	1,900	2,250	1,900
Combined Total	3,900	2,600	2,600	3,000	2,600

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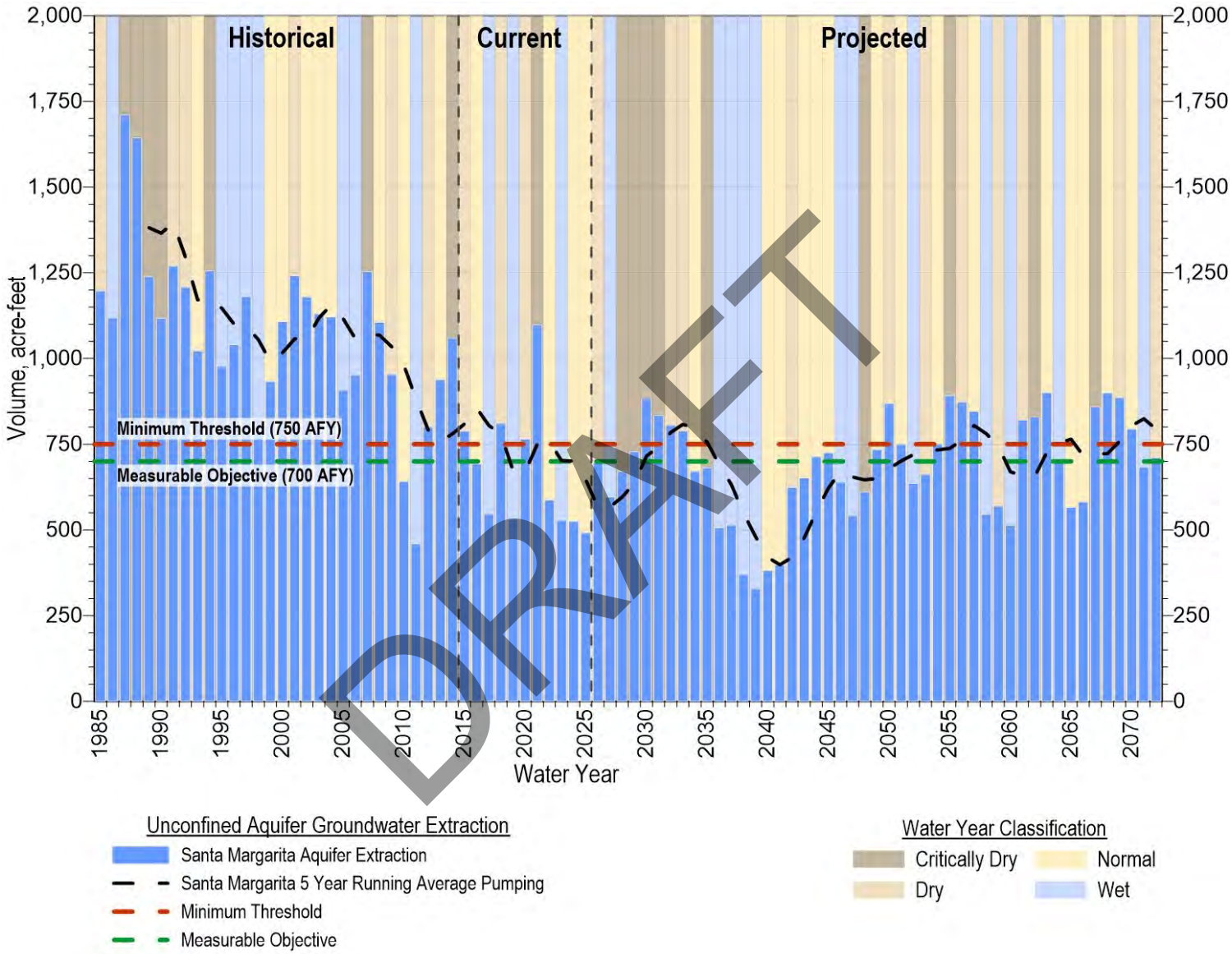

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Figure 7-1. Unconfined Aquifer Historical and Projected Extraction, Minimum Threshold, and Measurable Objective

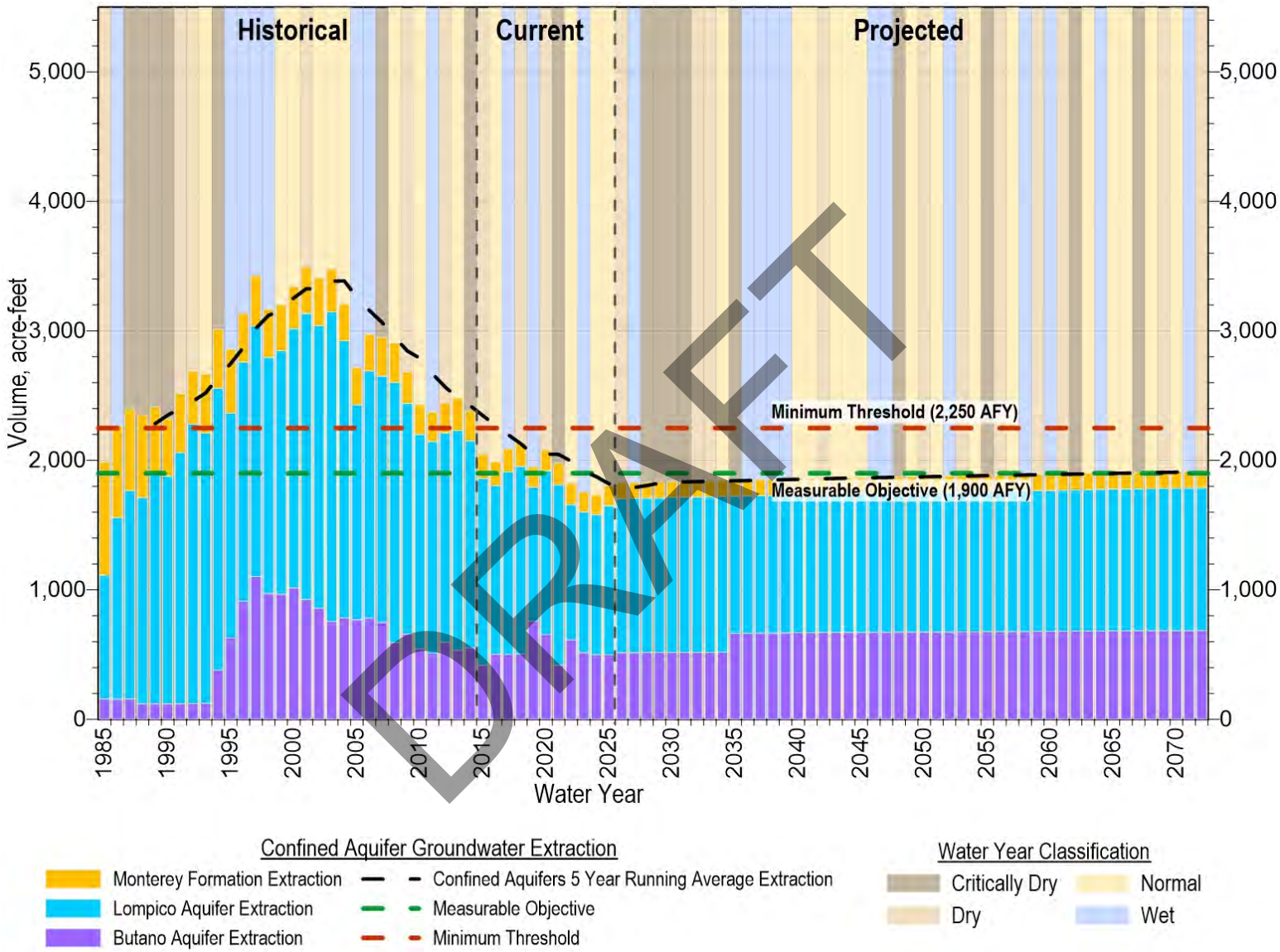

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Figure 7-2. Confined Aquifer Historical and Projected Extraction, Minimum Threshold, and Measurable Objective

7.4.2.3 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

Reduction of groundwater in storage MTs can influence other sustainability indicators. However, by design (see Section 7.4.1.1 above), MTs for reduction of groundwater in storage avoid occurrence of undesirable results in other sustainability indicators.

- **Chronic Lowering of Groundwater Levels**. Reduction of groundwater in storage MTs, by definition, prevent pumping in excess of the sustainable yield that would cause chronic lowering of groundwater level undesirable results. Therefore, the reduction of groundwater in storage MTs will not result in an exceedance of the chronic lowering of groundwater levels MTs.
- **Degraded groundwater quality**. Rising or falling groundwater elevations may cause wells to draw from different aquifers or hydrogeologic subunits, potentially impacting groundwater quality. Historical groundwater levels are not believed to have caused degradation of groundwater quality. Because MTs are set at volumes that avoid undesirable results and should maintain groundwater levels above historical minimum levels, reduction of groundwater in storage MTs should not result in exceedances of groundwater quality MTs.
- **Depletion of interconnected surface water**. Reduction of groundwater in storage MTs do not promote additional pumping or lowering of groundwater elevations adjacent to interconnected surface water and therefore, will not result in significant or unreasonable depletion of interconnected surface water.
- **Seawater intrusion**. Not applicable.
- **Subsidence**. Not applicable.

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7.4.2.4 Effect of Minimum Thresholds on Neighboring Basins

The anticipated effect of the MTs for reduction in groundwater storage on each of the neighboring basins is addressed below.

- **Santa Cruz Mid-County Basin** (critically overdrafted). There is a relatively impermeable basement high that separates the 2 basins and very limited areas where the Purisima Formation, the largest supply aquifer for Santa Cruz Mid-County Basin, is in direct contact with the principal aquifers of the Santa Margarita Basin. As a result, it is very unlikely that changes of groundwater in storage due to PMAs in either basin could change hydraulic gradients near the shared basin boundary or affect MT for the reduction of groundwater in storage in the neighboring basin.

- **Purisima Highlands Subbasin of the Corralitos Basin** (very low priority). The Santa Margarita Basin is hydraulically downgradient from the Purisima Highlands Subbasin but is separated from it by the Zayante-Vergeles fault zone, which acts as a barrier to groundwater flow. With a flow barrier between the 2 basins and a MT based on sustainable yield less than historical pumping, it is highly unlikely Santa Margarita Basin pumping will have a negative influence on groundwater in storage in the Purisima Highlands Subbasin.
- **West Santa Cruz Terrace Basin** (very low priority). The boundary between the Santa Margarita Basin and West Santa Cruz Terrace Basin is located where Tertiary sedimentary rocks that form the principal aquifers in the Santa Margarita Basin thin abruptly against basement rocks that are exposed at the surface or are at shallow depth in the subsurface. Groundwater pumping in West Santa Cruz Terrace Basin is mostly from private wells tapping low-yielding Quaternary alluvium and terrace deposits. These Quaternary deposits are not hydrologically connected to similar deposits scattered in small patches in Santa Margarita Basin. The lack of continuity in the Quaternary deposits and thinning of the Santa Margarita Basin aquifers makes it unlikely that groundwater extraction at MTs in the Santa Margarita Basin would cause a reduction of groundwater in storage in the West Santa Cruz Terrace Basin.

7.4.2.5 Effects of Minimum Thresholds on Beneficial Users and Land Uses

The reduction of groundwater in storage MTs are set at volumes that avoid undesirable results in the other sustainability indicators and therefore maintain groundwater elevations above their MTs. Since groundwater level MTs are intended to avoid undesirable conditions in the Basin, extraction MTs should continue to support similar beneficial use in the future:

- **Urban land uses and users**. Maintaining available groundwater in storage will benefit municipal groundwater pumpers by protecting their ability to pump groundwater from municipal wells and meet public water supply demands.
- **Rural residential land uses and users**. Maintaining available groundwater in storage will benefit all domestic users of groundwater by protecting their ability to pump groundwater from their wells.
- **Industrial land uses and users**. Maintaining available groundwater in storage will benefit industrial land uses and beneficial users by protecting their ability to pump groundwater from their wells.
- **Agricultural land uses and users**. For the very limited agriculture in the Basin, maintaining available groundwater in storage will benefit those beneficial users and land uses by protecting their ability to pump groundwater from irrigation wells.

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- **Ecological land uses and users**. Maintaining groundwater extraction historical levels will preserve groundwater elevation and their respective connection to surface water in the Basin, thereby protecting GDE habitat used by priority species and generally benefit ecological land uses and users.

7.4.2.6 Relevant Federal, State, or Local Standards

No federal, state, or currently enforced local standards exist for reduction of groundwater in storage.

7.4.2.7 Method for Quantitative Measurement of Minimum Thresholds

Exceedance of MTs for reduction of groundwater in storage will be quantified using metered and estimated groundwater extractions within the Basin. Municipal and small water systems have metered pumping data, while *de minimis* and limited private non-*de minimis* extraction will be estimated.

7.4.3 Measurable Objectives - Reduction of Groundwater in Storage

The MO for reduction of groundwater in storage is set as a 5-year rolling average not-to-exceed of 700 AFY in the Unconfined aquifer and 1,900 AFY in the Confined aquifers. MOs are equivalent to the sustainable yield, discussed in Section 5.6. Reduction of groundwater in storage historical, current, and projected groundwater extraction relative to the MT and MO are summarized in Table 7-2. Current extraction in the Basin is less than the MO (Figure 7-1; Figure 7-2), therefore interim milestones are not needed to achieve the MO.

7.5 Degraded Water Quality Sustainable Management Criteria

Groundwater in the Basin is generally of good quality and meets primary drinking water standards. However, both naturally occurring and anthropogenic groundwater quality COCs are present in some aquifers and areas, based on local land use and hydrogeologic conditions. The COCs that present the greatest risk to groundwater viability for beneficial use are naturally occurring arsenic and TDS, which are found in both the unconfined and confined aquifers and anthropogenic nitrate from septic system leaching, typically found in the unconfined aquifer. Other constituents that are public health concerns but are only detected sporadically at low concentrations below drinking water standards (e.g., VOCs) or are naturally occurring and managed by water providers prior to distribution (e.g., iron and manganese) are not considered COCs. These other constituents will be evaluated annually through review of public water supply monitoring results and coordination with SCEH, as discussed in Section 8.2.2.

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7.5.1 Undesirable Results - Degraded Water Quality

Degraded water quality is considered significant and unreasonable when 3 or more RMPs experience an MT exceedance for the same constituent for 2 consecutive years.

7.5.1.1 Criteria for Defining Degraded Water Quality Undesirable Results

Primary criteria for undesirable results for groundwater quality are the exceedance of drinking water standards or degradation of existing water quality that impacts safe and affordable access to groundwater for beneficial use. An additional criteria for defining degraded water quality for nitrate is the presence of a TMDL for nitrate in the San Lorenzo River of 0.33 mg/L, which is well below the drinking water standard of 10 mg/L. Some areas of the Basin have naturally high concentrations of constituents. In those circumstances, undesirable results are focused on limiting increases from existing concentrations.

7.5.1.2 Potential Causes of Undesirable Results

Groundwater extraction and SMGWA approved projects and management activities may potentially degrade groundwater quality under the following conditions:

- **Changes to Basin Pumping.** If the location and rates of groundwater pumping change as a result of projects implemented or management actions taken under the GSP, these changes could alter hydraulic gradients and cause movement of existing, poor-quality groundwater toward a supply well at concentrations that exceed MTs.
- **Groundwater Recharge**. Active groundwater recharge through injection wells, Aquifer Storage and Recovery (ASR), or surface spreading could potentially modify groundwater gradients and move existing poor-quality groundwater toward a supply well in concentrations that exceed MTs. Another potential cause of groundwater degradation from recharge by injecting water into the aquifer is mobilization of metals. Introducing surface water into an aquifer may change the geochemistry of groundwater in such a way that minerals in the aquifer such as pyrite break down or trace elements are desorbed from clays, thereby releasing iron, manganese, or arsenic into the groundwater. Pilot testing can help understand geochemical impacts an injection or ASR project may or may not have before a decision can be made on its feasibility.
- **Recharge of Poor-Quality Water.** Although highly unlikely because of the state's antidegradation policy that requires the project proponent to demonstrate a project will not cause surface water or groundwater degradation, a recharge project could potentially introduce poor quality water or contaminants into the Basin. Recharge of stormwater from an urban area and recharge of wastewater are examples of sources with potential poor-quality water. Recharge water needs to be treated to concentrations that will not cause undesirable results by degrading groundwater or surface water. Using wastewater

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as a recharge source requires advanced treatment that may include ozonation, membrane filtration, reverse osmosis, and ultraviolet advanced oxidation. Nitrate concentrations introduced by poor-quality recharge water is a concern because increased nitrate concentrations in groundwater may result in increased nitrate in surface water through groundwater's contribution to baseflows. Elevated nitrate in surface water may stimulate biological growth in the aquatic ecosystem, depressing dissolved oxygen levels and adversely impacting aquatic biota. It may also result in increased production of organic compounds that can cause taste and odor problems and disinfection byproducts adversely affecting municipal water supply and costs for surface water treatment.

- **Degraded Groundwater Impacts to Surface Water**: Groundwater in the Basin is highly connected to surface water which means the quality of groundwater influences the quality of surface water. This is evident in the elevated nitrate concentrations in the San Lorenzo River influenced in large part by septic system leaching to groundwater. Users of surface water within the Basin are primarily SLVWD, and to a lesser extent a few private users and small water systems who have water rights. Surface water from the Basin is also used outside of the Basin by the City of Santa Cruz that has appropriative rights to San Lorenzo River water via licenses. These licenses allow the withdrawal of water at the San Lorenzo River Intake in Santa Cruz for delivery to the Graham Hill WTP and the Felton diversion for storage at Loch Lomond Reservoir. Surface water is always treated before being used by the City of Santa Cruz for potable water. Additional treatment may be needed depending on the chemical constituents and concentrations.
- **Degraded Groundwater Impacts to Soil Vapor**: If Groundwater extraction moves existing plumes with vapor-forming chemicals, a potential impact on urban land use could be the formation of soil vapor plumes that may impact health. Vapor intrusion occurs when vapor-forming chemicals in contaminated soils or groundwater migrate into overlying buildings. Vapor-forming chemicals may include VOCs, such as TCE and benzene, select semi-volatile organic compounds, such as naphthalene, elemental mercury, and some polychlorinated biphenyls and pesticides (USEPA, 2020).

7.5.1.3 Effects on Beneficial Users and Land Use

Undesirable results from degradation of groundwater quality can have the following general impacts on beneficial users and land uses:

- **Urban land uses and users**. If municipal supply wells cannot be pumped anymore because of contamination, an alternative water source will need to be used or the groundwater will need to be treated to drinking water standards. New wells or increased pumping in existing wells may change the groundwater pumping regime, which could promote migration of degraded groundwater. If surface water or soil vapor impacts are caused by groundwater degradation, then water or soil vapor treatment may be needed to

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ensure public safety. With groundwater and surface water closely connected, degraded groundwater quality can degrade surface water quality. The only urban user impacted would be the City of Santa Cruz, which is a downstream user of surface water. Elevated nitrate in surface water may result in increased production of organic compounds that can cause taste and odor problems and disinfection byproducts adversely affecting municipal water supply and costs for surface water treatment. SLVWD surface water sources are outside of and upgradient of the Basin and will not be impacted.

- **Rural residential land uses and users**. Since private well owners do not routinely test groundwater pumped by their wells, there is a strong possibility that they could unknowingly drink groundwater exceeding drinking water standards and experience potential health effects. In addition, not having access to groundwater as a water source because of known undesirable results will significantly devalue properties that have no alternative water source or cannot be connected to a municipal water system. Finally, costly treatment systems may need to be installed depending on the concentration and chemical found in rural water supplies.
- **Industrial land uses and users**. Industrial use of groundwater in the Basin is limited to process and dust suppression water at 1 remaining sand quarry at Quail Hollow. Degraded groundwater quality will have limited negative effect on the use of water used at the quarry. Impacts on groundwater quality by sand mining have a greater potential negative effect than projects or management actions implemented to achieve sustainability.
- **Agricultural land uses and users**. For the very limited agriculture in the Basin, degraded groundwater quality has the potential to damage crops. It is unlikely that the agricultural land use will be impacted by degraded water quality caused by SMGWA approved projects or management actions since those land uses are many miles away from the urban settings that have known contaminant plumes.
- **Ecological land uses and users**. GDEs have the potential to be directly impacted if baseflows contaminated by degraded groundwater enter their root zone. Each species has differing tolerance to groundwater quality, but in general, groundwater quality degradation may cause nuisance or toxicity for some riparian, aquatic, or terrestrial species. Elevated nitrate in surface water may stimulate biologic growth in the aquatic ecosystem, depressing dissolved oxygen levels and adversely impacting aquatic biota.

7.5.2 Minimum Thresholds - Degraded Water Quality

The GSP Regulations allow 3 options for setting degraded water quality MTs. Section §354.28(c)(2) of the GSP Regulations states that “The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin” (CCR,

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2016). In this Basin, TDS, arsenic, and nitrate MTs will be monitored at supply wells. Unique MTs and MOs are established for each RMP public supply well based on historical data collected since 2011 and relevant drinking water standards. Several guidance documents were used to develop the SMC approach for the degraded water quality sustainability indicator (DWR, 2017; Moran and Belin, 2019; Community Water Center, 2019).

7.5.2.1 Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

MTs and MOs are developed relative to the maximum historical groundwater quality concentrations from each well and primary and secondary drinking water standards or MCLs. The metrics are established at progressively higher concentrations above the historical maximum. The MO will alert SMGWA that degradation is starting to occur by establishing the objective at a marginally higher concentration than the historical maximum concentration in the well. The MT is set at a higher concentration than the MO and below the drinking water standard in most RMPs to allow for SMGWA and member agencies to adjust operations if MTs are exceeded prior to exceeding drinking water standards.

7.5.2.2 Degraded Water Quality Minimum Thresholds

Using drinking water standards, or MCLs, to guide MT selection is consistent with the SMGWA defined significant and unreasonable water quality degradation that results in adverse impacts including materially diminished water supplies or undue costs for mitigating such negative impacts. MCLs are designed to protect public health and welfare, and they provide the clearest indication of the point beyond which there is a real risk of an undesirable result (Moran and Belin, 2019).

Nitrate (as N) concentrations in groundwater are typically less than 5 mg/L, which is half the MCL of 10 mg/L. Because nitrate in groundwater influences nitrate concentrations in the San Lorenzo River (described in Section 2.1.2.3), allowing nitrate concentrations in groundwater to increase above 5 mg/L will make it challenging to meet the San Lorenzo River's 0.33 mg/L nitrate TMDL enforced by the CCRWQCB.

An MT of 5 mg/L is established for nitrate (as N) because:

1. Concentrations in RMPs are historically below this threshold.
2. The groundwater quality goal is to prevent concentrations from worsening and concentrations above 5 mg/L are currently uncommon throughout the Basin.
3. Nitrate concentrations in SMGWA-approved project source waters close to 10 mg/L would increase the challenge of meeting the nitrate TMDL in the San Lorenzo River. Feasibility for future projects will need to demonstrate the Basin's good quality

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groundwater will not be degraded above 5 mg/L before the SMGWA can approve its implementation.

The 3 highest historical concentrations since 2011, MTs and Mos, are summarized in tables for TDS (Table 7-3), nitrate (Table 7-4), and arsenic (Table 7-5). Appendix 7B includes chemographs for COCs at each RMP showing historical data, MTs, and MOs.

RMPs that have MTs at concentrations greater than or equal to the MCL, are summarized below:

- TDS MTs are set below the secondary MCL of 500 mg/L at all but 2 RMPs. The MT is set at the primary MCL for SVWD Orchard and SLVWD Olympia #3 of 1,000 mg/L, which have historical maximum concentrations of 660 and 740 mg/L, respectively. Several wells have MTs that fall between the primary and secondary MCL based on their historic high concentrations.
- Arsenic MTs are less than the primary MCL of 0.01 mg/L, except for 2 RMPs with historical concentrations slightly above the MCL. The historical maximum concentration is 0.011 mg/L at SLVWD Pasatiempo #8; the MO is 0.013 mg/L and MT is 0.015 mg/L. SVWD #11B has a historical maximum concentration of 0.012 mg/L; the MO is 0.014 mg/L and MT is 0.016 mg/L. SLVWD and SVWD treat or blend raw water before distributing to customers, so having concentrations marginally above the MCL is not desirable, but also does not prevent beneficial use of groundwater from these wells.

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Table 7-3. TDS Minimum Thresholds and Measurable Objectives

Aquifer Group	Aquifer	Representative Monitoring Point	TDS Concentrations, mg/L				
			Highest TDS Concentrations Since 2011			Measurable Objective	Minimum Threshold
			Maximum TDS	2nd Highest	3rd Highest		
Unconfined	Santa Margarita	SLVWD Quail #4A	150	130	130	250	500
	Santa Margarita	SLVWD Quail #5A	130	130	120	250	500
	Santa Margarita	SLVWD Olympia #2	480	460	430	600	800
	Santa Margarita	SLVWD Olympia #3	740	730	690	900	1,000
Confined	Lompico	SLVWD Pasatiempo #5A	180	180	160	250	500
	Lompico	SLVWD Pasatiempo #7	190	180	150	250	500
	Lompico	SLVWD Pasatiempo #8	170	160	140	250	500
	Lompico	SVWD #10A	340	330	320	400	600
	Lompico	SVWD #11A	580	580	570	700	800
	Lompico	SVWD #11B	410	400	390	500	700
	Lompico/ Butano	SVWD Orchard Well	660	520	510	800	1,000
	Lompico/ Butano	SVWD Sucinto Well	534	500	NA	NA	NA
	Lompico/ Butano	SVWD Grace Way Well	324	NA	NA	NA	NA

NA – not applicable as there is not enough historical data. MTs and MOs will be established after 3 years of data are available.

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Table 7-4. Nitrate (as N) Minimum Thresholds and Measurable Objectives

Aquifer Group	Aquifer	Representative Monitoring Point	Nitrate (as N) Concentrations, mg/L				
			Highest Nitrate Concentrations Since 2011			Measurable Objective	Minimum Threshold
			Maximum Nitrate	2nd Highest	3rd Highest		
Unconfined	Santa Margarita	SLVWD Quail #4A	0.77	0.69	0.68	2	5
	Santa Margarita	SLVWD Quail #5A	3.4	2.7	2.6	4	5
	Santa Margarita	SLVWD Olympia #2	ND	ND	ND	2	5
	Santa Margarita	SLVWD Olympia #3	ND	ND	ND	2	5
Confined	Lompico	SLVWD Pasatiempo #5A	0.15	0.07	ND	2	5
	Lompico	SLVWD Pasatiempo #7	0.7	0.6	0.57	2	5
	Lompico	SLVWD Pasatiempo #8	ND	ND	ND	2	5
	Lompico	SVWD #10A	ND	ND	ND	2	5
	Lompico	SVWD #11A	ND	ND	ND	2	5
	Lompico	SVWD #11B	ND	ND	ND	2	5
	Lompico/ Butano	SVWD Orchard Well	ND	ND	ND	2	5
	Lompico/ Butano	SVWD Sucinto Well	ND	ND	NA	NA	NA
	Lompico/ Butano	SVWD Grace Way Well	ND	NA	NA	NA	NA

ND – not detected at the laboratory reporting limit

NA – not applicable as there is not enough historical data. MTs and MOs will be established after 3 years of data are available.

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Table 7-5. Arsenic Groundwater Quality Minimum Thresholds and Measurable Objectives

Aquifer Group	Aquifer	Representative Monitoring Point	Arsenic Concentrations, mg/L				
			Highest Arsenic Concentrations Since 2011			Measurable Objective	Minimum Threshold
			Maximum Arsenic	2nd Highest	3rd Highest		
Unconfined	Santa Margarita	SLVWD Quail #4A	0.0032	0.0029	0.0028	0.005	0.008
	Santa Margarita	SLVWD Quail #5A	0.0027	0.0022	0.0015	0.005	0.008
	Santa Margarita	SLVWD Olympia #2	ND	ND	ND	0.002	0.005
	Santa Margarita	SLVWD Olympia #3	ND	ND	ND	0.002	0.005
Confined	Lompico	SLVWD Pasatiempo #5A	0.0035	0.0035	0.0034	0.005	0.008
	Lompico	SLVWD Pasatiempo #7	0.0028	0.0025	0.002	0.005	0.008
	Lompico	SLVWD Pasatiempo #8	0.011	0.011	0.011	0.013	0.015
	Lompico	SVWD #10A	ND	ND	ND	0.002	0.005
	Lompico	SVWD #11A	0.0052	0.0046	0.0046	0.006	0.008
	Lompico	SVWD #11B	0.012	0.012	0.011	0.014	0.016
	Lompico/ Butano	SVWD Orchard Well	ND	ND	ND	0.002	0.005
	Lompico/ Butano	SVWD Sucinto Well	0.0013	ND	NA	NA	NA
	Lompico/ Butano	SVWD Grace Way Well	0.0026	NA	NA	NA	NA

ND – not detected at the laboratory reporting limit

NA – not applicable as there is not enough historical data. MTs and MOs will be established after 3 years of data are available.

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7.5.2.3 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

GSP Regulations do not require projects or management actions to improve existing groundwater quality, although the GSA may undertake such a goal. Since the Basin's groundwater quality is generally suitable for all beneficial users and uses, the SMGWA's objective is to keep it at current concentrations and will not be taking any actions to improve it other than maintaining groundwater levels above historical low levels. Keeping groundwater quality at current concentrations, therefore, poses no threat to other sustainability indicators. However, preventing migration of poor-quality groundwater may limit projects or management actions needed to achieve MTs for other sustainability indicators.

- **Chronic lowering of groundwater levels**. Degraded groundwater quality MTs could negatively impact groundwater level MTs by limiting the types of water that can be used for recharge to increase groundwater levels if groundwater levels started to approach MTs.
- **Change in groundwater storage**. Degraded groundwater quality MTs do not promote pumping in excess of the sustainable yield that is needed to ensure change in groundwater storage does not cause undesirable results. Therefore, the degraded groundwater quality MTs will not result in an exceedance of the groundwater storage MT.
- **Depletion of interconnected surface water**. Degraded groundwater quality MTs do not promote additional pumping or lower groundwater elevations adjacent to interconnected surface water. Therefore, the degraded groundwater quality MTs will not result in a significant or unreasonable depletion of interconnected surface water.
- **Seawater intrusion**. Not applicable.
- **Subsidence**. Not applicable.

7.5.2.4 Effect of Minimum Thresholds on Neighboring Basins

The anticipated effect of the MTs for degraded groundwater quality on each of the neighboring basins is addressed below.

- **Santa Cruz Mid-County Basin** (critically overdrafted). Limited groundwater flows from the Santa Cruz Mid-County Basin into the Santa Margarita Basin. Groundwater quality in the vicinity of the basins' boundary is generally good except for naturally occurring elevated iron, manganese, and occasionally arsenic. No GSP projects or management actions, for either basin, that might change hydraulic gradients or directions are being considered in the vicinity of the basins' shared boundary. The Santa Cruz Mid-County Basin's MTs for groundwater quality are drinking water standards and therefore, it is unlikely that the degraded groundwater quality MTs established for the Basin will

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prevent the Santa Cruz Mid-County Basin from achieving sustainability. Even though the Santa Cruz Mid-County Basin's MT for nitrate (as N) of 10 mg/L is higher than the Santa Margarita Basin's MT of 5 mg/L, the lack of connection between the Santa Cruz Mid-County Basin's primary aquifer (Purisima Formation) and the Santa Margarita Basin's primary aquifers (Santa Margarita, Lompico and Butano aquifers) will not prevent the Santa Margarita Basin from achieving its nitrate (as N) MT.

- **Purisima Highlands Subbasin of the Corralitos Basin** (very low priority). The Santa Margarita Basin is hydraulically downgradient from the Purisima Highlands Subbasin, but is separated from it by the Zayante-Vergeles fault zone, which acts as a barrier to groundwater flow. Furthermore, with MTs in the Santa Margarita Basin generally set below drinking water standards, groundwater quality at those concentrations or better will remain safe for Purisima Highlands Subbasin beneficial users.
- **West Santa Cruz Terrace Basin** (very low priority). The boundary between the Santa Margarita Basin and West Santa Cruz Terrace Basin is located where Tertiary sedimentary rocks that are the principal aquifers in Santa Margarita Basin thin abruptly against basement rocks that are exposed at the surface or are at shallow depth in the subsurface. Groundwater pumping in West Santa Cruz Terrace Basin is mostly from private wells tapping low-yielding Quaternary alluvium and terrace deposits. These Quaternary deposits are not hydrologically connected to similar deposits scattered in small patches in Santa Margarita Basin. Even if the sediments in the 2 basins were highly connected, groundwater quality at drinking water standards would not adversely impact rural residential or GDE groundwater users in the West Santa Cruz Terrace Basin.

7.5.2.5 Effects of Minimum Thresholds on Beneficial Users and Land Uses

In general, groundwater quality concentrations at or less than the MTs will not impact beneficial users and land uses in the Basin. The selected MTs generally benefit beneficial users and land uses in the Basin:

- **Urban land uses and users**[7]. The degraded groundwater quality MTs benefit urban water users in the Basin. Preventing groundwater for drinking water supply from exceeding state drinking water standards ensures an adequate supply of groundwater for municipal use.
- **Rural residential land uses and users**[8]. The degraded groundwater quality MTs benefit domestic water users in the Basin. Ensuring constituents of concern in water supply wells remain below state drinking water standards also protects groundwater quality for private domestic use.

[7] Urban land users include a small area of a DAC supplied water by SLVWD.
[8] Rural land users include an estimated fewer than 10 DAC residents who depend on private wells for domestic use.

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- **Industrial land uses and users.** The degraded groundwater quality MTs generally benefit industrial water users in the Basin. Ensuring constituents of concern in water supply wells remain below state drinking water standards is more protective than is needed for industrial use.
- **Agricultural land uses and users.** The degraded groundwater quality MTs generally benefit the limited agricultural water use in the Basin by preventing impacts to crop health from degraded groundwater.
- **Ecological land uses and users**. Although the groundwater quality MTs do not directly benefit ecological uses, it can be inferred that the degraded groundwater quality MTs generally benefit the environmental water uses in the Basin. Preventing poor-quality groundwater from migrating to GDEs and surface water bodies will limit ecosystem impacts.

7.5.2.6 Relevant Federal, State, or Local Standards

The degraded groundwater quality MTs are defined at concentrations below the state drinking water standards in most RMPs, except for a couple of RMPs with TDS MTs at the secondary MCL and a couple of RMPs with arsenic MTs slightly greater than the primary MCL. The wells with arsenic MTs at higher concentration than the MCL occasionally have detections that marginally exceed the MCL and are managed by the water providers before public distribution.

7.5.2.7 Method for Quantitative Measurement of Minimum Thresholds

Groundwater quality in RMPs will be directly measured by collecting and testing groundwater samples in accordance with the monitoring protocols outlined in Section 6.7. COC concentrations reported by the laboratory will be compared to their respective MTs. Should a MT be exceeded, follow-up sampling and analysis will be conducted to confirm that exceedances are not due to sample collection or laboratory errors.

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7.5.3 Measurable Objectives - Degraded Water Quality

7.5.3.1 Measurable Objectives

All MOs set for degraded groundwater quality strive to prevent groundwater quality degradation from historical maximum concentrations. MOs will alert SMGWA that degradation is starting to occur. The historical maximum concentrations, MTs, and MOs are summarized in tables for TDS (Table 7-3), nitrate (Table 7-4), and arsenic (Table 7-5). Appendix 7B includes chemographs for COCs at each RMP showing historical data, MTs, and MOs.

7.5.3.2 Interim Milestones

Groundwater in the Basin is currently of better quality than MTs for all RMPs with no changes in quality expected from PMAs implemented to achieve sustainability. Since the MOs effectively represent marginal degradation from current conditions, interim milestones are set at the same concentration as MOs.

7.6 Depletion of Interconnected Surface Water Sustainable Management Criteria

The GSP Regulations developed by DWR staff require identifying the location of interconnected surface water and the estimating timing and quantity of depletions. Locations of interconnected surface water are identified in Section 4.6.1. Surface water is hydraulically connected to groundwater in most areas of the Basin. Stream gage monitoring, accretion studies, groundwater level monitoring, stream and GDE field reconnaissance, and groundwater modeling show that during the dry-season from May through October, almost all the water flowing in the Basin's streams and creeks is derived from groundwater.

The direct measurement of streamflow depletion is not feasible given the Basin's geology and topography. Rather, it is more effectively measured in the form of the amount of baseflow contribution from groundwater (accretion) to the San Lorenzo River and its tributaries within the Basin. SMGWA has reviewed the needs of beneficial uses and users of interconnected surface water in comparison to mean daily flows in the San Lorenzo River at Big Trees over 25 years. SMGWA has also evaluated the relationship between baseflow compared to both groundwater extraction and groundwater elevations and has found a stronger correlation between groundwater elevations and baseflow (Sections 4.6.2 and 4.6.3). SMGWA believes that this analysis, summarized in Section 4.6.5, provides justification for the sufficiency of groundwater elevations as a proxy for direct interconnected surface water measurements.

A relevant concern associated with the timing and quantity of depletion (or reduced accretion in this Basin) from groundwater is whether this is resulting in significant and unreasonable impacts to beneficial uses and users. The baseflow analysis strongly supports that September is the most common period of low streamflow in the Basin that also corresponds with potential impacts associated with public supply diversion requirements and minimum flows needed to support spawning of sensitive fish species. This issue of timing, locations, and quantity was considered in establishing the MTs and MOs discussed further below.

7.6.1 Undesirable Results - Depletion of Interconnected Surface Water

Depletion of interconnected surface water is considered significant and unreasonable under any of the following conditions:

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- Groundwater elevations in 3 or more RMPs fall below the MT in 2 consecutive years in the Unconfined aquifer
- Groundwater elevations in 3 or more RMPs fall below the MT in 2 consecutive years in the Confined aquifers
- Groundwater extraction volumes exceed the MT in the Unconfined aquifer
- Groundwater extraction volumes exceed the MT in the Confined aquifers

7.6.1.1 Criteria for Defining Depletion of Interconnected Surface Water Undesirable Results

The criteria used to define significant and unreasonable impacts and undesirable results for depletion of interconnected surface water are focused on the protection of beneficial uses and users. To protect these uses and users, maintaining groundwater elevations that result in sufficient surface water baseflow, in conjunction with maintaining groundwater extraction at levels below their historical highs that occurred prior to SGMA, are intended to result in avoiding impacts to surface water users within and outside the Basin, riparian and aquatic habitat and species, and GDEs adjacent to interconnected surface water.

While the information reviewed by SMGWA indicates that groundwater elevations and extraction from the Unconfined aquifer have a more immediate impact on baseflow in any given year, groundwater elevations and extraction from the deeper, Confined aquifers are also considered as criteria. This is in recognition that declining water levels in the Confined aquifers could introduce vertical gradients that result in baseflow depletion over a multi-year timeframe.

7.6.1.2 Potential Causes of Undesirable Results

Section 4.6.2 identifies there is a relatively weak correlation between surface water flow and groundwater extraction. However, undesirable results may occur if groundwater pumping causes declines in shallow groundwater levels that support GDEs and baseflow to creeks. Given the strong correlation between precipitation and surface water flow, a likely cause of undesirable results would be an extended dry period of 2 or more years (e.g., 2014 and 2015) or an extremely dry single year (e.g., 2021).

7.6.1.3 Effects on Beneficial Users and Land Use

Undesirable results from depletion of surface water can have the following general impacts on beneficial users and land uses:

- **Urban land uses and users**. If municipal supply wells cannot be pumped due to depletion of interconnected surface water SMC, an alternative water source will need to be used. This will likely add stress on municipal water systems that will result in installation of new wells or increased pumping in wells away from the impacted area,

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which increases the potential for further depletions of interconnected surface water in other portions of the Basin. Depletion of interconnected surface water may reduce the availability of surface water for the City of Santa Cruz, which is a downstream user of surface water that can only divert when there are flows greater than the Agreed Flows described in Section 2.2.8.

- **Rural residential land uses and users**. Depletion of interconnected surface water may limit the amount of available groundwater for residential groundwater supply due to reduced recharge from streams. Property values may decline if lowering of groundwater levels causes undesirable results that require residential pumping restrictions, deepening of wells, or connection to a public water system.
- **Industrial land uses and users**. Industrial use of groundwater in the Basin is limited to process and dust suppression water at 1 remaining sand quarry at Quail Hollow. Depletion of interconnected surface water has the potential to reduce access to groundwater for similar reasons listed above for rural residential users.
- **Agricultural land uses and users**. For the very limited agriculture in the Basin, depletion of interconnected surface water may reduce access to groundwater for similar reasons listed above for rural residential users.
- **Ecological land uses and users**. GDEs have the potential to be impacted directly if the depth to groundwater exceeds GDE rooting depth. Surface water bodies connected to groundwater may also incur reductions in baseflow. Under late summer low flow conditions, there is a direct relationship between streamflow and the amount of suitable GDE habitat. Reduction of flow directly reduces the amount of suitable rearing habitat for steelhead, by reducing the amount of wetted area, stream depth, flow velocity, cover, and dissolved oxygen. Reduced flow can also result in increased water temperature. In extreme conditions, dewatering of stream reaches eliminates the ability of fish to move to more suitable areas and can cause mortality. In even more extreme conditions, lowering of groundwater levels below the root zone of riparian vegetation can result in the loss of vegetation, impacting terrestrial GDE habitat. Section 2.4.1.8 includes a detailed discussion of the ecological users in the basin, including: a list of priority species and co-beneficiaries of priority species, resources and methods available to evaluate instream flows for priority species, steelhead and coho minimum passage and spawning criteria, and a summary of ongoing programs to evaluate the biological response of priority species within the basin.

7.6.2 Minimum Thresholds - Depletion of Interconnected Surface Water

SMGWA and its partners have studied the relationship between groundwater and ISW throughout the Basin. Based on our understanding, direct measurement of depletion of ISW is infeasible and is not the most important information related to beneficial uses and users. Instead,

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SMGWA believes the following framework for location, quantity, and timing of depletion of ISW addresses the intent of the regulation:

- **Location:** The San Lorenzo River at Big Trees is an appropriate measuring point to account for the effect of depletion throughout the Basin. Accretion studies and dry-season streamflow monitoring indicate that the measurement of flow taken at this location are representative of Basin conditions.
- **Quantity:** The flow volume at Big Trees is appropriate for measuring depletion of ISW. This quantity can be related to the ability of both in-Basin and out-of-Basin surface water users to divert for public supply needs and the need of environmental uses to support critical fish species.
- **Timing:** September flow is the best indicator for evaluating depletion of ISW. It coincides with when flows are most critical for both diverters and fish. It also comes at the end of the dry season when the effects of groundwater levels are most prominent on baseflow.

Specifics of how these factors are tied to MTs are provided below.

7.6.2.1 Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

The information and methodology used to establish the depletion of interconnected surface water MTs and MOs are the same as those used for chronic lowering of groundwater levels and reduction of groundwater in storage.

Groundwater levels serve as a proxy for depletion of interconnected surface water due to their demonstrated relationship to contributions to baseflow as described in Section 4.6.3. WY 2013 was identified as a relatively dry year that supported a minimum baseflow greater than 10 cfs through the month of September. Because the diversion restriction below 10 cfs impacts SLVWD as a beneficial user of surface water in the Basin, groundwater elevations from fall 2013, which supported more than the minimum baseflow, are used as the basis for establishing MTs. This flow is greater than the minimum flow of 8 cfs identified in the 2025 City of Santa Cruz HCP for rearing of sensitive fish species.

The MOs are established at the fall 2006 groundwater elevations at each RMP. Fall 2006 was the second of 2 consecutive wet years, which followed 3 consecutive normal water years. Groundwater elevations were at a relatively high level similar to recent wet years like water years 2017, 2018, and 2023. In 2006, San Lorenzo River flow supported downstream diversions and met the 2025 City of Santa Cruz HCP in-stream flow requirements for a very wet year of 13.3 cfs, further making this an achievable target year for Basin groundwater level management.

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Figure 7-3 shows mean daily flow for water years 2013 and 2006. Flow in WY2013 remained above the September Flow Minimum of 10 cfs, Groundwater levels in 2013 supporting this baseflow are the basis for the MTs. Flow in WY2006 stayed well above the Wet Year September Flow Minimum of 13.3 cfs. Groundwater levels from 2006 that supported this baseflow are the basis for the MOs.

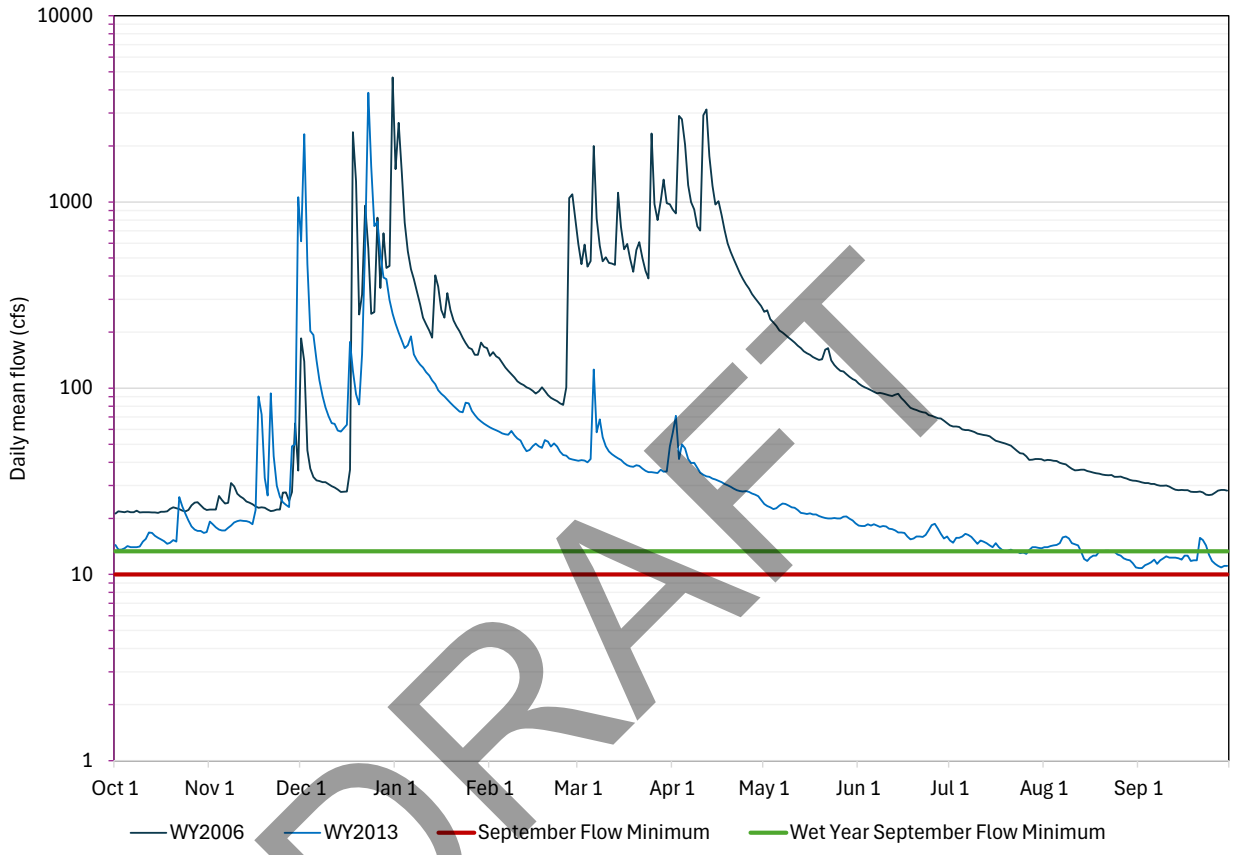

Figure 7-3. Daily Mean Flow at Big Trees for WY 2006 and 2013 and HCP Minimum Flow Requirements

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Groundwater extraction is used as an additional SMC indicator for depletion of ISW. As discussed in Section 7.4 above, the MO is established as the model-determined sustainable yield of the Basin and the MT is associated with allowing additional extraction during dry conditions to develop future conjunctive use programs while operating within the sustainable yield over the long-term.

7.6.2.2 Depletion of Interconnected Surface Water Minimum Thresholds

Identical MTs are used for this sustainability indicator and the chronic lowering of groundwater levels and reduction of groundwater in storage indicators described in Sections 7.3 and 7.4.

Chronic lowering of groundwater levels is used as a proxy for the depletion of interconnected surface water. MTs for each RMP are summarized in Table 7-1. Hydrographs showing MTs and

MOs for each RMP are included in Appendix 7A. The cross-sections on Figure 7-4 and Figure 7-5 show MTs and MOs near the downstream reaches of the interconnected stream reaches on the San Lorenzo River/Newell Creek, Bean Creek, and Zayante Creek. The MTs and MOs are at a higher elevation than nearby interconnected stream reaches on the San Lorenzo River, Newell Creek, Zayante Creek, and Bean Creek and thus continue to support baseflow of groundwater to streams. The figures also show groundwater levels measured in fall 2025 for an example of how current conditions compare to the SMC.

Groundwater extraction SMC are shown in Table 7-2. Figure 7-1 and Figure 7-2 show the SMC for the unconfined and confined aquifers, respectively along with the historical, current, and projected conditions based on modeling.

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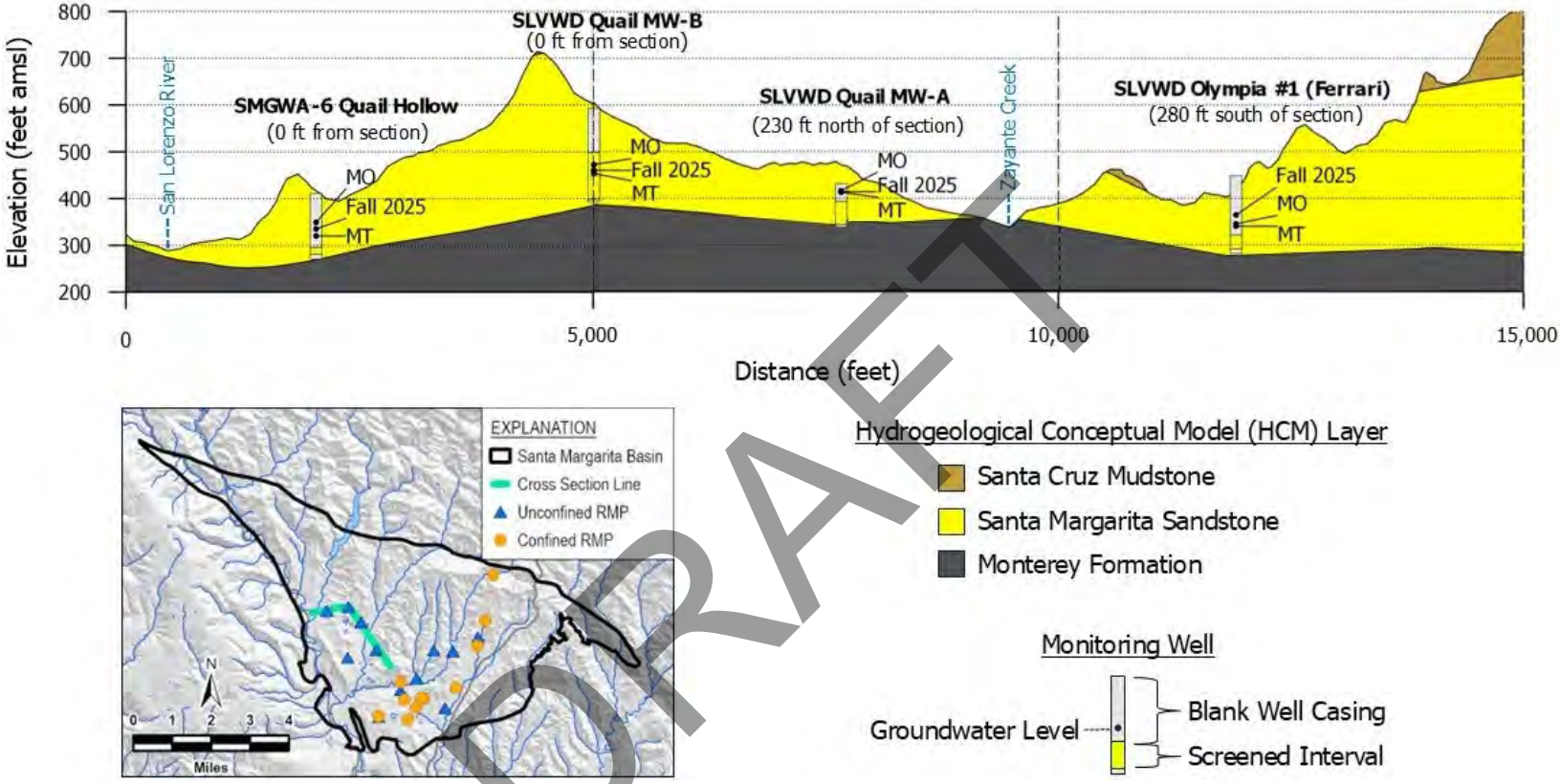

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Figure 7-4: Cross Section of Groundwater Level Minimum Thresholds, Measurable Objectives, and WY2025 Groundwater Elevations Relative to Interconnected Streams in the Quail Hollow and Olympia/Mission Springs Subareas

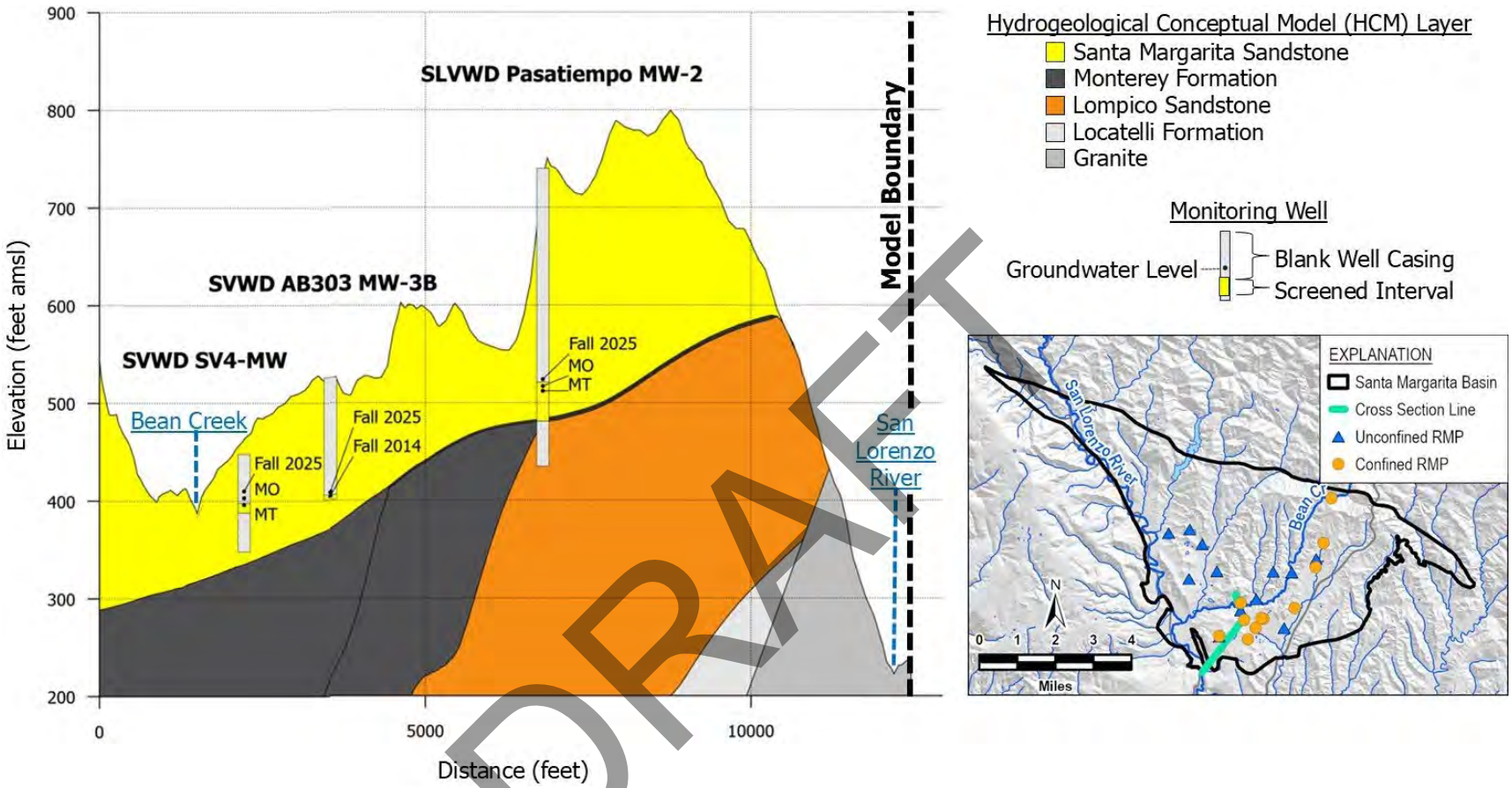

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Figure 7-5. Cross-Section of 2027 GSP Amendment Groundwater Level Minimum Thresholds, Measurable Objectives, and WY2025 Groundwater Elevations Relative to Interconnected Streams in the Olympia/Mission Springs and Mount Hermon / South Scotts Valley Subareas

7.6.2.3 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

Using chronic lowering of groundwater levels and reduction of groundwater in storage SMC proxy should avoid undesirable results for other sustainability indicators, as described below:

- **Chronic lowering of groundwater levels**. The SMC are identical for the unconfined aquifer and confined aquifers for both sustainability indicators.
- **Reduction of groundwater in storage**. The SMC are identical for the unconfined aquifer and confined aquifers subject to stream depletion in this Basin.
- **Degraded groundwater quality**. MTs for depletion of interconnected surface water are intended to maintain groundwater levels above 2013 and extraction operating within the sustainable yield. Since groundwater quality degradation was not occurring under these conditions, the MTs are not expected to cause future exceedances of groundwater quality MTs.
- **Seawater intrusion**. Not applicable.
- **Subsidence**. Not applicable.

7.6.2.4 Effect of Minimum Thresholds on Neighboring Basins

The anticipated effect of the depletion of interconnected surface water MTs on each of the neighboring basins is addressed below.

- **Santa Cruz Mid-County Basin** (critically-overdrafted). The Santa Margarita Basin is upstream of the Santa Cruz Mid-County Basin. The San Lorenzo River does not run through the Santa Cruz Mid-County Basin, but the West Branch of Soquel Creek and Blackburn Gulch/Branciforte Creek do. Only a very small portion of the West Branch of Soquel Creek runs through the Santa Margarita Basin). By maintaining groundwater levels above 2013 levels in areas near interconnected streams, the MTs do not prevent the Santa Cruz Mid-County Basin from meeting their respective surface water depletion MTs which are based on groundwater elevations slightly higher than historical lows. Groundwater flow between the Santa Cruz Mid-County Basin and the Santa Margarita Basin is limited, and there are no GSP projects or management actions planned for either basin that might change hydraulic gradients near the basins' shared boundary. The lack of connection between the Santa Cruz Mid-County Basin's primary aquifer (Purisima Formation) and the Santa Margarita Basin's primary aquifers (Santa Margarita, Lompico and Butano aquifers) further reduces the likelihood of either basin affecting depletion of interconnected surface water MTs in the neighboring basin.

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- **Purisima Highlands Subbasin of the Corralitos Basin** (very low priority). The Purisima Highlands Subbasin is hydraulically upgradient from the Santa Margarita Basin and separated by the Zayante-Vergeles fault zone which acts as a barrier to groundwater flow. This hydrogeologic disconnect provides little opportunity for depletion of interconnected surface water in the Santa Margarita Basin to influence groundwater in the Purisima Highlands Subbasin.
- **West Santa Cruz Terrace Basin** (very low priority). Most private domestic wells in the West Santa Cruz Terrace Basin pump from low yielding Quaternary alluvium and terrace deposits (DWR, 2003). These deposits are not principal aquifers in the Santa Margarita Basin nor are they hydraulically downgradient of the Santa Margarita Basin. Therefore, it is unlikely that the depletion of interconnected surface water MTs in the Santa Margarita Basin would influence the West Santa Cruz Terrace Basin.

7.6.2.5 Effects of Minimum Thresholds on Beneficial Users and Land Uses

The MTs for depletion of ISW measured using chronic lowering of groundwater levels and reduction of groundwater in storage SMC proxy assumes that maintaining groundwater levels at or above fall 2013 conditions, will maintain groundwater's contribution to creeks thus supporting beneficial users in the Basin. The following specifically describes how managing to these MT proxies will benefit land use and beneficial water use in the Basin:

- **Urban land uses and users**. Municipal groundwater pumpers will still be able to meet their typical water demands if surface water's connection with groundwater remains similar to the historical degree of connection. The City of Santa Cruz, as a user of Basin surface water and implementor of habitat conservation in the San Lorenzo River watershed, relies on baseflows to help achieve the Agreed Flows described in Section 2.2.8. If groundwater levels adjacent to creeks are no lower than fall 2013 levels, baseflows should remain within the historical range of flows used to determine the Agreed Flows.
- **Rural residential land uses and users**. Maintaining surface water interconnection with groundwater at or above fall 2013 levels will protect the ability of residential beneficial users to pump from domestic wells.
- **Industrial land uses and users**. Maintaining surface water interconnection with groundwater should benefit industrial land uses and beneficial users by supporting similar groundwater pumping to historical levels.
- **Agricultural land uses and users**. For the very limited agriculture in the Basin, maintaining interconnection of surface water and groundwater at historical levels should not impact irrigation water supply.

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- **Ecological land uses and users**. Meeting MTs will support GDEs and priority species by maintaining sufficient in-stream flows.

7.6.2.6 Relevant Federal, State, or Local Standards

No explicit federal, state, or local standards exist for depletion of interconnected surface water. However, both the CCRWQCB and state and federal endangered species provisions call for the protection and restoration of conditions necessary for steelhead and coho salmon habitat in San Lorenzo River. These provisions were considered in development of the MTs for ISW depletion.

7.6.2.7 Method for Quantitative Measurement of Minimum Thresholds

Identical metrics are used for this sustainability indicator and the chronic lowering of groundwater levels and reduction of groundwater in storage indicators described in prior sections.

7.6.3 Measurable Objectives - Depletion of Interconnected Surface Water

Identical MOs and interim milestones are used for this sustainability indicator and the chronic lowering of groundwater levels and reduction of groundwater in storage indicators described in Sections 7.3 and 7.4.

7.7 Land Subsidence Sustainable Management Criteria

Land subsidence is highly unlikely in this consolidated bedrock Basin and therefore no SMC are established for this sustainability indicator. Section 4.5 provides substantiating evidence for subsidence's inapplicability as an indicator of groundwater sustainability. Even though the indicator is not applicable, the SMGWA Board agreed that any land subsidence caused by lowering of groundwater levels occurring in the Basin would be considered significant and unreasonable.

If, during GSP implementation, the Basin experiences conditions of inelastic subsidence specifically due to groundwater use, the SMGWA would develop land subsidence SMC in an update to the GSP.

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8 PROJECTS AND MANAGEMENT ACTIONS

This chapter describes a range of potential PMAs that will allow the Basin to achieve sustainability in accordance with §354.42 and §354.44 of the GSP Regulations.

As a Joint Powers Authority, SMGWA includes 3 member agencies: SLVWD, SVWD, and the County. The SMGWA Board consists of representatives from the 3 member agencies and from other public agencies and private groups that rely directly or indirectly on groundwater from the Basin: City of Scotts Valley, City of Santa Cruz, MHA, and private well owners. PMAs presented herein may provide benefits to just a single agency, to multiple agencies, and/or other groundwater or surface water users within the Basin. The term *cooperating agencies* is used throughout this section to represent the diverse water supply and land use planning agencies, organizations, and other operations that have a role in developing or implementing projects and/or management actions within the Basin. It includes SMGWA member agencies, other public agencies, and private parties.

PMAs discussed in this section are in varying stages of development. They are proposed to achieve one or more of the following outcomes:

- Achieve groundwater sustainability in the Basin by meeting SMC by 2042
- Meet the water supply goals of the cooperating agencies
- Provide a framework for future collaboration and cost sharing for cooperating agencies

The Santa Margarita Basin is not currently experiencing undesirable results based on the SMC in this GSP. Additionally, modeling of projected conditions with future demands (Section 5.4) indicates that the Basin is generally in balance and will likely be sustainable with limited PMAs. This current and projected status has been achieved through a combination of PMAs implemented over the past 2 decades that are already providing significant benefits to the Basin. These ongoing PMAs are:

- Conjunctive use of groundwater and surface water (Section 2.3.4.1)
- Stormwater recharge (Section 2.3.4.2)
- Water use efficiency programs (Section 2.3.4.4)
- Recycled water use (Section 2.3.4.5)

Additional PMAs that have yet to be implemented are presented below in 2 groups, classified as primary and supplemental PMAs:

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- **Primary PMAs:** Primary PMAs are considered the Basin's most immediate options for the continued avoidance of undesirable results in the SGMA implementation horizon. Primary projects require detailed feasibility and environmental review. Management actions can be implemented at the discretion of the GSA. Continuation of ongoing projects listed above, supplemented by the primary PMAs is anticipated to allow the Basin to achieve long-term sustainability. If this combination of PMAs cannot meet the SMGWA's sustainability goals, additional supplemental projects may need to be evaluated.
- **Supplemental PMAs:** If groundwater model projections and assumptions of future supply availability change or if primary projects do not achieve the expected results further PMAs will be required to achieve sustainability. Similarly, if primary projects fail to become feasible either due to costs, environmental requirements, or any other reason, SMGWA may need to look to additional projects. In either case, appropriate supplemental projects may be explored. As work continues on water supply and resource management efforts, it may be prudent to incorporate additional projects into future GSP amendments.

Primary and supplemental projects included here are generally the result of work and ideas emanating from a 2017 Memorandum of Agreement between SLVWD, SVWD, City of Santa Cruz, and County of Santa Cruz (City of Santa Cruz *et al.*, 2017) to explore and evaluate potential projects for the conjunctive use of surface and groundwater resources in the Basin and San Lorenzo River watershed.

8.1 How Projects will be Accomplished

PMAs included in Sections 8.2 and 8.3 provide a framework for achieving the outcomes described above. However, project feasibility analysis must be completed, funding secured, and necessary cooperation agreements negotiated before any of the PMAs proceed with design, permitting, water rights, environmental review, and ultimately implementation. Costs for implementing projects are in addition to the costs for operation of the SMGWA described in the GSP's implementation plan in Section 9.

Projects are not sufficiently developed for cooperating agencies to commit to them before the SMGWA submits the GSP Amendment to DWR in January 2027. Cooperating agencies, rather than the SMGWA, lead project implementation and coordinate with one another on projects with multi-stakeholder benefits. Some projects may ultimately carry substantial costs, and their implementation depends on obtaining grants and low-interest loans to supplement local revenue streams.

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Through project feasibility analysis, cooperating agencies will need to demonstrate to the SMGWA that their projects meet SMGWA's groundwater sustainability goals, water supply goals of the individual cooperating agencies without causing undesirable effects to other groundwater beneficial uses or users.

Feasibility and analysis of projects will require additional information, technical and financial analysis, modeling, and potentially, pilot scale testing. Findings and results of such feasibility and analysis will be provided to the SMGWA Board for final evaluation and approval. SMGWA Board involvement in project evaluation is likely limited to determining if projects interfere with achieving the Basin's sustainability goals or have negative impacts on other GSP-related PMAs. Cooperating agencies are encouraged to coordinate with one another on projects to ensure multi-stakeholder benefits, thereby decreasing the likelihood of project interference.

Aside from feasibility and analysis, each SMGWA member and cooperating agency is responsible for permitting and other specific implementation oversite for its own projects. Inclusion in this GSP does not forego any obligations under local, state, or federal regulatory programs. A complete summary table of PMAs is included in Appendix 8A.

8.2 Primary Projects and Management Actions

The main groundwater condition that PMAs in the Santa Margarita Basin aim to improve is lowered groundwater levels in the Basin's confined aquifer. The Lompico aquifer in the Mount Hermon / South Scotts Valley area has experienced a historical decline of about 150 to 200 feet, as described in Section 4.2.4. This long-term decline has been stabilized largely through successful water use efficiency programs and use of supplying recycled water for non-potable demands. However, maintaining groundwater level recovery will likely require additional PMAs to maintain sustainability with climate change (Section 5.5).

The following subsection provides a project description followed by a summary of objectives and discussion of circumstances for implementation, and other aspects of the Basin's primary sustainability project. This is followed by a description of the Basin's primary management action related to groundwater quality sustainability.

8.2.1 Project 1: SLVWD Expanded Conjunctive Use

Project Description

As discussed in Section 2.3.4.1, SLVWD has been practicing conjunctive use in their North System for decades, however, SLVWD has an opportunity to expand conjunctive use in their South System. The South System is supplied groundwater pumped from the Lompico aquifer by

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SLVWD's Pasatiempo wellfield. Expanding conjunctive use will allow SLVWD to optimize use of currently available treated surface water sources in their North System and Felton System by using existing system interties and potential capacity enhancements to offset groundwater pumping in their South System where lowered groundwater levels have occurred. SLVWD would achieve reductions in groundwater pumping in the South System by substituting Pasatiempo pumping with excess surface water from the North System and/or Felton System. In very wet years when there is more surface water available than needed to meet SLVWD's South System demands, the Santa Margarita aquifer will benefit by resting SLVWD's Quail Hollow and Olympia wellfields in the North System.

Details on the climate projection and water availability analysis are described in the 2022 GSP groundwater model report included as Appendix 3A. Estimated available excess surface water is 227 AFY, including approximately 99 AFY from the North System and up to 128 AFY the Felton System. Available excess surface water is based primarily on runoff simulated to occur in response to the future climate projection developed for the GSP.

In general, availability of excess surface water is constrained by several factors, including drinking water treatment capacity, water rights place of use restrictions, required minimum fish flows, and availability of adequate surface water supplies to serve SLVWD customers in the North System. SLVWD's Fall Creek diversion that supplies the Felton System is currently limited by the water right place of use to the town of Felton. The following constraints are considered in the analysis of availability:

- Minimum Fall Creek winter (November 1 through March 31) bypass flow of 0.75 cfs for dry years, and 1.5 cfs for other years. Dry years are defined based on cumulative flow volume in the San Lorenzo River at Big Trees from the beginning of the water year, and it should be noted that the administrative definition of dry year used to constrain Felton System diversions differs from the definition of dry year used for the GSP.
- SLVWD's permitted appropriative right to divert at a maximum total diversion rate of 1.7 cfs from Fall and Bull Creeks, and Bennett Spring, with a maximum total annual diversion volume of 1,059 AF.
- Diversions from streams serving SLVWD's Felton System are permitted only if streamflow in the San Lorenzo River at Big Trees is at least 20 cfs.

As of August 2026, SLVWD is working on mapping out the process for the project, which would likely include developing a conjunctive use plan, followed by developing a project description for an environmental review and subsequently applying for a permit amendment.

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Project Objectives

The project objective is to use existing infrastructure to expand conjunctive use to passively recharge groundwater in SLVWD's Quail Hollow, Olympia, and Pasatiempo wellfield areas by resting those wells when excess North and Felton Systems surface water is available while also increasing stream baseflows. Groundwater stored by in-lieu recharge can be pumped in years when surface water flows are less available. As a result of expanding conjunctive use in the Basin, it is expected that there will be increased groundwater levels, increased stored groundwater, and increased baseflows.

Circumstances for Implementation

SLVWD is committed to this expanded conjunctive use project, which is already in the early planning stages and is likely to be implemented in the next few years.

Public Noticing

Public noticing is anticipated to occur through compliance with CEQA for any plans associated with the project. Specific actions related to the project will be approved through regular SLVWD public board meetings in which public discussions or comments will occur.

Overdraft Mitigation and Management Actions

The water budget described in Section 5 identifies there have been historical losses of groundwater in storage in the Basin. The historical declines in groundwater levels in the Mount Hermon / South Scotts Valley started to lessen in the mid-2000s due to water use efficiency efforts by SLVWD and SVWD as well as elimination of pumping by the former Hanson Quarry and the former Valley Gardens Golf Course to the point that groundwater levels are no longer declining. While the stabilization of groundwater levels in recent years is promising, model projections with future climate change (Section 5.5) indicate that declines could resume in the future with hotter temperatures and more variable precipitation without the project.

Permitting and Regulatory Process

The project will require compliance with CEQA. No new water rights are being requested as part the project. However, change of water rights place of use will be needed for excess surface water available from the Fall Creek diversion in the Felton System.

Timetable for Implementation

SLVWD is in the planning stage for expanded conjunctive use and anticipates that expanded conjunctive use will be implemented within the next 5 years, with the majority of the time needed for approval of the water rights place of use modification through the SWRCB.

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Expected Benefits

Additional conjunctive use is expected to help increase groundwater levels in areas where wells are rested. The past several years have already seen a preview of the benefit to the Pasatiempo area. SLVWD has been able to operate under an emergency authorization to deliver surface water to offset groundwater use in its wells since the CZU Lightning Complex Wildfire. Groundwater levels in the Pasatiempo MW-1 monitoring well in the Lompico aquifer have seen some of their highest elevations in the past 20 years during this period.

Legal Authority

California state law gives SLVWD the authority to take actions necessary to supply sufficient water for present or future beneficial use.

Estimated Costs and Funding Plan

Cost estimates are currently unknown, although no capital facility improvements and expenses are assumed to be needed. SLVWD is expected to fund the project through its rates, although it may pursue grant funding opportunities should they come available.

Management of Groundwater Extractions and Recharge

This project is not intended to limit groundwater extraction. The GSP monitoring networks will be used to track groundwater levels, groundwater extraction, groundwater quality, and interconnected surface water SMC to evaluate sustainability associated with project implementation. SLVWD would be expected to coordinate with SMGWA should sustainability concerns arise.

8.2.2 Management Action 1: Groundwater Quality Coordination with Santa Cruz County Environmental Health Division

Project Description

This management action will include SMGWA reviewing all publicly available water quality data compiled by the State Division of Drinking Water for public water supply wells in the Basin. The review will include looking for any VOC detections or any constituent exceeding an MCL. SMGWA will complete this review by December 31 each year. SMGWA will share any water quality items of interest in an annual coordination meeting with SCEH Site Mitigation Program representatives. SCEH is the local agency authorized by the CCRWQCB and California Department of Toxic Substances Control (DTSC) to oversee investigation and cleanup of waste releases in Santa Cruz County. At the meeting, SCEH and SMGWA will also discuss active site investigations or remediation activities as they could relate to sampling results or future recommended sampling.

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Project Objectives

The management action objective is to track and identify issues of emerging concern with respect to contaminants. Coordination is intended to assist SCEH in its oversight role in working with responsible parties to protect the beneficial uses of groundwater.

Circumstances for Implementation

SMGWA is committed to implementing this management action. The level of effort will vary in any given year depending on the results of groundwater quality review and coordination with SCEH.

Public Noticing

Public noticing of emerging issues would occur through regular public meetings of the SMGWA Board.

Overdraft Mitigation and Management Actions

This management action does not involve overdraft mitigation. It will directly address the degradation of groundwater quality SMC.

Permitting and Regulatory Process

Coordination does not require permitting and does not affect the regulatory process of the SCEH in its oversight role.

Timetable for Implementation

The management action will take effect immediately and be an ongoing process. SMGWA has already met with SCEH in November 2025 to get their concurrence with this coordination.

Expected Benefits

The expected benefit is to increase the effectiveness of the GSA and the County in their respective roles. Consistent review by the GSA of all water quality monitoring in the Basin could help the SCEH in identifying potential sources of contamination and information from the SCEH on active sites or investigations could help local water suppliers with targeting sampling for specific water quality parameters in addition to those required for drinking water regulatory programs.

Legal Authority

Legal authority is not required for this coordination.

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Estimated Costs and Funding Plan

The management action is not expected to add significant expense to the baseline activities of SMGWA. The level of effort would equate to approximately $2,500 to 5,000 per year, depending on the level of activity. SMGWA would fund the activity through its annual budget process.

Management of Groundwater Extractions and Recharge

The management action does not require the management of groundwater extractions or recharge. However, it is expected that SMGWA would coordinate with water suppliers potentially impacted by future contaminants to identify feasible operational changes to limit or mitigate impacts.

8.3 Supplemental Projects and Management Actions

If the primary expanded conjunctive use project is deemed infeasible or anticipated outcomes change, SMGWA may look to supplemental projects to meet SMGWA sustainability goals. Because these are supplemental projects, the level of detail provided for them is significantly less detailed than the primary PMAs. Note that despite these being classified as supplemental projects, they may still proceed based on the interests of the cooperating agencies.

8.3.1 Project 2: SVWD/City of Santa Cruz Conjunctive Use

Similar to the expanded conjunctive use project presented in Section 8.2.1, this is a conjunctive use project, but it relies on treated surface water from outside of the Basin to offset some or all SVWD groundwater pumping during the wet season months and for active banking. Treated surface water would be provided by the City when excess water is available. To facilitate the transfer of treated surface water to the Basin, Intertie-1, comprising a new 2-mile pipeline and a 12-inch-diameter, bi-directional, 1 million gallon per day intertie and pump station between the City of Santa Cruz and SVWD has been constructed. The project also includes a new extraction well in SVWD to replace aging wells, increase extraction capacity, strengthen SVWD's ability to provide redundancy and meet potential increased demand, and to supply water to neighboring agencies in drought conditions. The project is funded through a 2021 Urban and Multibenefit Drought Relief grant for $9.5 million to implement a Regional Drought Resiliency Project awarded to SVWD.

In addition to providing benefits during drought of other emergency conditions, the intertie and increased extraction capacity enables conjunctive use of the 2 systems. The City can convey surplus surface water to SVWD for active and passive recharge of the Basin, banking water during wet years for use during dry years.

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The City of Santa Cruz and SVWD are currently evaluating what infrastructure and capacities are needed to store water in the Basin for drought supply. The Basin Model is being used to evaluate the potential benefits and impacts of storage to the Basin's aquifers and ISW, and to determine how the project can be operated in conformance with the Basin's SMC.

As a means of further expanding conjunctive use capacities, both agencies are interested in studying the use of ASR wells. Substantial analysis and investigation would be needed before advancing this concept, including hydraulic modeling of the SVWD system; water quality modeling to identify potential water quality impacts; drilling exploratory boreholes to confirm suitable geology; identifying potential ASR well sites; constructing or converting wells with ASR capability and conducting ASR pilot testing to determine injection and extraction capacities and potential water quality impacts; upgrading water treatment plant capacity; and constructing additional conveyance to and from the ASR wells.

8.3.2 Project 3: Expanded Stormwater Recharge

This project includes, where feasible, installation of small to medium scale, 10 AFY to 100 AFY per site, facilities to capture stormwater to recharge the Santa Margarita aquifer through surface spreading, linear infiltration galleries or constructed dry wells. Preliminary siting of such facilities could be within the Lockhart Gulch area where stormwater runoff is currently diverted, near an existing detention basin on Marion Avenue, or one of several previously disturbed sites in public ownership or on property owned by the Santa Cruz Land Trust. Benefits would be location dependent but would likely increase groundwater levels locally around the recharge site and increase Santa Margarita aquifer baseflows to creeks. If stormwater recharge locations can be found in the Camp Evers area where the Monterey Formation is absent, recharge could also benefit the Lompico aquifer underlying the Santa Margarita aquifer.

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9 GROUNDWATER SUSTAINABILITY PLAN IMPLEMENTATION

This section describes the agency's funding and an estimate of the cost to implement the GSP over the next 5 years. It includes a schedule for implementation that serves as a roadmap for GSP implementation activities between 2027 and 2042 but focuses on implementation activities between 2027 and 2032.

9.1 Agency Funding

The SMGWA is organized as a JPA by and between 3 public agencies: SLVWD, SVWD, and the County. The water districts are the Basin's principal water purveyors, while the County oversees the well permitting process and represents non-municipal pumpers. The SMGWA is funded by its 3 member agencies and other agencies represented on the SMGWA Board through annual contributions. The cost allocation is currently established at: 46.4% to SVWD; 31.7% to SLVWD; 12.5% County of Santa Cruz; 5.0%; City of Santa Cruz; and 4.5% Mount Hermon Association. Future contribution amounts may be reassessed based upon SMGWA's annual budgetary requirements and equitable cost share rationale between the member and other represented agencies. The SMGWA will continue to pursue funding opportunities from state and federal sources to support GSP implementation activities.

As authorized under Chapter 8 of the SGMA, a GSA may impose fees, including, but not limited to, permit fees and fees on groundwater extraction or other regulated activity, to fund the costs including groundwater sustainability planning and program activities and administration. While the SMGWA has elected to not assess other private users of groundwater in the Basin, SMGWA reserves the right to evaluate assessing fees on other private users of groundwater should they be determined to either cause impacts to Basin sustainability or substantially benefit from SMGWA's management activities. There are no current plans to impose a fee on private users of groundwater in the Basin.

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9.2 Estimate of GSP Implementation Costs

This section provides an estimate of the cost to implement the GSP and a general description of activities. Implementation costs are presented in 2 principal categories: 1) Governance, Administration and Business Operations and 2) SGMA Compliance and GSP Implementation. Table 9-1 presents the estimated costs by budget category and major tasks. Each of the line items correspond to the GSP implementation activities described in the subsections that follow.

Since formation in 2017, the SMGWA has used a collaborative staffing model whereby cooperating agencies participating in Basin management through the SMGWA do so as part of their internal budgets and not that of the SMGWA. Executive Staff from the 3 member agencies provide leadership and management while member agency professional and technical staff

support Basin monitoring/data collection activities. Except for the agency's Treasurer, the collaborative staff support is provided as "in kind" services that are not funded by the SMGWA.

Consultants and service providers are retained to support governance, administration and business operations and to perform specialized activities such as technical work, legal counsel, financial audit, facilitation, public outreach, and grant administration. Staffing needs will be assessed periodically to ensure the collaborative staffing model and consultant support meets the agency's needs as SGMA compliance and GSP implementation proceeds.

A cost estimate for the 5-year period between WY2027-2032 is provided in Table 9-1. More accurate costs will be brought to the Board annually through the annual budget review and approval process.

Table 9-1. Santa Margarita Groundwater Agency 5-Year Estimated Costs for GSP Implementation

Categories and Tasks	Annual Cost	Lump Sum Items	5-Year Total	Annualized Cost (5 Years)
Governance, Administration and Business Operations				
Governance and Administrative Services	$153,000	$0	$765,000	$153,000
Administrative General Expenses	$17,000	$0	$85,000	$17,000
Treasurer Services	$10,000	$0	$50,000	$10,000
Annual Financial Audit	$10,000	$0	$50,000	$10,000
Legal Counsel	$12,000	$0	$60,000	$10,000
SGMA Compliance and GSP Implementation				
GSP Planning and Implementation Services	$105,000	$0	$525,000	$105,000
Basin Monitoring	Individual agencies will conduct monitoring			
Basin Monitoring – SMGWA specific expenses	$5,000	$0	$25,000	$25,000
Technical Services (as needed)	$10,000	$0	$50,000	$10,000
Data Management System	$15,000	$0	$75,000	$75,000
GSP Annual Report	$35,000	$0	$175,000	$35,000
GSP Periodic Evaluations (5-year)	$0	$60,000	$60,000	$12,000
Community Outreach and Engagement	$15,000	$0	$75,000	$15,000
TOTAL	$387,000	$60,000	$1,995,000	$397,000

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9.2.1 Governance, Administration and Business Operations

Governance, administration, and business operations are necessary for the SMGWA to function. Estimated costs to cover these tasks are presented in Table 9-1.

9.2.1.1 Governance and Administrative Services

This category encompasses the services necessary for the governance and operations of the agency. Activities include Board and committee support, meeting coordination, agenda and packet preparation, policy implementation, public noticing, records management, regulatory compliance, financial management, budgeting, invoicing, contract procurement and administration, and organizational administration. It includes coordination among member agencies, consultants, and the public to ensure efficient day-to-day operations. The agency currently utilizes a non-profit organization to provide these services. It is anticipated that the approach of using a service provider/consultant to support these services will continue in the next 5-year period.

9.2.1.2 Administrative General Expenses

These expenses include the day-to-day business operations of the Agency, including insurance, office and meeting expenses, memberships, software subscriptions, supplies, document management, communications, and other organizational costs required to maintain Agency operations.

9.2.1.3 Treasurer Services

The SVWD Finance Manager serves as SMGWA Treasurer and is responsible for the financial and accounting activities of the SMGWA. The Treasurer provides financial management services including accounts payable, financial reporting, budget monitoring, cash and reserve management, preparation of financial statements, annual budgeting activities, and support for Board financial oversight. SMGWA compensates SVWD annually for the Treasurer's services. While SVWD Finance Manager currently serves in this role, SLVWD Finance Manager previously served in this role.

9.2.1.4 Annual Financial Audit

An accounting firm coordinates and conducts the Agency's independent annual financial audit, including preparation of financial records, auditor support, review of findings, and presentation of audited financial statements to the SMGWA Board of Directors.

9.2.1.5 Legal Counsel

The agency contracts with legal counsel for advice and representation related to Agency governance, SGMA compliance, contracts, Brown Act requirements, public records matters, regulatory issues, and other legal matters necessary to support Agency operations.

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9.2.2 SGMA Compliance and GSP Implementation

This category includes activities necessary to comply with SGMA including GSP planning, implementation, and reporting. Estimated costs to cover these tasks are presented in Table 9-1.

9.2.2.1 GSP Planning and Implementation Services

This broadly encompasses the range of activities to manage and coordinate implementation of the Basin's GSP, including Basin project planning, regulatory coordination, coordination with the member and cooperating agencies, coordination with technical consultants, implementation tracking, and technical studies. These services are to ensure the overall implementation efforts are proceeding consistently with the GSP and to achieve the Basin sustainability objectives under SGMA. These services are currently supported by a service provider/consultants. It is anticipated that this approach will continue in the next 5-year period.

9.2.2.2 Basin Monitoring

The SMGWA's monitoring program is described in Section 6. Individual member agencies will continue to collect data from their monitoring networks as they have been doing to inform management and operation of their respective water supplies. One of the primary ongoing functions of GSP implementation is data collection and its evaluation, comparison of data against SMC, and reporting of groundwater conditions. Cooperating agencies will provide the monitoring data they collect from their existing monitoring networks as part of their ongoing operations.

Groundwater level, groundwater quality, extraction, streamflow, and rainfall data collected by cooperating agencies will be uploaded semi-annually to the DMS described in Section 6.8. Data stored in the DMS will be downloaded by the consultant or SMGWA staff preparing the annual report and summarized in the required tables and figures to demonstrate that progress is being made toward sustainability in the Basin. Cooperating agencies will upload seasonal high and low groundwater elevation data, at a minimum, to the to the DMS, so the data can be uploaded to DWR's SGMA portal by January 1 and July 1 of each year to comply with SGMA requirements.

9.2.2.3 Basin Monitoring – SMGWA Specific Expenses

Basin monitoring expenses due to activities conducted specifically at the request of SMGWA will be funded by SMGWA. Examples include the costs to install and maintain monitoring equipment, monitoring station improvements, and associated technical support. These are intended for activities and expenses that the member agencies would not otherwise be incurring in the routine monitoring of their respective water system operations.

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9.2.2.4 Technical Services – As Needed

It is anticipated the SMGWA will need technical support on an as needed basis. This line item includes specialized technical services assistance to support GSP implementation and to address emerging Basin management needs.

9.2.2.5 Data Management System

As described in Section 6.8, the SMGWA, MGA, and County of Santa Cruz have established a regional DMS to upload, store, and review data collected by the GSP monitoring networks for the Santa Margarita and Santa Cruz Mid-County Basins. Having all groundwater related data in the DMS will streamline data collation while preparing GSP annual reports and 5-year periodic evaluations. Ongoing costs to SMGWA, shared with the MGA, include fees for hosting, maintenance, user support, and licensing of the WISKI DMS. Cooperating agencies that collect relevant data within the Basin will be responsible for semi-annual uploads to the DMS.

9.2.2.6 GSP Annual Report

GSP Regulations require that the SMGWA submit annual reports to DWR documenting Basin conditions and progress toward sustainability prior to April 1 of each year. The purpose of the report is to provide monitoring and total groundwater use data to DWR, compare monitoring data to SMC, and adaptively implement PMAs to achieve sustainability.

Preparation of the GSP Annual Report is currently led by consultants in coordination with member agency staff and a Board ad hoc committee and is anticipated to continue in this manner for the next 5-year period.

9.2.2.7 GSP Periodic Evaluations (5-Year)

The SMGWA will conduct a Periodic Evaluation of the GSP at least every 5 years to assess whether it is achieving its sustainability goals. The evaluation will include a description of significant new information that has been made available since GSP adoption, amendment, or the prior evaluation, and whether the new information or understanding warrants changes to any aspect of the plan. The initial Periodic Evaluation will be submitted to DWR in January 2027. The next GSP Periodic Evaluation will be submitted prior to January 2032.

Preparation of the GSP Periodic Evaluation is currently led by consultants in coordination with member agency staff and a Board ad hoc committee. It is anticipated that this approach will continue in the next 5-year period.

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9.2.2.8 Community Outreach and Engagement

The agency will continue to implement public outreach and stakeholder engagement activities that increase awareness of groundwater sustainability efforts, communicate agency programs and decisions, support public participation, maintain website and communication materials, and engage groundwater users, private well owners, and other Basin stakeholders.

9.2.3 Items Not Included in Estimate of Implementation Cost

The following activities are not included in Table 9-1 as GSP implementation costs because they are not directly funded by SMGWA (e.g., project implementation) or the activity is not anticipated in the next 5-year period (e.g., groundwater model updates) or is anticipated to only proceed in the next 5-year period if outside funding is obtained (e.g., Butano aquifer groundwater monitoring well). These activities are summarized below.

9.2.3.1 Projects and Management Actions

The GSP implementation cost estimate does not include the cost of evaluating, planning, designing, and constructing a project(s) to achieve groundwater sustainability. As discussed in Section 8, cooperating agencies will cover their respective costs of these activities because the SMGWA will not serve as the lead agency for implementing PMAs. Project costs may be shared between multiple agencies if the project provides greater water supply reliability and resiliency benefit to multiple agencies. Regional collaboration to achieve both Basin sustainability and increase regional water supply reliability and resiliency is encouraged by the SMGWA.

Costs associated with implementing new projects would be funded through a combination of increased operating revenue and outside funding sources. Securing outside funding to supplement local revenue streams will be critical to implementing some of the PMAs. Considering the size of the population and scale of the projects required to achieve sustainability, it is important to ensure financial feasibility and long-term affordability.

9.2.3.2 Groundwater Model Simulations and Updates

The Basin groundwater model helps inform development of PMAs, and ongoing performance assessment of the GSP's SMC. Periodic updates to the groundwater model are required to continue to refine and improve its capabilities and maintain ongoing functionality. This includes incorporating new model tools and features, aquifer parameters, refining of climate change projections, and related work to support ongoing simulations of PMAs.

A comprehensive update to the groundwater model is not anticipated in the next 5 years. The agency will continue to conduct groundwater model simulations of Basin conditions as part of the GSP annual reports as well as part of the Periodic Evaluation. The cost estimate (Table 9-1)

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includes the cost to conduct the model simulations necessary to complete the required SGMA annual and periodic reporting.

9.2.3.3 GSP Amendment

Although not required by GSP Regulations, the SMGWA may prepare amendment(s) to the GSP if the implementation approach needs to change significantly to adaptively manage the Basin. With the completion of this 2027 GSP Amendment, the need to further amend the GSP in the next 5 years is not anticipated at this time and therefore not included as a cost in Table 9-1.

9.2.3.4 Address Monitoring Network Data Gaps

There is a single monitoring data gap identified in the 2027 GSP Amendment. As described in Section 6.9.1, the SMGWA has requested TSS support to install a dedicated Butano aquifer well and is waiting for confirmation from DWR. SMGWA and SVWD will continue to evaluate other funding mechanisms if TSS funding is not available.

9.3 Financial Reserves and Contingencies

Prudent financial management prescribes that the SMGWA carry a general reserve in order to manage cash flow and mitigate the risk of expense overruns due to unanticipated expenditures. General reserves have no restrictions on the types of expenses they can be used to fund. In May 2024, the Board approved a reserves policy that established maintaining general reserves at 20% of the annual operating expenses budget. The ending balance in total reserves becomes the beginning reserves balance for the next fiscal year.

The SMGWA Treasurer, responsible for overseeing the financial health of the agency, will advise the Board on the appropriate reserves and request a contingency amount as part of the budget adoption process.

9.4 GSP Implementation Schedule

A general schedule showing the major GSP implementation activities and their estimated timelines during the next 5 years of GSP implementation is provided on Table 9-2. The amended GSP will be presented to the Board for adoption in fall 2026 and will be submitted to DWR by January 3, 2027. Many of the categories on Table 9-2 consist of ongoing tasks and efforts that will continue throughout GSP implementation. GSP reporting will occur on an annual and a 5-year basis as required under SGMA. Annual reports will be submitted to DWR by April 1 of each year. Periodic reports will be submitted to DWR at least every 5 years or sooner following a formal GSP amendment. PMAs summarized in Section 8 will have their own implementation timelines that would be determined after the project is deemed feasible and funding is secured.

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Table 9-2. Implementation Schedule 2026 - 2032

Description	2026	2027	2028	2029	2030	2031	2032
GSP Amendment							
GSP Amendment – Board Adoption	●						
GSP Amendment – Submittal to DWR		●					
Governance, Administration and Operations							
Agency Administration & Operations	→	→	→	→	→	→	→
SGMA Compliance and GSP Implementation							
GSP Planning and Implementation Services	→	→	→	→	→	→	→
Basin Monitoring	→	→	→	→	→	→	→
Data Management System	→	→	→	→	→	→	→
Projects and Management Actions	→	→	→	→	→	→	→
Community Outreach and Engagement	→	→	→	→	→	→	→
GSP Annual Report	●	●	●	●	●	●	●
GSP Periodic Evaluations		●					●

Key: ● denotes a submittal/event

→ denotes an ongoing activity

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Appendix 1A

Definition of SGMA and Groundwater Terms

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Definition of SGMA and Groundwater Terms

Aquifer – a geologic formation(s) that is water bearing; a geological formation or structure that stores and/or transmits water, such as to wells and springs. Use of the term is usually restricted to those water-bearing formations capable of yielding water in sufficient quantity to constitute a usable supply for people's needs.

Aquifer (confined) – soil or rock below the land surface that is saturated with water. There are layers of impermeable material both above and below it, and it is under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer.

Aquifer (unconfined) – an aquifer whose upper water surface (water table) is at atmospheric pressure, and thus is able to rise and fall.

Aquitard – a geologic formation or stratum that lies adjacent to an aquifer and that allows only a small amount of liquid to pass.

Artificial recharge – a process where water is put back into groundwater storage from surface-water supplies such as irrigation, or induced infiltration from streams or wells.

Best available science – the use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision that is consistent with scientific and engineering professional standards of practice.

Best management practice – a practice, or combination of practices, that are designed to achieve sustainable groundwater management and have been determined to be technologically and economically effective, practicable, and based on best available science.

Conjunctive use – the combined use of groundwater and surface water sources that optimizes the beneficial characteristics of each source.

Data gap – a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of GSP implementation, and could limit the ability to assess whether a basin is being sustainably managed.

***De minimis* extractor** – a person who extracts, for domestic purposes, 2 acre-feet or less per year. SGMA does not authorize GSAs to require *de minimis* users to meter their wells.

Department of Water Resources (DWR) – State agency that oversees the implementation of SGMA.

Drawdown – a lowering of the groundwater surface caused by pumping.

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Evapotranspiration – the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.

Groundwater – water that exists underground in saturated zones beneath the land surface. The upper surface of the saturated zone is called the water table.

Groundwater dependent ecosystem – ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.

Groundwater flow – the volume and direction of groundwater movement into, out of, or throughout a basin.

Groundwater Sustainability Agency (GSA) – 1 or more local agencies that implement the provisions of this part. For purposes of imposing fees pursuant to Chapter 8 (commencing with Section 10730) or taking action to enforce a GSP, groundwater sustainability agency also means each local agency comprising the groundwater sustainability agency if the GSP authorizes separate agency action.

Groundwater Sustainability Plan (GSP or Plan) – in groundwater basins designated by the Department of Water Resources (DWR) as critically-overdrafted high and medium priority, local public agencies and GSAs are required to develop and implement groundwater sustainability plans (GSPs) by January 31, 2020. All other groundwater basins designated as high or medium priority basins to be managed under a GSP by January 31, 2022.

Hydraulic conductivity – property of geologic materials that controls the ease with which groundwater flows through pore spaces or fractures. Higher hydraulic conductivity allows water to travel faster through geologic media. Units with very low hydraulic conductivity slow or may prevent groundwater flow. Hydraulic conductivity has units with dimensions of length per time (e.g., feet per day).

Injection well – an injection well is used to place fluid underground into porous geologic formations. These underground formations may range from deep sandstone or limestone to a shallow soil layer. Injected fluids may include water, wastewater, brine (salt water) or water mixed with chemicals.

In-lieu use – the use of surface water by persons that could otherwise extract groundwater in order to leave groundwater in the basin.

Interconnected surface water – surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted.

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Interim milestone (IM) – a target value representing measurable groundwater conditions, in increments of 5 years, set by a groundwater sustainability agency as part of a GSP.

Local agency – a local public agency that has water supply, water management, or land use responsibilities within a groundwater basin.

Management area – an area within a basin for which the GSP may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors.

Measurable objectives – specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted GSP to achieve the sustainability goal for the basin.

Minimum threshold – a numeric value for each sustainability indicator used to define undesirable results.

Monitoring well – a well designed and installed to obtain representative groundwater quality samples and hydrogeologic information. Deep and shallow monitoring wells provide controlled access for sampling groundwater near an agricultural waste storage or treatment facility to detect seepage and monitor groundwater quality.

Overdraft – overdraft occurs when, over a period of years, more water is pumped from a groundwater basin than is replaced from all sources – such as rainfall, irrigation water, streams fed by mountain runoff and intentional recharge. While many of its individual aquifers are not overdrafted, California as a whole uses more groundwater than is replaced.

Plan or GSP implementation – an Agency's exercise of the powers and authorities described in the SGMA, which commences after an Agency adopts and submits a GSP or Alternative to the Department of Water Resources and begins exercising such powers and authorities.

Plan manager – an employee or authorized representative of an Agency, or Agencies, appointed through a coordination agreement or other agreement, who has been delegated management authority for submitting the GSP and serving as the point of contact between the Agency and the Department.

Principal aquifers – aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.

Private pumpers – groundwater users operating their own wells outside of any water agency.

Recharge – water added to an aquifer. For instance, rainfall that seeps into the ground.

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Reference point – a permanent, stationary and readily identifiable mark or point on a well, such as the top of casing, from which groundwater level measurements are taken, or other monitoring site.

Representative monitoring point – a monitoring site within a broader network of sites that typifies 1 or more conditions within the basin or an area of the basin.

Seasonal high – the highest annual static groundwater elevation that is typically measured in the Spring and associated with stable aquifer conditions following a period of lowest annual groundwater demand.

Seasonal low – the lowest annual static groundwater elevation that is typically measured in the Summer or Fall, and associated with a period of stable aquifer conditions following a period of highest annual groundwater demand.

Storativity (or storage coefficient) – the volume of water (e.g., cubic feet) released from aquifer storage per unit decline in hydraulic head in the aquifer (e.g., foot), per unit area of the aquifer (e.g., square feet). Storativity is a volumetric ratio and therefore unitless. A large value for storativity implies a highly productive aquifer. Storativity is applied only to aquifers under local or regional confinement; specific yield is a roughly equivalent measure of aquifer productivity in an unconfined aquifer.

Specific yield – the volume of water released from storage by an unconfined aquifer per unit surface area of aquifer per unit decline of the water table. Specific yield is a volumetric ratio and therefore unitless. Specific yield is used to characterize unconfined aquifers; high specific yield indicates a productive aquifer unit.

Surface water – water that is on the Earth's surface, such as in a stream, river, lake or reservoir.

Sustainability goal – the existence and implementation of 1 or more groundwater sustainability plans that achieve sustainable groundwater management by identifying and causing the implementation of measures targeted to ensure that the applicable basin is operated within its sustainable yield.

Sustainability indicator – any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x).

Sustainable Groundwater Management Act (SMGA) – the SGMA provides a framework for sustainable management of groundwater supplies by local authorities. Recognizing that groundwater is most effectively managed at the local level, the SGMA empowers local agencies to achieve sustainability within 20 years. The SGMA establishes minimum standards for

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sustainable groundwater management, improves coordination between land use and groundwater planning, provides state technical assistance, protects water rights, and creates a mechanism for state intervention if a local agency is not managing its groundwater sustainability.

Sustainable Management Criteria (SMC) – refers collectively to sustainability goal, undesirable results, minimum thresholds, interim milestones, and measurable objectives.

Sustainable yield – the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin, and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result.

Transmissivity – a measure of how much water can be transmitted horizontally. It is derived from the hydraulic conductivity of an aquifer unit multiplied by its total thickness. High transmissivity units are very conductive to groundwater flow, very thick, or both. Transmissivity is usually expressed in units of length^2 per time, or occasionally as volume per length per time.

Uncertainty – a lack of understanding of the basin setting that significantly affects an Agency's ability to develop sustainable management criteria and appropriate projects and management actions in a GSP, or to evaluate the efficacy of GSP implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.

Undesirable results – a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin. Undesirable results may be defined by minimum threshold exceedances at a single monitoring site, multiple monitoring sites, a portion of a basin, a management area, or an entire basin. Undesirable results are one or more of the following effects:

- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.
- Significant and unreasonable reduction of groundwater storage.
- Significant and unreasonable seawater intrusion.
- Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
- Significant and unreasonable land subsidence that substantially interferes with surface land uses.

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- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

Water budget – an accounting of the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored.

Water table – the top of the water surface in the saturated part of an aquifer.

Water use – water that is used for a specific purpose, such as for domestic use, irrigation or industrial processing. Water use pertains to human's interaction with and influence on the hydrologic cycle and includes elements such as water withdrawal from surface and groundwater sources, water delivery to homes and businesses, consumptive use of water, water released from wastewater treatment plants, water returned to the environment, as well as instream uses, such as using water to produce hydroelectric power.

Water year – the period from October 1 through the following September 30, inclusive.

Watershed – the land area that drains water to a particular stream, river or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large watersheds, like the Mississippi River Basin, contain thousands of smaller watersheds.

Well Owner Representative – director on the Santa Margarita Groundwater Agency Board who represents private pumpers.

Terminology References:

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Appendix 1B

Joint Exercise of Powers Agreement Creating the Santa Margarita Groundwater Agency

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JOINT EXERCISE OF POWERS AGREEMENT

by and among

SCOTTS VALLEY WATER DISTRICT

SAN LORENZO VALLEY WATER DISTRICT

and

COUNTY OF SANTA CRUZ

creating the

SANTA MARGARITA GROUNDWATER AGENCY

June 1, 2017

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JOINT EXERCISE OF POWERS AGREEMENT OF THE SANTA MARGARITA GROUNDWATER AGENCY

This **Joint Exercise of Powers Agreement ("Agreement")** is made and entered into as of June 1, 2017 ("Effective Date"), by and among the Scotts Valley Water District, the San Lorenzo Valley Water District, and the County of Santa Cruz, sometimes referred to herein individually as a "**Member**" and collectively as the "**Members**" for purposes of forming the Santa Margarita Groundwater Agency ("**Agency**") and setting forth the terms pursuant to which the Agency shall operate. Capitalized defined terms used herein shall have the meanings given to them in Article 1 of this Agreement.

RECITALS

A. Each of the Members is a local agency, as defined by the Sustainable Groundwater Management Act of 2014 ("**SGMA**"), duly organized and existing under and by virtue of the laws of the State of California, and each Member can exercise powers related to groundwater management.

B. SGMA requires designation of a groundwater sustainability agency ("**GSA**") by June 30, 2017, for groundwater basins designated by the California Department of Water Resources ("**DWR**") as medium- and high-priority basins.

C. SGMA requires adoption of a groundwater sustainability plan ("**GSP**") by January 31, 2022, for all medium- and high-priority basins not identified as being subject to critical conditions of overdraft.

D. Each of the Members either extracts groundwater from or regulates land use activities overlying a common groundwater basin located in Santa Cruz County in the vicinity of Scotts Valley, Felton, Ben Lomond and Boulder Creek. This area is known as the Santa Margarita Groundwater Basin (hereafter **"Basin"**), and is proposed by DWR to be designated as Basin 3-027 in the Draft Bulletin 118 Basins (2016 Edits). It is expected that the Basin will be designated by DWR as having a medium or high priority.

E. The Members intend for the Agency to develop a GSP and manage the Basin pursuant to SGMA.

F. Under SGMA, a combination of local agencies may form a GSA through a joint powers agreement.

G. The Members have determined that the sustainable management of the Basin pursuant to SGMA may best be achieved through the cooperation of the Members operating through a joint powers agency.

H. The Joint Exercise of Powers Act of 2000 ("Act") authorizes the Members to create a joint powers authority, to jointly exercise any power common to the Members, and to exercise additional powers granted under the Act.

I. The Act, including the Marks-Roos Local Bond Pooling Act of 1985 (Government Code sections 6584, *et seq.*), authorizes an entity created pursuant to the Act to issue bonds, and under certain circumstances, to purchase bonds issued by, or to make loans to,

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the Members for financing public capital improvements, working capital, liability and other insurance needs or projects whenever doing so results in significant public benefits, as determined by the Members. The Act further authorizes and empowers a joint powers authority to sell bonds so issued or purchased to public or private purchasers at public or negotiated sales.

J. The Members have a history of collaborating on groundwater management issues in the Santa Margarita Groundwater Basin, originally with a memorandum of understanding dated June 30, 1995, forming the Santa Margarita Groundwater Basin Management Advisory Committee (SMGBAC).

K. The Members agree that by approving the creation of the Santa Margarita Groundwater Agency they are withdrawing from and disbanding the Santa Margarita Groundwater Basin Management Advisory Committee (SMGBAC).

L. Based on the foregoing legal authority, the Members desire to create a joint powers authority for the purpose of taking all actions deemed necessary by the joint powers authority to ensure sustainable management of the Basin as required by SGMA.

M. The governing board of each Member has determined it to be in the Member's best interest and in the public interest that this Agreement be executed.

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TERMS OF AGREEMENT

In consideration of the mutual promises and covenants herein contained, the Members agree as follows:

ARTICLE 1
DEFINITIONS

The following terms have the following meanings for purposes of this Agreement:

1.1 "Act" means the Joint Exercise of Powers Act, set forth in Chapter 5 of Division 7 of Title 1 of the Government Code, sections 6500, *et seq.*, including all laws supplemental thereto.

1.2 "Agreement" has the meaning assigned thereto in the Preamble.

1.3 "Auditor" means the auditor of the financial affairs of the Agency appointed by the Board of Directors pursuant to Section 14.3 of this Agreement.

1.4 "Agency" has the meaning assigned thereto in the Preamble.

1.5 "Basin" has the meaning assigned thereto in Recital D.

1.6 "Board of Directors" or "Board" means the governing body of the Agency as established by Article 6 of this Agreement.

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1.7 "Bylaws" means the bylaws, if any, adopted by the Board of Directors pursuant to Article 11 of this Agreement to govern the day-to-day operations of the Agency.

1.8 "Director" and "Alternate Director" mean a director or alternate director appointed pursuant to Article 6 of this Agreement. "Member Director" is a Director or Alternate Director appointed by and representing a Member agency pursuant to Article 6 of this Agreement.

1.9 "DWR" has the meaning assigned thereto in Recital B.

1.10 "GSA" has the meaning assigned thereto in Recital B.

1.11 "GSP" has the meaning assigned thereto in Recital C.

1.12 "Member" means each party to this Agreement that satisfies the requirements of Section 5.1 of this Agreement, including any new members as may be authorized by the Board, pursuant to Section 5.2 of this Agreement.

1.13 "Officer(s)" means the Chair, Vice Chair, Secretary, or Treasurer of the Agency to be appointed by the Board of Directors pursuant to Section 7.1 of this Agreement.

1.14 "SGMA" has the meaning assigned thereto in Recital A.

1.15 "State" means the State of California.

ARTICLE 2
CREATION OF THE AGENCY

2.1 Creation of a Joint Powers Authority. There is hereby created pursuant to the Act a joint powers authority, which will be a public entity separate from the Members to this Agreement, and shall be known as the Santa Margarita Groundwater Agency ("**Agency**"). Within 30 days after the Effective Date of this Agreement and after any amendment, the Agency shall cause a notice of this Agreement or amendment to be prepared and filed with the office of the California Secretary of State containing the information required by Government Code section 6503.5. Within 10 days after the Effective Date of this Agreement, the Agency shall cause a statement of the information concerning the Agency, required by Government Code section 53051, to be filed with the office of the California Secretary of State and with the County Clerk for the County of Santa Cruz, setting forth the facts required to be stated pursuant to Government Code section 53051(a).

2.2 Purpose of the Agency. Each Member to this Agreement has in common the power to study, plan, develop, finance, acquire, construct, maintain, repair, manage, operate, control, and govern the water supply and water management within the Basin, either alone or in cooperation with other public or private non-member entities, and each is a local agency eligible to serve as a GSA within the Basin, either alone or jointly through a joint powers agreement as provided for by SGMA. The purpose of this Agency is to serve as the GSA for the Basin and to develop, adopt, and implement the GSP for the Basin pursuant to SGMA and other applicable provisions of law.

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ARTICLE 3
TERM

This Agreement shall become effective upon execution by each of the Members and shall remain in effect until terminated pursuant to the provisions of Article 17 (Withdrawal of Members) of this Agreement.

ARTICLE 4
POWERS

The Agency shall possess the power in its own name to exercise any and all common powers of its Members reasonably related to the purposes of the Agency, including but not limited to the following powers, together with such other powers as are expressly set forth in the Act and in SGMA. For purposes of Government Code section 6509, the powers of the Agency shall be exercised subject to the restrictions upon the manner of exercising such powers as are imposed on the County of Santa Cruz, and in the event of the withdrawal of the County of Santa Cruz as a Member under this Agreement, then the manner of exercising the Agency's powers shall be those restrictions imposed on the Scotts Valley Water District.

4.1 To exercise all powers afforded to a GSA pursuant to and as permitted by SGMA.

4.2 To develop, adopt and implement the GSP pursuant to SGMA.

4.3 To adopt rules, regulations, policies, bylaws and procedures governing the operation of the Agency and adoption and implementation of the GSP.

4.4 To obtain rights, permits and other authorizations for or pertaining to implementation of the GSP.

4.5 To perform other ancillary tasks relating to the operation of the Agency pursuant to SGMA, including without limitation, environmental review, engineering, and design.

4.6 To make and enter into all contracts necessary to the full exercise of the Agency's power.

4.7 To employ, designate or otherwise contract for the services of agents, officers, employees, attorneys, engineers, planners, financial consultants, technical specialists, advisors, and independent contractors.

4.8 To exercise jointly the common powers of the Members, as directed by the Board, in developing and implementing a GSP for the Basin.

4.9 To investigate legislation and proposed legislation affecting the Basin and to make appearances regarding such matters.

4.10 To cooperate and to act in conjunction and contract with the United States, the State of California or any agency thereof, counties, municipalities, public and private corporations of any kind (including without limitation, investor-owned utilities), and individuals, or any of them, for any and all purposes necessary or convenient for the full exercise of the powers of the Agency.

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4.11 To incur debts, liabilities or obligations, to issue bonds, notes, certificates of participation, guarantees, equipment leases, reimbursement obligations and other indebtedness, and, to the extent provided for in a duly adopted Agency to impose assessments, groundwater extraction fees or other charges, and other means of financing the Agency as provided in Chapter 8 of SGMA commencing at Section 10730 of the Water Code.

4.12 To collect and monitor data on the extraction of groundwater from, and the quality of groundwater in the Basin.

4.13 To establish and administer a conjunctive use program for the purposes of maintaining sustainable yields in the Basin consistent with the requirements of SGMA.

4.14 To exchange and distribute water.

4.15 To regulate groundwater extractions as permitted by SGMA.

4.16 To impose groundwater extraction fees as permitted by SGMA.

4.17 To spread, sink and inject water into the Basin.

4.18 To store, transport, recapture, recycle, purify, treat or otherwise manage and control water for beneficial use.

4.19 To apply for, accept and receive licenses, permits, water rights, approvals, agreements, grants, loans, contributions, donations or other aid from any agency of the United States, the State of California, or other public agencies or private persons or entities necessary for the Agency's purposes.

4.20 To develop and facilitate market-based solutions for the use and management of water rights.

4.21 To acquire property and other assets by grant, lease, purchase, bequest, devise, gift or eminent domain, and to hold, enjoy, lease or sell, or otherwise dispose of, property, including real property, water rights, and personal property, necessary for the full exercise of the Agency's powers.

4.22 To sue and be sued in its own name.

4.23 To provide for the prosecution of, defense of, or other participation in actions or proceedings at law or in public hearings in which the Members, pursuant to this Agreement, may have an interest and may employ counsel and other expert assistance for these purposes.

4.24 To exercise the common powers of its Members to develop, collect, provide, and disseminate information that furthers the purposes of the Agency, including but not limited to the operation of the Agency and adoption and implementation of the GSP to the Members, legislative, administrative, and judicial bodies, as well the public generally.

4.25 To accumulate operating and reserve funds for the purposes herein stated.

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4.26 To invest money that is not required for the immediate necessities of the Agency, as the Agency determines is advisable, in the same manner and upon the same conditions as Members, pursuant to Government Code section 53601, as it now exists or may hereafter be amended.

4.27 To undertake any investigations, studies, and matters of general administration.

4.28 To perform all other acts necessary or proper to carry out fully the purposes of this Agreement.

ARTICLE 5
MEMBERSHIP

5.1 Members. The Members of the Agency shall be the Scotts Valley Water District, the San Lorenzo Valley Water District, and the County of Santa Cruz, as long as they have not, pursuant to the provisions hereof, withdrawn from this Agreement.

5.2 New Members. Any public agency (as defined by the Act) that is not a Member on the Effective Date of this Agreement may become a Member upon: (a) the approval of the Board of Directors by a supermajority of at least seventy-five (75%) of the votes held among all Directors as specified in Article 9 (Member Voting); (b) payment of a pro rata share of all previously incurred costs that the Board of Directors determines have resulted in benefit to the public agency, and are appropriate for assessment on the public agency; and (c) execution of a written agreement subjecting the public agency to the terms and conditions of this Agreement.

ARTICLE 6
BOARD OF DIRECTORS AND OFFICERS

6.1 Formation of the Board of Directors. The Agency shall be governed by a Board of Directors ("**Board**"). The Board shall consist of eleven (11) Directors consisting of the following representatives who shall be appointed in the manner set forth in Section 6.3:

6.1.1 Two (2) representatives appointed by the governing body of each of the following public agency Members: the Scotts Valley Water District, the San Lorenzo Valley Water District and the County of Santa Cruz

6.1.2 One (1) representative appointed by the governing body of the City of Scotts Valley

6.1.3 One (1) representative appointed by the governing body of the City of Santa Cruz

6.1.4 One (1) representative of the Mt. Hermon Association Community Water System

6.1.5 Two (2) representatives of private well owners or small public water systems within the boundaries of the Agency.

6.2 Duties of the Board of Directors. The business and affairs of the Agency, and all of its powers, including without limitation all powers set forth in Article 4 (Powers), are reserved

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to and shall be exercised by and through the Board of Directors, except as may be expressly delegated to the staff or others pursuant to this Agreement, Bylaws, or by specific action of the Board of Directors.

6.3 Appointment of Directors. The Directors shall be appointed as follows:

6.3.1 The two representatives from the Scotts Valley Water District shall be appointed by the Scotts Valley Water District Board of Directors.

6.3.2 The two representatives from the San Lorenzo Valley Water District shall be appointed by the San Lorenzo Valley Water District Board of Directors.

6.3.3 The two representatives from the County of Santa Cruz shall be appointed by the County of Santa Cruz Board of Supervisors.

6.3.4 The representative from the City of Scotts Valley shall be appointed by the City of Scotts Valley Council.

6.3.5 The representative from the City of Santa Cruz shall be appointed by the City of Santa Cruz Council.

6.3.6 The representative from the Mt. Hermon Association Community Water System shall be appointed by the Mt Hermon Association, Inc.

6.3.7 The two representatives of private well owners shall be appointed by unanimous vote of the Member Agency Directors unless the private well owners choose their representatives by a method of self-selection as described in the Bylaws. The procedures for nominating the private well owners shall be set forth in the Bylaws. Prior to the adoption of the Bylaws and selection of the private well owner representatives, the Board may appoint temporary Directors to serve as the representatives of the private well owners.

6.4 Alternate Directors. Each Member may have one Alternate to act as a substitute Director for either of the Member's Directors. One Alternate shall also be appointed to act as a substitute Director for the two Directors representing private well owners, and one alternate for each entity may be appointed to act as a substitute Director for the City of Scotts Valley, City of Santa Cruz and Mt. Hermon Association. All Alternates shall be appointed in the same manner as set forth in Section 6.3. Alternate Directors shall have no vote, and shall not participate in any discussions or deliberations of the Board unless appearing as a substitute for a Director due to absence or conflict of interest. If the Director is not present, or if the Director has a conflict of interest which precludes participation by the Director in any decision-making process of the Board, the Alternate Director appointed to act in their place shall assume all rights of the Director, and shall have the authority to act in his/her absence, including casting votes on matters before the Board. Alternates are strongly encouraged to attend Board meetings and stay informed on current issues before the Board.

6.5 Requirements. Each Member's Directors and Alternate Director shall be appointed by that Member's governing body. A Member's Director or Alternate Director may be removed during his or her term or reappointed for multiple terms at the pleasure of the Member that appointed him or her. A Director representing private well owners, the City of

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Scotts Valley, the City of Santa Cruz or the Mt. Hermon Association may be removed or reappointed in the same manner as he or she was appointed as set forth in Section 6.3. No individual Director may be removed in any other manner, including by the affirmative vote of the other Directors except as described in Section 6.6

6.6 Code of Conduct. All Directors and Alternate Directors shall agree in writing to comply with the Code of Conduct as contained in the Bylaws. Breech of the Code could result in the removal of the Director from the Board.

6.7 Vacancies. A vacancy on the Board of Directors shall occur when a Director resigns or at the end of the Director's term as set forth in Section 6.5. For Member Directors, a vacancy shall also occur when he or she is removed by his or her appointing Member. For Directors representing private well owners, the City of Scotts Valley, the City of Santa Cruz or the Mt. Hermon Association, a vacancy shall also occur when the Director is removed as set forth in Section 6.5. Upon the vacancy of a Director, the Alternate Director shall serve as Director until a new Director is appointed as set forth in Section 6.3 unless the Alternate is already serving as a substitute Director in the event of a prior vacancy, in which case, the seat shall remain vacant until a replacement Director is appointed as set forth in Section 6.3. Members shall provide notice of any changes in Director or Alternate Director positions to the Board of Directors or its designee in writing and signed by an authorized representative of the Member.

ARTICLE 7
OFFICERS

7.1 Officers. Officers of the Agency shall be a Chair, Vice Chair, Secretary, and Treasurer. The Treasurer shall be appointed consistent with the provisions of Section 14.3. The Vice Chair, or in the Vice Chair's absence, the Secretary, shall exercise all powers of the Chair in the Chair's absence or inability to act.

7.2 Appointment of Officers. Officers shall be elected annually by, and serve at the pleasure of, the Board of Directors. Officers shall be elected at the first Board meeting, and thereafter at the first Board meeting following January 1st of each year, or as duly continued by the Board. An Officer may serve for multiple consecutive terms, with no term limit. Any Officer may resign at any time upon written notice to the Board, and may be removed and replaced by a simple majority vote of the Board.

7.3 Principal Office. The principal office of the Agency shall be established by the Board of Directors, and may thereafter be changed by a simple majority vote of the Board.

ARTICLE 8
DIRECTOR MEETINGS

8.1 Initial Meeting. The initial meeting of the Board of Directors shall be held in the County of Santa Cruz, California, within thirty (30) days of the Effective Date of this Agreement.

8.2 Time and Place. The Board of Directors shall meet at least quarterly, at a date, time and place set by the Board within the jurisdictional boundaries of one or more of the Members and at such other times as may be determined by the Board.

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8.3 Special Meetings. Special meetings of the Board of Directors may be called by the Chair or by a simple majority of Directors, in accordance with the provisions of Government Code section 54956.

8.4 Conduct. All meetings of the Board of Directors, including special meetings, shall be noticed, held, and conducted in accordance with the Ralph M. Brown Act (Government Code sections 54950, *et seq.*). The Board may use teleconferencing in connection with any meeting in conformance with and to the extent authorized by applicable law.

8.5 Local Conflict of Interest Code. The Board of Directors shall adopt a local conflict of interest code pursuant to the provisions of the Political Reform Act of 1974 (Government Code sections 81000, *et seq.*)

ARTICLE 9
MEMBER VOTING

9.1 Quorum. A quorum of any meeting of the Board of Directors shall consist of an absolute majority of Directors plus one Director. In the absence of a quorum, any meeting of the Directors may be adjourned by a vote of the simple majority of Directors present, but no other business may be transacted. For purposes of this Article, a Director shall be deemed present if the Director appears at the meeting in person or participates telephonically, provided that the telephone appearance is consistent with the requirements of the Ralph M. Brown Act.

9.2 Director Votes. Voting by the Board of Directors shall be made on the basis of one vote for each Director. A Director, or an Alternate Director when acting in the absence of his or her Director, may vote on all matters of Agency business unless disqualified because of a conflict of interest pursuant to California law or the local conflict of interest code adopted by the Board of Directors.

9.3 Affirmative Decisions of the Board of Directors. Except as otherwise specified in this Agreement, all affirmative decisions of the Board of Directors shall require the affirmative vote of a simple majority of all appointed Directors participating in voting on a matter of Agency business, provided that if a Director is disqualified from voting on a matter before the Board because of a conflict of interest, that Director shall be excluded from the calculation of the total number of Directors that constitute a majority. Notwithstanding the foregoing, a unanimous vote of all Member Directors participating in voting shall be required to approve any of the following: (i) any expenditure that is estimated to cost $50,000 or more; (ii) the annual budget; (iii) the GSP for the Basin or any amendment thereto; (iv) the levying of assessments or fees; (v) issuance of indebtedness; or (vi) any stipulation to resolve litigation concerning groundwater rights within or groundwater management for the Basin.

ARTICLE 10
AGENCY ADMINISTRATION, MANAGEMENT AND OPERATION

The Board of Directors may select and implement an approach to Agency administration and management that is appropriate to the circumstances and adapted to the GSA's needs as they may evolve over time. Details of the Board's decision on Agency administration, management and operation shall be incorporated into the GSA's bylaws and reviewed and revised as needed using the established process for revising the GSA's bylaws.

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ARTICLE 11
BYLAWS

The Board of Directors shall cause to be drafted, approve, and amend Bylaws of the Agency to govern the day-to-day operations of the Agency. The Bylaws shall be adopted within six months from the Board's first meeting.

ARTICLE 12
ADVISORY COMMITTEES

The Board of Directors may from time to time appoint one or more advisory committees or establish standing or ad hoc committees to assist in carrying out the purposes and objectives of the Agency. The Board shall determine the purpose and need for such committees and the necessary qualifications for individuals appointed to them.

ARTICLE 13
OPERATION OF COMMITTEES

Each committee shall include a Director as the chair thereof. Other members of each committee may be constituted by such individuals approved by the Board of Directors for participation on the committee. However, no committee or participant on such committee shall have any authority to act on behalf of the Agency except as duly authorized by the Board.

ARTICLE 14
ACCOUNTING PRACTICES

14.1 General. The Board of Directors shall establish and maintain such funds and accounts as may be required by generally accepted public agency accounting practices. The Agency shall maintain strict accountability of all funds and a report of all receipts and disbursements of the Agency.

14.2 Fiscal Year. Unless the Board of Directors decides otherwise, the fiscal year for the Agency shall run from July 1st through June 30th.

14.3 Appointment of Treasurer and Auditor; Duties. The Treasurer and Auditor shall be appointed in the manner, and shall perform such duties and responsibilities, specified in Sections 6505.5 and 6505.6 of the Act.

ARTICLE 15
BUDGET AND EXPENSES

15.1 Budget. Within 120 days after the first meeting of the Board of Directors, and thereafter prior to the commencement of each fiscal year, the Board shall adopt a budget for the Agency for the ensuing fiscal year no later than June 30th . In the event that a budget is not so approved, the prior year's budget shall be deemed approved for the ensuing fiscal year, and any groundwater extraction fee or assessment(s) of contributions of Members, or both, approved by the Board during the prior fiscal year shall again be assessed in the same amount and terms for the ensuing fiscal year.

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15.2 Agency Funding and Contributions. For the purpose of funding the expenses and ongoing operations of the Agency, the Board of Directors shall maintain a funding account in connection with the annual budget process. The Board of Directors may fund the Agency and the GSP as provided in Chapter 8 of SGMA, commencing with Section 10730 of the Water Code, and may also issue assessments for contributions by the Members in the amount and frequency determined necessary by the Board. Such Member contributions shall be paid by each Member to the Agency within 30 days of assessment by the Board.

15.3 Return of Contributions. In accordance with Government Code section 6512.1, repayment or return to the Members of all or any part of any contributions made by Members and any revenues by the Agency may be directed by the Board of Directors at such time and upon such terms as the Board of Directors may decide; provided that (1) any distributions shall be made in proportion to the contributions paid by each Member to the Agency, and (2) any capital contribution paid by a Member voluntarily, and without obligation to make such capital contribution pursuant to Section 15.2, shall be returned to the contributing Member, together with accrued interests at the annual rate published as the yield of the Local Agency Investment Fund administered by the California State Treasurer, before any other return of contributions to the Members is made. The Agency shall hold title to all funds and property acquired by the Agency during the term of this Agreement.

15.4 Issuance of Indebtedness. The Agency may issue bonds, notes or other forms of indebtedness, as permitted under Section 4.11, provided such issuance be approved at a meeting of the Board of Directors by unanimous vote of the Member Directors as specified in Article 9 (Member Voting).

ARTICLE 16
LIABILITIES

16.1 Liability. In accordance with Government Code section 6507, the debt, liabilities and obligations of the Agency shall be the debts, liabilities and obligations of the Agency alone, and not the Members.

16.2 Indemnity. Funds of the Agency may be used to defend, indemnify, and hold harmless the Agency, each Member, each Director, and any officers, agents and employees of the Agency for their actions taken within the course and scope of their duties while acting on behalf of the Agency. Other than for gross negligence or intentional acts, to the fullest extent permitted by law, the Agency agrees to save, indemnify, defend and hold harmless each Member from any liability, claims, suits, actions, arbitration proceedings, administrative proceedings, regulatory proceedings, losses, expenses or costs of any kind, whether actual, alleged or threatened, including attorney's fees and costs, court costs, interest, defense costs, and expert witness fees, where the same arise out of, or are in any way attributable, in whole or in part, to negligent acts or omissions of the Agency or its employees, officers or agents or the employees, officers or agents of any Member, while acting within the course and scope of a Member relationship with the Agency.

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ARTICLE 17
WITHDRAWAL OF MEMBERS

17.1 Unilateral Withdrawal. Subject to the Dispute Resolution provisions set forth in Section 18.9, a Member may unilaterally withdraw from this Agreement without causing or requiring termination of this Agreement, effective upon 30 days written notice to the Board of Directors or its designee.

17.2 Rescission or Termination of Agency. This Agreement may be rescinded and the Agency terminated by unanimous written consent of all Members, except during the outstanding term of any Agency indebtedness.

17.3 Effect of Withdrawal or Termination. Upon termination of this Agreement or unilateral withdrawal, a Member shall remain obligated to pay its share of all debts, liabilities and obligations of the Agency required of the Member pursuant to terms of this Agreement, and that were incurred or accrued prior to the effective date of such termination or withdrawal, including without limitation those debts, liabilities and obligations pursuant to Sections 4.11 and 15.4. Any Member who withdraws from the Agency shall have no right to participate in the business and affairs of the Agency or to exercise any rights of a Member under this Agreement or the Act, but shall continue to share in distributions from the Agency on the same basis as if such Member had not withdrawn, provided that a Member that has withdrawn from the Agency shall not receive distributions in excess of the contributions made to the Agency while a Member. The right to share in distributions granted under this Section 17.3 shall be in lieu of any right the withdrawn Member may have to receive a distribution or payment of the fair value of the Member's interest in the Agency.

17.4 Return of Contribution. Upon termination of this Agreement, any surplus money on-hand shall be returned to the Members in proportion to their contributions made. The Board of Directors shall first offer any property, works, rights and interests of the Agency for sale to the Members on terms and conditions determined by the Board of Directors. If no such sale to Members is consummated, the Board of Directors shall offer the property, works, rights, and interest of the Agency for sale to any non-member for good and adequate consideration. The net proceeds from any sale shall be distributed among the Members in proportion to their contributions made.

ARTICLE 18
MISCELLANEOUS PROVISIONS

18.1 No Predetermination or Irretrievable Commitment of Resources. Nothing herein shall constitute a determination by the Agency or any of its Members that any action shall be undertaken, or that any unconditional or irretrievable commitment of resources shall be made, until such time as the required compliance with all local, state, or federal laws, including without limitation the California Environmental Quality Act, National Environmental Policy Act, or permit requirements, as applicable, has been completed.

18.2 Notices. Notices to a Director or Member hereunder shall be sufficient if delivered to the respective Director or clerk of the Member agency and addressed to the Director or clerk of the Member agency. Delivery may be accomplished by U.S. Postal Service, private mail service or electronic mail.

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18.3 Amendments to Agreement. This Agreement may be amended or modified at any time only by subsequent written agreement approved and executed by all of the Members.

18.4 Agreement Complete. The foregoing constitutes the full and complete Agreement of the Members. This Agreement supersedes all prior agreements and understandings, whether in writing or oral, related to the subject matter of this Agreement that are not set forth in writing herein.

18.5 Severability. Should any part, term or provision of this Agreement be decided by a court of competent jurisdiction to be illegal or in conflict with any applicable federal law or any law of the State of California, or otherwise be rendered unenforceable or ineffectual, the validity of the remaining parts, terms, or provisions hereof shall not be affected thereby, provided however, that if the remaining parts, terms, or provisions do not comply with the Act, this Agreement shall terminate.

18.6 Withdrawal by Operation of Law. Should the participation of any Member to this Agreement be decided by the courts to be illegal or in excess of that Member's authority or in conflict with any law, the validity of the Agreement as to the remaining Members shall not be affected thereby.

18.7 Assignment. The rights and duties of the Members may not be assigned or delegated without the written consent of all other Members. Any attempt to assign or delegate such rights or duties in contravention of this Agreement shall be null and void.

18.8 Binding on Successors. This Agreement shall inure to the benefit of, and be binding upon, the successors and assigns of the Members.

18.9 Dispute Resolution. In the event that any dispute arises among the Members relating to (i) this Agreement, (ii) the rights and obligations arising from this Agreement, or (iii) or a Member proposing to withdraw from membership in the Agency, the aggrieved Member or Member proposing to withdraw from membership shall provide written notice to the other Members of the controversy or proposal to withdraw from membership. Within thirty (30) days thereafter, the Members shall attempt in good faith to resolve the controversy through informal means. If the Members cannot agree upon a resolution of the controversy within thirty (30) days from the providing of written notice specified above, the dispute shall be submitted to mediation prior to commencement of any legal action or prior to withdrawal of a Member proposing to withdraw from membership. The mediation shall be no less than a full day (unless agreed otherwise among the Members) and the cost of mediation shall be paid in equal proportion among the Members. The mediator shall be either voluntarily agreed to or appointed by the Superior Court upon a suit and motion for appointment of a neutral mediator. Upon completion of mediation, if the controversy has not been resolved, any Member may exercise all rights to bring a legal action relating to the controversy or (except where such controversy relates to withdrawal of a Member's obligations upon withdrawal) withdraw from membership as otherwise authorized pursuant to this Agreement.

18.10 Counterparts. This Agreement may be executed in counterparts, each of which shall be deemed an original.

18.11 Singular Includes Plural. Whenever used in this Agreement, the singular form of any term includes the plural form and the plural form includes the singular form.

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Appendix 1C

Santa Margarita Groundwater Agency Guiding Principles

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Santa Margarita Groundwater Agency Guiding Principles

1. The Santa Margarita Groundwater Basin (Basin) is located entirely within Santa Cruz County (County). The Basin is a diverse area. It:

    - Is characterized by different communities with various land uses, and land and water management approaches.
    - Is defined by a complex set of aquifers through which groundwater passes and on which residents and ecosystems depend.
    - Has extensive biodiversity hotspots that support important terrestrial and aquatic ecosystems and species, many of which are protected by the California and Federal Endangered Species Acts.
    - Provides essential connectivity between groundwater and surface water on which the base flows of several creeks and rivers (including the San Lorenzo River) depend.
    - Is subject to climatological changes that alone, can significantly impact the availability of water.
    - Is hydrogeologically disconnected from other groundwater basins. There are no current plans to receive imported water from outside of the county. The Basin's Beneficial Users (as defined in the Sustainable Groundwater Management Act [SGMA] – See Attachment A) rely on effective management of a water budget to achieve sustainable groundwater and surface water conditions.

2. SGMA affects all Beneficial Users in the Basin. It describes groundwater sustainability requirements and mandates that Beneficial Users are able to fully participate to achieve and maintain sustainable groundwater conditions in the Basin.

3. The Santa Margarita Groundwater Agency (SMGWA) represents and preserves the water interests of all Beneficial Uses / Users in the Basin equitably and transparently. The SMGWA is a governing public agency, granted with regulatory authorities as provided in SGMA, to ensure that the Basin achieves and maintains sustainable groundwater conditions.

4. Consistent with SGMA, groundwater users that extract 2 acre-feet of groundwater or less per year for domestic purposes are defined as "de minimis". This classification limits the statutory financial and measurement responsibilities of these groundwater extractors and is a means through which some SGMA-related burdens are minimized. The SMGWA is committed to the definition of de minimis and will explore opportunities to minimize SGMA-related impacts to all groundwater extractors.

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5. While the Member agencies and participants serving as Directors of the SMGWA Board have unique responsibilities to serve their respective organizations and interests, these individuals also have a sworn responsibility (as signatory parties to the Joint Powers Agreement that formed the SMGWA) to serve the interests and regulatory authorities of the SMGWA in its required role to identify, achieve, and maintain sustainable groundwater conditions in the Basin. SMGWA Directors and staff are committed to fulfill this SGMA-specific responsibility.

6. In addition to its statutory responsibilities and authorities, the SMGWA is committed to provide consistent, transparent educational opportunities for all Beneficial Users about water resources, land uses, and water management in the Basin.

7. Historic groundwater management, surface water management and land use practices in the Basin have created overdraft conditions in some of the underlying aquifers. The practices that created overdraft conditions were not sustainable and the practices that took place will not be repeated by any member of the SMGWA nor any Beneficial User in the Basin.

8. Future sustainable groundwater conditions will depend on Basin land uses and water demand targets being in balance with available water resources. The SMGWA is committed to work with land use agencies in the Basin to promote land use practices and water demand targets that achieve sustainable water resources.

9. The SMGWA will ensure that a Groundwater Sustainability Plan (GSP) is in place by and after January 2022. Actions to achieve sustainable conditions will be described in the GSP for the Basin. Objectives and thresholds may be set Basin-wide, or may be defined differently for unique parts of the Basin in "Management Areas" (as allowed for under SGMA).

10. Beyond minimum sustainability thresholds and objectives described in the GSP, the SMGWA will examine possibilities to recover/restore the Basin's aquifers and restore tributary base flows to the best extent possible.

11. SMGWA members and Beneficial Users may have different requirements under different water resource conditions to ensure that minimum thresholds are achieved or exceeded. These potential different requirements will be defined in the GSP and implemented by the SMGWA.

12. Actions to achieve sustainable outcomes, report outcomes to the State and maintain the daily activities of the SMGWA will require consistent funding. Financial contributions to support this work will be proportionally distributed among the SMGWA membership and many Beneficial Users, based on impacts and benefits to groundwater and surface water resources. Specific proportional contributions will be determined in the future.

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13. The SMGWA also recognizes its duty to taxpayers, ratepayers, and future generations to ensure that our financial resources are used effectively and responsibly as a tool to promote sustainable groundwater conditions.

14. Integrated water management is a set of methods to extract, transport, store, use, and share groundwater and surface water throughout a groundwater basin to ensure a resilient water supply for all water users. To support SGMA objectives and Basin-wide water needs, the SMGWA will pursue an integrated water management approach for this Basin. An integrated water management approach will honor the social, cultural, natural, and economic diversity of the Basin. It will capitalize on the diverse water resources throughout the Basin and will seek to ensure that all Beneficial Users have necessary water resources. An integrated water management approach may rely on but may not be limited to:

    - Science-based decision-making.
    - Projects and Methods to recover and restore the Basin aquifers.
    - Collective and individual groundwater use requirements to ensure that groundwater elevations are not depleted below minimum thresholds.

15. Discussions between SMGWA Directors, Directors and staff, and SMGWA representatives and Beneficial Users to address the above responsibilities and outcomes may be challenging at times. Consistent with the SMGWA Board of Directors Code of Conduct (as presented in Appendix A of the SMGWA Bylaws), the SMGWA will conduct these discussions at all times in a collaborative manner with a commitment to respectful civil discourse between all participants.

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ATTACHMENT A
Beneficial Users as defined in the Sustainable Groundwater Management Act

10723.2. CONSIDERATION OF ALL INTERESTS OF ALL BENEFICIAL USES AND USERS OF GROUNDWATER

The groundwater sustainability agency shall consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans. These interests include, but are not limited to, all of the following:

(a) Holders of overlying groundwater rights, including:

- Agricultural users
- Domestic well owners

(b) Municipal well operators.

(c) Public water systems

(d) Local land use planning agencies.

(e) Environmental users of groundwater.

(f) Surface water users, if there is a hydrologic connection between surface and groundwater bodies.

(g) The federal government, including, but not limited to, the military and managers of federal lands.

(h) California Native American tribes.

(i) Disadvantaged communities, including, but not limited to, those served by private domestic wells or small community water systems.

(j) Entities listed in Section 10927 that are monitoring and reporting groundwater elevations in all or a part of a groundwater basin managed by the groundwater sustainability agency.

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Appendix 2A

Stakeholder Communication & Engagement Plan

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SANTA MARGARITA
Groundwater Agency

smgwa.org

Stakeholder Communication and Engagement Plan

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SANTA MARGARITA Groundwater Agency

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List of Abbreviations

Board
Santa Margarita Groundwater Agency Board of Directors

C&E Plan
Stakeholder Communication and Engagement Plan

County
County of Santa Cruz

DWR
California Department of Water Resources

GSA
Groundwater Sustainability Agency

GSP
Groundwater Sustainability Plan

MHA
Mount Hermon Association

PWO
Private Well Owner

SCWD
City of Santa Cruz Water Department

SGMA
Sustainable Groundwater Management Act

SLVWD
San Lorenzo Valley Water District

SMGB or Basin
Santa Margarita Groundwater Basin

SMGWA
Santa Margarita Groundwater Agency

SVWD
Scotts Valley Water District

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Background

Groundwater is a critical and integral component of California's overall water supply, benefitting residents, businesses, agriculture, industries and the environment. In many areas of the state, including the San Lorenzo Valley and Scotts Valley areas of the Central Coast, groundwater is a primary water source. Yet unlike surface water, groundwater historically was not regulated at the statewide level. This contributed to serious adverse impacts to water supply and quality including declines in groundwater levels and storage, irreversible land subsidence and degradation of groundwater-dependent ecosystems.

The Sustainable Groundwater Management Act (SGMA), which went into effect on January 1, 2015, establishes a path for the sustainable management of groundwater through the formation of locally organized Groundwater Sustainability Agencies (GSAs), which are public agencies. As part of SGMA, the California Department of Water Resources (DWR) designated groundwater basins as low, medium or high priority. The goal of SGMA is to develop and implement basin-specific Groundwater Sustainability Plans (GSPs) that outline a pathway to achieve long-term groundwater sustainability within 20 years and maintain it for 30 years beyond that.

The Santa Margarita Basin Groundwater Agency (SMGWA) is a GSA formed as a Joint Powers Authority (consistent with California Government Code 6500 – Joint Exercise of Powers Act) in June 2017. It has three member agencies: Scotts Valley Water District (SVWD), San Lorenzo Valley Water District (SLVWD), and the County of Santa Cruz (County). It is governed by the Board of Directors (Board), comprised of two representatives from each member agency, one representative from the City of Scotts Valley, one from City of Santa Cruz, one from Mount Hermon Association (MHA) and two private well owner representatives. The Board holds regular meetings that, consistent with requirements for all California public agencies through the Brown Act, are open to the public.

SMGWA is developing a GSP to ensure a sustainable groundwater supply supporting environmental and human needs, in compliance with SGMA. Under the requirements of SGMA, GSPs developed by GSAs are required to consider the interests of beneficial uses and users of groundwater, and of land uses and property interests potentially affected by using groundwater in the basin. For the Santa Margarita Groundwater Basin (SMGB or Basin), beneficial users also include customers of the City of Santa Cruz Water Department (SCWD), located outside of Basin boundaries. The San Lorenzo River, which is fed, in part, by groundwater, is a significant source of the SCWD's water supply. The GSP regulations require that GSAs document the opportunities for public engagement and active involvement of diverse social, cultural, environmental and economic elements of the population within the basin in a communication section of the GSP.

Groundwater is an essential source of drinking water for most residents living in the SMGB boundaries. Groundwater is also an important source of baseflow for the San Lorenzo River and its tributaries, especially in the summer months. Rainfall is the only source of recharge to the SMGB. Municipal pumpers — SVWD, SLVWD and MHA — as well as businesses, small water systems, residents using private wells to pump water for domestic purposes, and groundwater-dependent ecosystems, share the groundwater resource. To that end and beyond the requirements of SGMA, the member agencies of SMGWA recognize that sustainable groundwater management is essential for ensuring a reliable and resilient water supply and will continue to work collectively on the implementation of SGMA.

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Purpose

This Stakeholder Communication and Engagement Plan (C&E Plan) assists SMGWA in its efforts to disseminate and receive feedback on relevant information and to engage the public, including groundwater beneficial users, regarding the development and implementation of SMGWA's GSP with a particular focus on fulfilling and exceeding the requirements of § 354.10 Notice and Communication of the Sustainable Groundwater Management Act of 2014 (SGMA) (as amended 2015). The C&E Plan is a work plan to ensure sufficient opportunities for public participation are included in the GSP process.

The C&E Plan also provides SMGWA board members and staff a guide to ensure consistent messaging about SGMA requirements and other related information. It establishes a roadmap for GSP development that identifies how and when beneficial users and other stakeholders can provide timely and meaningful input into GSA decision-making. Additionally, the C&E Plan ensures beneficial users and other stakeholders in the SMGB are informed of milestones and offered opportunities to participate in GSP development and implementation.

SGMA has specific requirements for stakeholder engagement that include:

- Consider the interests of all beneficial uses of water and users of groundwater (Section 10723.2).
- Encourage the active involvement of diverse social, cultural and economic elements of the population within the groundwater basin (Section 10727.8).
- Establish and maintain a list of persons interested in receiving notices regarding plan preparation, meeting announcements and availability of draft plans, maps and other relevant documents (Section 10723.4).
- Make available to the public and DWR a written statement describing the manner in which interested parties may participate in the development and implementation of the GSP (Section 10723.2).

Goals and Outcomes

The C&E Plan is an evolving document that is updated and refined as GSP planning and implementation progresses. The C&E Plan supports the following goals:

1. Provide opportunities to educate stakeholders about SGMA and its requirements, and how those requirements could affect them.
2. Articulate strategies and channels to obtain ongoing stakeholder input to inform GSP development.
3. Increase awareness and understanding among stakeholders of the challenges and opportunities that SMGWA faces to achieve and maintain groundwater sustainability and other related issues facing the SMGB.
4. Increase engagement among stakeholders in support of the GSP.

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Communication and Outreach Objectives

The following are the communications and outreach objectives that the C&E Plan supports:

- **Expand Audience Reach**
  - » Maintain a robust stakeholder list of interested individuals, groups and/or organizations.
  - » Secure a balanced level of participants who represent the interests of beneficial uses and users of groundwater.
- **Increase Engagement**
  - » Keep a list of interested stakeholders informed and aware of opportunities for involvement through email communications and/or their preferred communications.
  - » Publish meeting agendas, minutes, recordings and summaries on the SMGWA website (www.smgwa.org).
  - » Inform and encourage comments from the general public during Board meetings.
  - » Facilitate productive dialogue among participants throughout the planning process.
  - » Seek the input of interest groups during the implementation of the GSP and any future planning efforts.
- **Increase GSP Awareness**
  - » Provide timely and accurate public reporting of planning milestones through the distribution of outreach materials and posting of materials on the SMGWA website for the GSP.
  - » Seek to secure quality media coverage that is accurate, complete and fair.
  - » Utilize social media to engage with the general public.
  - » Utilize direct mailers to beneficial users when additional outreach seems necessary.
- **Track Efforts**
  - » Maintain an active communications tracking tool to capture stakeholder engagement and public outreach activities and to demonstrate the reporting of GSP outreach activities.

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Target Audiences and Stakeholders

SMGB stakeholders are other agencies and interested parties including all beneficial users of groundwater or representatives of those users. Under the requirements of SGMA, all beneficial uses and users of groundwater must be considered in the development of GSPs, and GSAs must encourage the active involvement of diverse social, cultural and economic elements of the population.

There are a variety of audiences targeted within the SMGB whose SGMA knowledge varies from high to little or none. Given this variance, communication and engagement efforts are broad and all-inclusive. Target audiences include:

- **SMGWA Board of Directors**
  How to contact: direct calls, email, press releases, board meetings, community events
- **SMGWA member and partner agencies, including management, staff and customers**
  How to contact: email newsletters, bill inserts, social media, press releases, board meetings, community events
- **Elected officials, and local and state agencies within the SMGB**
  How to contact: presentations, direct calls, email, press releases, board meetings, community events
- **Beneficial uses and users of groundwater including private pumpers and environmental uses such as fish and plant habitat**
  How to contact: presentations, email newsletters, postcard mailings, social media, press releases, board meetings, community events
- **Diverse social, cultural and economic segments of the population within the SMGB including Disadvantaged Communities (DACs)**
  How to contact: email newsletters, social media, press releases, board meetings, community events
- **Public**
  How to contact: press releases, social media, community events

The SGMA mandates that beneficial users participate in development of the GSP. The SMGB's beneficial users rely on effective management of groundwater sustainability indicators to achieve and maintain sustainable groundwater conditions that support each of their uses.

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Target Audiences and Stakeholders

Category of Interest	Examples of Stakeholder Groups	Engagement Purpose
General Public	• Basin residents	Inform to improve public awareness of sustainable groundwater management
Land Use	• County Planning • City of Scotts Valley Planning • LAFCO • AMBAG	Consult and involve to ensure land use policies are supporting GSP, and GSP reflects projected population and development
Private Users	• Private domestic pumpers • Small water systems • Mount Hermon Association • Quarries • Irrigation users such as Home Owner Associations • Amah Mutsun Tribal Band	Inform and involve to avoid negative impact to these users, and inform about the need and basis for possible future fees
Urban and Agriculture Users	• Resource Conservation District of Santa Cruz County • Farm Bureau • Cannabis Licensing Division • Municipal water ratepayers • Commercial users • City, County and State parks	Collaborate to ensure sustainable management of groundwater, and to inform about the need and basis for possible future fees
Environmental and Ecosystem	• Federal and State regulatory agencies (Fish and Wildlife) • Wetland managers • Environmental groups	Inform and involve to sustain vital groundwater-dependent ecosystems
Economic Development	• Chambers of commerce • Elected officials	Inform and involve to support a stable economy
Human Right to Water	• Disadvantaged communities • Environmental justice groups • Human service non-profits	Inform and involve to provide a safe and secure groundwater supply to DACs
Integrated Water Management	• Regional Water Management Group of Santa Cruz County • Water Advisory Commission of Santa Cruz County	Inform, involve and collaborate to improve regional sustainability

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Engagement and Public Outreach

Stakeholder involvement and public outreach is critical to the GSP development and implementation because it helps promote the plan development, based on input and broad support. The following activities summarize involvement opportunities and outreach methods to inform target audiences and stakeholders. It is important to note that levels of interest will evolve and shift according to the GSP's development stage.

Goals and Outcomes

An email listserve of interested persons and organizations is created and maintained. The listserve includes stakeholders that represent the region's broad interests, perspectives and geography. It is developed by leveraging existing lists and by conducting research of potential stakeholders that may be interested in one or all of the following categories: municipal users and groundwater users including private pumpers, community/neighborhood, agricultural, environmental, industrial, institutional, business, disadvantaged communities, state lands and agencies, and integrated water management. Members of the public also can sign up for the listserve via the SMGWA website.

Audience/Stakeholder Contact Strategies

Groundwater Users in the Basin

- **Scotts Valley Water District customers (all)**
  How to contact: Email newsletters, bill inserts, newspaper advertising, social media, presentations to board of directors, community events
- **San Lorenzo Valley Water District customers (all)**
  How to contact: Email newsletters, bill inserts, newspaper advertising, social media, presentations to board of directors, community events
- **Mount Hermon Association, private well residential users, and small water systems (all)**
  How to contact: Newspaper advertising, social media, community events, postcard mailing, agency-led well owner meetings
- **Non-profit organizations and government agencies**
  Email newsletters, newspaper advertising, social media, presentations, direct outreach to key staff

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Key Messages and Talking Points

The C&E Plan is intended to be transparent and direct about how the GSP will impact stakeholders. Key messages and talking points include:

- SMGWA represents the groundwater interests of all beneficial uses and users of the basin equitably and transparently to ensure that the Basin achieves and maintains sustainable groundwater conditions.
- SMGWA is working to sustainably manage local groundwater to meet all users' needs without harming the environment or jeopardizing future water supply reliability.
- SMGWA is committed to working with stakeholders using an open and transparent communication and engagement process.
- As the overall GSP will be more comprehensive with an engaged group of stakeholders providing useful information, SMGWA will create substantial opportunities to educate stakeholders on basin conditions and the GSP process to facilitate soliciting their feedback on GSP development.
- As updating and implementing the GSP will be most successful with an engaged community, outreach will be ongoing past the GSP submittal date.

These messages are being used as the basis for specific talking points/Q&A/FAQ documents to support effective engagement with audiences. The SMGWA Guiding Principles also are used to support communication with audiences (see Appendix).

Strategies for Engagement

The SMGWA utilizes a variety of tactics to achieve broad, enduring and productive involvement with stakeholders during the development of the GSP. Below are activities that SMGWA uses to engage the public:

- Develop and maintain a list of interested parties
- Public informational sessions
  - » "Understanding Our Water" three-part education series
  - » "Undesirable Results – the SGMA Road to What Should be Avoided" workshop
  - » "State of Surface Water in the Santa Margarita Basin" workshop
  - » "The Path to Groundwater Sustainability: Goals and Challenges" discussion
  - » Virtual PWO meeting hosted on Zoom and broadcast live on Facebook
  - » "Drought: Global Challenge, Local Solutions" open house event
- SMGB tours
- Stakeholder interviews conducted by Sacramento State, Consensus and Collaboration Program as a third party neutral facilitator to SMGWA (see Appendix).

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Strategies for Engagement (cont.)

- Board meetings
  - » Regular public notices and updates; Brown Act compliance
  - » Signs to notify residents of upcoming meetings
  - » Publish meeting summaries monthly (beginning March 2020)
  - » Virtual board meetings (beginning Spring 2020) hosted on GoToMeeting and Zoom platforms, including dial-in option for people without Internet access
  - » Hybrid board meetings (beginning Spring 2021) that continues virtual meetings while providing members of the public with an in-person option to participate
- Digital communications
  - » SMGWA website: maintain with current information
  - » SMGWA Facebook and Instagram pages: maintain and grow social media presence, promote content though advertising to target audiences
  - » Direct email via Mailchimp
- Mailings to private well owners and additional SMGB residents
- Media coverage
  - » Op-eds in the local newspapers
  - » Press releases
  - » Radio interviews
- Participation at outreach events hosted by other local agencies i.e. "Connecting the Drops"
- Co-promotional opportunities with member agencies including email newsletters, social media (Facebook, Instagram, Nextdoor), board meetings and mailings to customers
- SMGWA intern position dedicated to youth outreach
  - » Compiled an extensive list of pre- and post-pandemic outreach activities to reach a younger audience
  - » Created the Groundwater Stewardship Program, a self-paced online educational classroom that consisted of videos, articles, interactive quizzes, discussion boards and live game-play (Margaritaville) to encourage critical thinking
  - » The Quail Hollow Homeschool (K-5) participated in a lesson plan designed to promote an understanding of groundwater and how our basin functions
  - » Created 5-question trivia quizzes to share online
- Talks and presentations to various stakeholder groups and associations
- Educational and outreach materials (see Appendix)

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Implementation Timeline and Tactics

SMGWA uses a 4-phase plan to conduct outreach.

PHASE 1
Ongoing Efforts

- SMGWA website (www.smgwa.org): consistent updates
- Press releases: highlighting key milestones and opportunities for public engagement
- Social media: consistent updates
- Email newsletter: quarterly or more often
- Mailings: as needed
- Board meetings: recorded public meetings available online, written board meeting summaries provided to member agencies and the media after each meeting
- Co-promotional efforts with partner agencies: consistent updates

PHASE 2
GSP Development

- Review draft stakeholder engagement plan, make suggestions and update
- Media outreach
- Public workshops and events: Educational Series, community discussions, basin tours, Private Well Owner meetings
- Create youth outreach programs: speak to school groups, facilitate online Youth Education Program

PHASE 3
GSP Rollout

- Review draft stakeholder engagement plan, make suggestions and update
- Media outreach and advertising: engage with a broad audience of stakeholders and beneficial users
- Public informational events: host community conversation for GSP
- Website: modernize website for GSP presentation and to collect comments

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SANTA MARGARITA Groundwater Agency

Implementation Timeline and Tactics (cont.)

SMGWA uses a 4-phase plan to conduct outreach.

PHASE 4
GSP Submission-Ongoing

- Review draft stakeholder engagement plan, make suggestions and update
- Rollout of final plan
- Media outreach
- C&E Plan and GSP milestone requirements by phase:
  - » Prior to initiating plan development: Share how interested parties may contact the GSA and participate in development and implementation of the plan submitted to DWR. (Sec. 353.6)
  - » Prior to GSP development: Establish and maintain an email list of interested parties. (Sec. 10723.4)
  - » Prior to and with GSP submission:
    - ▪ Record statements of issues and interests of beneficial users of basin groundwater including types of parties representing the interests and consultation process
    - ▪ Lists of public meetings
    - ▪ Inventory of comments and summary of responses
    - ▪ Communication section in GSP (Sec. 354.10) that includes: agency decision-making process, identification of public engagement opportunities and response process, description of process for inclusion, and method for public information related to progress in implementing the plan (status, projects, actions)
- Supporting tactics to be used to communicate messages and supporting resources available:
  - » SMGWA website, updated regularly to reflect meetings and workshops
  - » Direct email via Mailchimp, sent approximately monthly to announce board meetings, special workshops and other opportunities for engagement such as the SMGB tours
  - » Outreach to local media to secure coverage of announcements and events, radio interviews, op-ed placement
  - » Workshops, information sessions and other community meetings
  - » Social media, specifically Facebook, updated regularly to share information and support other outreach efforts

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SANTA MARGARITA Groundwater Agency

Stakeholder Outreach

Interviews conducted by Sacramento State, Consensus and Collaboration Program
(as a third party neutral facilitator to SMGWA)

Name of Interviewee	Position/Affiliation
2018	
Donna Lind	SMGWA Board, City of Scotts Valley
Rosemary Menard	Staff, City of Santa Cruz
Gene Ratcliffe **Chuck Baughman**	SMGWA Board, SLVWD
Chris Perri	SMGWA Board, SVWD
Danny Reber	SMGWA Board (Alternate), SVWD
John Ricker **Sierra Ryan**	SMGWA Staff, County of Santa Cruz
John Leopold	SMGWA Board, County of Santa Cruz
Piret Harmon	Staff, SVWD
Heidi Luckenbach	Staff, City of Santa Cruz
Nick Vrolyk	SMGWA Board, Well Owner Representative
Dale Pollock	SMGWA Board, Mt. Hermon Assoc.
Jen Michelsen **Rick Rogers**	Staff, SLVWD
David McNair	Staff, SVWD
David Hodgin	SMGWA Board, SVWD
Jack Dilles	SMGWA Board (Alternate), City of Scotts Valley
Bill Smallman	SMGWA Board, SLVWD
Edan Cassidy	SMGWA Board (Alternate), Well Owner Rep.
Ruth Stiles	SMGWA Board, SVWD

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Stakeholder Outreach (cont.)

Name of Interviewee	Position/Affiliation
Bruce McPherson	SMGWA Board, County of Santa Cruz
Brian Lee	General Manager, SLVWD
Bruce Holloway	Community Representative
SMGWA Facilitation Subcommittee Meeting	5x
Lois Henry	SMGWA Board, SLVWD
Stephen Swan	SMGWA Board, SLVWD
William "Bill" Ekwall	SMGWA Board, SVWD
2019	
SMGWA Facilitation Subcommittee Meeting	2x
Rick Moran	Board, SLVWD
Jeff Koopman	SMGWA Board, SVWD
2020	
Doug Engfer	SMGWA Board, City of Santa Cruz
Donna Lind	SMGWA Board, SVWD
Jack Dilles	SMGWA Board (Alternate), City of Scotts Valley
Lois Henry	SMGWA Board, SLVWD
Jeff Koopman	SMGWA Board (Alternate), Well Owner Rep.
Chris Perri	SMGWA Board, SVWD
Angela Franklin	SMGWA Board (Alternate), Well Owner Rep.
Rick Moran	SMGWA Board, SLVWD
John Leopold	SMGWA Board, County of Santa Cruz
Dale Pollack	SMGWA Board, Mt. Hermon Assoc.

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Stakeholder Outreach (cont.)

Name of Interviewee	Position/Affiliation
Ruth Stilles	SMGWA Board, SVWD
Bruce McPherson / J.M. Brown	SMGWA Board, County of Santa Cruz
Lew Farris	Board, SLVWD
William "Bill" Ekwall	SMGWA Board, SVWD
Edan Cassidy	SMGWA Board (Alternate), Well Owner Rep.
2021	
Gail Mahood	SMGWA Board, SLVWD
Tina To	Board, SLVWD
Mark Smolley	SMGWA Board, SLVWD
Note regarding tribal stakeholders:	
There is no currently active or known group representing the descendants of the Awaswas. The neighboring tribe to the Awaswas were the Mutsun, now represented through the Amah Mutsun Tribal Band (AMTB). Staff met with a representative of the AMTB who indicated their focus at the moment is on their ancestral lands. However, they do maintain an interest in the surrounding areas as well. As rivers are of particular importance, SMGWA and contributing agencies will notify the Amah Mutsun Tribal Band about projects that may impact waterways, and work with them to accommodate any actions they recommend.	

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Evaluation and Assessment

A phased approach to outreach provides opportunities to assess to the program and evaluate how the plan is performing against goals and objectives. Assessment is conducted by the Santa Margarita Groundwater Agency Working Group and reviewed by Board Members during quarterly communications updates to the Board. Areas for consideration:

- What worked well?
- What didn't go as planned?
- Are stakeholders educated about the GSP development process and their own role?
- Is the timeline for implementation of the GSP clear?
- Has the GSA received positive press coverage?
- Do diverse stakeholders feel included?
- Have there been behavior changes related to the program goals? Has there been improved trust/relationships among participants?
- Community and board meeting recaps and next steps
- Lessons learned

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Appendix

MEDIA		
Date	Media	Topic/Headline
2/16/17	Santa Cruz Sentinel	Coast Lines: Private well owners invited to meet
2/17/17	Press Banner	Feb. 22 workshop on mountain aquifer
2/22/17	County of Santa Cruz	Groundwater Agency Formation Workshop
2/7/18	Press Release	$1 Million Grant Recommended for Santa Margarita Groundwater Agency by CA Dept of Water Resources
2/22/18	Press Banner	SMGWA aims to maintain water flow
3/9/18	Press Banner	SMGWA first meeting of 2018
6/14/18	Press Banner	Private well owners reject any new metering fees
12/11/18	Press Release	Santa Margarita Groundwater Agency Announces Three-Part 'Understanding Our Water' Educational Series
1/6/19	Santa Cruz Sentinel	Water agency will be important for years to come
2/15/19	Scotts Valley Times	Understanding Our Water
4/14/19	Santa Cruz Sentinel	Community participation is key to future of water supply
2/4/20	Press Banner	Finding a Sustainable Water Solution
6/13/20	Scotts Valley Times	Santa Margarita Board Evaluates Groundwater
6/23/20	My Scotts Valley	Santa Margarita Groundwater Agency begins high school groundwater steward program
7/15/20	Press Banner	Santa Margarita Groundwater Agency Begins Groundwater Steward Program
8/4/20	My Scotts Valley	SMGWA Board Reviews Communications Plan
9/21/20	Press Release	Santa Margarita Groundwater Agency Offers Second Session of Groundwater Steward Program
9/21/20	My Scotts Valley	Santa Margarita Groundwater Agency Offers Second Session of Groundwater Steward Program

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MEDIA (CONT.)		
11/1/20	My Scotts Valley	SMGWA Board advances development of Groundwater Sustainability Plan
11/13/20	My Scotts Valley	SMGWA Board meets Monday, Nov. 16
11/19/20	My Scotts Valley	Well users invited to groundwater management meeting
11/21/20	Scotts Valley Times	Scotts Valley Private Well Owners Invited to Meeting
1/14/21	My Scotts Valley	SMGWA Board Finishes 2020 with Workshop, Two Meetings
2/22/21	My Scotts Valley	SMGWA board reviews hydrogeological modeling
3/8/21	My Scotts Valley	Santa Margarita Groundwater Agency Seeks Well Owner to Serve on Board of Directors
3/10/21	My Scotts Valley	SMGWA Board progresses on Groundwater Sustainability
4/6/21	My Scotts Valley	SMGWA Board Aims to Complete Draft of GSP for Review in July
4/15/21	Press Release	New Monitoring Wells Planned for Santa Margarita Groundwater Agency
4/16/21	My Scotts Valley	New Monitoring Wells Planned for Santa Margarita Groundwater Agency
5/13/21	My Scotts Valley	SMGWA Board Reviews Project and Management Actions
7/1/21	My Scotts Valley	Draft Groundwater Sustainability Plan nears completion
7/13/21	Santa Cruz Sentinel	Santa Cruz to hold public meetings on possible water rights update
7/29/21	Santa Cruz Sentinel	Santa Margarita Groundwater Agency to host sustainability event Saturday
7/30/21	Lookout Santa Cruz	Morning Lookout: As Delta details grow scarier, more establishments take precautions
8/4/21	My Scotts Valley	Draft Groundwater Sustainability Plan released
8/1/21	Scotts Valley Times	Got Groundwater?
8/13/21	Press Banner	Local groundwater agency plan open for public comment
9/9/21	My Scotts Valley	Draft Groundwater Sustainability Plan Public Comment Period Continues Until Sept. 23

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SANTA MARGARITA Groundwater Agency

PUBLIC COMMENT ADMINISTRATIVE RECORD

Date Submitted	Venue Received	Subject	Comment
8/27/20	Board Meeting	UR for Degraded WQ	Use 10-year exponential moving average: reflects change in contaminants quicker
8/27/20	Board Meeting	UR for Degraded WQ	Allow one well (20%) to exceed the MT
6/25/20	Board Meeting	Approach for MT and MO for Chronic Lowering of GWL	Favors MT #2 and UR #3 (red). There is nothing bad/ negative about the dropped GW levels as long as the GDE, fish, WQ etc are satisfied and protected.
8/27/20	Board Meeting	Statement of S&U for Depletion of Interconnected SW	SGMA does not give a pass to de-minimis users if they are causing significant adverse impacts.
8/27/20	Board Meeting	Statement of S&U for Depletion of Interconnected SW	Undue is a legal term. Defining "undue financial burden" for all indicators is helpful.
8/27/20	Board Meeting	Statement of S&U for Depletion of Interconnected SW	Use an average of historical minimums instead of one single datapoint when determining MT.
8/27/20	Board Meeting	Statement of S&U for Depletion of Interconnected SW	Having only two RMPs poses a potential data gap. Agrees with previous comment about using average of historical minimums for MT.
9/24/20	Board Meeting	Statement of S&U and MT for Depletion of Interconnected SW	"Viability" of priority species is too low bar. Consider "thrive" or "sustain" instead.
1/28/21	Board Meeting	Basin Problem Statement	Comment about the County's responsibility in addressing the nitrate in San Lorenzo River – wishes that County did more enforcement on septic systems. Appreciates the thorough and detailed discussion that including opposing views.
4/22/21	Board Meeting	Measurable Objectives last five years, In Lieu Projects	Frank Cheap prefers average seasonal lows.
5/27/21	Board Meeting	Public Outreach	Frank Cheap does not like the format of the zoom meetings; does not know who is at the meeting; supports the social media efforts. Need to promote this agency; offers to help promote public exposure.

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PUBLIC COMMENT ADMINISTRATIVE RECORD (CONT.)

6/24/21		Section 4 of GSP	C. Dzendzel requests access Loch Lomond raw water; Felton Resident; concern about chemistry of pipelines. Requests new treatment plant in Felton. Frank Cheap asks for zoom adjustment; supports Board's efforts; supports voluntarily metering and make data anonymous; wants help for private well owners during drought
7/22/21		GSP Public Review Draft	Cynthia commented about budget and asked whether it may be easier to get grants.
7/22/21		GSP Public Review Draft	Cynthia commented about private pumpers. Response. This budget helps the Agency to apply for grants.
7/22/21		GSP Public Review Draft	Frank Cheap asked Piret to read into the record his comments. Wants to protect deminimis users from future costs imposed by the Agency.
7/22/21		GSP Public Review Draft	Cynthia commented about Section 4 about the proposed revision requested by Director Mahood; Cynthia encouraged cooperation among agencies. Cooperation is the reason we have this agency. Encourage all agencies to be forthcoming and to work with other districts.
7/22/21		GSP Public Review Draft	Motion to approve the issuance of the Groundwater Sustainability Plan, with edits addressed and agreed upon during the Board's July 22 meeting. After call for public comment, no comments from the public.
9/23/21		Draft GSP Public Hearing	Jesse Maxfield Department of Fish and Wildlife. Georgina's response: Monitoring wells only two. We have to put in wells; need 5 years of data. Shallow groundwater levels are stable. We must reassess after 5 years; datagap.
9/23/21			Work with National Marine Fishery Service Streamflow coordinator. Right now working on a comment letter. Hope to get it done tonight. Minimum thresholds historical groundwater flows. Commented on this on several plans. Streamflow and groundwater connection. Don't believe they are appropriate. Salmon and steelehead are threatened. Concern about a minimum threshhold based upon 2 consecutive years. Fish and aquatic organizims are viable at a moment in time. D182 years is not based on ecological factors.

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PUBLIC COMMENT ADMINISTRATIVE RECORD (CONT.)			
10/28/21		GSP response to comments	Frank Cheap expressed thanks for the work; inquired about public participation and outreach.
10/28/21		Outreach	Frank Cheap expresses appreciation for Kelly's presentation on public outreach. Suggests power point; work with County to reach wider audience.

Abbreviations

GSP
Groundwater Sustainability Plan

UR
Undesirable Result

WQ
Water Quality

S&U
Significant & Unreasonable

MT
Minimum Threshold

GW
Groundwater

GDE
Groundwater Dependent Ecosystems

MO
Measurable Objectives

GWL
Groundwater Level

RMP
Representative Monitoring Point

SMGA
Sustainable Groudnwater Management Act

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OUTREACH ACTIVITIES

Date	Activity	Description/Goals	Venue/Platform	Audience
January – March 2019	"Understanding Our Water" educational series	The three-part educational series beginning in January to engage and inform all people who rely on the water supply from the Santa Margarita Groundwater Basin. • **January 12:** Land Use and Water: How Much Does Growth Matter? • **February 9:** Water Budgets: How Do We Balance All Needs? • **March 9:** Managing Groundwater: How Can We Prepare for an Uncertain Future?	In person	General public, elected officials, media, private domestic pumpers, federal and state agencies
August 2019	"State of Surface Water in the Santa Margarita Basin" workshop	This public workshop is the next in an ongoing series of public workshops hosted by SMGWA. This workshop focuses on the relationship of surface water to CA's Sustainable Groundwater Management Act and the complex nature of surface water management, rights and regulations.	In person	General public, elected officials, private domestic pumpers
September 2019	"The Path to Groundwater Sustainability: Goals and Challenges" discussion	SMGWA Board Meeting and an informational session about groundwater sustainability. Topics include Groundwater Sustainability Plan (GSP) road map, hydrogeologic conceptual model, sustainability goals and sustainability indicators.	In person	General public, elected officials, private domestic pumpers

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OUTREACH ACTIVITIES (CONT.)				
Date	Activity	Description/Goals	Venue/Platform	Audience
September 2019	Basin Tours	This program further educated the SMGWA Board on Basin conditions, and provided an effective public outreach tool to members of the public interested in agency activities. It also served as a vehicle to promote inter-agency understanding and cooperation among SMGWA constituent organizations.	In person	All SMGWA constituent agencies and organizations, staff and public
February 2020	Scotts Valley High School Lecture	A presentation to build awareness that the water supply is a local natural resource, local water resources support other species as well as people, the current GSP development and the Groundwater Steward Program as an opportunity to learn more.	In person	Scotts Valley High School K Street Science (1 section) and Environmental Sciences (2 sections) classes, approximately 50-60 students
Spring 2020 – Winter 2020	Groundwater Stewardship Program	A self-paced online educational classroom that consisted of videos, articles, interactive quizzes, discussion boards and live game-play (Margaritaville) that was offered to students and the general public. The goals of the program were to encourage critical thinking about balancing the needs of the agency to help inform the current GSP and also to engage a younger audience than had historically been involved and expand a general understanding of the Basin and GSP process. The program was offered as community service credit through the Scotts Valley High School and shared with San Lorenzo Valley School District, Pacific Collegiate School and the Santa Cruz County Office of Education.	Online - Google Classroom	Youth, targeting high school and college students

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OUTREACH ACTIVITIES (CONT.)

Date	Activity	Description/Goals	Venue/Platform	Audience
December 2020	Private Well Owner Meeting	Hosted a virtual meeting on Zoom and broadcast on Facebook Live to provide private well owners with an update on SMGWA activities.	Online: Zoom and Facebook Live	Private domestic pumpers and small community systems
April 2021	Groundwater Experiment	Students participated in a lesson plan designed to promote an understanding of groundwater and how the Basin functions. The experiment, called Aquifer in a Cup, was led both online and in-person to promote an understanding of where our water comes from, what is groundwater, and who does it affect.	Online and in-person	Quail Hollow Homeschool K-5 students
Spring 2021	Trivia Quizzes	A series of five-question trivia quizzes promoted learning about the groundwater basin, promoted through the SMGWA email newsletter and their Facebook and Instagram pages. There was a raffle incentive for participating.	Online - promoted through Facebook, Instagram and email newsletter	All
2021	Farmers Markets	Staff and board members provided an opportunity for community members to learn more about SMGWA and the GSP process by tabling at farmers markets in Scotts Valley and Felton.	In person	General public
July 24, 2021	Santa Cruz Mountains Classic Car Show	This fundraising event in Brookdale, a DAC in the San Lorenzo Valley, supported local fire departments. The event drew community members and provided a forum for SMGWA staff and board members to connect one-on-one with Basin users while providing free drinking water.	In person	General public

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OUTREACH ACTIVITIES (CONT.)				
Date	Activity	Description/Goals	Venue/Platform	Audience
July 31, 2021	"Drought: Global Challenge, Local Solutions" open house event	This family-friendly event at Skypark in Scotts Valley shared the agency's work on groundwater sustainability. The two-hour event featured several booths where attendees could learn about various aspects of SMGWA's work and get stamps in a "passport." There also was short presentation by SMGWA staff and board members, as well as a question-and-answer session. Prizes were offered for completing the passport and there were free activities for kids.	In person	General public, elected officials, private domestic pumpers
Aug. 21-22, 2021	Scotts Valley Art, Wine & Beer Festival	Staff connected with community members to share information about SGMWA and the public comment period for the GSP at the two-day Scotts Valley Art, Wine & Beer Festival.	In person	General public
Ongoing	Youth Outreach Activities	Researched an extensive list of pre- and post-pandemic outreach activities to reach a younger audience, stratified by age group and life stage to consider the variety of ways people might want to participate.		Youth

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OUTREACH ACTIVITIES (CONT.)

SMGWA Basin Tour Program August-November 2019

Participants pose in front of the Scotts Valley Water District Offices before the pilot run of the program on August 23rd, 2019.

John Ricker of County of Santa Cruz Discusses the geology of the Zayante fault line at the northern boundary of the Basin on upper Bean Creek.

Rick Rogers, manager of SLVWD explains the unique habitat provided by the Olympia Quarry Wellfield and land management considerations for SLV.

Chris Berry of City of Santa Cruz Water Department demonstrates the decision matrix used to operate the inflatable dam at the Felton Diversion.

Dates:
August 23
September 18
October 16
November 20

Participants:
All SMGWA Constituent Agencies and Organizations, Staff, and Public.

Supported Lines of Effort:
- Professional Development/Education
- Stakeholder Outreach/Engagement
- Strengthening Inter-Agency Relationships

Narrative:
From August to November of 2019, the Santa Margarita Groundwater Agency conducted a series of 4 educational tours to highlight the unique features, conditions, and challenges that face the Santa Margarita Basin.

These events were mainly aimed at the Board of Directors and their Alternates, and members of the public attended all iterations of the event on a space-available basis.

This program further educated the SMGWA Board on Basin conditions, and provided an effective public outreach tool to members of the public interested in Agency activities. It further served as a vehicle to promote inter-agency understanding and cooperation among SMGWA constituent organizations.

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SAMPLE OF EDUCATIONAL MATERIALS

SAMPLE OF EDUCATIONAL MATERIALS (CONT.)

SANTA MARGARITA Groundwater Agency

The Santa Margarita Groundwater Agency is being formed to improve the regional collaboration on managing the groundwater basin and comply with State requirements.

The new agency is comprised of the representatives of public agencies and private well owners who use the basin for their water supply.

To get more information and participate in the process, sign up for the newsletter at smgwa.org and attend the upcoming workshop.

• PUBLIC MEETING •

FEBRUARY 22, 2017

Scotts Valley Water District
Santa Margarita Community Room (lower level)
2 Civic Center Drive, Scotts Valley
7 to 9 pm

Information: Sierra Ryan (831) 454-3133
Sierra.Ryan@santacruzcounty.us • smgwa.org

THE COUNTY OF SANTA CRUZ · 1850 ·

San Lorenzo Valley WATER DISTRICT

SCOTTS VALLEY WATER DISTRICT

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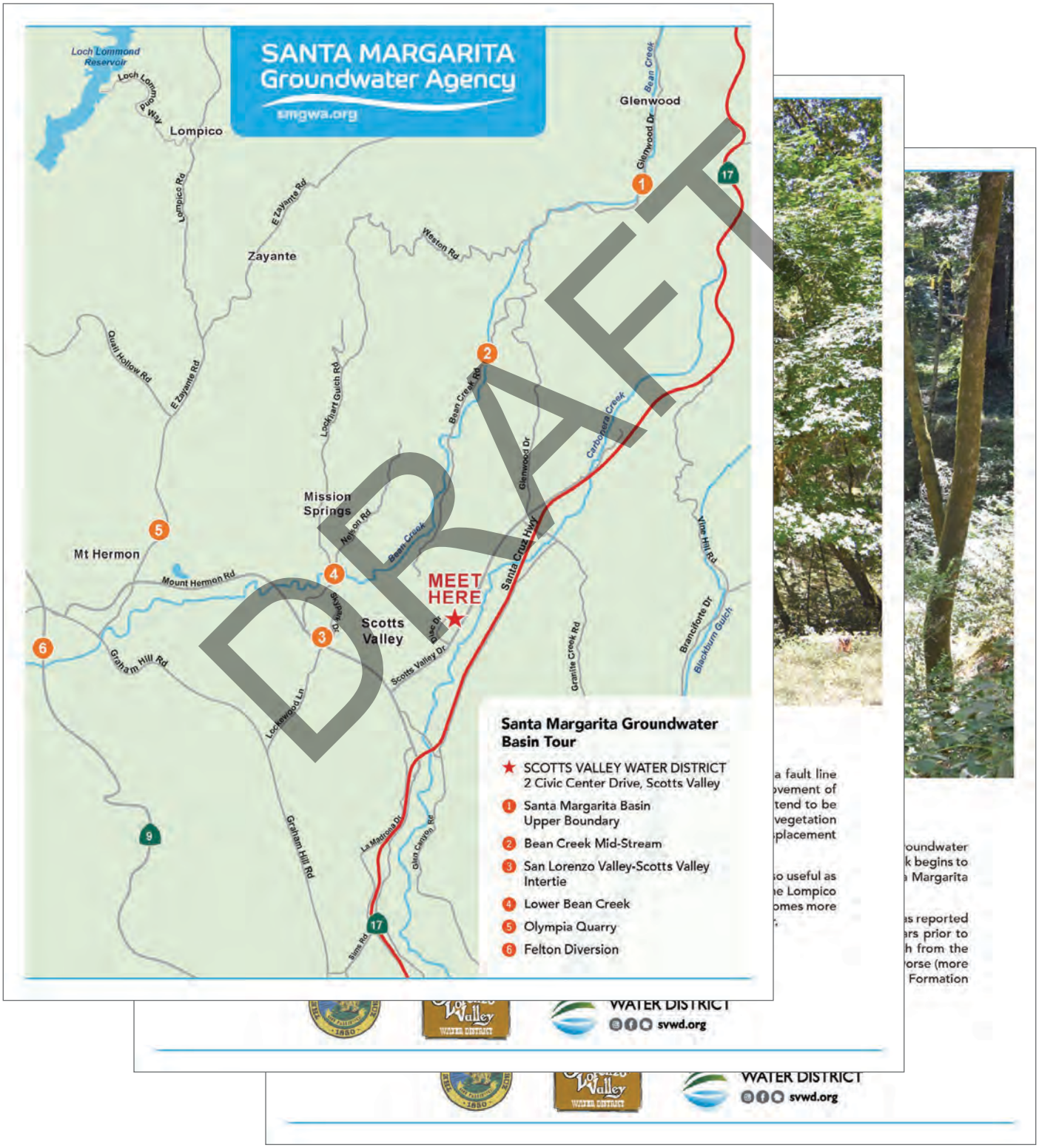
SANTA MARGARITA
Groundwater Agency

SAMPLE OF EDUCATIONAL MATERIALS (CONT.)



SAMPLE OF EDUCATIONAL MATERIALS (CONT.)

STOP 3: SAN LORENZO VALLEY-SCOTTS VALLEY INTERTIE

Intertie 2 is one of the four bidirectional interties constructed between the San Lorenzo Valley Water District (SLVWD) and Scotts Valley Water District (SVWD) that allow the adjacent water systems to share water during a water emergency.

This project for the first time connects the two water districts, so that in the event of a major fire, winter storm, or an earthquake, the two valleys can help each other out by directly providing water through this Intertie connection. Additionally, the intertie system could improve water supply reliability for SLVWD customers and reduce aquifer pumping during winter months when stream flow is high. Previously, SLVWD could not move water between the North, South and Felton systems. With the interties in place, water could be transferred from one system to another within the district, depending on availability and demand.

SVWD led a grant application effort to obtain Proposition 50 Water Security funding from the California Department of Public Health in 2013. The state funds of about $3.9 million covered 44% of the total project costs for interties.

The other three interties that were included in the project are: Intertie 3, connecting SLVWD South System to SLVWD North System, Intertie 4, connecting SLVWD South System to Mount Hermon, and Intertie 6, connecting SLVWD North System to Felton.

Intertie 2, completed in Spring 2016, connects the SVWD water system and the SLVWD water system along Lockwood Lane and Skypark Drive and includes a pump station on Skypark Drive allowing for water transfers either up or down gradient and enhancing water security across the region. It has a capacity of 600 gpm (gallons per minute).

SCOTTS VALLEY
WATER DISTRICT
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SAMPLE OF EDUCATIONAL MATERIALS (CONT.)

SAMPLE OF EDUCATIONAL MATERIALS (CONT.)

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SAMPLE OF EDUCATIONAL MATERIALS (CONT.)

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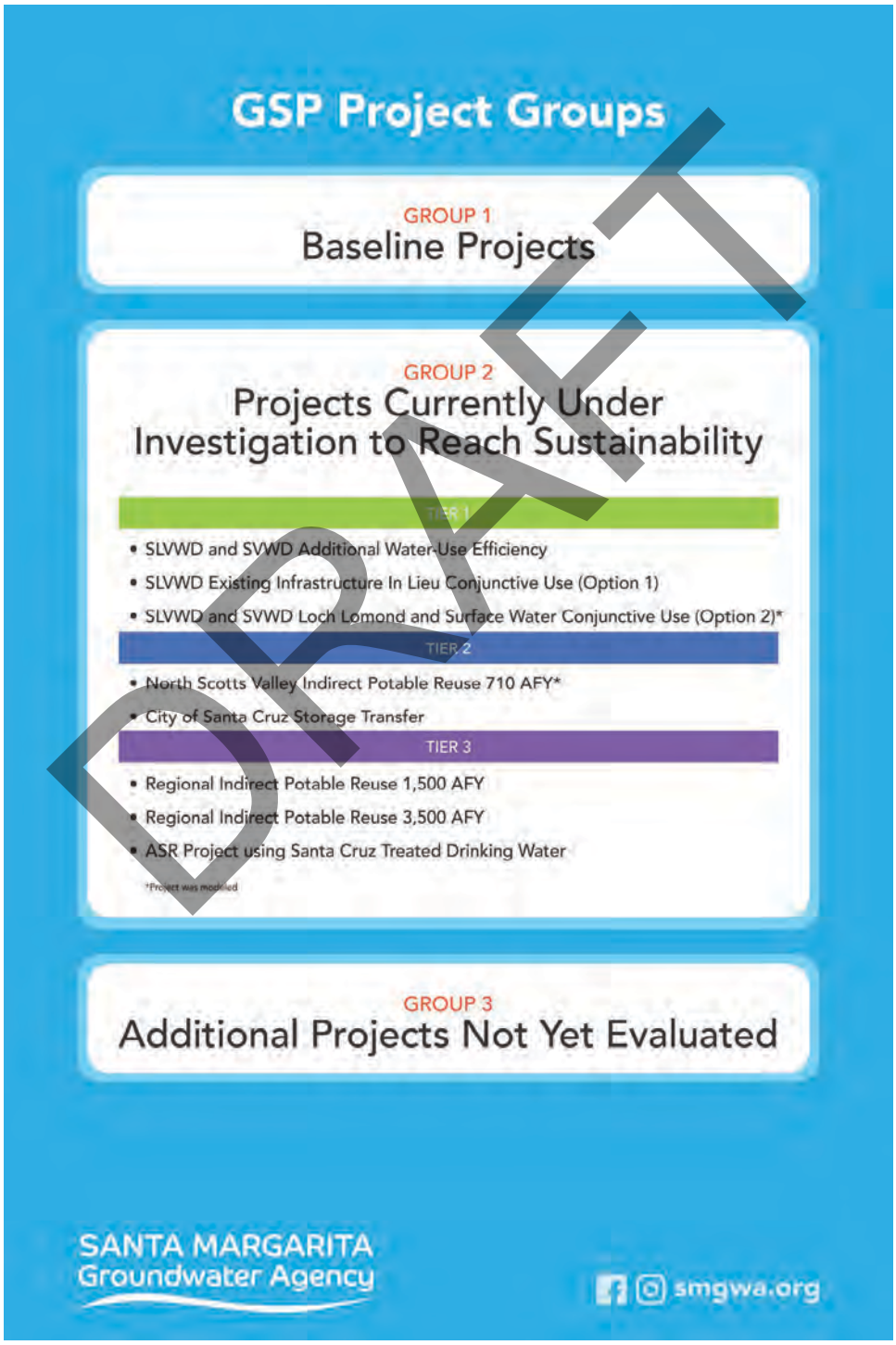
SAMPLE OF EDUCATIONAL MATERIALS (CONT.)



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SANTA MARGARITA GROUNDWATER AGENCY

Guiding Principles

1 The Santa Margarita Groundwater Basin (Basin) is located entirely within Santa Cruz County (County). The Basin is a diverse area. It:

- Is characterized by different communities with various land uses, and land and water management approaches.
- Is defined by a complex set of aquifers through which groundwater passes and on which residents and ecosystems depend.
- Has extensive biodiversity hotspots that support important terrestrial and aquatic ecosystems and species, many of which are protected by the California and Federal Endangered Species Acts.
- Provides essential connectivity between groundwater and surface water on which the base flows of several creeks and rivers (including the San Lorenzo River) depend.
- Is subject to climatological changes that alone, can significantly impact the availability of water.
- Is hydrogeologically disconnected from other groundwater basins. There are no current plans to receive imported water from outside of the county. The Basin's Beneficial Users (as defined in the Sustainable Groundwater Management Act [SGMA] – See Attachment A) rely on effective management of a water budget to achieve sustainable groundwater and surface water conditions.

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Groundwater Agency

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SANTA MARGARITA GROUNDWATER AGENCY

Guiding Principles

2 SGMA affects all Beneficial Users in the Basin. It describes groundwater sustainability requirements and mandates that Beneficial Users are able to fully participate to achieve and maintain sustainable groundwater conditions in the Basin.

3 The Santa Margarita Groundwater Agency (SMGWA) represents and preserves the water interests of all Beneficial Uses / Users in the Basin equitably and transparently. The SMGWA is a governing public agency, granted with regulatory authorities as provided in SGMA, to ensure that the Basin achieves and maintains sustainable groundwater conditions.

4 Consistent with SGMA, groundwater users that extract two acre-feet of groundwater or less per year for domestic purposes are defined as "de minimis." This classification limits the statutory financial and measurement responsibilities of these groundwater extractors and is a means through which some SGMA-related burdens are minimized. The SMGWA is committed to the definition of de minimis and will explore opportunities to minimize SGMA-related impacts to all groundwater extractors.

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SANTA MARGARITA GROUNDWATER AGENCY

Guiding Principles

5 While the Member agencies and participants serving as Directors of the SMGWA Board have unique responsibilities to serve their respective organizations and interests, these individuals also have a sworn responsibility (as signatory parties to the Joint Powers Agreement that formed the SMGWA) to serve the interests and regulatory authorities of the SMGWA in its required role to identify, achieve and maintain sustainable groundwater conditions in the Basin. SMGWA Directors and staff are committed to fulfill this SGMA-specific responsibility.

6 In addition to its statutory responsibilities and authorities, the SMGWA is committed to provide consistent, transparent educational opportunities for all Beneficial Users about water resources, land uses and water management in the Basin.

7 Historic groundwater management, surface water management and land use practices in the Basin have created overdraft conditions in some of the underlying aquifers. The practices that created overdraft conditions were not sustainable and the practices that took place will not be repeated by any member of the SMGWA nor any Beneficial User in the Basin.

8 Future sustainable groundwater conditions will depend on Basin land uses and water demand targets being in balance with available water resources. The SMGWA is committed to work with land use agencies in the Basin to promote land use practices and water demand targets that achieve sustainable water resources.

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SANTA MARGARITA GROUNDWATER AGENCY

Guiding Principles

9 The SMGWA will ensure that a Groundwater Sustainability Plan (GSP) is in place by and after January 2022. Actions to achieve sustainable conditions will be described in the GSP for the Basin. Objectives and thresholds may be set Basin-wide, or may be defined differently for unique parts of the Basin in "Management Areas" (as allowed for under SGMA).

10 Beyond minimum sustainability thresholds and objectives described in the GSP, the SMGWA will examine possibilities to recover / restore the Basin's aquifers and restore tributary base flows to the best extent possible.

11 SMGWA members and Beneficial Users may have different requirements under different water resource conditions to ensure that minimum thresholds are achieved or exceeded. These potential different requirements will be defined in the GSP and implemented by the SMGWA.

12 Actions to achieve sustainable outcomes, report outcomes to the State and maintain the daily activities of the SMGWA will require consistent funding. Financial contributions to support this work will be proportionally distributed among the SMGWA membership and many Beneficial Users, based on impacts and benefits to groundwater and surface water resources. Specific proportional contributions will be determined in the future.

13 The SMGWA also recognizes its duty to taxpayers, ratepayers and future generations to ensure that our financial resources are used effectively and responsibly as a tool to promote sustainable groundwater conditions.

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Groundwater Agency

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SANTA MARGARITA GROUNDWATER AGENCY

Guiding Principles

14 Integrated water management is a set of methods to extract, transport, store, use and share groundwater and surface water throughout a groundwater basin to ensure a resilient water supply for all water users. To support SGMA objectives and Basin-wide water needs, the SMGWA will pursue an integrated water management approach for this Basin. An integrated water management approach will honor the social, cultural, natural and economic diversity of the Basin. It will capitalize on the diverse water resources throughout the Basin and will seek to ensure that all Beneficial Users have necessary water resources. An integrated water management approach may rely on but may not be limited to:

- Science-based decision-making.
- Projects and Methods to recover and restore the Basin aquifers.
- Collective and individual groundwater use requirements to ensure that groundwater elevations are not depleted below minimum thresholds.

15 Discussions between SMGWA Directors, Directors and staff, and SMGWA representatives and Beneficial Users to address the above responsibilities and outcomes may be challenging at times. Consistent with the SMGWA Board of Directors Code of Conduct (as presented in Appendix A of the SMGWA Bylaws), the SMGWA will conduct these discussions at all times in a collaborative manner with a commitment to respectful civil discourse between all participants.

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Appendix 2B

Comments and Reponses on Public Draft GSP

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Comments and Responses on Public Draft GSP

Note: public written comments as received follow this table

Comment Number	Commentor	GSP Section	Topic	Recommendation/Comment	Response
1	Amanda McLeod	Section 2	Santa Margarita aquifer recharge	I hereby request that sustainability plan to be amended to cover sustainability of the Santa Margarita aquifer and, specifically, plans around recharge. I appreciate the language that was added to underscore that consistent with current law, taxation of private well owners is unlawful.	The GSP includes sustainable management criteria for all principal aquifers in the Basin, of which the Santa Margarita aquifer is one. Other than in the Mount Hermon/South Scotts Valley area there has been no long-term widespread overdraft or chronic lowering of groundwater levels in the Santa Margarita aquifer that needs to be addressed under the Sustainable Groundwater Management Act. Recharge of the Santa Margarita aquifer happens naturally by rainfall. Low rainfall years means less recharge and high rainfall years means the aquifer recharges fairly quickly until it is full. It acts as a leaky bathtub where it is always discharging some of its water in the form of baseflow to creeks, regardless of how much rain there is. Without this flow, many creeks would dry up in summer and aquatic species would not survive. The Basin is unique in this way as it can support aquatic habitat in many creeks year-round because of the nature of the Santa Margarita aquifer. In the Mount Hermon/South Scotts Valley area, parts of the Santa Margarita aquifer are dewatered (meaning the entire thickness has no groundwater) because of past historical use described in Section 2.2.5.1.2.1. In this area, groundwater levels have not increased much even though there are no longer industrial, contamination remediation, or municipal extractions from it. It is believed groundwater levels have not recovered because the underlying Monterey Formation and Lompico aquifer also have lowered groundwater levels that are inducing recharge through the Santa Margarita aquifer. Section 2.2.5.1.2.1 of the GSP describes induced recharge through the Santa Margarita aquifer as generally following 1 of 2 pathways depending on the underlying formation: 1) infiltration to the top of the underlying low permeability Monterey Formation from where it flows horizontally until it emerges as seeps to Bean Creek, and 2) vertically into the Lompico aquifer where it directly underlies the Santa Margarita aquifer. Model simulations show that by implementing projects to increasing groundwater levels in the Lompico aquifer, groundwater levels in the Santa Margarita aquifer and Monterey Formation benefit because of reduced induced recharge. Earlier model runs not included in the GSP indicate that directly recharging the Santa Margarita aquifer in the dewatered area results in a large portion of the recharged water cannot be retained in the aquifer but rather flows into Bean Creek. Recharge projects directly targeting the dewatered Santa Margarita aquifer are therefore not planned, but the aquifer will indirectly benefit from projects that address improving groundwater levels in the underlying Lompico aquifer.
2	Bret McLeod	Section 2	Santa Margarita Watershed Protection	Would like to know what steps are being taken and what steps will be taken to care for the Santa Margarita Watershed no and in the future. I would also like to have these actions/plans detailed in the upcoming management plan for the water board.	The focus of this Plan is on groundwater and not watershed protection. The SMGWA has no authority over the entire San Lorenzo watershed. There are other efforts on watershed protection that are carried out by the County, SLVWD and City of Santa Cruz who rely on surface water as a source of water. These are described in Section 2.1.3.4.1 of the GSP. If this comment is related to the Santa Margarita aquifer and not the watershed, please see response to comment 1.
3	Philip McReynolds	Section 2	Santa Margarita aquifer recharge	Asking for the plan to be amended to cover sustainability of the Santa Margarita aquifer, specifically plans around recharge of this aquifer.	Same as response to comment 1.

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Comment Number	Commentor	GSP Section	Topic	Recommendation/Comment	Response
4	Frank Cheap	Section 2	Santa Margarita aquifer sustainability	First of all, I appreciate the years of work, the long hours, and expense that the Santa Margarita Groundwater Basin Agency invested into this draft plan. As a member of the public, I've attended many meetings and sat through numerous presentations to understand some of the goals and science applied to the undertaking of Groundwater Management in this basin. Though private well owners (PWO) have two seats on the agency, the thrust in the draft plan appears to be dominated by the water districts with deeper aquifers and surface water that supply those districts vs the PWO drafting from the more shallow Santa Margarita Aquifer. Note, there are estimated 800 to 1100 private well owners and small water systems within this water management basin, primarily drawing upon the Santa Margarita Aquifer, little effort has been applied to proactively managing this aquifer, aside from a small number monitor wells. Convention wisdom is PWO will be very conservative with water consumption. In the same breath, the PMOs and small water agencies and little or no resources to manage at scale or recharge this Santa Margarita Aquifer, other than land conservation practices, as mentioned, and of watershed protection of their respective properties. Private well owners and small water systems are the most risk for reduction in groundwater due to climate and/or drought conditions. My request is that the groundwater agency consider language into the draft for protection of private well owners who in most cases have no alternative source of water, as stated. In addition, active plans for aquifer management, specifically conservation education efforts, monetary incentives to conserve and voluntary metering (anonymised data collection) as well as active plans to assist in recharge the aquifer above and beyond annual rainfall: options include: dormant quarries, recharge ponds and temporary inflatable dams, water injection wells, are some of the potential options. Currently, the County has a voluntary well water depth sounding program as free service to PWOs, collection of this data and publication should be a resource for current and future assessment of aquifer conditions and health. Analysis and publication of this data is a low inertia and cost-effective way of both and historic view and ongoing monitoring of the Santa Margarita Aquifer,	See response to comment 1. To address some of the recommendations made by the commenter, Section 4.3.1.1 is revised to include the County of Santa Cruz to the Group 2 Tier 1 project SLVWD and SVWD Additional Water Use Efficiency. The County would bring conservation practices and opportunities to small water systems and private well owners. There are several potential projects in the suite of projects included in the GSP to recharge the Santa Margarita aquifer, these are: • SLVWD Olympia Groundwater Replenishment (Section 4.6.1) • Public/Private Stormwater Recharge and Low Impact Development (Section 4.6.2) • Enhanced Santa Margarita Aquifer Conjunctive Use (Section 4.6.3) • Santa Margarita Aquifer Private Pumpers Connect to Public Water System (Section 4.6.5) A very recent Senate Bill 352 (approved by Governor September 23, 2021) now requires counties to establish a standing county drought and water shortage task force to facilitate drought and water shortage preparedness for state small water systems and domestic wells within the county's jurisdiction. This is too recent to include in the GSP at this time, but whatever plan the Santa Cruz Drought and Water Shortage Task Force comes up will be incorporated into the first GSP Update in 5 years.
5	NGO Consortium	Section 2	Identification of Key Beneficial Uses and Users	Include a well density map for domestic wells only, not all water supply wells.	It is not a requirement that well density for each use type is prepared. The well density map required by the GSP regulations shows density of all groundwater extraction occurring in the Basin. Figure 2-9 shows the location of private domestic wells in the Basin.
6	NGO Consortium	Section 2	Identification of Key Beneficial Uses and Users	Provide the population of each identified DAC block group and include details on the population dependent on groundwater for their domestic water use.	Figure 2-9 was updated to the most recent DAC data (2018) which is a single DAC block group that is smaller in area than the 2016 DACs used in the Public Draft GSP. The DAC population using groundwater within the Basin is estimated in the final GSP as < 10 people based on the number of residential parcels not served municipal water.
7	NGO Consortium	Section 2	Identification of Key Beneficial Uses and Users	Describe tribal interests in the basin, including lands with historical importance to the tribe.	Section 2.1.1.4.5 describe the California Tribal and Cultural Area that historically belonged to a division of the Ohlone people known as the Awaswas. There is no currently active or known group representing the descendants of the Awaswas. The neighboring tribe to the Awaswas were the Mutsun, now represented through the Amah Mutsun Tribal Band (AMTB). Staff met with a representative of the AMTB who indicated their focus at the moment is on their ancestral lands, however they do maintain an interest in the surrounding areas as well. As rivers are of particular importance, SMGWA and contributing agencies will notify the Amah Mutsun Tribal Band about projects that may impact waterways, and work with them to accommodate any actions they recommend.
8	NGO Consortium	Section 2	Identification of Interconnected Surface Waters	While the GSP identifies data gaps and their locations in GSP Section 2.2.4.11 (Hydrogeologic Conceptual Model Data Gaps), please also describe the data gaps in the ISW section.	A new subsection and map have been added under Section 2.2.5.6 Interconnected Surface Water to cover data gaps
9	NGO Consortium	Section 2	Identification of Interconnected Surface Waters	On the ISW map (Figure 2-72), clearly label the areas with data gaps. We recommend that the GSP considers any segments with data gaps as potential ISWs and clearly marks them as such on the ISW map.	Figure 2-72 has been revised to indicate segments that were classed as "Not Connected" are now "Potentially Connected"

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Comment Number	Commentor	GSP Section	Topic	Recommendation/Comment	Response
10	NGO Consortium	Section 2	GDEs	Develop and describe a systematic approach for analyzing the basin's GDEs. For example, provide a map of the NC Dataset. On the map, label polygons retained, removed, or added to/from the NC dataset (include the removal reason if polygons are not considered potential GDEs, or include the data source if polygons are added). Discuss how local groundwater data was used to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer. Refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer.	Section 2.2.4.9 has been revised to clarify the approach for analyzing the GDEs. All GDEs in the NC dataset were retained as GDEs. The GDEs included in the GSP were shown to the Surface Water Technical Advisory Group and additional sites were added by local experts, who have a working knowledge of GDEs in the Basin.
11	NGO Consortium	Section 2	GDEs	Use depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) to determine the range of depth to groundwater around NC dataset polygons. We recommend that a baseline period (10 years from 2005 to 2015) be established to characterize groundwater conditions over multiple water year types. Refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer.	Figure 2-72 identifies the percent of time from 1985-2018 that groundwater is connected to creeks and within 30 feet of ground surface. Conservatively almost all creeks are identified as connected or potentially connected to groundwater. A depth to water map would not change this.
12	NGO Consortium	Section 2	GDEs	Provide depth-to-groundwater contour maps, noting the best practices presented in Attachment D. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a DEM to estimate depth-to-groundwater contours across the landscape.	See comment 11 above.
13	NGO Consortium	Section 2	GDEs	If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons as "Potential GDEs" in the GSP until data gaps are reconciled in the monitoring network.	All of the GDEs from the NC dataset are included as GDEs in the GSP. Refer to Section 2.2.4.9.
14	NGO Consortium	Section 2	Native vegetation and managed wetlands and their inclusion in Water Budget	Quantify and present all water use sector demands in the historical, current, and projected water budgets with individual line items for each water use sector, including native vegetation. If native vegetation is included as one of the land use types in the numerical model, specifically state this in the GSP and provide a separate line item in water budget tables.	Water budget tables do include a line item for evapotranspiration by vegetation, see Tables 2-24, 2-28, and 2-32.
15	NGO Consortium	Section 2	Native vegetation and managed wetlands and their inclusion in Water Budget	State whether or not there are managed wetlands in the basin. If there are, ensure that their groundwater demands are included as separate line items in the historical, current, and projected water budgets.	No managed wetlands
16	NGO Consortium	Section 2	Engaging Stakeholders	Include a more detailed and robust Stakeholder Communication and Engagement Plan that describes active and targeted outreach to engage DACs, domestic well owners, environmental stakeholders, and tribal stakeholders during the remainder of the GSP development process and throughout the GSP implementation phase. Refer to Attachment B for specific recommendations on how to actively engage stakeholders during all phases of the GSP process.	The C&E Plan will be updated with more detail on the extensive outreach that has been carried out.
17	NGO Consortium	Section 2	Engaging Stakeholders	Describe efforts to consult and engage with tribes within the basin. Refer to the DWR guidance entitled Engagement with Tribal Governments for specifics on how to consult with tribes	See response to comment 6.

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Comment Number	Commentor	GSP Section	Topic	Recommendation/Comment	Response
18	NGO Consortium	Section 2	Climate change	Integrate extreme wet and dry scenarios into the projected water budget to form the basis for development of sustainable management criteria and projects and management actions.	The projected water budget does reflect wet and dry periods included in the transient climate change scenario, but all years are averaged in the water budget tables. The projected water budget is not used to set sustainable management criteria because most criteria are not based on water budget terms and the criteria for groundwater in storage is the projected pumping that will meet other criteria, The range of simulated groundwater levels during wet and dry extremes in the transient climate change scenario are compared to sustainable management criteria to evaluate whether the GSP will achieve sustainability. The choice of climate change projection used is described in Appendix 2C that contains a report called "Santa Margarita Basin Groundwater Model Updates and Simulations for Groundwater Sustainability Planning", specifically Subsection 7.1. The climate change scenario used is transient and covers the period from 2020 through 2072. Section 4 contains water budget tables for baseline and 2 projects (Tables 4-1 and 4-5). Each of these tables includes a comparison of baseline against the project. Average critically dry and average wet water year budgets have been added to the overall average water budget in response to public comments received.
19	John Ricker	Section 2	Start of population growth	p. ES-3. Period of rapid growth in basin began in 1970-1980, particularly in unincorporated areas, see Fig 2-34 p. ES-8 states: "Groundwater levels in both aquifers started to decline as early as the 1970s…", while ES-9 states: "Lowered groundwater levels in certain parts of the Basin have caused a corresponding reduction in groundwater stored in the Basin. Since the 1980s, and even possibly starting in the 1960s,..." These should be reworded for consistency. Maybe best to say: "Since the 1970s and possibly even starting in the 1960s"	Revised 1980 to 1970 on pg ES-3 and in Section 2.1.1.6. Revised as suggested on pg ES-9 and Section 2.2.5.3.
20	John Ricker	Section 2	Local Area Management Program	p. ES-5. The County's LAMP for septic systems is correctly titled the Local Area Management Program (not Plan)	Updated to Local Area Management Program in list of abbreviations, pg ES-5 and Section 2.1.2.4.4.
21	John Ricker	Section 2		p. 2-107: Last paragraph: Suggest adding a sentence about the City's Tait Street Diversion on the San Lorenzo River derives a significant amount of its flow from the Basin. This is consistent with including it in Table 2-17, which I appreciate.	Added a sentence to the paragraph describing City of Santa Cruz sources within the Basin in Section 2.2.4.10
22	Eric Brune	Section 2	New developments and growth in Scotts Valley	First, thank you for such a great document. The plan does not seem to directly address the large number of new developments and growth in the Scotts Valley area. Will there be recommendations about curbing the number of new developments in the area? The plan seems to imply that there will be a large push for more efficient water use, but no limit on the number households / commercial developments that can be supported. Whether or not a limit or curb is required; sustainable development is a huge concern that should be directly addressed in this type of report.	SMGWA, like all other Groundwater Sustainability Agencies, does not have authority over land use. The GSP uses water demand projections that are in alignment with the County of Santa Cruz and City of Scotts Valley General Plans. Both public water agencies, SLVWD and SVWD have completed 2020 updates to their Urban Water Management Plans, which include demand projections over the next 20 years, and take into consideration anticipated growth that is very moderate. A large majority of new developments only use potable water indoors where the current plumbing code requires very high efficiency fixtures and appliances. Recycled water is used for outdoor irrigation. Thus, the combined additional potable demand predicted from new developments is very moderate. Sections 2.1.3.2 (Potential Water Demand Changes), 2.2.6.4.3 (Projected Groundwater Budget), and 2.2.6.5 (Sustainable Yield) describe the projected water demands for the Basin.
23	NGO Consortium	Section 3	Considering Beneficial Uses and Users When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users	Chronic Lowering of Groundwater Levels ● Describe direct and indirect impacts on DACs and tribes when defining undesirable results for chronic lowering of groundwater levels, in addition to describing impacts to drinking water users. ● Consider and evaluate the impacts of selected minimum thresholds and measurable objectives on DACs, drinking water users, and tribes within the basin. Further describe the impact of passing the minimum threshold for these users. For example, provide the number of domestic wells that would be de-watered at the minimum threshold.	DACs in the GSP are grouped into beneficial user types based on their source of water supply, which is either municipal water or privately pumped. This is described in Section 2.1.4.2.5 but will be reiterated in relevant places in Section 3. Added footnote in Section 3.4.3.5 to make this clear. Revised Section 3.4.3.5. Effects of Minimum Thresholds on Beneficial Users and Land Uses; for Rural residential land uses and users, including DACs, to better describe potential impacts to rural residential land users and uses.

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Comment Number	Commentor	GSP Section	Topic	Recommendation/Comment	Response
24	NGO Consortium	Section 3	Considering Beneficial Uses and Users When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users	Degraded Water Quality ● Describe direct and indirect impacts on DACs and tribes when defining undesirable results for degraded water quality. For specific guidance on how to consider these users, refer to "Guide to Protecting Water Quality Under the Sustainable Groundwater Management Act." ● Evaluate the cumulative or indirect impacts of proposed minimum thresholds on DACs and tribes.	The DAC is grouped into beneficial user types based on their source of water supply, which is either municipal water or privately pumped. This is described in Section 2.1.4.2.5 but will be reiterated in relevant places in Section 3. Added footnote in Section 3.6.3.5.
25	NGO Consortium	Section 3	Considering GDEs and ISW When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users	When defining undesirable results for chronic lowering of groundwater levels, provide specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs. Undesirable results to environmental users occur when 'significant and unreasonable' effects on beneficial users are caused by one of the sustainability indicators (i.e., chronic lowering of groundwater levels, degraded water quality, or depletion of interconnected surface water). Thus, potential impacts on environmental beneficial uses and users need to be considered when defining undesirable results9 in the basin. Defining undesirable results is the crucial first step before the minimum thresholds can be determined.	Updated Section 3.4.2.4 to include a reference to Section 3.7.2.5. See response to comment 21. Updated Section 2.1.3.4.9 to include that given the current condition of waterways that continue to support threatened and endangered species, current impacts to GDEs are not thought to be significant and unreasonable.
26	NGO Consortium	Section 3	Considering GDEs and ISW When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users	For the interconnected surface water SMC, the undesirable results should include a description of potential impacts on instream habitats within ISWs when defining minimum thresholds in the basin11. The GSP should confirm that minimum thresholds for ISWs avoid adverse impacts to environmental beneficial users of interconnected surface waters as these environmental users could be left unprotected by the GSP. These recommendations apply especially to environmental beneficial users that are already protected under pre-existing state or federal law.	Section 3.7.2.5 includes a discussion on the undesirable results to ecological land uses and users. It includes a description of potential impacts on instream habitat. This section was updated to reference Section 2.1.4.8, that includes a detailed discussion of the ecological users in the basin, including: a list of priority species and co-beneficiaries of priority species, resources and methods available to evaluate instream flows for priority species, steelhead and coho minimum passage and spawning criteria, and a summary of on-going programs to evaluate the biological response of priority species within the basin. The minimum thresholds for ISW are based on historical conditions, which are considered sufficient to support GDES for priority species (Section 3.7.3.5). Minimum thresholds will be re-evaluated during the first 5-year annual update, when there are data from new shallow monitoring wells and nearby stream gages.
27	NGO Consortium	Section 3	Monitoring Network Data Gaps	Provide a complete set of maps that overlay monitoring well locations (both existing RMPs and new RMPs) with the locations of DACs, domestic wells, and GDEs to clearly identify potentially impacted areas. Ensure that existing and proposed RMPs adequately cover DAC, domestic well, and GDE portions of the basin.	Figure 3-7 is updated with additional recommended features
28	NGO Consortium	Section 3	Monitoring Network Data Gaps	Evaluate how the gathered data will be used to identify and map GDEs and ISWs, and to identify DACs and shallow domestic well users that are vulnerable to undesirable results.	If this refers to new monitoring well data: new data may be used to confirm or reclassify areas that are now classed as "Potentially Connected" because currently the GSP conservatively assumes all creeks are connected. Also, if groundwater levels are found to be deeper in private well areas than expected then shallow wells in those areas may be at risk.

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Comment Number	Commentor	GSP Section	Topic	Recommendation/Comment	Response
29	Rick Rogers NMFS	Section 3	Minimum thresholds for Depletion of Interconnected Surface Water	Does not feel a minimum threshold that maintains estimated streamflow depletions at historical maximum amounts is appropriately protective. Basic hydraulic principles dictate that groundwater flow is proportional to the difference between groundwater elevations at different locations along a flow path. Using this basic principle, groundwater flow to a stream, or conversely seepage from a stream to the underlying aquifer, is proportional to the difference between water elevation in the stream and groundwater elevations at locations away from the stream. Minimum thresholds and measurable objectives consistent with the lowest groundwater elevations on record would likely create historically high streamflow depletion rates that, when combined with low surface flow input, would be very likely to adversely affect protected species and their critical habitat.	Comment noted. Minimum thresholds represent the groundwater elevation below which significant and unreasonable depletions of streamflow occur. The objective of SGMA is not to maintain levels at minimum thresholds but rather to be at the more aspirational measurable objectives by 2042, or even higher. Maintaining levels at minimum thresholds would certainly cause undesirable results and that is not the intention of SGMA nor this GSP. The GSA has 20 years to achieve measurable objectives and it may happen during this time that shallow groundwater levels supporting streamflow will fall below the minimum thresholds. When that happens, it will likely correspond to consecutive years of below average rainfall. The amount of rainfall the Santa Margarita aquifer, which is the main contributor of creek baseflow, receives has a far greater impact on groundwater levels in the aquifer than reducing Santa Margarita aquifer pumping has. In multi-year below average rainfall periods, even if there was no groundwater pumping, groundwater levels may fall below minimum thresholds purely because of the sensitivity of the Santa Margarita aquifer to rainfall. This is a natural response in this aquifer that GDEs have had to contend with prior to human development of the Basin. If this happens, field observations of GDEs, analysis of groundwater level data collected, and evaluation of predictive modeling will be able to confirm if significant and unreasonable streamflow depletions of baseflows are occurring in response to those levels. The next 20 years will be a period of figuring it all out because this sustainability indicator is new to groundwater managers and there is no tried-and-true method to quantify depletions of interconnected surface waters from groundwater pumping. Since water demand is not expected to increase very much, climate change is going to be the biggest challenge for all beneficial groundwater users and uses in this Basin. It will be especially challenging for GDEs because creek baseflows are mostly supported by the rainfall-dependent Santa Margarita aquifer. It is expected that greater extremes in rainfall will change the timing and amounts of baseflows creeks receive each year. The same is true for private domestic well owners with shallow wells in the Santa Margarita aquifer. When there is limited rainfall, all beneficial users have to make do with less water. For now, groundwater level is the only measurable attribute that provides an indication of gaining and losing stream conditions, and groundwater models relying on those same groundwater levels for calibration can be used to simulate surface water and groundwater interactions. With SGMA's requirements in mind, the SMGWA will work diligently to better understand the complex interactions of groundwater and surface water over the next 20 years, if not sooner.
30	Rick Rogers NMFS	Section 3	Undesirable results for Depletion of Interconnected Surface Water	Undesirable results based on multi-year exceedances are not appropriate, as impacts to fish are in a moment of time. There is no ecological basis for multi-year criteria for undesirable results.	Comment is noted and will be considered during the first 5-year GSP update when more data are available from the expanded monitoring network to evaluate minimum thresholds and undesirable results.
31	Jessie Maxfield CA Dept. Fish and Wildlife	Section 3	Representative Monitoring Points	Will any of the new monitoring wells become representative monitoring points?	Yes, they will be once there are several years of data collected and the wells are found to be representative of nearby wells. Section 3.3.5.1 and 3.3.5.4 has been updated to reflect this more clearly.

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Comment Number	Commentor	GSP Section	Topic	Recommendation/Comment	Response
32	John Ricker	Section 3	Degraded groundwater quality SMC	p.3-72-73: The discussion of groundwater quality should be more explicit on one point, specifically related to nitrate. Recharge with treated wastewater has the potential to increase nitrate levels in groundwater, resulting in an increase in nitrate in surface water. This can cause biostimulation in the aquatic ecosystem, depressing dissolved oxygen levels and adversely impacting aquatic biota, and it can result in increased production of organic compounds that can cause taste and odor problems and disinfection byproducts adversely affecting municipal water supply and costs for surface water treatment. 5 mg-N/L may still be too high as a minimum threshold for nitrate to prevent undesirable results in surface water. If extensive areas of the Basin were allowed to reach a nitrate concentration of 5 mg-N/L, it is very likely the target of 0.33 mg-N/L would be significantly exceeded in the San Lorenzo River. Ongoing monitoring should include monitoring for nitrate in the River as well as groundwater, with consideration to reducing the minimum threshold in the future as needed. Achieving the nitrate TMDL target for the River will require reducing current nitrate inputs to the Basin, which will result in lower nitrate concentrations in groundwater than presently exist as shown in Table 3-21.	Revised suggested text has been added to the bullet titled "Recharge of Poor-Quality Water" in Section 3.6.2.3. Additionally, effects to users have been updated in Section 3.6.2.4. Comments on minimum threshold of 5 mg/L for nitrate as N are noted. It is agreed that the first 5-year GSP update must re-examine the nitrate minimum threshold.
33	John Ricker	Section 3	Estimates of streamflow depletion from groundwater extraction	P 3-82: I concur with the estimates of streamflow depletion from groundwater extraction estimated for the Basin and for Bean Creek. Those figures are consistent with my analysis of streamflow records going back to the early 1970's. It will be good to further address this critical issue through the installation of additional shallow monitoring wells and stream gages and further evaluate that data in future GSP updates. Hopefully this will help establish measurable objectives that will help restore some of the depleted flows.	Comment noted.
34	John Ricker	Section 3	Depletion of interconnected surface water SMC for representative monitoring point SV4-MW	Fig. 3-23: This figure illustrates some concerns I have with the minimum threshold and objectives for SV4-MW. The minimum threshold seems too low, particularly if levels can be allowed to fall below the minimum threshold for up to two years or during a drought period. Drought periods are the time when baseflow contributions to the streams are the most critical for maintaining minimum flows in streams and the River. During droughts there is almost no surface contribution from the areas of the watershed north of the Zayante fault and the contribution from the Santa Margarita basin is critically important. Perhaps some sort of minimum threshold during drought periods should be considered. If groundwater levels are low, there is a need to reduce groundwater extractions during drought periods, rather than just allowing groundwater levels to fall below minimum thresholds. I am also concerned about setting the measurable objective at levels observed in 2004 in SV4-MW. Figure 3-23 shows that the levels in 2004 were uncharacteristically low, even though it was preceded by "normal" rainfall years. For that location I might suggest a minimum threshold during drought periods of 381 ft, a minimum threshold during non-drought of 387 ft and a measurable objective of 397 ft.	Comment noted. The SV4-MW representative monitoring point (RMP) is not an ideal location because of many interferences in streamflow other than just precipitation, runoff, and groundwater extraction. It was included because without it, there would only be one RMP for the basin. The first 5-year update will specifically be looking at the RMPs for the depletion of interconnected surface water SMC; adding new points and re-evaluating the SMC from existing points.
35	John Ricker	Section 3	Impacts to Santa Cruz Mid-County Basin from depletion of interconnected surface water minimum thresholds	p. 3-95: In discussing the effect on the Santa Cruz Mid-County Basin, Carbonera Creek does not flow into the Santa Cruz Mid-County Basin but Branciforte Cr. (Blackburn Gulch) does. Depletion of groundwater contribution to portions of Branciforte in the Santa Margarita Basin could have a significant effect on flow downstream in the Santa Cruz Mid-County Basin.	Revised Section 3.7.3.4.

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Comment Number	Commentor	GSP Section	Topic	Recommendation/Comment	Response
36	Debra Loewen	Section 4	Group 1 and 2 projects	Thank you for the opportunity to submit comments on the SMGWA GSP July 2021 draft report. As an interested member of the public, I'm familiar with both the previous Santa Margarita interagency group and the present SMGA groundwater agency. SMGWA work towards the present GSP overall has greatly contributed to refining and understanding parameters and conditions within the Basin. The GSP seems to indicate positive conditions on groundwater use, as it unifies and amplifies pre-existing monitoring done by both water districts. The emphasis in the GSP draft seems to be on stream flow monitoring and habitat. My understanding is the State formed SMGA to ensure that water use is equitably distributed, that no user or agency takes more than their fair share, and that the common asset of water is available to all. I think a key phrase in the State Water Board mission is also the universal affordability of drinking water as an essential need. For the above reasons I would like the GSP to better emphasize the importance of taking incremental steps towards attaining sustainability. The first is a request to state that and strike the following phrase: These projects and management actions do not achieve sustainability on their own. Group 1 projects include: • Water use efficiency programs • SVWD low-impact development • SLVWD conjunctive use • SVWD recycled water use I believe the GSP undervalues these four steps and their effect in favor of more expensive and risky solutions, and their dismal is unwarranted. Please consider the following: Water use efficiency: I believe it's been shown that progress to reduce leaks in our water mains can be very effective, that greater efficiencies in residential water use are worthwhile, and further the use of recaptured or recycled water is possible. As an example, the draft GSP report cites there is no official record of cannabis cultivation in the Basin (section 2-9 2.1.1.6) but acknowledges their presence. As big water users I believe they are of some significance and should statistically be included in agricultural use profile. Agriculture is now described as "very limited" (3-68) at 0.1% versus residential 25.9% (2.8), both numbers which will alter if adjusted and refined to include cannabis growers. The County's cannabis commission could likely help with those estimates; for instance known unpermitted commercial size growers in my area using wells have had an acknowledged affect on other well users, notably the former Lompico Water District's. It is likely the same for surface water users, as per studies done throughout California on the significant effect on stream flows. Those using metered residential water are easiest to identify, with those numbers moved to agricultural. Under an efficiency program to address all agricultural growers, a GSP could then, in steps: steer towards , assist, or require use of recycled water or rainwater catchment to provide majority of their water needs. This may greatly reduce the residential water demand. Land Use Elements 2.1.3.1 and Potential Water Demand 2.1.3.2 A changing parameter in housing element is coming top-down from the State. Based on current levels this report concludes that water demand reductions from water use efficiency will be outpaced by demand from increasing growth. As a direct relation, it seems key to address this as an agency. I believe SGMA collaborators and agencies should be pursuing legislative action to reduce housing growth mandates driving the current explosive trend in both Scotts Valley and City of Santa Cruz, as it impacts all users of our aquifer. This is particular to Santa Cruz County as is regularly stated in the news as having limited water resources and no access to State projects. The GSP notes that the State general plan was revised 2017 and that the issue of water supply within the housing element will be in their next, intended to trigger their SGMA mandate to consider impacts of development on groundwater supply. The GSP report states both Scotts Valley and County of Santa Cruz are in the process of updating their general plans, but have not yet adopted consideration of water availability. It therefore seems premature to consider any actions or studies beyond Group one actions, and I would like the GSP to include such observation.	Comment noted. Group 1 projects are given priority in the GSP. Section 4.2 states "Group 1 are existing commitments by cooperating agencies and are currently being implemented". As you correctly point out, this alone has allowed groundwater levels to stabilize. However, predictive modeling taking into account projected climate change, shows Group 1 projects are not able to keep groundwater levels in the Lompico aquifer in the Mt Hermon/South Scotts Valley area stable or improve them per the SMGWA's Sustainability Goals. The charts showing this are found in Appendix 2D, for example, Figures 63 and 65. Projects in Group 2 and Group 3 reduce reliance on groundwater by either using more surface water conjunctively with groundwater, or by storing water from outside the Basin through injecting that water into the Lompico aquifer where the historical declines have occurred in that aquifer to use in place of groundwater.

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Comment Number	Commentor	GSP Section	Topic	Recommendation/Comment	Response
36 continued	Debra Loewen	Section 4	Group 1 projects	Actions beyond Group 1 eliminated, or noted and frozen The GSP draft report shows largely stabilized groundwater elevations starting in the 2000's (2.111) (2.118), with Quail Hollow and Olympia subareas have remained consistent (2.120) and did not show change in the 1980s-1990s severe drought. The report cites no clear association to groundwater extractions and reductions in fish have been made (Executive Summary). I'd therefore like to see SMGWA committed to successful implementation of Group one actions as fulfilling both its mission and that of the State to provide a clean, affordable and sustainable drinking water supply. In particular, I am opposed to inclusion or any language supporting Aquifer Storage and Recovery (ASRs) as in Group 2 tier 2, injection wells, and Group 2 tier 3 wastewater recharge. The GSP notes that the injection well is to be implemented next year and ASR studies to currently continue. I would like both comments struck from the report and SMGWA instead commit to Group one actions only. Altering water chemistry in our aquifers is a high risk, as has been documented in studies, and ASRs elsewhere in our State have been reported as causing nearby wells to become contaminated or fail. I am familiar with studies done for an EIR here in California on both injection wells and ASRs, with the benefits of both given by engineers as uncertain, and risk assessments that include catastrophic, with damages non-recoverable. I do not believe the draft GSP study results support any those actions nor warrant their risk. I would favor the Group 3 water use restriction as being moved in the draft GSP report to a lower tier, and injection wells or ASRs eliminated, or noted and frozen.	
37	Angela Franklin	Section 4	Santa Margarita Aquifer Private Pumpers Connect to Public Water System Group 3 Existing Sources Public water systems	Not happy to see you are still threatening to take away private wells when they are a VERY small percentage of the water usage. I can see this being miss-used considering we will be continuing a mega drought for who knows how long. It IS only a matter of time before we run out of water due to increased growth in SV and the drought situation. To take away private wells when they really are the stewards of proper water management is ridiculous in my mind. Santa Margarita Aquifer Private Pumpers Connect to Public Water System Group 3 Existing Sources Public water systems incorporate parcels or developments dependent on private wells extracting from the Santa Margarita aquifer if it was found that private pumping was impacting surface water sources, or if there was concern about shallower private wells going dry.	Comment noted. A list of many different types of projects is included in the GSP because to receive future grant funding, the project seeking funding needs to be included in the GSP. Group 2 and 3 projects in the GSP are mostly conceptual in nature and most will never be implemented. Connecting private well owners to a public system will not be implemented without the support of the population involved, and likely at their request. It is only included in the event that climate change impacts private well owners extracting from the Santa Margarita aquifer such that their wells go dry because of multiple consecutive dry years. Should this happen, the cost to drill a deeper well or connect to a nearby water district would fall to the property owner and may be prohibitive without the benefit of additional funding. Groundwater levels in the Santa Margarita aquifer are directly dependent on how much rain falls each year. This correlation is evident in any Santa Margarita aquifer hydrograph plotting measured groundwater levels over time. Given climate change and anticipated multiple years of below average rainfall, there is a threat of groundwater levels in the aquifer falling below well pumps or even below the bottom of screens in shallow wells. This is not due to municipal pumping in the Scotts Valley area but because there is not enough rainfall. To provide a potential option to private well owners who rely on shallow wells in the Santa Margarita aquifer, this project was included in the GSP.

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Comment Number	Commentor	GSP Section	Topic	Recommendation/Comment	Response
38	Becky Steinbruner	Section 4	Section 4.5.1.3 Purified Wastewater Augmentation at Loch Lomond (page 4-36)	There is no information included regarding how the State Required holding times for indirect potable re-use would be monitored and met. There is no information regarding the inherent potential health problems with unregulated contaminants, hormones, and radioactive constituents associated with chemotherapy drugs in the waste water train. "Advanced treatment would occur via an AWTF located at or near City of Santa Cruz WWTF employing full advanced treatment technology that meets regulatory requirements and industry best practices." It is unclear whether new a Advanced Treatment Facility would be associated with the Soquel Creek Water District's Modified PureWater Soquel Project. There is no space available at the Santa Cruz Wastewater Treatment Plant for an Advanced Water Treatment Facility, which is why Soquel Creek Water District is only constructing a tertiary treatment plant and an nBAF treatment plant there. The Advanced Treatment Facility is proposed to be in Live Oak. This should be made clear, as it would influence the route of the conveyance system, and place dependence on Soquel Creek Water District's facilities. Page 4-36: "Reservoir augmentation would take place about half of each year and be sized to produce 3.2 MGD of advanced treated water when the reservoir is being drawn down to meet demands." Why pump the recycled water into Loch Lomond instead of using it for irrigation in the summer months? This would greatly reduce the potential ill health effects of the treated wastewater, which likely would contain unregulated pharmaceuticals, hormones, CEC's and radiologic contaminants, as well as the DEET, Sucralose caffeine, ibuprofen and other compounds that cannot be fully eliminated in the treatment process. It would also reduce use of the potable water from Loch Lomond and maintain it as a relatively clean potable water source. Please include using recycled water only for irrigation, and model that scenario relative to reduced draw-down from Loch Lomond inherent as opposed to pumping the recycled water into Loch Lomond. Please include the public process for notification of all CEQA hearings relative to the addition of recycled water to Loch Lomond, a practice that is not currently allowed by the State.	Comment noted. The Purified Wastewater Augmentation at Loch Lomond project is conceptual, however, the City of Santa Cruz has recently started a study looking at a variety of recycled water projects that may include reservoir augmentation. That analysis would address some of the issues raised in the comment. Until there is more information from that study, there are no responses to specific questions posed.
39	Becky Steinbruner	Section 4	Section 4.5.4 Permitting and Regulatory Process (page 4-38) of Group 2 Projects	Please include requirement for a Final Anti-Degradation Analysis for Loch Lomond if the recycled water were to be added and mixed, to comply with Resolution 68-16. Please include a discussion regarding how the Agency would collaborate with California Dept. of Fish and Wildlife to develop meaningful and enforceable mitigation measures to protect the receptive sensors.	Comment noted. Any project involving recycled water is required to comply with the State's Water Quality Control Policy for Recycled Water. This policy includes the need for an antidegradation analysis demonstrating that the existing projects, reasonably foreseeable future projects, and other sources of loading to the basin included within the plan will, cumulatively, satisfy the requirements of State Water Board Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality of Waters in California (Antidegradation Policy). Sections 4.5.4 and 4.5.9 have been revised to reflect this.
40	Becky Steinbruner	Section 4	Section 4.5.6 Expected Benefits of Group 2 Projects	"While basin groundwater levels have stabilized in the last few decades, supplemental sources of water from outside the Basin may be needed to increase Lompico aquifer groundwater levels and meet Basin sustainability objectives. After recharging enough purified wastewater to increase groundwater levels to measurable objectives, any additional water stored in the aquifer may be used to augment groundwater or surface water providing a drought resilient supply that will increase the cooperating agencies' water supply resiliency." Does this mean that the Agency plans to inject recycled water into the aquifer as well as into Loch Lomond? Where would the injection wells be located? What would the energy demand be, and how would there be redundancy built in to accommodate PSPS events in the summer fire season when water use is higher? Page 4-39 Expected Benefits "Compared to 540 AFY conjunctive use (Section 4.3.6, Table 4-1), the amount of groundwater discharge to creeks from 710 AFY purified wastewater recharge (Table 4-5) is very similar, but there is 75% more groundwater in storage because of direct injection into the Lompico aquifer." How would private well owners be impacted by the injection of potentially-contaminated recycled water if there are system malfunctions? How would the six-month holding times required by the State be met and monitored, as they affect nearby private well potable sources?	All projects listed in Group 2, Tier 3 and Group 3 are purely conceptual at this point. All Group 2, Tier 3 projects involve use of purified wastewater. Two of them would inject the purified wastewater into the Lompico aquifer while one of them augments Loch Lomond with purified wastewater. There are no plans underway to study and implement the Purified Wastewater Augmentation at Loch Lomond project at present. It will be more likely that, if groundwater levels do not recover with Group 2, Tier 1 projects (using existing basin water sources), Tier 2 (use of surface water sources outside of the Basin) or Tier 3 (use of purified wastewater) projects may be needed to reduce pumping native groundwater. It is anticipated that over the next 10 years, some of the Group 2, Tier 2 and 3 and some Group 3 projects may have their feasibility evaluated by individual water agencies. An example of this is the Purified Wastewater Augmentation at Loch Lomond project which is currently conceptual, however, the City of Santa Cruz has recently started a study looking at a variety of recycled water projects that may include reservoir augmentation to further evaluate its feasibility. Any project involving recycled water / purified wastewater falls under the State Water Boards' Recycled Water Policy and will not be permitted by the State Water Board or accepted by the SMGWA if all requirements, including an anti-degradation study and monitoring, are not included (see Section 4.5.4). There is also a requirement for any ASR project to comply with the State's General Order for Aquifer Storage and Recovery projects (WQ Order 2012-0010). Section 4.4.9 has added text to describe this.

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Comment Number	Commentor	GSP Section	Topic	Recommendation/Comment	Response
41	Becky Steinbruner	Section 4	Section 4.5.7 of Group 2 projects	Section 4.5.7 Legal Authority (page 4-42) of Group 2 Projects "California state law gives water districts the authority to take actions necessary to supply sufficient water for present or future beneficial use. Land use jurisdictions have police powers to develop similar programs. The Sustainable Groundwater Management Act of 2014 grants SMGWA legal authority to pass regulations necessary to achieve sustainability. Water use efficiency projects make use of preserving existing sources already within each member agency's specific system to which each agency already has rights." Please include discussion of Anti-Degradation Analysis requirements to comply with State Water Board Resolution 68-16 to protect high quality waters from contamination / degradation. Please include discussion of necessary collaboration with California Dept. of Fish and Wildlife to develop meaningful and enforceable mitigations, especially for stream crossings and stream inflow contamination monitoring from injected effluent.	Sections 4.5.4 and 4.5.9 address this.
42	Becky Steinbruner	Section 4	Section 4.5.8 of Group 2, Tier 3 projects	Section 4.5.8 Estimated Costs and Funding Plan (page 4-43) "Projects included in this subsection require new infrastructure such as pipelines, interties, pump stations, injection wells, and new treatment facilities. Costs associated with the new infrastructure would be funded through a combination of increased operating revenue and outside funding sources." This would be a very expensive supplemental source, funded by raising rates, when there are less expensive options available. Table 4-7 on page 4-44 shows projected annually operating costs to be $2.6 million to $7.5 million. How can the area's low-income residents and struggling businesses ever hope to afford this water? Page 4-48: "Part of this study will be to review other reuse and system expansion opportunities for adjacent water agencies." Please identify those water agencies...is it the City of Santa Cruz, or Soquel Creek Water District? This matters because of the implications inherent with necessary infrastructure and conveyance systems.	Section 4.6.8 has been updated to "...adjacent water agencies such as the City of Santa Cruz or Soquel Creek Water District"
43	NGO Consortium	Section 4	Projects & Management Actions	Recharge ponds, reservoirs and facilities for managed stormwater recharge can be designed as multiple-benefit projects to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. For guidance on how to integrate multi-benefit recharge projects into your GSP, refer to the "Multi-Benefit Recharge Project Methodology Guidance Document".	Multi-benefit recharge projects as described in the referenced guidance document are not applicable to this basin. Small stormwater recharge projects are included in the Projects Table contained in Appendix 4A.

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44	NGO Consortium	Section 4	Projects & Management Actions	For DACs and domestic well owners, include discussion of a drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation. Refer to Attachment B for specific recommendations on how to implement a drinking water well mitigation program.	A drinking water well impact mitigation program is not needed in this Basin at this time because private well owners, including the <10 DAC population in the Basin, are mostly located north of Bean Creek in areas of the Basin that are not pumping from the same aquifer or area that has had chronic lowering of groundwater levels, i.e., Mount Hermon/South Scotts Valley. GSP related projects and management actions are focused in the Mt Hermon/South Scotts Valley area to mitigate lowered groundwater levels in the Lompico aquifer. Impacts to private well owners and DAC wells north of Bean Creek (approximately 488 wells or 63% of all private wells) will be minimal because their wells are screened in aquifers above the Lompico aquifer and are hydrogeologically upgradient from the Scotts Valley area (see Figure 2-45 for contour map of Lompico aquifer). Even those private wells south of Bean Creek will be minimally impacted because they are predominantly hydrogeologically upgradient of where projects in the Scotts Valley area will be implemented (see Figure 2-45). Any impact is likely to be an overall benefit as groundwater levels increase in response to projects. A recognized data gap in Basin monitoring are in the areas of private domestic pumping where there are no long-term groundwater level records (described in Section 3.3.4.1). To improve the monitoring network, 9 new monitoring wells, most near areas of private domestic pumping, are being installed in 2022 to collect groundwater level data in these areas with the possibility they could become representative monitoring points in the 1st 5-year update. When representative monitoring points are established near private domestic wells, an adaptive management trigger system may be developed if the data collected from the new wells are sufficient to do so. Section 2.1.2.4.1 of the GSP describes the County of Santa Cruz private well groundwater elevation monitoring network in parts of the County. Prior to development of the GSP, there have been no volunteer private well owners in the Basin that are part of the County's network. Through the process of GSP development and private well owner meetings, private well owners are now becoming aware of this program and are starting to volunteer their wells for groundwater level monitoring. The County will work to increase the number of private domestic wells in the network.
45	NGO Consortium	Section 4	Water quality impacts from Projects & Management Actions on DACs and tribes	For DACs and domestic well owners, include a discussion of whether potential impacts to water quality from projects and management actions could occur and how the GSA plans to mitigate such impacts. Impacts to supply wells are discussed, but not to DACs and domestic well owners.	See response above regarding groundwater level impacts. Water quality impacts from projects are unlikely because most private domestic wells are some distance away and upgradient of where potential projects and management actions may take place. Text added to Sections 4.3.9, 4.4.9, and 4.5.9.
46	NGO Consortium	Section 4	Management actions	Develop management actions that incorporate climate and water delivery	Comment noted. The intent of nearly all of the described Projects & Management Actions is to address water delivery under the future climate scenario. No changes were made.
47	NGO Consortium	Section 4	Climate change	Incorporate climate change scenarios into projects and management actions.	The simulation of Projects & Management Actions did include projected climate change and the resulting groundwater levels compared to SMC to determine ability to avoid undesirable results over both wet and dry extremes. Note the climate change implemented in this GSP is transient in nature and not based on 2030 and 2070 snap shots in time. In addition, state provided datasets representing central tendency climate change recommended by DWR for projected water budgets show wetter conditions than the scenario used for the GSP; the SMGWA opted to use a scenario representing drier conditions on average that includes wet and dry extremes over time. See response 17 for more on climate change used in the GSP.

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48	Bob Fultz	Section 4	Cost of projects	There is a lot in the plan with which I agree. I think we must also recognize that our community has made tremendous strides in reducing per capita water usage to levels that beat the state's ultimate requirement for indoor water use by almost 20%. And early indications are that we are seeing substantial gains in reducing outdoor use as well. We should also recognize Scotts Valley Water District's significant improvements in its use of groundwater over these past decades, arresting a negative trend and placing our aquifer in a position where it was designated as moderately impacted when the Act was implemented. However, as is the case with many plans like this, the financial implications are not explored in enough depth (for example, min/max and inflation scenarios) and do not bring the reality of the financial pain our water customers will endure should any of the expensive plans be implemented. In summary, anything past the 2nd line in the Group 2, Tier 1 table is simply not financially feasible given the scale of our District. Or even all of the Districts together. Let's bring it down to numbers more understandable for everyone. The rule of thumb is that 30-year financing results in a payback of about double the principal. So if an agency borrows $10 million it will pay back about $20 million. However, should the current inflationary pressures continue for some time, the artificial suppression of interest rates will not be sustainable over the long run and so the costs of borrowing could go up even more. The SLVWD has approximately 8,000 customers. Every $10 million in capital costs translates into an increase of $7 a month in each customer's water bill—If we qualify for the loan given the debt coverage ratio required. But, for the purposes of these calculations, let's say it's covered. And every $100,000 in operating costs translates to about $1 a month in each customer's water bill. Implementing the projects in the last two lines of Table 4-3, Group 2, Tier 1 requires $76.5 in capital and $4 million in operating expenses. Assuming a 50/50 split between SLVWD and SVWD, that's about $47 per month on top of the existing SLVWD 4-unit bill of about $100 a month—and that's before the SLVWD considers any further rate increases. For perspective, the SLVWD already has approximately $30 million of historical unfunded capital obligations which ultimately have to be paid as well. Now, let's say that the taxpayers of the State or Federal governments provide grants to cover 100% of the capital costs. We're still looking at an increase of $21 a month just for operating expenses—again, at a 50/50 split. Plus, at the rate construction costs are increasing, by the time these projects are implemented, the construction costs could increase by 50% - 100%, driving the bills even higher. Are the returns we get for this worth this kind of rate increase? Because by making the decision to proceed with projects like this we are essentially saying that, within a decade or so, only high-income people will be able to afford to live in the San Lorenzo Valley since these costs will be much more than a reasonable 1.0 - 1.5% of gross median household income (in a high-cost state like California). This isn't including the higher costs of living, e.g., an unreliable power grid (and generators) or the costs of vehicle maintenance associated with the light road maintenance in the San Lorenzo Valley. Let's look at Group 2, Tier 2. Capital costs are a bit higher—about $83 million—with annual operating expenses likewise a bit higher--$5 million. Fortunately, the GSP states that these projects won't be done IF we do the projects in Group 2, Tier 1. Now that is some choice—the unaffordable costs of Group 2, Tier 1 or the even more unaffordable costs of Group 2, Tier 2. And then we get to Group 2, Tier 3. I sincerely hope that everyone on the SMGA Board views this group, collectively, as being well beyond the reach of the scale that we have in SLVWD and SVWD combined. The capital costs outlined in Table 4-7 total just shy of $600 million with operating costs of $16 million. Applying the same formula would take us to an increase of almost $200 a month for these projects or triple the current cost of 4 units of water in the SLVWD. I'm hopeful that this table exists merely to satisfy some state requirement that we look at all options exhaustively, regardless of community feasibility. Because these options are clearly nowhere near feasible for the size of our communities. I hope the SMGA Board seriously considers modifying the report to move the unaffordable projects in Table 4-3 into Table 4-7, enabling the SLVWD and SVWD to focus on the affordable projects that will, in my opinion, deliver a much better return on investment while still meeting our groundwater sustainability goals. Doing this simple edit will result in a win-win for this multi-year process. Thank you for your attention.	Comments on the significant cost of some projects in the GSP is noted. The GSP does not go into substantial detail on project costs because no project is at the stage where enough is known to warrant detailed costing. Individual agency or multi-agencies pursuing a project will very thoroughly study and evaluate all aspects of feasibility, including financial, of the potential project before their governing bodies make a decision to go ahead or not. Understanding the project's impact on rates is clearly one of the aspects the proponent agency(ies) will study as part of feasibility. SLVWD and SVWD will not be the only agencies financing projects but rather any agency and/or groups of beneficial groundwater users benefiting from the project will be expected to contribute relative to their benefit. This is expressed in the SMGWA Guiding Principle 12 (see Appendix 1C of the GSP). It is assumed that the relatively simpler, cheaper and/or more cost-efficient projects will be implemented first, and based on performance of those projects with respect to groundwater sustainability, the more costly and complicated projects might need to be considered and executed. Group 2 and 3 projects in the GSP are mostly conceptual in nature at this point in time with several of them designed to accomplish other (water supply) goals in addition to helping to achieve the groundwater sustainability in this basin. However, a suite of different types of projects is included in the GSP to ensure eligibility for potential grant funding in the future. Important to note is that SMGWA Guiding Principle 13 (see Appendix 1C of the GSP) recognizes SMGWA's duty to taxpayers, ratepayers, and future generations to ensure that our financial resources are used effectively and responsibly as a tool to promote sustainable groundwater conditions. Fiscal responsibility will be taken very seriously by the water agencies in their consideration of potential projects and long-term project benefits for future generations.

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Comment Number	Commentor	GSP Section	Topic	Recommendation/Comment	Response
49	John Ricker	Section 4	SLVWD conjunctive use projects in Group 2	Are SLVWD's surface water sources for conjunctive use considered to be within the Basin? That is a bit of a stretch. Maybe better to say within the basin watershed. In that case, the San Lorenzo River would also be considered an in-basin source.	Comment noted. It is acknowledged that it may not be technically correct to call SLVWD diversions within the basin, but they are considered sources that flow into the basin. The location of diversion on tributaries to the San Lorenzo River being just outside the basin boundary and close to where the tributaries flow into the San Lorenzo River does not preclude it from being considered a source within the basin. Water just has to flow downstream a short distance from the point of diversion to be within the basin.
50	John Ricker	Sections 4 and 5	General comment	Sections 4 and 5: It is encouraging to see potential projects under consideration and real possibilities to meet measurable objectives of the GSP; and to see the budget and implementation program going forward.	Comment noted.
51	Thomas Hogye		Comment not related directly to GSP content		

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SMGWA Online Comment

Name: Eric Brune

Address: Scotts Valley

Comment:
First, thank you for such a great document. The plan does not seem to directly address the large number of new developments and growth in the Scotts Valley area. Will there be recommendations about curbing the number of new developments in the area? The plan seems to imply that there will be a large push for more efficient water use, but no limit on the number households / commercial developments that can be supported. Whether or not a limit or curb is required; sustainable development is a huge concern that should be directly addressed in this type of report. Thank you.

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SMGWA Online Comment

Name: Frank Cheap

Organization: Private Well Owner

Comment:
First of all, I appreciate the years of work, the long hours, and expense that the Santa Margarita Groundwater Basin Agency invested into this draft plan.As a member of the public, I've attended many meetings and sat through numerous presentations to understand some of the goals and science applied to the undertaking of Groundwater Management in this basin. Though private well owners (PWO) have two seats on the agency, the thrust in the draft plan appears to be dominated by the water districts with deeper aquifers and surface water that supply those districts vs the PWO drafting from the more shallow Santa Margarita Aquifer. Note, there are estimated 800 to 1100 private well owners and small water systems within this water management basin, primarily drawing upon the Santa Margarita Aquifer, little effort has been applied to proactively managing this aquifer, aside from a small number monitor wells. Convention wisdom is PWO will be very conservative with water consumption. In the same breath, the PMOs and small water agencies and little or no resources to manage at scale or recharge this Santa Margarita Aquifer, other than land conservation practices, as mentioned, and of watershed protection of their respective properties. Private well owners and small water systems are the most risk for reduction in groundwater due to climate and/or drought conditions. My request is that the groundwater agency consider language into the draft for protection of private well owners who in most cases have no alternative source of water, as stated. In addition, active plans for aquifer management, specifically conservation education efforts, monetary incentives to conserve and voluntary metering (anonymised data collection) as well as active plans to assist in recharge the aquifer above and beyond annual rainfall: options include: dormant quarries, recharge ponds and temporary inflatable dams, water injection wells, are some of the potential options. Currently, the County has a voluntary well water depth sounding program as free service to PWOs, collection of this data and publication should be a resource for current and future assessment of aquifer conditions and health. Analysis and publication of this data is a low inertia and cost effective way of both and historic view and ongoing monitoring of the Santa Maria Aquifer, Thank you for your consideration of my comments. Frank Cheap

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SMGWA Online Comment

Name: Angela Franklin

Organization: Private Well Owner

Address: Scotts Valley, CA 95066

Comment:

Not happy to see you are still threatening to take away private wells when they are a VERY small percentage of the water usage. I can see this being miss-used considering we will be continuing a mega drought for who knows how long. It IS only a matter of time before we run out of water due to increased growth in SV and the drought situation. To take away private wells when they really are the stewards of proper water management is ridiculous in my mind. Santa Margarita Aquifer Private Pumpers Connect to Public Water System Group 3 Existing Sources Public water systems incorporate parcels or developments dependent on private wells extracting from the Santa Margarita aquifer if it was found that private pumping was impacting surface water sources, or if there was concern about shallower private wells going dry.

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SMGWA Online Comment

Name: Bob Fultz

Address: Boulder Creek

Comment:
I want to thank everyone who participated in the SMGA, past and present, who served our community and who produced this Groundwater Sustainability Plan. There is a lot in the plan with which I agree. I think we must also recognize that our community has made tremendous strides in reducing per capita water usage to levels that beat the state's ultimate requirement for indoor water use by almost 20%. And early indications are that we are seeing substantial gains in reducing outdoor use as well. We should also recognize Scotts Valley Water District's significant improvements in its use of groundwater over these past decades, arresting a negative trend and placing our aquifer in a position where it was designated as moderately impacted when the Act was implemented. However, as is the case with many plans like this, the financial implications are not explored in enough depth (for example, min/max and inflation scenarios) and do not bring the reality of the financial pain our water customers will endure should any of the expensive plans be implemented. In summary, anything past the 2nd line in the Group 2, Tier 1 table is simply not financially feasible given the scale of our District. Or even all of the Districts together. Let's bring it down to numbers more understandable for everyone. The rule of thumb is that 30-year financing results in a payback of about double the principal. So if an agency borrows $10 million it will pay back about $20 million. However, should the current inflationary pressures continue for some time, the artificial suppression of interest rates will not be sustainable over the long run and so the costs of borrowing could go up even more. The SLVWD has approximately 8,000 customers. Every $10 million in capital costs translates into an increase of $7 a month in each customer's water bill—If we qualify for the loan given the debt coverage ratio required. But, for the purposes of these calculations, let's say it's covered. And every $100,000 in operating costs translates to about $1 a month in each customer's water bill. Implementing the projects in the last two lines of Table 4-3, Group 2, Tier 1 requires $76.5 in capital and $4 million in operating expenses. Assuming a 50/50 split between SLVWD and SVWD, that's about $47 per month on top of the existing SLVWD 4-unit bill of about $100 a month—and that's before the SLVWD considers any further rate increases. For perspective, the SLVWD already has approximately $30 million of historical unfunded capital obligations which ultimately have to be paid as well. Now, let's say that the taxpayers of the State or Federal governments provide grants to cover 100% of the capital costs. We're still looking at an increase of $21 a month just for operating expenses—again, at a 50/50 split. Plus, at the rate construction costs are increasing, by the time these projects are implemented, the construction costs could increase by 50% - 100%, driving the bills even higher. Are the returns we get for this worth this kind of rate increase? Because by making the decision to proceed with projects like this we are essentially saying that, within a decade or so, only high-income people will be able to afford to live in the San Lorenzo Valley since these costs will be much more than a reasonable 1.0 - 1.5% of gross median household income (in a high-cost state like California). This isn't including the higher costs of living, e.g., an unreliable power grid (and generators) or the costs of vehicle maintenance associated with the light road maintenance in the San Lorenzo Valley. Let's look at Group 2, Tier 2. Capital costs are a bit higher—about $83 million—with annual operating expenses likewise a bit higher--$5 million. Fortunately, the GSP states that these projects won't be done IF we do the projects in Group 2, Tier 1. Now that is some

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choice—the unaffordable costs of Group 2, Tier 1 or the even more unaffordable costs of Group 2, Tier 2. And then we get to Group 2, Tier 3. I sincerely hope that everyone on the SMGA Board views this group, collectively, as being well beyond the reach of the scale that we have in SLVWD and SVWD combined. The capital costs outlined in Table 4-7 total just shy of $600 million with operating costs of $16 million. Applying the same formula would take us to an increase of almost $200 a month for these projects or triple the current cost of 4 units of water in the SLVWD. I'm hopeful that this table exists merely to satisfy some state requirement that we look at all options exhaustively, regardless of community feasibility. Because these options are clearly nowhere near feasible for the size of our communities. I hope the SMGA Board seriously considers modifying the report to move the unaffordable projects in Table 4-3 into Table 4-7, enabling the SLVWD and SVWD to focus on the affordable projects that will, in my opinion, deliver a much better return on investment while still meeting our groundwater sustainability goals. Doing this simple edit will result in a win-win for this multi-year process. Thank you for your attention. Bob Fultz

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SMGWA Online Comment

Name: Debra Loewen

Organization: concerned citizen

Address: residential home in Lompico Canyon

Comment:
Thank you. My letter of comment is attached.

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SMGWA Online Comment

Name: Thomas Hogye

Address: Ben Lomond

Comment:

Disgusting - Scotts Valley let's the "Chair" build apartments on land that's never required water before and now will require more than 5,000 gallons per day - first 19 condos and now 16 more? Where will all the water come from. Carbonero and Bean Creek are already dry. Some of the last "wooded" spaces in Scotts Valley. You guys should be ashamed of yourselves. Do the math - 58 gallons of water per person, per day - 19+16 = 35 condos + average 2.5 persons per condo - 5,075 gallons - average - per day. Then he gets accolades from the rest of the city officials on what a "beautiful" project it is? How many empty buildings are already in Scotts Valley taking up permeable land paved and roofed over? He'll want to tap into the San Lorenzo River Watershed next and it will be most certain death to Steelhead and Salmon. Then he'll take his money, move and retire somewhere where the grass will surely be greener while this county sits as a tinder box. You need to stop building, not build more. Already unsustainable.

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Thank you for the opportunity to submit comments on the SMGWA GSP July 2021 draft report.

As an interested member of the public, I'm familiar with both the previous Santa Margarita interagency group and the present SMGA groundwater agency.

SMGWA work towards the present GSP overall has greatly contributed to refining and understanding parameters and conditions within the Basin. The GSP seems to indicate positive conditions on groundwater use, as it unifies and amplifies pre-existing monitoring done by both water districts. The emphasis in the GSP draft seems to be on stream flow monitoring and habitat.

My understanding is the State formed SMGA to ensure that water use is equitably distributed, that no user or agency takes more than their fair share, and that the common asset of water is available to all. I think a key phrase in the State Water Board mission is also the universal affordability of drinking water as an essential need.

For the above reasons I would like the GSP to better emphasize the importance of taking incremental steps towards attaining sustainability. The first is a request to state that and strike the following phrase:

~~These projects and management actions do not achieve sustainability on their own~~. Group 1 projects include:

- Water use efficiency programs
- SVWD low-impact development
- SLVWD conjunctive use
- SVWD recycled water use

I believe the GSP undervalues these four steps and their effect in favor of more expensive and risky solutions, and their dismal is unwarranted. Please consider the following:

Water use efficiency: I believe it's been shown that progress to reduce leaks in our water mains can be very effective, that greater efficiencies in residential water use are worthwhile, and further the use of recaptured or recycled water is possible.
As an example, the draft GSP report cites there is no official record of cannabis cultivation in the Basin (section 2-9 2.1.1.6) but acknowledges their presence. As big water users I believe they are of some significance and should statistically be included in agricultural use profile. Agriculture is now described as "very limited" (3-68) at 0.1% versus residential 25.9% (2.8), both numbers which will alter if adjusted and refined to include cannabis growers. The County's cannabis commission could likely help with those estimates; for instance known unpermitted commercial size growers in my area using wells have had an acknowledged affect on other well users, notably the former Lompico Water District's. It is likely the same for surface water users, as per studies done throughout California on the significant effect on stream flows. Those using metered residential water are easiest to identify, with those numbers moved to agricultural. Under an efficiency program to address all agricultural growers, a GSP could then, in steps: steer towards , assist, or require use of recycled water or rainwater catchment to provide majority of their water needs. This may greatly reduce the residential water demand.

Land Use Elements 2.1.3.1 and **Potential Water Demand** 2.1.3.2
A changing parameter in housing element is coming top-down from the State. Based on current levels this report concludes that water demand reductions from water use efficiency will be outpaced by

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demand from increasing growth. As a direct relation, it seems key to address this as an agency. I believe SGMA collaborators and agencies should be pursuing legislative action to reduce housing growth mandates driving the current explosive trend in both Scotts Valley and City of Santa Cruz, as it impacts all users of our aquifer. This is particular to Santa Cruz County as is regularly stated in the news as having limited water resources and no access to State projects.

The GSP notes that the State general plan was revised 2017 and that the issue of water supply within the housing element will be in their next, intended to trigger their SGMA mandate to consider impacts of development on groundwater supply. The GSP report states both Scotts Valley and County of Santa Cruz are in the process of updating their general plans, but have not yet adopted consideration of water availability. It therefore seems premature to consider any actions or studies beyond Group one actions, and I would like the GSP to include such observation.

Actions beyond Group 1 eliminated, or noted and frozen

The GSP draft report shows largely stabilized groundwater elevations starting in the 2000's (2.111) (2.118), with Quail Hollow and Olympia subareas have remained consistent (2.120) and did not show change in the 1980s-1990s severe drought. The report cites no clear association to groundwater extractions and reductions in fish have been made (Executive Summary). I'd therefore like to see SMGWA committed to successful implementation of Group one actions as fulfilling both its mission and that of the State to provide a clean, affordable and sustainable drinking water supply.

In particular, I am opposed to inclusion or any language supporting Aquifer Storage and Recovery (ASRs) as in Group 2 tier 2, injection wells, and Group 2 tier 3 wastewater recharge. The GSP notes that the injection well is to be implemented next year and ASR studies to currently continue. I would like both comments struck from the report and SMGWA instead commit to Group one actions only.
Altering water chemistry in our aquifers is a high risk, as has been documented in studies, and ASRs elsewhere in our State have been reported as causing nearby wells to become contaminated or fail. I am familiar with studies done for an EIR here in California on both injection wells and ASRs, with the benefits of both given by engineers as uncertain, and risk assessments that include catastrophic, with damages non-recoverable. I do not believe the draft GSP study results support any those actions nor warrant their risk. I would favor the Group 3 water use restriction as being moved in the draft GSP report to a lower tier, and injection wells or ASRs eliminated, or noted and frozen.

Thank you

Debra Loewen
Lompico Canyon

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SMGWA Online Comment

Name: Bret McLeod

Organization:

Address: Scotts Valley, CA 95066

Comment:

I would like to know what steps are being taken and what steps will be taken to care for the Santa Margarita Watershed no and in the future. I would also like to have these actions/plans detailed in the upcoming management plan for the water board.

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SMGWA Online Comment

Name: Amanda McLeod

Organization: Private citizen

Address: Scotts Valley, CA 95066

Comment:

Thank you for your work on this project! I hereby request that sustainability plan plan to be amended to cover sustainability of the Santa Margarita aquifer and, specifically, plans around recharge. I appreciate the language that was added to underscore that consistent with current law, taxation of private well owners is unlawful.

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SMGWA Online Comment

Name: Phil McReynolds

Organization:

Address: Scotts Valley, CA 95066

Comment:

I would like to have a plan for the Santa Margarita Aquifer. Most of all a recharge plan.

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SMGWA Online Comment

Name: J. Pablo Ortiz-Partida

Phone:

Email: ngos.sgma@gmail.com

Comment:

Subject: Comments on Draft Groundwater Sustainability Plan for Santa Margarita Basin

Hello, I am writing on behalf of Audubon California, Clean Water Action, Clean Water Fund, Local Government Commission, The Nature Conservancy, and Union of Concerned Scientists with the attached comments on the draft Groundwater Sustainability Plan for this basin. We know that SGMA plan development and implementation is a major undertaking, and we want every basin to be successful. We would be happy to meet with you to discuss our evaluation as you finalize your Plan for submittal to DWR. Feel free to contact us at ngos.sgma@gmail.com for more information or to schedule a conversation. Sincerely, J. Pablo Ortiz-Partida, Ph.D. Western States Climate and Water Scientist Union of Concerned Scientists

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The Nature Conservancy | Audubon | CALIFORNIA | Local Government Commission — Leaders for Livable Communities | Union of Concerned Scientists — Science for a healthy planet and safer world | CLEAN WATER ACTION | CLEAN WATER FUND

September 20, 2021

Santa Margarita Groundwater Agency

Submitted via web: https://www.smgwa.org/publicfeedbackform

Re: Public Comment Letter for the Santa Margarita Groundwater Basin Draft GSP

Dear Sierra Ryan,

On behalf of the above-listed organizations, we appreciate the opportunity to comment on the Draft Groundwater Sustainability Plan (GSP) for the Santa Margarita Groundwater Basin being prepared under the Sustainable Groundwater Management Act (SGMA). Our organizations are deeply engaged in and committed to the successful implementation of SGMA because we understand that groundwater is critical for the resilience of California's water portfolio, particularly in light of changing climate. Under the requirements of SGMA, Groundwater Sustainability Agencies (GSAs) must consider the interests of all beneficial uses and users of groundwater, such as domestic well owners, environmental users, surface water users, federal government, California Native American tribes and disadvantaged communities (Water Code 10723.2).

As stakeholder representatives for beneficial users of groundwater, our GSP review focuses on how well disadvantaged communities, tribes, climate change, and the environment were addressed in the GSP. While we appreciate that some basins have consulted us directly via focus groups, workshops, and working groups, we are providing public comment letters to all GSAs as a means to engage in the development of 2022 GSPs across the state. Recognizing that GSPs are complicated and resource intensive to develop, the intention of this letter is to provide constructive stakeholder feedback that can improve the GSP prior to submission to the State.

Based on our review, we have significant concerns regarding the treatment of key beneficial users in the Draft GSP and consider the GSP to be **insufficient** under SGMA. We highlight the following findings:

1. Beneficial uses and users **are not sufficiently** considered in GSP development.
    a. Human Right to Water considerations **are not sufficiently** incorporated.
    b. Public trust resources **are not sufficiently** considered.
    c. Impacts of Minimum Thresholds, Measurable Objectives and Undesirable Results on beneficial uses and users **are not sufficiently** analyzed.
2. Climate change **is not sufficiently** considered.
3. Data gaps **are not sufficiently** identified and the GSP **needs additional plans** to eliminate them.

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4. Projects and Management Actions **do not sufficiently consider** potential impacts or benefits to beneficial uses and users.

Our specific comments related to the deficiencies of the Santa Margarita Groundwater Basin Draft GSP along with recommendations on how to reconcile them, are provided in detail in **Attachment A.**

Please refer to the enclosed list of attachments for additional technical recommendations:

Attachment A	GSP Specific Comments
Attachment B	SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users
Attachment C	Freshwater species located in the basin
Attachment D	The Nature Conservancy's "Identifying GDEs under SGMA: Best Practices for using the NC Dataset"

Thank you for fully considering our comments as you finalize your GSP.

Best Regards,

Ngodoo Atume
Water Policy Analyst
Clean Water Action/Clean Water Fund

J. Pablo Ortiz-Partida, Ph.D.
Western States Climate and Water Scientist
Union of Concerned Scientists

Samantha Arthur
Working Lands Program Director
Audubon California

Danielle V. Dolan
Water Program Director
Local Government Commission

E.J. Remson
Senior Project Director, California Water Program
The Nature Conservancy

Melissa M. Rohde
Groundwater Scientist
The Nature Conservancy

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Attachment A

Specific Comments on the Santa Margarita Groundwater Basin Draft Groundwater Sustainability Plan

1. Consideration of Beneficial Uses and Users in GSP development

Consideration of beneficial uses and users in GSP development is contingent upon adequate identification and engagement of the appropriate stakeholders. The (A) identification, (B) engagement, and (C) consideration of disadvantaged communities, drinking water users, tribes, groundwater dependent ecosystems, streams, wetlands, and freshwater species are essential for ensuring the GSP integrates existing state policies on the Human Right to Water and the Public Trust Doctrine.

A. Identification of Key Beneficial Uses and Users

Disadvantaged Communities, Drinking Water Users, and Tribes
The identification of Disadvantaged Communities (DACs), drinking water users, and tribes is **insufficient**. We note the following deficiencies with the identification of these key beneficial users.

- The GSP states that there are two DAC census block groups, both of which are partially located within the basin (Figure 2-9). Within the basin, the DACs include part of the Census Designated Places of Boulder Creek, Brookdale, and Ben Lomond. The GSP, however, does not describe the size of the population in each DAC.

- The GSP shows the estimated location of private residential groundwater use (Figure 2-31), but provides no information on depth of these domestic wells. The GSP provides a well density map showing the number of all water supply wells, including municipal, small water systems, private domestic, and industrial (Figure 2-32), but all water supply wells are grouped together in this single figure.

- Figure 2-9 maps locations of small water systems and private domestic wells. However, specifics are not given about how much each community relies on a particular water supply (e.g., what percentage is supplied by groundwater).

- The GSP states: “The [Amah Mutsun] Tribal Band is petitioning the federal government for tribal recognition and has formed the Amah Mutsun Land Trust to access, protect, and steward lands important to the tribe.” The location of these lands, however, is not provided.

These missing elements are required for the GSA to fully understand the specific interests and water demands of these beneficial users, to support the development of water budgets using the best available information, and to support the development of sustainable management criteria and projects and management actions (PMAs) that are protective of these users.

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RECOMMENDATIONS

- Include a map showing domestic well locations and average well depth across the basin.
- Include a well density map for domestic wells only, not all water supply wells.
- Provide the population of each identified DAC block group and include details on the population dependent on groundwater for their domestic water use.
- Describe tribal interests in the basin, including lands with historical importance to the tribe.

Interconnected Surface Waters

The identification of Interconnected Surface Waters (ISWs) is **incomplete**, due to the lack of a complete description of data gaps for ISWs.

We commend the GSA for the thorough, comprehensive evaluation of ISWs in the basin presented in the GSP. Figure 2-72 presents the spatial and temporal distribution of interconnected surface water. To analyze ISWs in the basin, the GSP uses accretion studies and comparisons between stream bed elevations and 30 years of proximal monitoring wells data (Figures 3-8 and 3-9). Findings from these studies and observations are combined with model-simulated groundwater elevations to produce the ISW map presented in Figure 2-72.

The following recommendations would strengthen the clarity and completeness of the ISW evaluation.

RECOMMENDATIONS

- While the GSP identifies data gaps and their locations in GSP Section 2.2.4.11 (Hydrogeologic Conceptual Model Data Gaps), please also describe the data gaps in the ISW section.
- On the ISW map (Figure 2-72), clearly label the areas with data gaps. We recommend that the GSP considers any segments with data gaps as *potential* ISWs and clearly marks them as such on the ISW map.

Groundwater Dependent Ecosystems

The identification of Groundwater Dependent Ecosystems (GDEs) is **insufficient**, due to a lack of comprehensive, systematic analysis of the basin's GDEs.

The GSP states (p. 2-98) that the Natural Communities Commonly Associated with Groundwater dataset (NC dataset) was used as a starting point, and "[i]n addition, several known springs,

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seeps, or other groundwater-dependent wetlands were identified as likely GDEs." We commend the GSA for starting with the NC dataset and using additional sources to identify GDEs in the basin.

Further description in the GSP, however, of the GDE analysis process is very sparse. The GSP states (p. 2-98): "The GDE analysis in this GSP includes assessment of the extent of GDE indicator vegetation, groundwater elevations in shallow aquifers, and impacts of seasonal surface water and groundwater interaction or accretion. Where groundwater level data are unavailable, the groundwater model is used to identify where surface water and groundwater are likely connected." This statement is the only description of how the GDEs were identified. The GSP does not discuss how the NC dataset was verified with the use of groundwater data from the shallow aquifer or model output (e.g., which locations were verified with each method). Without an analysis of groundwater data to verify the NC dataset polygons, it will be difficult or impossible to adequately monitor and manage the basin's GDEs throughout GSP implementation.

RECOMMENDATIONS

- Develop and describe a systematic approach for analyzing the basin's GDEs. For example, provide a map of the NC Dataset. On the map, label polygons retained, removed, or added to/from the NC dataset (include the removal reason if polygons are not considered potential GDEs, or include the data source if polygons are added). Discuss how local groundwater data was used to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer. Refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer.

- Use depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) to determine the range of depth to groundwater around NC dataset polygons. We recommend that a baseline period (10 years from 2005 to 2015) be established to characterize groundwater conditions over multiple water year types. Refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer.

- Provide depth-to-groundwater contour maps, noting the best practices presented in Attachment D. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a DEM to estimate depth-to-groundwater contours across the landscape.

- If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons as "Potential GDEs" in the GSP until data gaps are reconciled in the monitoring network.

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Native Vegetation and Managed Wetlands

Native vegetation and managed wetlands are water use sectors that are required[1,2] to be included into the water budget. The integration of native vegetation into the water budget is **insufficient**. The water budget did not explicitly include the current, historical, and projected demands of native vegetation. The omission of explicit water demands for native vegetation is problematic because key environmental uses of groundwater are not being accounted for as water supply decisions are made using this budget, nor will they likely be considered in project and management actions. Managed wetlands are not mentioned in the GSP, so it is not known whether or not they are present in the basin.

RECOMMENDATIONS

- Quantify and present all water use sector demands in the historical, current, and projected water budgets with individual line items for each water use sector, including native vegetation. If native vegetation is included as one of the land use types in the numerical model, specifically state this in the GSP and provide a separate line item in water budget tables.
- State whether or not there are managed wetlands in the basin. If there are, ensure that their groundwater demands are included as separate line items in the historical, current, and projected water budgets.

B. Engaging Stakeholders

Stakeholder Engagement during GSP development

Stakeholder engagement during GSP development is **insufficient**. SGMA's requirement for public notice and engagement of stakeholders[3] is not fully met by the description in the Stakeholder Communication and Engagement Plan included in the GSP (Appendix 2A).

We note the following deficiencies with the overall stakeholder engagement process:

- The opportunities for public involvement and engagement are described in very general terms. They include maintenance of the SMGWA website; continued social media presence through Facebook and Instagram; email newsletter; youth engagement efforts; promoting and conducting community meetings, workshops and events; coordination with member agencies to share information; and developing print materials.
- Private domestic pumpers, small water systems, and the Amah Mutsun Tribal Band are listed as private users. Disadvantaged communities, environmental justice groups, and human service nonprofits are listed under the human right to water category (p. 8 in the Stakeholder Communication and Engagement Plan). However very little information is

[1] "'Water use sector' refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation." [23 CCR §351(al)]

[2] "The water budget shall quantify the following, either through direct measurements or estimates based on data: (3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow." [23 CCR §354.18]

[3] "A communication section of the Plan shall include a requirement that the GSP identify how it encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin." [23 CCR §354.10(d)(3)]

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provided other than stating that their participation is invited in the GSP development process.

- The Stakeholder Outreach Plan does not include enough detail describing plans for continual opportunities for engagement through the *implementation* phase of the GSP for stakeholders.

RECOMMENDATIONS

- Include a more detailed and robust Stakeholder Communication and Engagement Plan that describes active and targeted outreach to engage DACs, domestic well owners, environmental stakeholders, and tribal stakeholders during the remainder of the GSP development process and throughout the GSP implementation phase. Refer to Attachment B for specific recommendations on how to actively engage stakeholders during all phases of the GSP process.

- Describe efforts to consult and engage with tribes within the basin. Refer to the DWR guidance entitled *Engagement with Tribal Governments* for specifics on how to consult with tribes.[4]

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C. Considering Beneficial Uses and Users When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users

The consideration of beneficial uses and users when establishing sustainable management criteria (SMC) is **insufficient**. The consideration of potential impacts on all beneficial users of groundwater in the basin are required when defining undesirable results[5] and establishing minimum thresholds.[6,7]

Disadvantaged Communities and Drinking Water Users

For chronic lowering of groundwater levels, while the GSP does describe or analyze direct or indirect impacts on domestic drinking water wells when defining undesirable results (p. 3-54), the GSP does not sufficiently describe how the existing minimum threshold groundwater levels are consistent with avoiding undesirable results in the basin.

For degraded water quality, the GSP sets SMC for all identified Contaminants of Concern (COCs) in the basin. Water quality minimum thresholds are based on the Maximum Contaminant levels (MCLs). The GSP does not, however, specifically analyze direct and indirect impacts on DACs or

[4] DWR Guidance Document for Engagement with Tribal Governments https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Guidance-Doc-for-SGM-Engagement-with-Tribal-Govt_ay_19.pdf

[5] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results." [23 CCR §354.26(b)(3)]

[6] "The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]

[7] "The description of minimum thresholds shall include [...] how state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the agency shall explain the nature of and the basis for the difference." [23 CCR §354.28(b)(5)]

tribes when defining undesirable results for degraded water quality, nor does it evaluate the cumulative or indirect impacts of proposed minimum thresholds on DACs or tribes. The GSP may group DACS under rural residents. The GSP states: "When developing the GSP, the SMGWA considered impacts on all beneficial uses and users, including domestic well owners, Disadvantaged Communities (DACs), and priority species." We recommend that undesirable results specifically describe direct and indirect impacts to DACs and tribes.

RECOMMENDATIONS

Chronic Lowering of Groundwater Levels

- Describe direct and indirect impacts on DACs and tribes when defining undesirable results for chronic lowering of groundwater levels, in addition to describing impacts to drinking water users.
- Consider and evaluate the impacts of selected minimum thresholds and measurable objectives on DACs, drinking water users, and tribes within the basin. Further describe the impact of passing the minimum threshold for these users. For example, provide the number of domestic wells that would be de-watered at the minimum threshold.

Degraded Water Quality

- Describe direct and indirect impacts on DACs and tribes when defining undesirable results for degraded water quality. For specific guidance on how to consider these users, refer to "Guide to Protecting Water Quality Under the Sustainable Groundwater Management Act."[8]
- Evaluate the cumulative or indirect impacts of proposed minimum thresholds on DACs and tribes.

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Groundwater Dependent Ecosystems and Interconnected Surface Waters

The GSP sets minimum thresholds for chronic lowering of groundwater levels to the average of the five lowest historical minimum elevations, and states that "[b]ecause historical levels have not appeared to cause significant and unreasonable conditions in the past, these levels should continue to support similar beneficial use in the future." As a proxy for the depletion of interconnected surface water SMC, two monitoring wells from the existing monitoring network adjacent to creeks and screened in the aquifer connected to the creek will be used as RMPs for the depletion of interconnected surface water. Consistent with the approach used for chronic lowering of groundwater level minimum threshold, historical data from the two existing surface water depletion RMPs are used to develop surface water depletion minimum thresholds.

The GSP makes the following statement under effects of minimum thresholds on beneficial users for ecological land uses and users (p. 3-61): "Maintaining groundwater elevations at or above historical levels will maintain the very connected nature of groundwater and surface water in the Basin. This will protect GDE habitat used by priority species, and generally benefit ecological land uses and users." However, the true impacts to ecosystems under this scenario are not fully

[8] Guide to Protecting Water Quality under the Sustainable Groundwater Management Act https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858.

discussed in the GSP. In fact, the GSP states (p. 2-47): "Impacts to GDEs within the Basin have yet to be identified. The groundwater model shows a Basin-wide reduction in streamflow from pumping, but without GDE monitoring data, a quantifiable correlation has yet to be established."

If minimum thresholds are set to historic low groundwater levels and the basin is allowed to operate at or close to those levels over many years, there is a risk of causing catastrophic damage to ecosystems that are more adverse than what was occurring at the height of the 2012-2016 drought. This is because California ecosystems, which are adapted to our Mediterranean climate, have some drought strategies that they can utilize to deal with short-term water stress. However, if the drought conditions are prolonged, the ecosystem can collapse.

RECOMMENDATIONS

- When defining undesirable results for chronic lowering of groundwater levels, provide specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs. Undesirable results to environmental users occur when 'significant and unreasonable' effects on beneficial users are caused by one of the sustainability indicators (i.e., chronic lowering of groundwater levels, degraded water quality, or depletion of interconnected surface water). Thus, potential impacts on environmental beneficial uses and users need to be considered when defining undesirable results[9] in the basin. Defining undesirable results is the crucial first step before the minimum thresholds[10] can be determined.

- For the interconnected surface water SMC, the undesirable results should include a description of potential impacts on instream habitats within ISWs when defining minimum thresholds in the basin[11]. The GSP should confirm that minimum thresholds for ISWs avoid adverse impacts to environmental beneficial users of interconnected surface waters as these environmental users could be left unprotected by the GSP. These recommendations apply especially to environmental beneficial users that are already protected under pre-existing state or federal law[6,12].

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2. Climate Change

The SGMA statute identifies climate change as a significant threat to groundwater resources and one that must be examined and incorporated in the GSPs. The GSP Regulations[13] require integration of climate

[9] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results". [23 CCR §354.26(b)(3)]
[10] The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]
[11] "The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results." [23 CCR §354.28(c)(6)]
[12] Rohde MM, Seapy B, Rogers R, Castañeda X, editors. 2019. Critical Species LookBook: A compendium of California's threatened and endangered species for sustainable groundwater management. The Nature Conservancy, San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/Critical_Species_LookBook_91819.pdf
[13] "Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply,

change into the projected water budget to ensure that projects and management actions sufficiently account for the range of potential climate futures.

The integration of climate change into the projected water budget is **insufficient**. The GSP does incorporate climate change into the projected water budget using a transient climate projection based on an ensemble of four commonly used global climate models. However, the GSP did not consider multiple climate scenarios (e.g., the 2070 extremely wet and extremely dry climate scenarios) in the projected water budget. The GSP should clearly and transparently incorporate the extremely wet and dry scenarios provided by DWR into projected water budgets or select more appropriate extreme scenarios for their basins. While these extreme scenarios may have a lower likelihood of occurring, their consequences could be significant, therefore they should be included in groundwater planning.

We acknowledge and commend the inclusion of climate change into key inputs (e.g., precipitation, evaporation, and surface water flow) of the projected water budget. Additionally, the sustainable yield is calculated based on the projected pumping with climate change incorporated. However, if the water budgets are incomplete, including the omission of extremely wet and dry scenarios, then there is increased uncertainty in virtually every subsequent calculation used to plan for projects, derive measurable objectives, and set minimum thresholds. Plans that do not adequately include climate change projections may underestimate future impacts on vulnerable beneficial users of groundwater such as ecosystems, DACs, and domestic well owners.

RECOMMENDATIONS

- Integrate extreme wet and dry scenarios into the projected water budget to form the basis for development of sustainable management criteria and projects and management actions.
- Incorporate climate change scenarios into projects and management actions.

3. Data Gaps

The consideration of beneficial users when establishing monitoring networks is **insufficient**, due to lack of clarity around the Representative Monitoring Points (RMPs) in the monitoring network that represent water quality conditions and shallow groundwater elevations around DACs, domestic wells, and GDEs.

The GSP states that areas with data gaps in the shallow aquifer include communities where there are a large number of private domestic wells pumping from either the Santa Margarita Sandstone or Monterey Formation, and areas where shallow groundwater is connected to surface water and groundwater pumping may be causing depletion of surface water. Figure 3-6 shows the locations of eight new monitoring wells to be installed in 2022. However, these wells are not shown on Figure 3-7 (Representative Monitoring Points for Groundwater Levels) or on Figure 3-13 (Representative Monitoring Points for Groundwater Quality). It is therefore difficult to determine if existing or proposed monitoring sites adequately represent shallow groundwater conditions in areas of the basin with DACs, domestic wells, and GDEs.

land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow." [23 CCR §354.18(e)]

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We commend the GSA for including GDE-related biological monitoring in the monitoring network. The GSP states that this will include use of the Nature Conservancy's GDE Pulse tool, and field assessments that will take place twice a year to include photo monitoring and site observations of GDEs.

RECOMMENDATIONS

- Provide a complete set of maps that overlay monitoring well locations (both existing RMPs and new RMPs) with the locations of DACs, domestic wells, and GDEs to clearly identify potentially impacted areas. Ensure that existing and proposed RMPs adequately cover DAC, domestic well, and GDE portions of the basin.
- Evaluate how the gathered data will be used to identify and map GDEs and ISWs, and to identify DACs and shallow domestic well users that are vulnerable to undesirable results.

4. Addressing Beneficial Users in Projects and Management Actions

The consideration of beneficial users when developing projects and management actions is **insufficient**, due to failing to completely identify benefits or impacts of identified projects and management actions to key beneficial users.

The GSP incorporates project and management actions into projected water budgets and sustainable yield. Additionally, the GSP acknowledges that SMGWA-approved projects and management activities might impact beneficial users of groundwater and lists the ways in which some beneficial users could be impacted, depending on the approved project. However, there is very little discussion of the manner in which DACs and tribes may be benefitted or impacted from identified projects and management actions. Therefore, potential project and management actions may not protect these beneficial users.

Groundwater sustainability under SGMA is defined not just by sustainable yield, but by the avoidance of undesirable results for all beneficial users. GDEs, DACs, and tribes were not sufficiently identified in the GSP. Therefore, potential project and management actions may not protect these beneficial users of groundwater. The following recommendations can improve the projects and management actions section of the GSP.

RECOMMENDATIONS

- Recharge ponds, reservoirs and facilities for managed stormwater recharge can be designed as multiple-benefit projects to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. For guidance on how to

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integrate multi-benefit recharge projects into your GSP, refer to the "Multi-Benefit Recharge Project Methodology Guidance Document"[14].

- For DACs and domestic well owners, include discussion of a drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation. Refer to Attachment B for specific recommendations on how to implement a drinking water well mitigation program.

- For DACs and domestic well owners, include a discussion of whether potential impacts to water quality from projects and management actions could occur and how the GSA plans to mitigate such impacts. Impacts to supply wells are discussed, but not to DACs and domestic well owners.

- Develop management actions that incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results.

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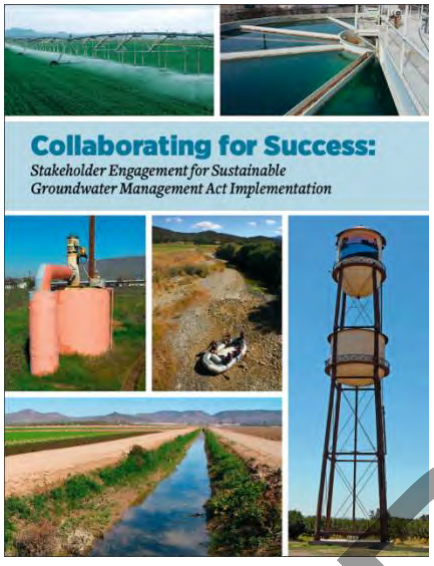
[14] The Nature Conservancy. 2021. Multi-Benefit Recharge Project Methodology for Inclusion in Groundwater Sustainability Plans. Sacramento. Available at: https://groundwaterresourcehub.org/sgma-tools/multi-benefit-recharge-project-methodology-guidance/

Attachment B

SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users

Stakeholder Engagement and Outreach



Clean Water Action, Community Water Center and Union of Concerned Scientists developed a guidance document called Collaborating for success: Stakeholder engagement for Sustainable Groundwater Management Act Implementation. It provides details on how to conduct targeted and broad outreach and engagement during Groundwater Sustainability Plan (GSP) development and implementation. Conducting a targeted outreach involves:

- Developing a robust Stakeholder Communication and Engagement plan that includes outreach at frequented locations (schools, farmers markets, religious settings, events) across the plan area to increase the involvement and participation of disadvantaged communities, drinking water users and the environmental stakeholders.
- Providing translation services during meetings and technical assistance to enable easy participation for non-English speaking stakeholders.
- GSP should adequately describe the process for requesting input from beneficial users and provide details on how input is incorporated into the GSP.

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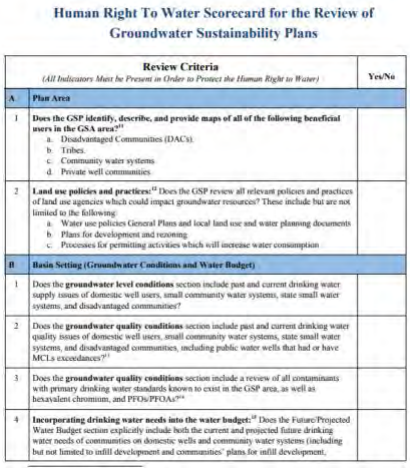
The Human Right to Water

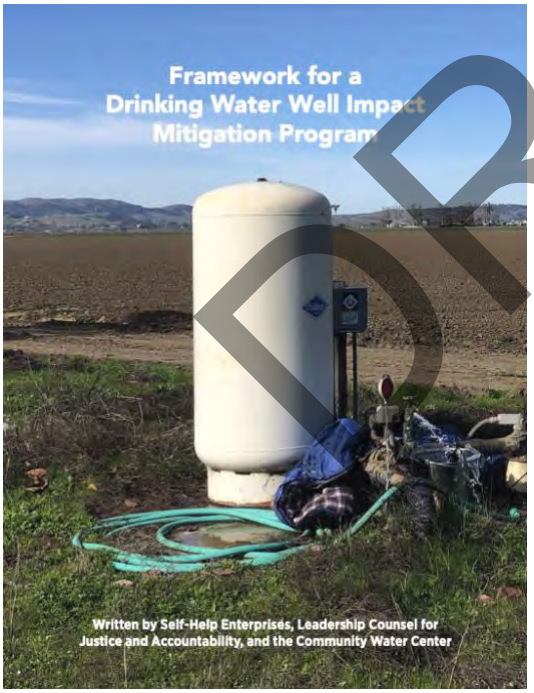


Human Right To Water Scorecard for the Review of Groundwater Sustainability Plans

	Review Criteria *(All Indicators Must be Present in Order to Protect the Human Right to Water)*	Yes/No
A	**Plan Area**	
1	**Does the GSP identify, describe, and provide maps of all of the following beneficial users in the GSA area?**[xii] a. Disadvantaged Communities (DACs). b. Tribes. c. Community water systems. d. Private well communities.	
2	**Land use policies and practices:**[xiii] Does the GSP review all relevant policies and practices of land use agencies which could impact groundwater resources? These include but are not limited to the following: a. Water use policies General Plans and local land use and water planning documents b. Plans for development and rezoning. c. Processes for permitting activities which will increase water consumption.	
B	**Basin Setting (Groundwater Conditions and Water Budget)**	
1	Does the **groundwater level conditions** section include past and current drinking water supply issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities?	
2	Does the **groundwater quality conditions** section include past and current drinking water quality issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities, including public water wells that had or have MCLs exceedances?[xi]	
3	Does the **groundwater quality conditions** section include a review of all contaminants with primary drinking water standards known to exist in the GSP area, as well as hexavalent chromium, and PFOs/PFOAs?[xx]	
4	**Incorporating drinking water needs into the water budget:**[xi] Does the Future/Projected Water Budget section explicitly include both the current and projected future drinking water needs of communities on domestic wells and community water systems (including but not limited to infill development and communities' plans for infill development,	

The Human Right to Water Scorecard was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid Groundwater Sustainability Agencies (GSAs) in prioritizing drinking water needs in SGMA. The scorecard identifies elements that must exist in GSPs to adequately protect the Human Right to Drinking water.

Drinking Water Well Impact Mitigation Framework



The Drinking Water Well Impact Mitigation Framework was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid GSAs in the development and implementation of their GSPs. The framework provides a clear roadmap for how a GSA can best structure its data gathering, monitoring network and management actions to proactively monitor and protect drinking water wells and mitigate impacts should they occur.

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Groundwater Resource Hub

The Nature Conservancy has developed a suite of tools based on best available science to help GSAs, consultants, and stakeholders efficiently incorporate nature into GSPs. These tools and resources are available online at GroundwaterResourceHub.org. The Nature Conservancy's tools and resources are intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Rooting Depth Database

The Plant Rooting Depth Database provides information that can help assess whether groundwater-dependent vegetation are accessing groundwater. Actual rooting depths will depend on the plant species and site-specific conditions, such as soil type and

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availability of other water sources. Site-specific knowledge of depth to groundwater combined with rooting depths will help provide an understanding of the potential groundwater levels are needed to sustain GDEs.

How to use the database

The maximum rooting depth information in the Plant Rooting Depth Database is useful when verifying whether vegetation in the Natural Communities Commonly Associated with Groundwater (NC Dataset) are connected to groundwater. A 30 ft depth-to-groundwater threshold, which is based on averaged global rooting depth data for phreatophytes[1], is relevant for most plants identified in the NC Dataset since most plants have a max rooting depth of less than 30 feet. However, it is important to note that deeper thresholds are necessary for other plants that have reported maximum root depths that exceed the averaged 30 feet threshold, such as valley oak (*Quercus lobata*), Euphrates poplar (*Populus euphratica*), salt cedar (*Tamarix spp.*), and shadescale (*Atriplex confertifolia*). The Nature Conservancy advises that the reported max rooting depth for these deeper-rooted plants be used. For example, a depth-to groundwater threshold of 80 feet should be used instead of the 30 ft threshold, when verifying whether valley oak polygons from the NC Dataset are connected to groundwater. It is important to re-emphasize that actual rooting depth data are limited and will depend on the plant species and site-specific conditions such as soil and aquifer types, and availability to other water sources.

The Plant Rooting Depth Database is an Excel workbook composed of four worksheets:

1. California phreatophyte rooting depth data (included in the NC Dataset)
2. Global phreatophyte rooting depth data
3. Metadata
4. References

How the database was compiled

The Plant Rooting Depth Database is a compilation of rooting depth information for the groundwater-dependent plant species identified in the NC Dataset. Rooting depth data were compiled from published scientific literature and expert opinion through a crowdsourcing campaign. As more information becomes available, the database of rooting depths will be updated. Please Contact Us if you have additional rooting depth data for California phreatophytes.

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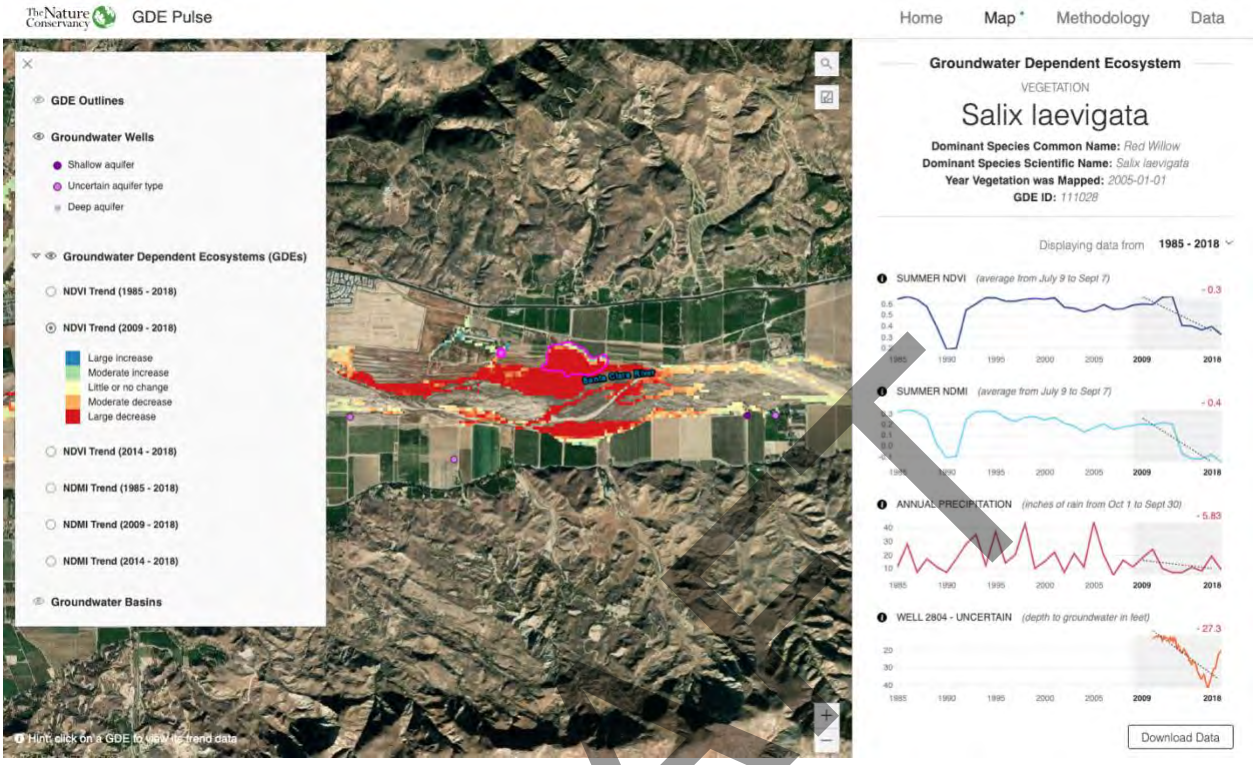
[1] Canadell, J., Jackson, R.B., Ehleringer, J.B. et al. 1996. Maximum rooting depth of vegetation types at the global scale. Oecologia 108, 583–595. https://doi.org/10.1007/BF00329030

GDE Pulse



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GDE Pulse is a free online tool that allows Groundwater Sustainability Agencies to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data. Remote sensing data from satellites has been used to monitor the health of vegetation all over the planet. GDE pulse has compiled 35 years of satellite imagery from NASA's Landsat mission for every polygon in the Natural Communities Commonly Associated with Groundwater Dataset. The following datasets are available for downloading:

Normalized Difference Vegetation Index (NDVI) is a satellite-derived index that represents the greenness of vegetation. Healthy green vegetation tends to have a higher NDVI, while dead leaves have a lower NDVI. We calculated the average NDVI during the driest part of the year (July - Sept) to estimate vegetation health when the plants are most likely dependent on groundwater.

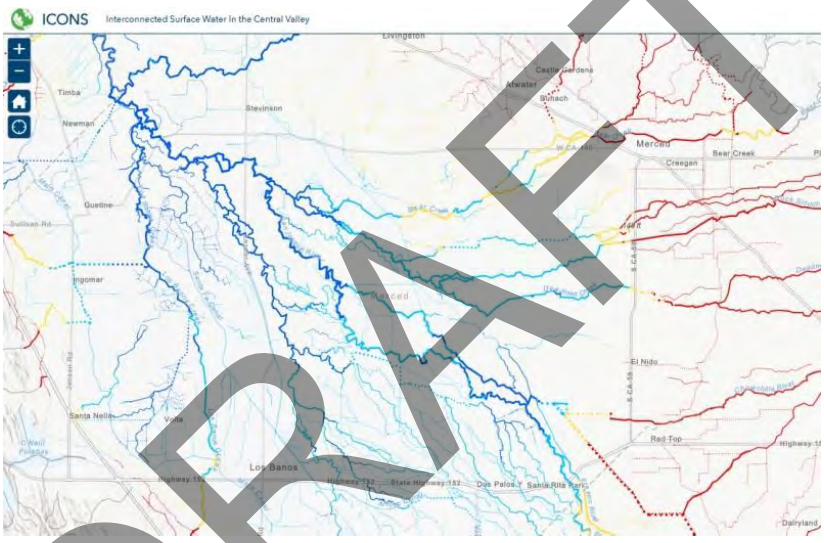
Normalized Difference Moisture Index (NDMI) is a satellite-derived index that represents water content in vegetation. NDMI is derived from the Near-Infrared (NIR) and Short-Wave Infrared (SWIR) channels. Vegetation with adequate access to water tends to have higher NDMI, while vegetation that is water stressed tends to have lower NDMI. We calculated the average NDVI during the driest part of the year (July–September) to estimate vegetation health when the plants are most likely dependent on groundwater.

Annual Precipitation is the total precipitation for the water year (October 1st – September 30th) from the PRISM dataset. The amount of local precipitation can affect vegetation with more precipitation generally leading to higher NDVI and NDMI.

Depth to Groundwater measurements provide an indication of the groundwater levels and changes over time for the surrounding area. We used groundwater well measurements from nearby (<1km) wells to estimate the depth to groundwater below the GDE based on the average elevation of the GDE (using a digital elevation model) minus the measured groundwater surface elevation.

ICONOS Mapper

Interconnected Surface Water in the Central Valley



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ICONS maps the likely presence of interconnected surface water (ISW) in the Central Valley using depth to groundwater data. Using data from 2011-2018, the ISW dataset represents the likely connection between surface water and groundwater for rivers and streams in California's Central Valley. It includes information on the mean, maximum, and minimum depth to groundwater for each stream segment over the years with available data, as well as the likely presence of ISW based on the minimum depth to groundwater. The Nature Conservancy developed this database, with guidance and input from expert academics, consultants, and state agencies.

We developed this dataset using groundwater elevation data available online from the California Department of Water Resources (DWR). DWR only provides this data for the Central Valley. For GSAs outside of the valley, who have groundwater well measurements, we recommend following our methods to determine likely ISW in your region. The Nature Conservancy's ISW dataset should be used as a first step in reviewing ISW and should be supplemented with local or more recent groundwater depth data.

Attachment C

Freshwater Species Located in the Santa Margarita Subbasin

To assist in identifying the beneficial users of surface water necessary to assess the undesirable result "depletion of interconnected surface waters", Attachment C provides a list of freshwater species located in the Santa Margarita Subbasin. To produce the freshwater species list, we used ArcGIS to select features within the California Freshwater Species Database version 2.0.9 within the basin boundary. This database contains information on ~4,000 vertebrates, macroinvertebrates and vascular plants that depend on fresh water for at least one stage of their life cycle. The methods used to compile the California Freshwater Species Database can be found in Howard et al. 2015[1]. The spatial database contains locality observations and/or distribution information from ~400 data sources. The database is housed in the California Department of Fish and Wildlife's BIOS[2] as well as on The Nature Conservancy's science website[3].

Scientific Name	Common Name	Legal Protected Status		
		Federal	State	Other
BIRDS				
Actitis macularius	Spotted Sandpiper			
Aechmophorus clarkii	Clark's Grebe			
Aechmophorus occidentalis	Western Grebe			
Agelaius tricolor	Tricolored Blackbird	Bird of Conservation Concern	Special Concern	BSSC - First priority
Aix sponsa	Wood Duck			
Anas acuta	Northern Pintail			
Anas americana	American Wigeon			
Anas clypeata	Northern Shoveler			
Anas crecca	Green-winged Teal			
Anas cyanoptera	Cinnamon Teal			
Anas discors	Blue-winged Teal			
Anas platyrhynchos	Mallard			
Anas strepera	Gadwall			
Ardea alba	Great Egret			
Ardea herodias	Great Blue Heron			
Aythya collaris	Ring-necked Duck			
Aythya marila	Greater Scaup			
Aythya valisineria	Canvasback		Special	
Botaurus lentiginosus	American Bittern			
Bucephala albeola	Bufflehead			
Bucephala clangula	Common Goldeneye			

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[1] Howard, J.K. et al. 2015. Patterns of Freshwater Species Richness, Endemism, and Vulnerability in California. PLoSONE, 11(7). Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130710

[2] California Department of Fish and Wildlife BIOS: https://www.wildlife.ca.gov/data/BIOS

[3] Science for Conservation: https://www.scienceforconservation.org/products/california-freshwater-species-database

Butorides virescens	Green Heron			
Calidris minutilla	Least Sandpiper			
Chen rossii	Ross's Goose			
Cinclus mexicanus	American Dipper			
Cistothorus palustris palustris	Marsh Wren			
Cypseloides niger	Black Swift	Bird of Conservation Concern	Special Concern	BSSC - Third priority
Egretta thula	Snowy Egret			
Empidonax traillii	Willow Flycatcher	Bird of Conservation Concern	Endangered	
Fulica americana	American Coot			
Gallinago delicata	Wilson's Snipe			
Haliaeetus leucocephalus	Bald Eagle	Bird of Conservation Concern	Endangered	
Lophodytes cucullatus	Hooded Merganser			
Megaceryle alcyon	Belted Kingfisher			
Mergus merganser	Common Merganser			
Nycticorax nycticorax	Black-crowned Night-Heron			
Oxyura jamaicensis	Ruddy Duck			
Phalacrocorax auritus	Double-crested Cormorant			
Podiceps nigricollis	Eared Grebe			
Podilymbus podiceps	Pied-billed Grebe			
Porzana carolina	Sora			
Rallus limicola	Virginia Rail			
Setophaga petechia	Yellow Warbler			BSSC - Second priority
Tachycineta bicolor	Tree Swallow			
Tringa solitaria	Solitary Sandpiper			
CRUSTACEANS				
Gammarus spp.	Gammarus spp.			
FISH				
Oncorhynchus mykiss irideus	Coastal rainbow trout			Least Concern - Moyle 2013
Oncorhynchus mykiss - CCC winter	Central California coast winter steelhead	Threatened	Special	Vulnerable - Moyle 2013
HERPS				
Actinemys marmorata marmorata	Western Pond Turtle		Special Concern	ARSSC
Ambystoma californiense californiense	California Tiger Salamander	Threatened	Threatened	ARSSC

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Anaxyrus boreas boreas	Boreal Toad			
Dicamptodon ensatus	California Giant Salamander			ARSSC
Rana boylii	Foothill Yellow-legged Frog	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Rana draytonii	California Red-legged Frog	Threatened	Special Concern	ARSSC
Taricha granulosa	Rough-skinned Newt			
Taricha torosa	Coast Range Newt		Special Concern	ARSSC
Thamnophis sirtalis sirtalis	Common Gartersnake			
Pseudacris regilla	Northern Pacific Chorus Frog			
Pseudacris sierra	Sierran Treefrog			
Thamnophis atratus atratus	Santa Cruz Gartersnake			Not on any status lists
Thamnophis elegans elegans	Mountain Gartersnake			Not on any status lists
Thamnophis elegans terrestris	Coast Gartersnake			Not on any status lists
INSECTS & OTHER INVERTS				
Aeshnidae fam.	Aeshnidae fam.			
Agabus spp.	Agabus spp.			
Agapetus spp.	Agapetus spp.			
Amiocentrus aspilus	A Caddisfly			
Antocha monticola				Not on any status lists
Antocha spp.	Antocha spp.			
Argia spp.	Argia spp.			
Argia vivida	Vivid Dancer			
Baetis spp.	Baetis spp.			
Baetis tricaudatus	A Mayfly			
Brachycentridae fam.	Brachycentridae fam.			
Brillia spp.	Brillia spp.			
Calineuria californica	Western Stone			
Callibaetis spp.	Callibaetis spp.			
Centroptilum spp.	Centroptilum spp.			
Cheumatopsyche spp.	Cheumatopsyche spp.			
Chironomidae fam.	Chironomidae fam.			
Chironomus spp.	Chironomus spp.			
Chloroperlidae fam.	Chloroperlidae fam.			
Cinygmula spp.	Cinygmula spp.			
Cladotanytarsus spp.	Cladotanytarsus spp.			
Cleptelmis addenda				Not on any status lists

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Conchapelopia spp.	Conchapelopia spp.			
Cordulegaster dorsalis	Pacific Spiketail			
Corixidae fam.	Corixidae fam.			
Cricotopus spp.	Cricotopus spp.			
Cryptochironomus spp.	Cryptochironomus spp.			
Dicrotendipes spp.	Dicrotendipes spp.			
Diphetor hageni	Hagen's Small Minnow Mayfly			
Drunella coloradensis	A Mayfly			
Drunella flavilinea	A Mayfly			
Drunella spp.	Drunella spp.			
Enallagma basidens	Double-striped Bluet			
Enallagma cyathigerum				Not on any status lists
Enallagma praevarum	Arroyo Bluet			
Epeorus spp.	Epeorus spp.			
Ephemerella maculata	A Mayfly			
Ephemerella spp.	Ephemerella spp.			
Ephemerellidae fam.	Ephemerellidae fam.			
Eubrianax edwardsii				Not on any status lists
Eukiefferiella spp.	Eukiefferiella spp.			
Glossosoma spp.	Glossosoma spp.			
Glossosomatidae fam.	Glossosomatidae fam.			
Gyrinus spp.	Gyrinus spp.			
Heptageniidae fam.	Heptageniidae fam.			
Hesperoperla spp.	Hesperoperla spp.			
Heterotrissocladius spp.	Heterotrissocladius spp.			
Holorusia hespera				Not on any status lists
Hydropsyche spp.	Hydropsyche spp.			
Hydropsychidae fam.	Hydropsychidae fam.			
Hydroptila spp.	Hydroptila spp.			
Ischnura cervula	Pacific Forktail			
Ischnura perparva	Western Forktail			
Isoperla spp.	Isoperla spp.			
Kogotus nonus	Smooth Springfly			
Lepidostoma spp.	Lepidostoma spp.			
Leucotrichia pictipes	A Micro Caddisfly			
Libellula pulchella	Twelve-spotted Skimmer			
Libellula saturata	Flame Skimmer			
Limnephilus frijole	A Caddisfly			

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Malenka spp.	Malenka spp.			
Maruina lanceolata				Not on any status lists
Matriella teresa	A Mayfly			
Micropsectra spp.	Micropsectra spp.			
Microtendipes spp.	Microtendipes spp.			
Mideopsis spp.	Mideopsis spp.			
Nanocladius spp.	Nanocladius spp.			
Narpus spp.	Narpus spp.			
Nemouridae fam.	Nemouridae fam.			
Neophylax rickeri	A Caddisfly			
Neophylax spp.	Neophylax spp.			
Neotrichia spp.	Neotrichia spp.			
Octogomphus specularis	Grappletail			
Optioservus quadrimaculatus				Not on any status lists
Optioservus spp.	Optioservus spp.			
Oreodytes spp.	Oreodytes spp.			
Pachydiplax longipennis	Blue Dasher			
Paltothemis lineatipes	Red Rock Skimmer			
Pantala hymenaea	Spot-winged Glider			
Paracladopelma spp.	Paracladopelma spp.			
Parakiefferiella spp.	Parakiefferiella spp.			
Paraleptophlebia spp.	Paraleptophlebia spp.			
Parametriocnemus spp.	Parametriocnemus spp.			
Paraphaenocladius spp.	Paraphaenocladius spp.			
Parapsyche almota	A Caddisfly			
Parapsyche spp.	Parapsyche spp.			
Paratanytarsus spp.	Paratanytarsus spp.			
Paratendipes spp.	Paratendipes spp.			
Perlidae fam.	Perlidae fam.			
Perlodidae fam.	Perlodidae fam.			
Petrophila spp.	Petrophila spp.			
Phaenopsectra spp.	Phaenopsectra spp.			
Plathemis lydia	Common Whitetail			
Plumiperla spp.	Plumiperla spp.			
Polycentropus spp.	Polycentropus spp.			
Polypedilum aviceps				Not on any status lists
Polypedilum scalaenum				Not on any status lists
Polypedilum spp.	Polypedilum spp.			
Polypedilum tritum				Not on any status lists

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Protanyderus spp.	Protanyderus spp.			
Pseudochironomus spp.	Pseudochironomus spp.			
Rheotanytarsus spp.	Rheotanytarsus spp.			
Rhionaeschna multicolor	Blue-eyed Darner			
Rhyacophila spp.	Rhyacophila spp.			
Robackia spp.	Robackia spp.			
Serratella micheneri	A Mayfly			
Serratella spp.	Serratella spp.			
Sialis spp.	Sialis spp.			
Sigara mckinstryi	A Water Boatman			Not on any status lists
Sigara spp.	Sigara spp.			
Simuliidae fam.	Simuliidae fam.			
Simulium spp.	Simulium spp.			
Siphlonurus spp.	Siphlonurus spp.			
Skwala spp.	Skwala spp.			
Sperchon spp.	Sperchon spp.			
Sublettea spp.	Sublettea spp.			
Suwallia spp.	Suwallia spp.			
Sweltsa spp.	Sweltsa spp.			
Sympetrum corruptum	Variegated Meadowhawk			
Sympetrum illotum	Cardinal Meadowhawk			
Tanypus spp.	Tanypus spp.			
Tanytarsus spp.	Tanytarsus spp.			
Telebasis salva	Desert Firetail			
Thienemannimyia spp.	Thienemannimyia spp.			
Timpanoga hecuba	A Mayfly			
Tricorythodes spp.	Tricorythodes spp.			
Tvetenia spp.	Tvetenia spp.			
Wormaldia spp.	Wormaldia spp.			
Zaitzevia spp.	Zaitzevia spp.			
Zoniagrion exclamationis	Exclamation Damsel			
MOLLUSKS				
Anodonta californiensis	California Floater		Special	
Ferrissia spp.	Ferrissia spp.			
Gyraulus spp.	Gyraulus spp.			
Hydrobiidae fam.	Hydrobiidae fam.			
Menetus opercularis	Button Sprite			CS
Physa spp.	Physa spp.			
Pisidium spp.	Pisidium spp.			
Pyrgulopsis spp.	Pyrgulopsis spp.			
Sphaeriidae fam.	Sphaeriidae fam.			
PLANTS				

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Alopecurus saccatus	Pacific Foxtail			
Ammannia coccinea	Scarlet Ammannia			
Beckmannia syzigachne	American Sloughgrass			
Callitriche marginata	Winged Water-starwort			
Campanula californica	Swamp Harebell		Special	CRPR - 1B.2
Carex densa	Dense Sedge			
Cirsium douglasii douglasii	Douglas' Thistle			
Cyperus erythrorhizos	Red-root Flatsedge			
Eleocharis macrostachya	Creeping Spikerush			
Eleocharis rostellata	Beaked Spikerush			
Galium trifidum	Small Bedstraw			
Hydrocotyle ranunculoides	Floating Marsh-pennywort			
Hydrocotyle verticillata verticillata	Whorled Marsh-pennywort			
Juncus falcatus falcatus	Sickle-leaf Rush			
Juncus phaeocephalus phaeocephalus	Brown-head Rush			
Lilium pardalinum pardalinum	Leopard Lily			
Ludwigia palustris	Marsh Seedbox			
Lupinus polyphyllus polyphyllus	Bigleaf Lupine			
Lysichiton americanus	Yellow Skunk-cabbage			
Mimulus cardinalis	Scarlet Monkeyflower			
Mimulus guttatus	Common Large Monkeyflower			
Panicum dichotomiflorum	NA			
Phacelia distans	NA			
Plagiobothrys chorisianus	NA		Special	CRPR - 1B.2
Platanus racemosa	California Sycamore			
Psilocarphus tenellus	NA			
Rhododendron columbianum				Not on any status lists
Rhododendron occidentale occidentale	Western Azalea			
Salix lasiandra lasiandra				Not on any status lists
Salix sitchensis	Sitka Willow			

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Sequoia sempervirens				
Solidago elongata				Not on any status lists
Spiranthes romanzoffiana	Hooded Ladies'-tresses			
Triglochin scilloides	NA			Not on any status lists
Veronica americana	American Speedwell			

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The Nature Conservancy

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IDENTIFYING GDEs UNDER SGMA
Best Practices for using the NC Dataset

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The Sustainable Groundwater Management Act (SGMA) requires that groundwater dependent ecosystems (GDEs) be identified in Groundwater Sustainability Plans (GSPs). As a starting point, the Department of Water Resources (DWR) is providing the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) online[1] to help Groundwater Sustainability Agencies (GSAs), consultants, and stakeholders identify GDEs within individual groundwater basins. To apply information from the NC Dataset to local areas, GSAs should combine it with the best available science on local hydrology, geology, and groundwater levels to verify whether polygons in the NC dataset are likely supported by groundwater in an aquifer (Figure 1)[2]. This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by groundwater.

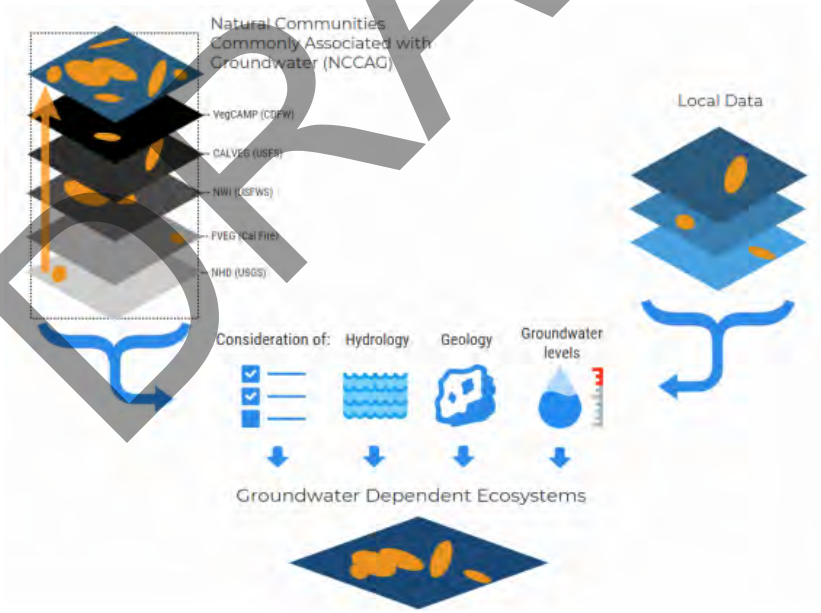

Figure 1. Considerations for GDE identification.
Source: DWR[2]

[1] NC Dataset Online Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/
[2] California Department of Water Resources (DWR). 2018. Summary of the "Natural Communities Commonly Associated with Groundwater" Dataset and Online Web Viewer. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Natural-Communities-Dataset-Summary-Document.pdf

The NC Dataset identifies vegetation and wetland features that are good indicators of a GDE. The dataset is comprised of 48 publicly available state and federal datasets that map vegetation, wetlands, springs, and seeps commonly associated with groundwater in California[3]. It was developed through a collaboration between DWR, the Department of Fish and Wildlife, and The Nature Conservancy (TNC). TNC has also provided detailed guidance on identifying GDEs from the NC dataset[4] on the Groundwater Resource Hub[5], a website dedicated to GDEs.

BEST PRACTICE #1. Establishing a Connection to Groundwater

Groundwater basins can be comprised of one continuous aquifer (Figure 2a) or multiple aquifers stacked on top of each other (Figure 2b). In unconfined aquifers (Figure 2a), using the depth-to-groundwater and the rooting depth of the vegetation is a reasonable method to infer groundwater dependence for GDEs. If groundwater is well below the rooting (and capillary) zone of the plants and any wetland features, the ecosystem is considered disconnected and groundwater management is not likely to affect the ecosystem (Figure 2d). However, it is important to consider local conditions (e.g., soil type, groundwater flow gradients, and aquifer parameters) and to review groundwater depth data from multiple seasons and water year types (wet and dry) because intermittent periods of high groundwater levels can replenish perched clay lenses that serve as the water source for GDEs (Figure 2c). Maintaining these natural groundwater fluctuations are important to sustaining GDE health.

Basins with a stacked series of aquifers (Figure 2b) may have varying levels of pumping across aquifers in the basin, depending on the production capacity or water quality associated with each aquifer. If pumping is concentrated in deeper aquifers, SGMA still requires GSAs to sustainably manage groundwater resources in shallow aquifers, such as perched aquifers, that support springs, surface water, domestic wells, and GDEs (Figure 2). This is because vertical groundwater gradients across aquifers may result in pumping from deeper aquifers to cause adverse impacts onto beneficial users reliant on shallow aquifers or interconnected surface water. The goal of SGMA is to sustainably manage groundwater resources for current and future social, economic, and environmental benefits. While groundwater pumping may not be currently occurring in a shallower aquifer, use of this water may become more appealing and economically viable in future years as pumping restrictions are placed on the deeper production aquifers in the basin to meet the sustainable yield and criteria. Thus, identifying GDEs in the basin should done irrespective to the amount of current pumping occurring in a particular aquifer, so that future impacts on GDEs due to new production can be avoided. A good rule of thumb to follow is: *if groundwater can be pumped from a well - it's an aquifer*.

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[3] For more details on the mapping methods, refer to: Klausmeyer, K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, A. Lyons. 2018. Mapping Indicators of Groundwater Dependent Ecosystems in California: Methods Report. San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/iGDE_data_paper_20180423.pdf
[4] "Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans" is available at: https://groundwaterresourcehub.org/gde-tools/gsp-guidance-document/
[5] The Groundwater Resource Hub: www.GroundwaterResourceHub.org

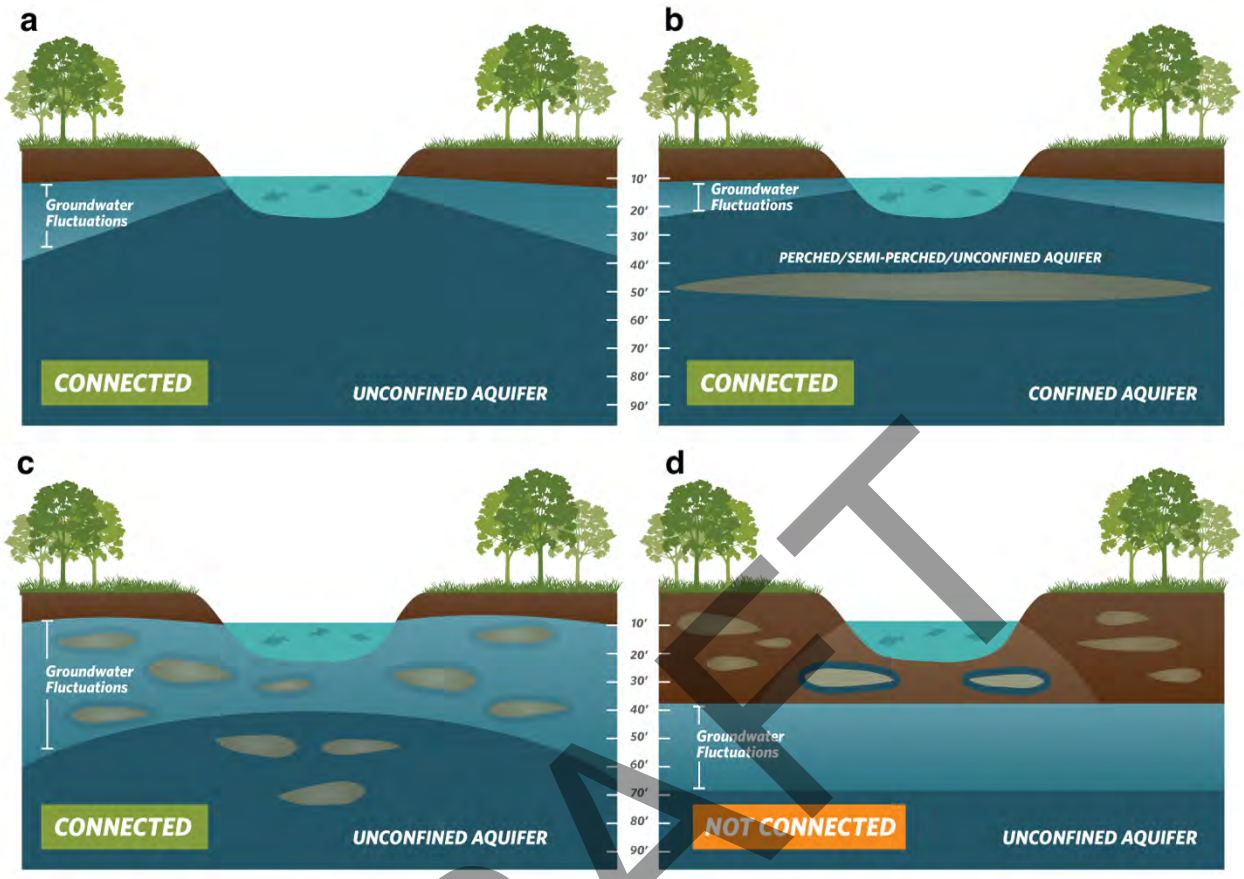

Figure 2. Confirming whether an ecosystem is connected to groundwater. Top: (a) Under the ecosystem is an unconfined aquifer with depth-to-groundwater fluctuating seasonally and interannually within 30 feet from land surface. (b) Depth-to-groundwater in the shallow aquifer is connected to overlying ecosystem. Pumping predominately occurs in the confined aquifer, but pumping is possible in the shallow aquifer. Bottom: (c) Depth-to-groundwater fluctuations are seasonally and interannually large, however, clay layers in the near surface prolong the ecosystem's connection to groundwater. (d) Groundwater is disconnected from surface water, and any water in the vadose (unsaturated) zone is due to direct recharge from precipitation and indirect recharge under the surface water feature. These areas are not connected to groundwater and typically support species that do not require access to groundwater to survive.

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BEST PRACTICE #2. Characterize Seasonal and Interannual Groundwater Conditions

SGMA requires GSAs to describe current and historical groundwater conditions when identifying GDEs [23 CCR §354.16(g)]. Relying solely on the SGMA benchmark date (January 1, 2015) or any other single point in time to characterize groundwater conditions (e.g., depth-to-groundwater) is inadequate because managing groundwater conditions with data from one time point fails to capture the seasonal and interannual variability typical of California's climate. DWR's Best Management Practices document on water budgets[6] recommends using 10 years of water supply and water budget information to describe how historical conditions have impacted the operation of the basin within sustainable yield, implying that a baseline[7] could be determined based on data between 2005 and 2015. Using this or a similar time period, depending on data availability, is recommended for determining the depth-to-groundwater.

GDEs depend on groundwater levels being close enough to the land surface to interconnect with surface water systems or plant rooting networks. The most practical approach[8] for a GSA to assess whether polygons in the NC dataset are connected to groundwater is to rely on groundwater elevation data. As detailed in TNC's GDE guidance document[4], one of the key factors to consider when mapping GDEs is to contour depth-to-groundwater in the aquifer that is supporting the ecosystem (see Best Practice #5).

Groundwater levels fluctuate over time and space due to California's Mediterranean climate (dry summers and wet winters), climate change (flood and drought years), and subsurface heterogeneity in the subsurface (Figure 3). Many of California's GDEs have adapted to dealing with intermittent periods of water stress, however if these groundwater conditions are prolonged, adverse impacts to GDEs can result. While depth-to-groundwater levels within 30 feet[4] of the land surface are generally accepted as being a proxy for confirming that polygons in the NC dataset are supported by groundwater, it is highly advised that fluctuations in the groundwater regime be characterized to understand the seasonal and interannual groundwater variability in GDEs. Utilizing groundwater data from one point in time can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. Time series data on groundwater elevations and depths are available on the SGMA Data Viewer[9]. However, if insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP until data gaps are reconciled in the monitoring network (see Best Practice #6).

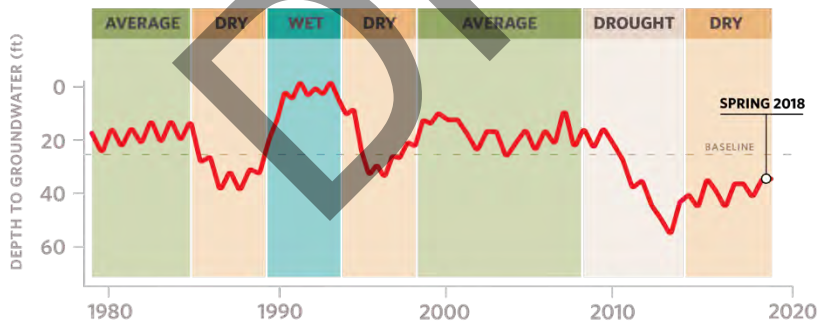

Figure 3. Example seasonality and interannual variability in depth-to-groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so adverse impacts are avoided.

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[6] DWR. 2016. Water Budget Best Management Practice. Available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_Water_Budget_Final_2016-12-23.pdf

[7] Baseline is defined under the GSP regulations as "historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin." [23 CCR §351(e)]

[8] Groundwater reliance can also be confirmed via stable isotope analysis and geophysical surveys. For more information see The GDE Assessment Toolbox (Appendix IV, GDE Guidance Document for GSPs[4]).

[9] SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer

BEST PRACTICE #3. Ecosystems Often Rely on Both Groundwater and Surface Water

GDEs are plants and animals that rely on groundwater for all or some of its water needs, and thus can be supported by multiple water sources. The presence of non-groundwater sources (e.g., surface water, soil moisture in the vadose zone, applied water, treated wastewater effluent, urban stormwater, irrigated return flow) within and around a GDE does not preclude the possibility that it is supported by groundwater, too. SGMA defines GDEs as "ecological communities and species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" [23 CCR §351(m)]. Hence, depth-to-groundwater data should be used to identify whether NC polygons are supported by groundwater and should be considered GDEs. In addition, SGMA requires that significant and undesirable adverse impacts to beneficial users of surface water be avoided. Beneficial users of surface water include environmental users such as plants or animals[10], which therefore must be considered when developing minimum thresholds for depletions of interconnected surface water.

GSAs are only responsible for impacts to GDEs resulting from groundwater conditions in the basin, so if adverse impacts to GDEs result from the diversion of applied water, treated wastewater, or irrigation return flow away from the GDE, then those impacts will be evaluated by other permitting requirements (e.g., CEQA) and may not be the responsibility of the GSA. However, if adverse impacts occur to the GDE due to changing groundwater conditions resulting from pumping or groundwater management activities, then the GSA would be responsible (Figure 4).

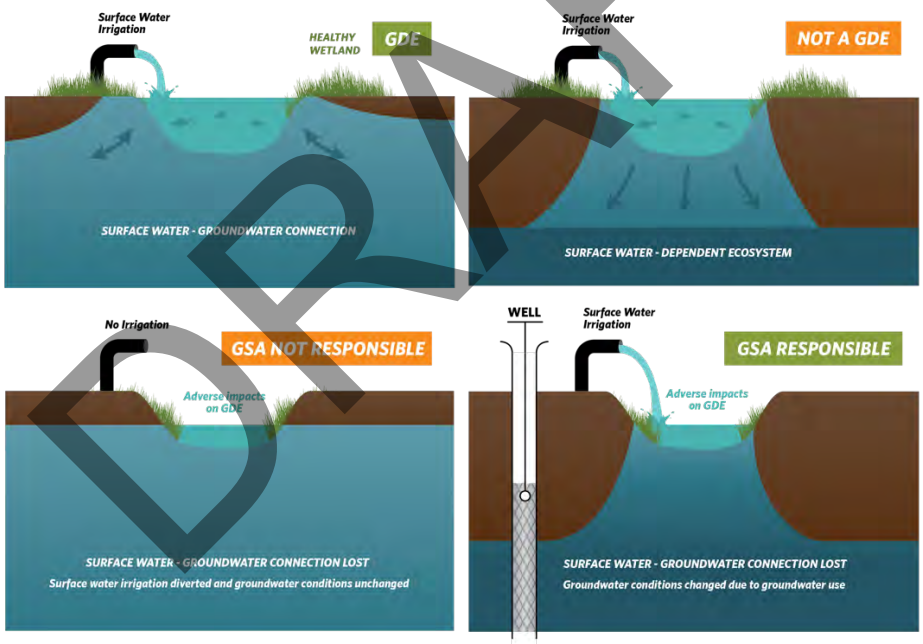

Figure 4. Ecosystems often depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, meaning that the GDE is supported by both groundwater and surface water. (Right) Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. Bottom: (Left) An ecosystem that was once dependent on an interconnected surface water, but loses access to groundwater solely due to surface water diversions may not be the GSA's responsibility. (Right) Groundwater dependent ecosystems once dependent on an interconnected surface water system, but loses that access due to groundwater pumping is the GSA's responsibility.

[10] For a list of environmental beneficial users of surface water by basin, visit: https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/

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BEST PRACTICE #4. Select Representative Groundwater Wells

Identifying GDEs in a basin requires that groundwater conditions are characterized to confirm whether polygons in the NC dataset are supported by the underlying aquifer. To do this, proximate groundwater wells should be identified to characterize groundwater conditions (Figure 5). When selecting representative wells, it is particularly important to consider the subsurface heterogeneity around NC polygons, especially near surface water features where groundwater and surface water interactions occur around heterogeneous stratigraphic units or aquitards formed by fluvial deposits. The following selection criteria can help ensure groundwater levels are representative of conditions within the GDE area:

- Choose wells that are within 5 kilometers (3.1 miles) of each NC Dataset polygons because they are more likely to reflect the local conditions relevant to the ecosystem. If there are no wells within 5km of the center of a NC dataset polygon, then there is insufficient information to remove the polygon based on groundwater depth. Instead, it should be retained as a potential GDE until there are sufficient data to determine whether or not the NC Dataset polygon is supported by groundwater.

- Choose wells that are screened within the surficial unconfined aquifer and capable of measuring the true water table.

- Avoid relying on wells that have insufficient information on the screened well depth interval for excluding GDEs because they could be providing data on the wrong aquifer. This type of well data should not be used to remove any NC polygons.

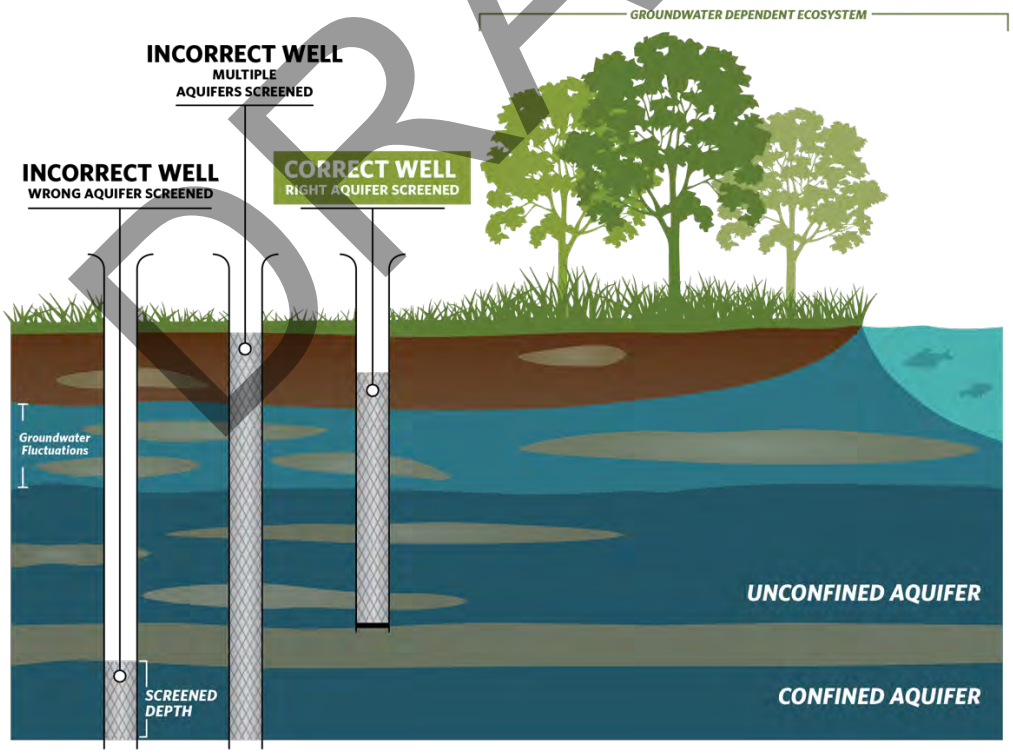

Figure 5. Selecting representative wells to characterize groundwater conditions near GDEs.

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BEST PRACTICE #5. Contouring Groundwater Elevations

The common practice to contour depth-to-groundwater over a large area by interpolating measurements at monitoring wells is unsuitable for assessing whether an ecosystem is supported by groundwater. This practice causes errors when the land surface contains features like stream and wetland depressions because it assumes the land surface is constant across the landscape and depth-to-groundwater is constant below these low-lying areas (Figure 6a). A more accurate approach is to interpolate groundwater elevations at monitoring wells to get groundwater elevation contours across the landscape. This layer can then be subtracted from land surface elevations from a Digital Elevation Model (DEM)[11] to estimate depth-to-groundwater contours across the landscape (Figure b; Figure 7). This will provide a much more accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found.

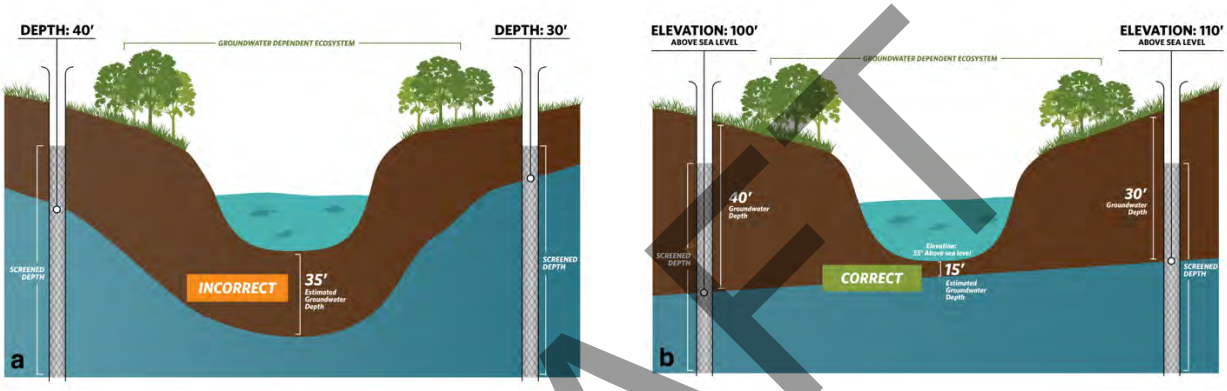

Figure 6. Contouring depth-to-groundwater around surface water features and GDEs. (a) Groundwater level interpolation using depth-to-groundwater data from monitoring wells. (b) Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

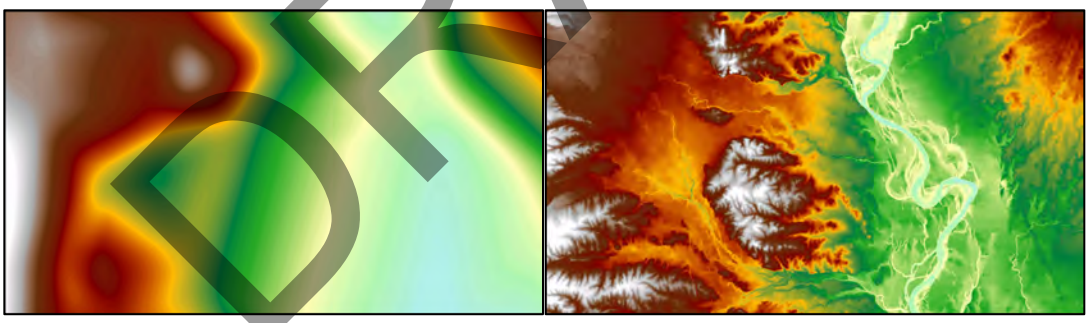

Figure 7. Depth-to-groundwater contours in Northern California. (Left) Contours were interpolated using depth-to-groundwater measurements determined at each well. (Right) Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation from DEM spatial data to generate depth-to-groundwater contours. The image on the right shows a more accurate depth-to-groundwater estimate because it takes the local topography and elevation changes into account.

[11] USGS Digital Elevation Model data products are described at: https://www.usgs.gov/core-science-systems/ngp/3dep/about-3dep-products-services and can be downloaded at: https://iewer.nationalmap.gov/basic/

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BEST PRACTICE #6. Best Available Science

Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decisions, and using the data collected through monitoring programs to revise decisions in the future. In many situations, the hydrologic connection of NC dataset polygons will not initially be clearly understood if site-specific groundwater monitoring data are not available. If sufficient data are not available in time for the 2020/2022 plan, The Nature Conservancy strongly advises that questionable polygons from the NC dataset be included in the GSP until data gaps are reconciled in the monitoring network. Erring on the side of caution will help minimize inadvertent impacts to GDEs as a result of groundwater use and management actions during SGMA implementation.

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KEY DEFINITIONS

Groundwater basin is an aquifer or stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom. *23 CCR §341(g)(1)*

Groundwater dependent ecosystem (GDE) are ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. *23 CCR §351(m)*

Interconnected surface water (ISW) surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted. *23 CCR §351(o)*

Principal aquifers are aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems. *23 CCR §351(aa)*

ABOUT US

The Nature Conservancy is a science-based nonprofit organization whose mission is *to conserve the lands and waters on which all life depends*. To support successful SGMA implementation that meets the future needs of people, the economy, and the environment, TNC has developed tools and resources (www.groundwaterresourcehub.org) intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

SMGWA Online Comment

Name: John Ricker

Organization:

Address: Soquel, CA

Comment:
The Santa Margarita GSP is a well written and thorough document that makes good use of available data and recognizes additional data needs. Implementation of the GSP should be expected to ensure long term sustainability. I have specific comments attached.

DRAFT

Santa Margarita GSP Comments – John Ricker

The Santa Margarita GSP is a well written and thorough document that makes good use of available data and recognizes additional data needs. Implementation of the GSP should be expected to ensure long term sustainability. I have the following comments:

p. ES-3. Period of rapid growth in basin began in 1970-1980, particularly in unincorporated areas, see Fig 2-34

p. ES-5. The County's LAMP for septic systems is correctly titled the Local Area Management Program (not Plan)

p. ES-8 states: "Groundwater levels in both aquifers started to decline as early as the 1970s…", while ES-9 states: "Lowered groundwater levels in certain parts of the Basin have caused a corresponding reduction in groundwater stored in the Basin. Since the 1980s, and even possibly starting in the 1960s,..." These should be reworded for consistency. Maybe best to say: "Since the 1970s and possibly even starting in the 1960s"

p. ES-10 Typo at end of last paragraph: "…losses from the adjacent Mount Hermon / South Scotts Valley area ~~implementation~~."

p. ES-13: Are SLVWD's surface water sources for conjunctive use considered to be within the Basin? That is a bit of a stretch. Maybe better to say within the basin watershed. In that case, the San Lorenzo River would also be considered an in-basin source.

p. 2-107: Last paragraph: Suggest adding a sentence about the City's Tait Street Diversion on the San Lorenzo River derives a significant amount of its flow from the Basin. This is consistent with including it in Table 2-17, which I appreciate.

p.3-72-73: The discussion of groundwater quality should be more explicit on one point, specifically related to nitrate. Recharge with treated wastewater has the potential to increase nitrate levels in groundwater, resulting in an increase in nitrate in surface water. This can cause biostimulation in the aquatic ecosystem, depressing dissolved oxygen levels and adversely impacting aquatic biota, and it can result in increased production of organic compounds that can cause taste and odor problems and disinfection byproducts adversely affecting municipal water supply and costs for surface water treatment.

5 mg-N/L may still be too high as a minimum threshold for nitrate to prevent undesirable results in surface water. If extensive areas of the Basin were allowed to reach a nitrate concentration of 5 mg-N/L, it is very likely the target of 0.33 mg-N/L would be significantly exceeded in the San Lorenzo River. Ongoing monitoring should include monitoring for nitrate in the River as well as groundwater, with consideration to reducing the minimum threshold in the future as needed. Achieving the nitrate TMDL target for the River will require reducing current nitrate inputs to the Basin, which will result in lower nitrate concentrations in groundwater than presently exist as shown in Table 3-21.

P 3-82: I concur with the estimates of streamflow depletion from groundwater extraction estimated for the Basin and for Bean Creek. Those figures are consistent with my analysis of streamflow records going back to the early 1970's. It will be good to further address this critical issue through the installation of

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additional shallow monitoring wells and stream gages and further evaluate that data in future GSP updates. Hopefully this will help establish measurable objectives that will help restore some of the depleted flows.

Fig. 3-23: This figure illustrates some concerns I have with the minimum threshold and objectives for SV4-MW. The minimum threshold seems too low, particularly if levels can be allowed to fall below the minimum threshold for up to two years or during a drought period. Drought periods are the time when baseflow contributions to the streams are the most critical for maintaining minimum flows in streams and the River. During droughts there is almost no surface contribution from the areas of the watershed north of the Zayante fault and the contribution from the Santa Margarita basin is critically important. Perhaps some sort of minimum threshold during drought periods should be considered. If groundwater levels are low, there is a need to reduce groundwater extractions during drought periods, rather than just allowing groundwater levels to fall below minimum thresholds. I am also concerned about setting the measurable objective at levels observed in 2004 in SV4-MW. Figure 3-23 shows that the levels in 2004 were uncharacteristically low, even though it was preceded by "normal" rainfall years. For that location I might suggest a minimum threshold during drought periods of 381 ft, a minimum threshold during non-drought of 387 ft and a measurable objective of 397 ft.

p. 3-95: In discussing the effect on the mid-county basin, Carbonera Creek does not flow into the mid-county basin but Branciforte Cr. (Blackburn Gulch) does. Depletion of groundwater contribution to portions of Branciforte in the Santa Margarita Basin could have a significant affect on flow downstream in the mid-county basin.

Sections 4 and 5: It is encouraging to see potential projects under consideration and real possibilities to meet measurable objectives of the GSP; and to see the budget and implementation program going forward.

DRAFT

From: Philip McReynolds
To: Nick Wallace
Subject: Santa Margarita Aquifer
Date: Sunday, September 19, 2021 8:51:10 PM

Hi, I'm asking for the plan to be amended to cover sustainability of the Santa Margarita aquifer, specifically plans around recharge of this aquifer.

With Respect

Philip McReynolds
[redacted]
Scotts Valley, Ca. 95066

DRAFT

SMGWA Online Comment

Name: Becky Steinbruner

Address: Aptos, CA 95003

Comment:

4.5.1.3 Purified Wastewater Augmentation at Loch Lomond (page 4-36) There is no information included regarding how the State Required holding times for indirect potable re-use would be monitored and met. There is no information regarding the inherent potential health problems with unregulated contaminants, hormones, and radioactive constituents associated with chemotherapy drugs in the waste water train. "Advanced treatment would occur via an AWTF located at or near City of Santa Cruz WWTF employing full advanced treatment technology that meets regulatory requirements and industry best practices." It is unclear whether new a Advanced Treatment Facility would be associated with the Soquel Creek Water District's Modified PureWater Soquel Project. There is no space available at the Santa Cruz Wastewater Treatment Plant for an Advanced Water Treatment Facility, which is why Soquel Creek Water District is only constructing a tertiary treatment plant and an nBAF treatment plant there. The Advanced Treatment Facility is proposed to be in Live Oak. This should be made clear, as it would influence the route of the conveyance system, and place dependence on Soquel Creek Water District's facilities. Page 4-36: "Reservoir augmentation would take place about half of each year and be sized to produce 3.2 MGD of advanced treated water when the reservoir is being drawn down to meet demands." Why pump the recycled water into Loch Lomond instead of using it for irrigation in the summer months? This would greatly reduce the potential ill health effects of the treated wastewater, which likely would contain unregulated pharmaceuticals, hormones, CEC's and radiologic contaminants, as well as the DEET, Sucralose caffeine, ibuprofen and other compounds that cannot be fully eliminated in the treatment process. It would also reduce use of the potable water from Loch Lomond and maintain it as a relatively clean potable water source. Please include using recycled water only for irrigation, and model that scenario relative to reduced draw-down from Loch Lomond inherent as opposed to pumping the recycled water into Loch Lomond. Please include the public process for notification of all CEQA hearings relative to the addition of recycled water to Loch Lomond, a practice that is not currently allowed by the State. 4.5.4 Permitting and Regulatory Process (page 4-38) Please include requirement for a Final Anti-Degradation Analysis for Loch Lomond if the recycled water were to be added and mixed, to comply with Resolution 68-16. Please include a discussion regarding how the Agency would collaborate with California Dept. of Fish and Wildlife to develop meaningful and enforceable mitigation measures to protect the receptive sensors. 4.5.6 Expected Benefits "While basin groundwater levels have stabilized in the last few decades, supplemental sources of water from outside the Basin may be needed to increase Lompico aquifer groundwater levels and meet Basin sustainability objectives. After recharging enough purified wastewater to increase groundwater levels to measurable objectives, any additional water stored in the aquifer may be used to augment groundwater or surface water providing a drought resilient supply that will increase the cooperating agencies' water supply resiliency." Does this mean that the Agency plans to inject recycled water into the aquifer as well as into

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Loch Lomond? Where would the injection wells be located? What would the energy demand be, and how would there be redundancy built in to accommodate PSPS events in the summer fire season when water use is higher? Page 4-39 Expected Benefits "Compared to 540 AFY conjunctive use (Section 4.3.6, Table 4-1), the amount of groundwater discharge to creeks from 710 AFY purified wastewater recharge (Table 4-5) is very similar, but there is 75% more groundwater in storage because of direct injection into the Lompico aquifer." How would private well owners be impacted by the injection of potentially-contaminated recycled water if there are system malfunctions? How would the six-month holding times required by the State be met and monitored, as they affect nearby private well potable sources? 4.5.7 Legal Authority (page 4-42) "California state law gives water districts the authority to take actions necessary to supply sufficient water for present or future beneficial use. Land use jurisdictions have police powers to develop similar programs. The Sustainable Groundwater Management Act of 2014 grants SMGWA legal authority to pass regulations necessary to achieve sustainability. Water use efficiency projects make use of preserving existing sources already within each member agency's specific system to which each agency already has rights." Please include discussion of Anti-Degradation Analysis requirements to comply with State Water Board Resolution 68-16 to protect high quality waters from contamination / degradation. Please include discussion of necessary collaboration with California Dept. of Fish and Wildlife to develop meaningful and enforceable mitigations, especially for stream crossings and stream inflow contamination monitoring from injected effluent. 4.5.8 Estimated Costs and Funding Plan (page 4-43) "Projects included in this subsection require new infrastructure such as pipelines, interties, pump stations, injection wells, and new treatment facilities. Costs associated with the new infrastructure would be funded through a combination of increased operating revenue and outside funding sources." This would be a very expensive supplemental source, funded by raising rates, when there are less expensive options available. Table 4-7 on page 4-44 shows projected annually operating costs to be $2.6 million to $7.5 million. How can the area's low-income residents and struggling businesses ever hope to afford this water? Page 4-48: "Part of this study will be to review other reuse and system expansion opportunities for adjacent water agencies." Please identify those water agencies...is it the City of Santa Cruz, or Soquel Creek Water District? This matters because of the implications inherent with necessary infrastructure and conveyance systems.

I commend the Agency for keeping management costs to a minimum, with the proposed annual budget of $393,580 for the next five years. (page 5-2) This is in stark contrast to the bloated MidCounty Groundwater Agency annual budget of $810,975 and a $1.4 million cash reserve. Page 5-6:"The SMGWA has no current plans to regulate or to charge a fee on either de minimis or non-de minimis private users. The SMGWA may evaluate these options as funding mechanisms in the future, with any fees that may be proposed being commensurate to the benefit received by de minimis and non-de minimis private users. Private users shall be engaged in this process." I commend the Agency not assessing the non-diminimus and diminimus private pumpers, and to involve all such pumpers in any future actions to consider such. Would there be an engineer's report conducted to establish the benefit level of any possible future fees? Please discuss this, with any possible timeline associated.

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Appendix **3A**

Santa Margarita Basin Groundwater Model

Updates and Simulations for Groundwater Sustainability Planning

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MONTGOMERY
& ASSOCIATES
Water Resource Consultants

July 16, 2021

Santa Margarita Basin Groundwater Model Updates and Simulations for Groundwater Sustainability Planning

Prepared for:

SANTA MARGARITA
Groundwater Agency

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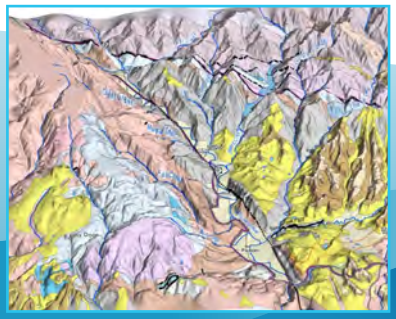

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Appendix A. Groundwater Level Target Calibration Hydrographs
Appendix B. Projected Groundwater Level Target Hydrographs for Predictive Scenarios

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ACRONYMS & ABBREVIATIONS

AFY.....acre-feet per year
amsl.....above mean sea level
bgs.....below ground surface
cfs.....cubic feet per second
DEM.....digital elevation model
DRN.....drain (MODFLOW6)
DWR.....Department of Water Resources
EKI.....EKI Environment & Water
ET.....evapotranspiration
ft/d.....feet per day
ft2/d.....square feet per day
GHB.....general head boundary (MODFLOW6)
GSP.....Groundwater Sustainability Plan
GWV.....Groundwater Vistas
HFB.....horizontal flow barrier (MODFLOW6)
IRWMP.....Integrated Regional Water Management Plan
KJ.....Kennedy/Jenks Consultants
M&A.....Montgomery & Associates
MHA.....Mount Hermon Association
MVR.....mover (MODFLOW6)
PET.....potential evapotranspiration
PRISM.....Parameter-elevation Regressions on Independent Slopes Model
RIV.....river (MODFLOW6)
RMP.....representative monitoring point
RPE.....reference point elevations
SLR.....San Lorenzo River
SFR.....streamflow routing (MODFLOW6)
SGMA.....Sustainable Groundwater Management Act
SMGB.....Santa Margarita Groundwater Basin
SLVWD.....San Lorenzo Valley Water District
SMGWA.....Santa Margarita Groundwater Agency
SVWD.....Scotts Valley Water District
UWMP.....Urban Water Management Plan
USGS.....U.S. Geological Survey
WY.....water year
WRI.....Water Resources Inc
WUF.....water use factors

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1 EXECUTIVE SUMMARY

1.1 Introduction

Santa Margarita Groundwater Agency (SMGWA) was formed under the Sustainable Groundwater Management Act (SGMA) and oversees development of a Groundwater Sustainability Plan (GSP). The Santa Margarita Groundwater Basin (SMGB or Basin) model is intended to support GSP development. ETIC originally developed the SMGB model in 2006, Kennedy/Jenks Consultants updated the model in 2015, and Hydrometrics Water Resources Inc (WRI) updated the model further in 2016 and 2017. Montgomery & Associates (M&A) has updated the model to be a suitable tool for quantifying water budgets and simulating future simulations based on different projects and management actions to support the GSP.

1.2 Results

The updates to the SMGB model include improvements to structure and inputs. Updates to the model such as temporal refinement to monthly stress periods and extension of the domain to cover SMGB provide the framework needed to run predictive future simulations based on projected climate change and pumping datasets. Future model inputs are developed based on different projects and management actions and are evaluated based on sustainability indicators.

Model calibration results indicate slight improvements from previous models for both groundwater and surface water. Groundwater level hydrographs of targets generally calibrate well to long-term trends and can be used to develop sustainable management criteria by accounting for the magnitude of calibration error as well as projecting the expected benefits of projects and management actions. Surface water flows generally calibrate well, but the model does not simulate some observed base flows. Model simulation of stream discharge and seepage can be improved with additional data from new streamflow gauging sites and accretion studies.

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2 INTRODUCTION

2.1 Purpose of Model Update and Improvements

The SMGB model is intended to be used to support GSP development through the following:

- Quantifying historical, current, and future water budgets
- Projecting sustainability indicators
- Evaluating effects from projects and management actions

Future monthly climate and pumping projections are used as inputs for the predictive model. The model had to be updated such that it can efficiently incorporate estimates of future conditions based on climate projections and potential projects and management actions. The model has also been expanded to cover the modified Santa Margarita Basin as required by SGMA (Figure 1). Model update needs for supporting GSP development was guided by EKI Environment & Water (EKI) model review (EKI, 2018) of the existing SMGB that was updated for the Scotts Valley Water District (SVWD) Annual Report in 2016. The following are EKI model review recommendations along with the corresponding sections in this report that address them:

1. Expand model to agree with SMGB boundaries (Section 5.2.1).
2. Preserve model cell dimensions or layering (Section 5.2).
3. Revise water transmitting parameters (Sections 5.2.4 and 6.2.2).
4. Refine recharge estimates (Sections 5.1.3 and 5.1.4).
5. Modify or remove ET package (Section 5.1.5).
6. Perform quality checks on data (Section 5).
7. Extend historic simulation by adding 2017-2018 data (Section 5.1.1).
8. Update calibration (Section 5.2.4).
9. Change from quarterly to monthly stress periods (Section 5.1.1).
10. Include downscaled climate change in projected hydrology (Section 7.1).

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2.2 Santa Margarita Basin Model History

The original version of the SMGB model was developed in 2006 by ETIC (ETIC, 2006) as part of the Prop 84 Planning Grant via Santa Cruz Integrated Regional Water Management Plan (IRWMP). The ETIC model was developed to provide a quantitative tool to assess regional groundwater conditions for the SMGB and was updated in 2015 by Kennedy/Jenks Consultants with updated geological interpretations (KJ model). Minor updates to extend the temporal data of the KJ model was carried out by HydroMetrics WRI in 2016-2017. In 2018, the SMGWA-commissioned EKI to evaluate the KJ model on its ability to support GSP development. EKI's report provided recommended updates to the model hydrogeologic framework, recharge, evapotranspiration (ET), and model calibration as shown in Section 2.1. This report documents the most recent model updates and improvements to the KJ model as part of developing the SMGB GSP.

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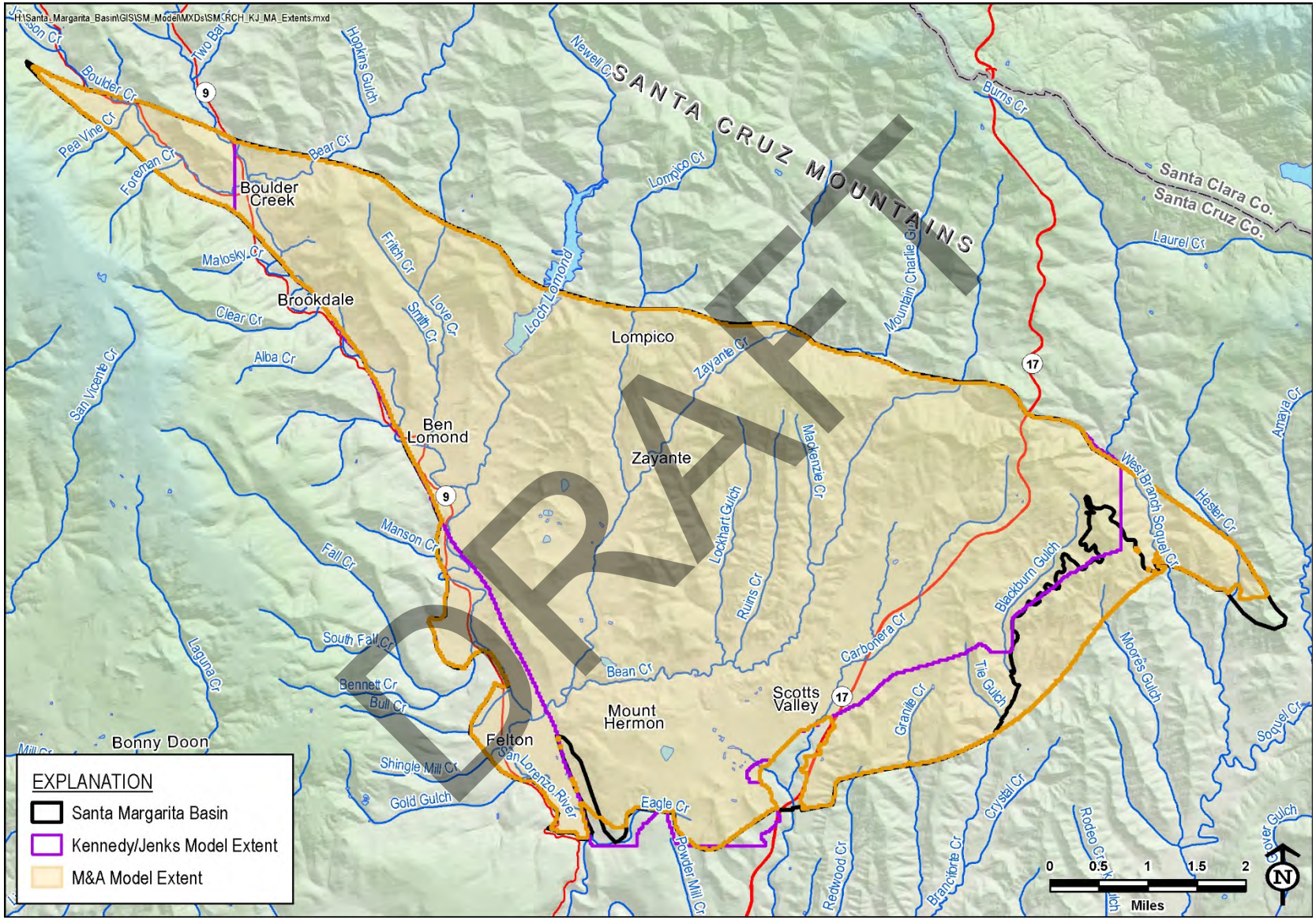

Figure 1. Santa Margarita Basin Compared to Kennedy/Jenks Model Extent and M&A Model Extent

3 CONCEPTUAL MODEL UPDATES

General conceptual model details can be found in the KJ model report (Kennedy/Jenks, 2015) and Section 2 of the GSP. Additional conceptual model updates include:

- Extension of existing spatial domain to include substantial extent of SMGB representing hydrogeologic boundaries described in basin boundary modification report (HydroMetrics WRI, 2016) and inclusion of Felton area alluvium
- Conversion of general head boundaries to no-flow boundaries along the model boundary at Santa Cruz Mid-County Basin to represent hydrogeologic boundary based on granitic high described in basin boundary modification report (HydroMetrics WRI, 2016)
- Removal of ET prior to recharge and runoff calculations from precipitation
- Removal of the simulation of ET by MODFLOW as recommended by EKI

Section 5.1 and 5.2 of this report elaborate further on how conceptual model updates are implemented.

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4 NUMERICAL MODEL AND CODE

The SMGB model was updated from MODFLOW-NWT to MODFLOW6 (Langevin and others, 2017). MODFLOW6 is the most recent core MODFLOW code developed by the United States Geological Survey (USGS). MODFLOW6 allows for the following improvements to model implementation:

- Multiple input files of the same model flow package to organize input development and output processing
- Pass-through cells to efficiently simulate geological pinch-outs
- Routing of flow from one model flow package to another via Mover (MVR) package

MODFLOW6 is the most frequently updated and supported version by the USGS and allows flexibility for future model updates.

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5 MODEL UPDATES AND IMPROVEMENTS

Model updates primarily involve changes to model inputs and model structure. Model inputs include period extension and refinement, pumping data, recharge and runoff, and ET. Structural updates include domain expansion, pinch-outs, stream network, and vertical hydraulic conductivity. This section addresses EKI recommendation 6 to perform quality checks on data as referenced in Section 2.1 in this report.

5.1 Model Input Updates

5.1.1 Model Period Extension

Model period was extended through Water Year (WY) 2018 and was discretized into monthly stress periods for a total of 409 stress periods to capture effects of seasonality and to match climate projection datasets. These changes address EKI recommendations 7 and 9 for extending the historical simulation and to change from quarterly to monthly stress periods as referenced in Section 2.1 of this report.

5.1.2 Pumping Volumes

5.1.2.1 Public Water Supply Agencies

San Lorenzo Valley Water District (SLVWD), SVWD, and Mount Hermon Association (MHA) meter extraction from their wells. Data were provided by the agencies as monthly volumes.

5.1.2.2 Small Water Systems

Since 2015, small water systems are required to report their monthly groundwater extraction to the County of Santa Cruz. These data are used in the model where available. Where data are not available, the same monthly volumes used in the KJ model were applied.

5.1.2.3 Private Residential

The location of private residential pumping was determined from County parcel data assigned as residential that has a building structure built on it, and that falls outside of the water service areas of SLVWD, SVWD, and MHA. The County's well permit data for domestic wells were compared with those selected parcels to ensure the locations of known wells aligned with those areas identified by the parcel selection method.

The volume of private residential pumping is based on annual water use factors (WUF) developed based on small water system metered use per connection. The annual WUF is distributed to each month by the seasonal distribution of SVWD's residential potable water

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demand. The range in WUF per home is from 0.46 acre-feet per year (AFY) in WY1985 to 0.23 AFY in WY2015 at the end of the recent drought.

An additional factor for changing population is applied to the data normalized to 2018 County of Santa Cruz unincorporated population sourced from the California Department of Finance (2019) population estimates. The range in the factor is from 0.89 in WY1985 at the start of the model to 1 in WY2018 at the end of the model.

Total private residential pumping over the model period averages 309 AFY. The KJ model cited an average of 282 AFY pumped by private wells from 1976 – 2012. This estimate only includes wells in the central and southern portion of the Basin and did not include wells to the north, or in the expanded portions of the modified Basin boundary.

5.1.2.4 Other Pumping

Other uses of pumped groundwater include sand quarries dust suppression and sand washing, environmental remediation, industrial, pond-filling, and landscape irrigation. Of these uses, only extraction for environmental remediation was metered. Pump and treat remediation were deactivated at the Scotts Valley Dry Cleaners in August 2015 and at the Watkins-Johnson Superfund site in July 2016. Groundwater pumping by these remediation systems was reported to the United States Environmental Protection Agency. Discharge reports were accessed through the State Water Resources Control Board GeoTracker database and used to update the volumes included in the KJ model and for the extended period.

Estimates for groundwater pumped for sand quarries, pond-filling, and landscape irrigation included in the KJ model were duplicated for the extended model period. Additional information regarding water use and pumping can be found in GSP Section 2.

5.1.3 Recharge and Runoff

The KJ model (2015) used isohyetal rainfall zones from Johnson (2009) to distribute quarterly precipitation totals from SVWD and SLVWD rain gauges to calculate recharge and runoff. The M&A model uses monthly spatial mean precipitation data from Parameter-elevation Regressions on Independent Slopes Model (PRISM) Climate Group (PRISM, 2004).

The KJ model used reference ET (ET_o) based on data for Santa Cruz County from Snyder et al 1992 and CIMIS (1998, 2005). The M&A model uses ET_o through 2000 provided by the Hydrologic Model developed by Balance Hydrologics (City of Santa Cruz, 2021). PRISM mean temperature data is used to extend the ET_o data through 2018 with the Blaney-Criddle (1962) method using adjusted factors from the Santa Cruz Water Balance Model. PRISM allows for calculation of recharge and runoff using ET_o consistent with climate change data sets. The KJ

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model used ET_o as a model input scaled by a crop factor to simulate ET over riparian areas while the M&A model uses ET_o as a part of recharge and runoff calculations.

The KJ model partitioned precipitation to recharge and runoff in the KJ model (2015) based on coefficients determined by land use and geology; remaining water after calculation of recharge and runoff was assumed to be lost without consideration of reference ET. Precipitation distribution has been updated to be affected by reference ET and therefore temperature with Equation (1) for each watershed:

$$P_{eff} = P - ET_o = R + RO \tag{1}$$

P_{eff} = effective precipitation

P = precipitation

ET_o = reference evapotranspiration calculated from temperature using Blaney-Criddle (1962)

R = recharge

RO = runoff

P_{eff} is then distributed to recharge-runoff zones within each watershed in the basin. Watershed averages for precipitation and temperature for ET_o in each recharge-runoff zone is calculated directly from PRISM datasets. KJ model (2015) had 125 zones delineated by rainfall isohyetals, land use, and geology. The number of zones is updated with watershed boundaries that encompass the basin boundary for the M&A model. Watershed boundaries are refined by land use and geology for a total of 420 zones.

The max precipitation filter used by KJ model (2015) is still applied to P_{eff} as 50% of P_{eff} in excess of 6.67 inches (20 inches per quarter) added to 6.67 inches as shown in Equation (2):

$$P_{eff_{filtered}} = \begin{cases} P_{eff}, & P_{eff} \leq 6.67 \\ 6.67 + \dfrac{(P_{eff} - 6.67)}{2}, & P_{eff} > 6.67 \end{cases} \tag{2}$$

A portion of $P_{eff_filtered}$ is distributed as runoff to the streams based on an area-weighted average of runoff coefficients within each watershed.

The second portion of P_{eff} applies the KJ model (2015) 3-quarter recharge lag of 60% from the current quarter, 30% from previous quarter, and 10% of the 2nd preceding quarter. Recharge lag for the M&A model is converted to monthly terms of 20% of each month in the current quarter,

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10% of each month in the previous quarter, and 3.33% of each month in the 2nd preceding quarter as shown in Equation (3):

$$P_{eff_{filtered_{lag}}} = 0.2 * \sum_{i=0}^{2} P_{eff_{filtered}}(month - i) + 0.1 * \sum_{j=3}^{5} P_{eff_{filtered}}(month - j) + 0.033 * \sum_{k=6}^{8} P_{eff_{filtered}}(month - k) \quad (3)$$

$P_{eff_filtered_lag}$ is distributed as recharge in each zone in the watershed weighted by zone area, recharge coefficients, and percent of watershed that is inside the basin boundary; recharge outside the basin boundary is assumed to not contribute inside the basin. Recharge and runoff coefficients from the KJ model (2015) were retained. Figure 2 shows the average annual recharge for each geology within the basin.

Recharge updates described this section addresses EKI recommendation 4 as referenced in Section 2.1 in this report. Incorporating reference ET facilitates simulation of the effects of warmer temperatures projected to occur with climate change.

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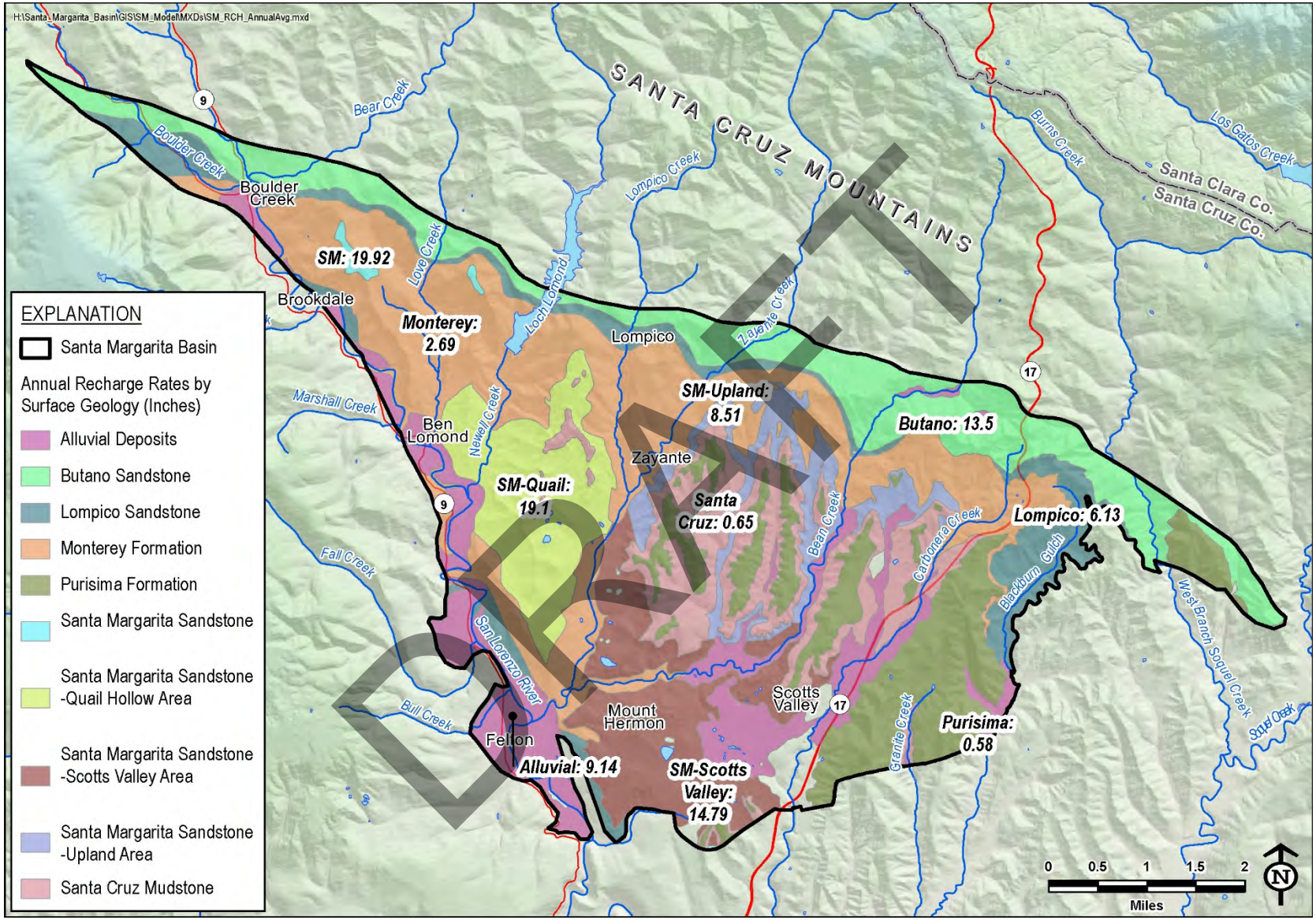

Figure 2. Average Annual Recharge by Surface Geology

5.1.4 Return Flow Recharge

Private well owner return flows comprise return flows generated from septic systems and outdoor irrigation. Figure 3 shows the assumptions made to determine the amount of return flow that recharges groundwater in the model.

Steady-state recharge from return flows in the Scotts Valley area are increased to account for septic system return flows occurring prior to sewering the City of Scotts Valley in the mid-1980s. Residential parcels are assumed to have septic systems and associated septic return flows for the steady-state period using the same assumptions as for private well owners shown in Figure 3.

Updated septic return flows for the M&A model (1,115 AFY average) is higher than in the KJ model (658 AFY average) due to the higher percentage of residential use that becomes return flow as well as the larger overall model area. Return flow averages over the model period are summarized in Table 1.

Table 1. Average Return Flow Recharge Over Model Period

Return Flow Component	Average Over Model Period, Acre-Feet per Year (Water Year 1985 – 2018)
Septic	1,115
Private Residential Landscape Irrigation	4
Landscape Irrigation in SLVWD, SVWD and MHA	26
Landscape Irrigation in Small Water Systems	13
Water System Losses	216
Sewer Losses	30

Return flow recharge updates described in this section addresses EKI recommendation 4 referenced in Section 2.1 in this report.

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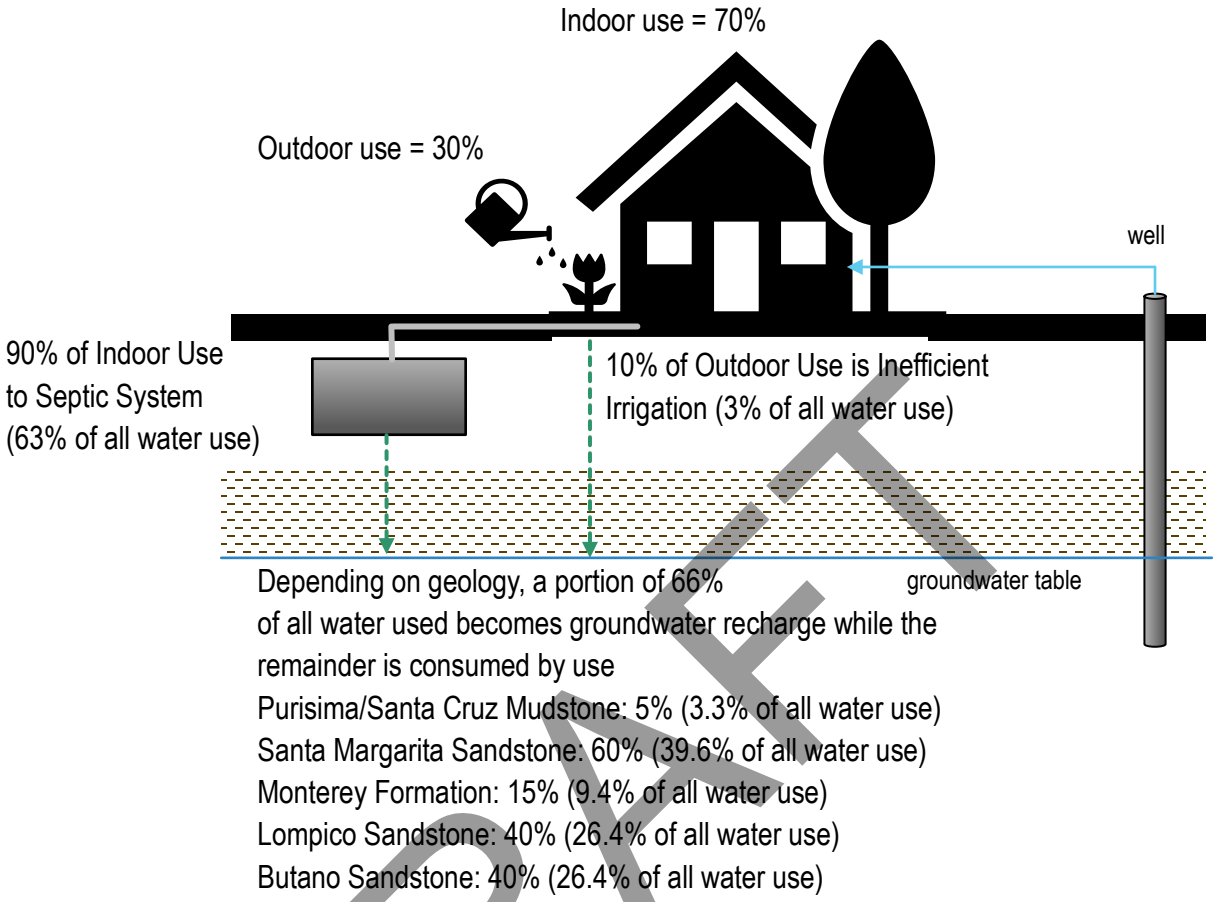

Figure 3. Private Well Owner Return Flow Assumptions

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5.1.5 Evapotranspiration

The simulation of ET by MODFLOW is removed in the M&A model because it is factored in the recharge-runoff calculations. Removal of simulated ET addresses EKI recommendation 5 to remove or modify ET package as referenced in Section 2.1 in this report, Purpose of Model Update and Improvements.

The existing model layer structure and cell dimensions are both preserved in the M&A model which addresses EKI recommendation 2 as referenced in Section 2.1 in this report.

5.2 Model Structural Improvements

5.2.1 Model Domain Extension

The model domain is extended to include the Bulletin 118 Department of Water Resources (DWR) basin boundary for the SMGB (DWR, 2018) using a 3D geologic model prepared in Leapfrog Geo (Seequent, 2020). Leapfrog is used to define how lithologic contact surfaces between the hydrogeologic units are defined as numerical model layers in the extended areas. The areas where the numerical model is extended are shown in Figure 4 and described as:

- Northwest extension in the Boulder Creek area where the Zayante and Ben-Lomond faults described in the basin boundary modification report (HydroMetrics WRI, 2016) converge
- Southwest extension to include alluvium associated in the Felton area, west of Ben Lomond Fault, included with the SMGB as part of the basin boundary modification approval by DWR
- South extension to a granitic bedrock high defining part of the shared boundary with the Santa Cruz Mid-County Basin boundary, as described in the basin boundary modification request to DWR (HydroMetrics WRI, 2016)
- East extension: south of the Zayante fault to include the West Branch of Soquel Creek that intersects the Butano aquifer of the Santa Margarita Basin

This addresses EKI recommendation 1 to expand model domain to agree with SMGB boundaries as referenced in Section 2.1 in this report.

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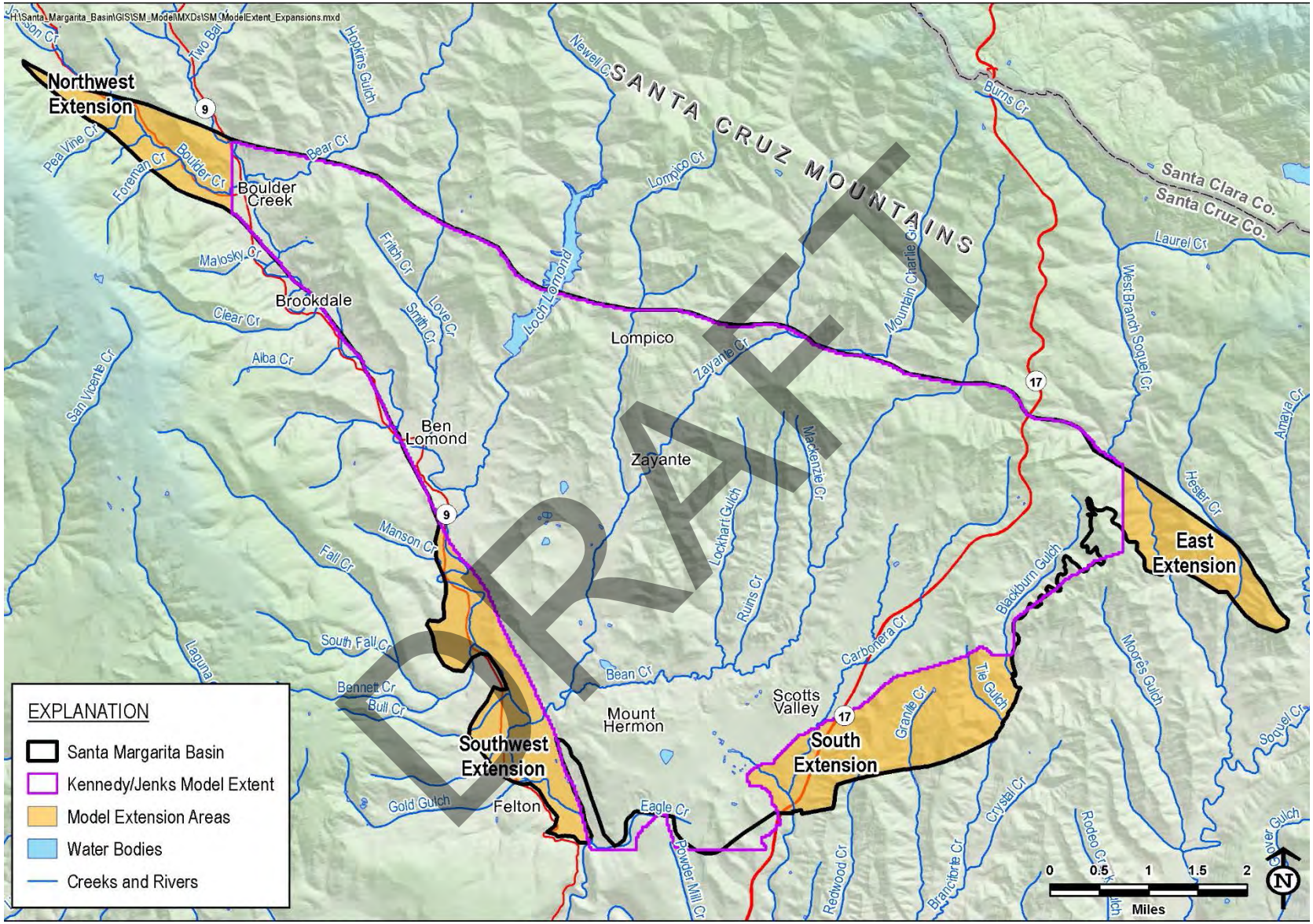

Figure 4. Model Domain Extension Areas

The M&A model extended areas are defined using hydrogeologic cross sections from the SLVWD Water Supply Master Plan (Johnson, 2009), KJ model report (2015), surface geology, selected well lithologic logs, and granitic bedrock derived from a residual gravity elevation map (Roberts et al., 2004). Land surface elevations are extended using a Lidar-generated digital elevation model (DEM) (USGS, 2012a and 2012b).

A summary of hydrogeologic units represented by the model layers in the extension areas follows along with the specific data sources used to define model layer elevations:

- **Northwest extension**: The geologic unit contact surfaces are extended using SLVWD Section C-C', and DEM.
- **Southwest extension**: The Felton area alluvium west of Ben Lomond Fault in the Felton area is a distinct geologic unit deposited on top of the Lompico aquifer Sandstone (Figure 5). Alluvium thicknesses estimated from lithologic logs near Felton vary from about 160 feet near Bean Creek, to about 100-125 feet near San Lorenzo River, and it pinches out to the west where the Lompico aquifer sandstone outcrops. Model layer elevations are based on Johnson (2009) cross sections A-A' and D-D', the extended DEM, surface geology maps, and lithologic logs from eight wells located west of Ben Lomond Fault. Alluvium is incorporated as part of layer 1 in the model and has its own set of hydraulic properties because it is not a part of the Santa Margarita aquifer.
- **South extension**: The geologic unit contact surfaces are extended using lithologic logs of wells in the extension area, granite bedrock elevation contour map, and DEM.
- **East extension**: The geologic unit contact surfaces are extended using granitic bedrock contours derived from a residual gravity elevation map (Roberts et al., 2004), and Johnson (2009) section A-A'.

With only 2 exceptions, the updated model layers within the existing KJ model domain are consistent with the KJ model. The resulting lithologic contacts match the existing bottom elevations of the KJ model layers. One exception occurs for model Layer 7 near the Santa Cruz Mid-County Basin boundary, where the bottom elevations of KJ model Layer 7 (Lower Butano aquifer-granitic bedrock contact) is merged with data from granitic bedrock contours derived from a residual gravity elevation map (Roberts et al., 2004) that covers the south and southeast edges of the model. A second exception occurs where bottom of Layer 7 matches this bedrock contour map that extends above the bottom layers of the KJ model near Mount Hermon. General head boundaries that used to run along the Mid-County Basin boundary were also switched to no-flow boundaries based on historically stable water levels in the area and the conceptualization of the granitic high representing a flow divide between the 2 basins.

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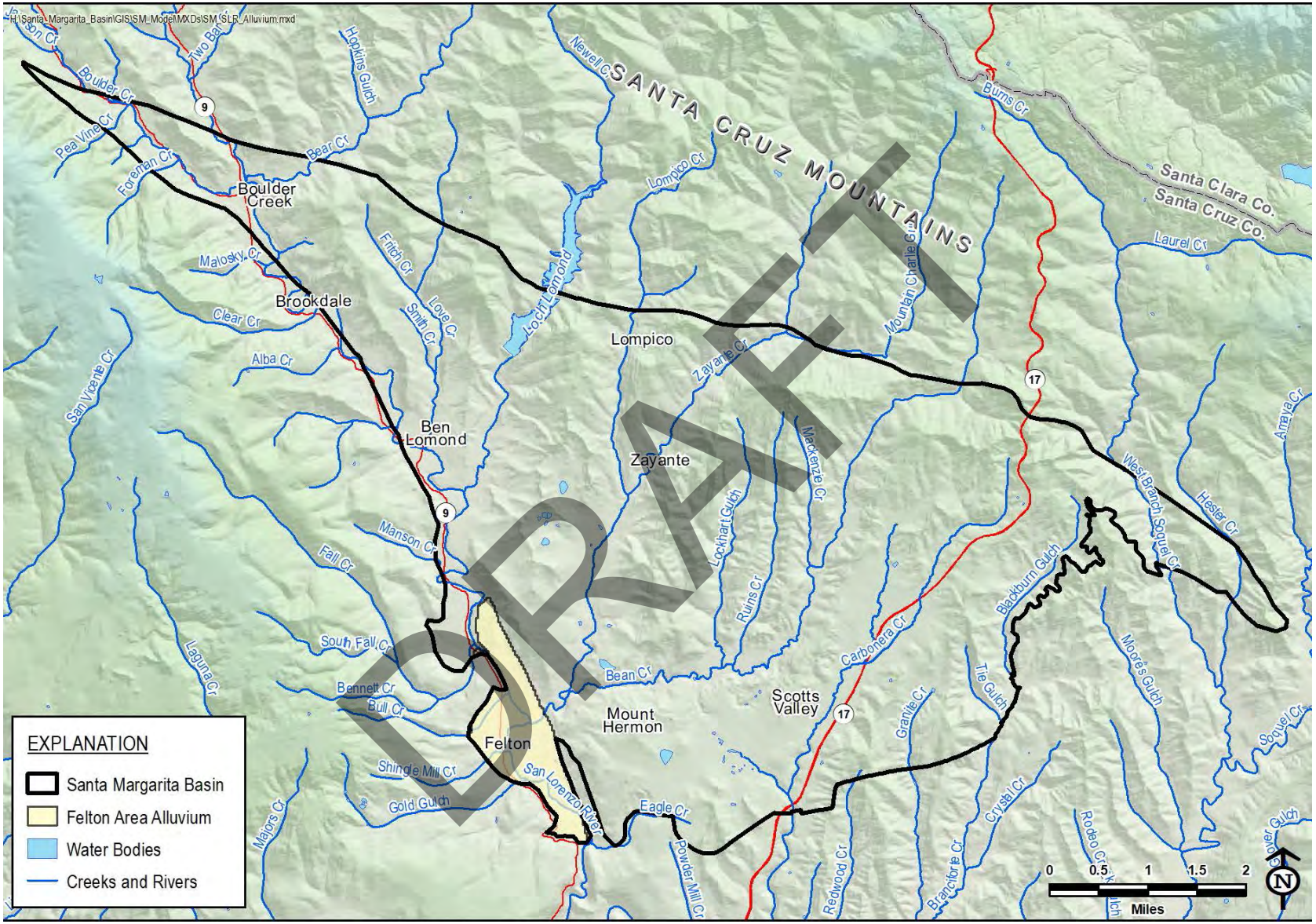

Figure 5. Felton Area Alluvium

5.2.2 Model Pinch-Out Implementation

Pinch-outs were previously implemented using the horizontal flow barrier (HFB) package. MODFLOW6 introduces the ability to assign pass-through cells which routes flow between the over- and underlying cells of the pass-through cell (Figure 6). The HFB package has been removed and pass-through cells are assigned to the same areas of pinch-outs in each layer as the KJ model. Figure 7 and Figure 8 summarize pinch-out area delineations for Monterey Formation and Butano aquifer. Pass-through cells allow for quicker model performance as no extra cells are simulated to account for pinch-outs.

5.2.3 Stream Network Updates

The stream network properties of the Streamflow Routing (SFR) package are preserved within the KJ model domain. Additional stream segments are added to model extension areas. The San Lorenzo River (SLR) was represented in the KJ model using the River (RIV) package but is now added to the SFR package in the M&A model due to availability of calibration data for seepage and streamflow. The RIV package for Loch Lomond Reservoir is preserved due to limited calibration data. General Head Boundary (GHB) cells are no longer used along SMGB basin boundaries. GHB cells that represent springs and seeps are preserved to simulate flow into Butano aquifer. Springs and seeps represented by the Drain (DRN) package in the existing model are retained. Figure 9 shows the updated stream network.

New segments are assigned bottom elevations at the first and last reach via LiDAR. New segment stages are set 2 feet above bottom elevation. Conductance values are calibrated, but initial values for stream width, length, and streambed thickness are set to 10, 100, and 1 ft, respectively. Roughness coefficients are maintained at 0.035 for all segments. Initial stream conductivities from previous model are maintained and range from 0.005 to 15 ft/day. Stream conductivity for new segments is initialized to 5 ft/day.

MODFLOW6 includes the MVR package which allows the routing of water between different water flow packages. The updated DRN package is linked to the SFR with the MVR package to route flows from springs and seeps to the stream network. MVR package is set up to route DRN flows with monthly factors representing percentage of flow to be routed that vary based on location and water year type. Monthly factors applied to model cells representing springs and seeps listed in Table 2 are shown in relation to the stream network on Figure 10.

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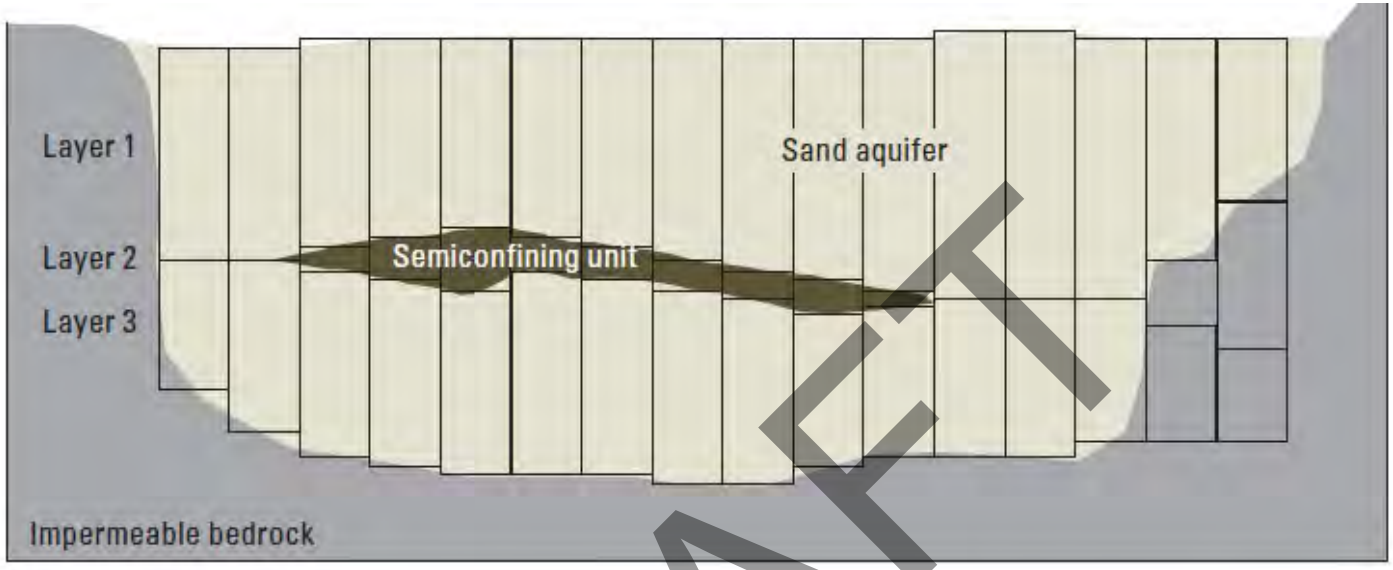

Layer 1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Layer 2	–1	–1	1	1	1	1	1	1	1	1	1	–1	–1	–1	0	0
Layer 3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0

EXPLANATION

IDOMAIN codes

>0 Included cell
=0 Excluded cell
<0 Excluded pass-through cell

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Source: Figure 3-3 in Documentation for the MODFLOW6 Groundwater Flow Model (Langevin et al., 2017)

Figure 6. Pass-through Cell Representation in MODFLOW6

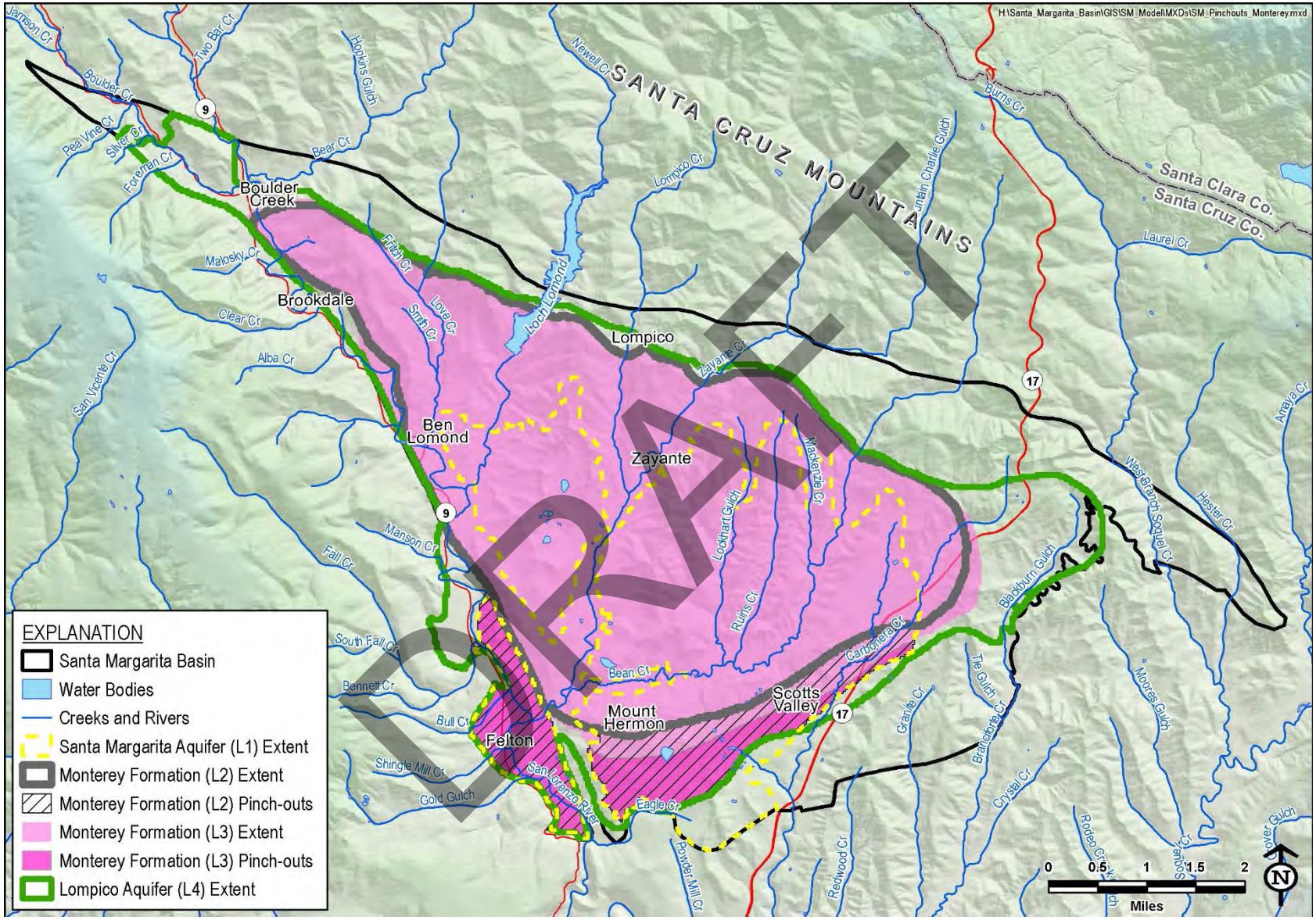

Figure 7. Pinch-out Area Delineation for Monterey Formation

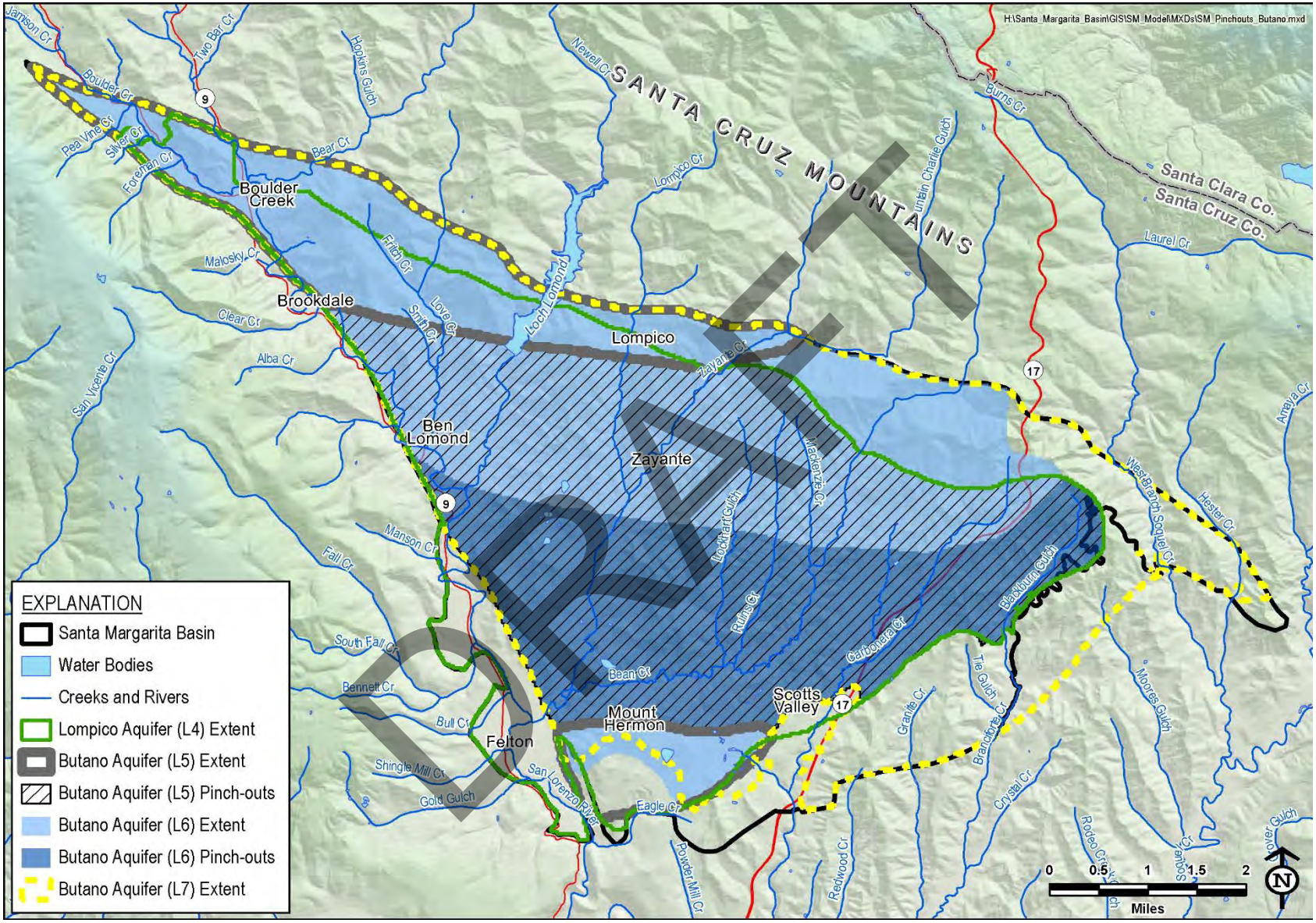

Figure 8. Pinch-out Area Delineation for Butano Aquifer

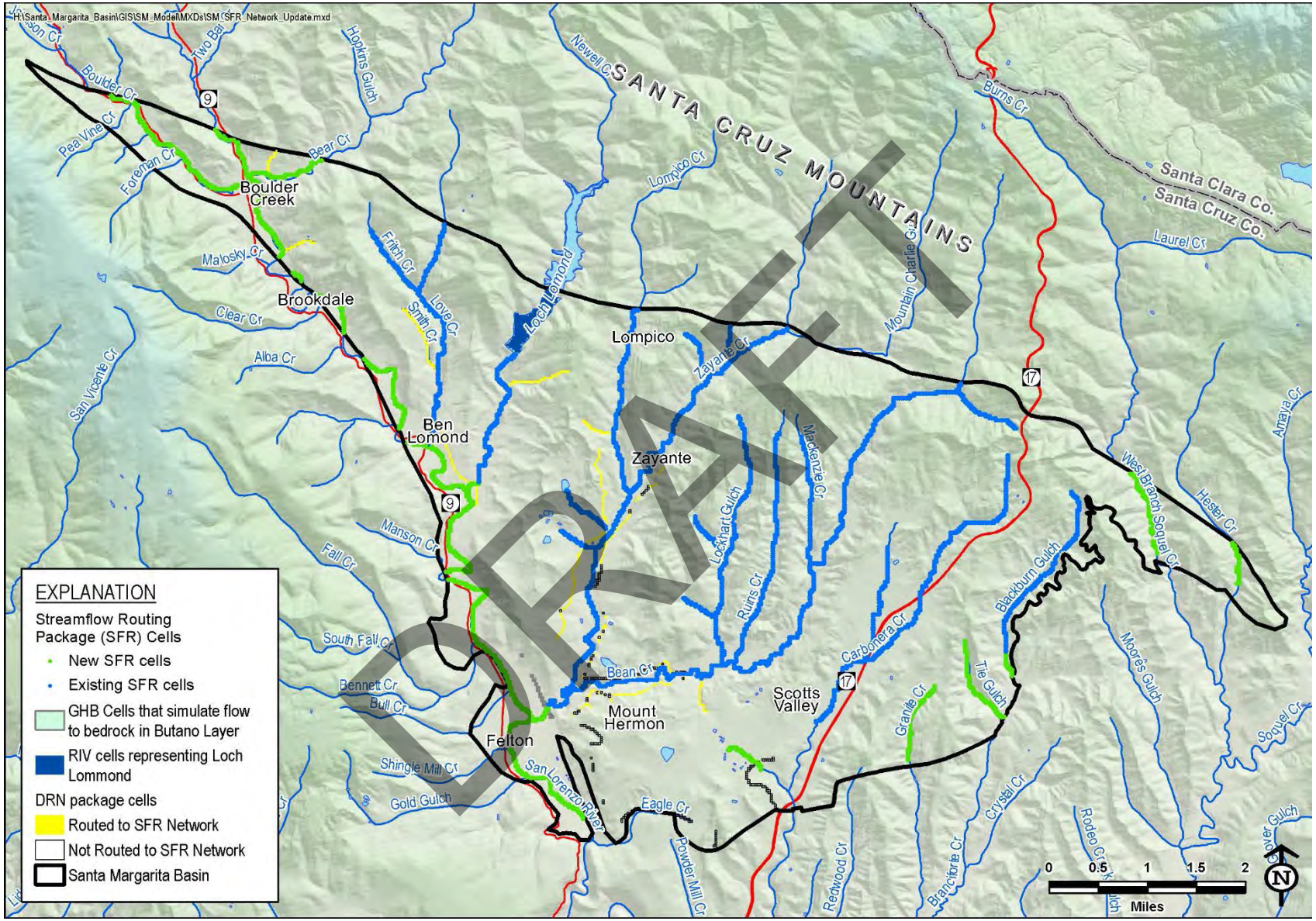

Figure 9. Updated Stream Network

Table 2. DRN Cell Factors

Cluster	Water Year Type	May	Jun	Jul	Aug	Sep	Oct	Nov - Apr
Spring Creek Gulch	Wet	0.80	0.80	0.75	0.75	0.75	0.75	1.00
	Normal	0.75	0.75	0.75	0.70	0.70	0.70	1.00
	Dry	0.75	0.70	0.65	0.55	0.40	0.40	1.00
	Critically Dry	0.65	0.60	0.50	0.40	0.30	0.30	1.00
Quail Hollow \ (San Lorenzo River side)	Wet	0.90	0.85	0.75	0.70	0.65	0.65	1.00
	Normal	0.85	0.85	0.75	0.70	0.60	0.60	1.00
	Dry	0.80	0.75	0.70	0.60	0.50	0.50	1.00
	Critically Dry	0.70	0.65	0.55	0.45	0.40	0.40	1.00
Quail Hollow (Zayante Creek side)	Wet	0.90	0.80	0.70	0.60	0.50	0.50	1.00
	Normal	0.85	0.75	0.60	0.50	0.35	0.35	1.00
	Dry	0.75	0.65	0.55	0.40	0.30	0.30	1.00
	Critically Dry	0.65	0.55	0.45	0.30	0.20	0.20	1.00
Canham-Glenwood	Wet	0.95	0.90	0.75	0.65	0.65	0.65	1.00
	Normal	0.90	0.80	0.65	0.60	0.55	0.55	1.00
	Dry	0.80	0.65	0.60	0.45	0.35	0.35	1.00
	Critically Dry	0.65	0.60	0.55	0.35	0.20	0.20	1.00
Mid-Zayante Creek	Wet	0.95	0.90	0.85	0.80	0.80	0.80	1.00
	Normal	0.95	0.90	0.85	0.80	0.80	0.80	1.00
	Dry	0.90	0.85	0.80	0.80	0.75	0.75	1.00
	Critically Dry	0.75	0.75	0.65	0.65	0.65	0.65	1.00
Mt Hermon-Bean Creek	Wet	0.95	0.90	0.85	0.85	0.75	0.75	1.00
	Normal	0.95	0.90	0.85	0.80	0.75	0.75	1.00
	Dry	0.90	0.90	0.85	0.80	0.75	0.75	1.00
	Critically Dry	0.85	0.85	0.80	0.80	0.75	0.75	1.00
Manana-Shadow Oaks	Wet	0.95	0.90	0.85	0.85	0.75	0.75	1.00
	Normal	0.95	0.90	0.85	0.80	0.75	0.75	1.00
	Dry	0.90	0.90	0.85	0.80	0.75	0.75	1.00
	Critically Dry	0.85	0.85	0.80	0.80	0.75	0.75	1.00
Skypark	Wet	0.85	0.80	0.75	0.70	0.70	0.70	1.00
	Normal	0.75	0.75	0.70	0.65	0.65	0.65	1.00
	Dry	0.75	0.70	0.70	0.65	0.65	0.65	1.00
	Critically Dry	0.70	0.60	0.60	0.55	0.55	0.55	1.00

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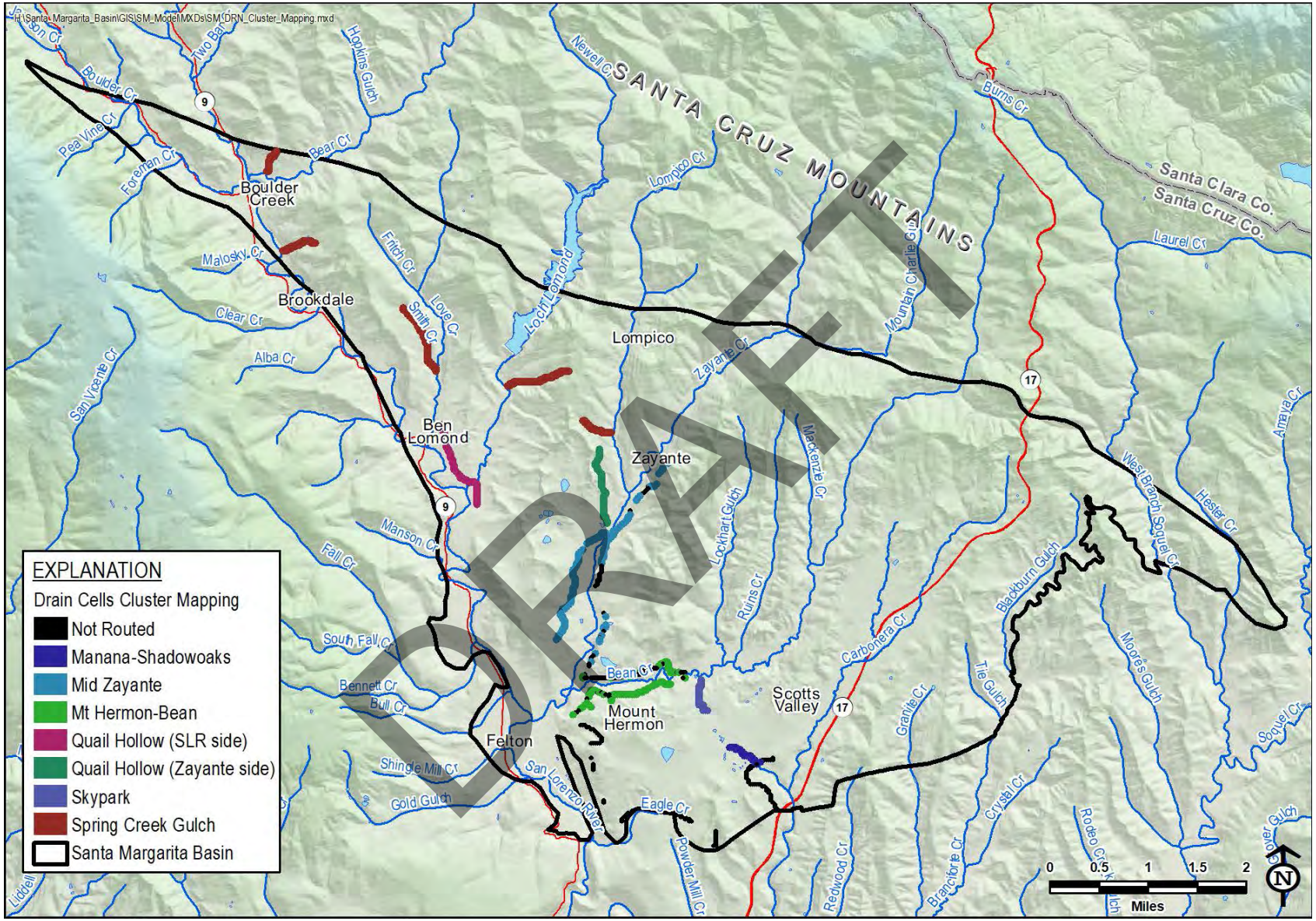

Figure 10. Drain Cluster Locations

5.2.4 Hydraulic Conductivity Updates

The KJ model implemented vertical hydraulic conductivity as part of the leakance property in Groundwater Vistas (GWV) with slightly different property zones than horizontal hydraulic conductivity. The updated SMGB model implements vertical hydraulic conductivity using anisotropy so a relationship between horizontal and vertical conductivity can be maintained over the same zones. This allowed for more efficient calibration during parameter estimation.

Hydraulic property zone values from the KJ model (2015) calibration were preserved as initial values. Hydraulic properties for the extended areas (Figure 4) are as follows:

- **Northwest extension**: Lompico aquifer and Butano aquifer hydraulic property zones are extended from the existing domain.
- **Southwest extension**: Lompico aquifer hydraulic property zones are extended from the existing domain and an additional hydraulic conductivity zone is added to represent the alluvium (Figure 5) since it is a layer that separates creeks with Lompico aquifer and it is not part of the Santa Margarita aquifer.
- **South extension**: Butano aquifer hydraulic properties are extended from existing domain.
- **East extension**: Butano aquifer hydraulic properties are extended from the existing domain.

The hydraulic property updates described address EKI recommendation 3 to revise water transmitting parameters as referenced in Section 2.1 in this report.

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6 MODEL CALIBRATION

Model calibration is split into surface water and groundwater calibration. Additional datasets for model calibration include monthly groundwater levels, daily streamflow measurements, and accretion studies. PEST++ (2020) software suite was used along with manual trial and error to perform parameter estimation using calibration data. Methods and results described in this section address EKI recommendations 3 and 8 to revise water transmitting parameters and to update calibration as referenced in Section 2.1 in this report.

The level of calibration is appropriate for use of the model in estimating water budgets in the GSP and evaluating expected sustainability benefits of projects and management actions. Further refinement may be needed to support more detailed planning of projects and management actions. The calibration presented here is potentially non-unique; other combinations of parameter values may equivalently match calibration data. We also recommend evaluating predictive uncertainty when using the model for more detailed planning of projects and management actions.

6.1 Calibration Methods

6.1.1 Surface Water Calibration

Stream conductance is the primary parameter that is estimated for surface water calibration. Daily streamflow data throughout the model period from WY1985 through WY2018 was collected from the following locations:

- SLVWD: Boulder Creek and Lompico Creek
- Santa Cruz County: Bean Creek near Mount Hermon Camp and Zayante Creek at Woodwardia
- USGS: Bean Creek near Mount Hermon Road, Zayante Creek, Carbonera Creek, and San Lorenzo River at Big Trees

Streamflow data is aggregated into average monthly streamflow in cubic feet per second (cfs) and used as calibration targets for simulated outflows for a total of 978 streamflow targets.

Stream seepage gains and losses are processed from accretion studies by Balance Hydrologics for Bean Creek in June 2010 and San Lorenzo River in September 2017. A total of 17 seepage calibration targets are compared to the simulated stream groundwater discharge. The stream network is discretized into 26 conductance zones that are estimated in PEST using the described streamflow and seepage data. Figure 11 shows the stream gauge locations, accretion study points, and conductance zones used for surface water calibration.

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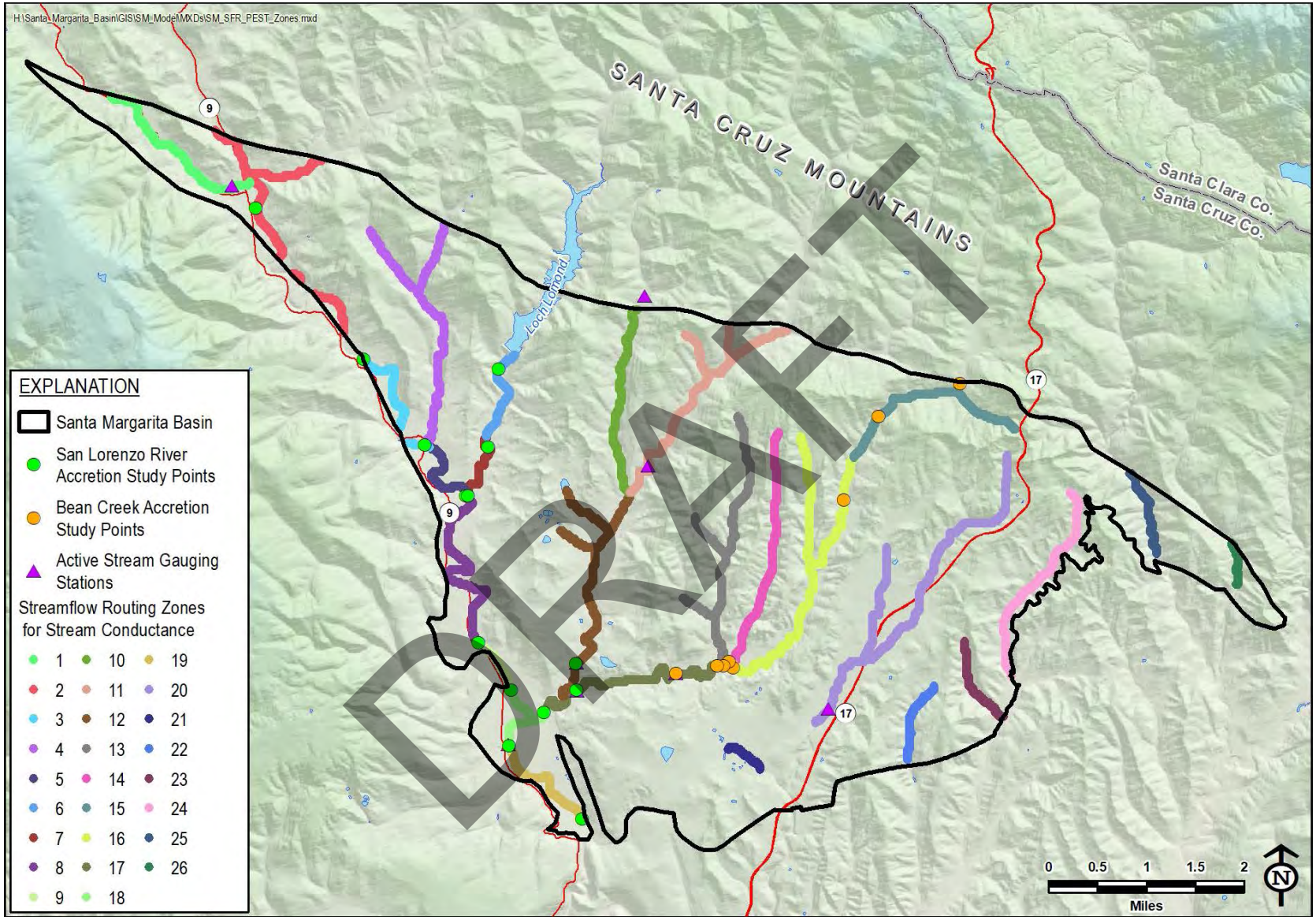

Figure 11. Streamflow Routing Network in Updated Model including Parameter Zones and Locations of Stream Gauges Used for Calibration

6.1.2 Groundwater Calibration

Groundwater level data for the whole model period from WY1985 through WY2018 is sourced from the database provided by SVWD and has been processed as average monthly groundwater levels for a total of 59 target wells with 5621 targets. Target wells are selected based on spatial distribution, and consistency and period of record of groundwater level measurement. Groundwater elevation targets are used to calibrate horizontal (Kx) and vertical hydraulic conductivity (Kz) and specific yield (Sy) and specific storage (Ss). There are 69 zones each for Kx and Kz and 23 zones for both Sy and Ss across all 7 layers of the model. PEST++ adjusted all parameters zones to achieve best fit to all groundwater level targets with calibration also informed by manual trial and error runs.

6.2 Calibration Results

6.2.1 Surface Water Calibration Results

Table 3 lists the final parameter values for stream conductance for each zone shown in Figure 11.

Table 3. Calibrated Streamflow Conductance

Stream Conductance Zone	Stream Conductance (ft^2/day)	Stream Conductance Zone	Stream Conductance (ft^2/day)
1	11.70	14	0.01
2	3.34	15	0.04
3	2.24	16	7.70
4	0.27	17	0.01
5	1.33	18	1.21
6	0.73	19	3.65
7	1.99	20	0.07
8	6.85	21	3.52
9	14.98	22	0.16
10	0.25	23	0.13
11	0.47	24	42.33
12	8.46	25	2.20
13	0.01	26	2.18

Streamflow calibration shows a good fit for Zayante Creek at Woodwardia (Figure 15), Bean Creek at Mount Hermon Camp (Figure 17), Carbonera Creek (Figure 18), and San Lorenzo River at Big Trees (Figure 19). Lompico Creek (Figure 13) indicates that the model simulates

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streamflow above 0.4 cfs. Base flows is underestimated for Boulder Creek (Figure 12) and is overestimated within 1 cfs for Zayante Creek (Figure 14) and Bean Creek near Mt Hermon Rd. (Figure 16).

Model calibration for streamflow is sufficient because baseflows trends are simulated within 1 cfs on all gauges except for Boulder Creek (Figure 12). The model can be used to estimate surface water components of the water budget and provide the best available estimate of streamflow depletion from pumping. Additional streamflow data from new gauges in areas of interest would help improve model calibration.

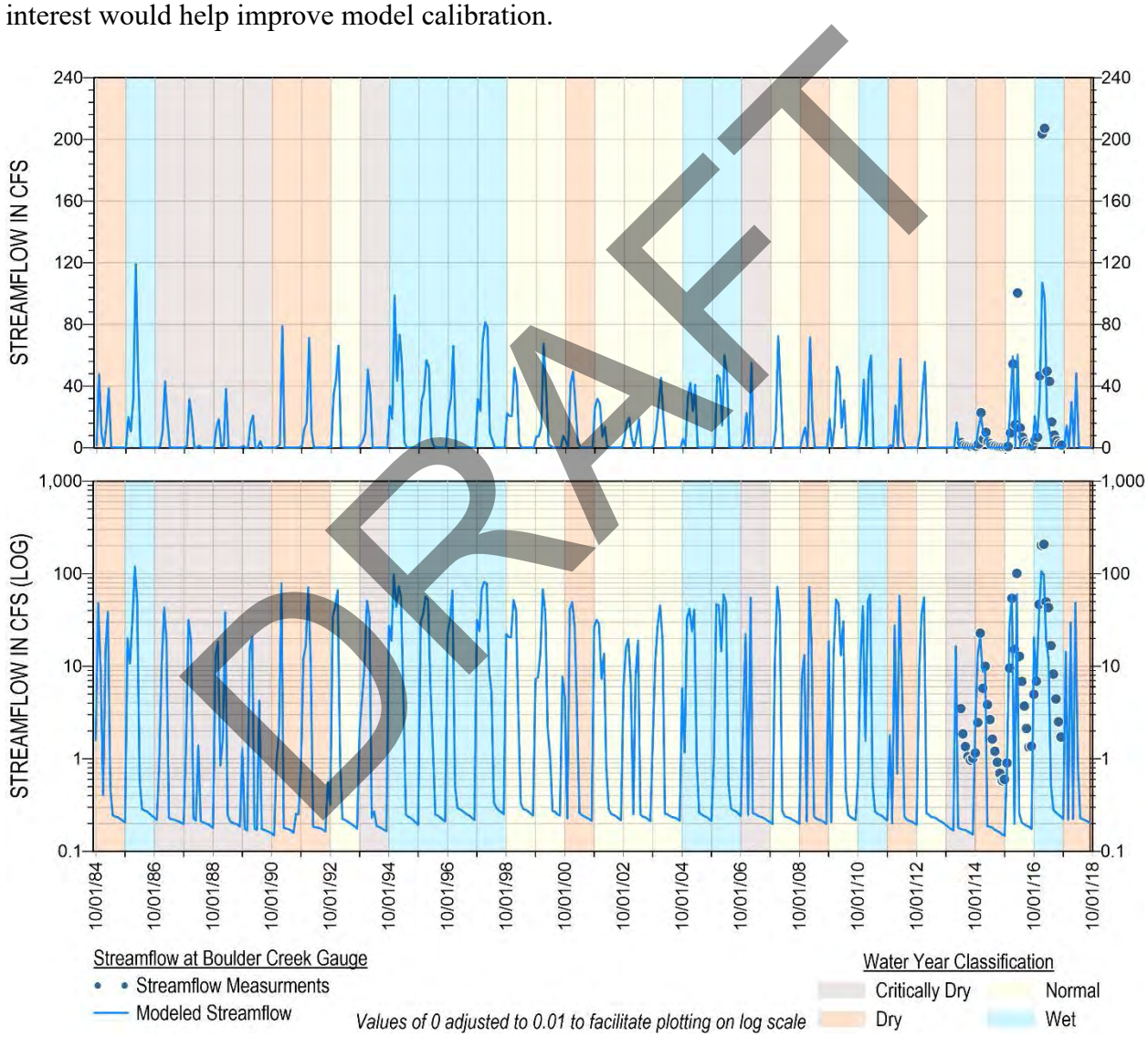

Figure 12. Boulder Creek Gauge Streamflow Hydrograph

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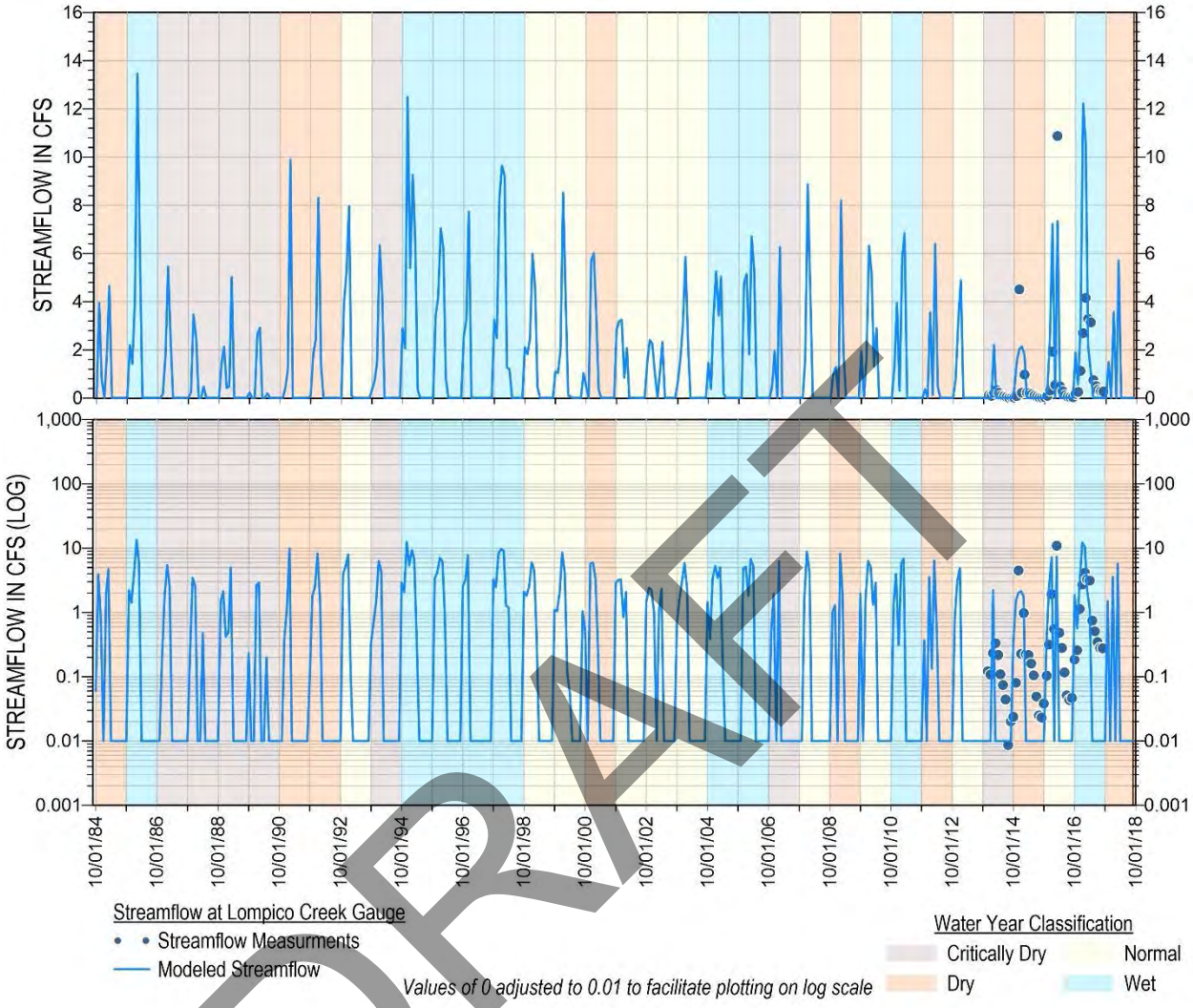

Figure 13. Lompico Creek Gauge Streamflow Hydrograph

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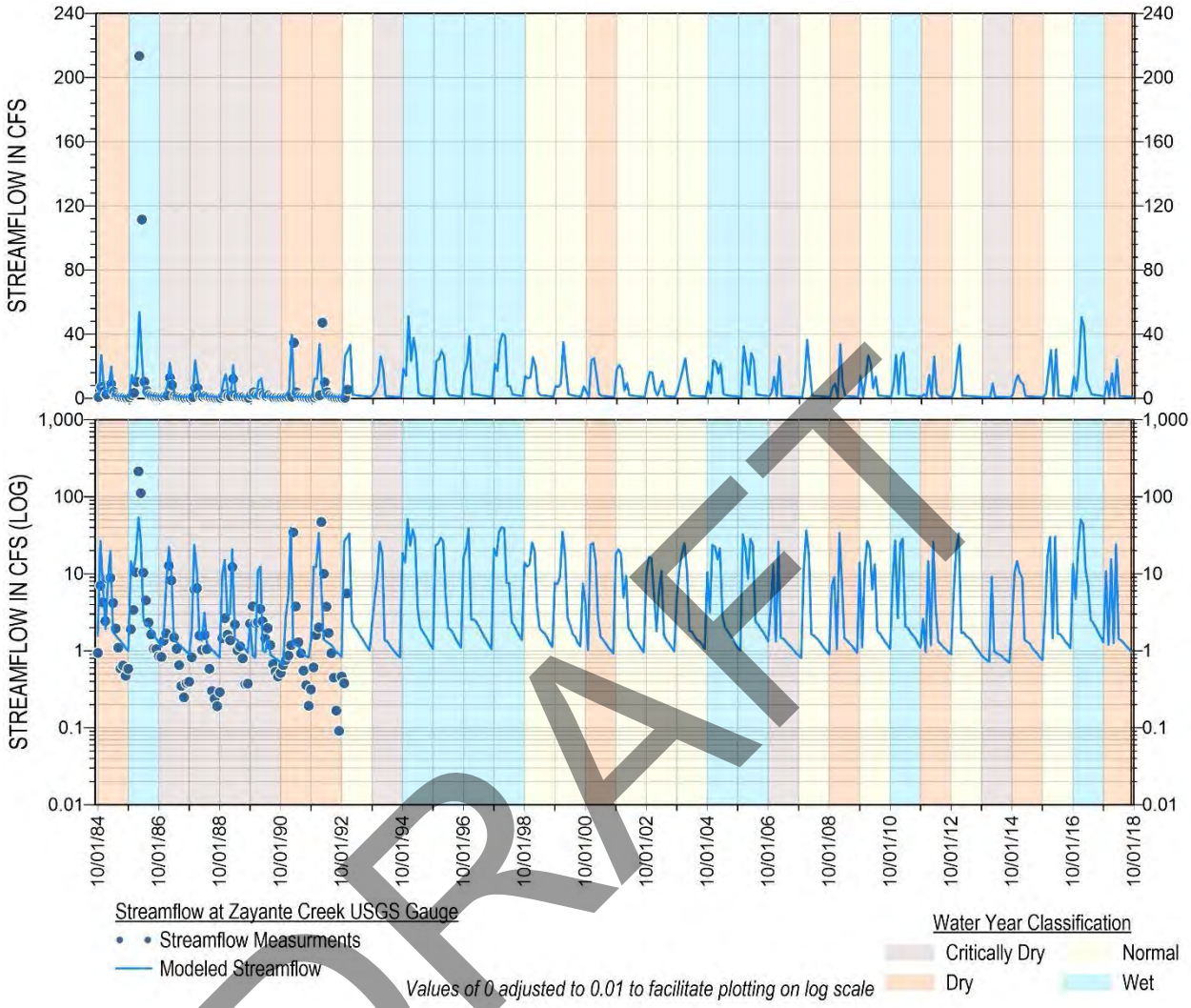

Figure 14. Zayante Creek USGS Gauge Streamflow Hydrograph

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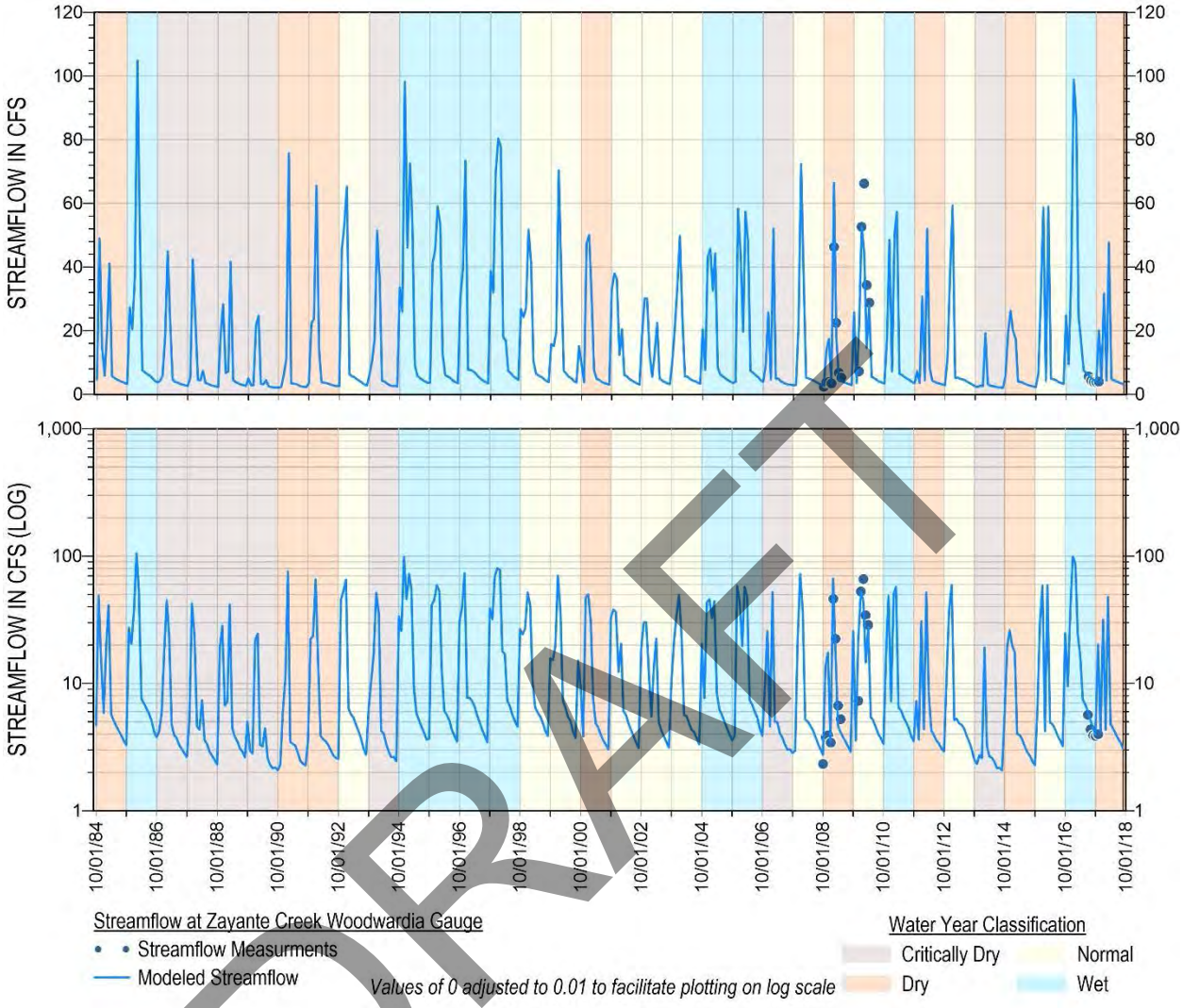

Figure 15. Zayante Creek Woodwardia Gauge Streamflow Hydrograph

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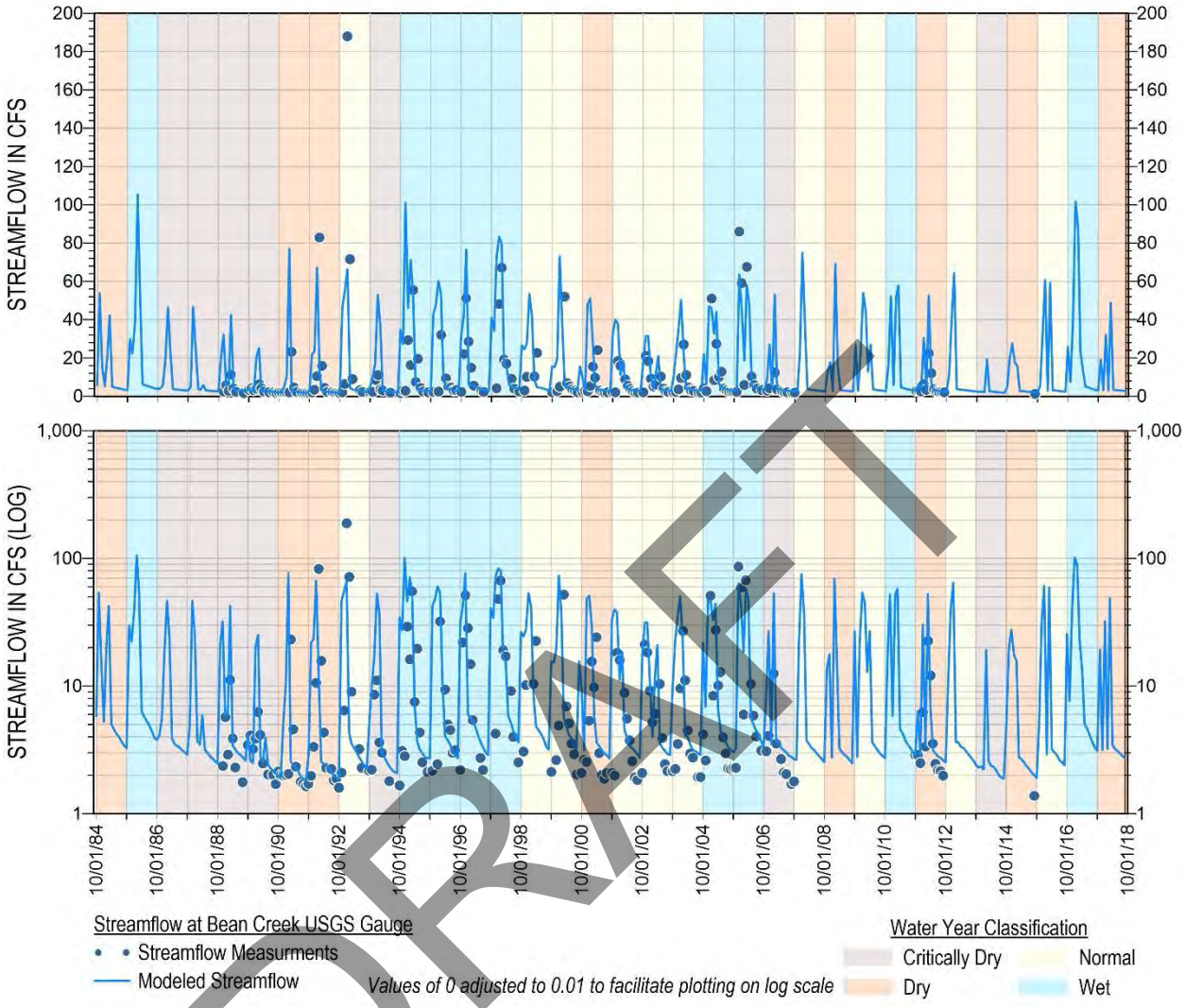

Figure 16. Bean Creek Near Mount Hermon Road Gauge Streamflow Hydrograph

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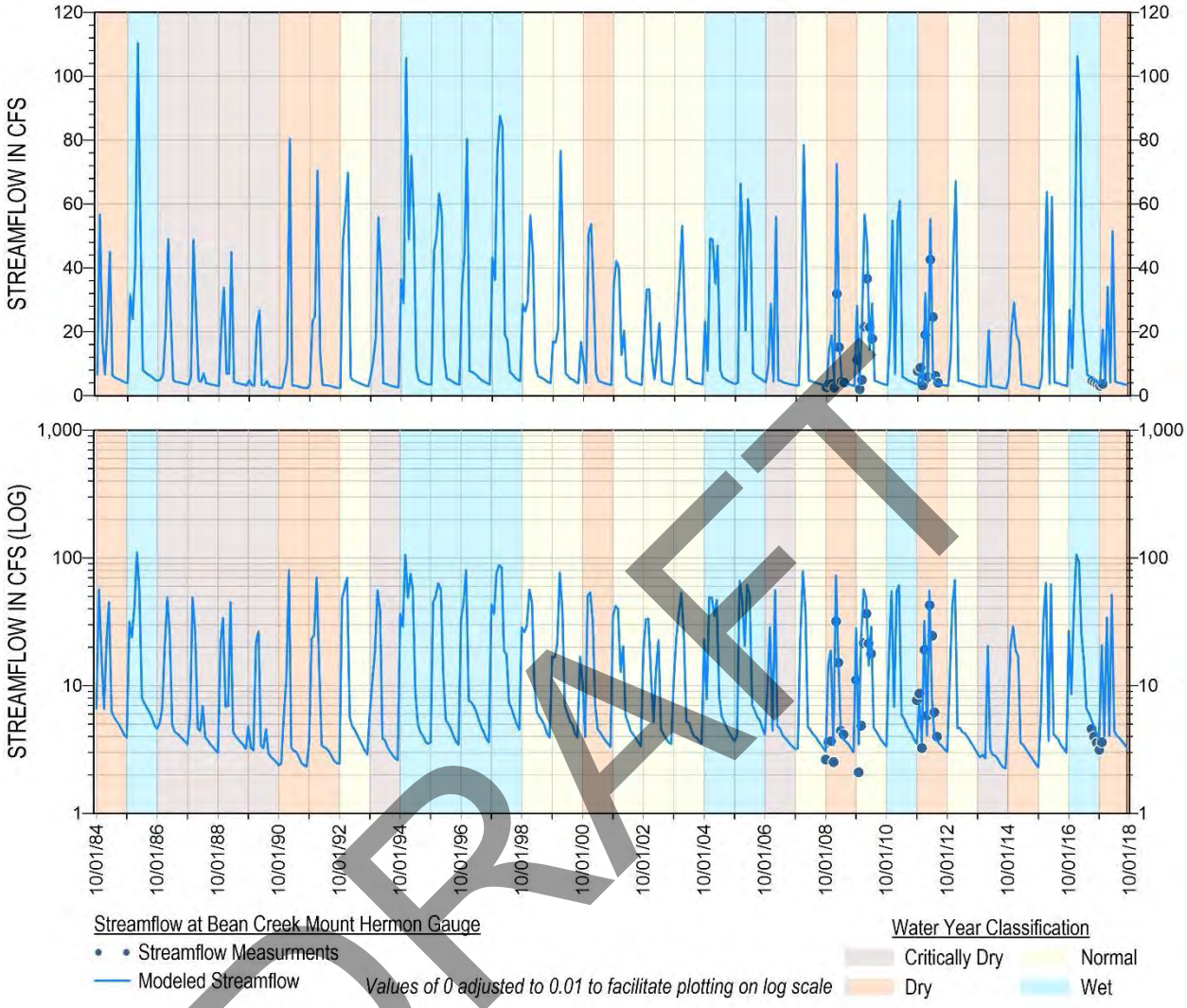

Figure 17. Bean Creek At Mount Hermon Camp Gauge Streamflow Hydrograph

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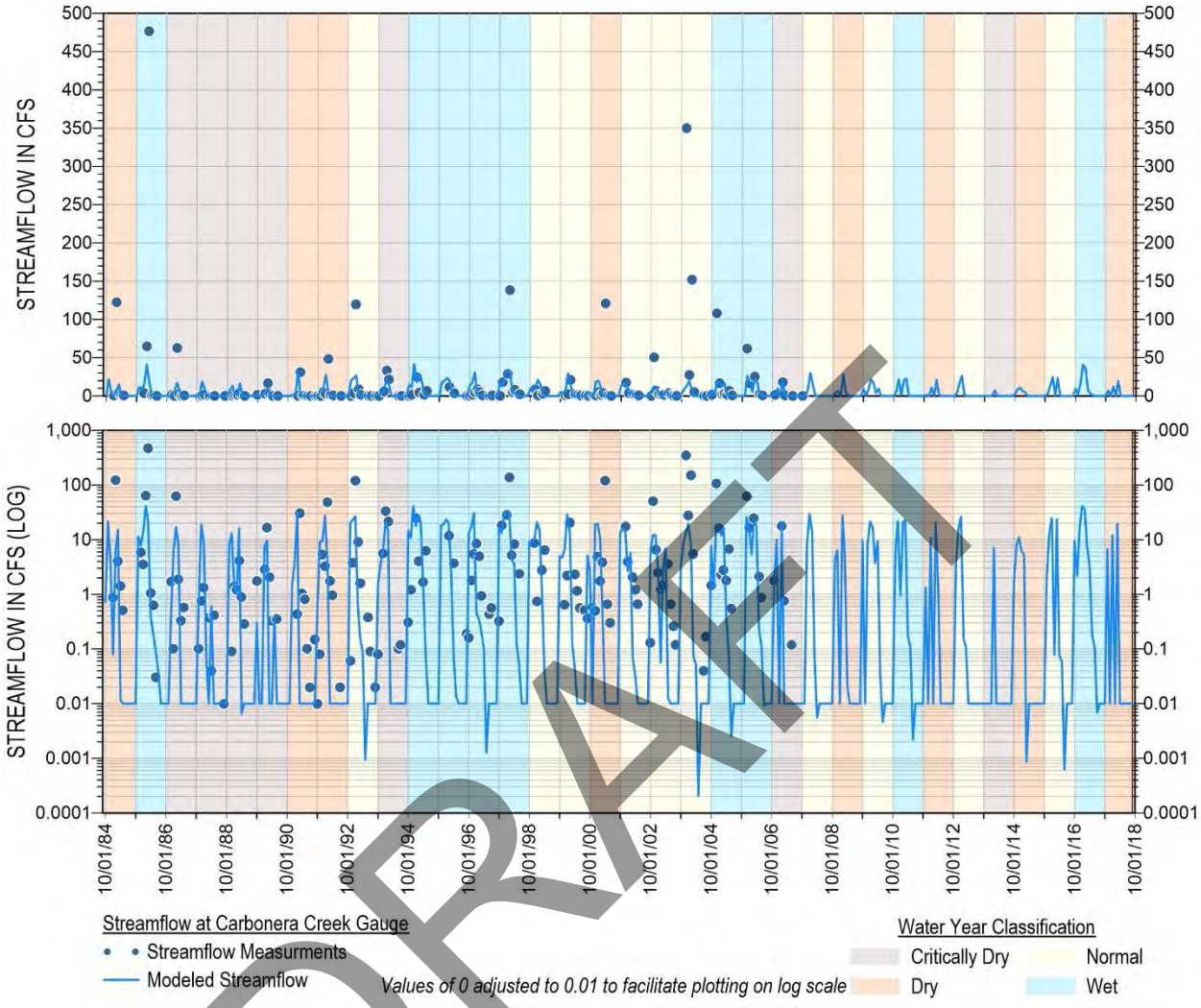

Figure 18. Carbonera Creek Gauge Streamflow Hydrographs

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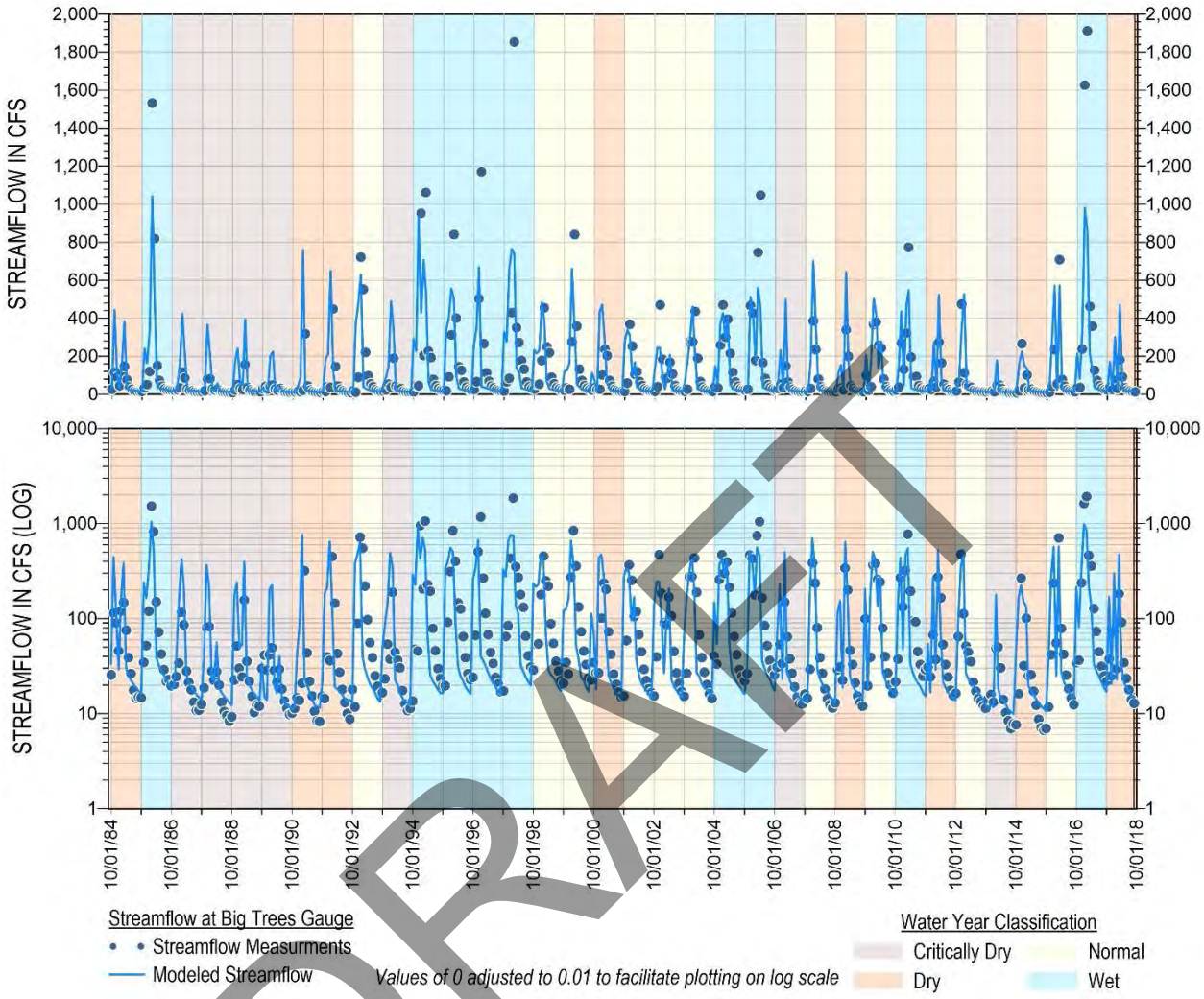

Figure 19. San Lorenzo River Big Trees Gauge Streamflow Hydrograph

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Measured seepage is intended to be used for qualifying streams as gaining or losing. Simulated seepage is output on a cell-by-cell basis while measured seepage represents total seepage between 2 accretion points. Simulated seepage at each stream cell is extrapolated by multiplying cell-by-cell results by the number of stream cells between the 2 accretion points that bound the stream cells. This allows for a more similar comparison of magnitudes between measured and simulated as well as more granular identification of where the model simulates as gaining and losing.

Figure 20 compares measured to extrapolated seepage for SLR for September 2017. Stream gains are accurately simulated in Newell Creek and underestimated in Zayante Creek. San Lorenzo River gains are accurately simulated except for the stretch after the confluence with Zayante Creek where loss was simulated instead. Simulated seepage at the Big Trees gauge is overestimated compared to the neutral flows indicated by measured data but flows near Big Trees are typically large (Figure 19) and the measured data might not be a representative average.

Measured seepage for Bean Creek for June 2010 (Figure 21) shows gaining segments at the first and last segments with the middle segments as losing. Simulated seepage for Bean Creek shows stretches of gaining and losing in the middle segments with higher magnitudes which indicate more variation along segments than indicated by measured data.

Additional accretion data is provided by Balance Hydrologics for September 2019 to represent more recent trends. Simulated seepage for September 2019 is extracted from the predictive baseline simulation described in Section 7.2 and shows similar results to simulated seepage in June 2010. Measured data indicates dominantly gaining streams throughout Bean Creek which generally matches simulated trends (Figure 22).

The model calibration is sufficient for the purposes of evaluating stream conditions as gaining or losing which is the intention of measured seepage. Simulated seepage generally matches the direction of measured seepage along stream reaches with seepage data and additional accretion studies would help improve overall calibration.

Stream conductance zones 21-26 are along stream reaches that are not connected to any streamflow or seepage calibration points and there are relatively few groundwater level data in the area. Therefore, stream-aquifer flows for the eastern part of the Basin are not well calibrated. Stream conductance zone 24 represents the Upper Blackburn Gulch area near the edge of the model and has the highest conductance to better simulate high groundwater levels in the Butano aquifer. Streamflow or seepage data would be needed to better evaluate whether the stream is a source of recharge or whether there is another explanation for high groundwater levels in the area.

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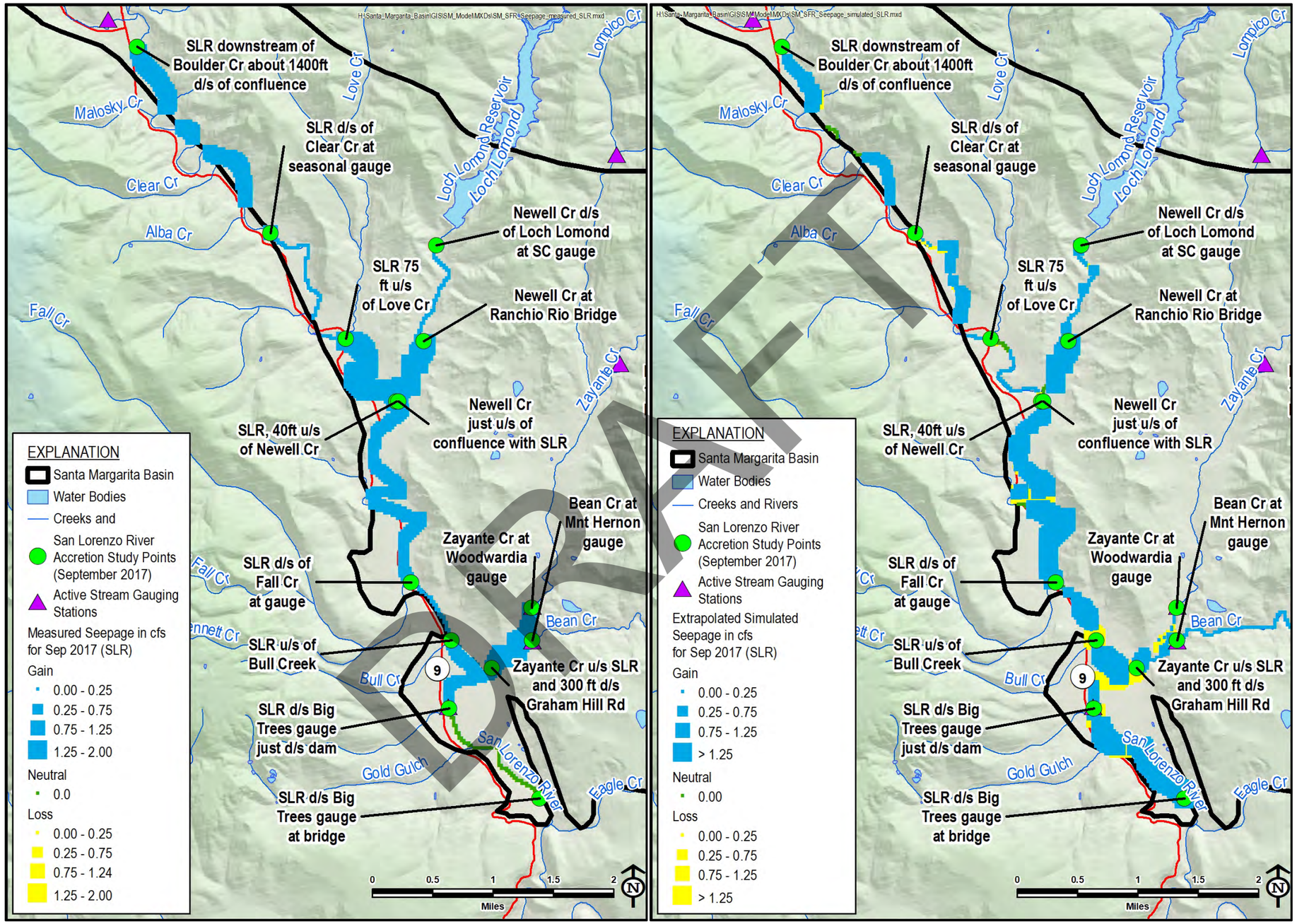

Figure 20. Measured and Extrapolated Simulated Seepage for San Lorenzo River

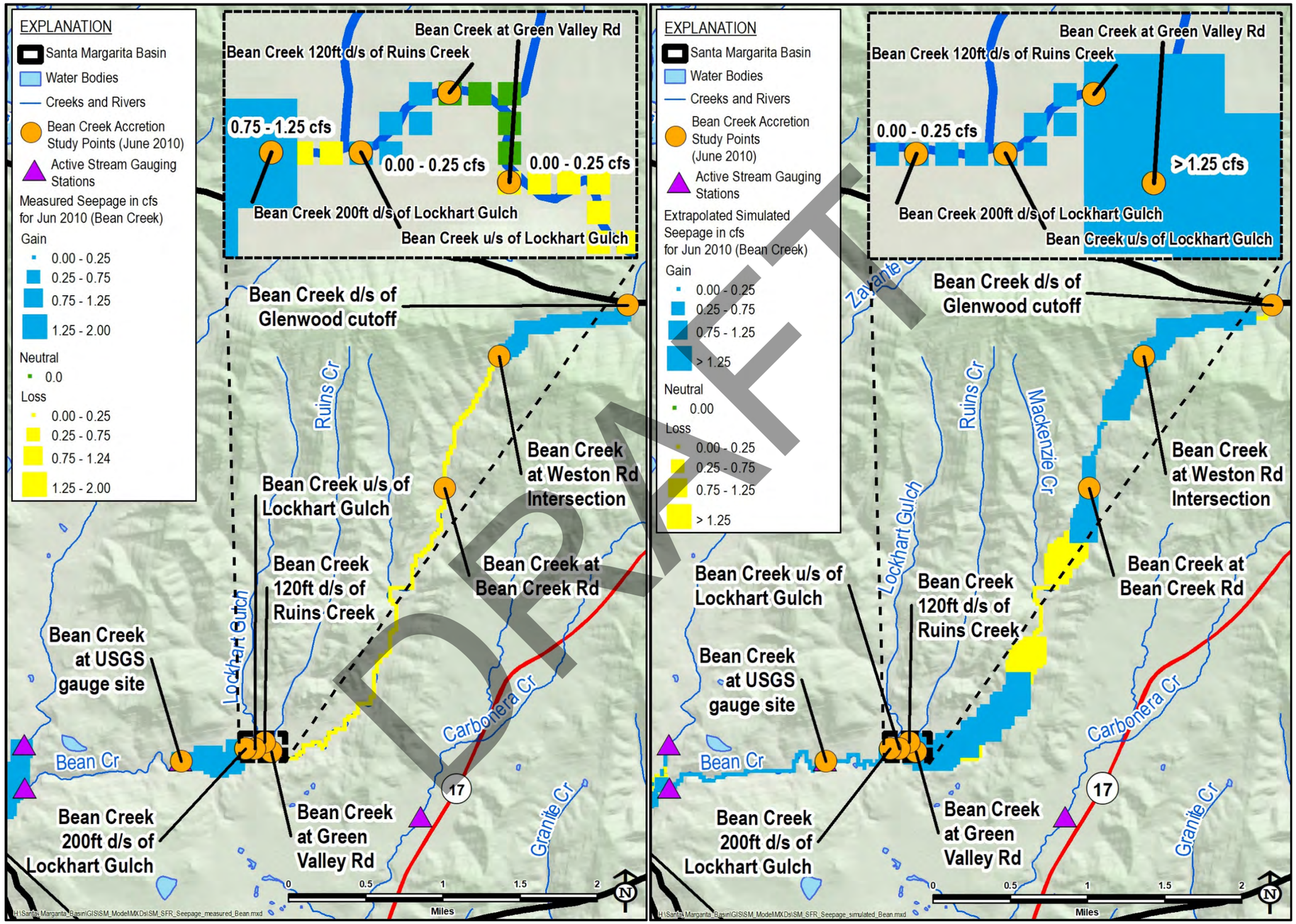

Figure 21. Measured and Extrapolated Simulated Seepage for Bean Creek

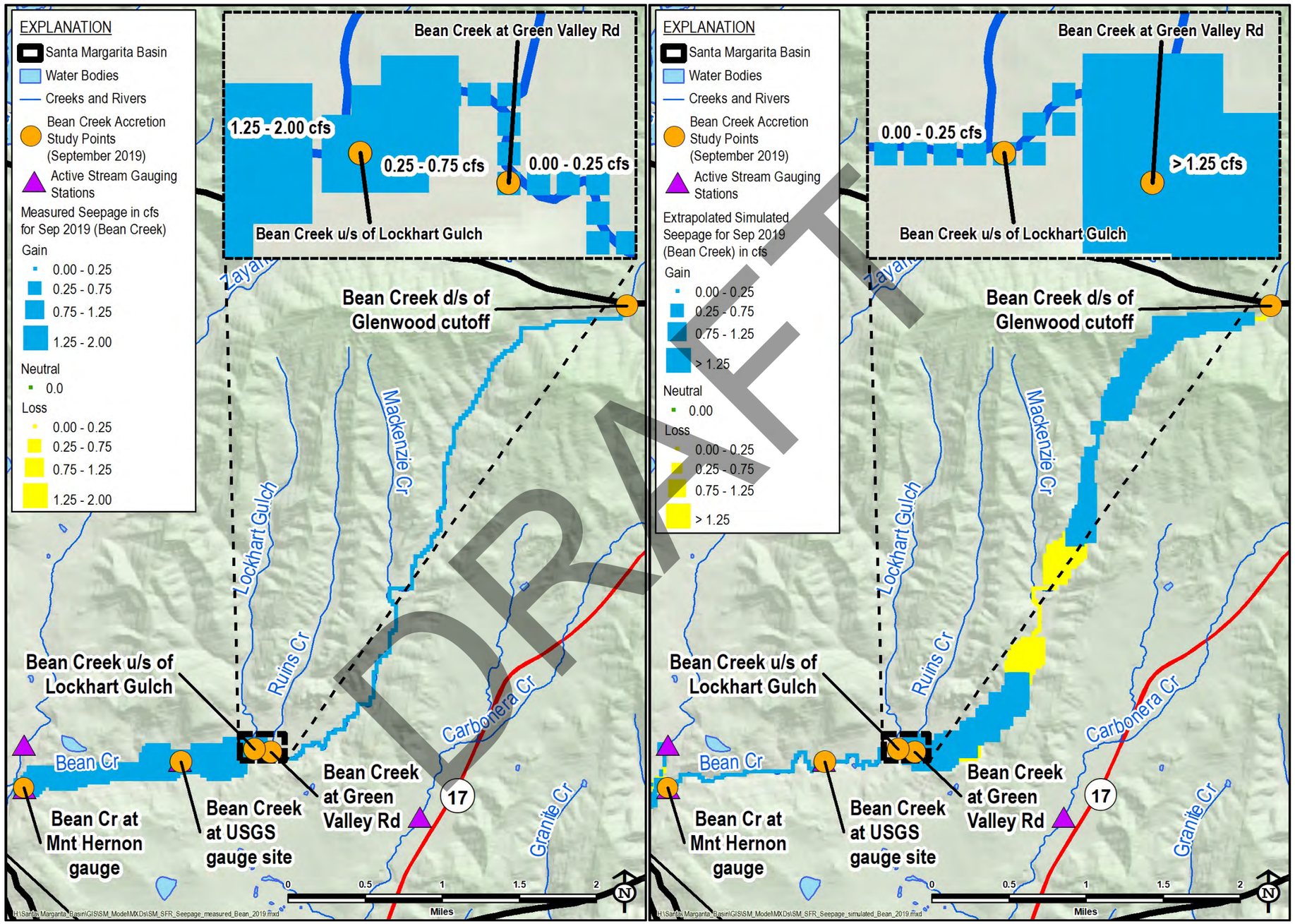

Figure 22. Measured and Extrapolated Simualted Seepage for Bean Creek in 2019

6.2.2 Groundwater Calibration Results

Calibrated parameters for Kx, Kz, Sy, and Ss are shown in Figure 23 through Figure 30. Comparison of simulated head and observed head (Figure 31) indicates that the model simulates heads matching observations for most layers, but underpredicts heads in Butano aquifer Layers 5-7. Updated reference point elevations (RPE) provided post-calibration resulted in more instances of underprediction. Figure 32 shows mean target residuals by aquifer calculated as the average of observed data less modeled data in model time. The model has a similar spread of over- and underprediction in the Santa Margarita aquifer and Monterey Formation with relatively small mean residuals. There are more locations of underprediction than overprediction in the Lompico aquifer, while Butano aquifer is generally underpredicting groundwater levels.

The GSP has 14 representative monitoring points (RMP) at which sustainable management criteria are defined. These are selected from 59 well targets used in calibration to represent groundwater level conditions for each model layer. Hydrographs showing observed groundwater levels and simulated groundwater levels from the M&A model and the KJ model for the 14 RMPs are shown in Figure 33 through Figure 46. RMPs for each aquifer are as follows:

- **Santa Margarita aquifer**: SLVWD Quail MW-A, SLVWD Quail MW-B, SLVWD Olympia #3, SLVWD Pasatiempo MW-2, SVWD TW-18, and SV4-MW
- **Monterey Formation**: SVWD #9
- **Lompico aquifer**: SLVWD Pasatiempo MW-1, SVWD #10, SVWD #11A, and SVWD TW-19
- **Butano aquifer**: SVWD #15 Monitoring Well, Canham Well, and Stonewood

Santa Margarita aquifer RMPs show good fits at SLVWD Olympia #3 (Figure 33) and SLVWD Quail MW-A (Figure 35); overprediction with good long-term trend at SLVWD Quail MW-B (Figure 36); underprediction with good long-term trends at SV4-MW (Figure 37); and underprediction without good long-term trends at SLVWD Pasatiempo MW-2 (Figure 34) and SVWD TW-18 (Figure 38). SLVWD Olympia #3 and SLVWD Pasatiempo MW-2 performed similarly to KJ model (2015) while SLVWD Quail MW-A and SV4-MW show improved fit. SVWD TW-18 and SLVWD Quail MW-B show worse overall fit to data, but the latter two show improved long-term trends compared to the KJ model (2015).

SVWD #9 (Figure 39) is the only RMP in the Monterey Formation and improves fit to declining trend from the beginning of the model period but deviates around 1995. There are improved simulation results starting in 2002 compared to the KJ model.

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Lompico aquifer RMPs show good fit at SVWD #11A (Figure 42) and underprediction with good long-term trends for SLVWD Pasatiempo MW- 1 (Figure 40), SVWD #10 (Figure 41), and SVWD TW-19 (Figure 43). The KJ model performs better on SVWD #10 and Pasatiempo MW-1, but the latter has a better long-term trend while the M&A model shows improved fit at SVWD #11A and SVWD TW-19.

RMPs in the Butano aquifer show good fit at SVWD #15 Monitoring Well (Figure 45), but consistently underpredicts at Canham Well (Figure 44) and Stonewood Well (Figure 46). Canham Well and Stonewood Well for the M&A model performs better than the KJ model while SVWD #15 Monitoring Well predicts similarly between both models.

Vertical gradients were not used as part of the calibration, but 4 sites of the 9 presented by EKI in its review of the KJ model are available for comparison of vertical gradients from to the selection of target wells. Simulated results for Site 1 (Figure 47) indicate a greater downward gradient relative to the measured by about 30 ft. Site 2 (Figure 48) shows that simulated vertical gradient is less than observed while Site 4 (Figure 49) shows more variation and greater vertical gradient than observed. Site 9 (Figure 50) shows little vertical gradient for both simulated and observed during the period when vertical gradient data are available.

Model calibration to groundwater level data is sufficient because long term trends at RMPs are generally simulated. The calibrated model can be used to interpret projected hydrographs from future scenario models by accounting for simulated average water level offsets. The calibrated model can also be used to estimate historical, current, and projected water budgets as required for the GSP. Recalibration can improve the model with additional grondwater level data at existing RMPs and new areas of interest.

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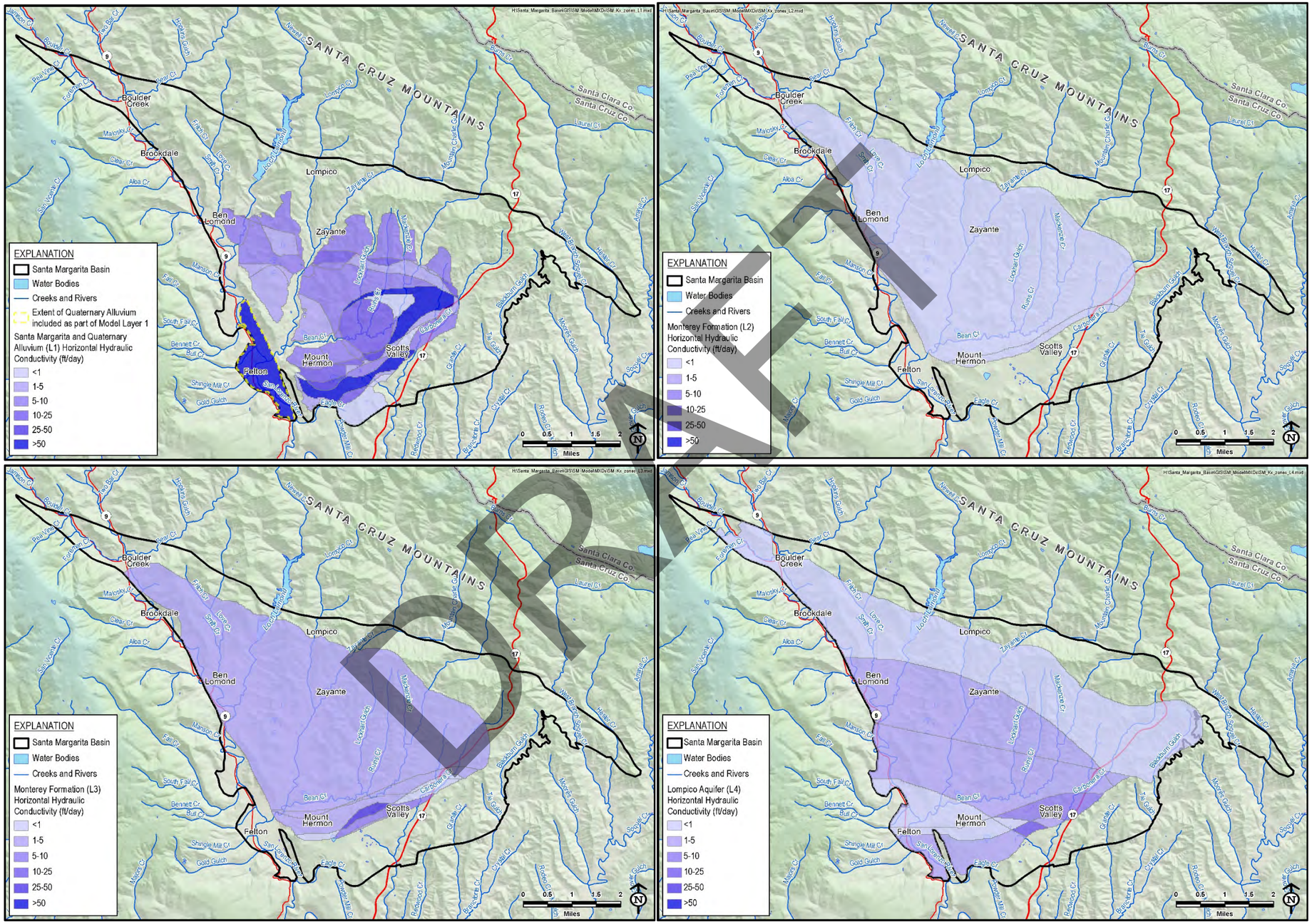

Figure 23. Horizontal Conductivity Zones for Santa Margarita Aquifer, Monterey Formation, and Lompico Aquifer

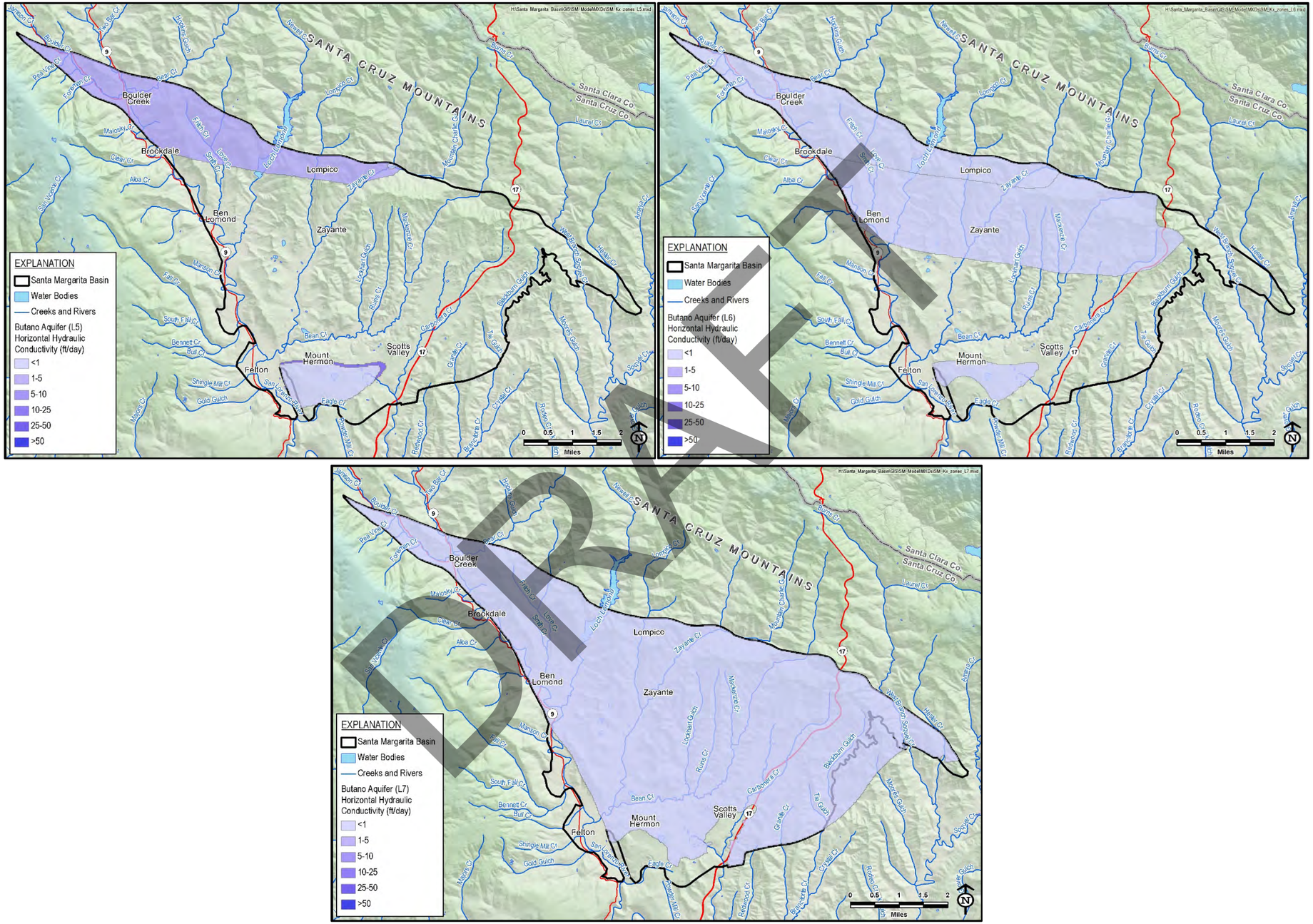

Figure 24. Horizontal Conductivity Zone Distribution for Butano Aquifer

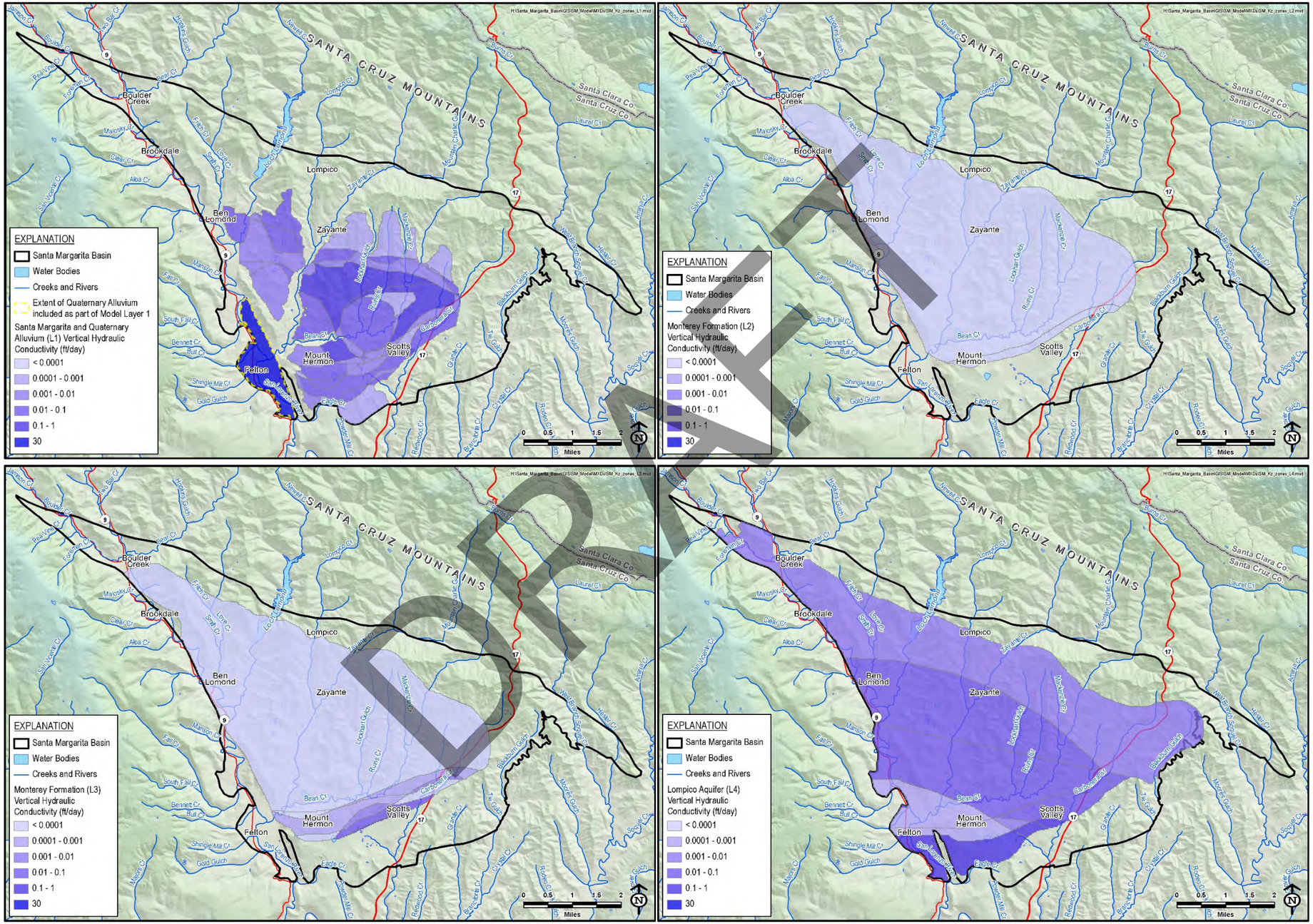

Figure 25. Vertical Conductivity Zones for Santa Margarita Aquifer, Monterey Formation, and Lompico Aquifer

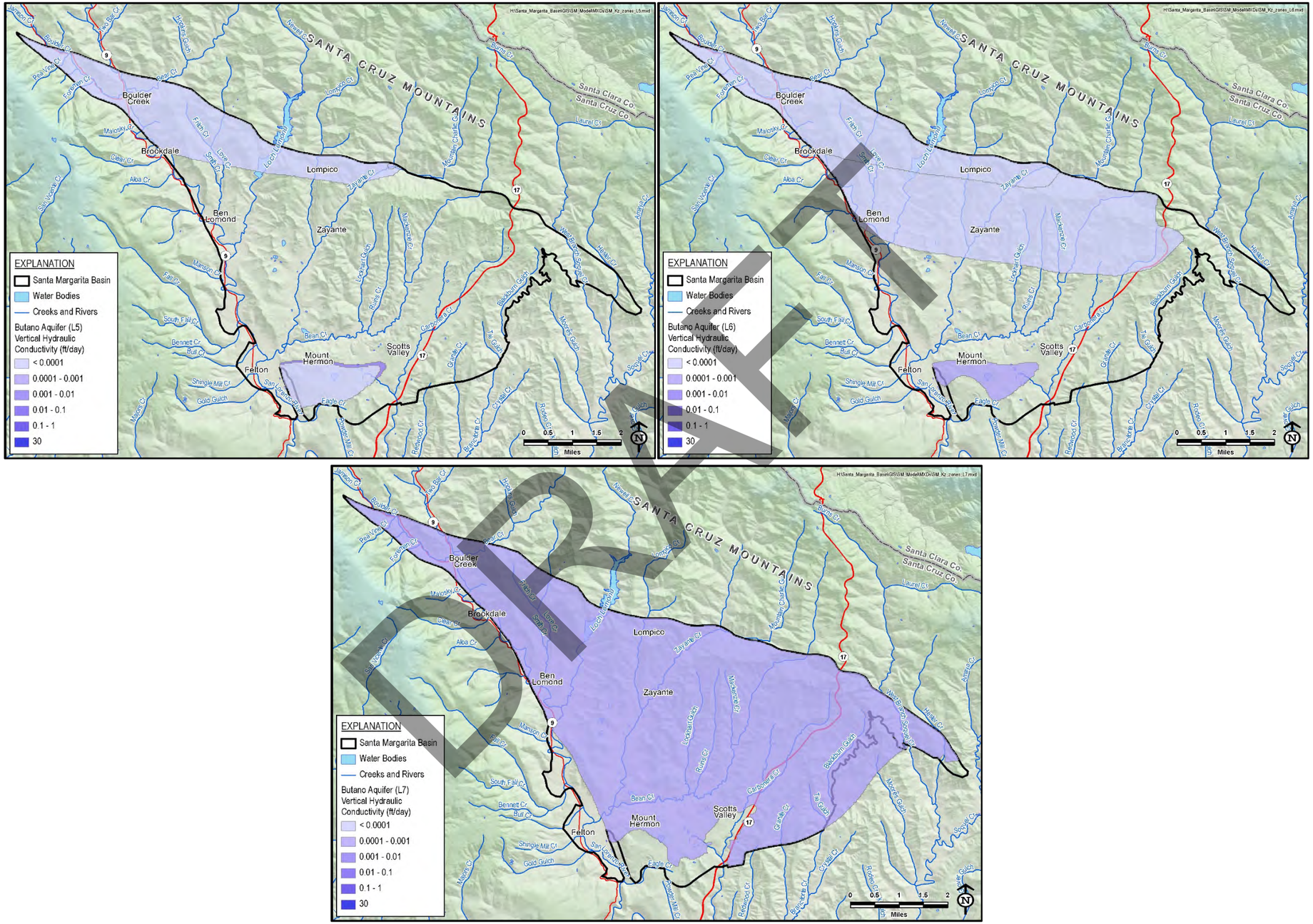

Figure 26. Vertical Conductivity Zone Distribution for Butano Aquifer

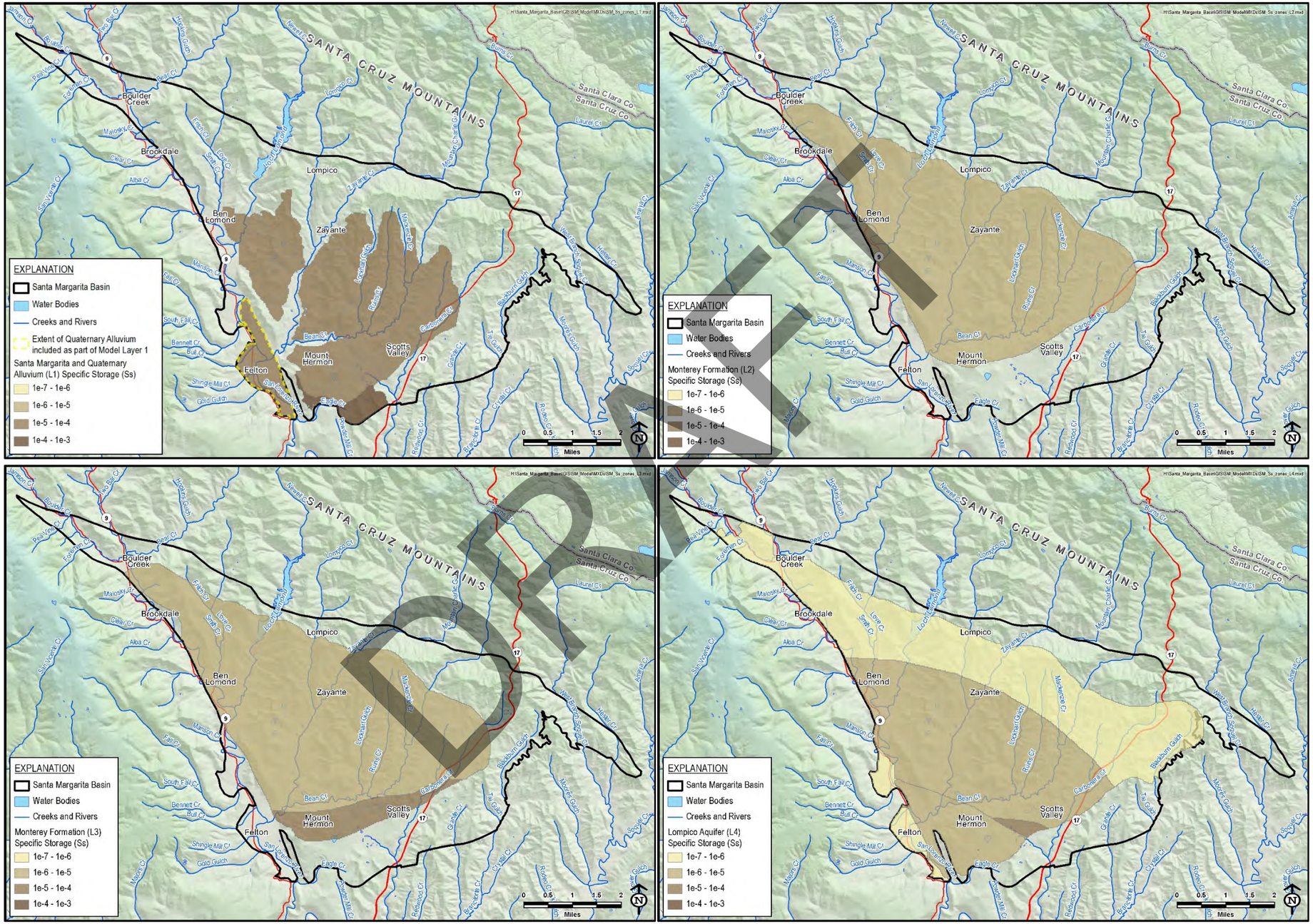

Figure 27. Specific Storage Zones for Santa Margarita Aquifer, Monterey Formation, and Lompico Aquifer

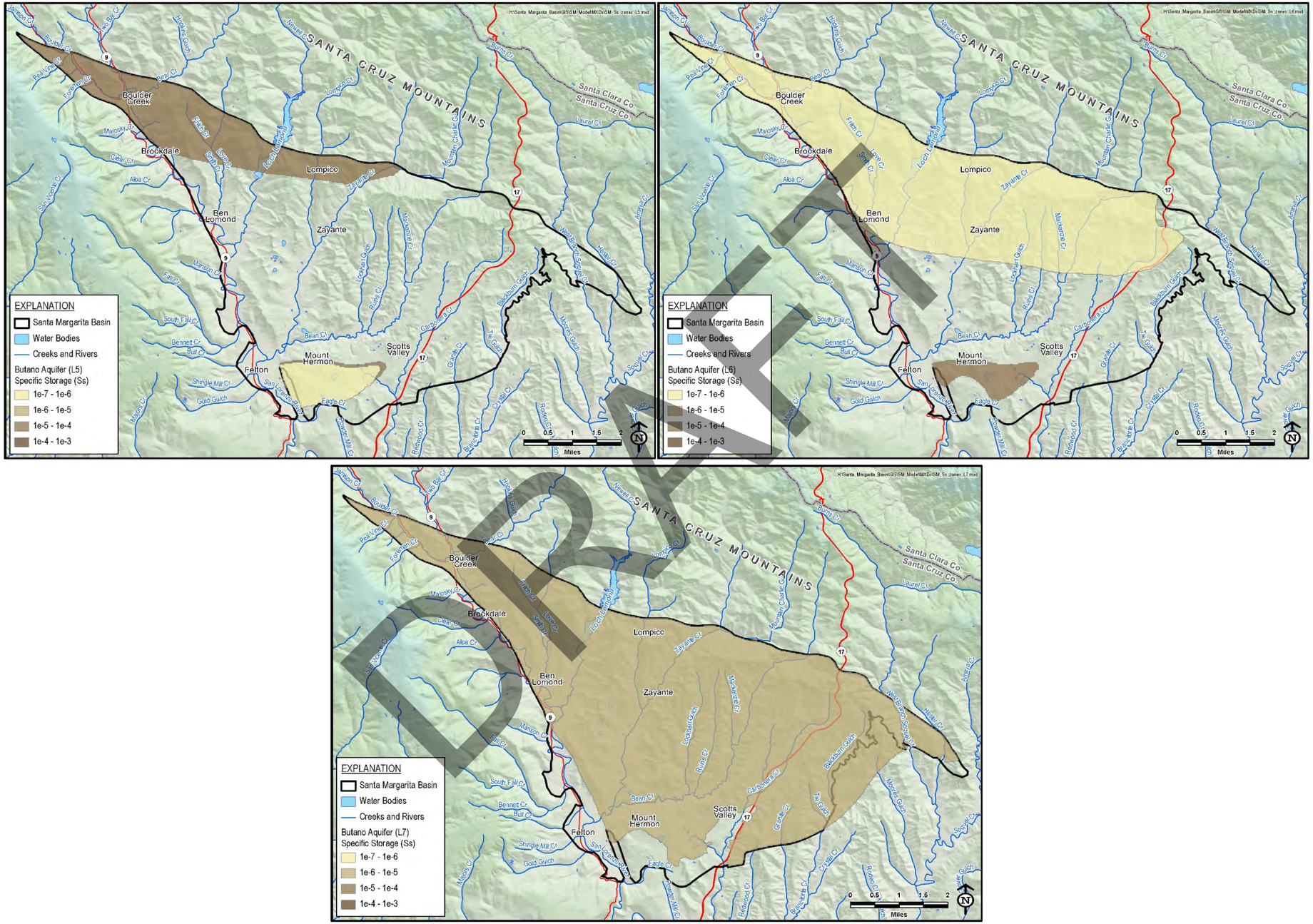

Figure 28. Specific Storage Zone Distribution for Butano Aquifer

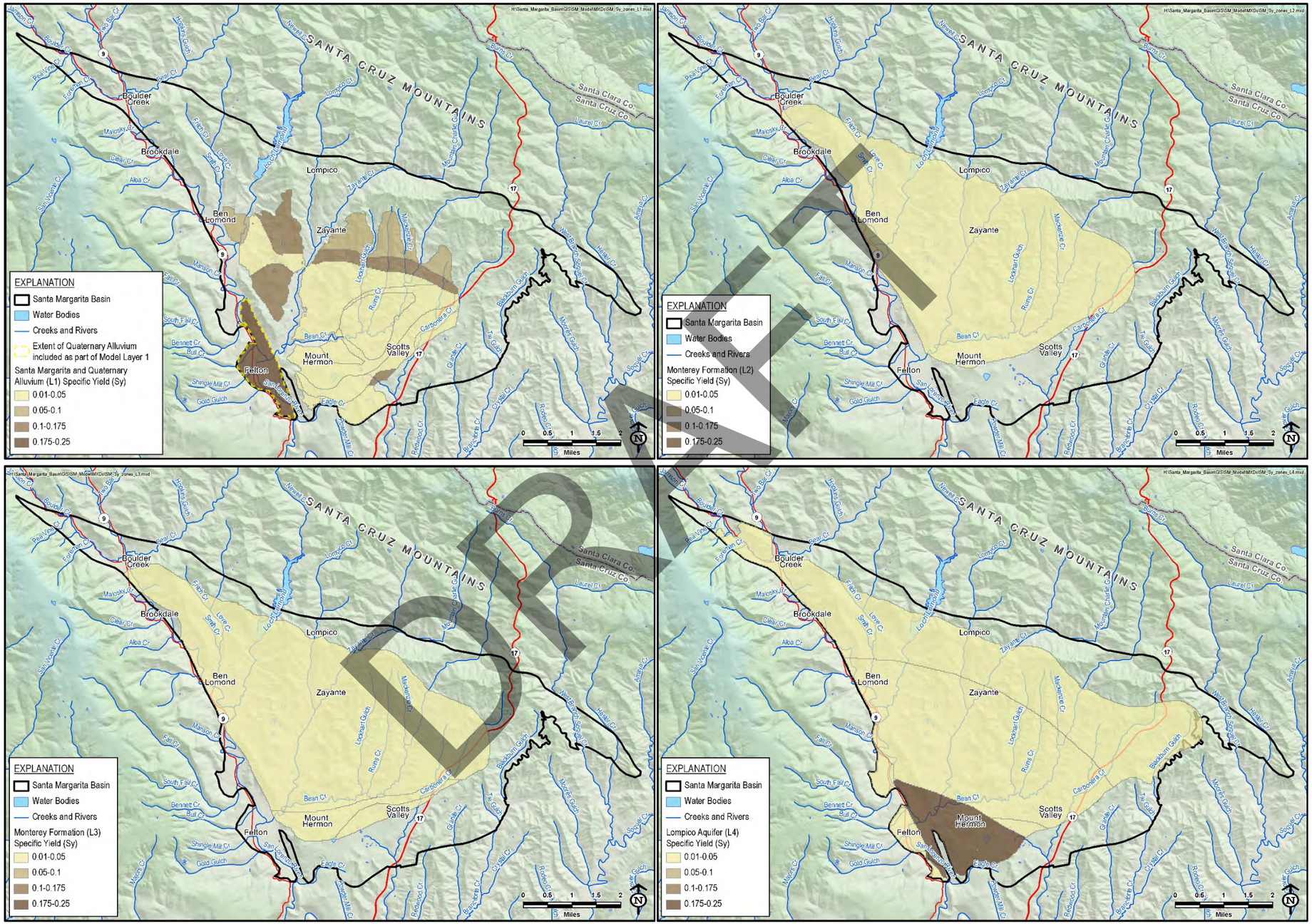

Figure 29. Specific Yield Zones for Santa Margarita Aquifer, Monterey Formation, and Lompico Aquifer

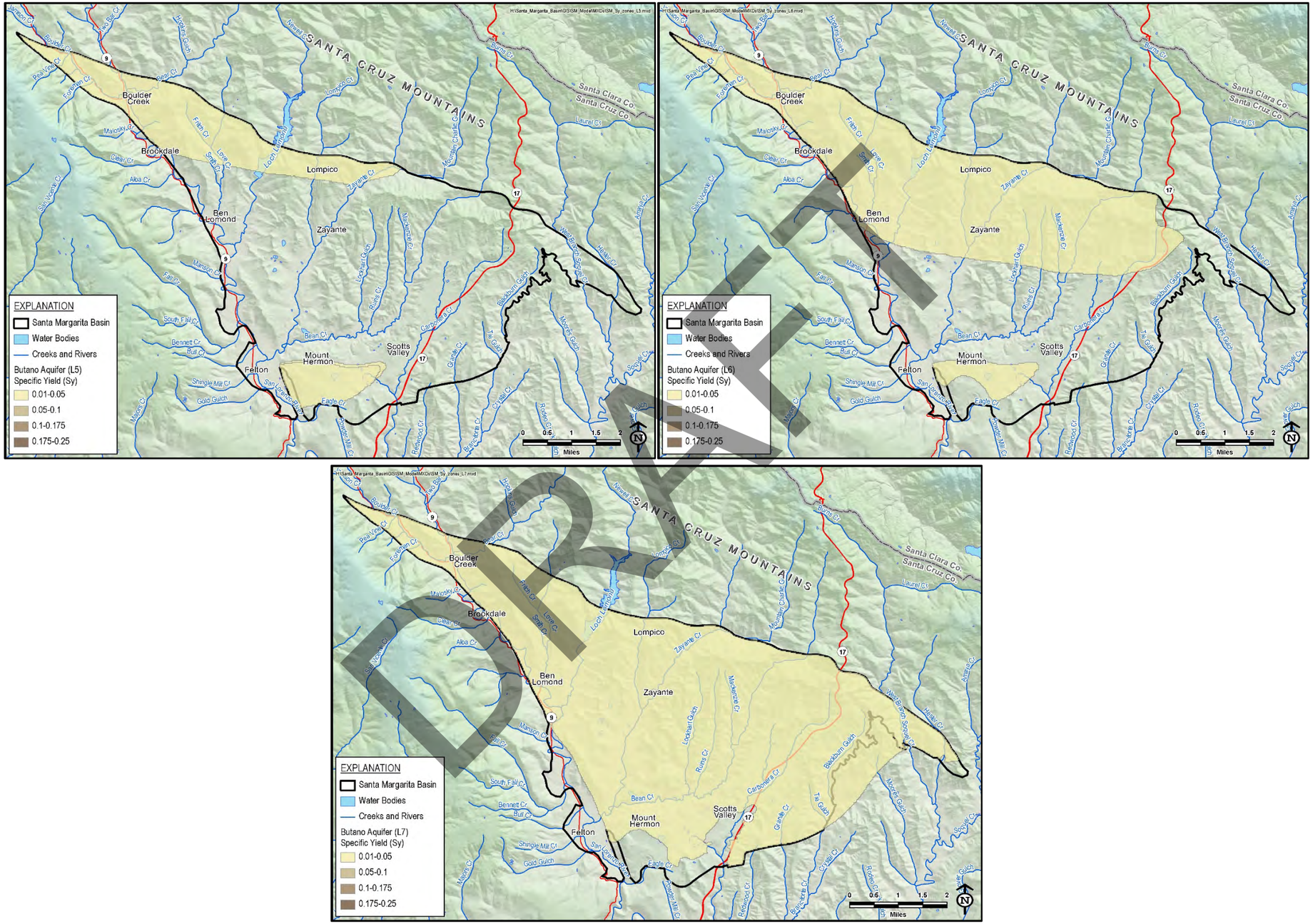

Figure 30. Specific Yield Zone Distribution for Butano Aquifer

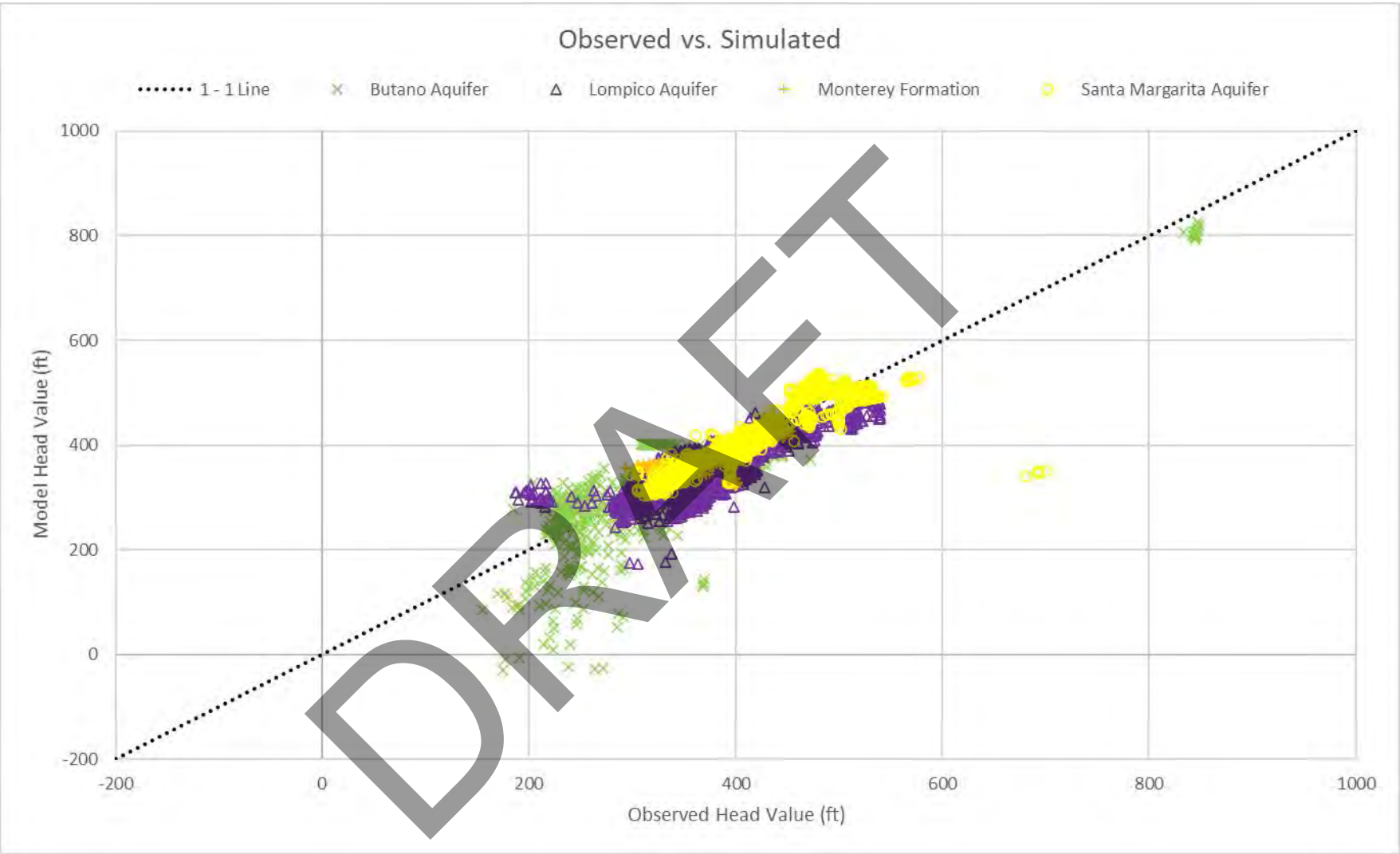

Figure 31. Simulated and Observed Head Target Comparison

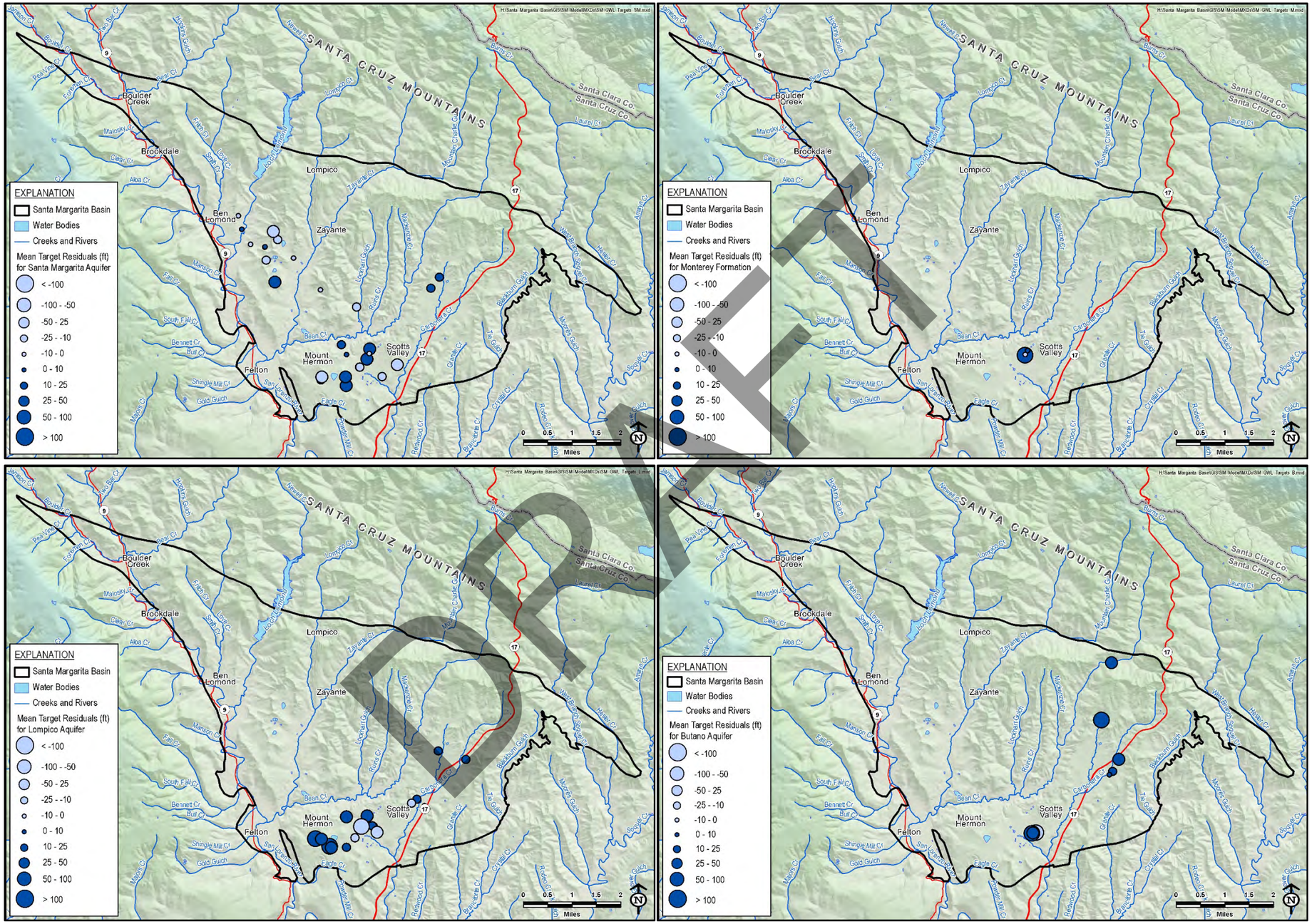

Figure 32. Mean Target Residual Maps (Observed – Simulated)

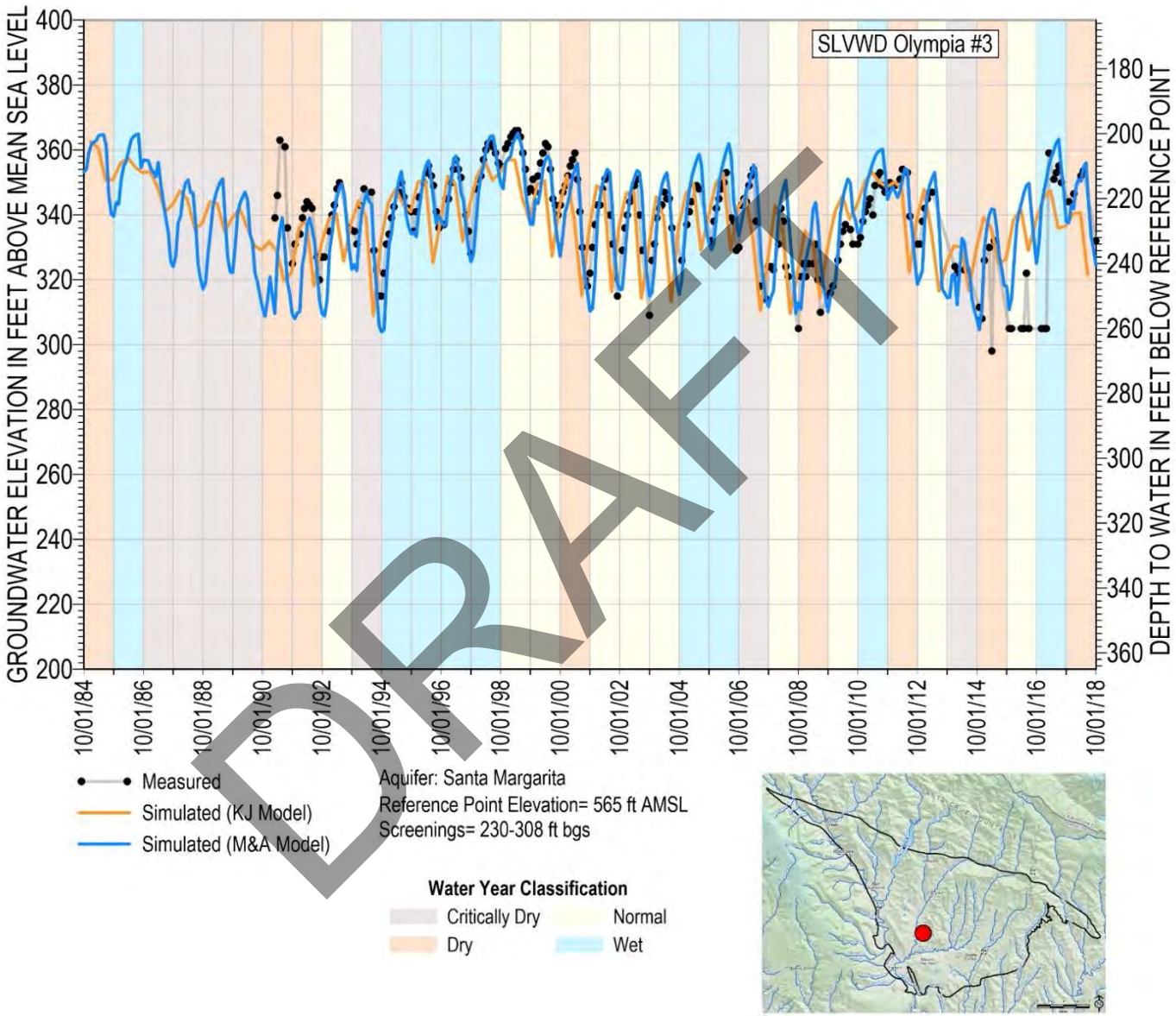

Figure 33. SLVWD Olympia #3 Hydrograph

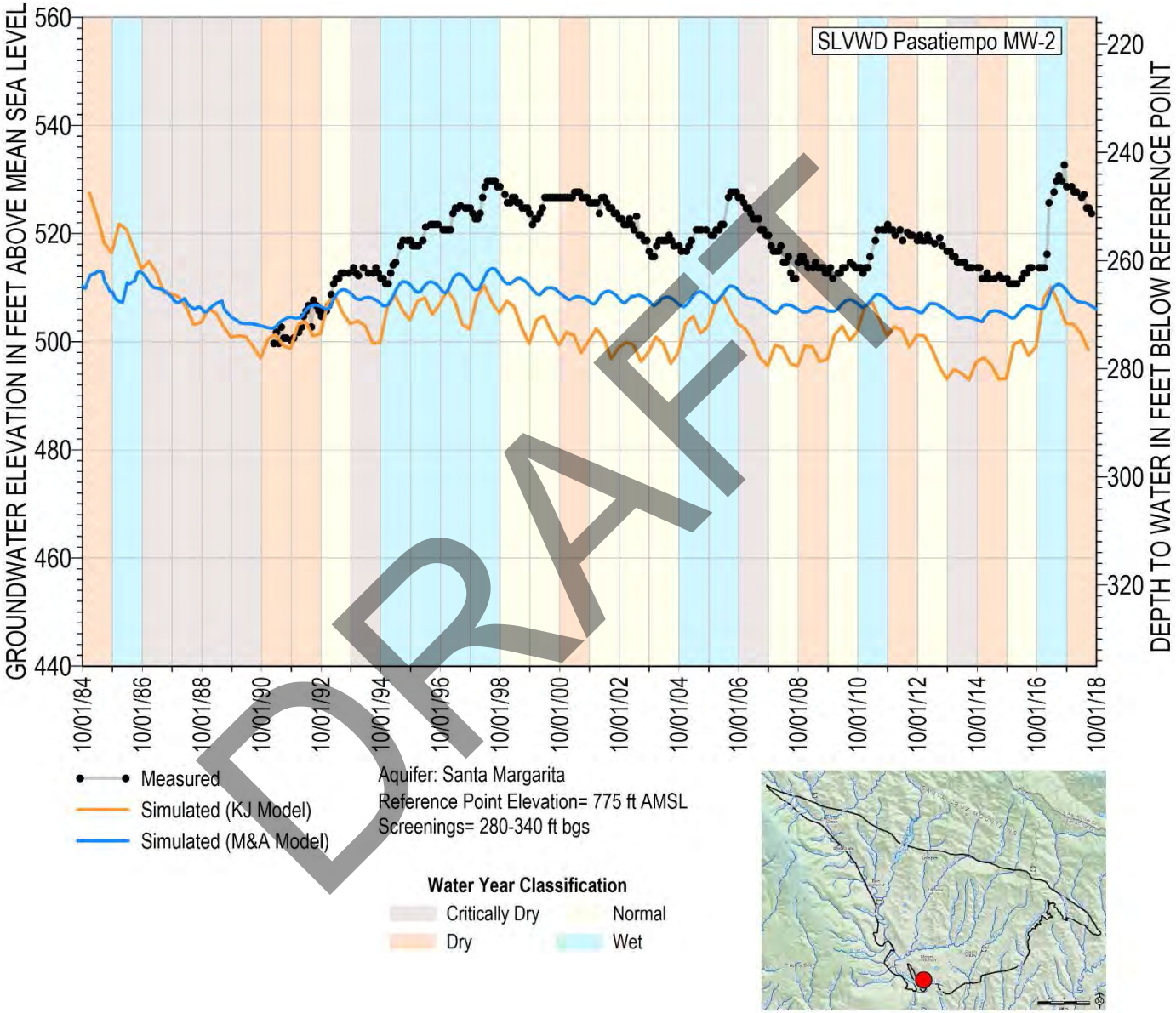

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Figure 34. SLVWD Pasatiempo MW-2 Hydrograph

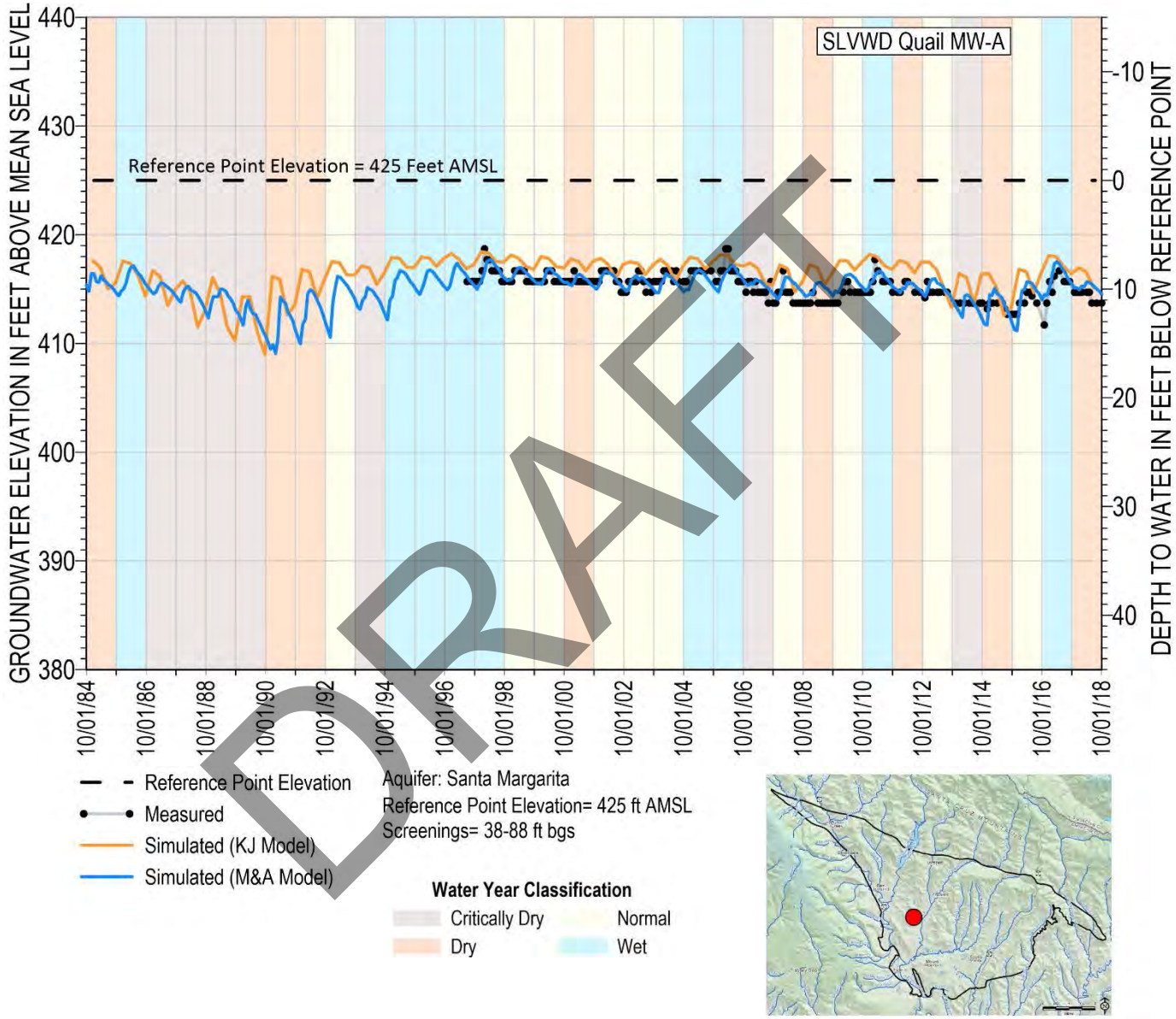

Figure 35. SLVWD Quaill MW-A Hydrograph

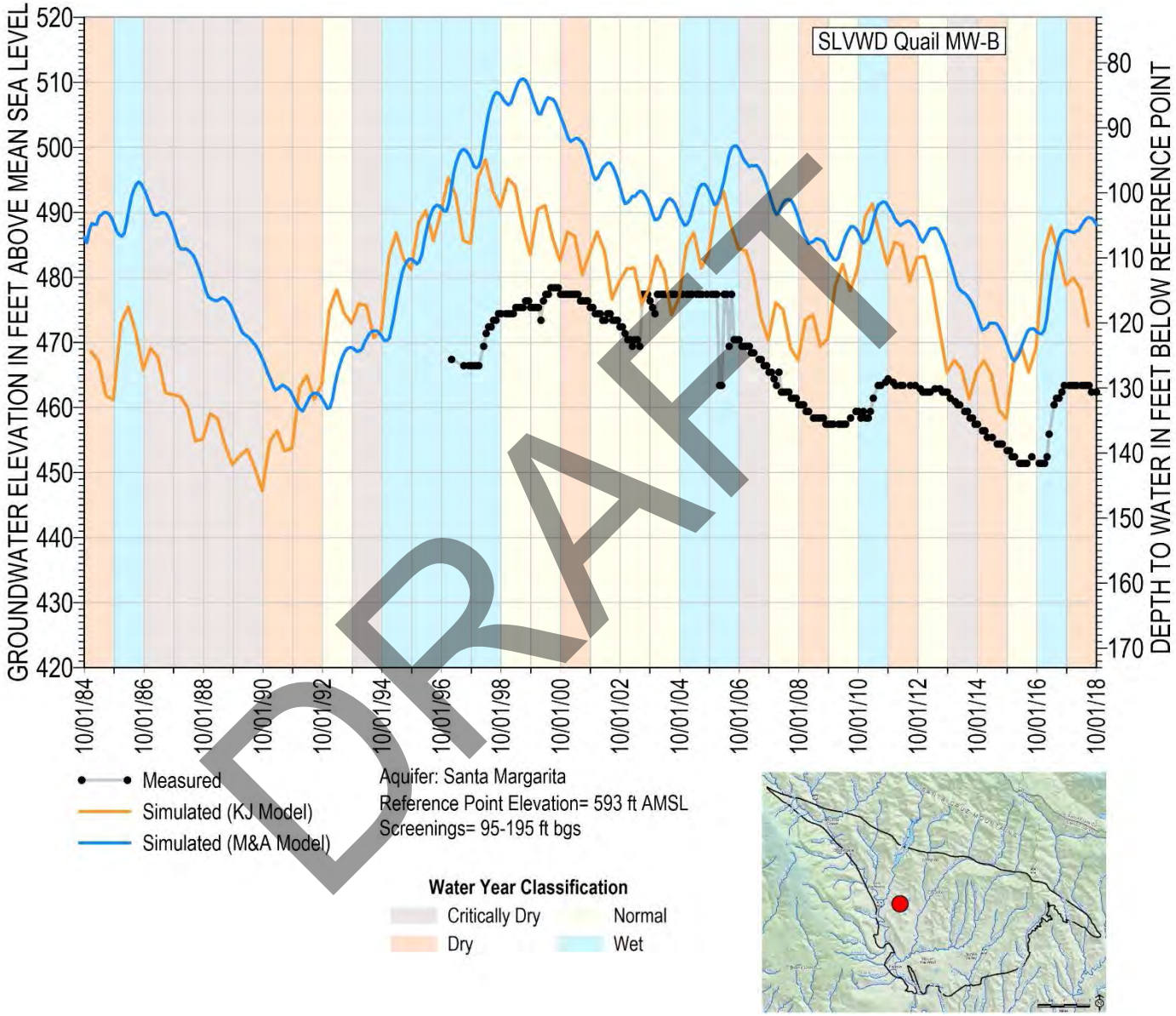

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Figure 36. SLVWD Quail MW-B Hydrograph

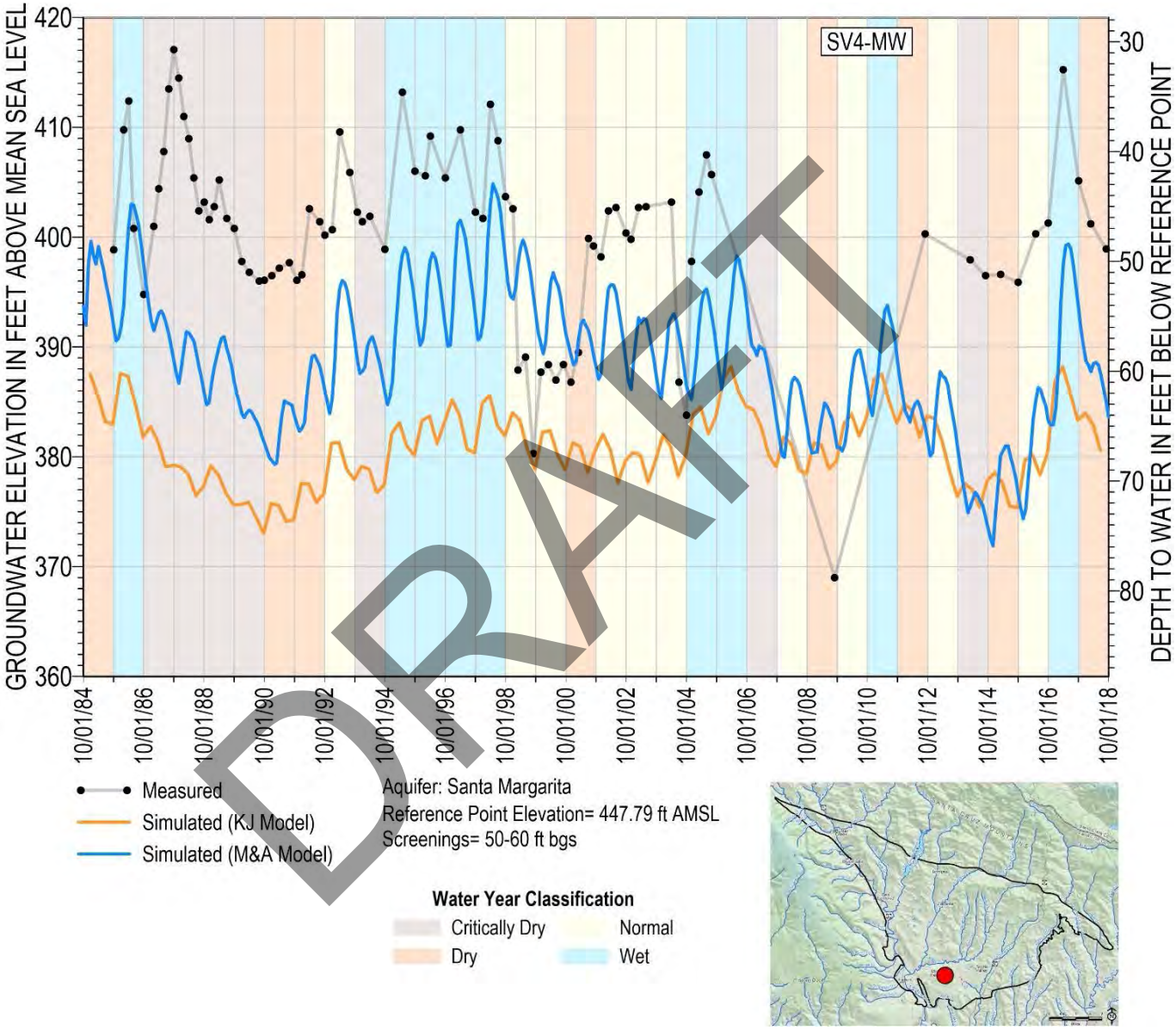

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Figure 37. SV4-MW Hydrograph

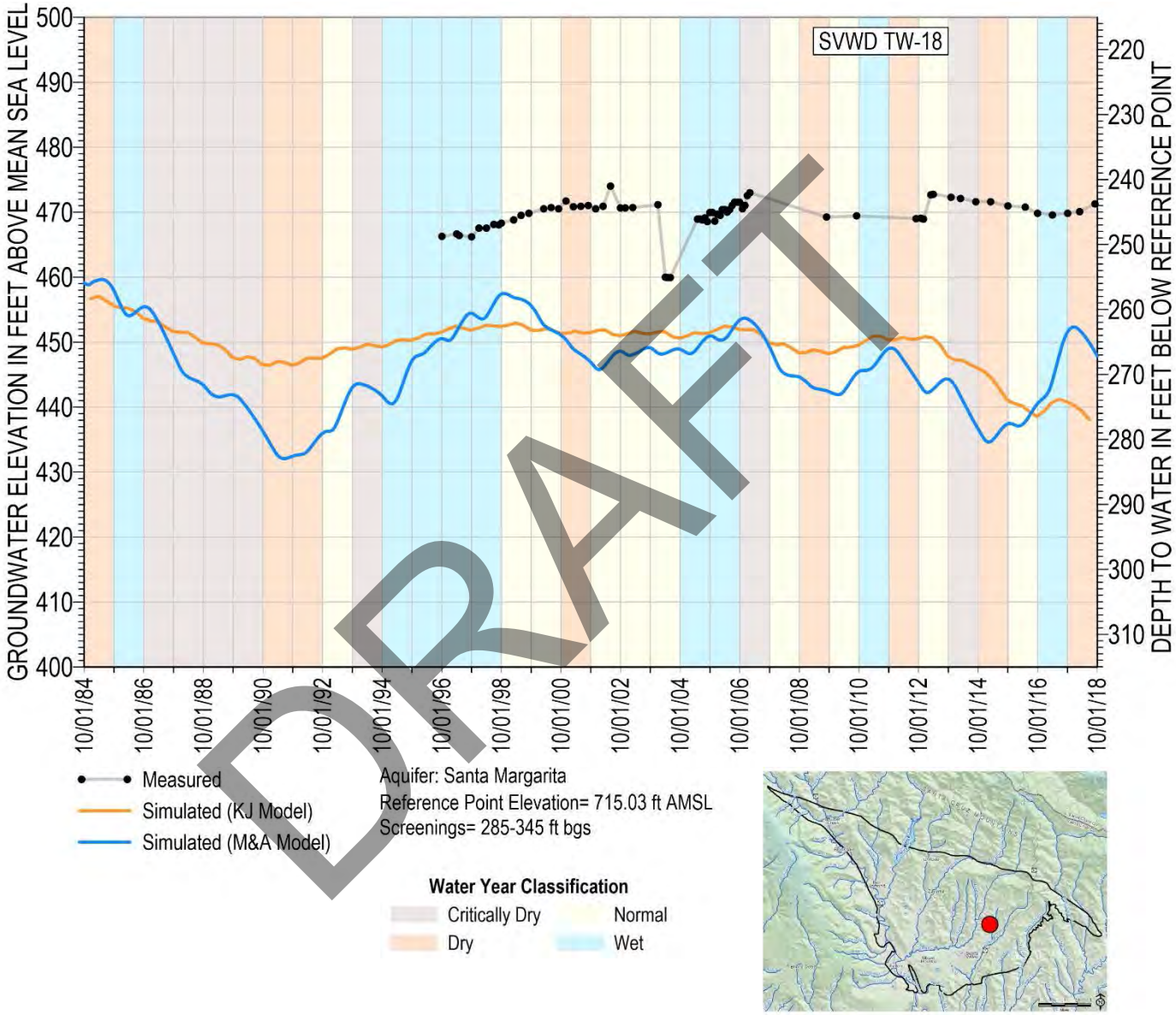

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Figure 38. SVWD TW-18 Hydrograph

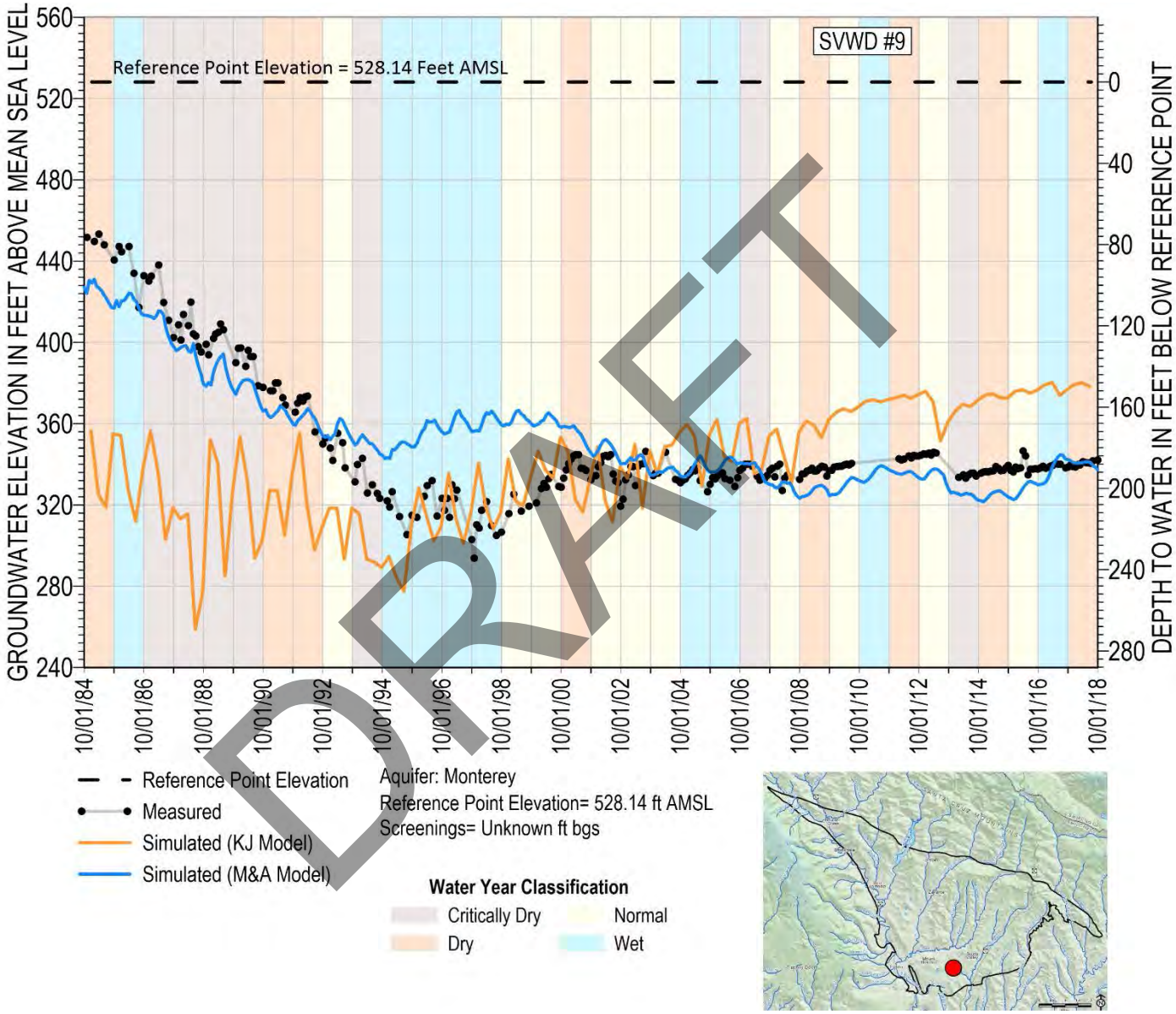

Figure 39. SVWD #9 Hydrograph

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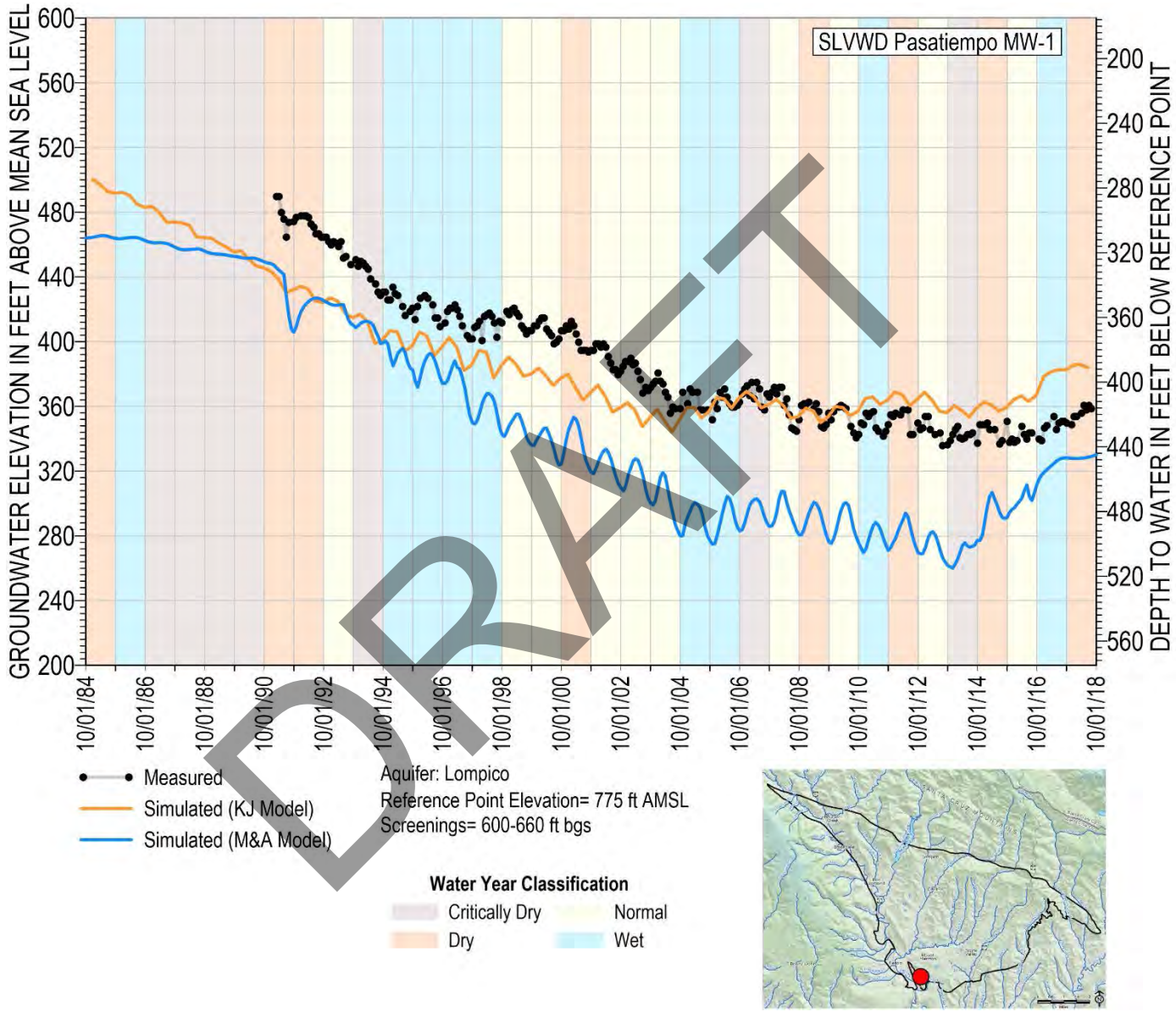

Figure 40. SLVWD Pasatiempo MW-1 Hydrograph

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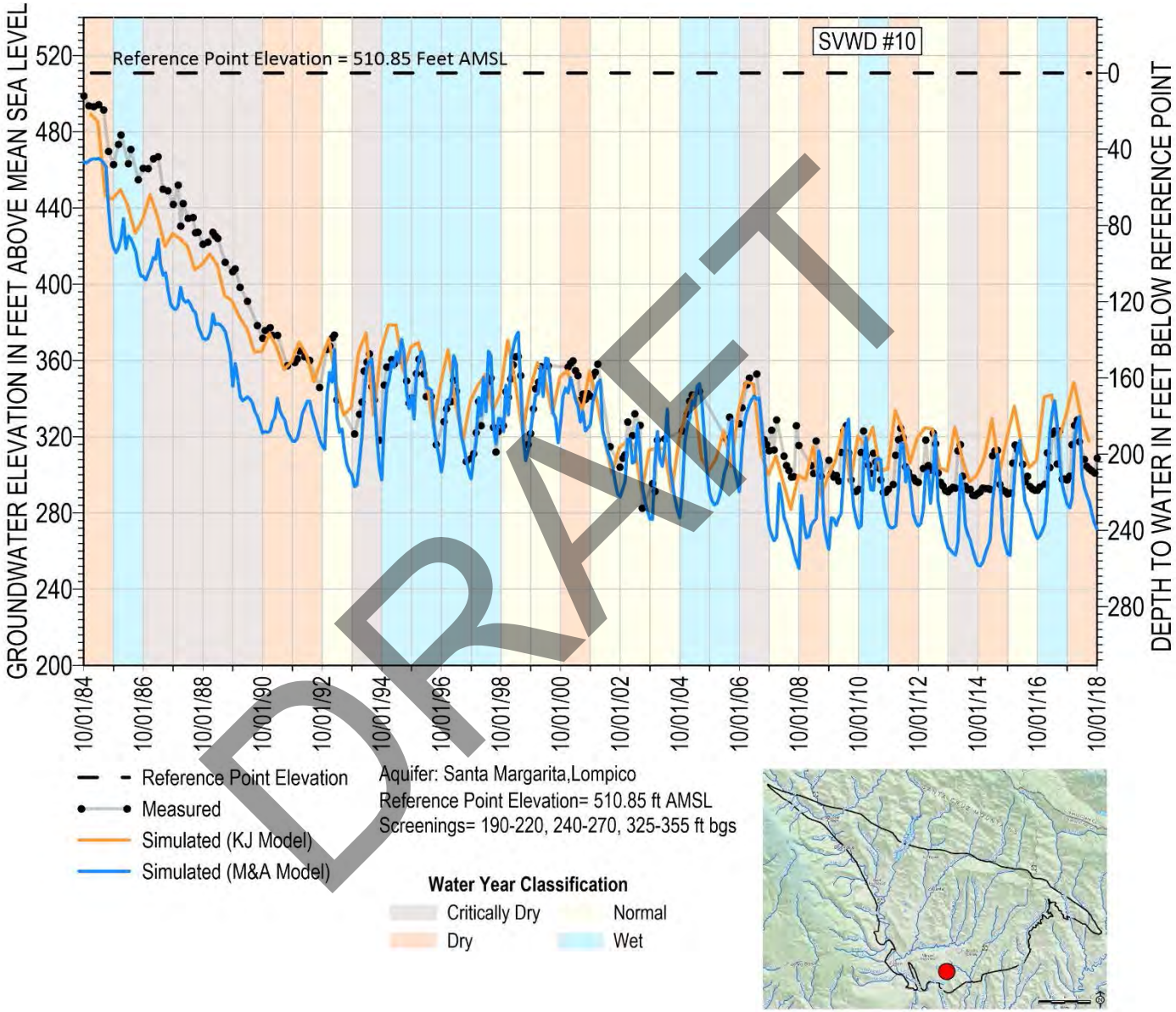

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Figure 41. SVWD #10 Hydrograph

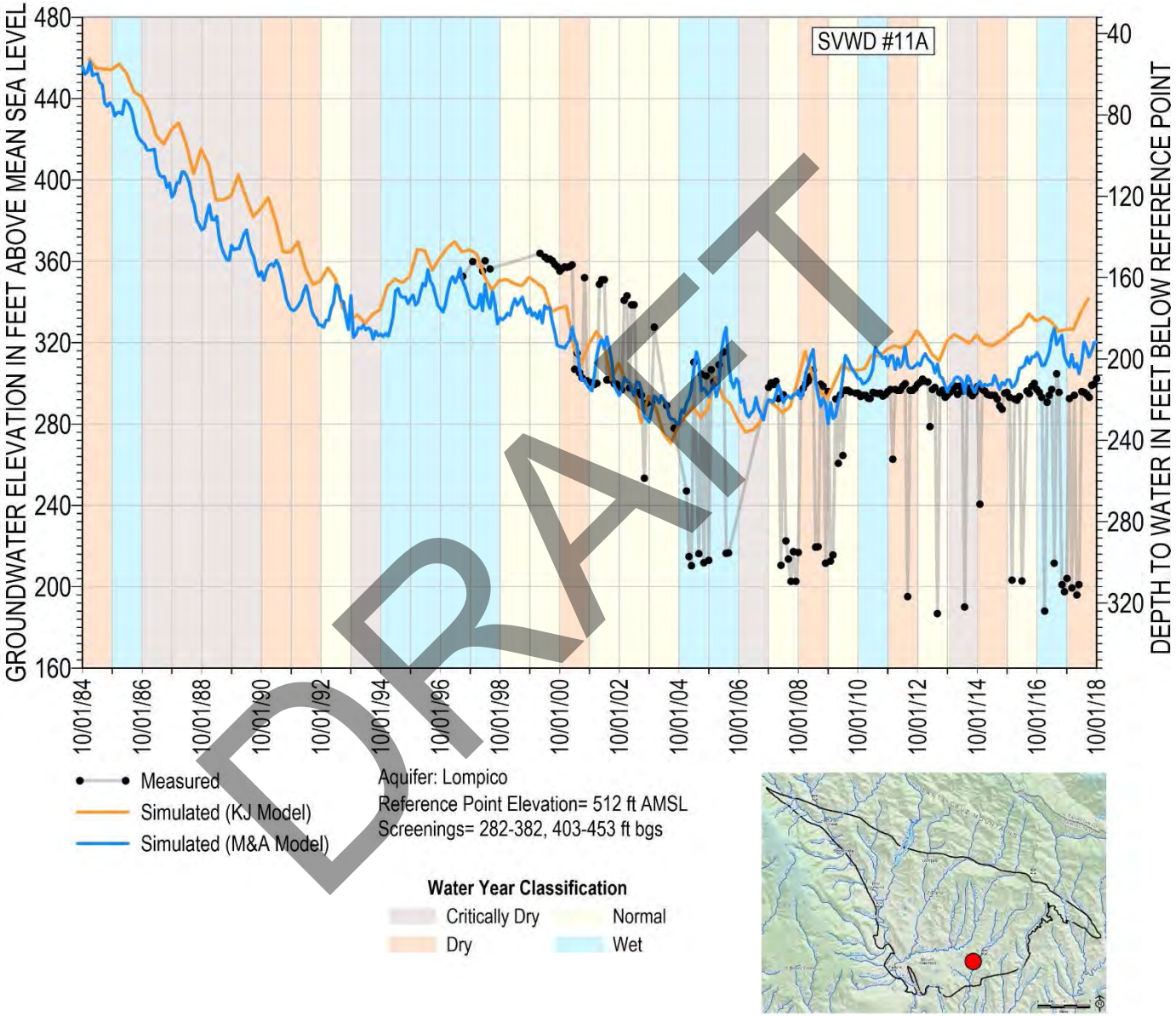

Figure 42. SVWD #11A Hydrograph

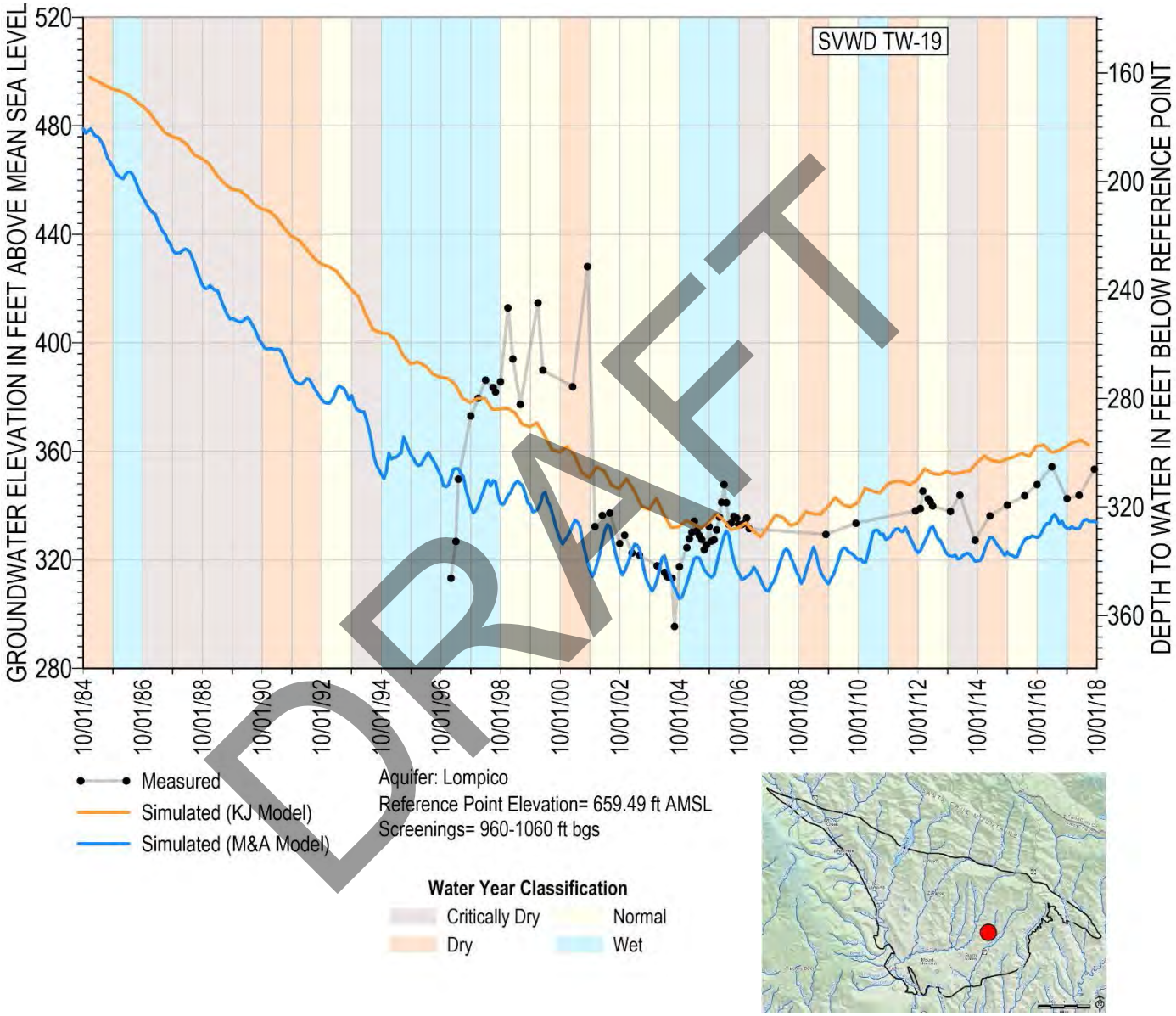

Figure 43. SVWD TW-19 Hydrograph

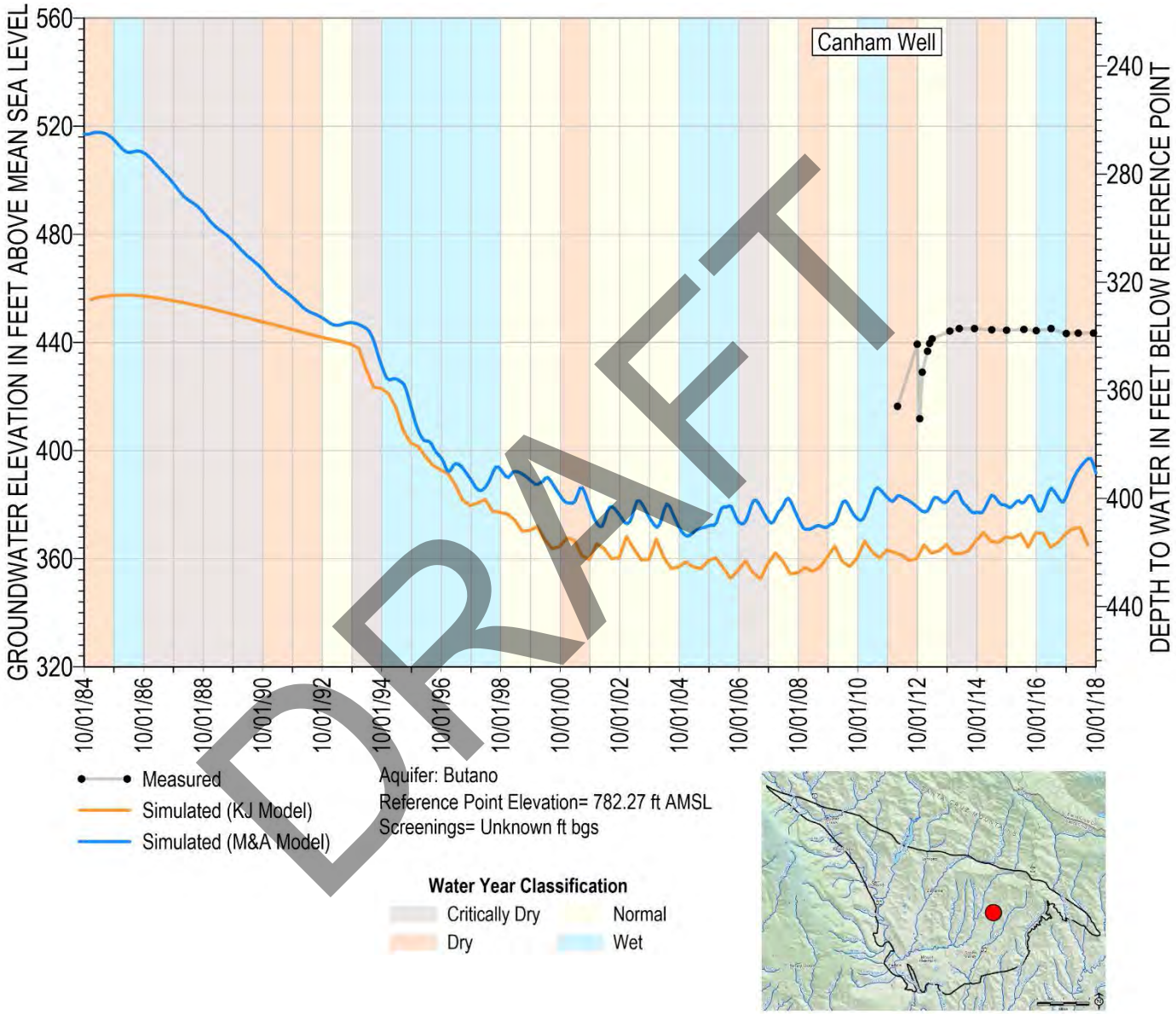

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Figure 44. Canham Well Hydrograph

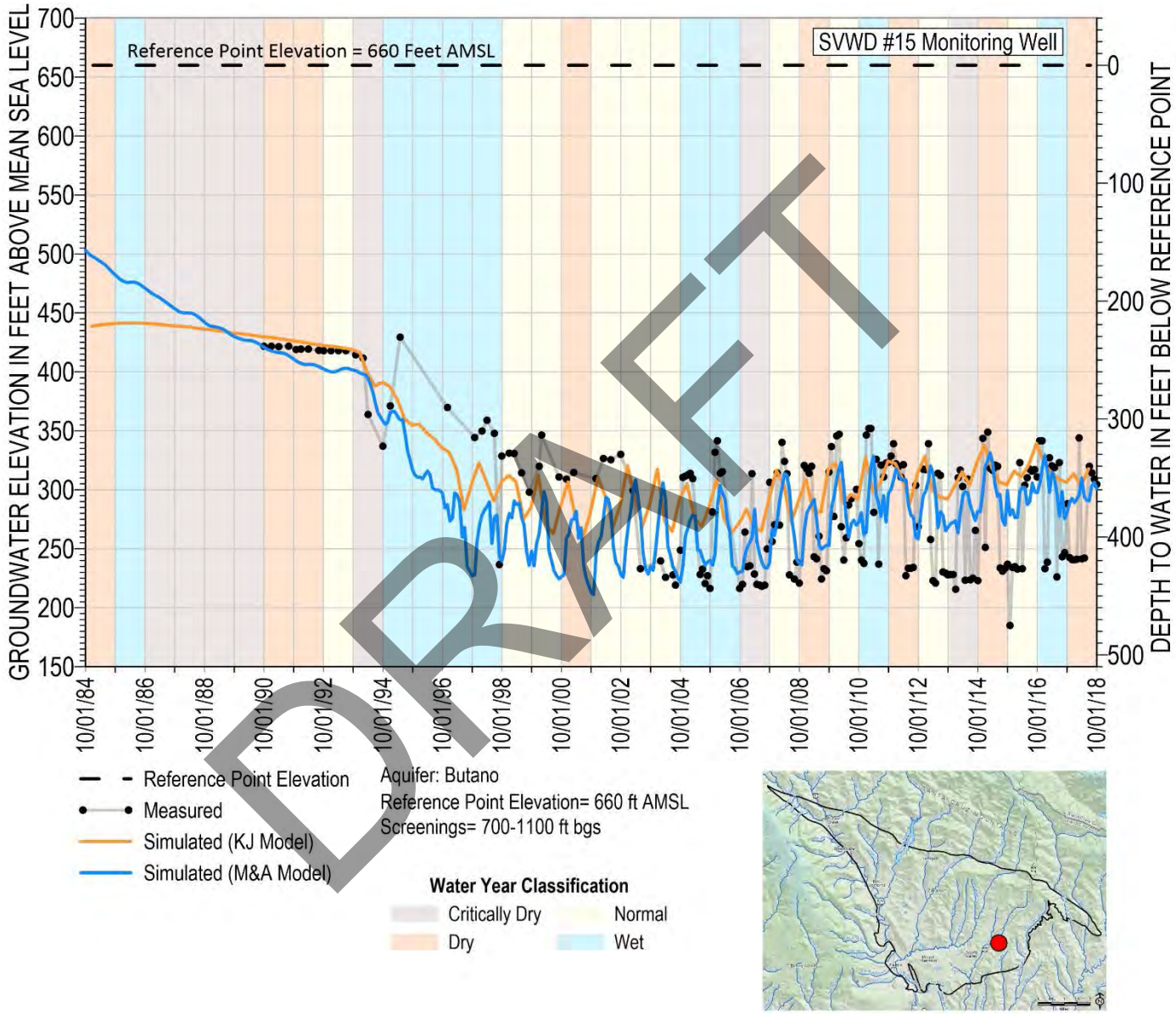

Figure 45. SVWD #15 Monitoring Well Hydrograph

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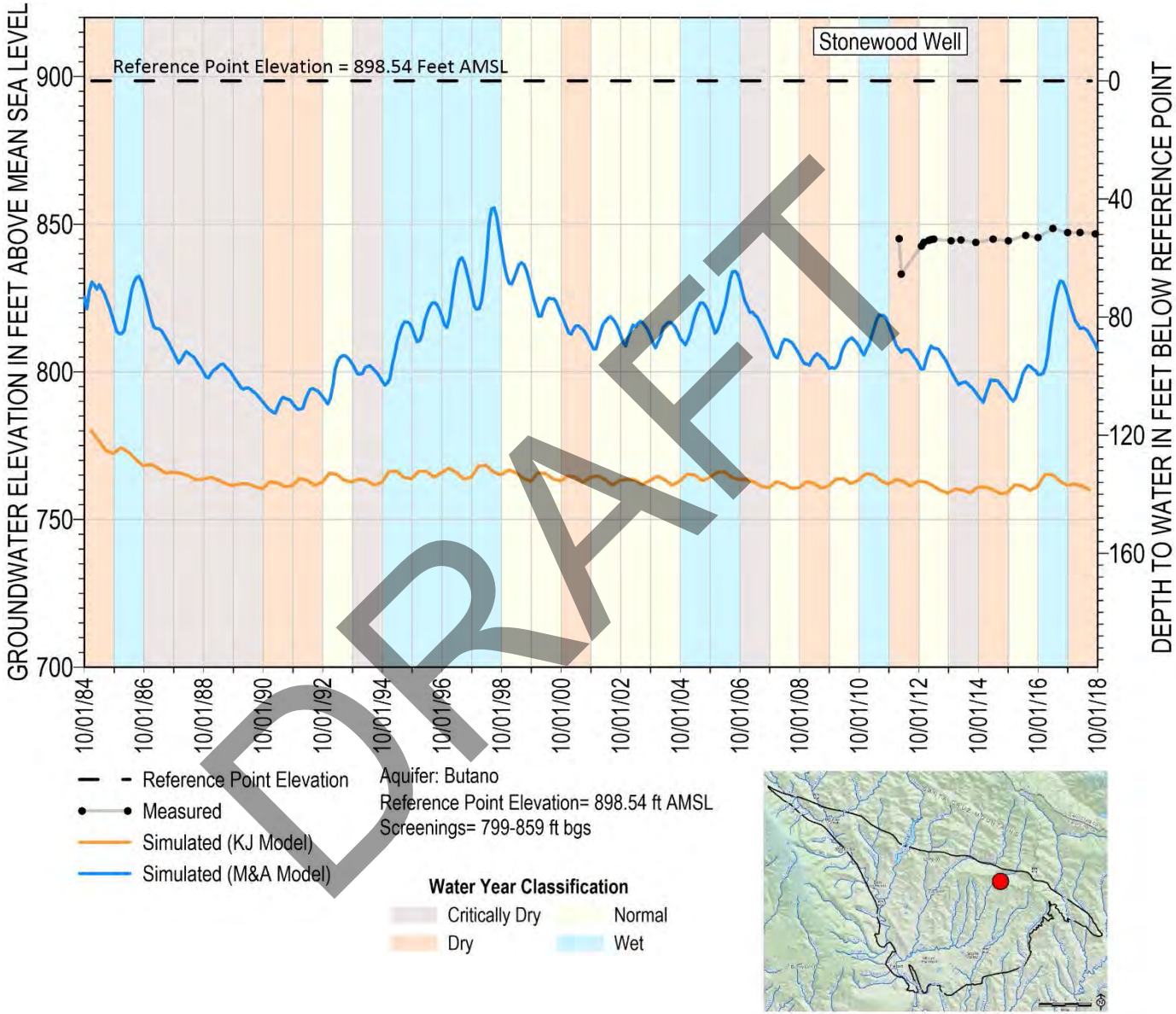

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Figure 46. Stonewood Hydrograph

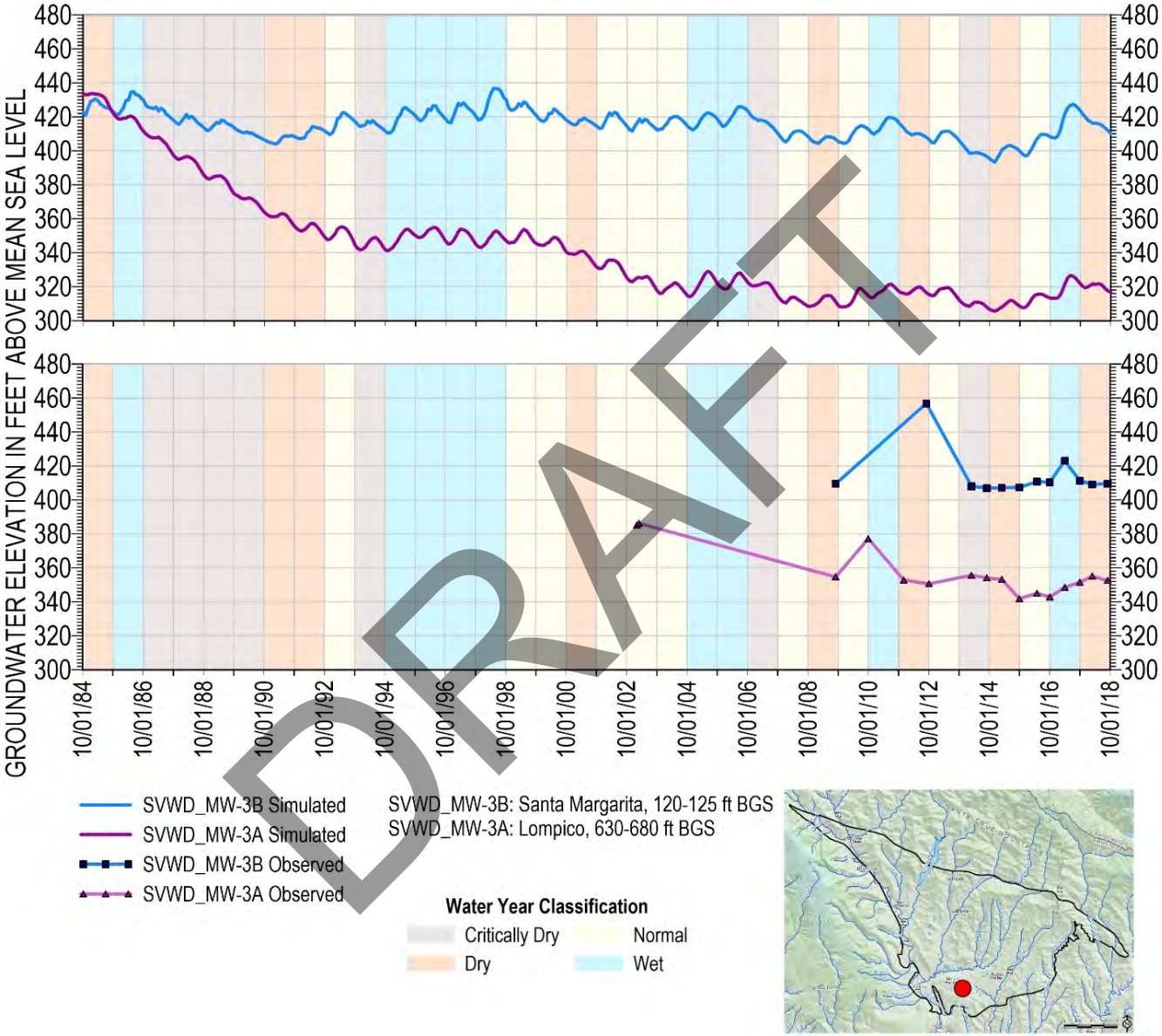

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Figure 47. EKI Vertical Gradient Site 1

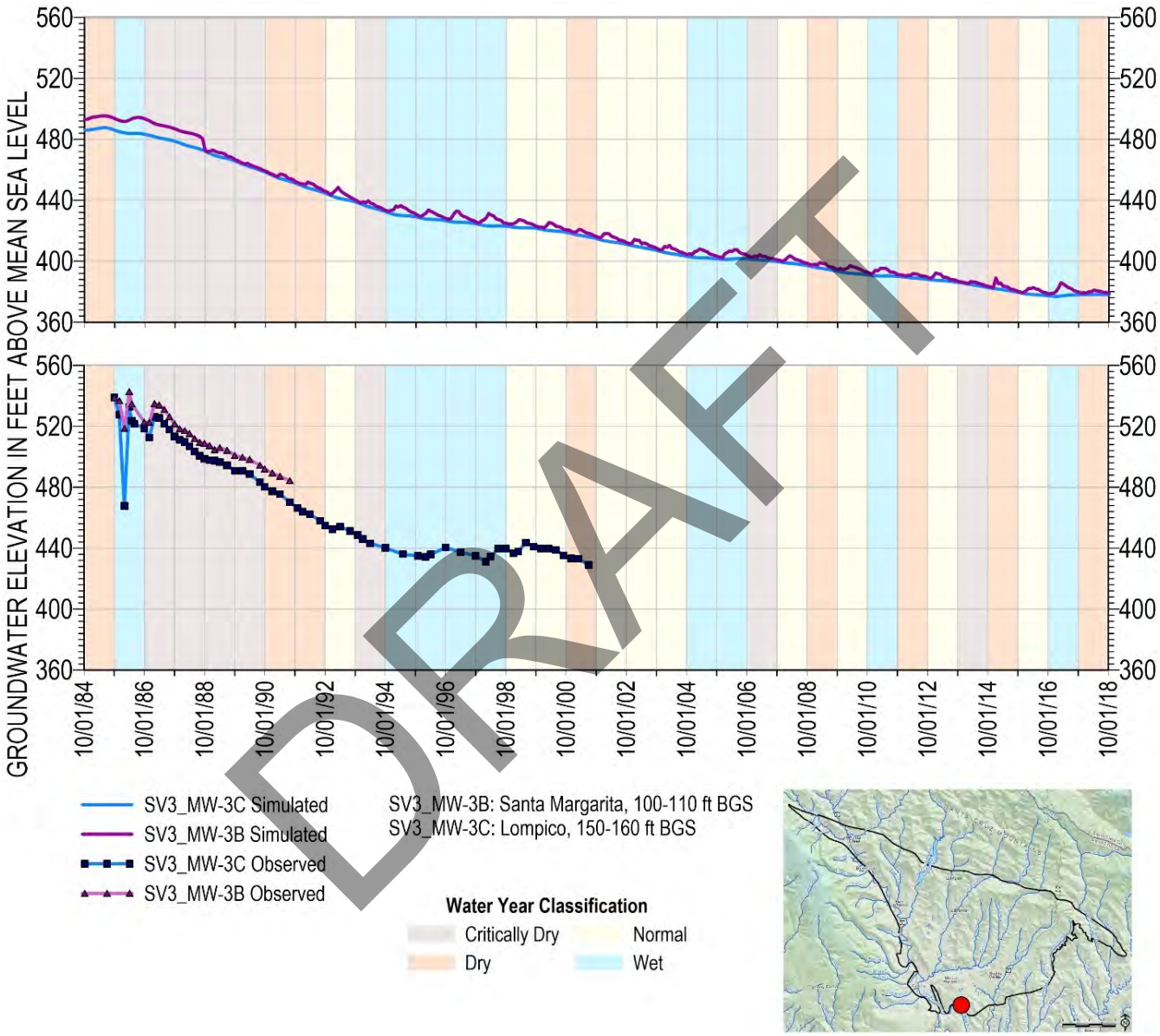

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Figure 48. EKI Vertical Graident Site 2

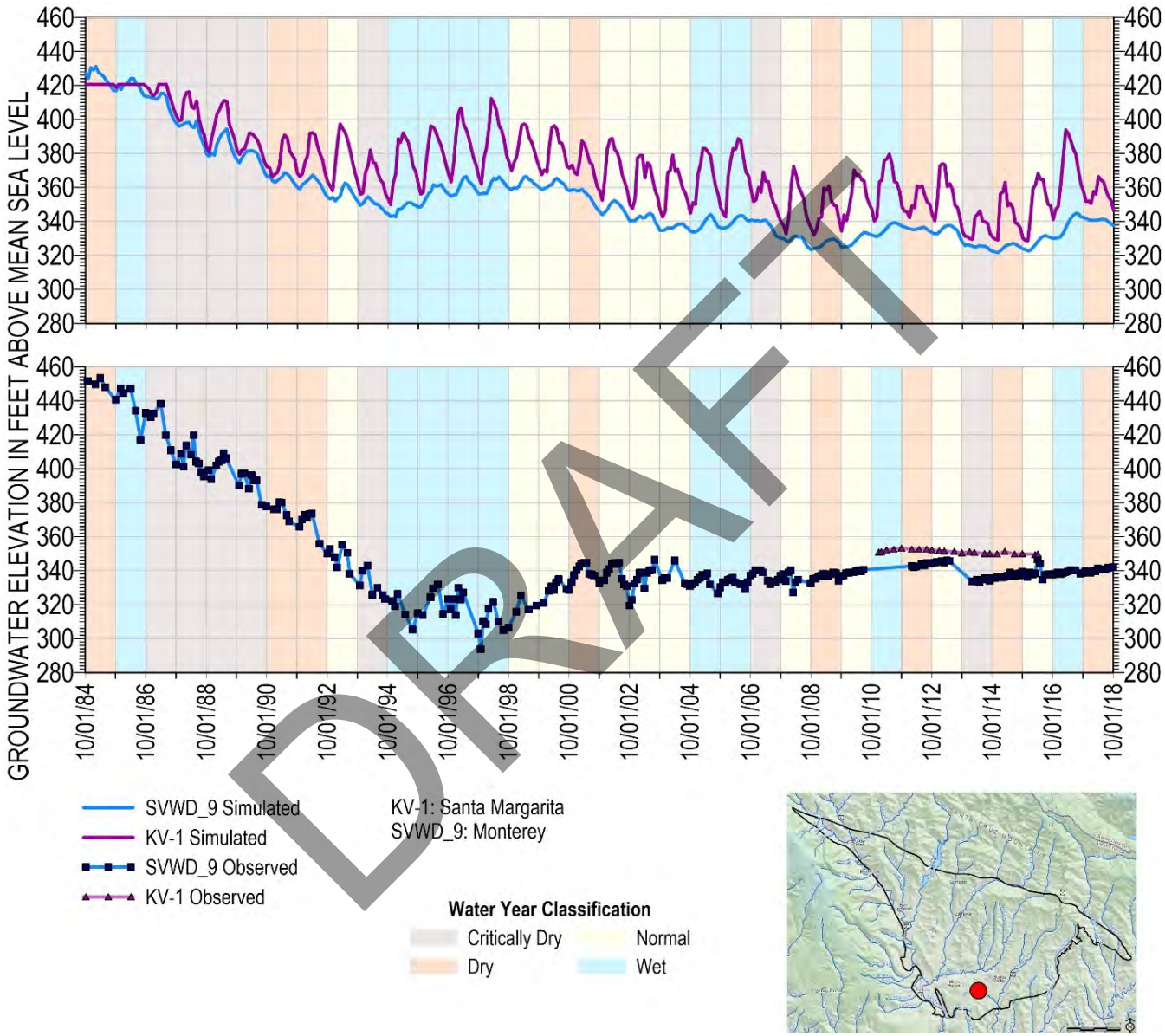

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Figure 49. EKI Vertical Gradient Site 4

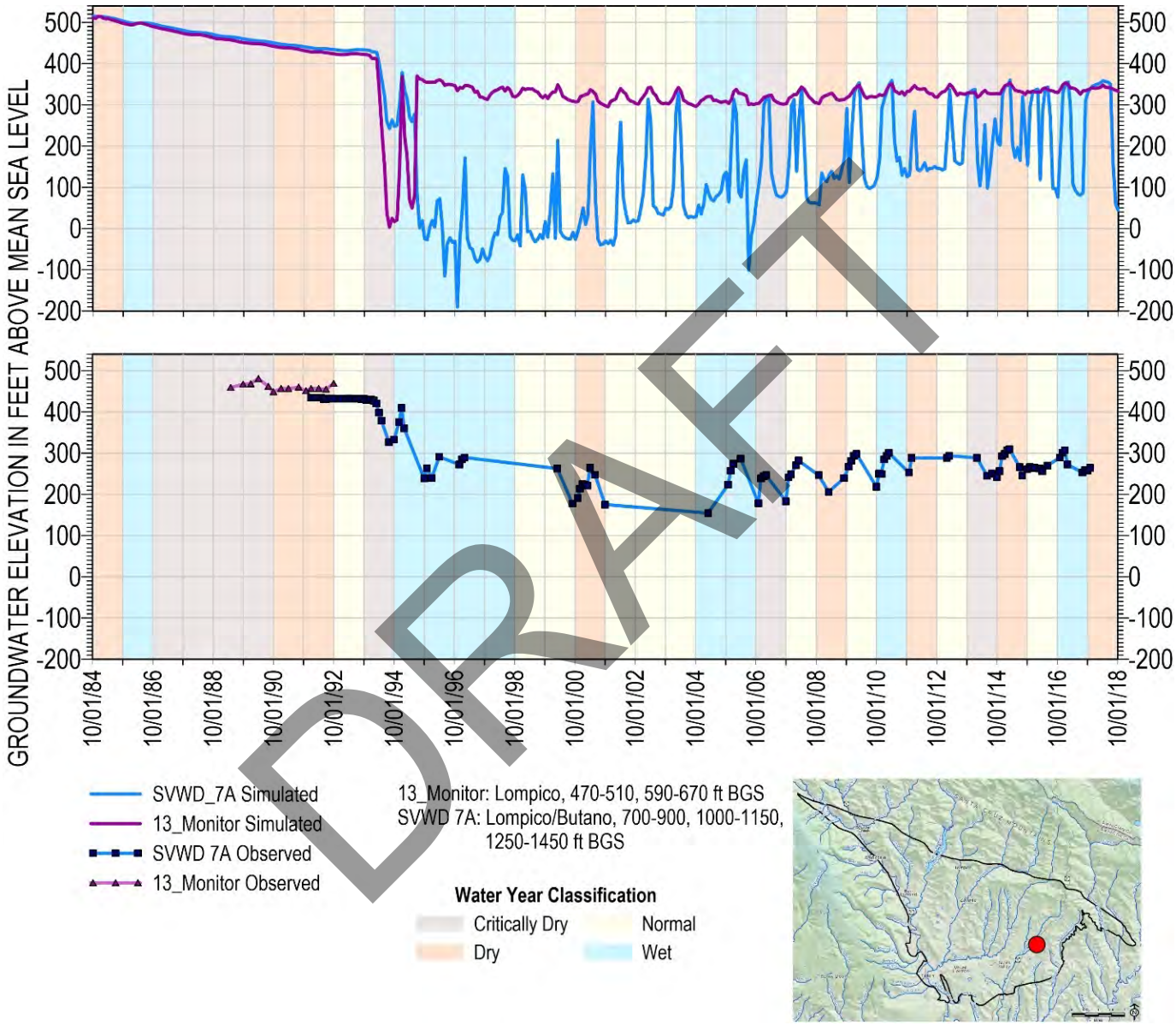

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Figure 50. EKI Vertical Gradient Site 9

7 PREDICTIVE SIMULATIONS

A predictive baseline simulation based on projected climate change has been developed to set up the M&A model for alternative predictive simulations. Alternate predictive simulations are developed to evaluate the effects of 2 groundwater management projects:

- Expanded conjunctive use of surface water and groundwater for in-lieu recharge of groundwater by increased surface water use and proportional reduction in groundwater use by SLVWD and SVWD
- Recharge of purified wastewater via injection wells

7.1 Projected Climate Change Scenario

EKI's recommendation 10 to include down-scaled climate change in projected hydrology is based on GSP regulation requirements for the GSP's projected water budget to incorporate projected climate change over the planning and implementation horizon. It also follows that model evaluation of expected benefits of projects and management actions over the planning and implementation horizon should also incorporate projected climate change. Projected climate change has been incorporated into the predictive simulations as described below.

7.1.1 Local Datasets for Climate Change

Although DWR provides projected climate change data sets for use in GSP development, DWR's guidance document on climate change data sets (DWR, 2018) states:

> *Local considerations and decisions may lead GSAs to use different approaches and methods than the ones provided by DWR for evaluating climate change. For example, the use of a transient climate change analysis approach may be appropriate where local models and data have been developed that include the best available science in that watershed or groundwater basin.*

While DWR's datasets are based on a climate period approach that incorporates the effects of climate change based on projected change from historical conditions to a specific future period (e.g. 2030 or 2070), transient climate change analysis evaluates the change of effects of climate change progressing over time (e.g., simulating the increasing effects of climate change from 2020 to 2070). Table 4 shows the local models and data that have previously been developed in the Basin's watershed and region.

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Table 4. Climate Change Model Scenarios Used Locally

Name	Primary Client	Primary Project	Description
Climate Catalog	Santa Cruz Mid-County Groundwater Agenecy	Santa Cruz Mid-County Basin GSP	Probabilistic selection of climate from historical years with higher weight for warmer years (HydroMetrics WRI, 2017)
GFDL2.1 A2	City of Santa Cruz	Water Supply Advisory Committee	Single global circulation model in the CMIP3 ensemble (Stratus et. al, 2015)
CMIP5 Mod (CC Projection 2 in Balance, 2020)	City of Santa Cruz	Habitat Conservation Plan	Statistical sample of multiple global circulation models in CMIP5 ensemble(Balance, 2020)

7.1.2 Simulated Climate Change Scenario

The predictive simulations use a transient climate change analysis that is a statistical sample of 4 global circulation models in the CMIP5 ensemble. A transient analysis is appropriate to represent inter-annual variability of precipitation that is indicated by recent research (Swain et al., 2018). The statistical sample is developed using the methodology implemented by Balance for the CMIP5 Mod scenario (Balance, 2020). The 4 global circulation models included in the statistical sample represent moderate overall conditions and are ACESS1-0.1, CCSM4.1, HADGEM2-CC.1, CANESM1 models of the RCP8.5 high emissions scenario.

As described by Balance (2020), precipitation is assigned on an annual basis based on whether the average annual rainfall for all samples is below (dry) or above (wet) the average annual rainfall for the entire projection period. For dry years, the sample representing the 10th percentile of annual rainfall is used. For wet years, the sample representing the 75th percentile of annual rainfall is used.

The following plots label the climate change scenario used for the Santa Margarita basin model predictive scenarios as “Four Model Ensemble 50-99.” Figure 51 shows the annual variability in precipitation for the Four Model Ensemble 50-99 compared to Climate Catalog used for the Santa Cruz Mid-County GSP, GFDL2.1 from the CMIP3 global circulation model ensemble used for the City of Santa Cruz Water Supply Advisory Committee, and GFDL CM3 from the more current CMIP5 ensemble. As designed, the annual variability in precipitation for the Four Model Ensemble 50-99 is greater than the other 3 scenarios. Figure 52 shows the cumulative departure from historical mean for Four Model Ensemble 50-99 compared to the historical mean. The Four Model Ensemble 50-99 ends up slightly drier than the historical mean and simulates a wetter than average period from 2023-2030, a predominantly average period from 2035-2045,

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and an extended drought from 2050-2064. These periods can be used to evaluate basin sustainability under a wide range of potential future climatic conditions.

The climate change scenario used for the predictive scenarios differs from CMIP5 Mod in that a warming trend is enforced. Temperature is assigned on an annual basis based on whether the average annual temperature for all samples is below (cooler) or above (warmer) the average annual temperature for the entire projection period. For the cooler years, the sample representing the 50th percentile of annual temperature is used. For the warmer years, the sample representing the 99th percentile of annual temperature is used.

Figure 53 shows how the simulated temperature of the Four Model Ensemble 50-99 translates to reference evapotranspiration used in the predictive simulations compared to the three other scenarios. Reference evapotranspiration increases over time in the predictive simulations consistent with the expected warming trend due to climate change.

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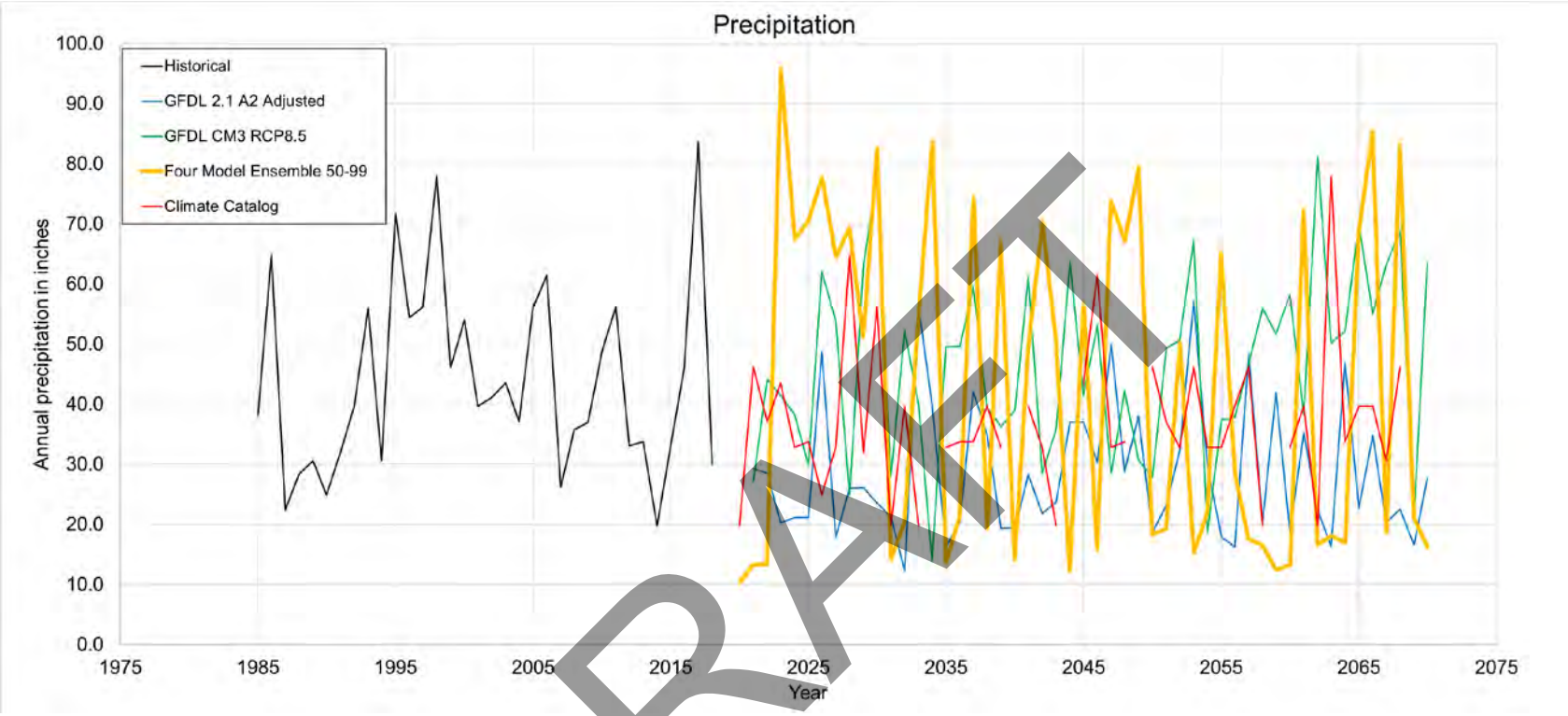

Figure 51. Precipitation Variability between Climate Models

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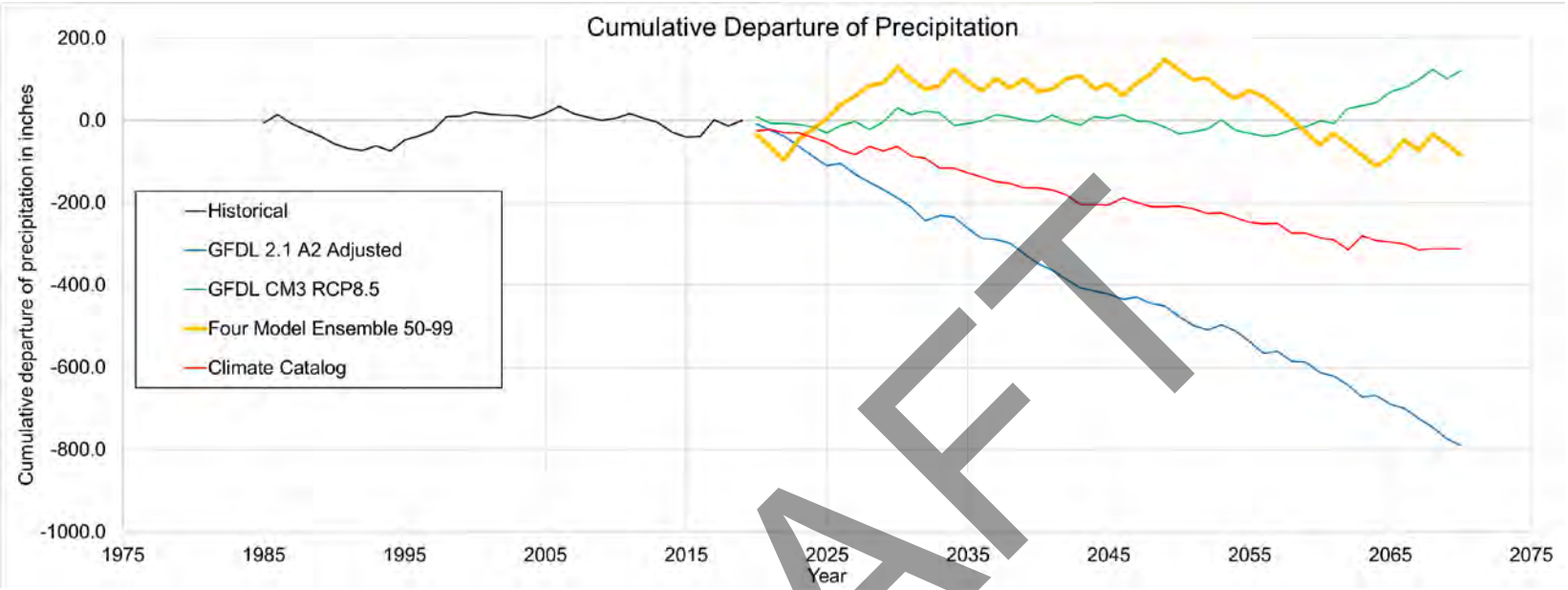

Figure 52. Variation of Cumulative Departure of Precipitation between Climate Models

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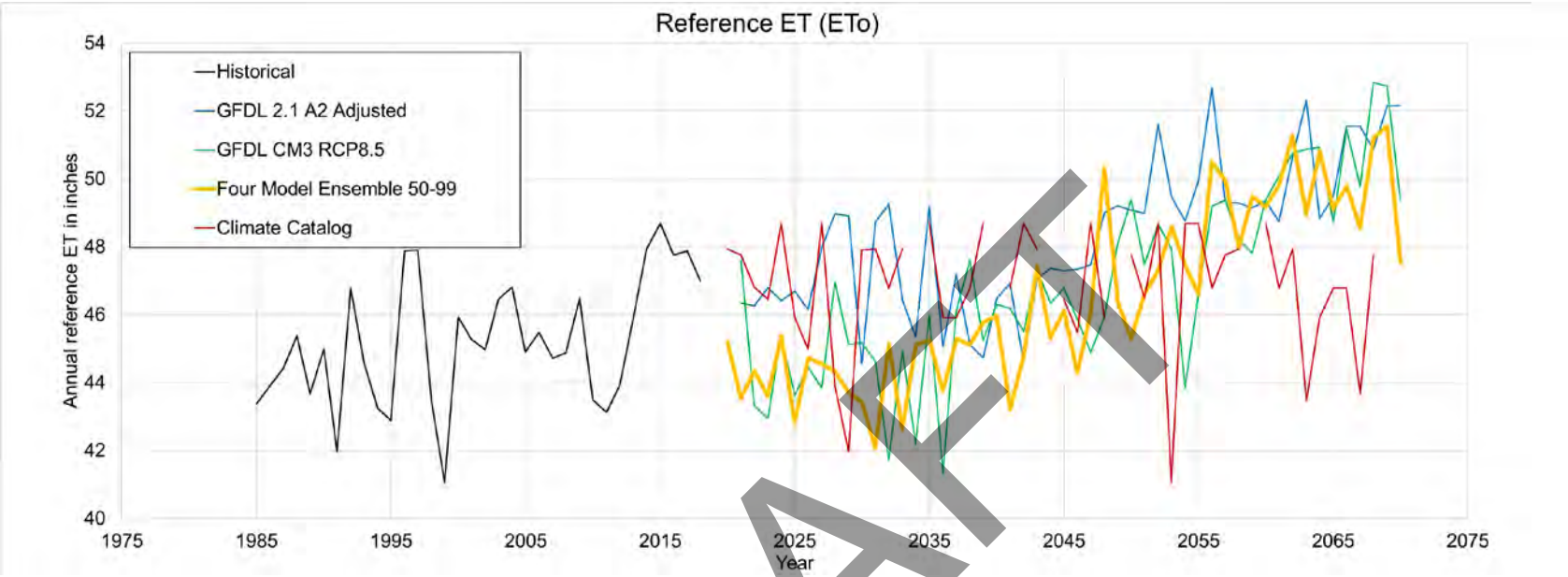

Figure 53. Variation of Annual Reference ET Betweeen Climate Models

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7.2 Baseline Simulation

A 54-year predictive baseline simulation was developed starting from WY2019, which is the year following the last water year of the calibrated model, through WY2072. The predictive period covers the 50-year GSP planning and implementation horizon from WY2022 through WY2072 as required by the SGMA. A baseline simulation is needed to evaluate the impact on the Basin from potential projects and management actions to be implemented to achieve sustainability by 2042.

7.2.1 Baseline Groundwater Extraction

Where available, actual measured data for groundwater pumping is used for WY2019 and WY2020. For WY2021 through WY2072 the following assumptions are made regarding groundwater pumping and water use:

- **Private domestic pumping:** since there are no meters on private well owner wells, metered pumping from small water systems that are required to be metered is used to determine a likely WUF. For the entire predictive period, the WUF remains constant at 0.3 AFY and there is no assumed increase in rural population over time. The amount of pumping each month is based on the seasonal distribution of SVWD's residential potable water demand consistent with the historical simulation of the M&A model.
- **Small Water Systems pumping:** where available, metered pumping data reported to County of Santa Cruz are used. In cases where there are gaps in reported pumping, the same annual pumping and monthly distribution used in the historical simulation of the M&A model is used for the predictive period.
- **Mount Hermon Association pumping:** the current residential area in MHA is built out and thus no increase in water demand is assumed over the predictive period. Since there are large areas of turf irrigation in MHA, annual groundwater pumping is varied by predicted water year type from projected climate described in Section 7.1.2. Average annual groundwater pumping for each of the 4 water year types is calculated, and that average pumping is applied to predicted water year types to arrive at predicted MHA annual pumping which is then distributed using the same monthly distribution used in the historical simulation of the M&A model.
- **San Lorenzo Valley Water District water demand and well pumping:** annual water demand increase is assumed to be 0.18% over the predictive period. Historical rainfall and diversion data are used to provide an approximate correlation between annual rainfall versus annual diversions. The historical correlation is applied to predicted annual rainfall from climate change hydrology (Section 7.1.2) to arrive at predicted surface water

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diversions. Groundwater pumping makes up the difference between water demand and surface water diversions. An adjustment is made to October through March 2021 surface water diversions where diversions are assumed to be zero because of damage to SLVWD's surface water systems caused by the August CZU Lightning Complex fire. During the months where there are no surface water diversions, groundwater pumping is increased to meet water demand. The distribution of pumping by well is based on the distribution of actual pumping during September 2020.

- **Scotts Valley Water District water demand and well pumping:** the amount of groundwater pumping from WY2021 through 2072 is based on an assumed water demand increase of 0.3% per year (2015 Urban Water Management Plan (UWMP), Kennedy/Jenks Consultants, 2016) starting at actual WY2020 water demand. It is noted that the demand increase used for the predictive simulation is higher than the 2020 UWMP projection of 0.15% (WSC and M&A, 2021) which was developed after the predictive simulations were developed. Reasons for the lower rate of demand increase is because system water losses are expected to decrease 10% by 2040 due to water use efficiency measures such as advanced metering infrastructure, leak detection and reduction, WaterSmart technology, and active promotion of lawn rebates. Due to a reduction in recycled water demand in Scotts Valley, projected recycled water use each year is held constant at 200 AFY. Groundwater pumping makes up the difference between water demand and recycled water use.

7.2.2 Results of Baseline Simulation

Predicted groundwater level results for baseline simulation are shown on hydrographs for all RMPs on Figure 56 through Figure 69.

Minimum thresholds for sustainable management criteria as defined by GSP Section 3 for RMPs are shown in Table 5. Minimum thresholds are an average of the 5 lowest groundwater level measurements in the historical period. Each projected hydrograph is shifted by an average offset between measured and simulated groundwater levels in the calibrated model for improved fit. This allows for a more representative interpretation of projected water levels relative to measured historical data.

Most RMPs fall below minimum thresholds once extended drought occurs in WY2052. SLVWD Pasatiempo MW-2 (Figure 57), SVWD #9 (Figure 62), SLVWD Pasatiempo MW-1 (Figure 63), SVWD #10 (Figure 64), and SVWD TW-19 (Figure 66) maintain projected groundwater levels above their corresponding minimum thresholds without any projects and management actions.

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7.3 Expanded Conjunctive Use with Loch Lomond (In-Lieu Recharge)

Expanded conjunctive use with the addition of SLVWD's entitlement to a portion of Loch Lomond water facilitates in-lieu recharge of the aquifers pumped by SLVWD and SVWD in the wet season months. The volumes of surface water available for conjunctive use are based on projected availability of surface water to satisfy SLVWD and SVWD demand during November through April. The following surface water sources are considered:

- 313 AFY from Loch Lomond, based on a draft agreement between SLVWD and the City of Santa Cruz (Exponent, 2019).
- Additional surface water diversions from North System streams tributary to the San Lorenzo River, subject to physical projected surface water availability, includes Peavine Creek, Foreman Creek, Clear Creek, and Sweetwater Creek.
- Additional surface water diversions from Felton System streams tributary to the San Lorenzo River, subject to both physical projected surface water availability and administrative constraints, includes Fall Creek, Bennet Spring, and Bull Creek.

Figure 54 shows the locations of SLVWD surface water diversions from the creeks listed above. Expansion of existing conveyance and treatment infrastructure would be required for the additional surface water diversions considered as part of this simulation. For modeling purposes, it is assumed that the infrastructure necessary for additional surface water diversion would be completed by WY2025.

Legal rights to transfer surface water outside of the SLVWD system from which the diversion takes place is not explicitly considered as part of this evaluation. In other words, it is assumed that any necessary surface water permits required to support additional surface water diversions will be in place by WY2025.

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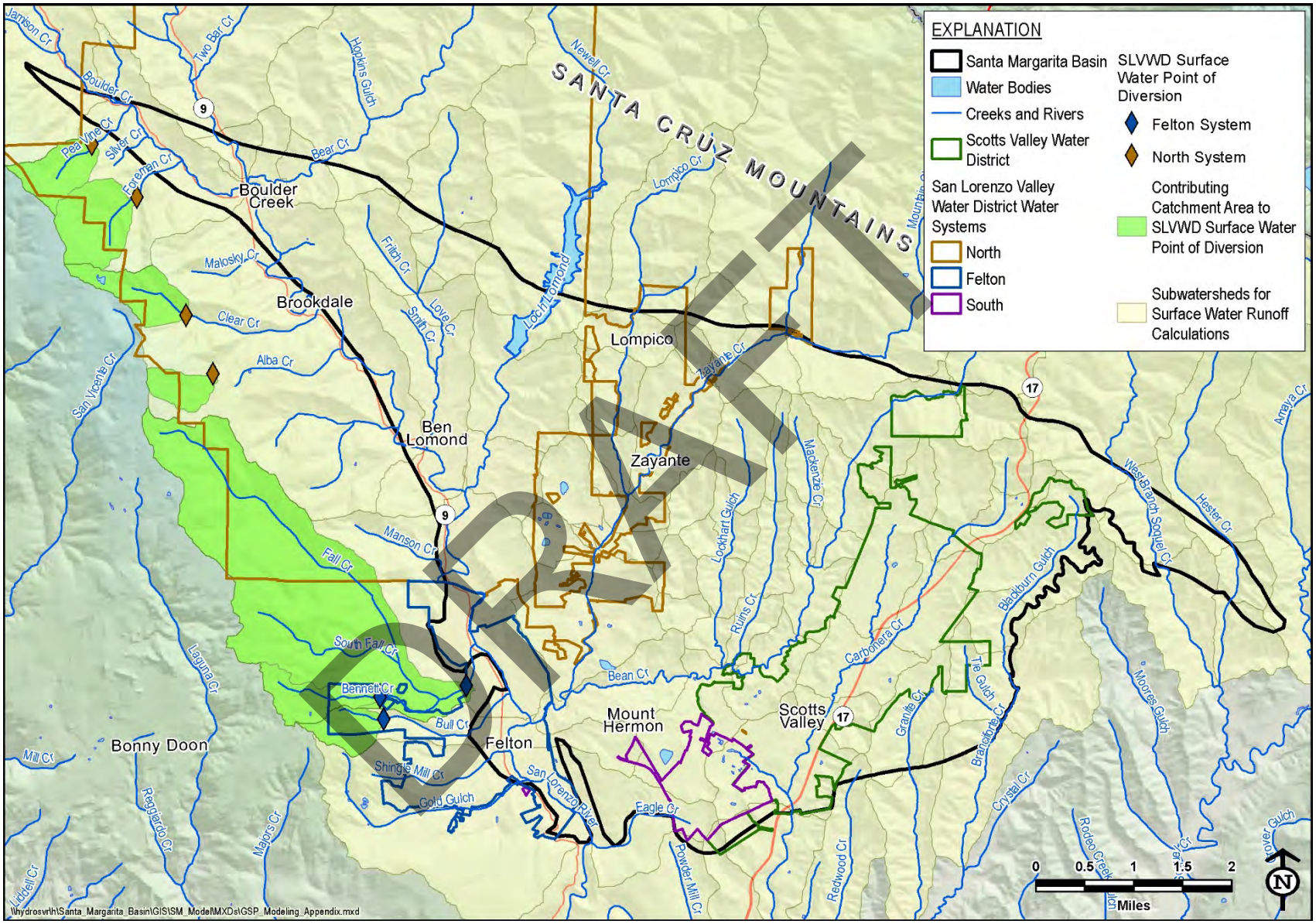

Figure 54. Location of SLVWD Surface Water Diversions

7.3.1 Projected Physical Availability of Surface Water

The physical availability of surface water is projected using the same assumptions and calculations used to determine surface water flows generated both inside and outside of the Basin (Section 5.1.3).

Surface water runoff calculations used to provide input to the groundwater model are at the subwatershed scale. The contributing area for each SLVWD point of diversion is smaller than the subwatersheds for which surface water runoff was calculated (Figure 54). Projected surface water runoff for each point of diversion is therefore rescaled to its corresponding contributing area by multiplying surface water runoff for the subwatershed area by the ratio of the contributing area to the subwatershed area for each point of diversion.

The surface water runoff calculations described in Section 5.1.3 do not explicitly consider or quantify baseflow or hydrograph recession following precipitation. Consequently, zero surface water runoff is calculated during a spring month with zero precipitation, even if that month was preceded by several months with above-average precipitation. This approach is used because evaluating and simulating watershed rainfall-runoff responses was outside the scope of the GSP model. However, baseflow in streams used for SLVWD surface water diversions is relevant for the purposes of determining how much additional surface water would be available to support in-lieu recharge.

Monthly streamflow for the streams used for in-lieu recharge is estimated as the cumulative runoff less the cumulative diversion over preceding months during each water year. For example, January streamflow would be computed as total October through January runoff less total October through January surface water diversions. The purpose of this simplified approach is to approximate the concept of surface water baseflow, even though baseflow is not explicitly quantified by the surface water runoff calculations used for the model.

7.3.2 Assumed Administrative Constraints on Additional Surface Water Use

In addition to water physically available in the stream, additional surface water diversions for conjunctive use are assumed to be constrained by the conditions of relevant surface water diversion permits.

Loch Lomond: It is assumed that Loch Lomond releases will be limited to 313 AFY.

SLVWD North System: It is assumed that additional diversions from streams in the SLVWD North System are limited solely to the water physically available in the creeks.

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SLVWD Felton System: Additional diversions from creeks serving the Felton System are assumed to be limited by the following constraints (Exponent, 2019):

- Minimum Fall Creek winter (November 1 through March 31) bypass flow of 0.75 cfs for dry years, and 1.5 cfs for otherwise. Dry years are defined based on cumulative flow volume in the San Lorenzo River at Big Trees from the beginning of the water year, and it should be noted that the administrative definition of dry year used to constrain Felton System diversions differs from the definition of dry year used for the GSP.
- Maximum diversion rate of 1.7 cfs
- Maximum annual diversion volume of 1,059 AF

Furthermore, it is assumed that diversions from streams serving the Felton System are permitted only if streamflow in the San Lorenzo River at Big Trees is at least 20 cfs (Exponent, 2019). Projected streamflow in the San Lorenzo River at Big Trees as simulated in the baseline simulation was used to identify dry years and months with streamflow less than 20 cfs.

7.3.3 Reductions to Projected Groundwater Pumping

Reductions of groundwater pumping for in-lieu recharge is preferentially allocated to the SLVWD Pasatiempo wellfield and all SVWD extraction wells. This assumes, as noted in Section 7.3, that additional surface water can be treated and conveyed to the point of use. November through April groundwater pumping is reduced monthly as follows:

1. 313 AFY Loch Lomond water is used to offset SLVWD Pasatiempo wellfield pumping, followed by SVWD pumping.
2. SLVWD North System surface water is used to first offset SLVWD Pasatiempo pumping, followed by SVWD pumping. Any remaining surface water is used to offset SLVWD pumping from its Olympia and Quail Hollow wellfields. On average 99 AFY of surface water is used conjunctively from the North System over the predictive period.
3. SLVWD Felton System surface water is used to first offset SLVWD Pasatiempo pumping, followed by SVWD pumping. Any remaining surface water is used to offset SLVWD pumping from its Olympia and Quail Hollow wellfields. On average 128 AFY of surface water is used conjunctively from the Felton System over the predictive period.

Figure 55 shows projected groundwater pumping and surface water diversions by water district based on the conjunctive use evaluation described above. From WY2025 through WY2072,

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average groundwater pumping reductions by SLVWD and SVWD are 170 AFY and 370 AFY respectively, for a total average of 540 AFY.

Note that the estimate of available surface water for conjunctive use is only preliminary since there are future water rights change applications planned by the City of Santa Cruz and SLVWD that would change assumptions used in developing this preliminary estimate.

7.3.4 Results of Expanded Conjunctive Use

Predicted groundwater level results for simulation of 540 AFY of expanded conjunctive use are shown on hydrographs for all RMPs on Figure 56 through Figure 69.

Expanded conjunctive use predicted groundwater levels show little improvement in all Santa Margarita aquifer wells (Figure 56 through Figure 61) and in Stonewood Well in Butano aquifer well (Figure 69), but indicate a benefit in achieving minimum thresholds before the extended drought in the remaining wells in Monterey Formation, Lompico aquifer, and Butano aquifer (Figure 62 through Figure 68). Predictive groundwater levels begin to fall below minimum thresholds during the extended drought starting in WY2052 (Figure 62 through Figure 68).

7.4 Recharge by Injection Only

The injection only simulation was developed to determine improvements to Lompico aquifer groundwater levels due to aquifer recharge by injection. The source of injection water is not a consideration for purposes of modeling, although Section 4 of the GSP describes some potential sources. The simulation assumes a constant volume of 710 AFY is injected at 3 injection wells located near the SVWD's El Pueblo yard and injection is distributed uniformly over each month. The simulation assumes the injected water is left in the aquifer and not pumped out.

Predicted groundwater level results for simulation of 540 AFY of expanded conjunctive use with 710 AFY of injection of the Lompico aquifer are shown on hydrographs for all RMPs on Figure 56 through Figure 69.

Measurable objectives for sustainable management criteria as defined by GSP Section 3 for RMPs are shown in Table 5. Results from expanded conjunctive use for WY2040 are used to determine measurable objectives for RMPs at Monterey Formation, Lompico aquifer, and Butano aquifer. Santa Margarita aquifer RMP measurable objectives are based on historical values in WY2004.

Predicted groundwater levels from expanded conjunctive use with injection only share similar results as described in Section 7.3.3 where there is minimal benefit in Santa Margarita aquifer

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wells (Figure 56 through Figure 61) and Stonewood Well in Butano aquifer (Figure 69), but more favorable benefit in the remaining wells in the Monterey Formation, Lompico aquifer, and Butano aquifer (Figure 62 through Figure 68). Expanded conjunctive use with injection action can maintain predictive groundwater levels above measurable objectives and minimum thresholds throughout the entire projection period from WY2021 through WY2072 (Figure 62 through Figure 68).

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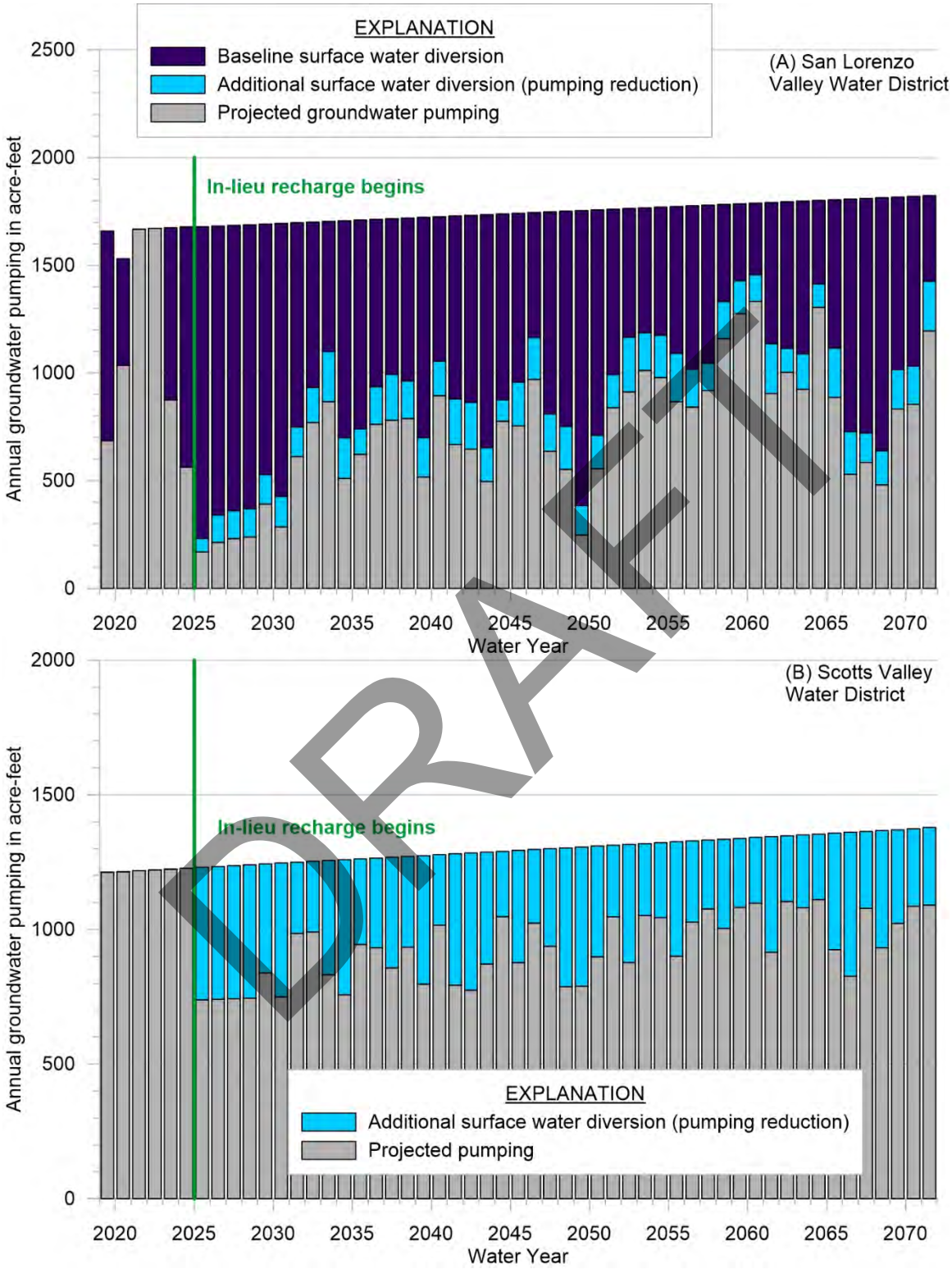

Figure 55. Projected Groundwater Pumping and Surface Water Diversion by Water District

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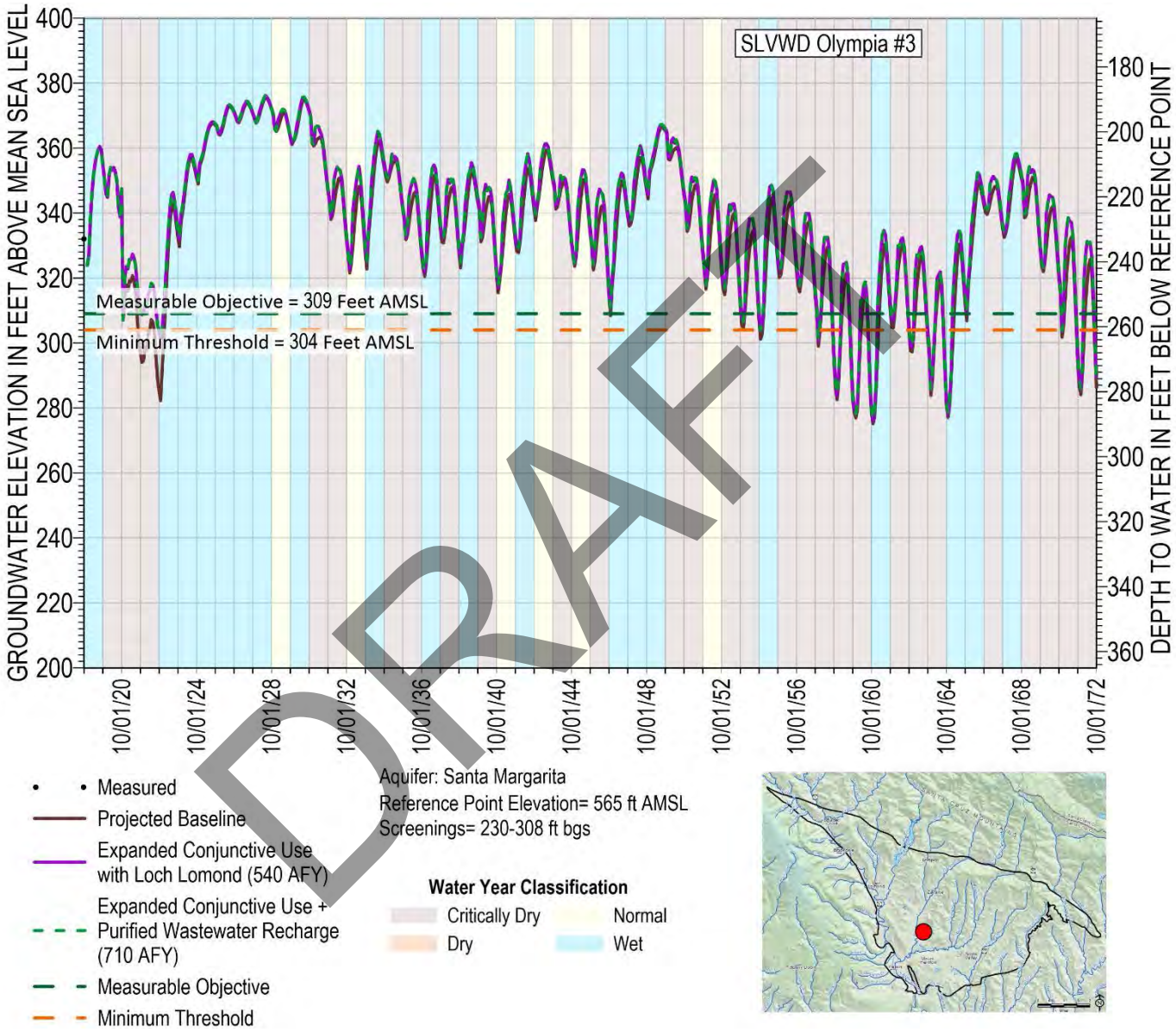

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Figure 56. SLVWD Olympia #3 Projected Hydrograph

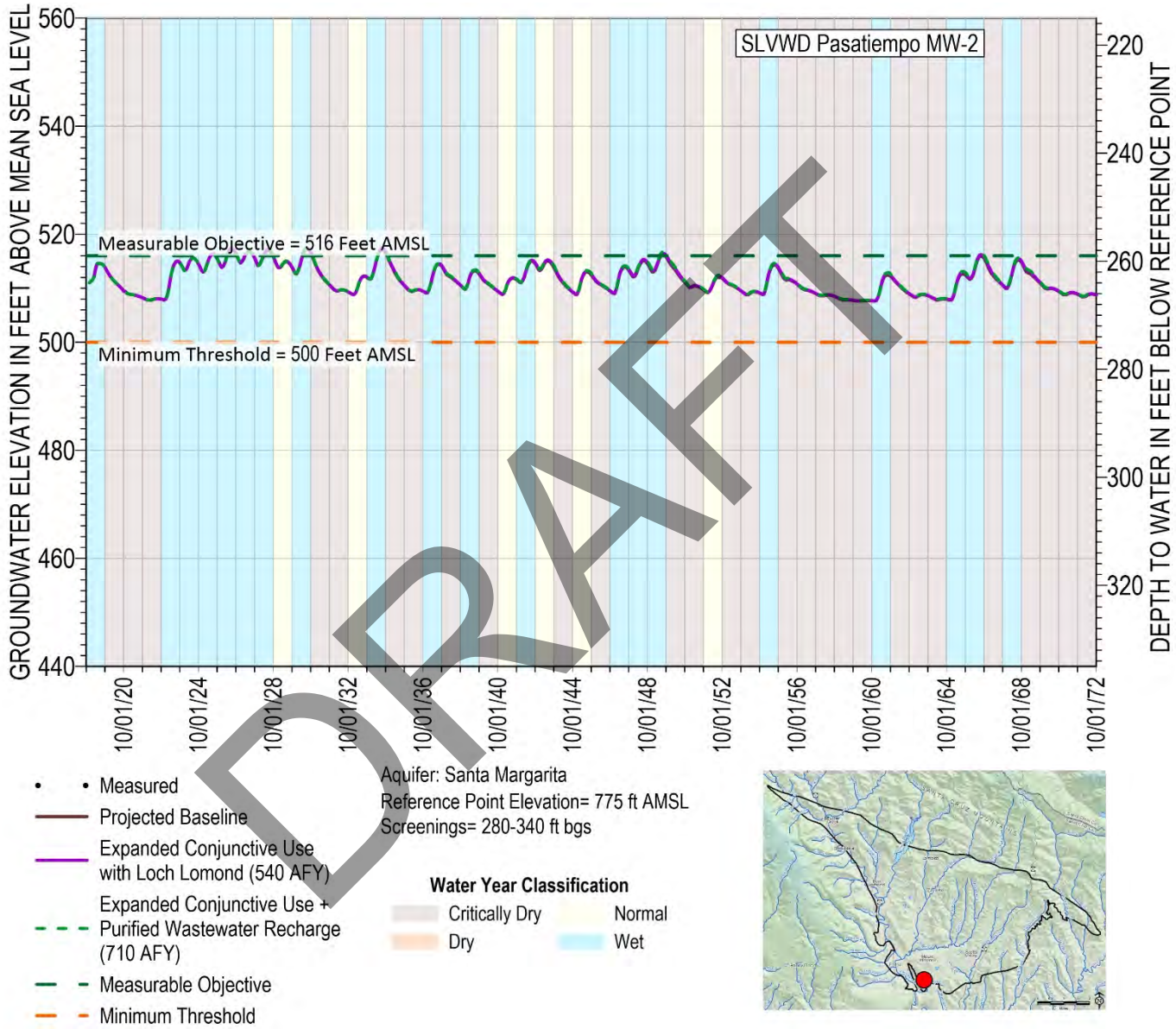

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Figure 57. SLVWD Pasatiempo MW-2 Projected Hydrograph

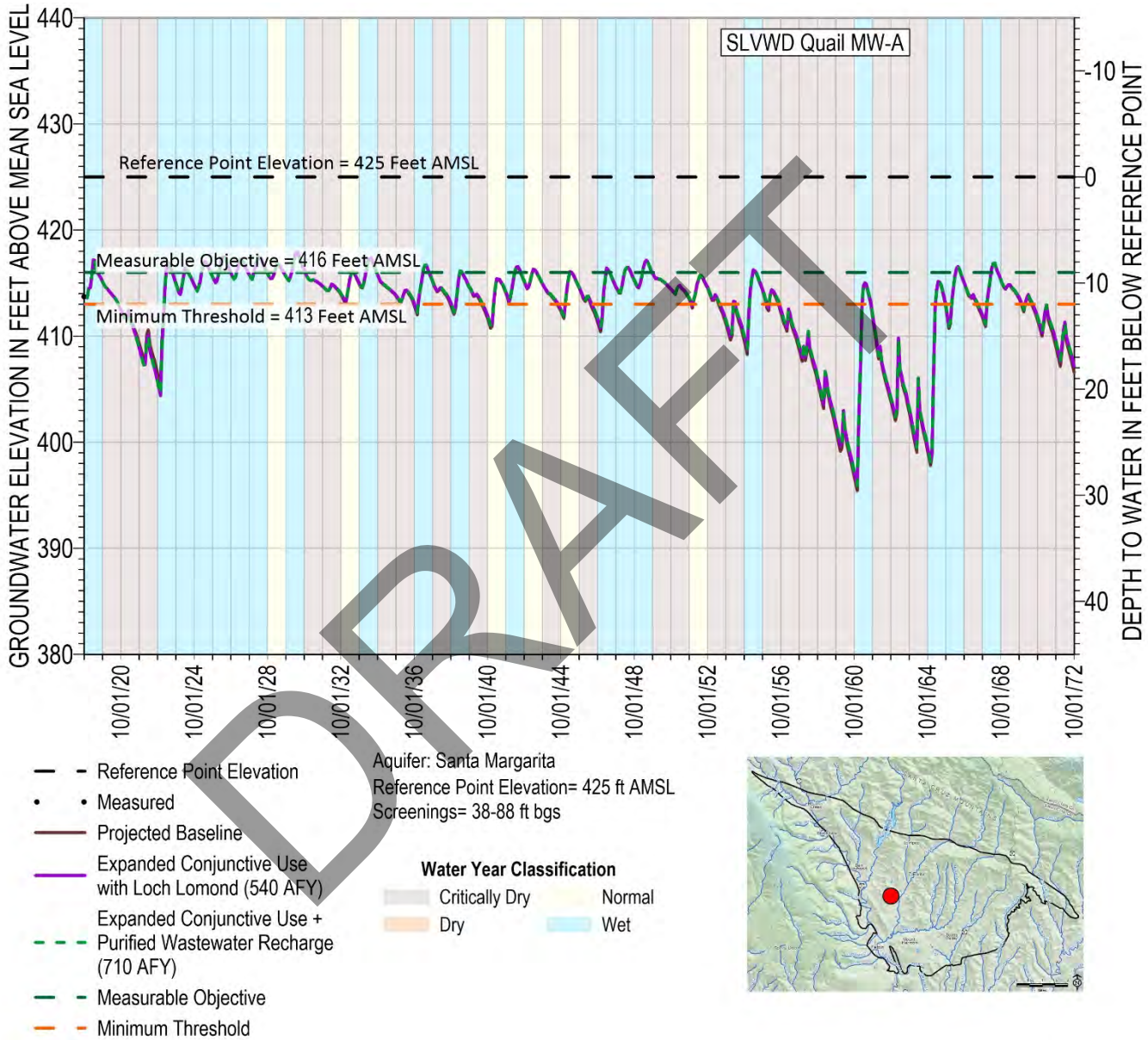

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Figure 58. SLVWD Quaill MW-A Projected Hydrograph

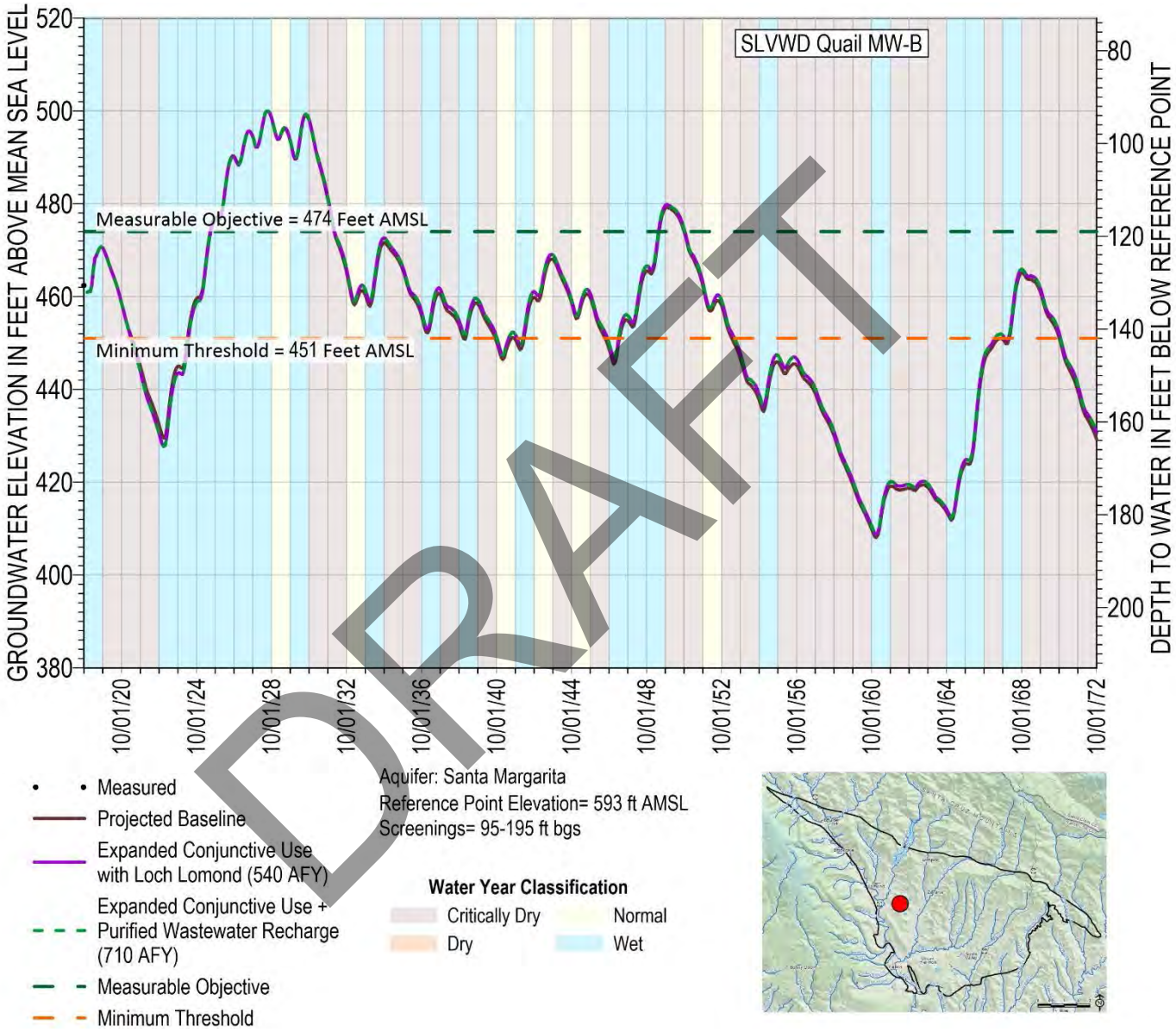

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Figure 59. SLVWD Quail MW-B Projected Hydrograph

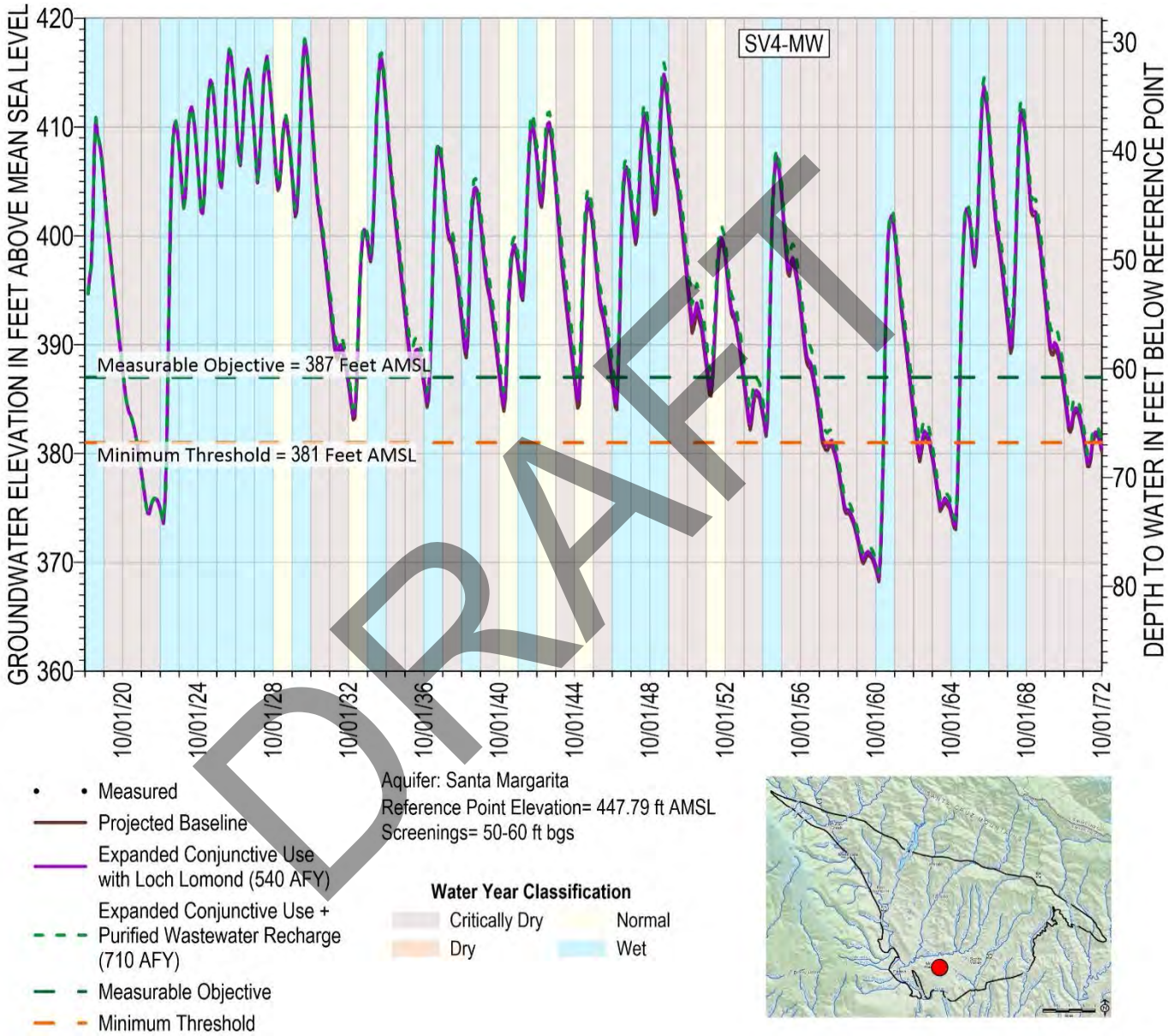

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Figure 60. SV4-MW Projected Hydrograph

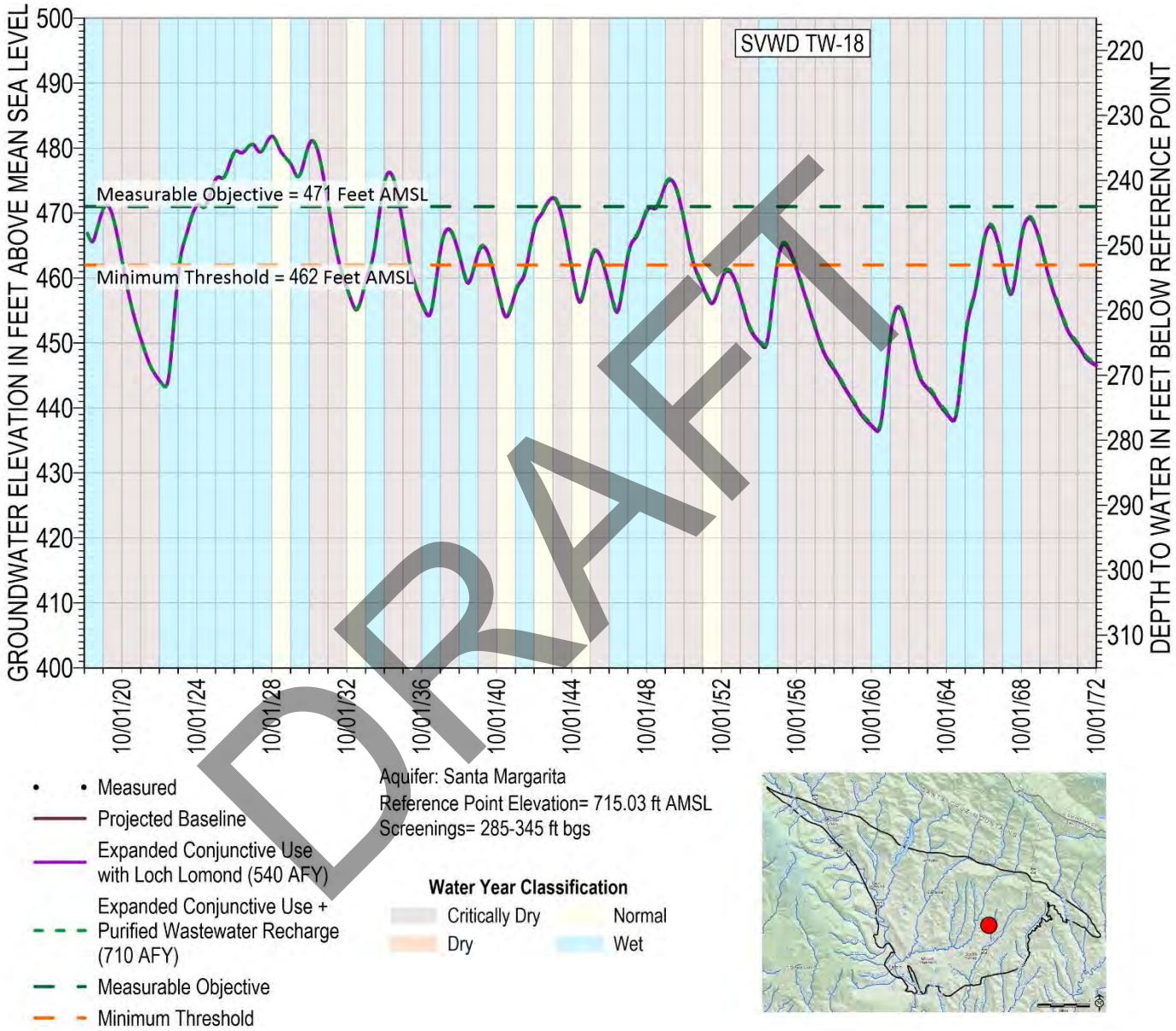

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Figure 61. SVWD TW-18 Projected Hydrograph

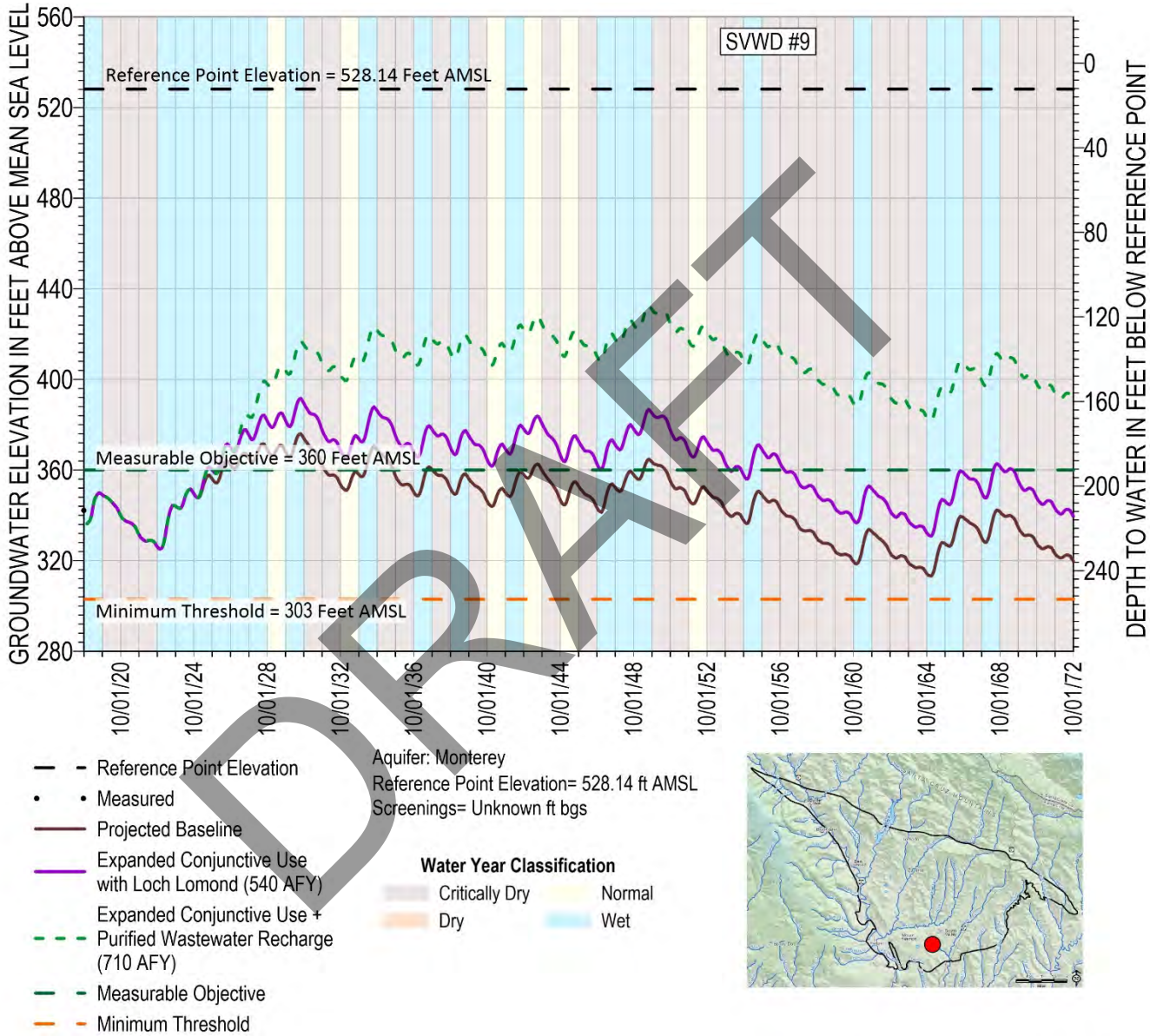

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Figure 62. SVWD #9 Projected Hydrograph

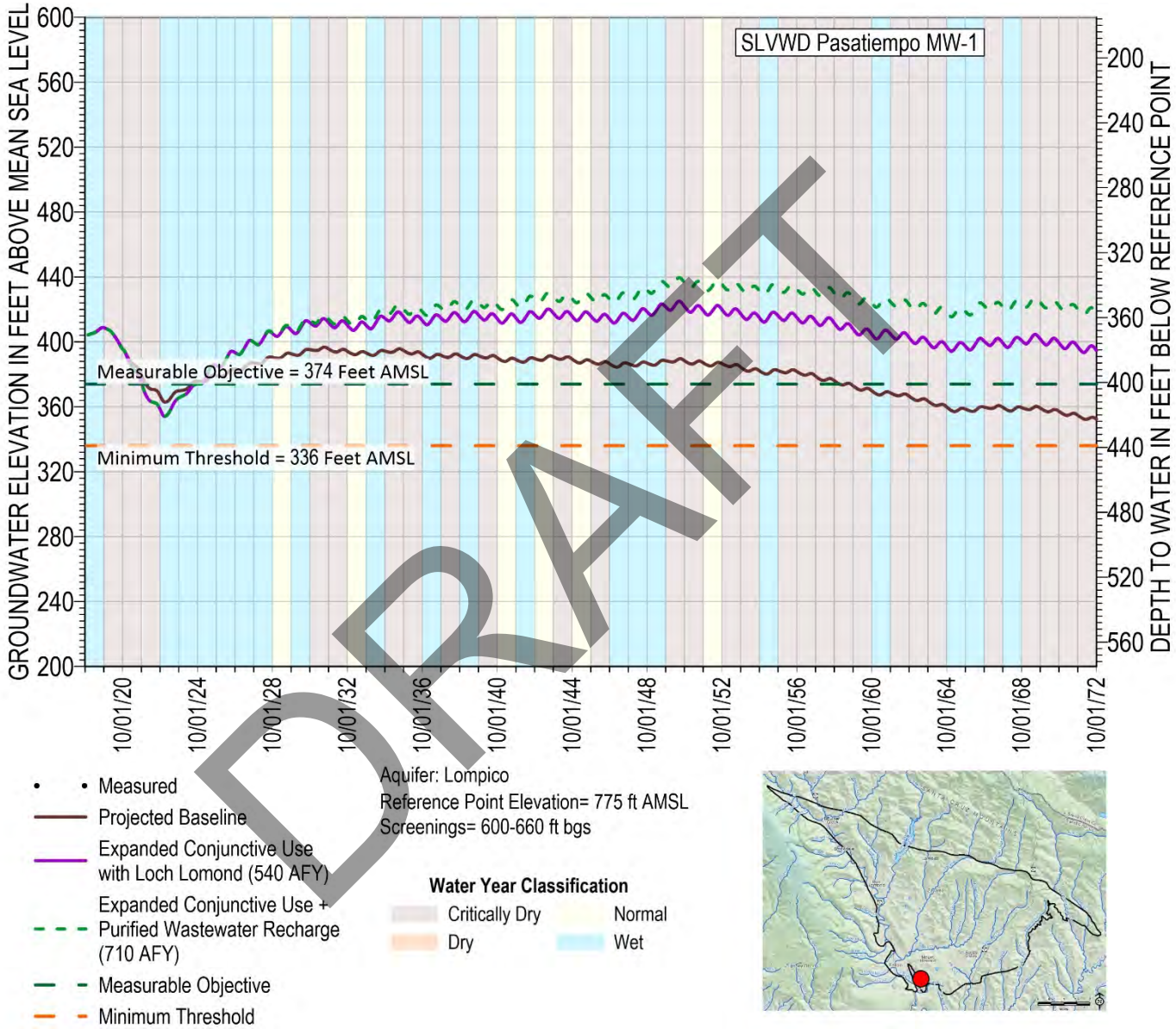

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Figure 63. SLVWD Pasatiempo MW-1 Projected Hydrograph

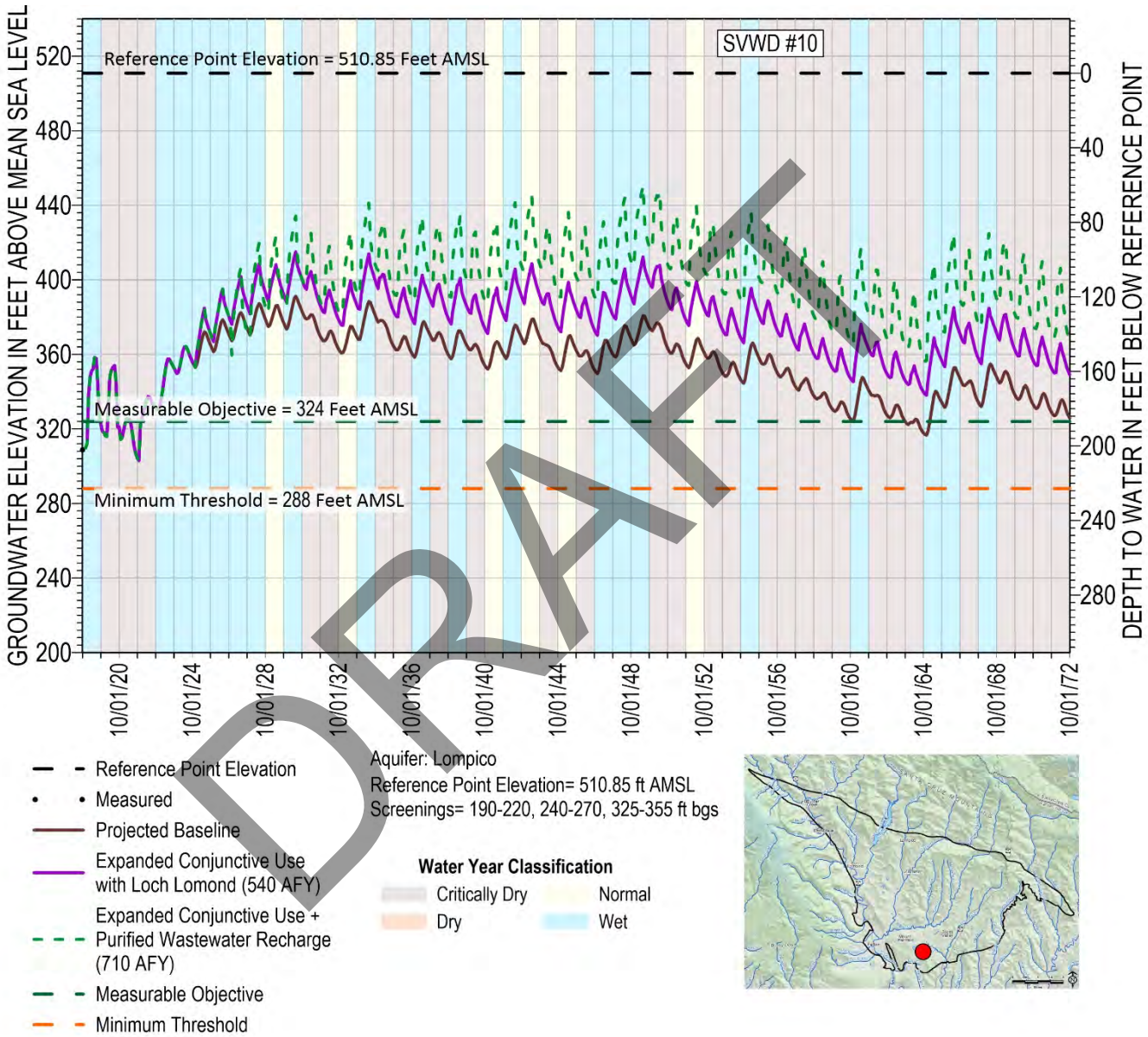

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Figure 64. SVWD #10 Projected Hydrograph

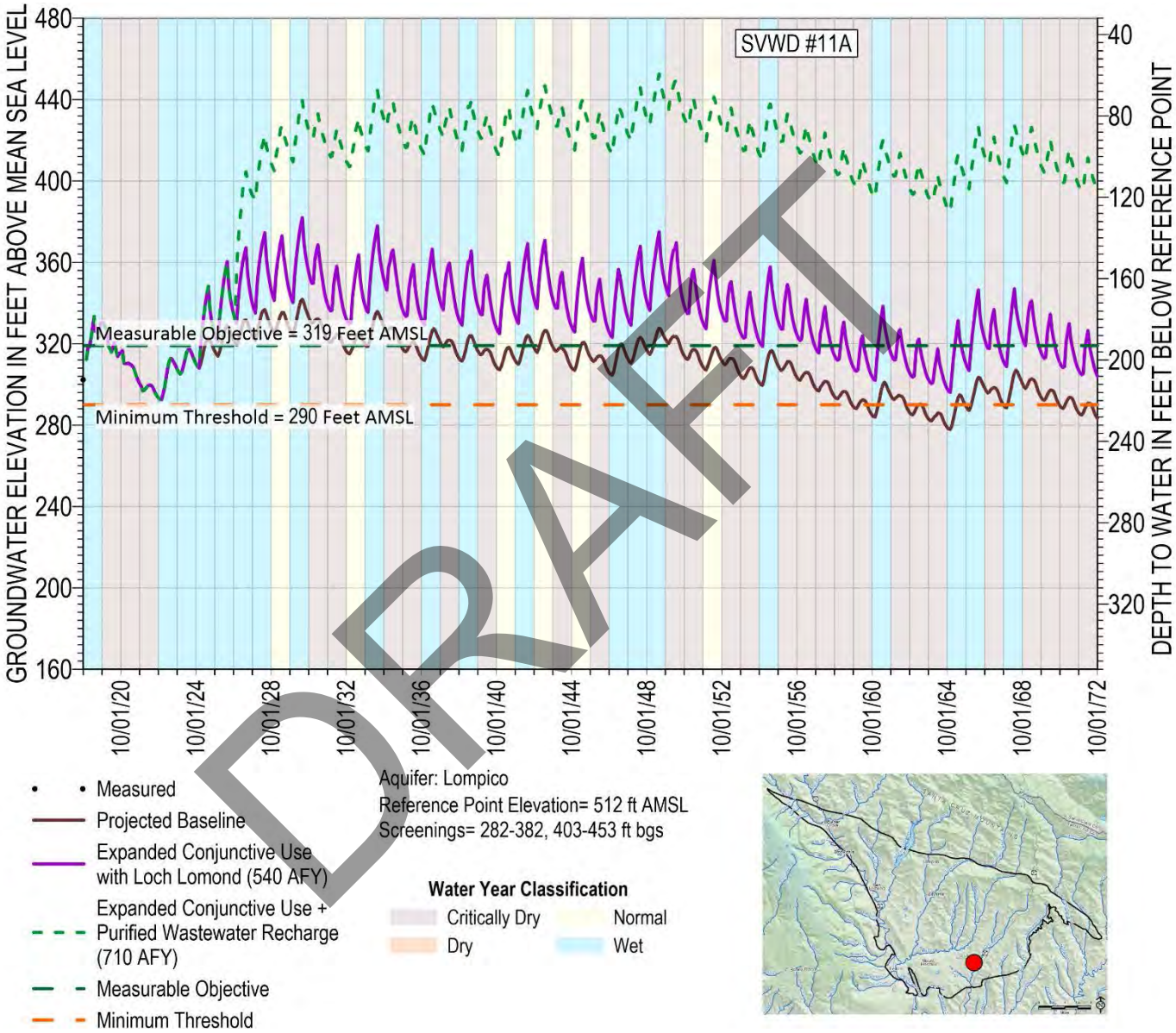

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Figure 65. SVWD #11A Projected Hydrograph

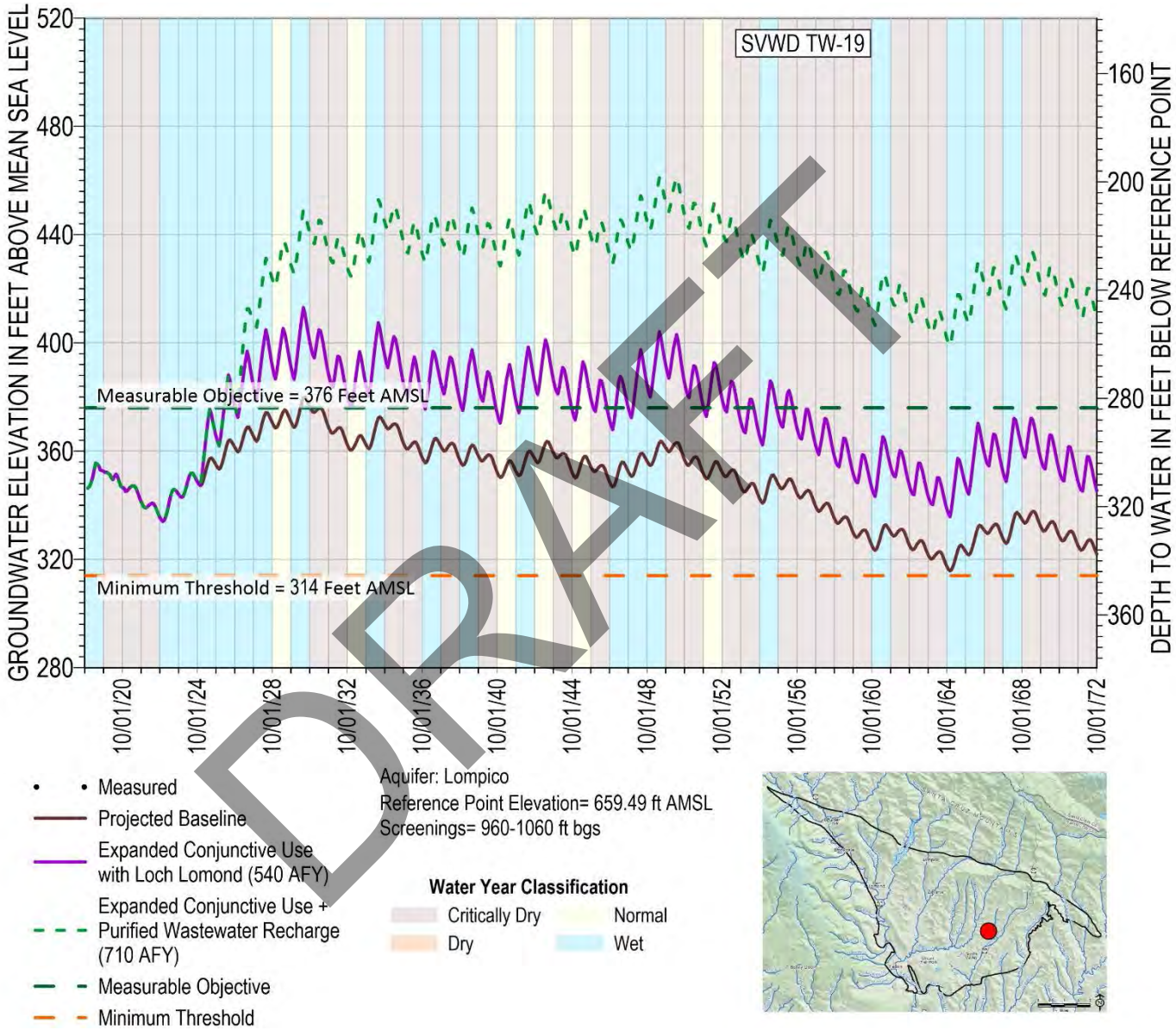

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Figure 66. SVWD TW-19 Projected Hydrograph

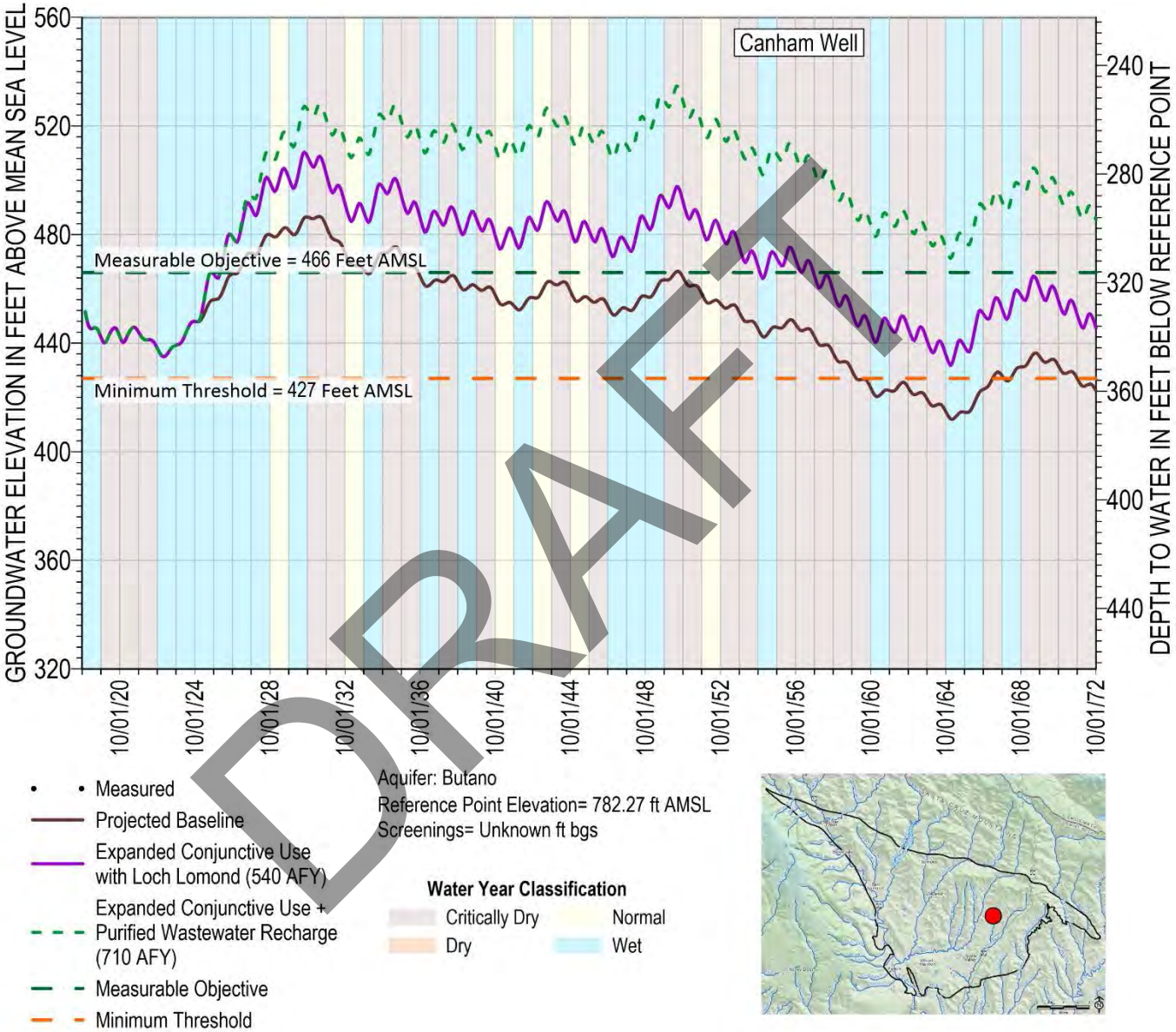

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Figure 67. Canham Well Projected Hydrograph

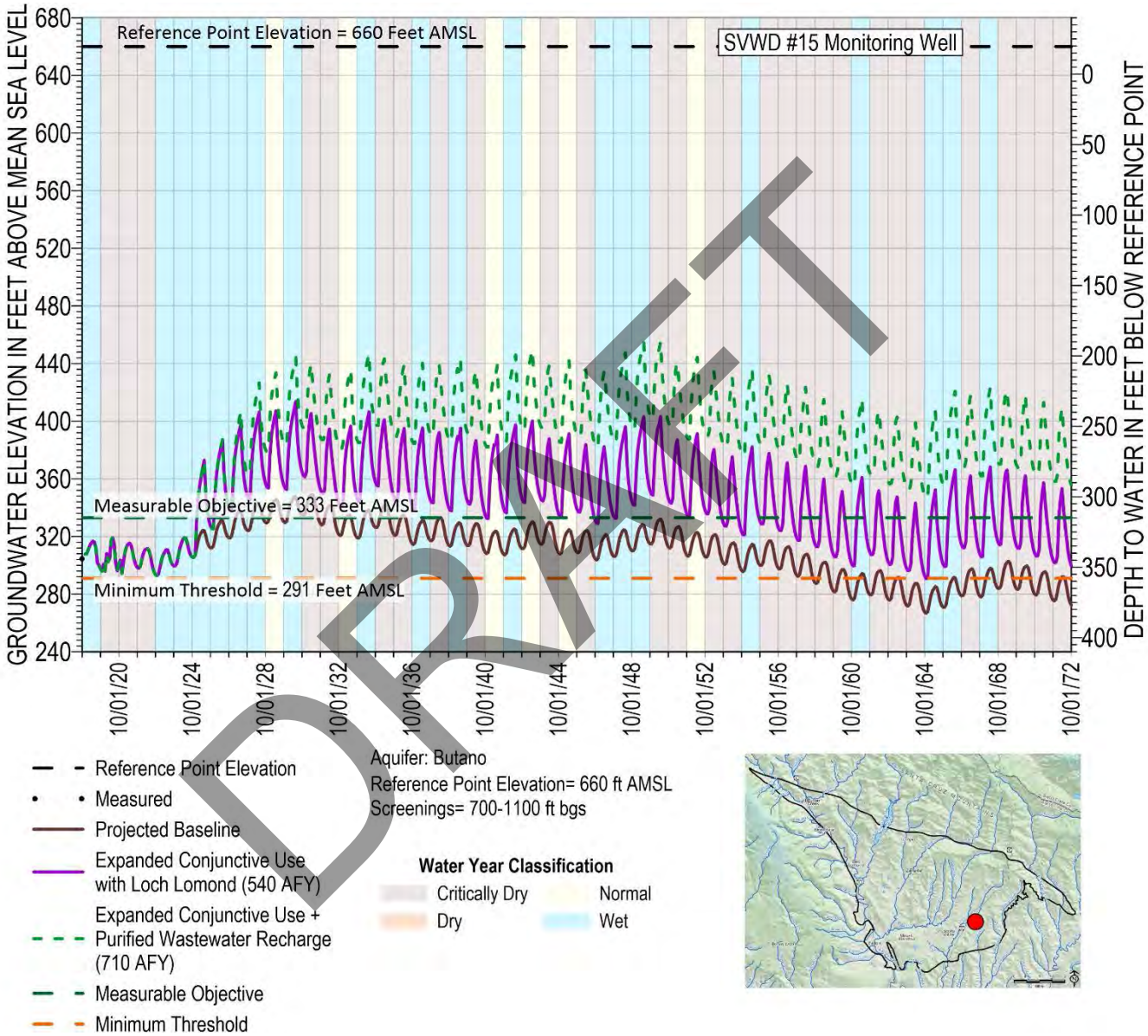

Figure 68. SVWD #15 Monitoring Well Projected Hydrograph

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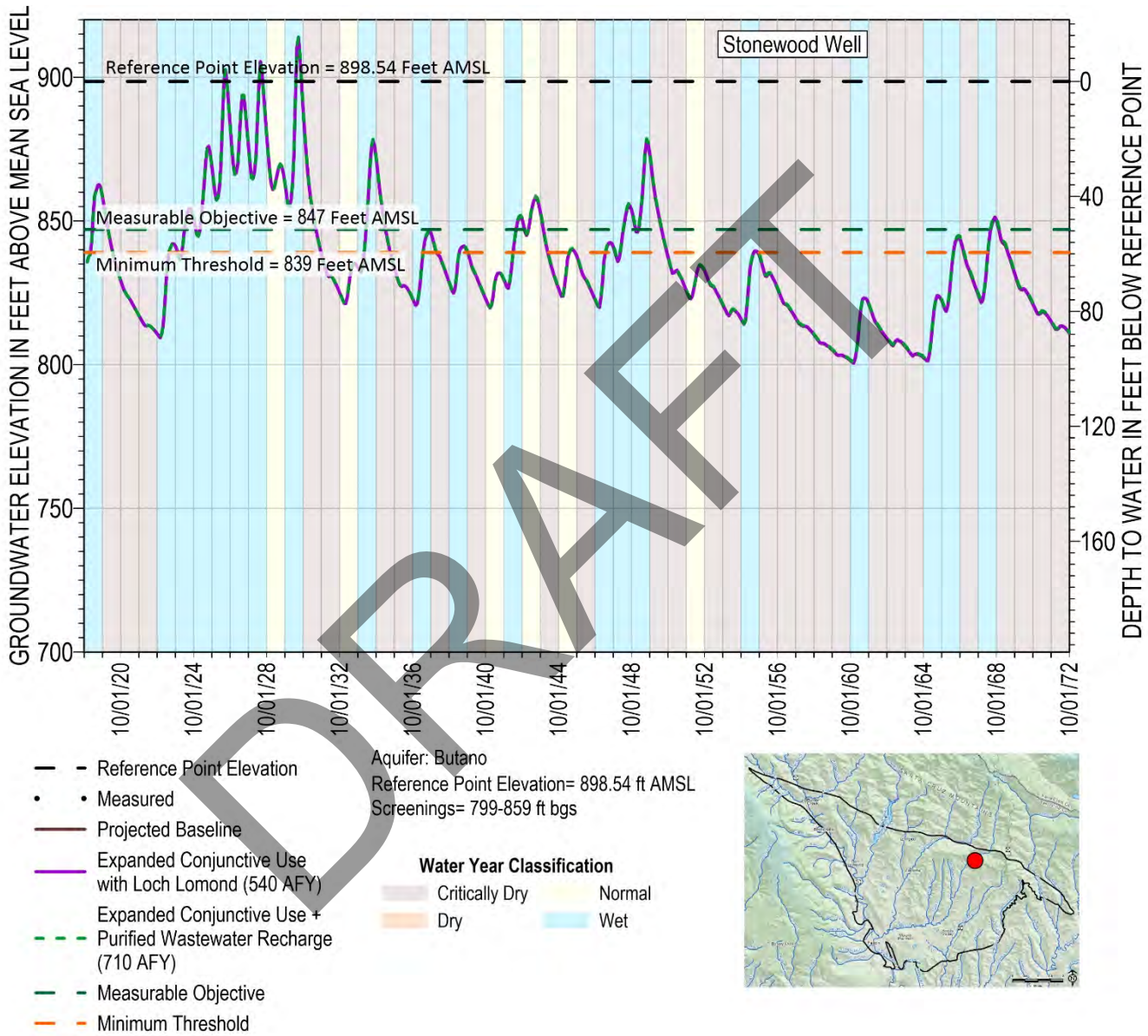

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Figure 69. Stonewood Projected Hydrograph

Table 5. Minimum Thresholds and Measurable Objectives Milestones for Groundwater Levels based on GSP Section 3

Aquifer	Well Name	Groundwater Elevation (feet above mean sea level)	
		Minimum Threshold	Measurable Objective
Santa Margarita	SLVWD Quail MW-A	413	416
	SLVWD Quail MW-B	451	474
	SLVWD Olympia #3	304	309
	SLVWD Pasatiempo MW-2	500	516
	SVWD TW-18	462	471
	SV4-MW	381	387
Monterey	SVWD #9	303	360
Lompico	SLVWD Pasatiempo MW-1	336	374
	SVWD #10	288	324
	SVWD #11A	290	319
	SVWD TW-19	314	376
Lompico/Butano	SVWD #15 Monitoring Well	291	333
Butano	SVWD Stonewood Well	839	847
	SVWD Canham Well	427	466

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8 CONCLUSIONS

The objectives for updating and improving the structure and inputs of the SMGB model are to improve its use as a suitable tool to support GSP development and to guide groundwater management decisions as the GSP is implemented. Upgrading to MODFLOW6 allowed for more efficient implementation of geological pinch-outs, routing of springs and seeps to the stream network, and organization of model inputs by having separate recharge packages for precipitation and return flow recharge. Model stress period refinement from quarterly to monthly allowed more compatibility with projected climate change datasets. Recharge and runoff calculations were redeveloped to maintain traceable water balance with precipitation and evapotranspiration. Model domain expansion allowed the model to cover the entire SMGB area. Most changes described were made with guidance from EKI recommendations (Section 2.1).

The updated SMGB model is generally able to simulate surface water and groundwater observations with slight improvements from previous model-term trends, but actual quantified values are offset at some locations. The model functionality and calibration is appropriate for estimates of historical, current, and projected water budgets as required for the GSP. As importantly, the model has the framework to run alternative simulations based on projects and management actions. With projected climate change and future pumping included in predictive simulations, various project or management action simulations can be compared to a baseline "no project" condition to quantify groundwater impacts and benefits. The simulation of long-term trends in the updated SMGB model allows for evaluation of alternative simulations at RMPs.

Recommended improvements to the model include reevaluation and recalibration after:

- Surveyed verification of all RPEs
- Several years of streamflow monitoring at 5 newly established gauges discussed in Section 3.3 of the GSP
- Additional stream seepage from accretion studies, new RMPs in data gap areas, and groundwater level data for all model targets.

Given the likelihood that any model calibration is non-unique, we also recommend evaluating predictive uncertainty when using the model for more detailed planning of projects and management actions.

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Santa Margarita Basin
Groundwater Model
Updates and Simulations for Groundwater Sustainability Planning

Appendix A
Groundwater Level Target Calibration Hydrographs

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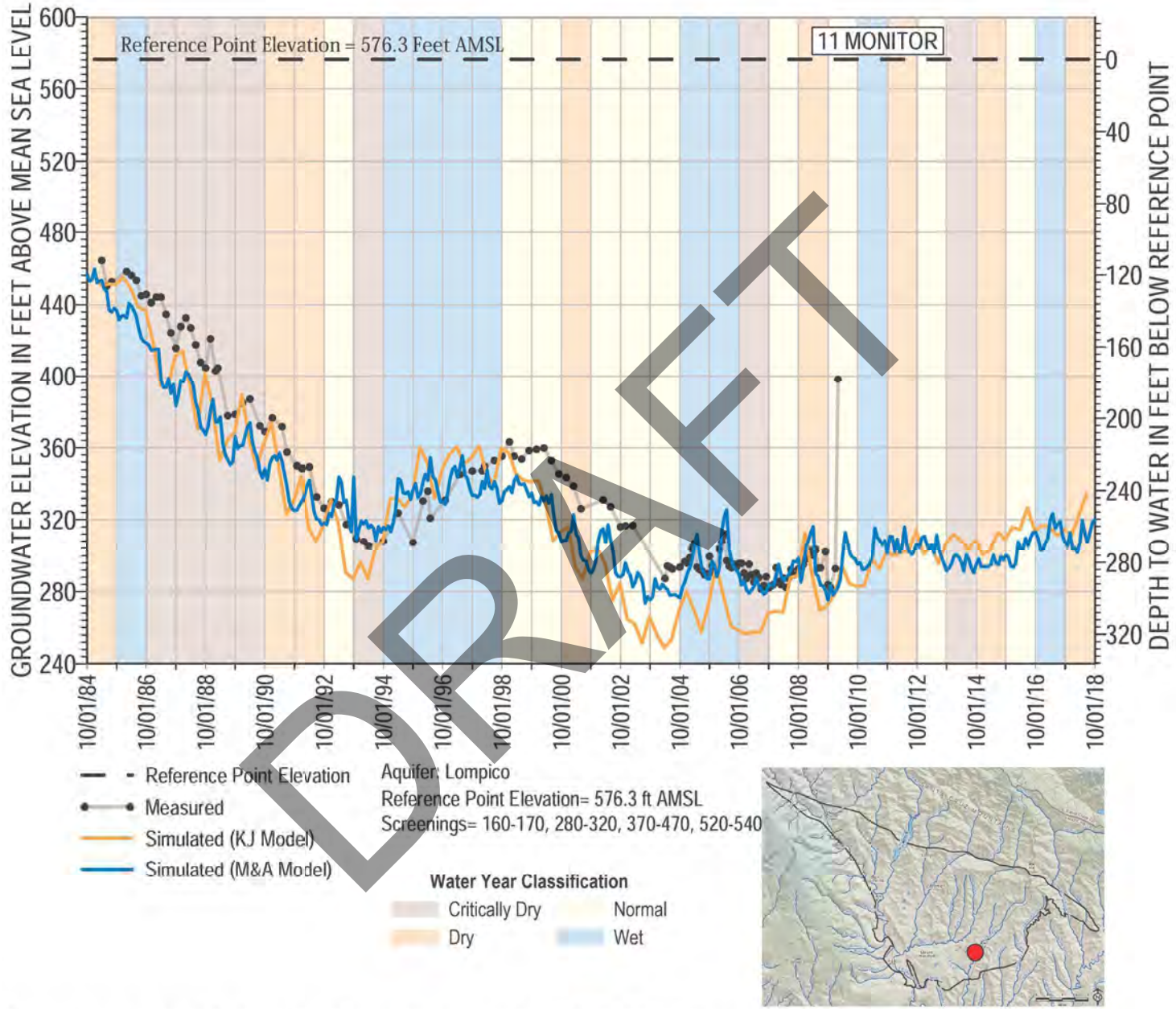

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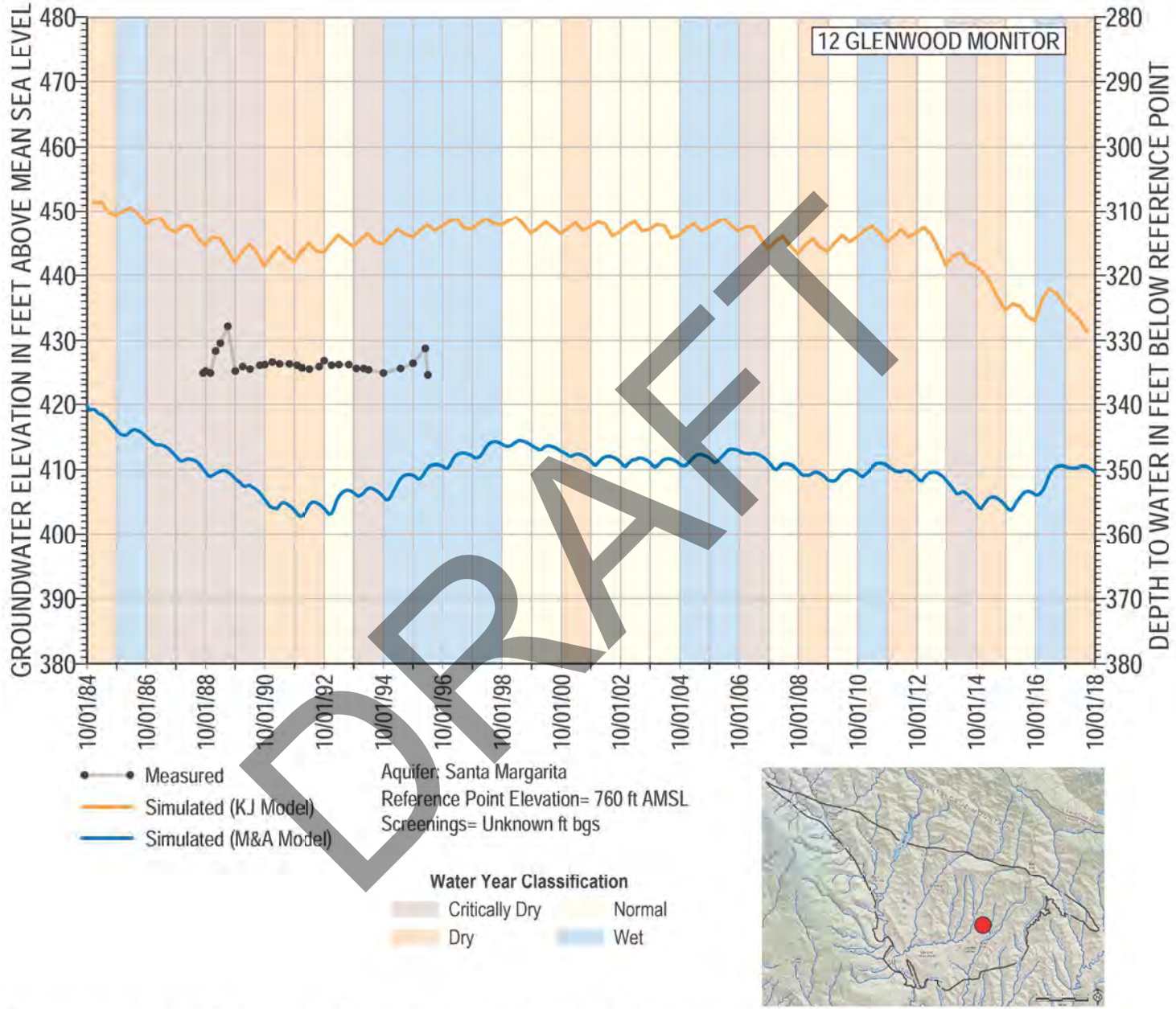
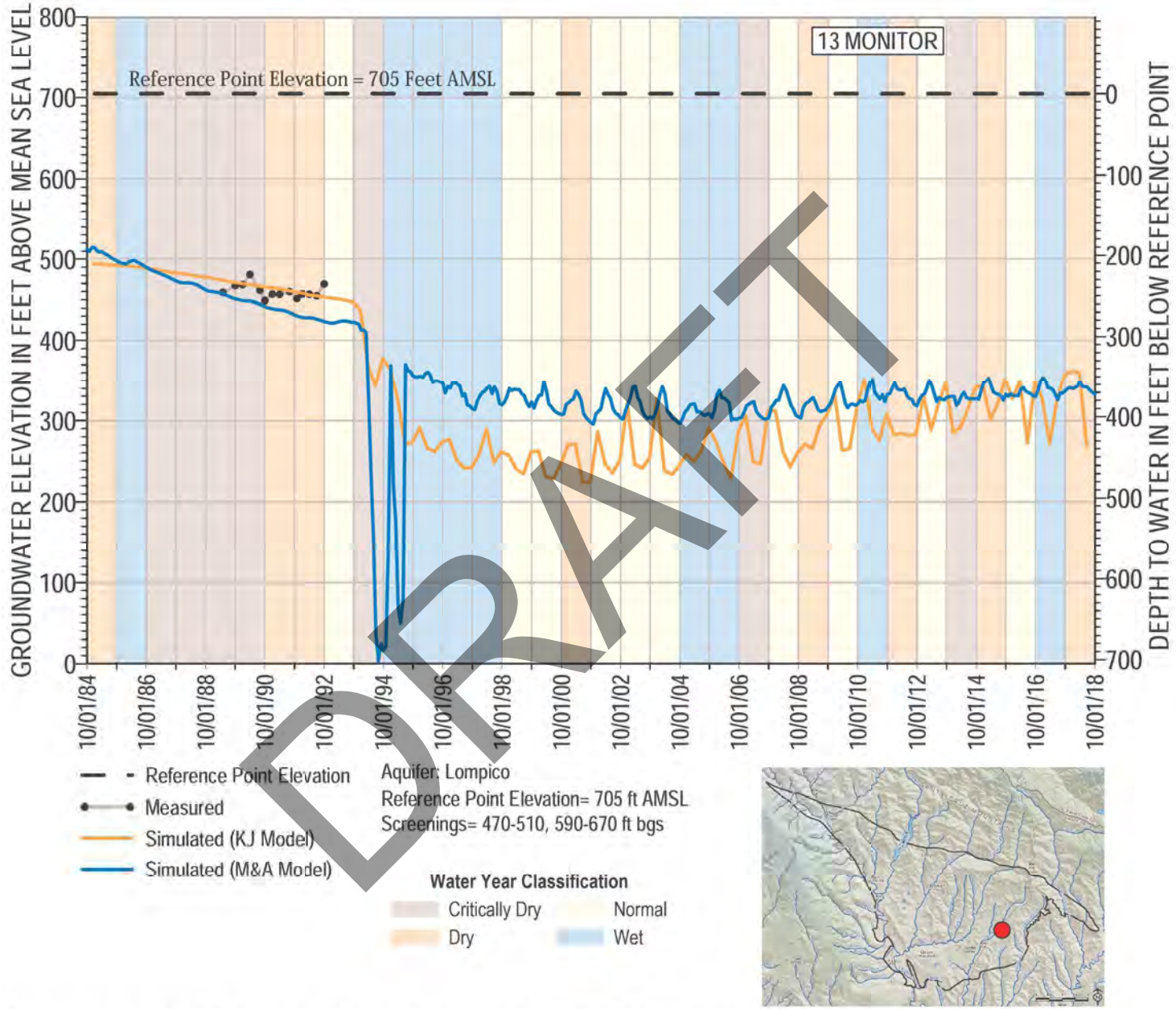
Groundwater Level Calibration Target Hydrograph for 11 MONITOR



DRAFT

Groundwater Level Calibration Target Hydrograph for 12 GLENWOOD MONITOR



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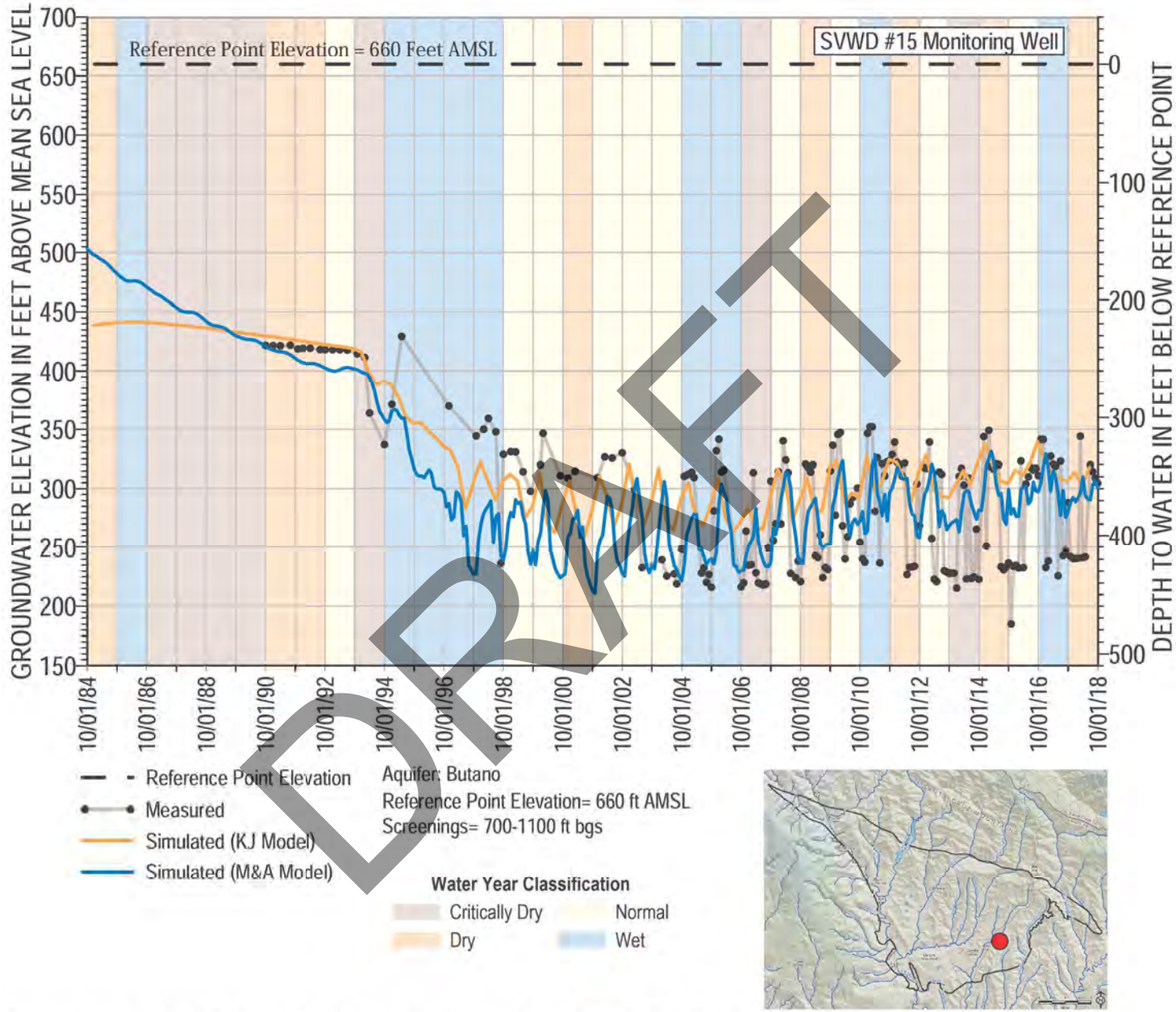
Groundwater Level Calibration Target Hydrograph for 13 MONITOR



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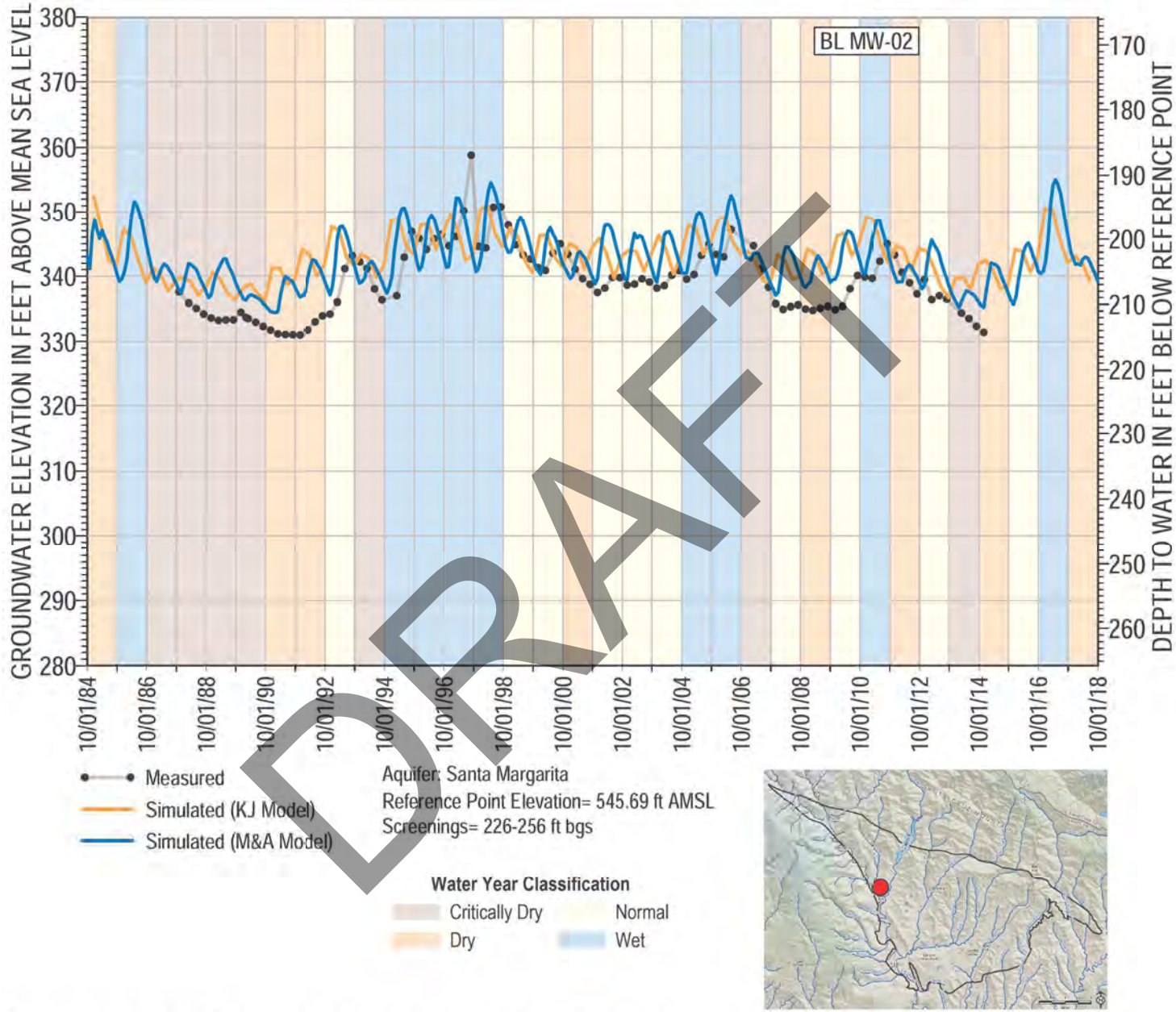
Groundwater Level Calibration Target Hydrograph for SVWD #15 Monitoring Well



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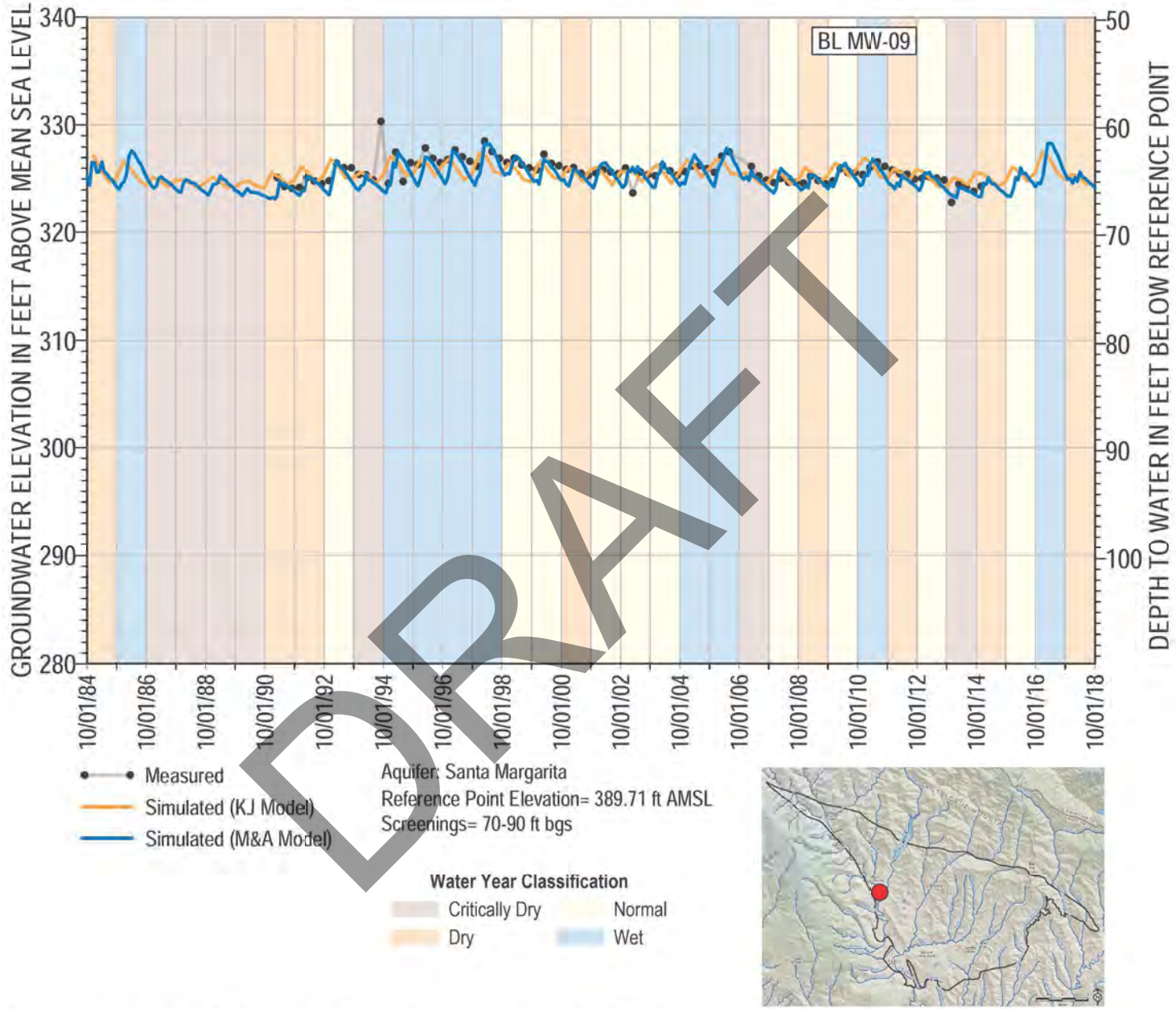
Groundwater Level Calibration Target Hydrograph for BL MW-02



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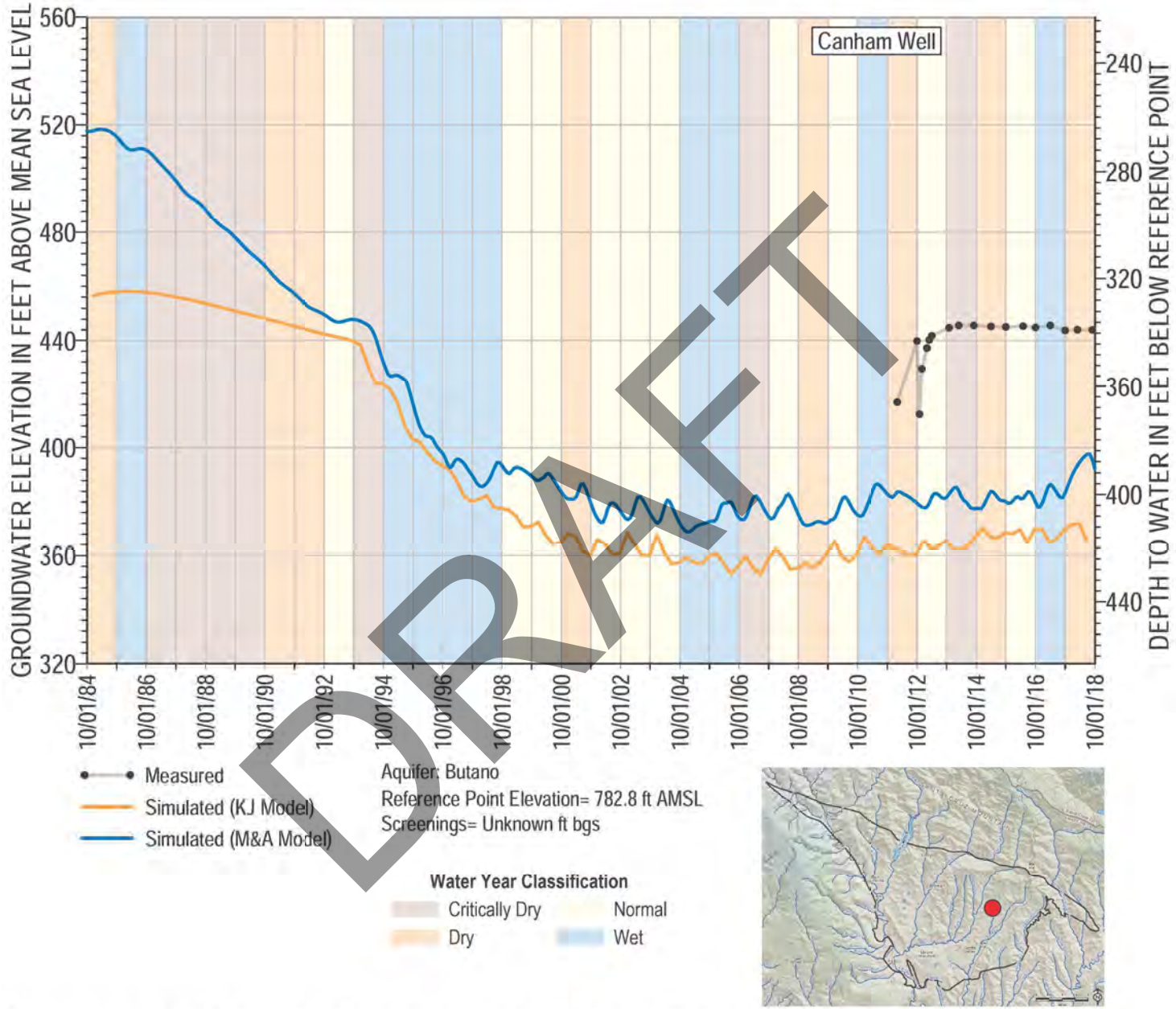
Groundwater Level Calibration Target Hydrograph for BL MW-09



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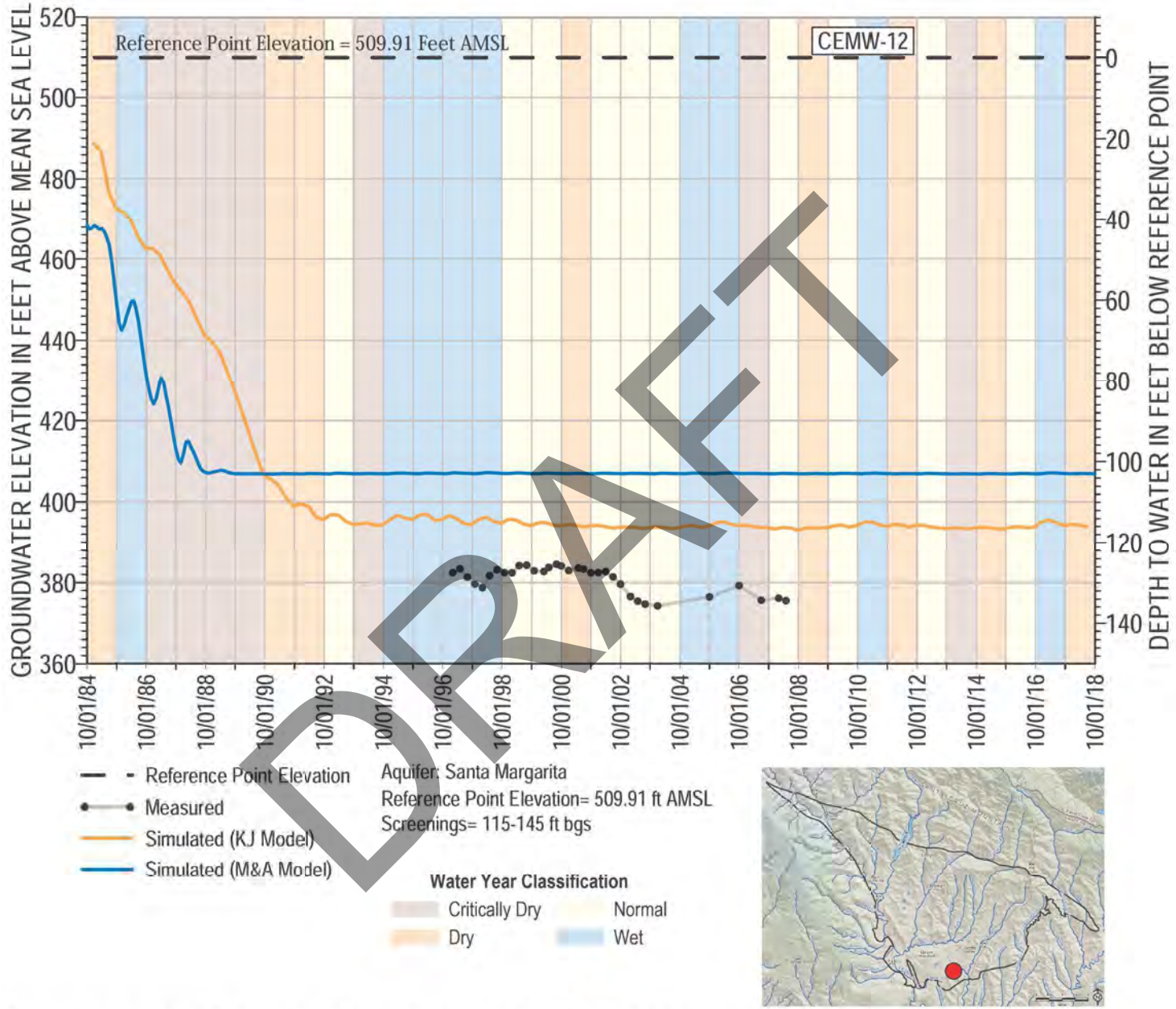
Groundwater Level Calibration Target Hydrograph for Canham Well



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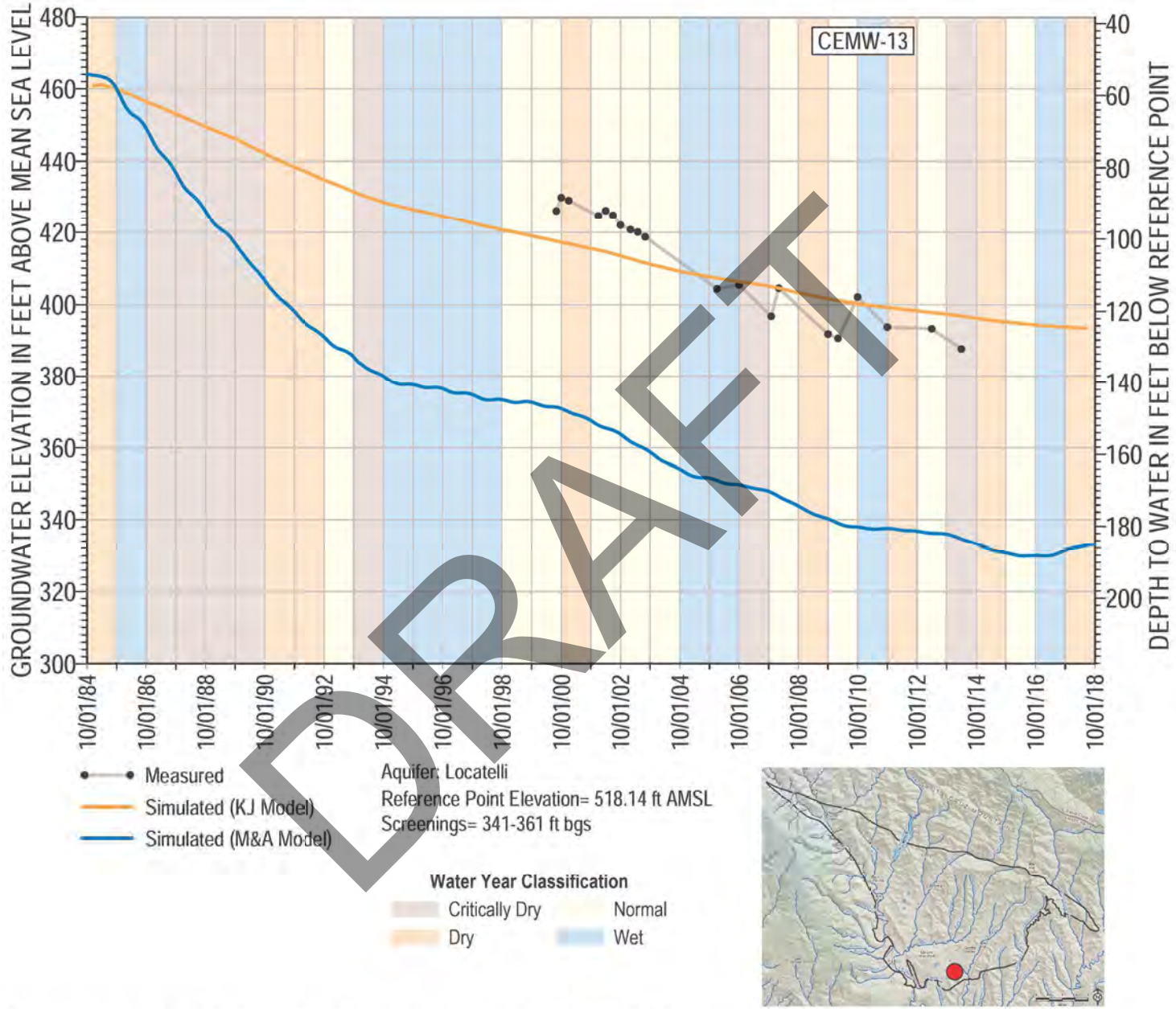
Groundwater Level Calibration Target Hydrograph for CEMW-12



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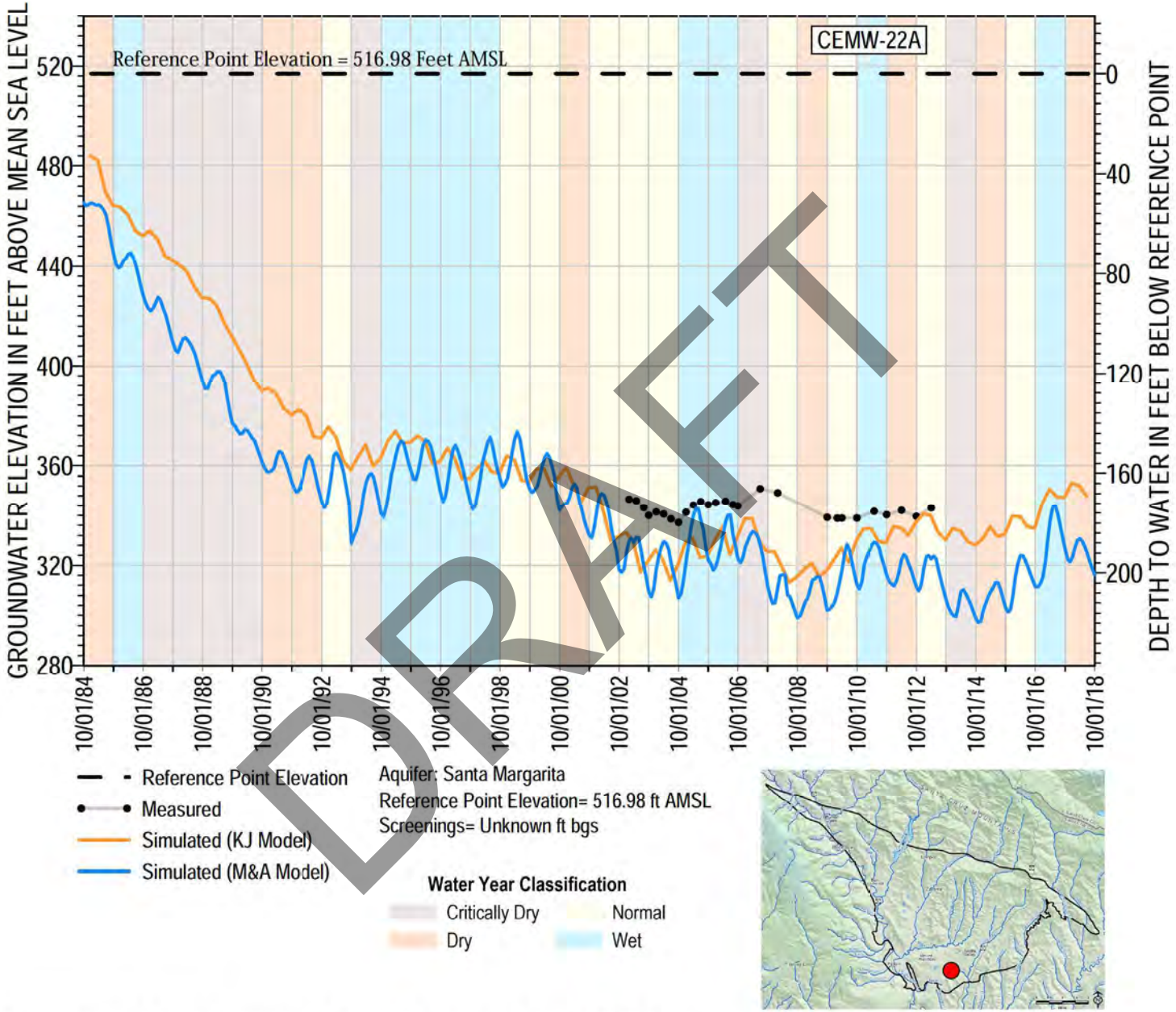
Groundwater Level Calibration Target Hydrograph for CEMW-13



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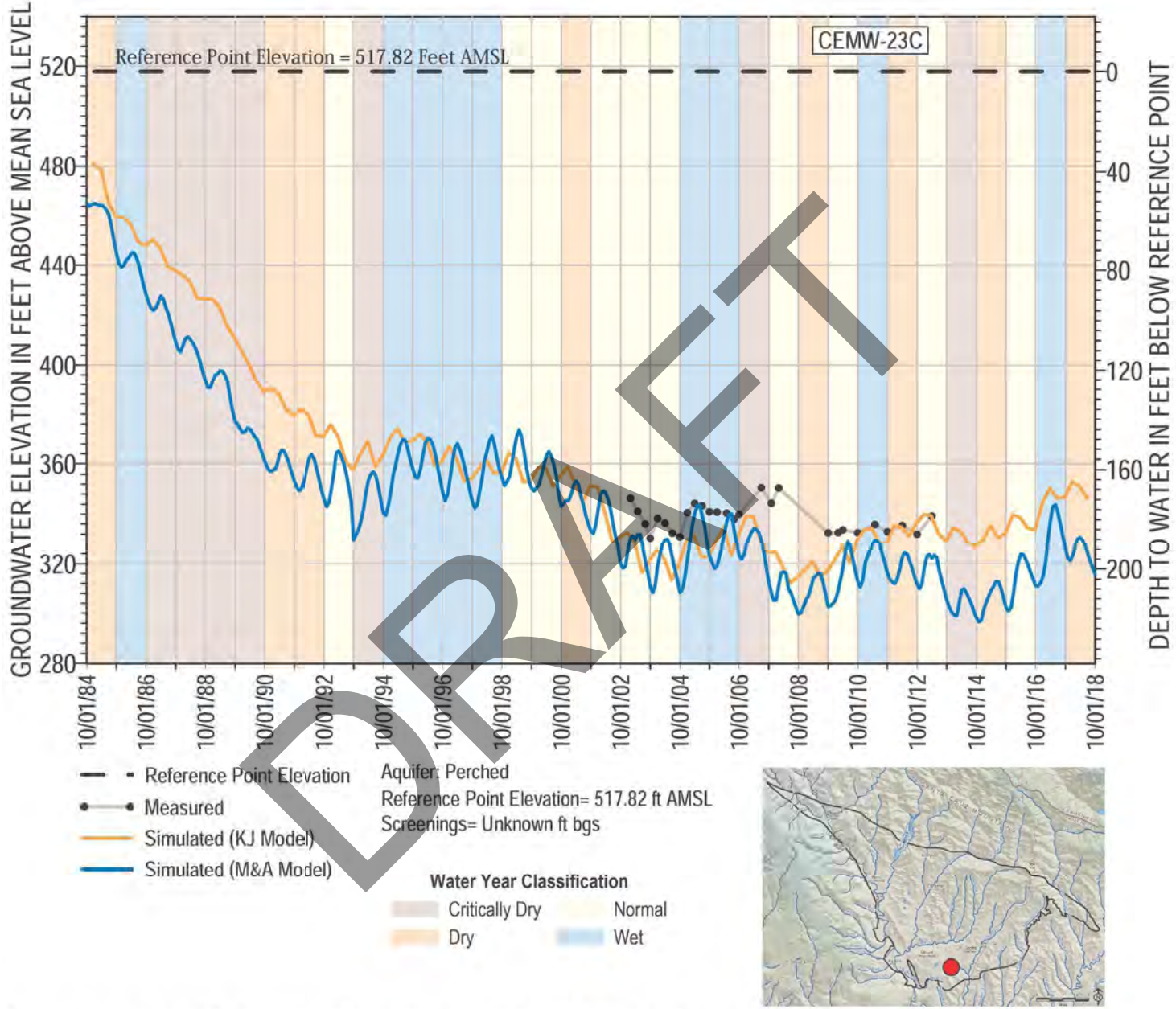
Groundwater Level Calibration Target Hydrograph for CEMW-22A



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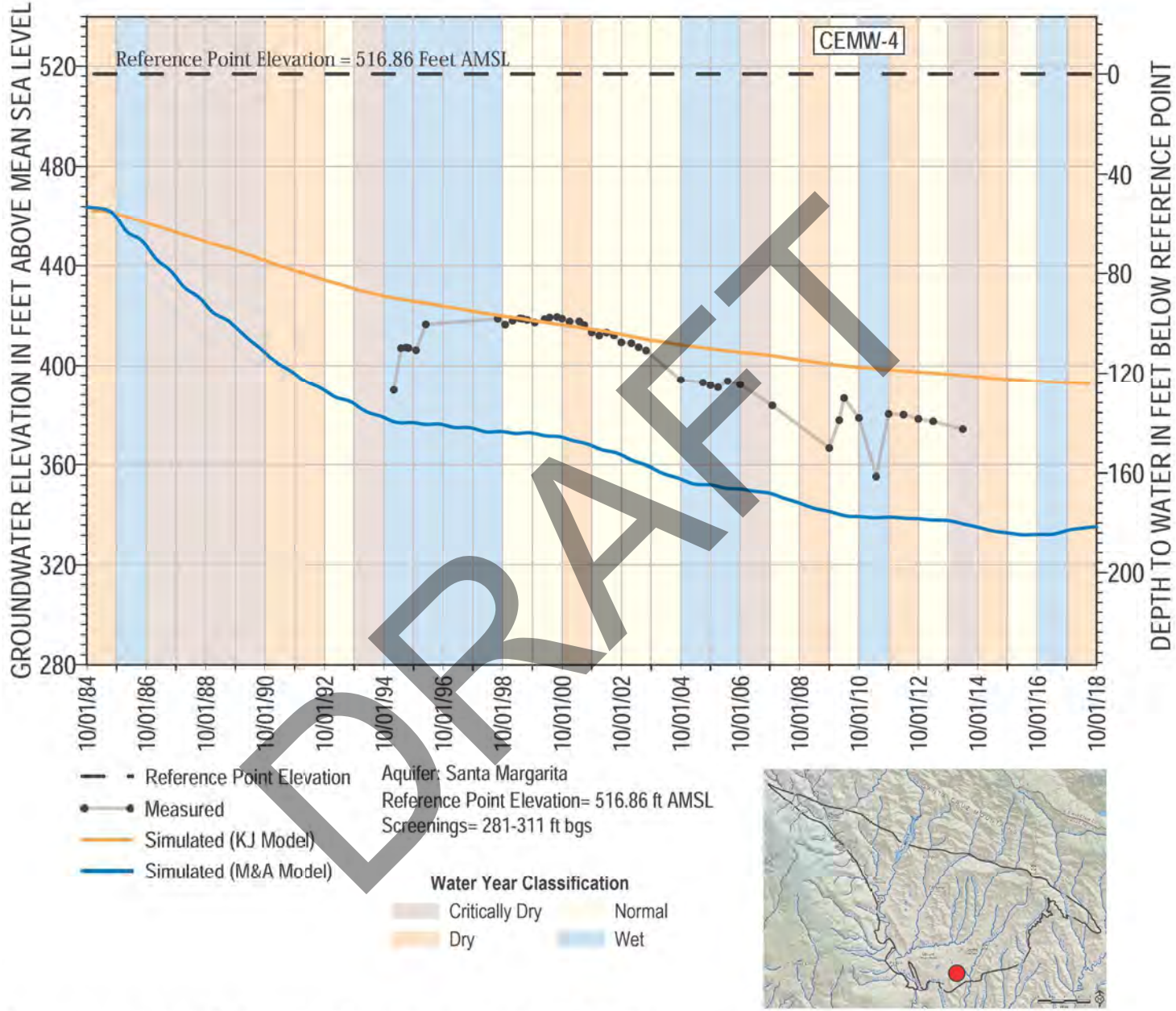
Groundwater Level Calibration Target Hydrograph for CEMW-23C



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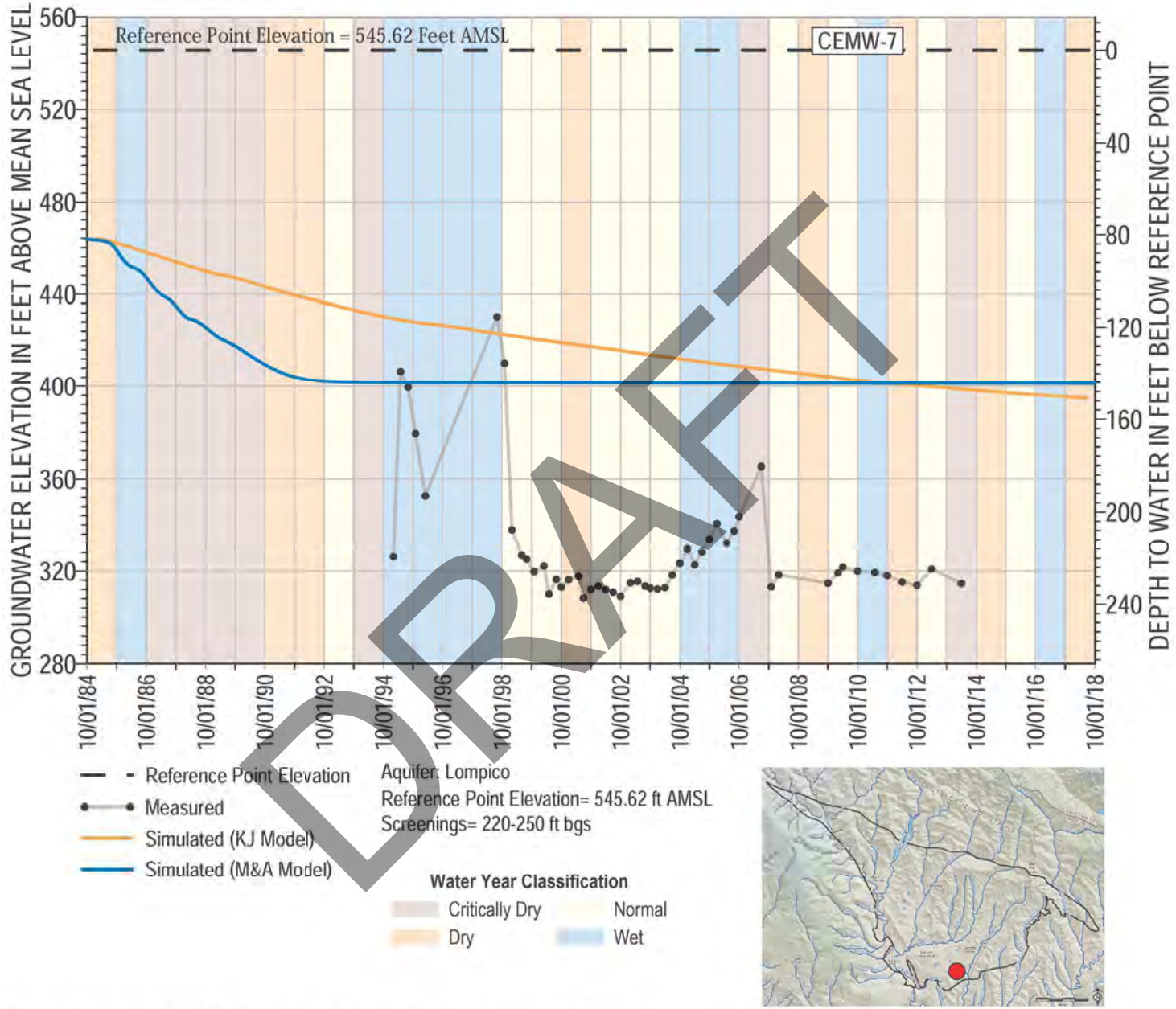
Groundwater Level Calibration Target Hydrograph for CEMW-4



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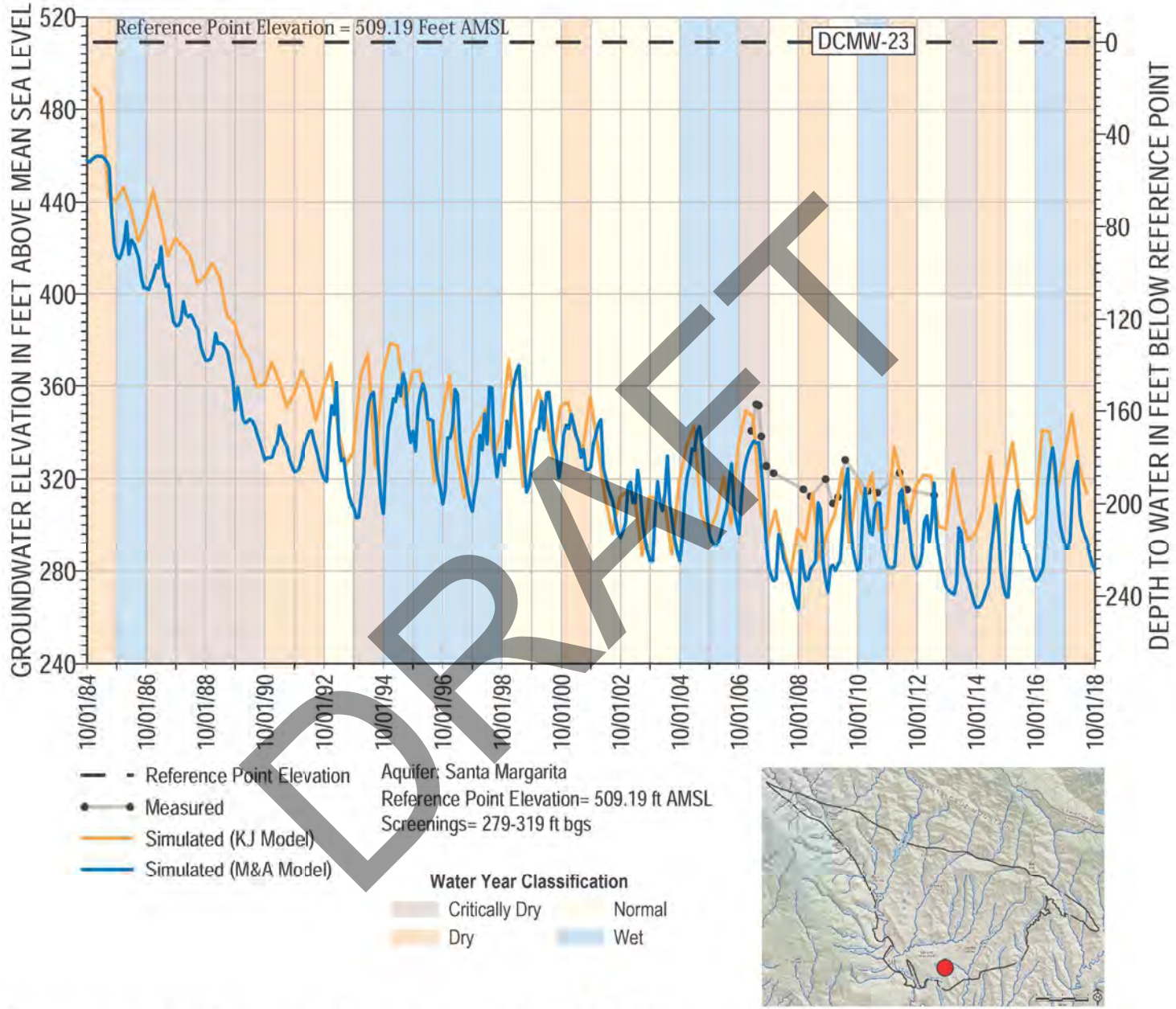
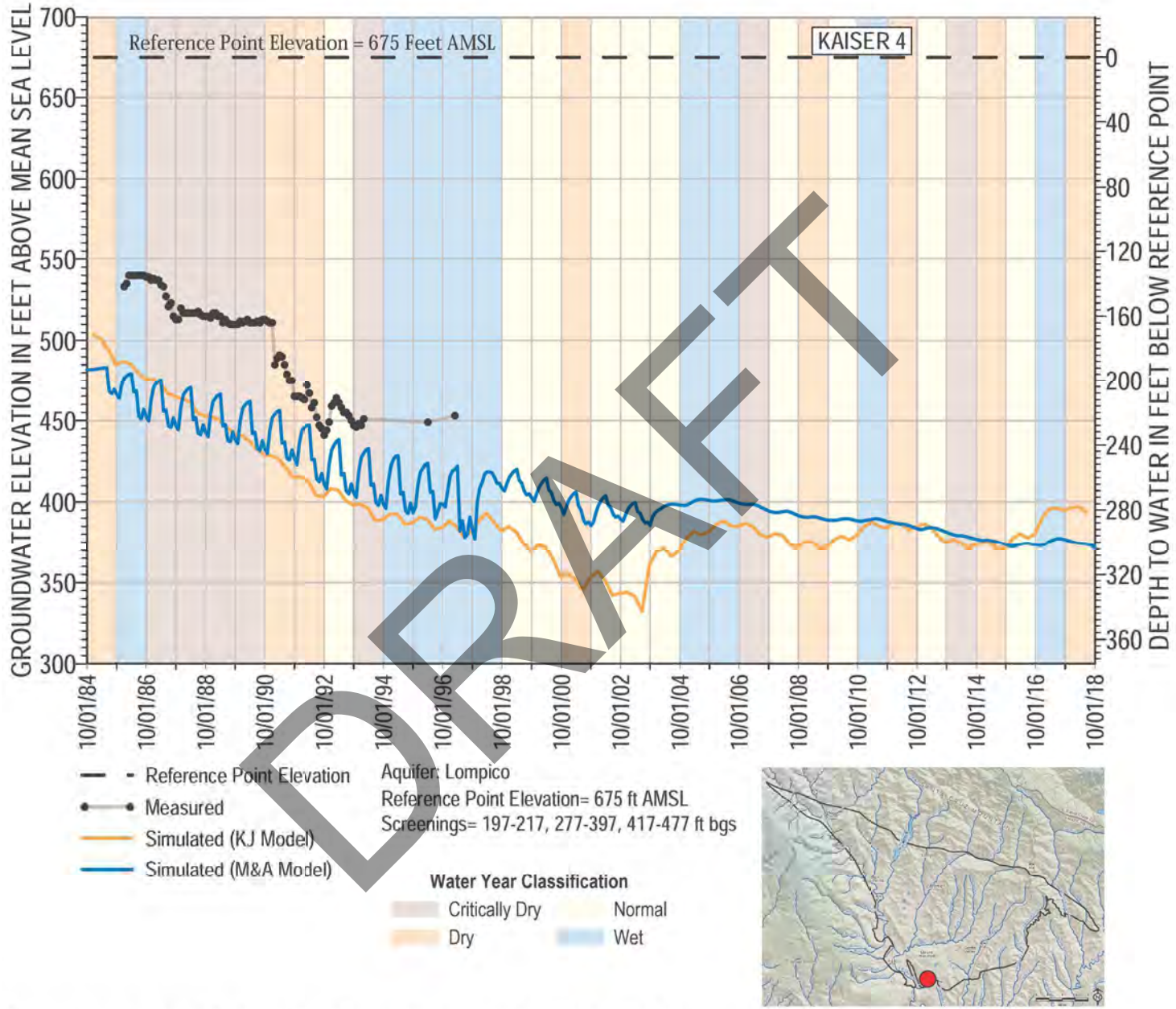
Groundwater Level Calibration Target Hydrograph for CEMW-7



Groundwater Level Calibration Target Hydrograph for DCMW-23



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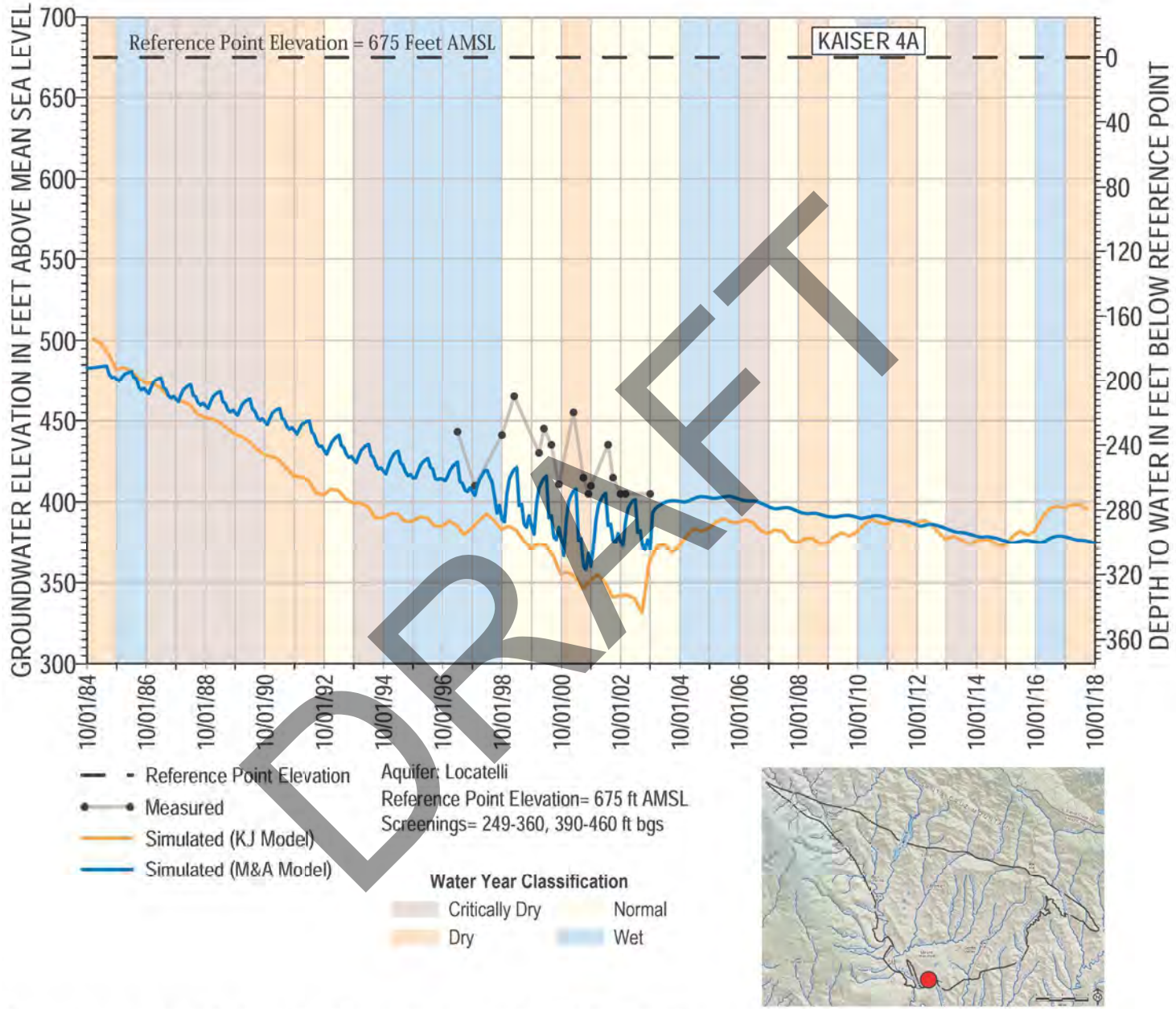
Groundwater Level Calibration Target Hydrograph for KAISER 4



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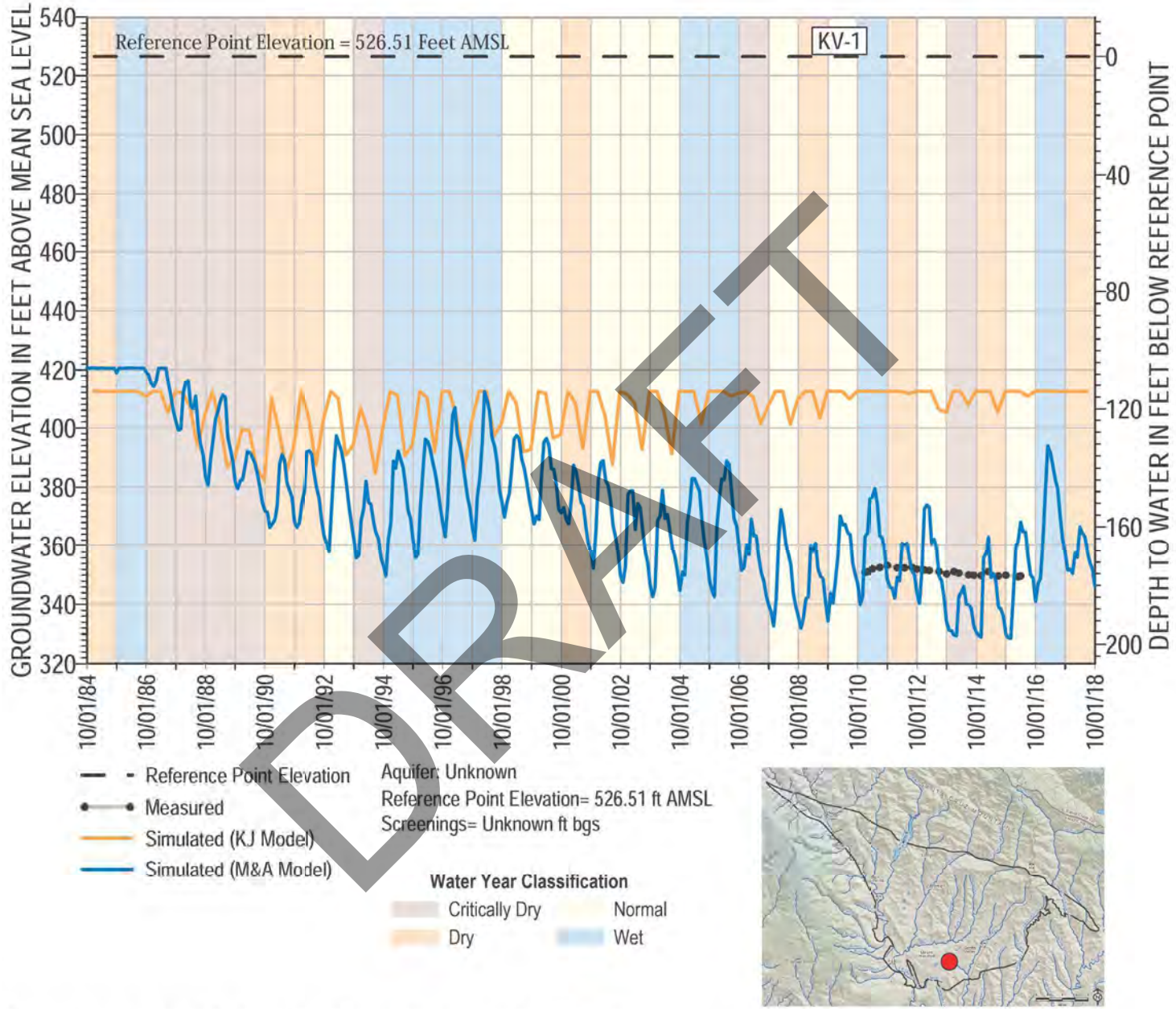
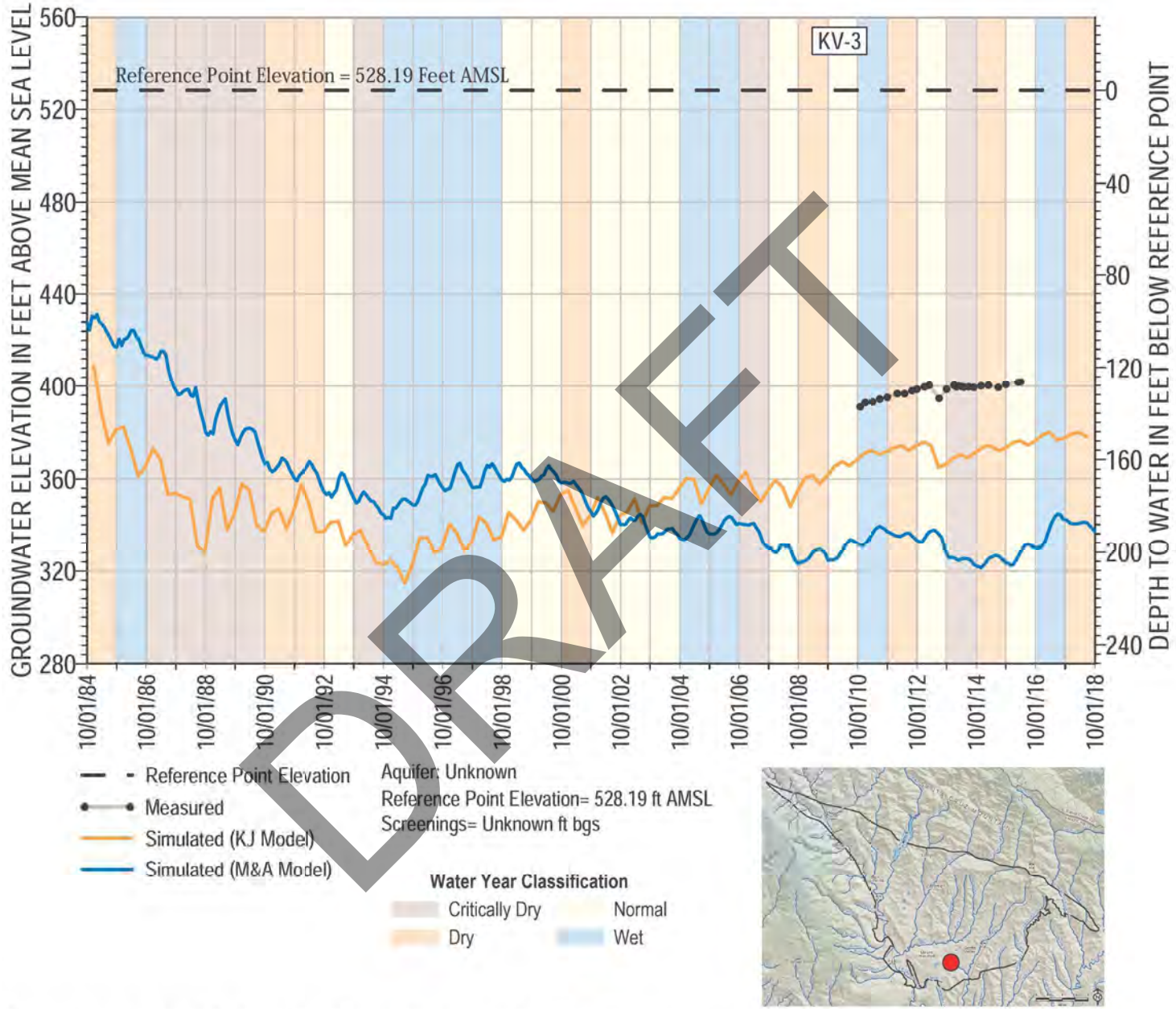
Groundwater Level Calibration Target Hydrograph for KAISER 4A



DRAFT

Groundwater Level Calibration Target Hydrograph for KV-1



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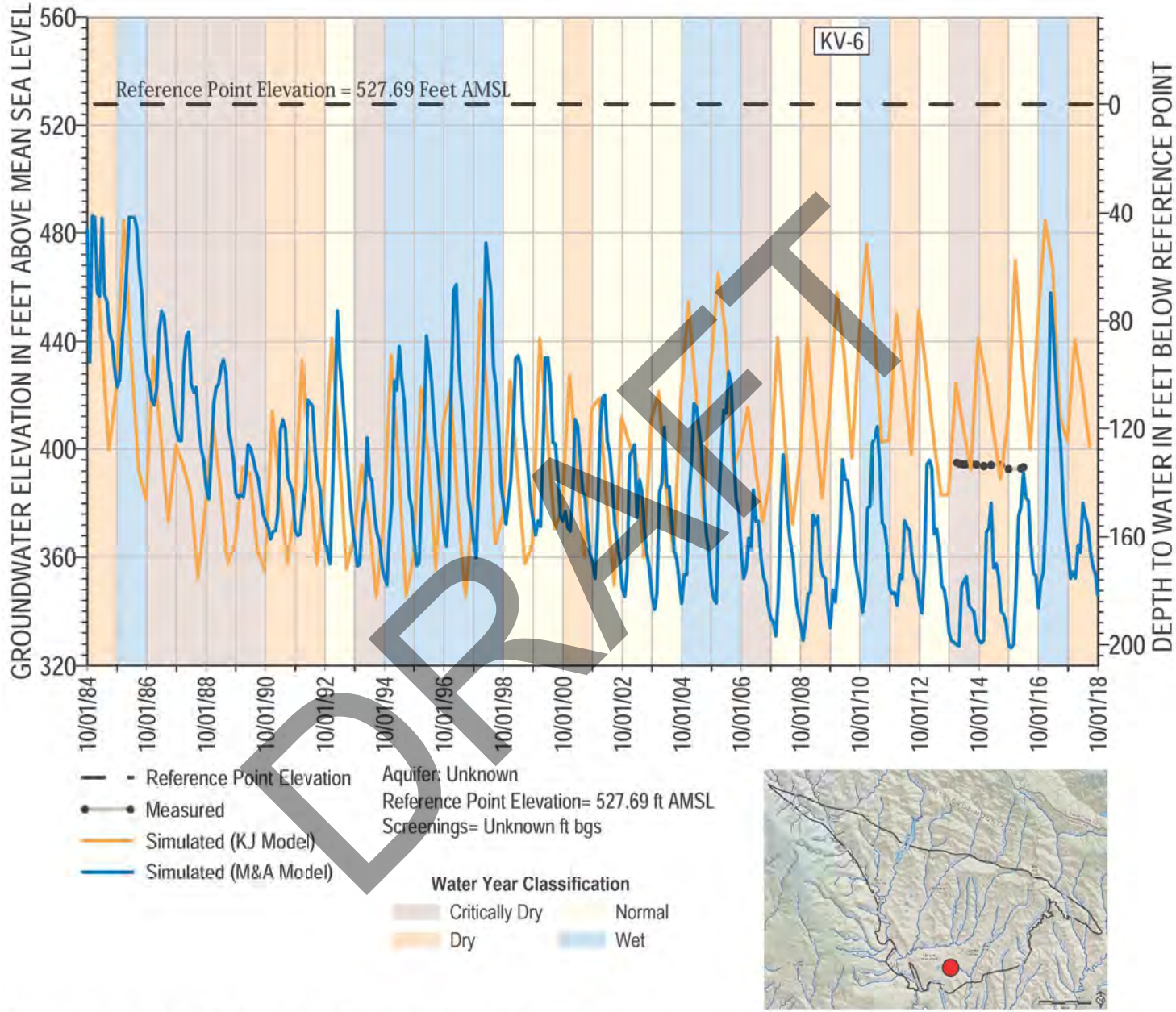
Groundwater Level Calibration Target Hydrograph for KV-3



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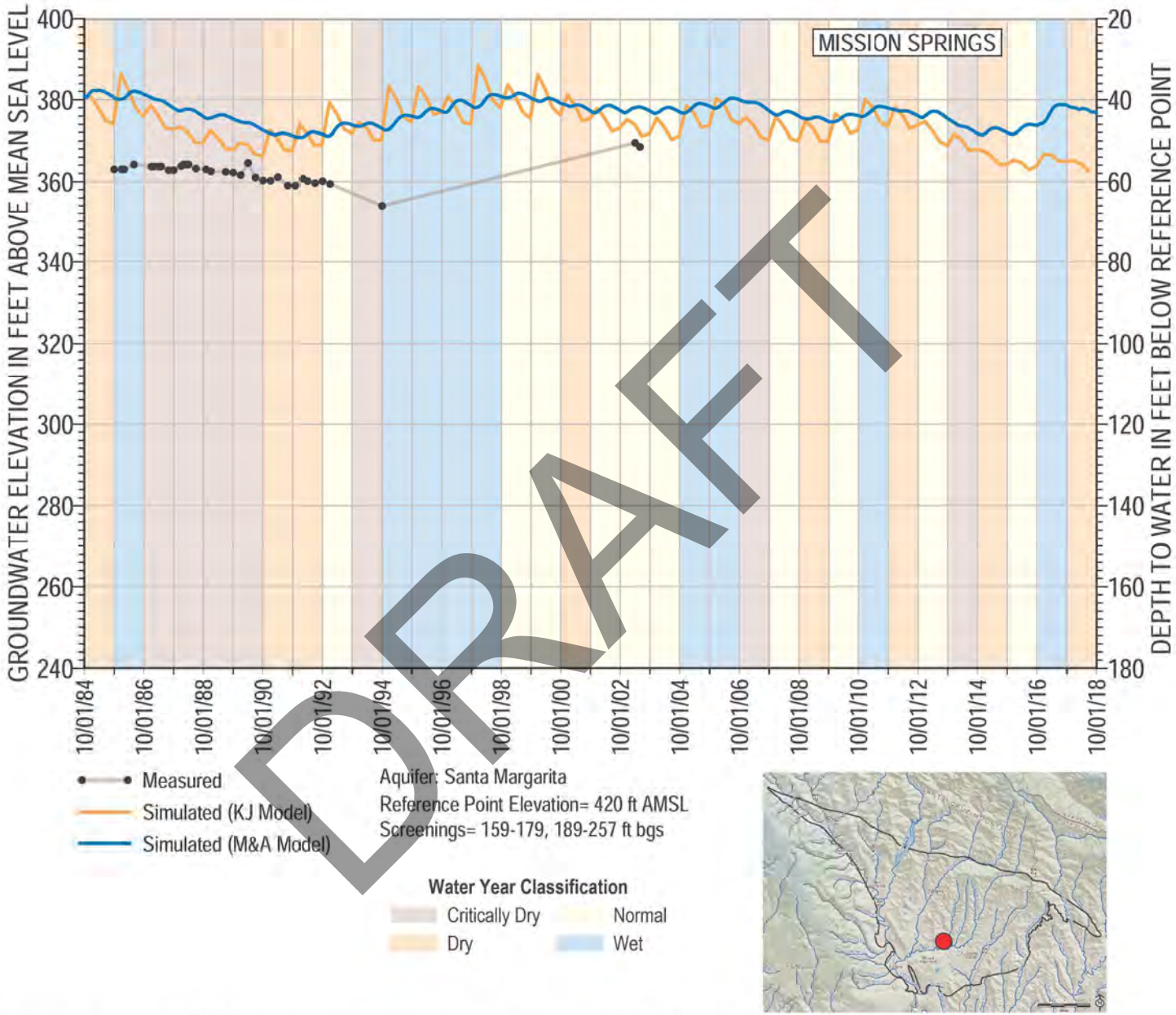
Groundwater Level Calibration Target Hydrograph for KV-6



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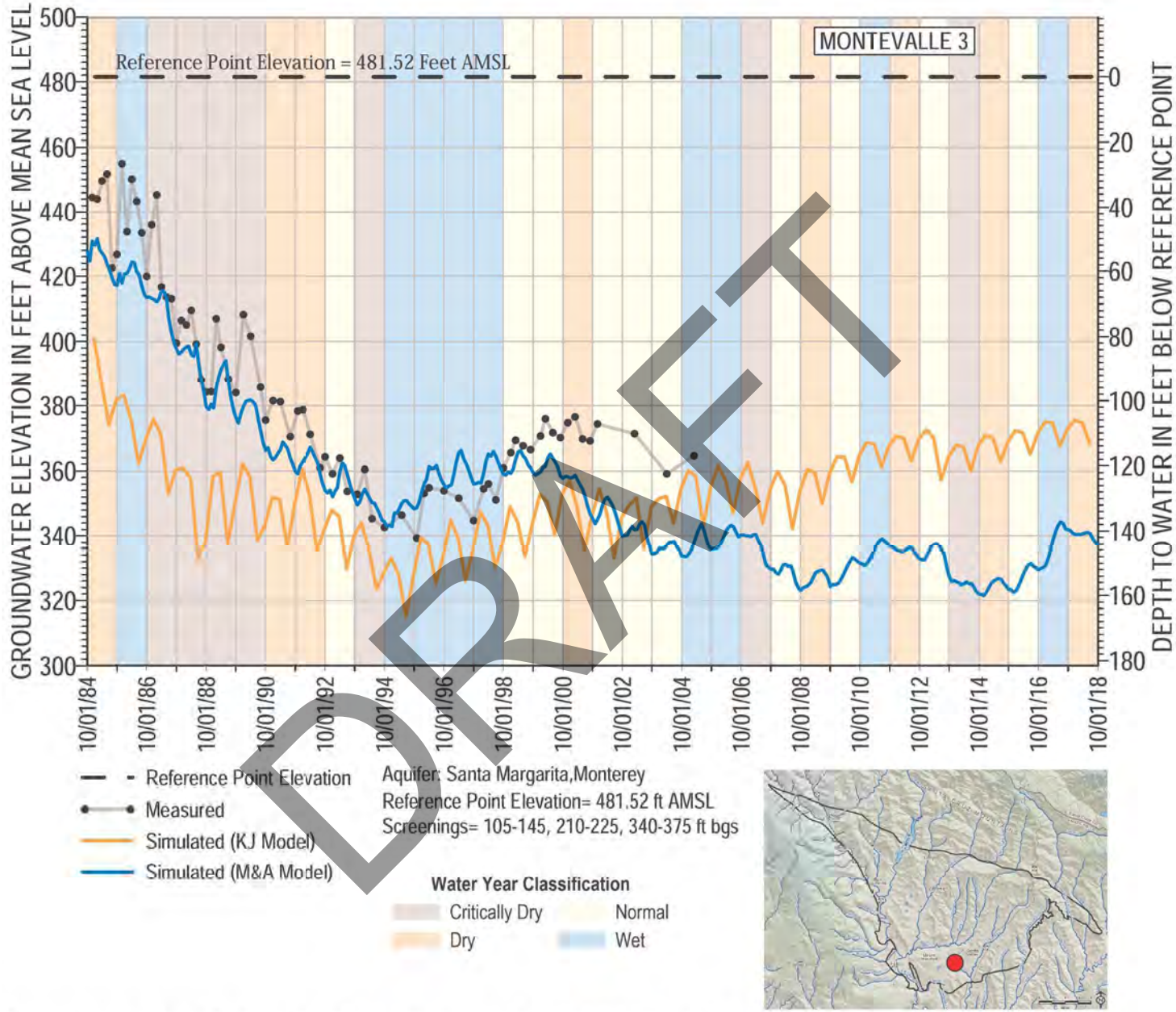
Groundwater Level Calibration Target Hydrograph for MISSION SPRINGS



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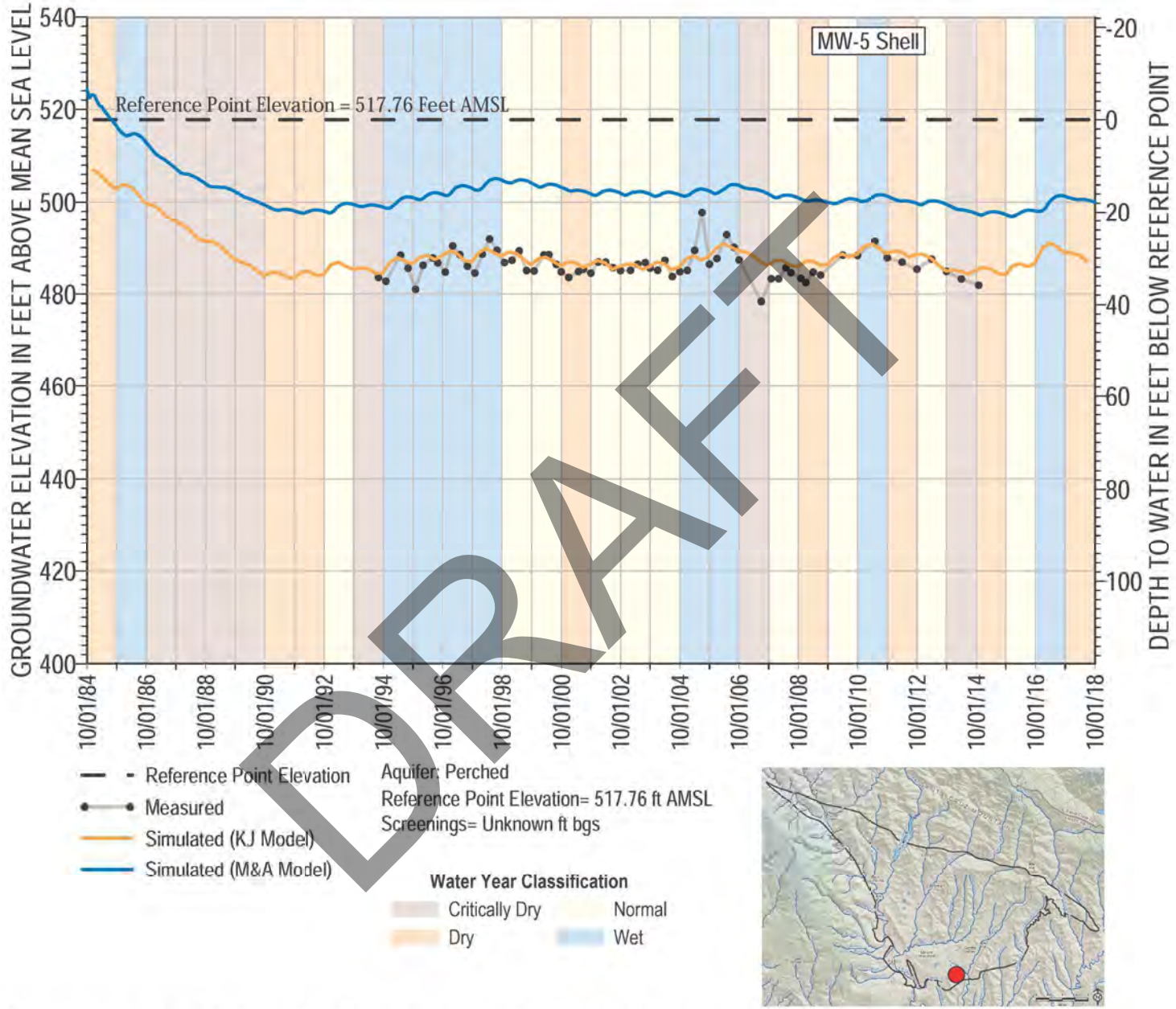
Groundwater Level Calibration Target Hydrograph for MONTEVALLE 3



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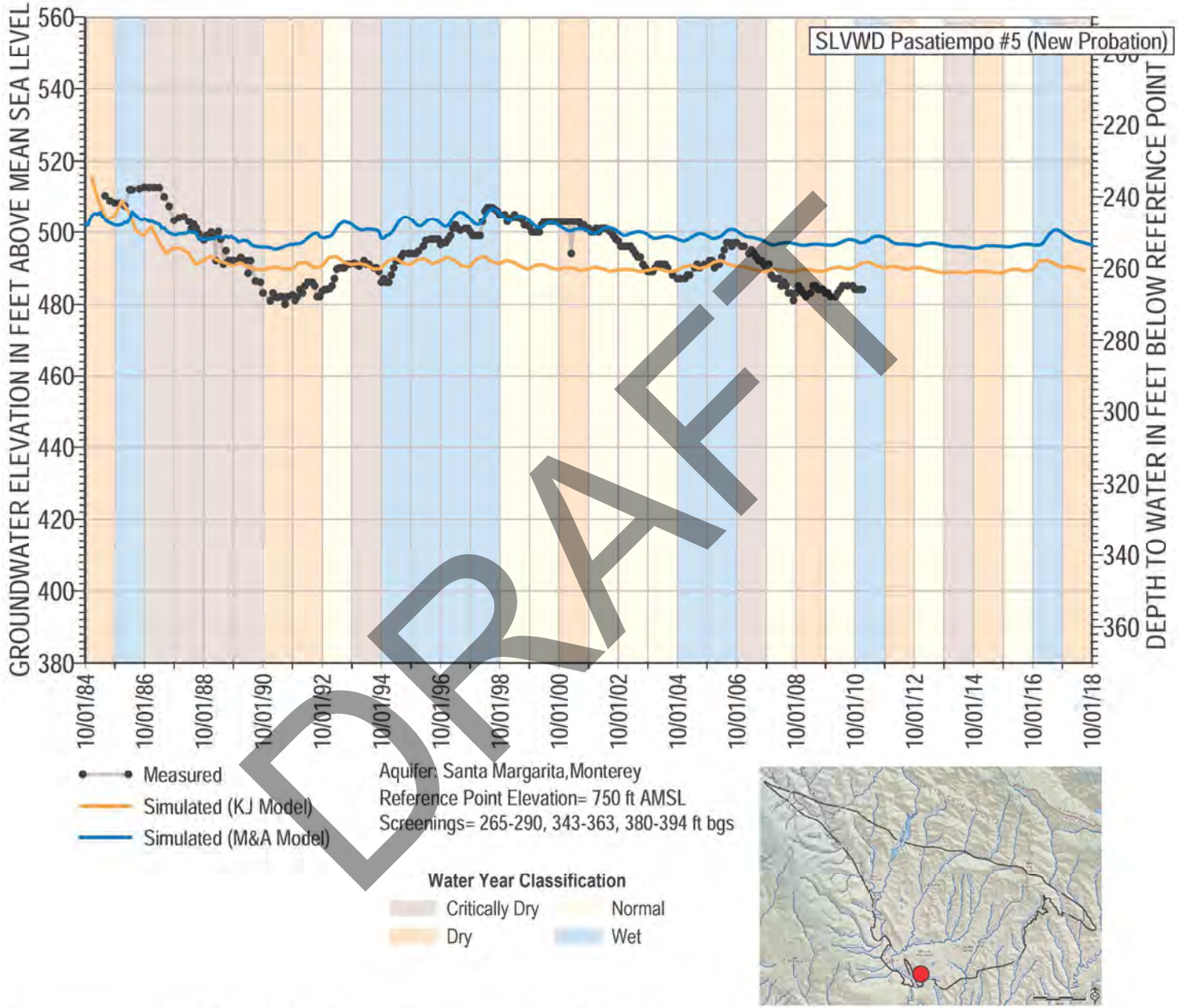
Groundwater Level Calibration Target Hydrograph for MW-5 Shell



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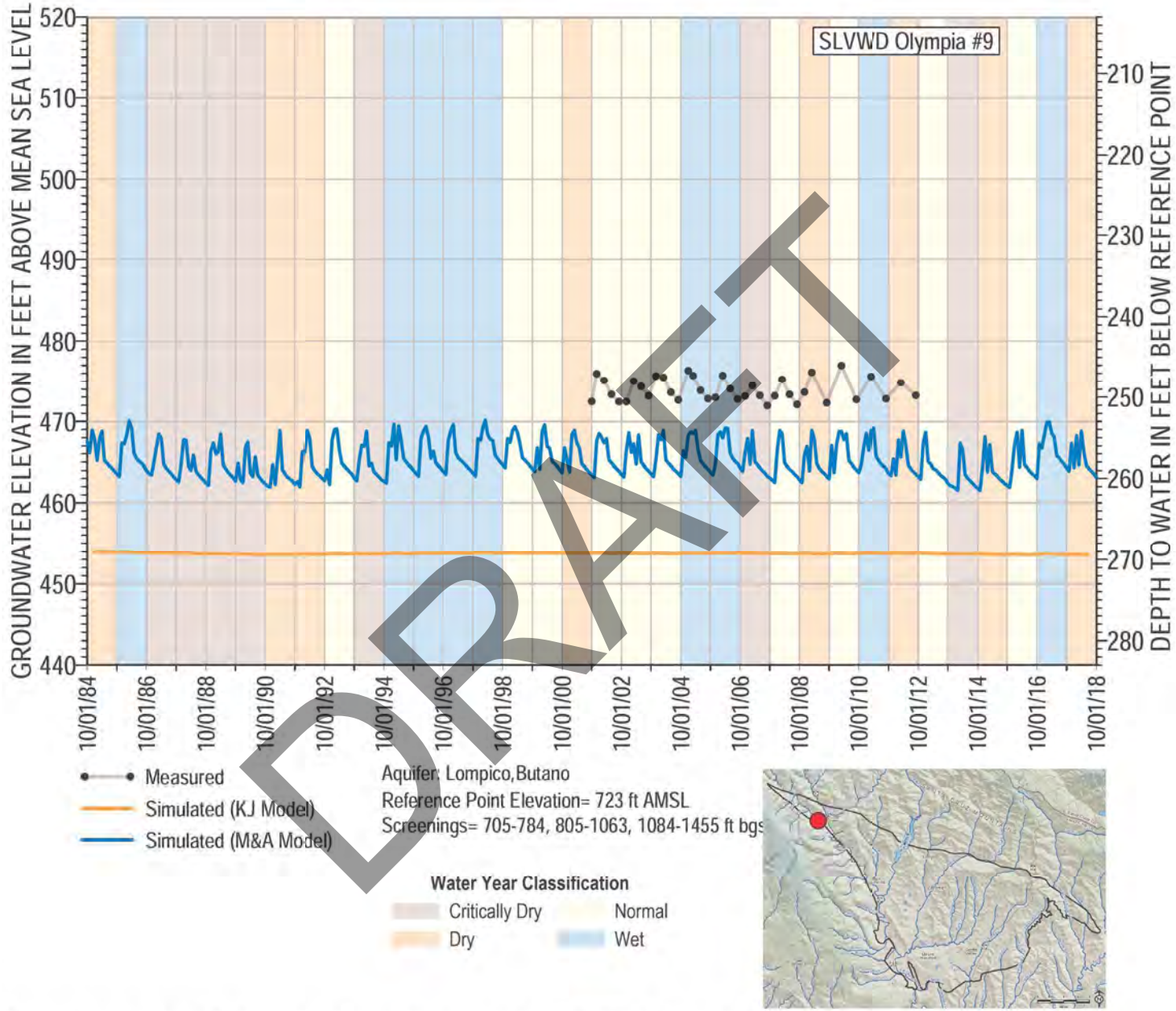
Groundwater Level Calibration Target Hydrograph for SLVWD Pasatiempo #5 (New Probation)



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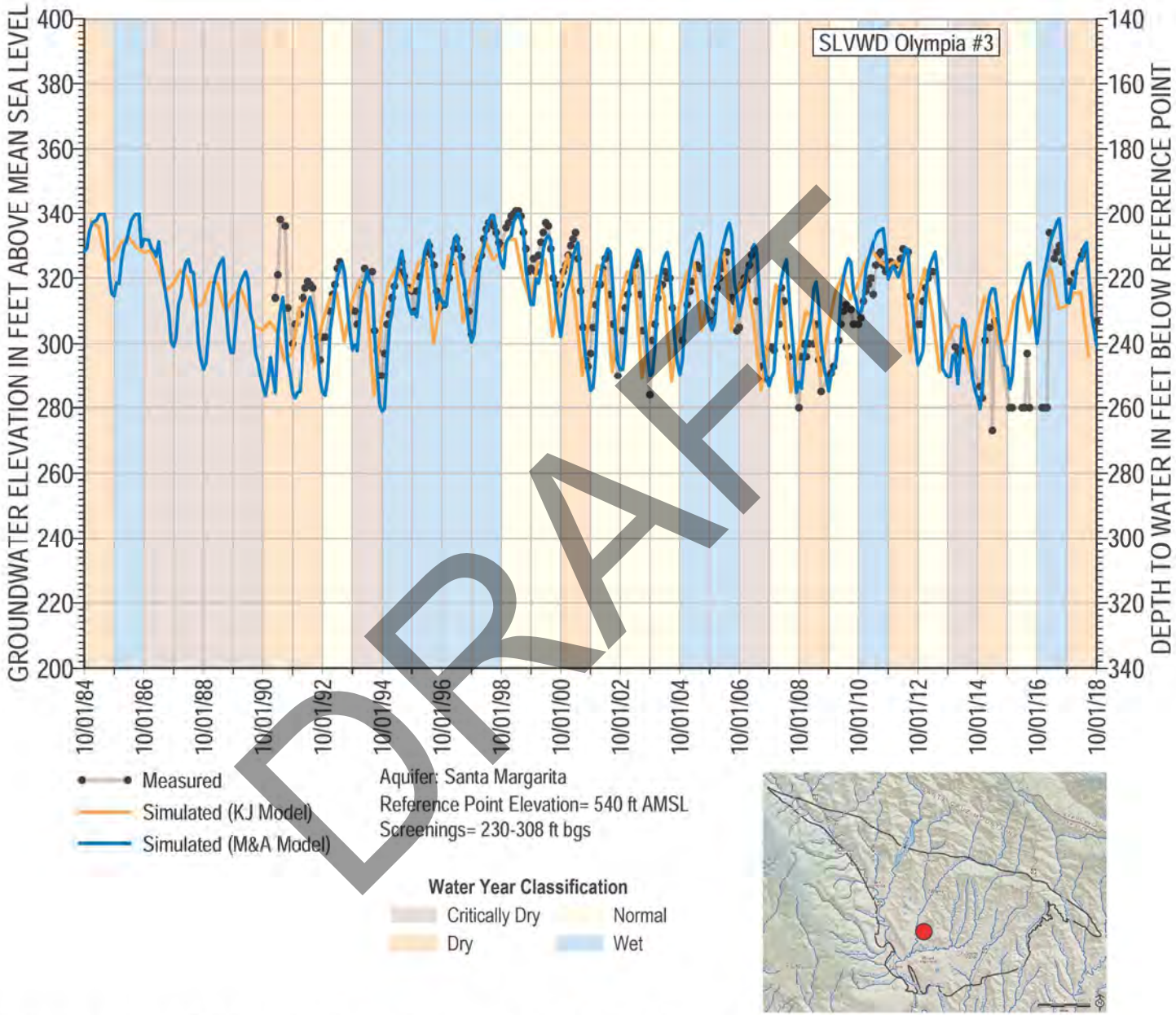
Groundwater Level Calibration Target Hydrograph for SLVWD Olympia #9



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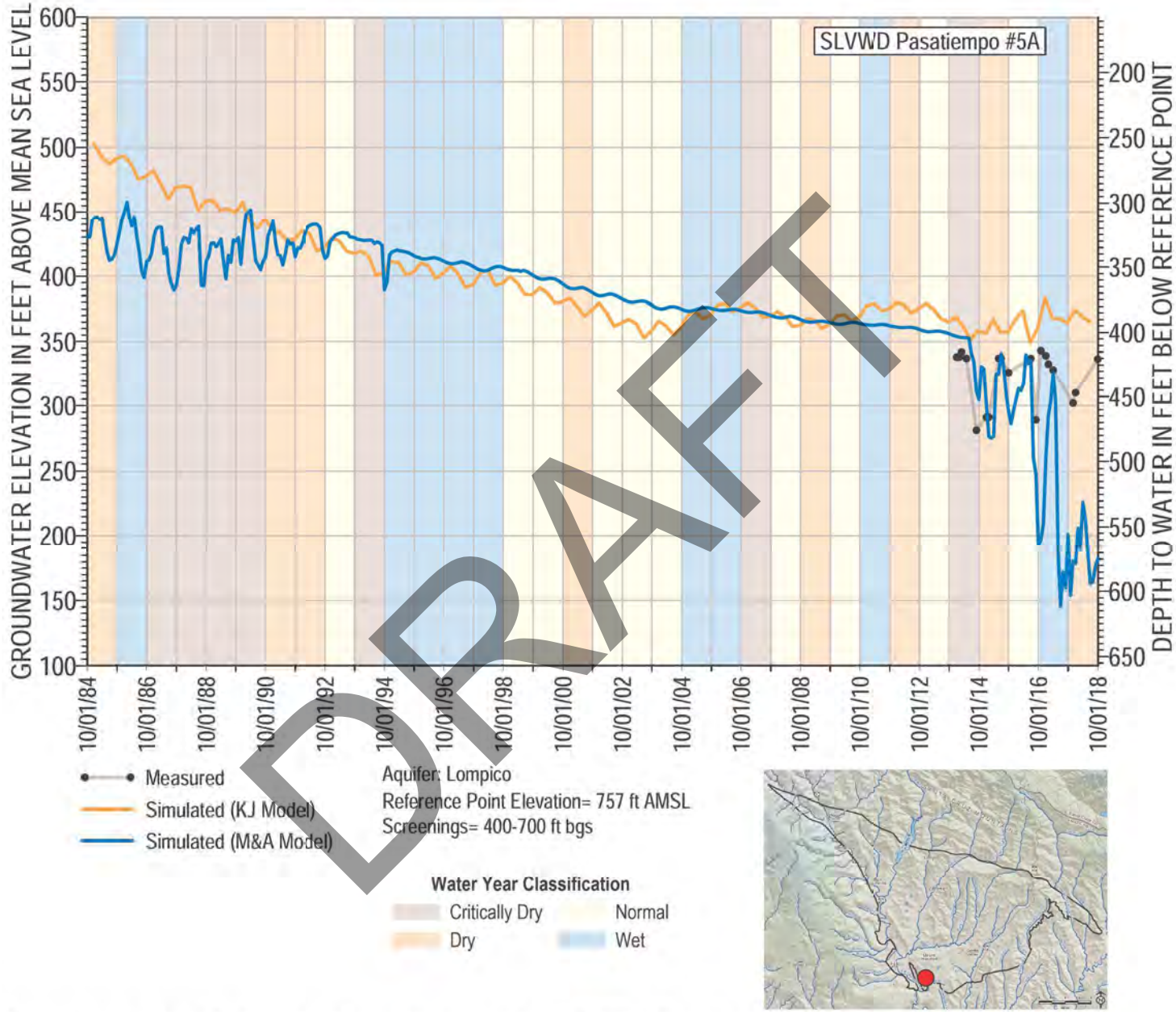
Groundwater Level Calibration Target Hydrograph for SLVWD Olympia #3



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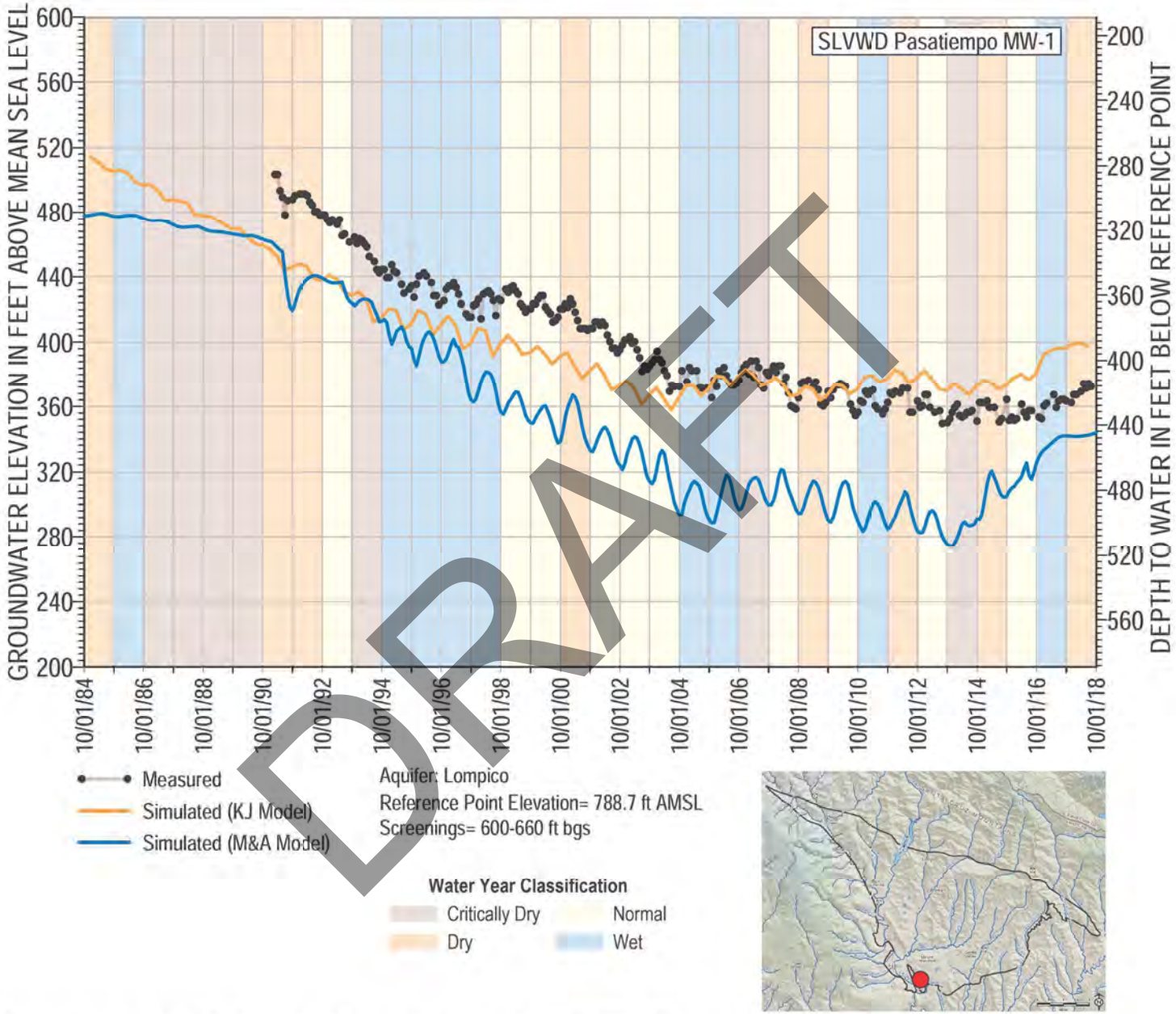
Groundwater Level Calibration Target Hydrograph for SLVWD Pasatiempo #5A



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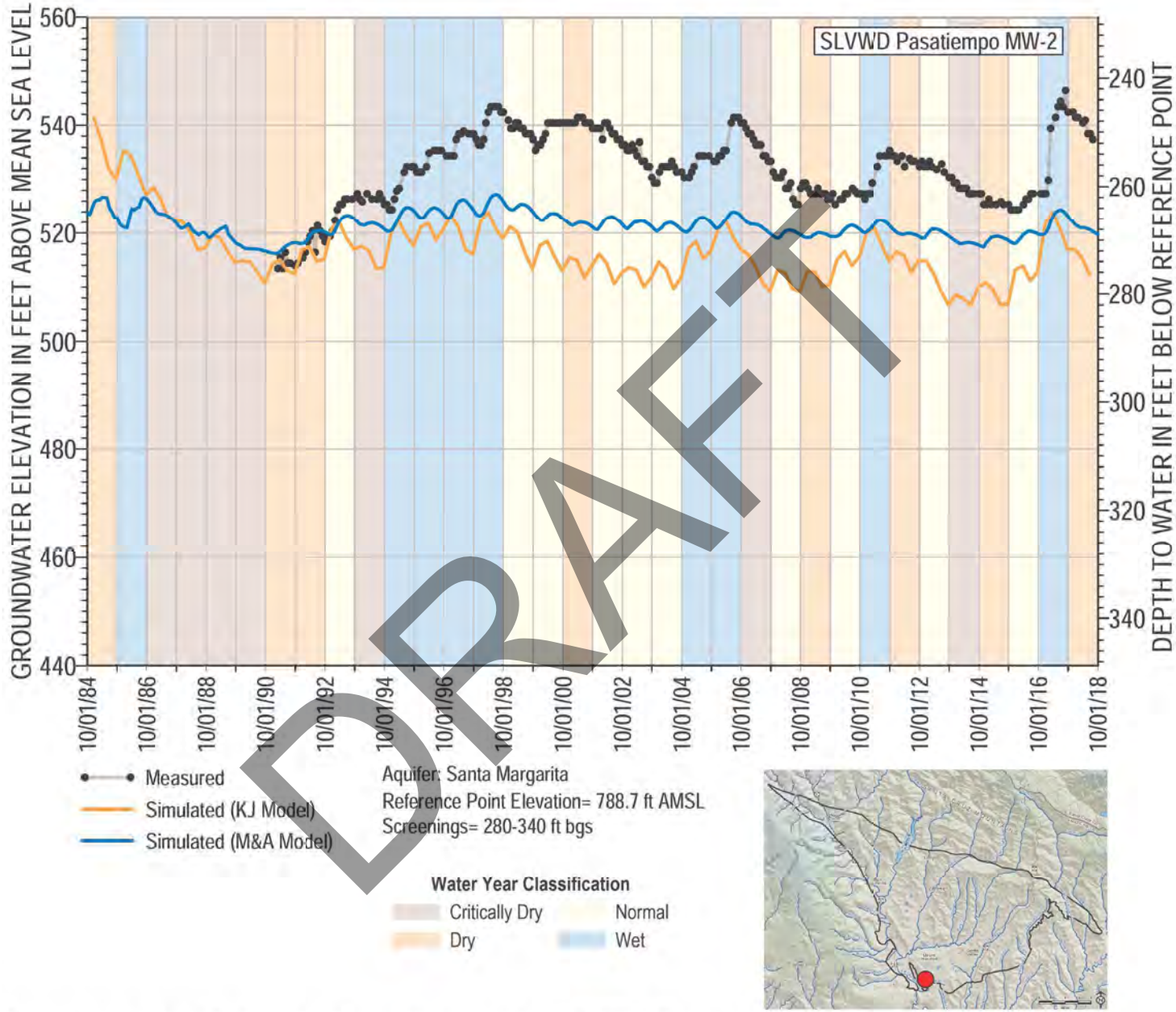
Groundwater Level Calibration Target Hydrograph for SLVWD Pasatiempo MW-1



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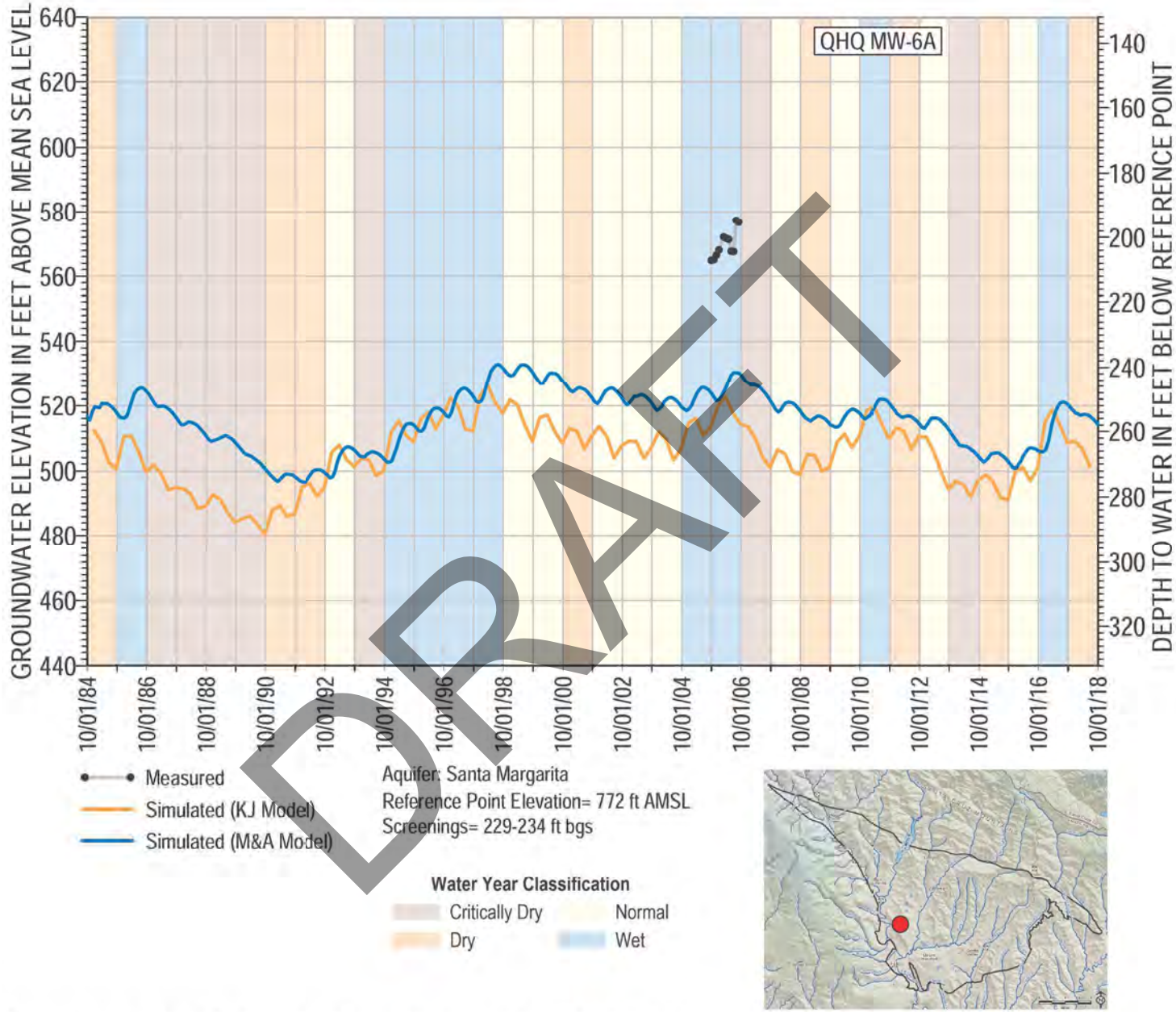
Groundwater Level Calibration Target Hydrograph for SLVWD Pasatiempo MW-2



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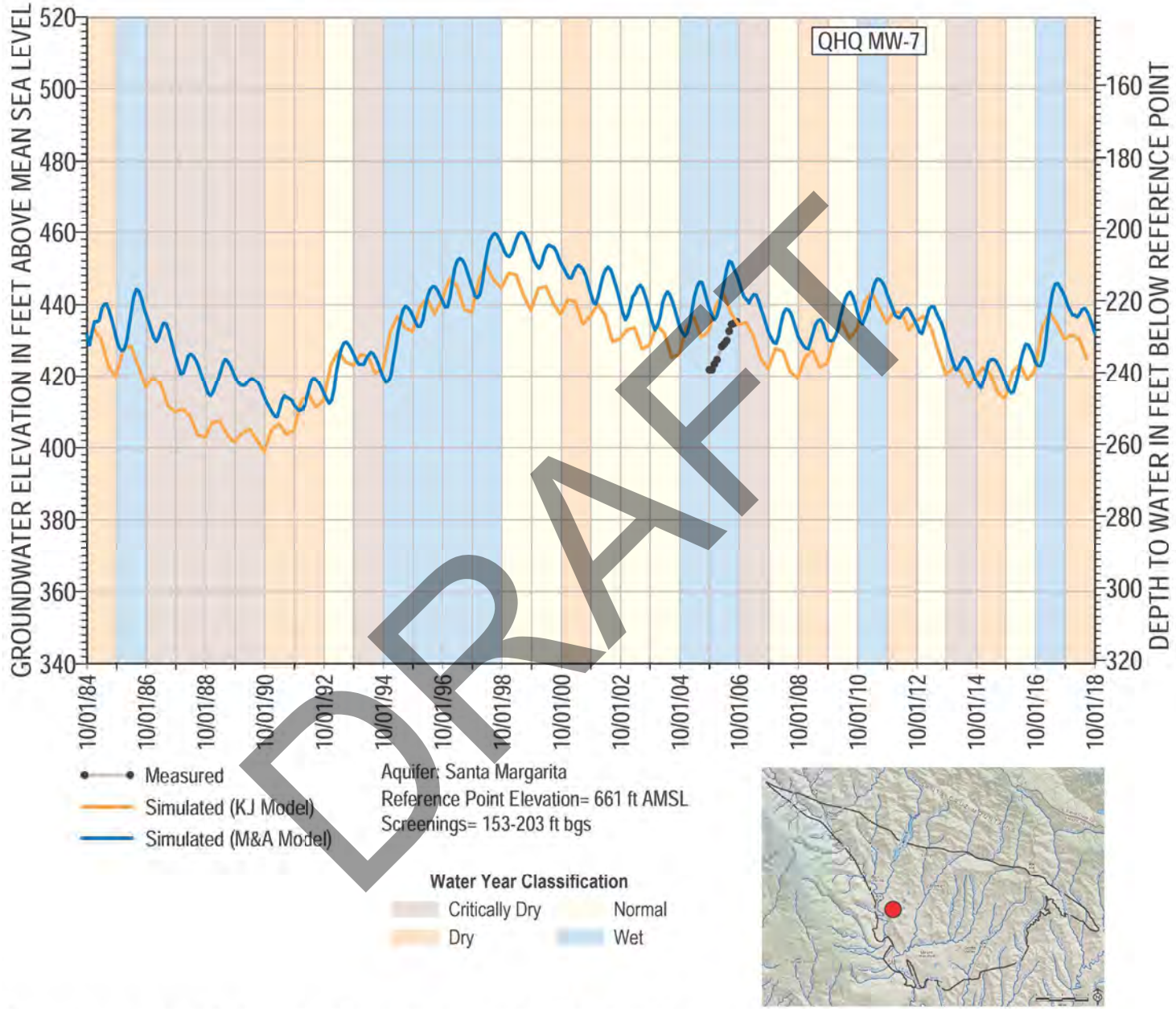
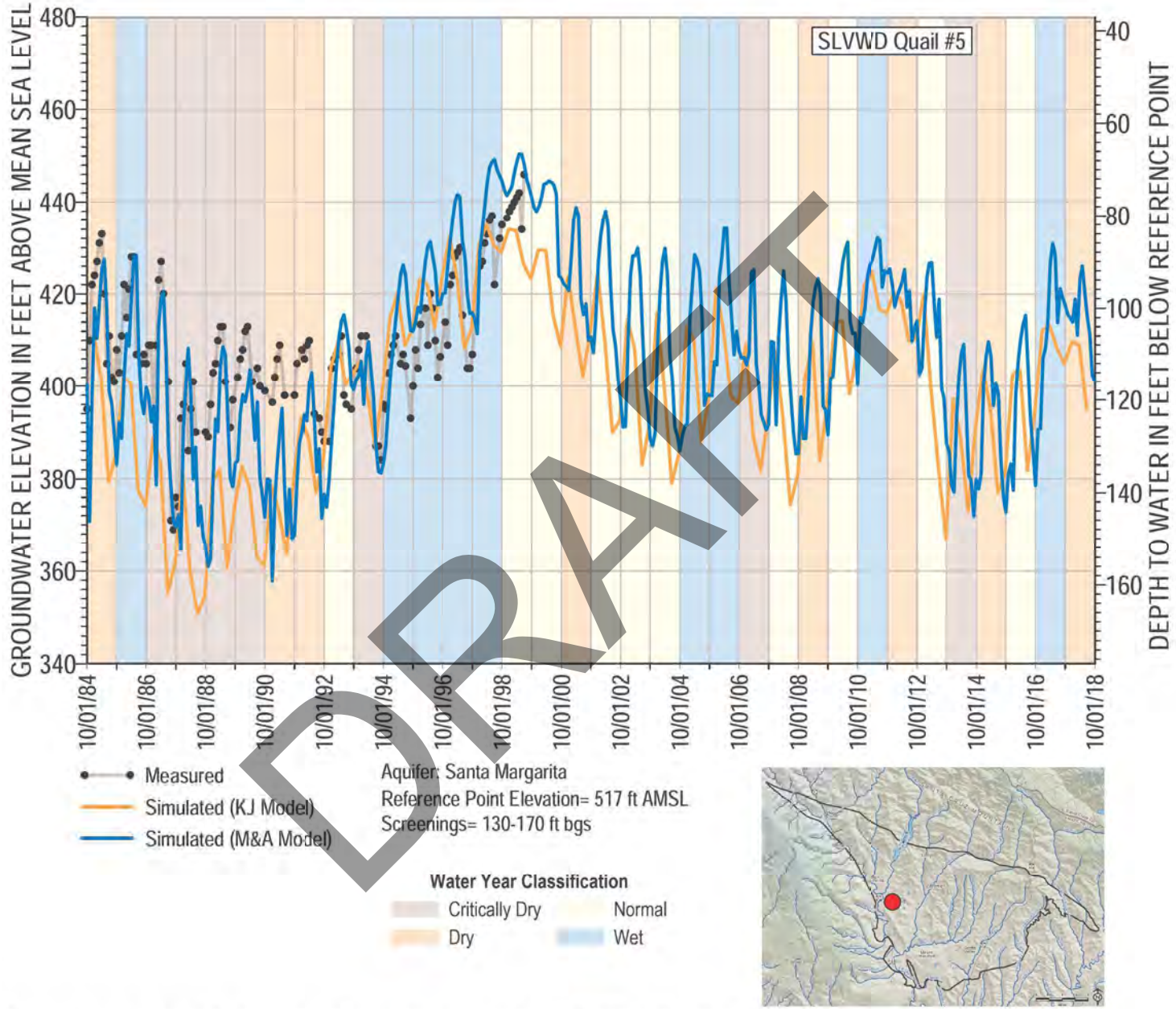
Groundwater Level Calibration Target Hydrograph for QHQ MW-6A



DRAFT

Groundwater Level Calibration Target Hydrograph for QHQ MW-7



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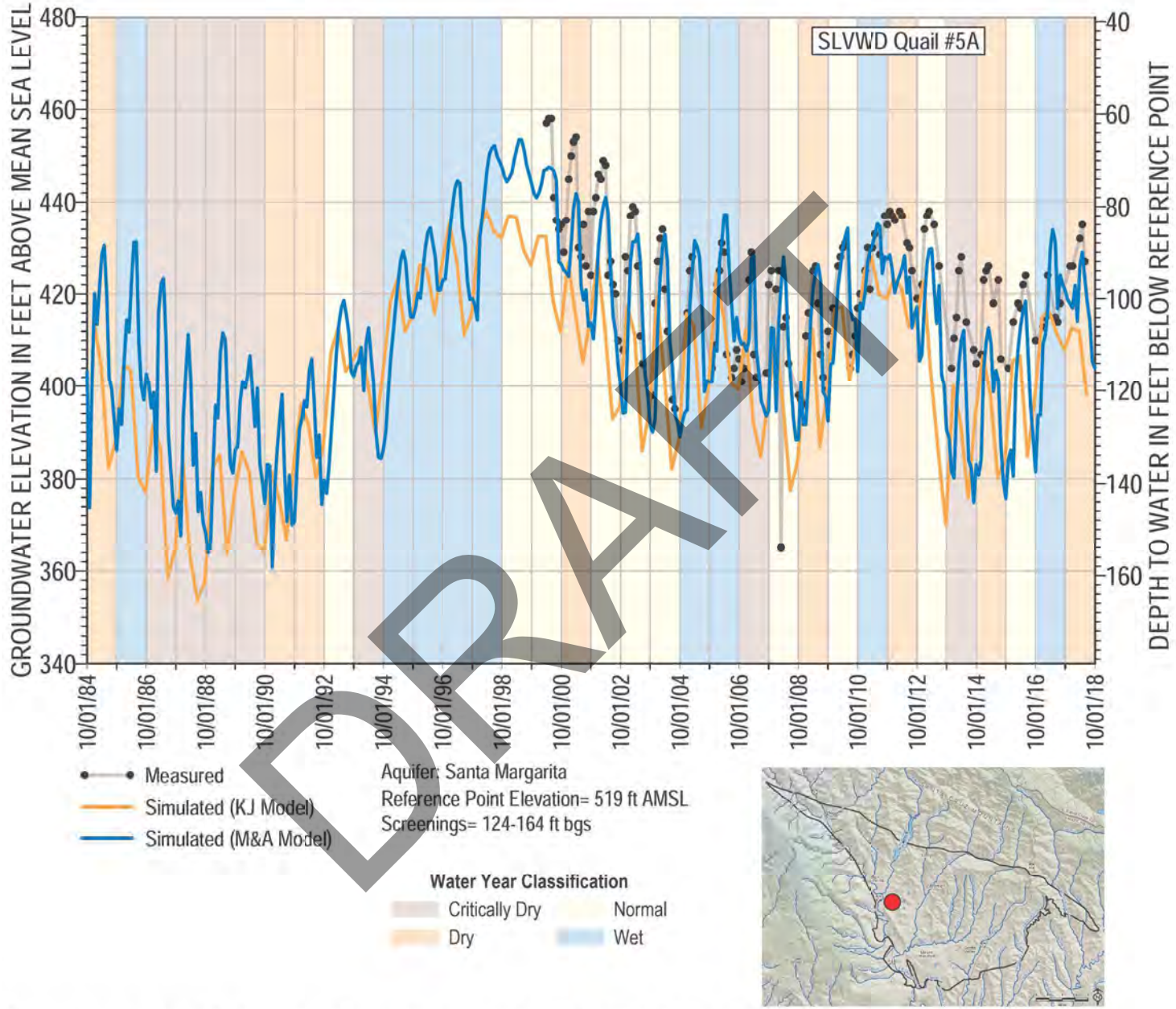
Groundwater Level Calibration Target Hydrograph for SLVWD Quail #5



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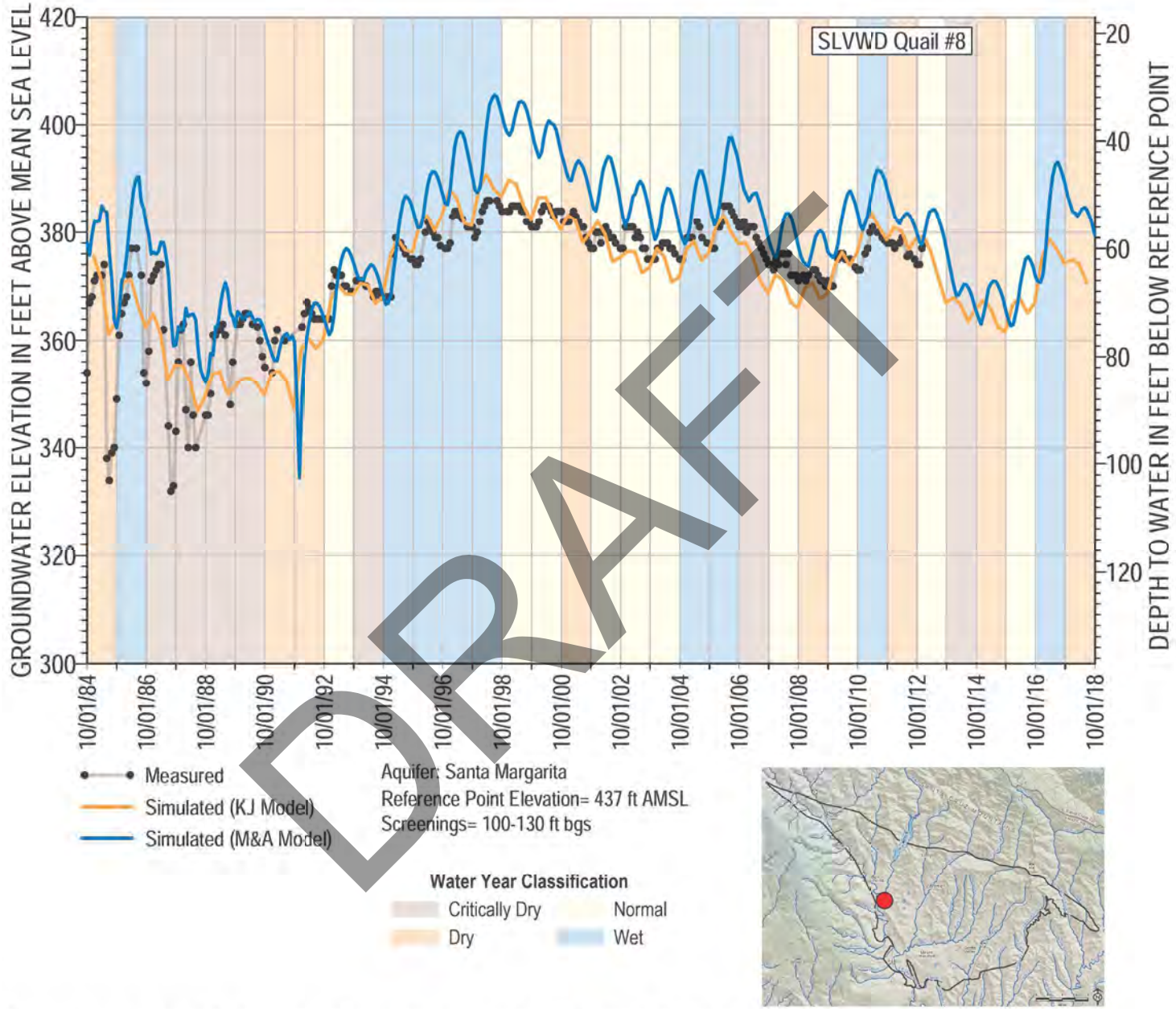
Groundwater Level Calibration Target Hydrograph for SLVWD Quail #5A



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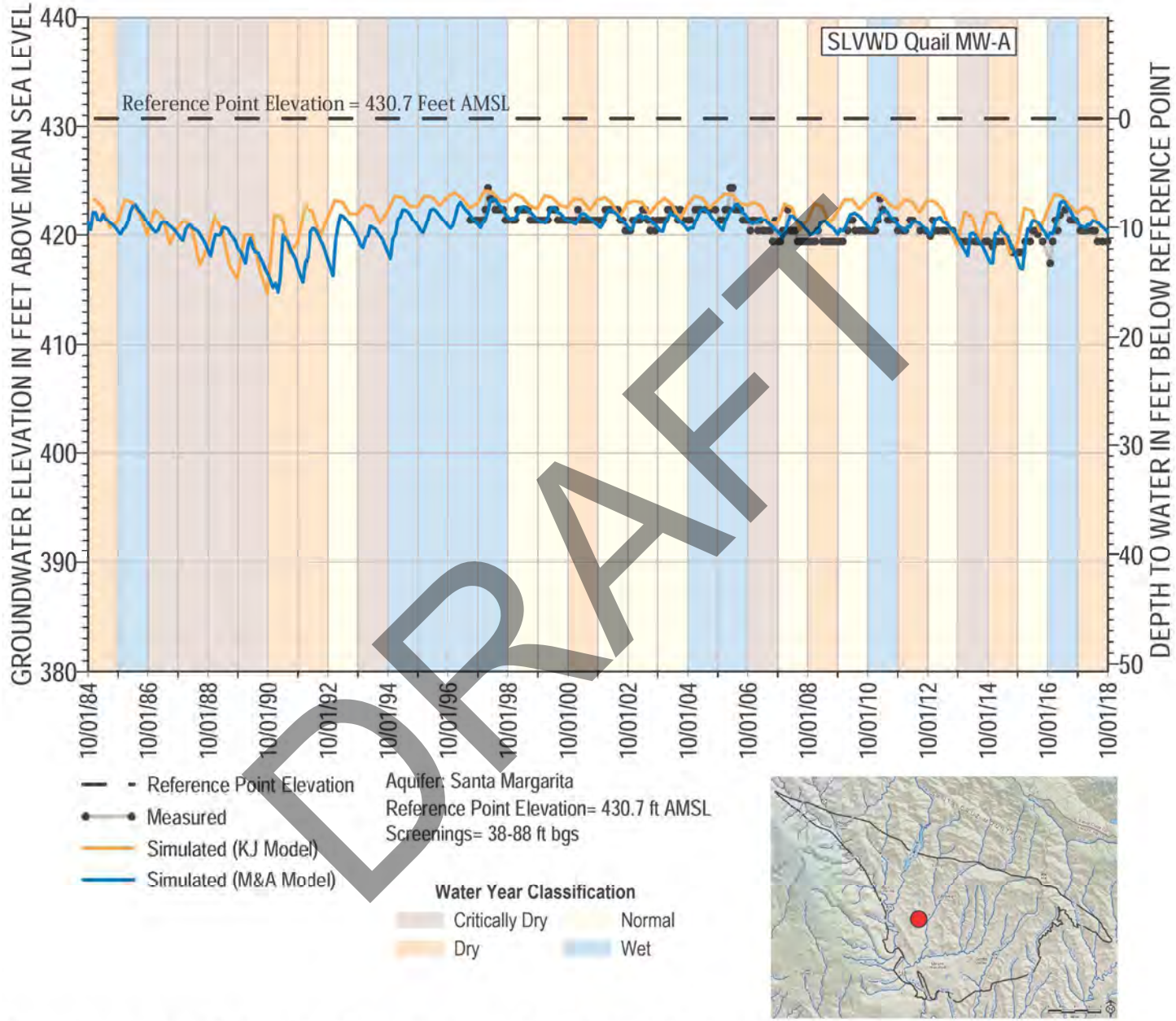
Groundwater Level Calibration Target Hydrograph for SLVWD Quail #8



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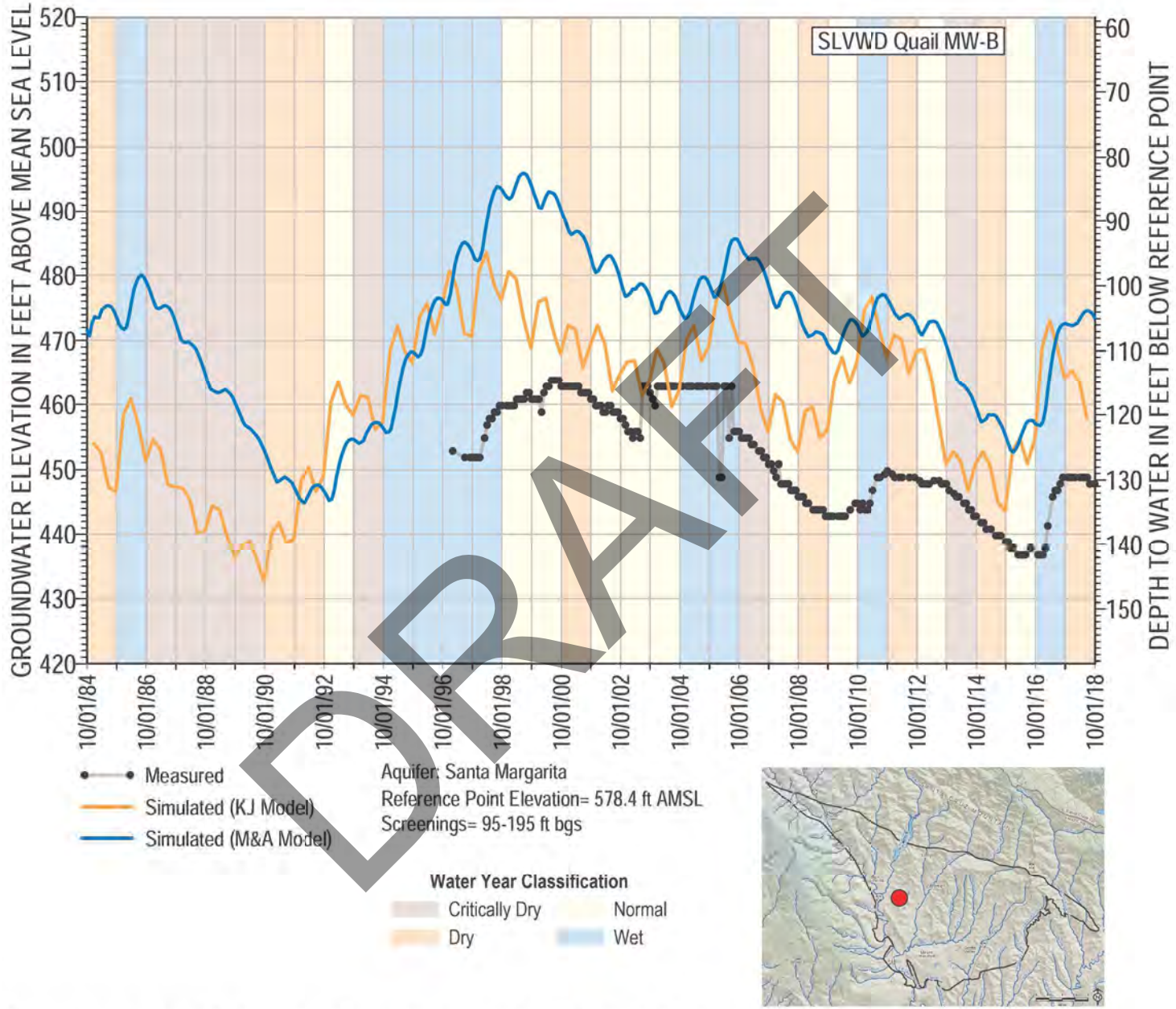
Groundwater Level Calibration Target Hydrograph for SLVWD Quail MW-A



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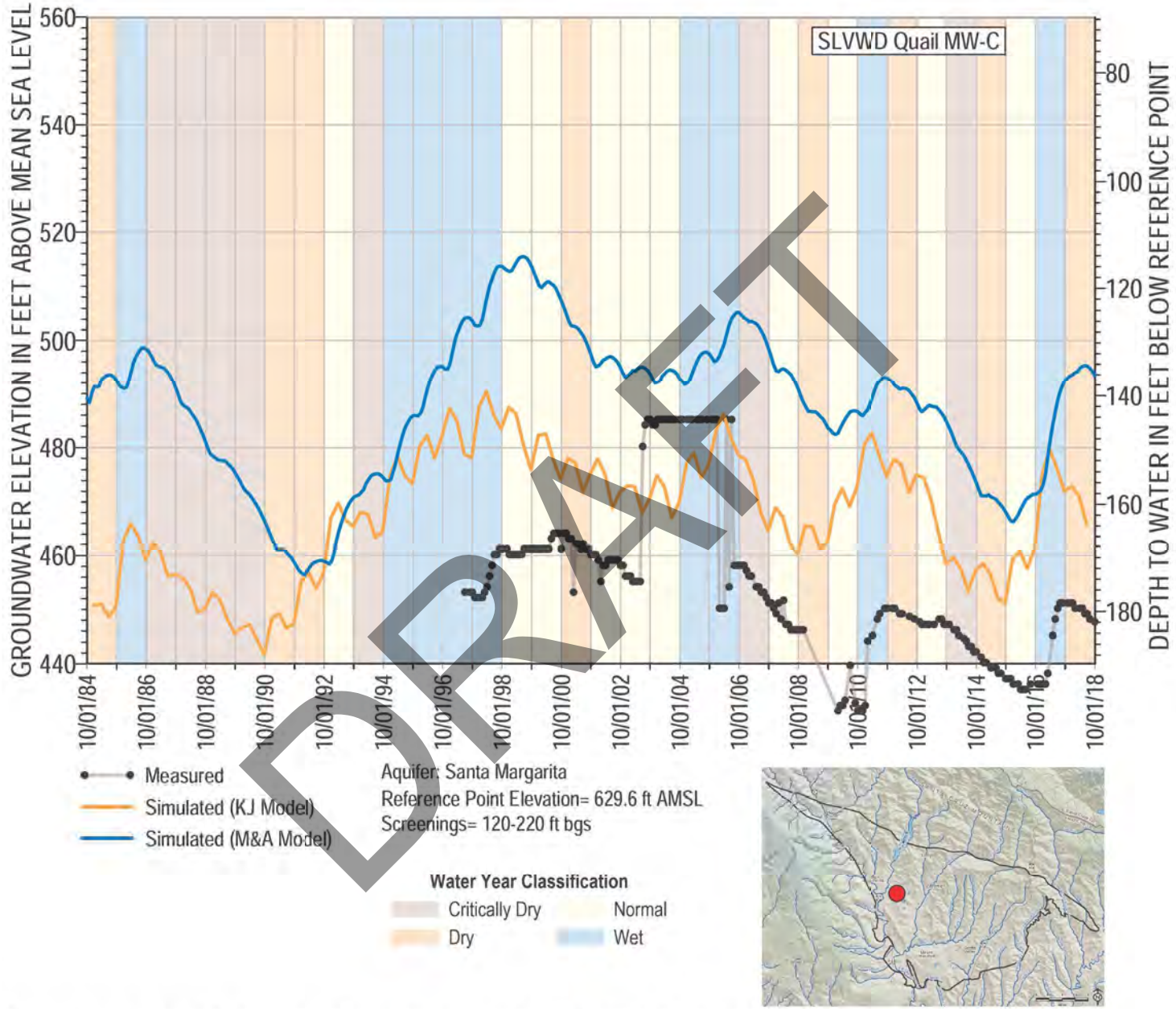
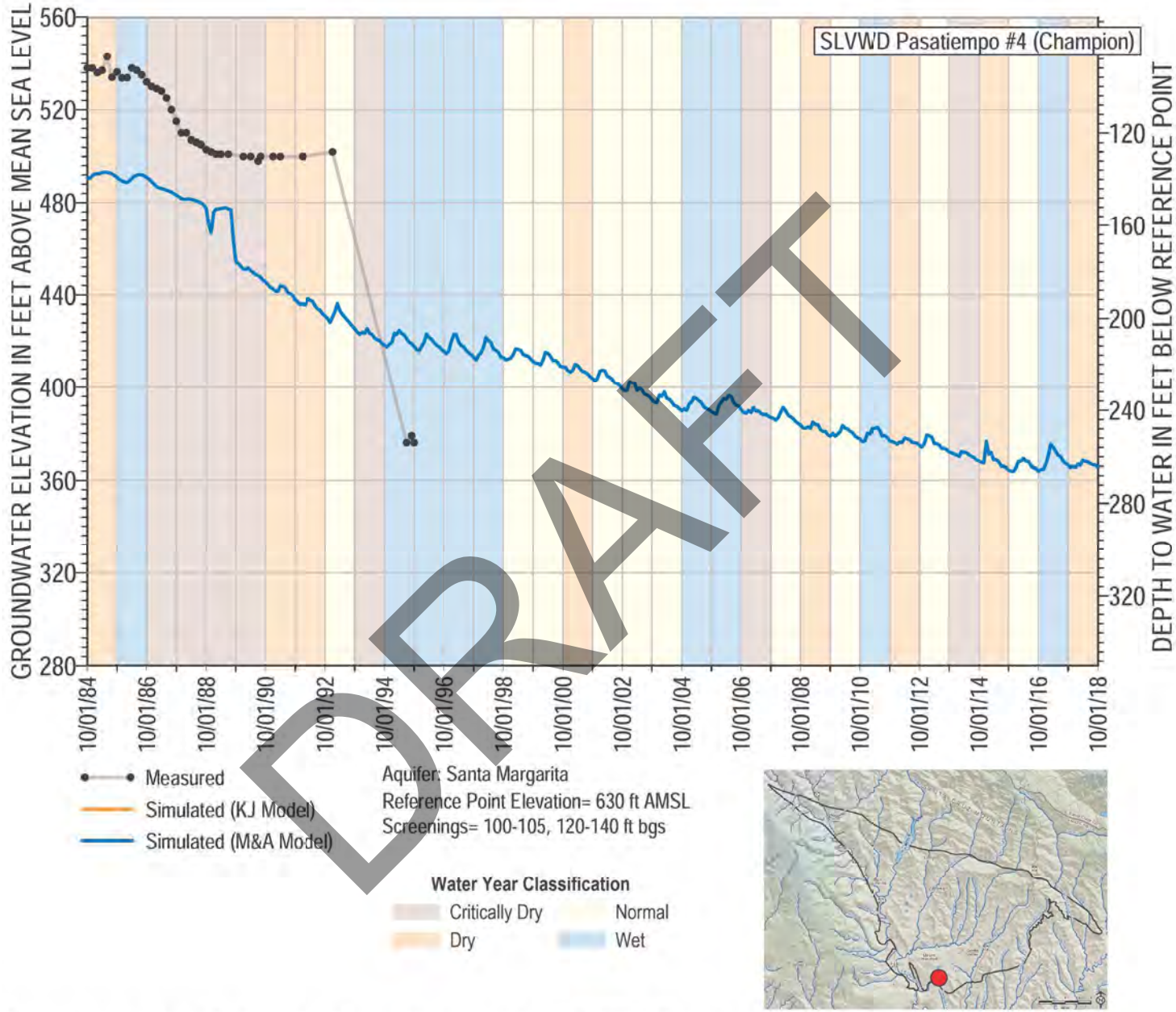
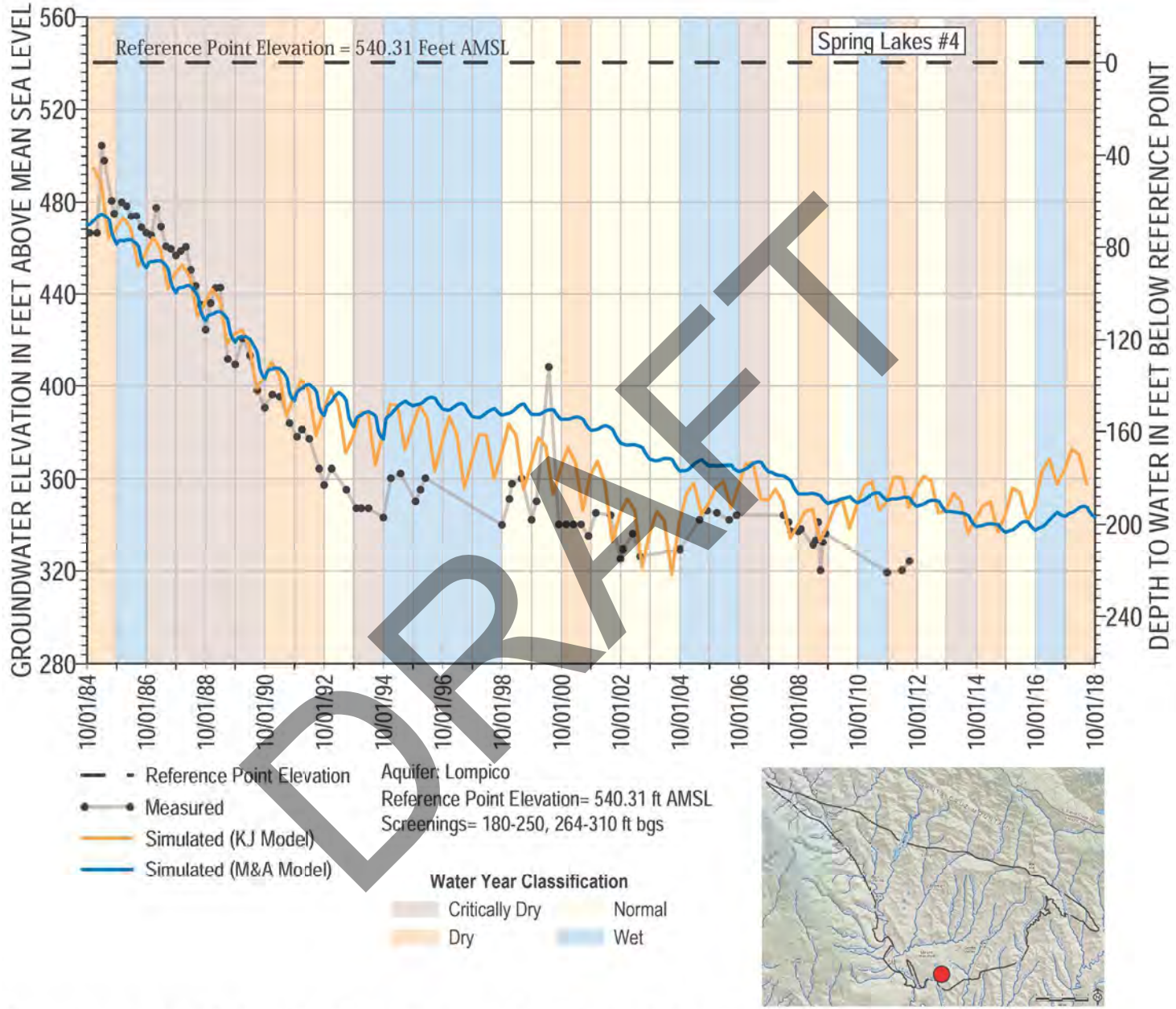
Groundwater Level Calibration Target Hydrograph for SLVWD Quail MW-B



Groundwater Level Calibration Target Hydrograph for SLVWD Quail MW-C



Groundwater Level Calibration Target Hydrograph for SLVWD Pasatiempo #4 (Champion)



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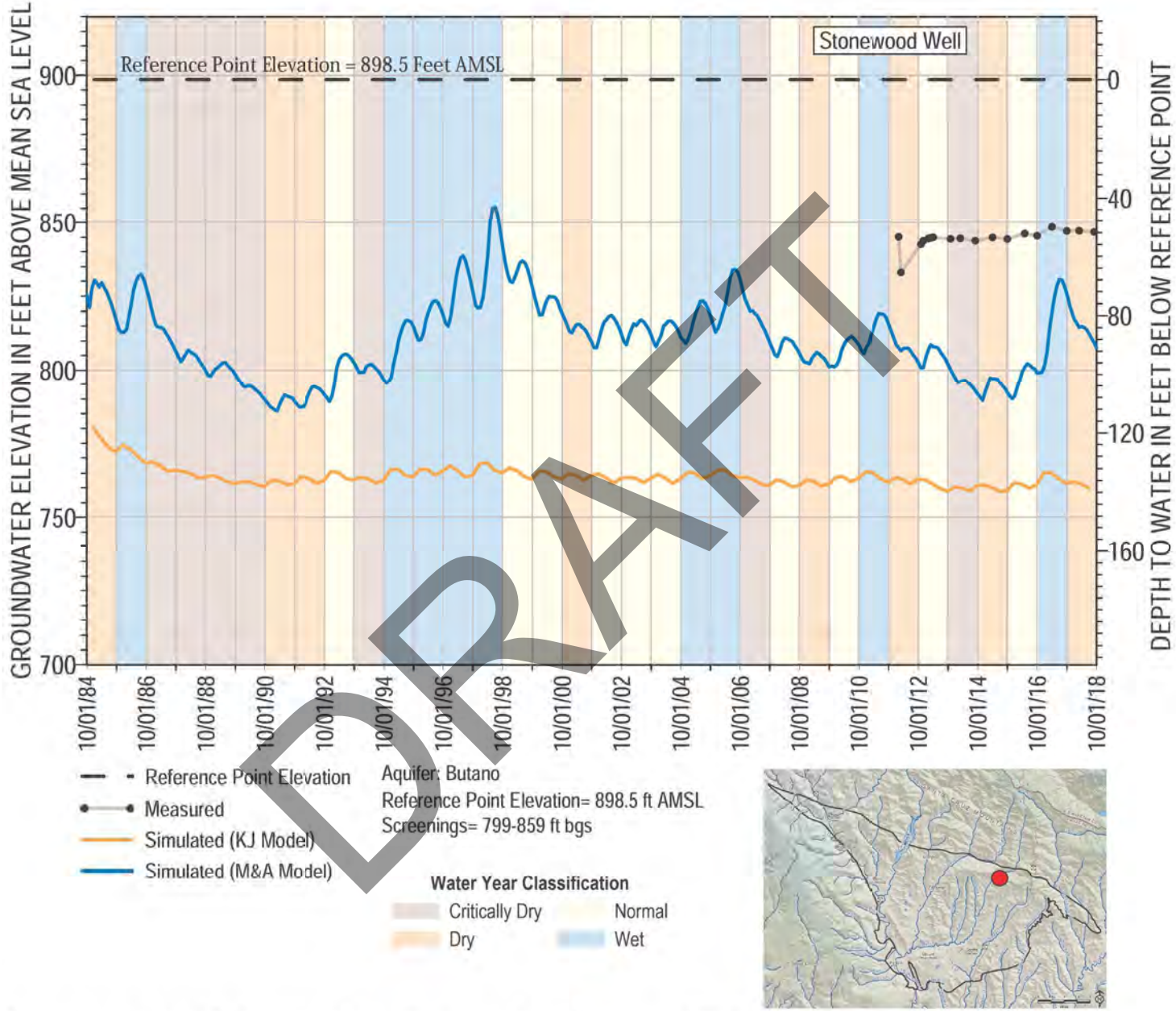
Groundwater Level Calibration Target Hydrograph for Spring Lakes #4



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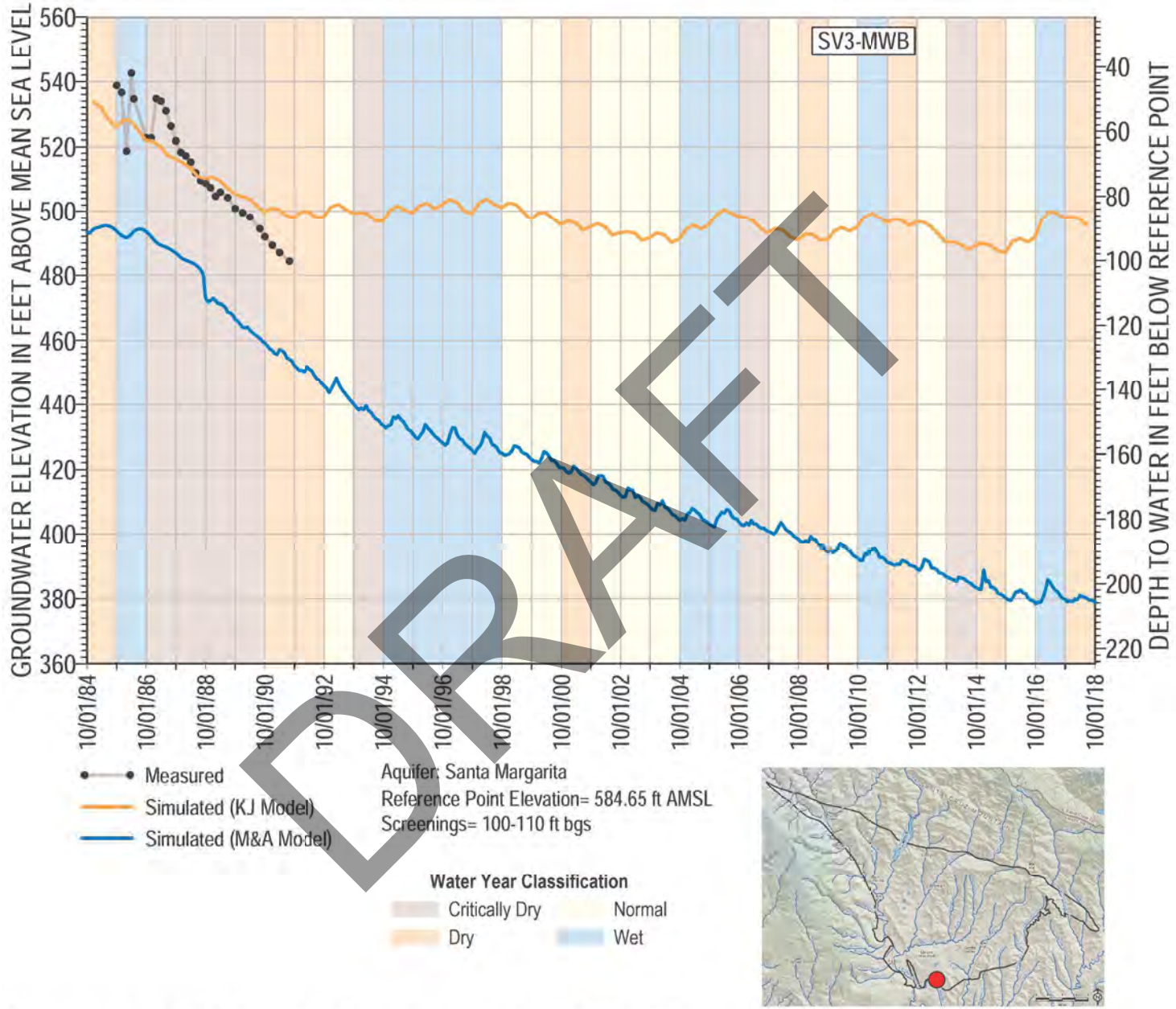
Groundwater Level Calibration Target Hydrograph for Stonewood Well



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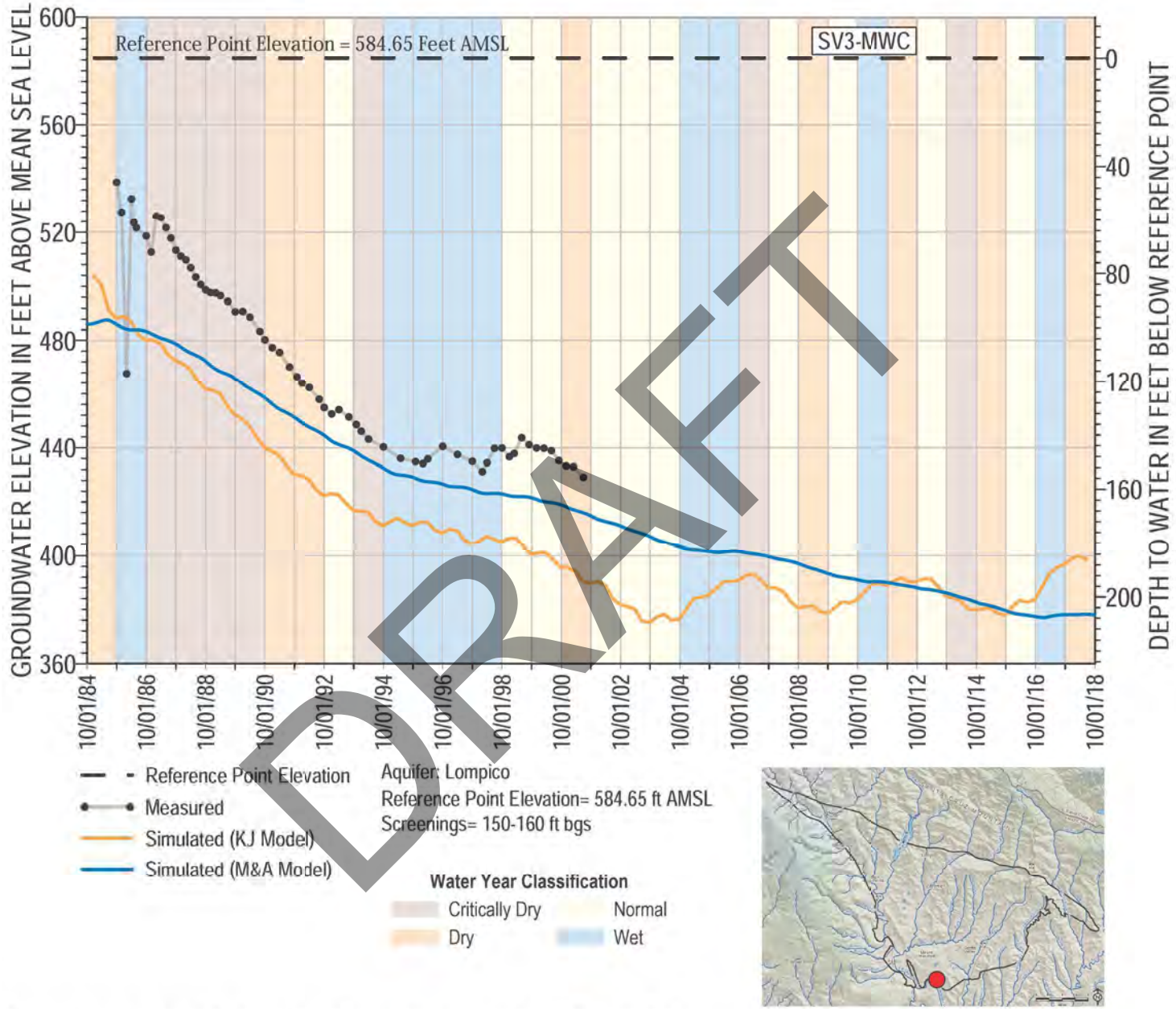
Groundwater Level Calibration Target Hydrograph for SV3-MWB



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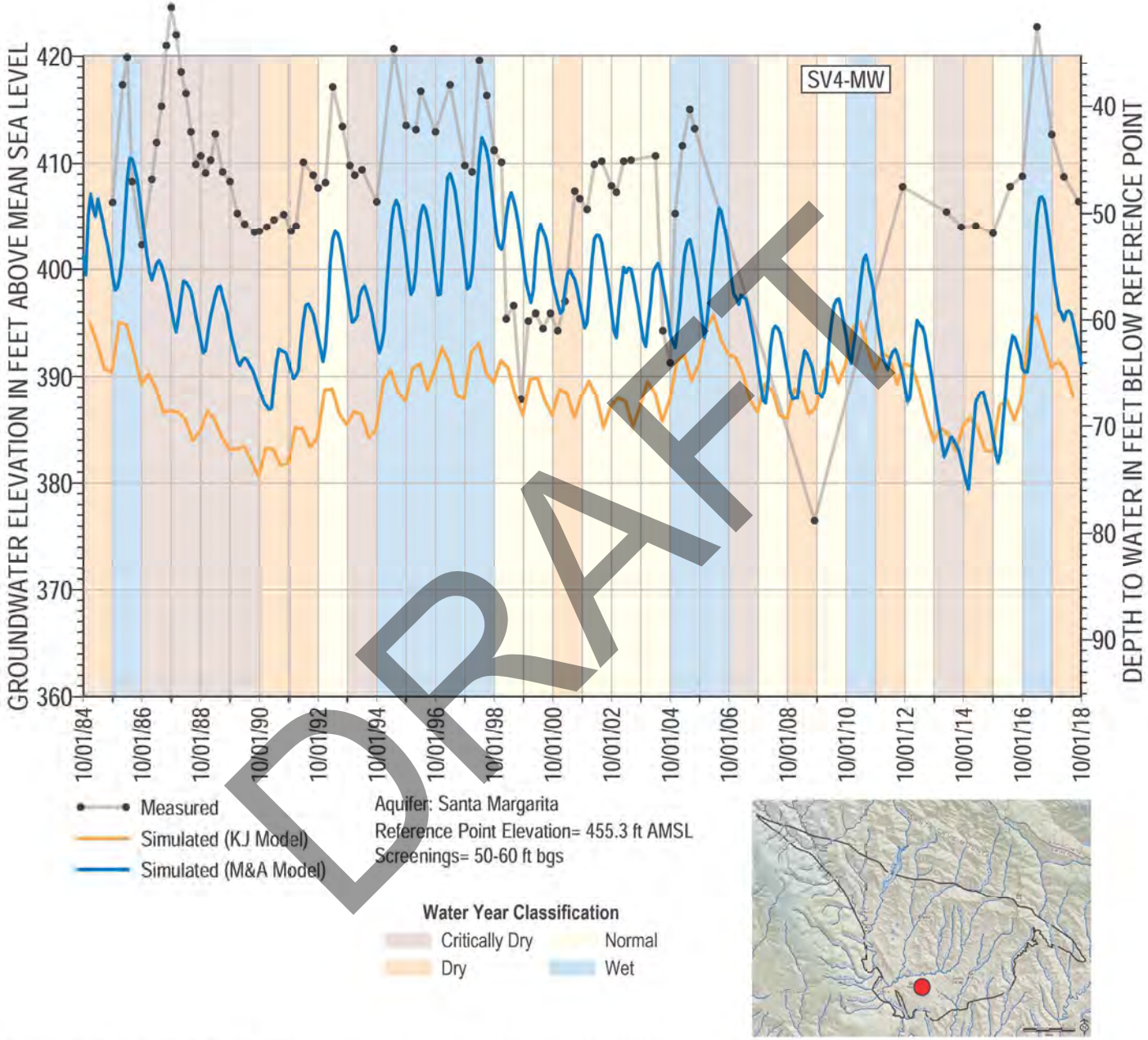
Groundwater Level Calibration Target Hydrograph for SV3-MWC



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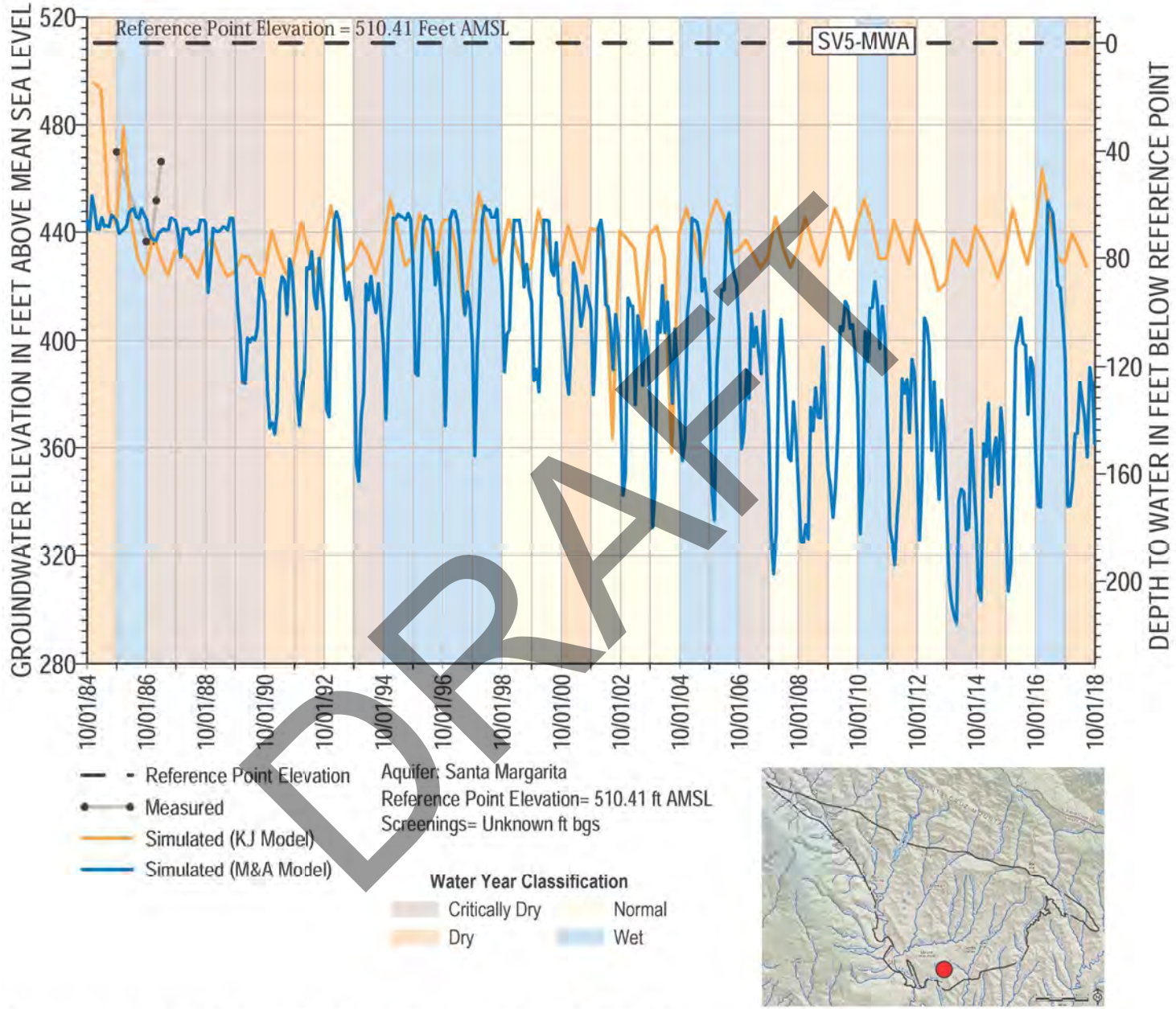
Groundwater Level Calibration Target Hydrograph for SV4-MW



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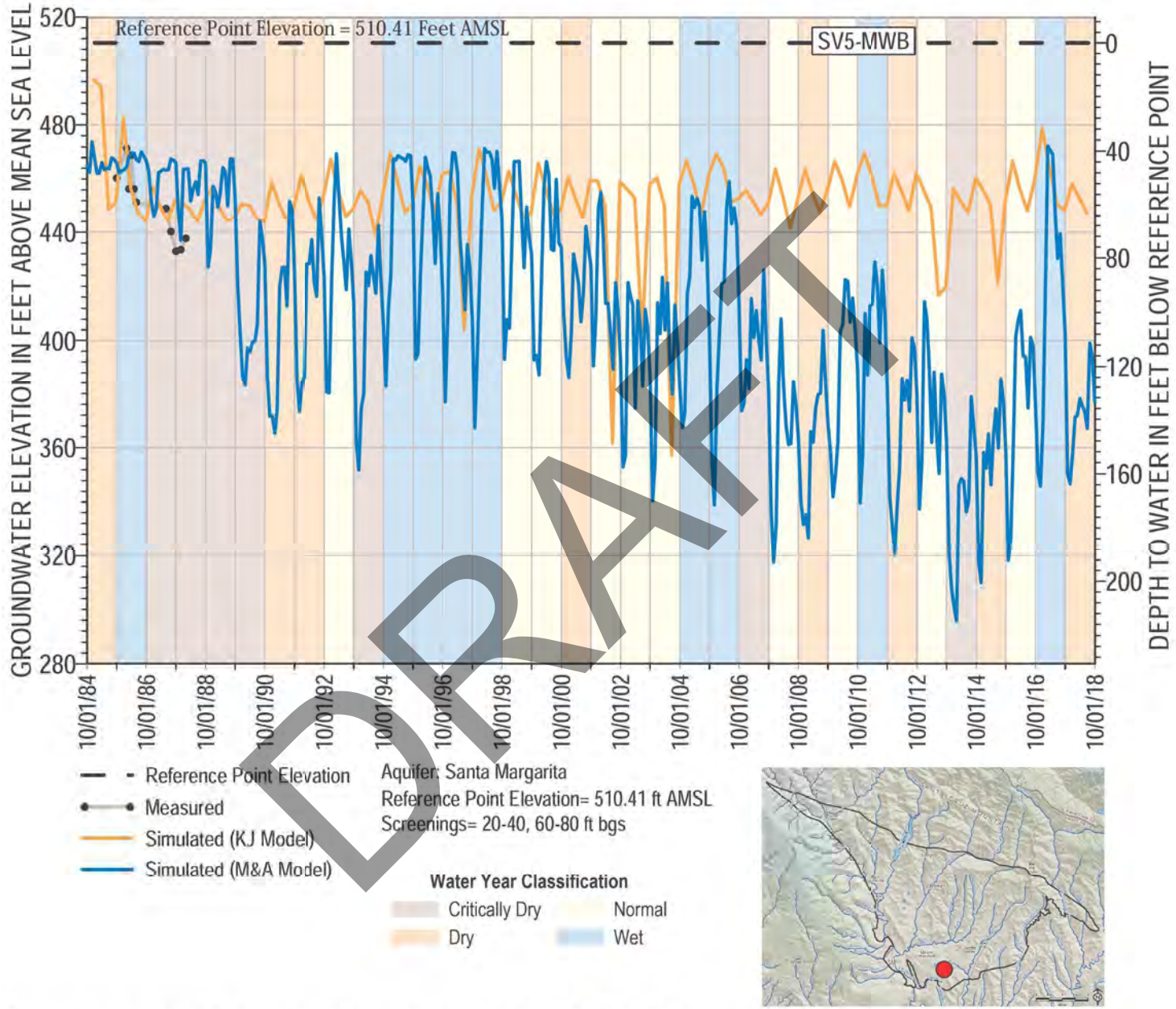
Groundwater Level Calibration Target Hydrograph for SV5-MWA



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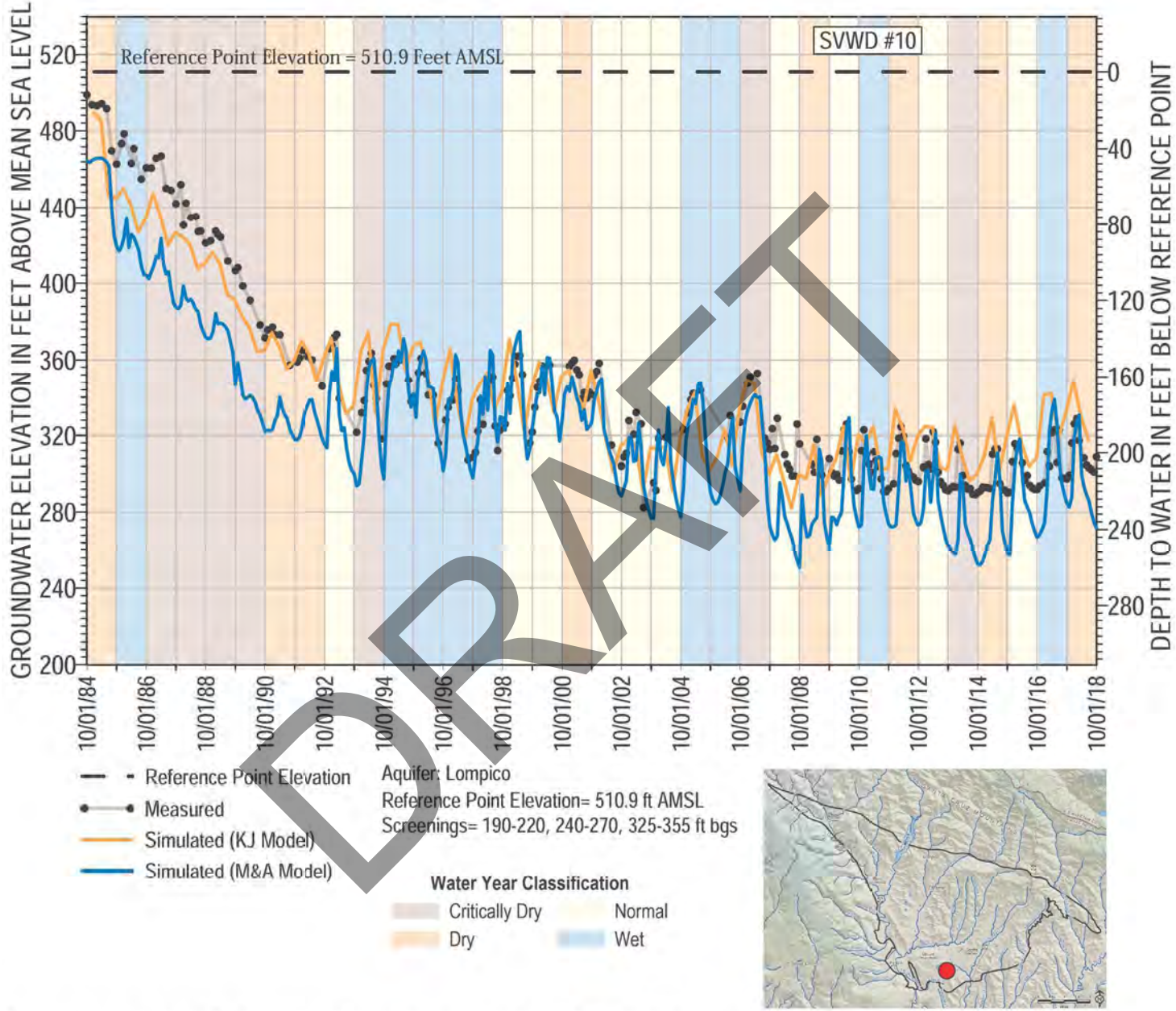
Groundwater Level Calibration Target Hydrograph for SV5-MWB



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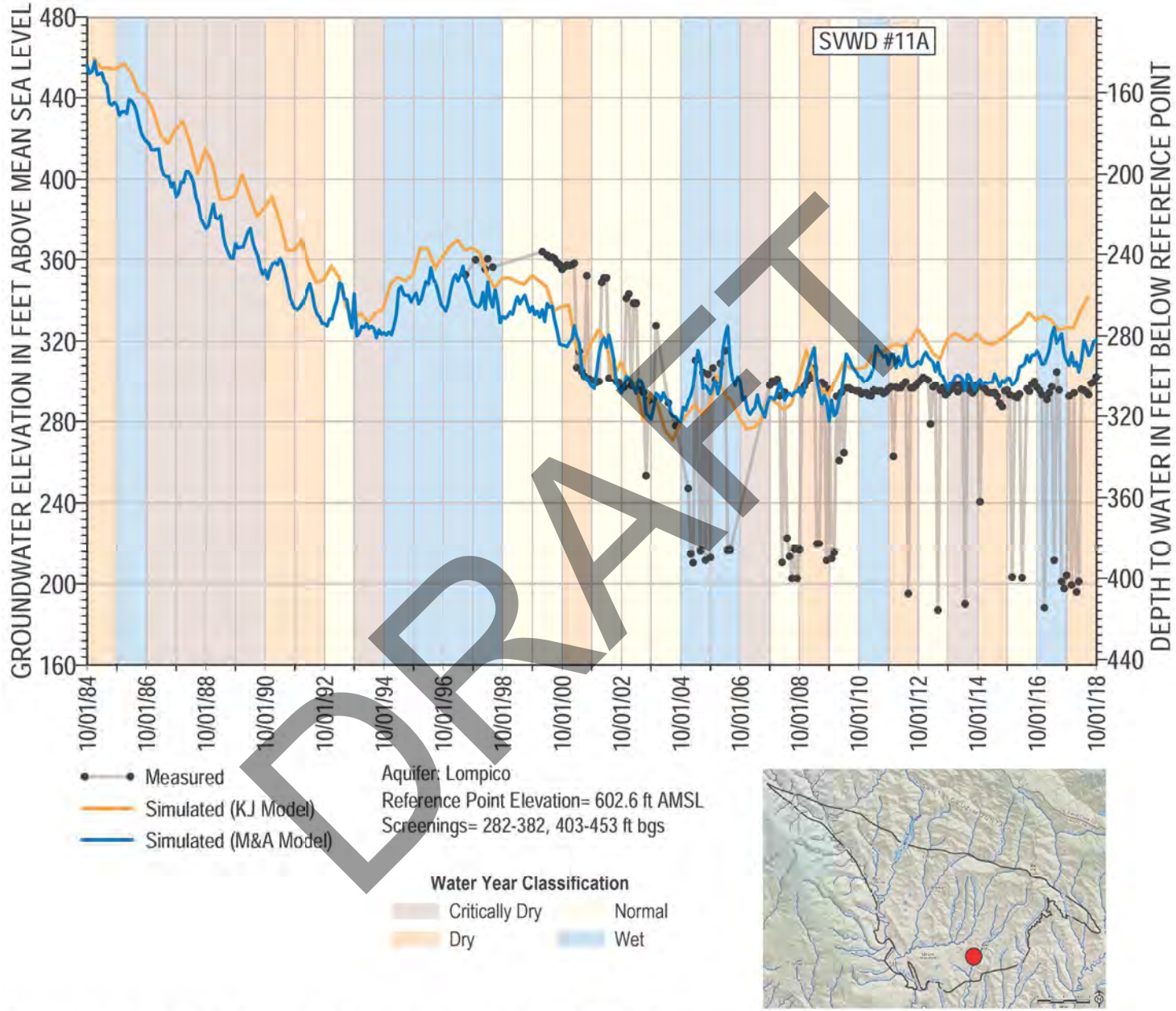
Groundwater Level Calibration Target Hydrograph for SVWD #10



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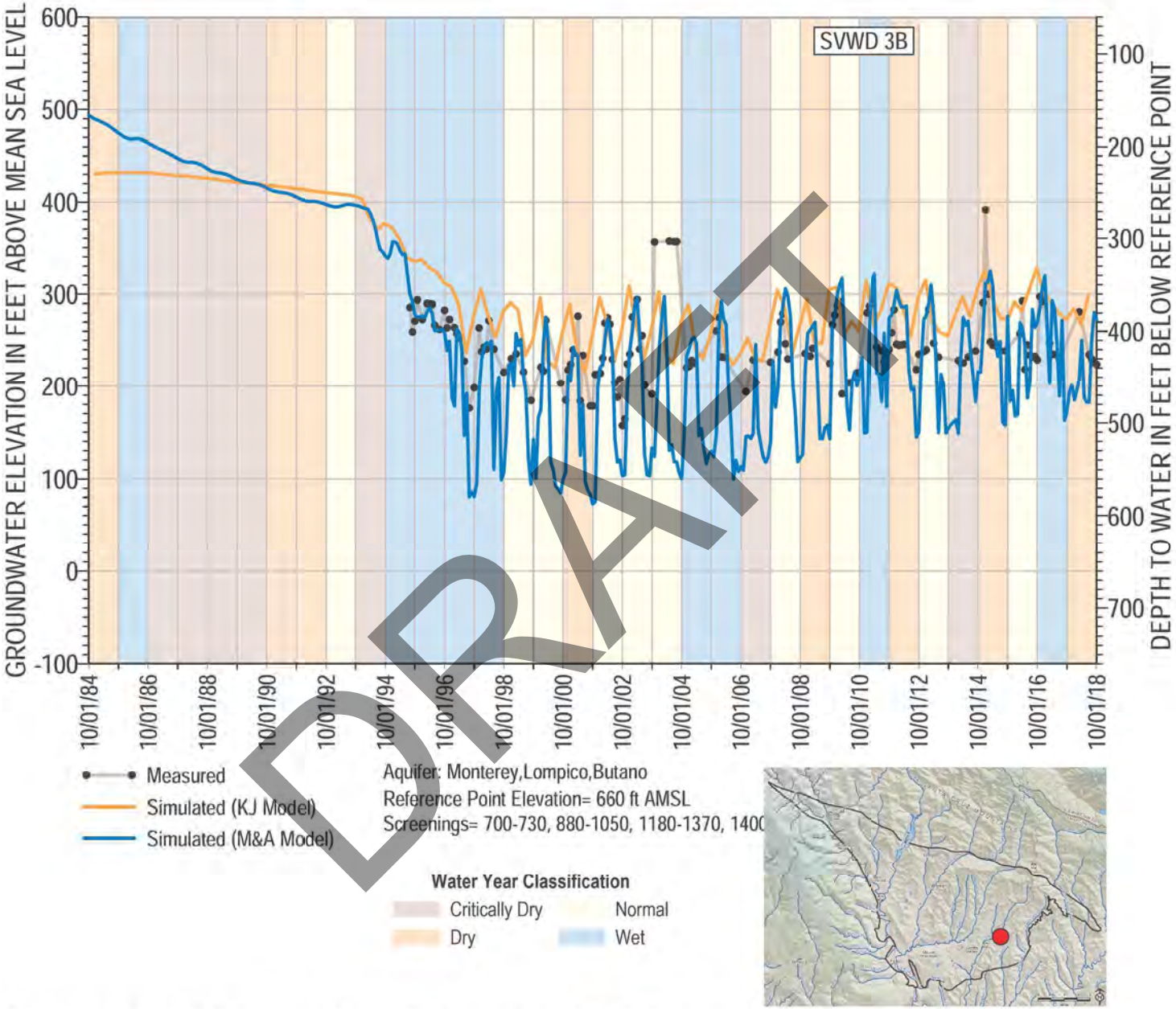
Groundwater Level Calibration Target Hydrograph for SVWD #11A



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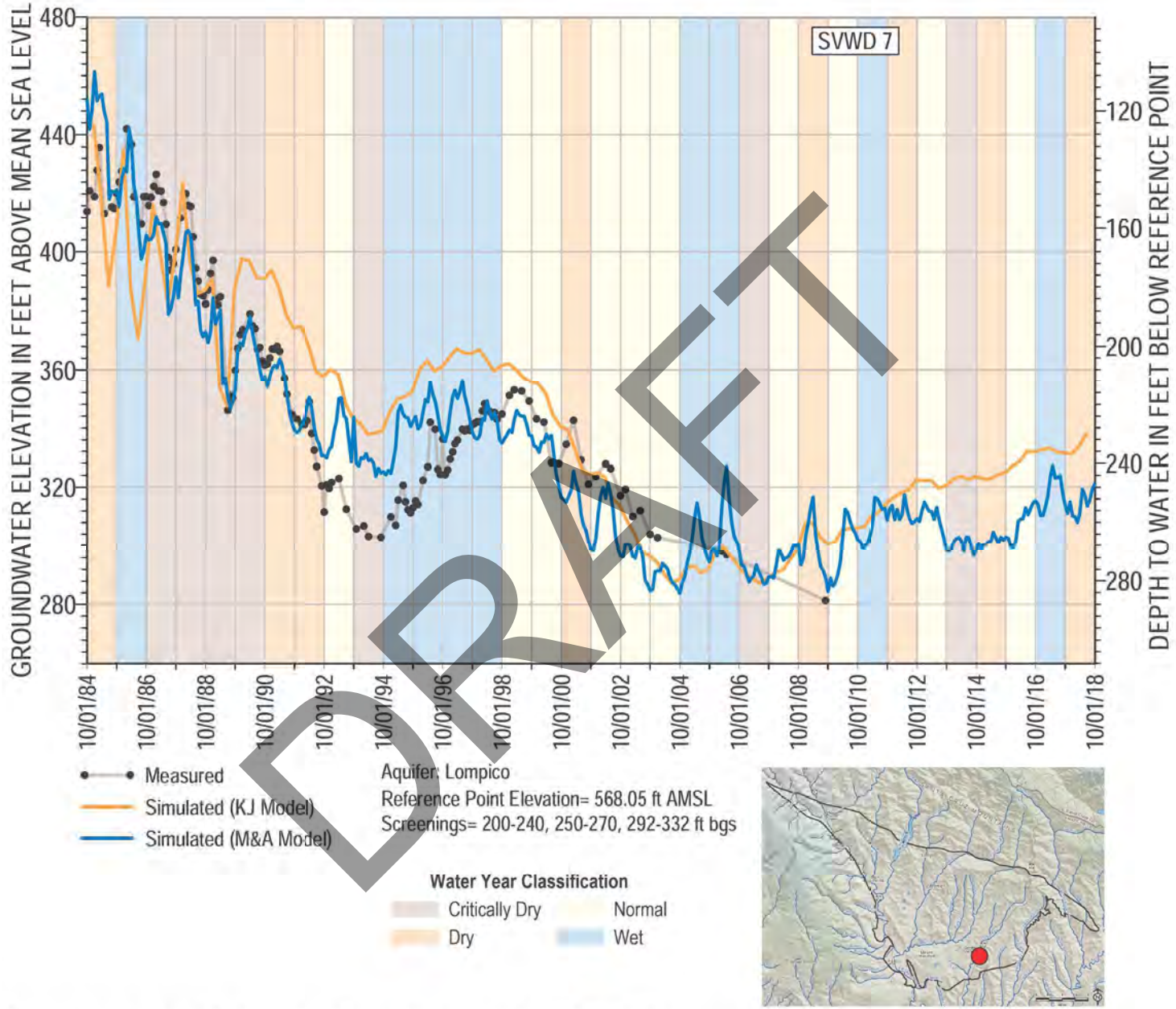
Groundwater Level Calibration Target Hydrograph for SVWD 3B



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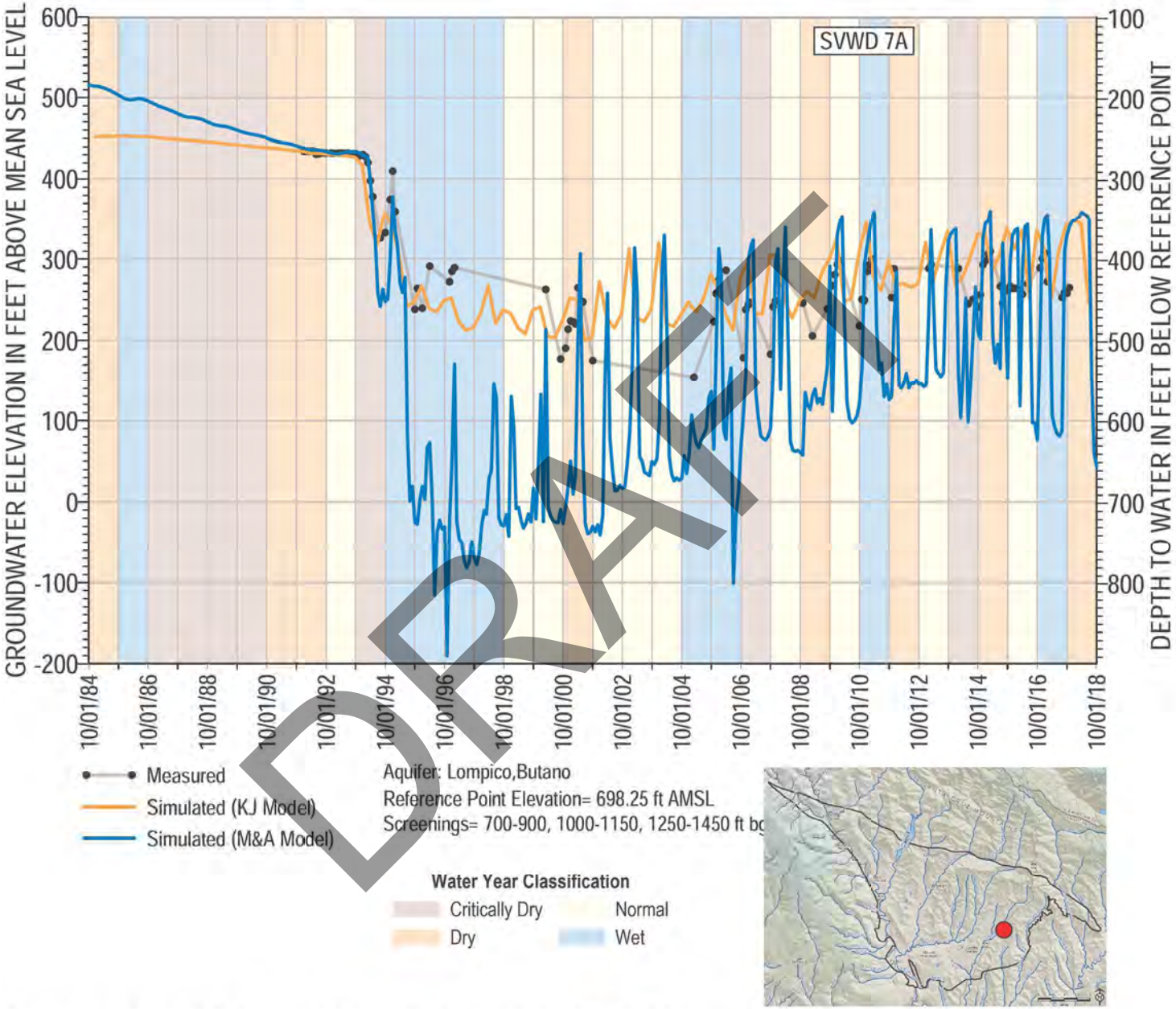
Groundwater Level Calibration Target Hydrograph for SVWD 7



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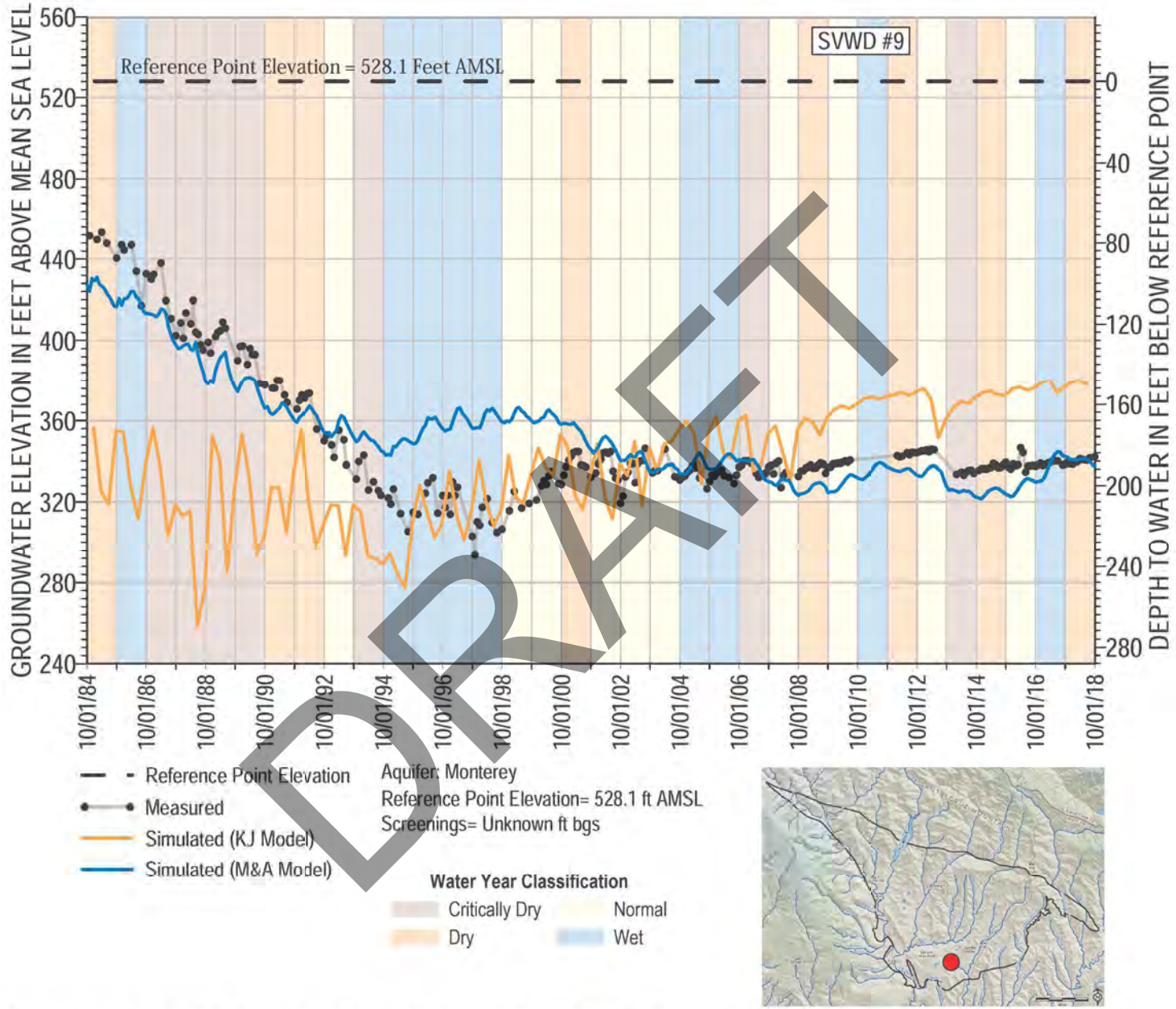
Groundwater Level Calibration Target Hydrograph for SVWD 7A



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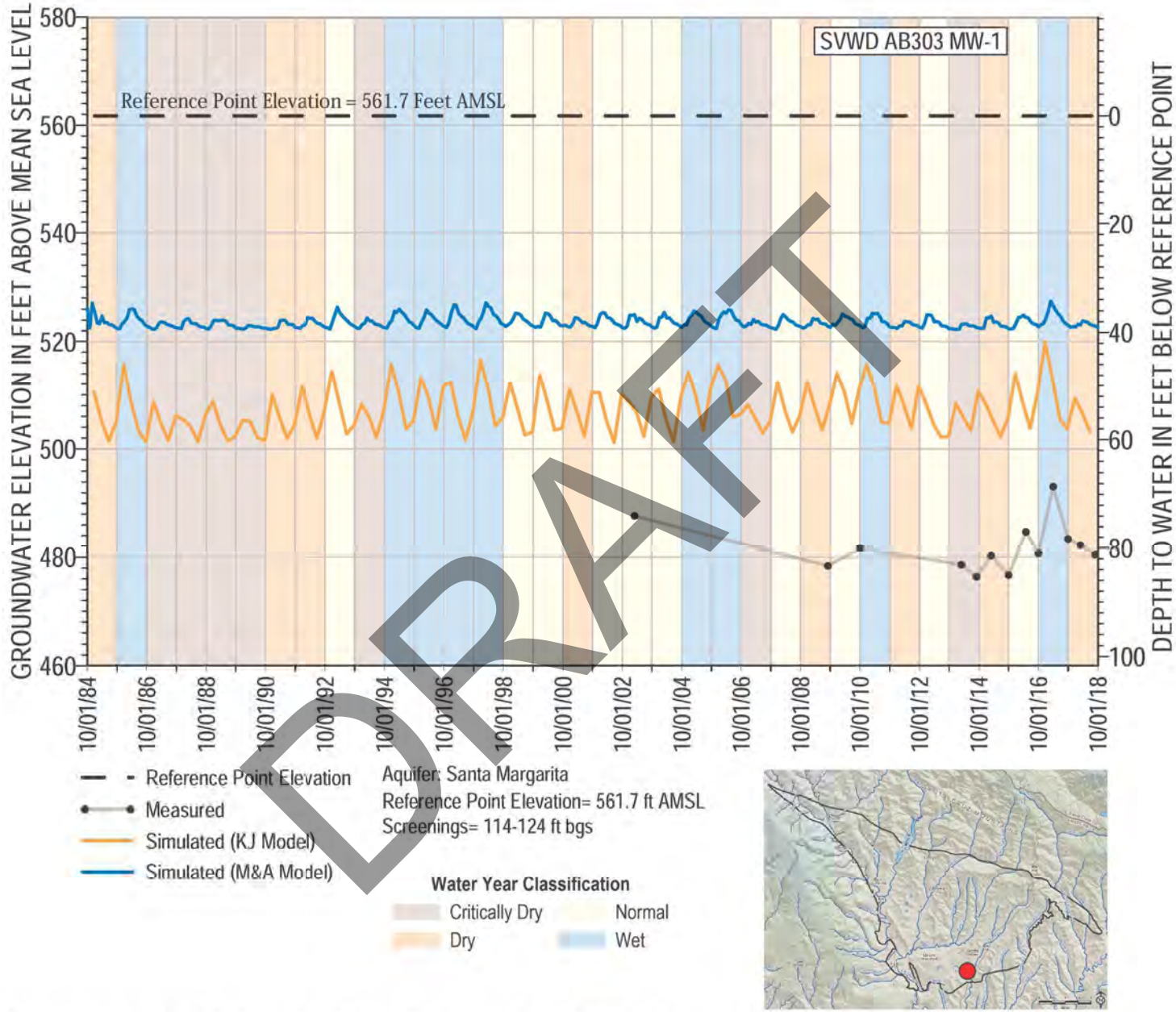
Groundwater Level Calibration Target Hydrograph for SVWD #9



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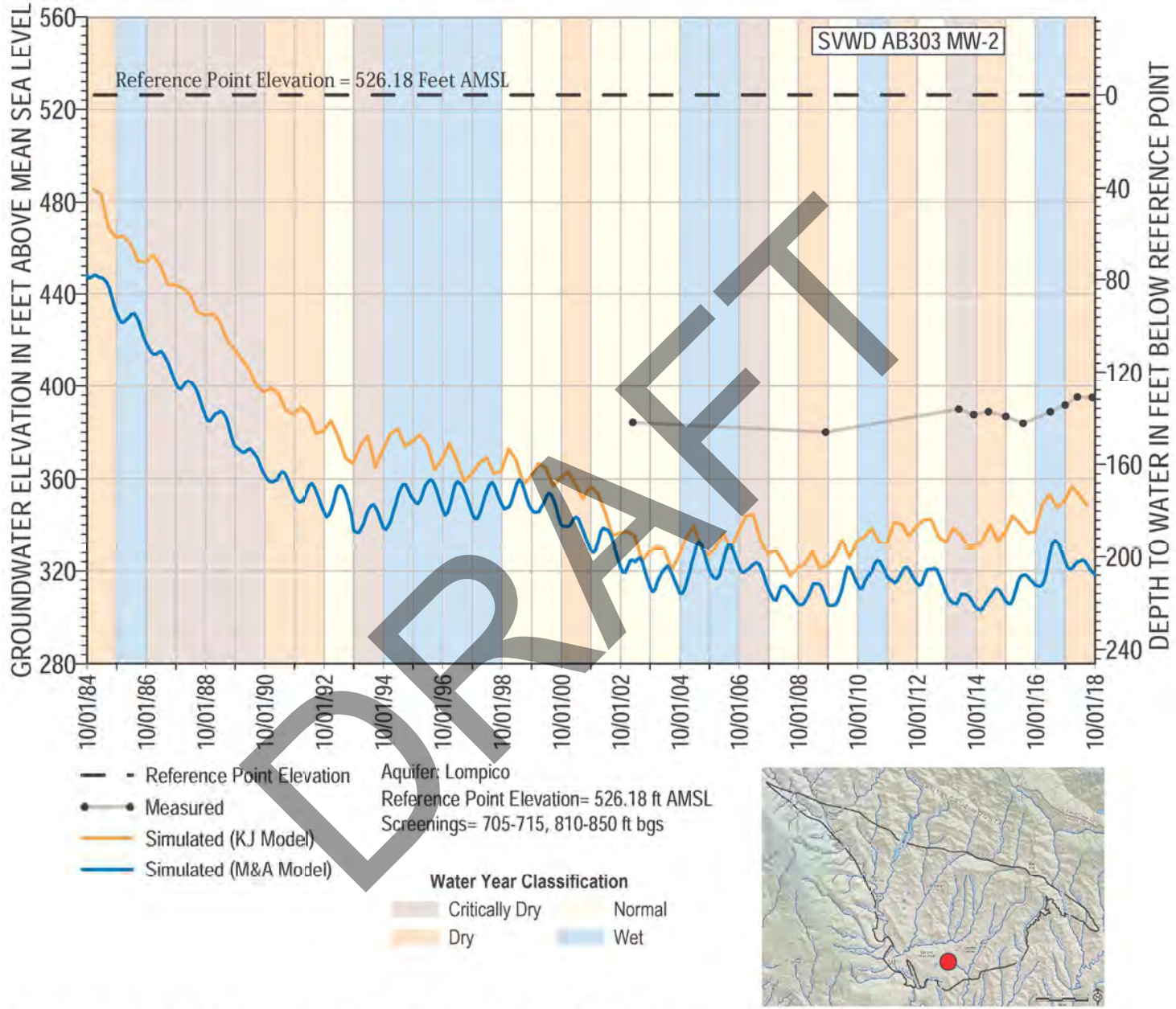
Groundwater Level Calibration Target Hydrograph for SVWD AB303 MW-1



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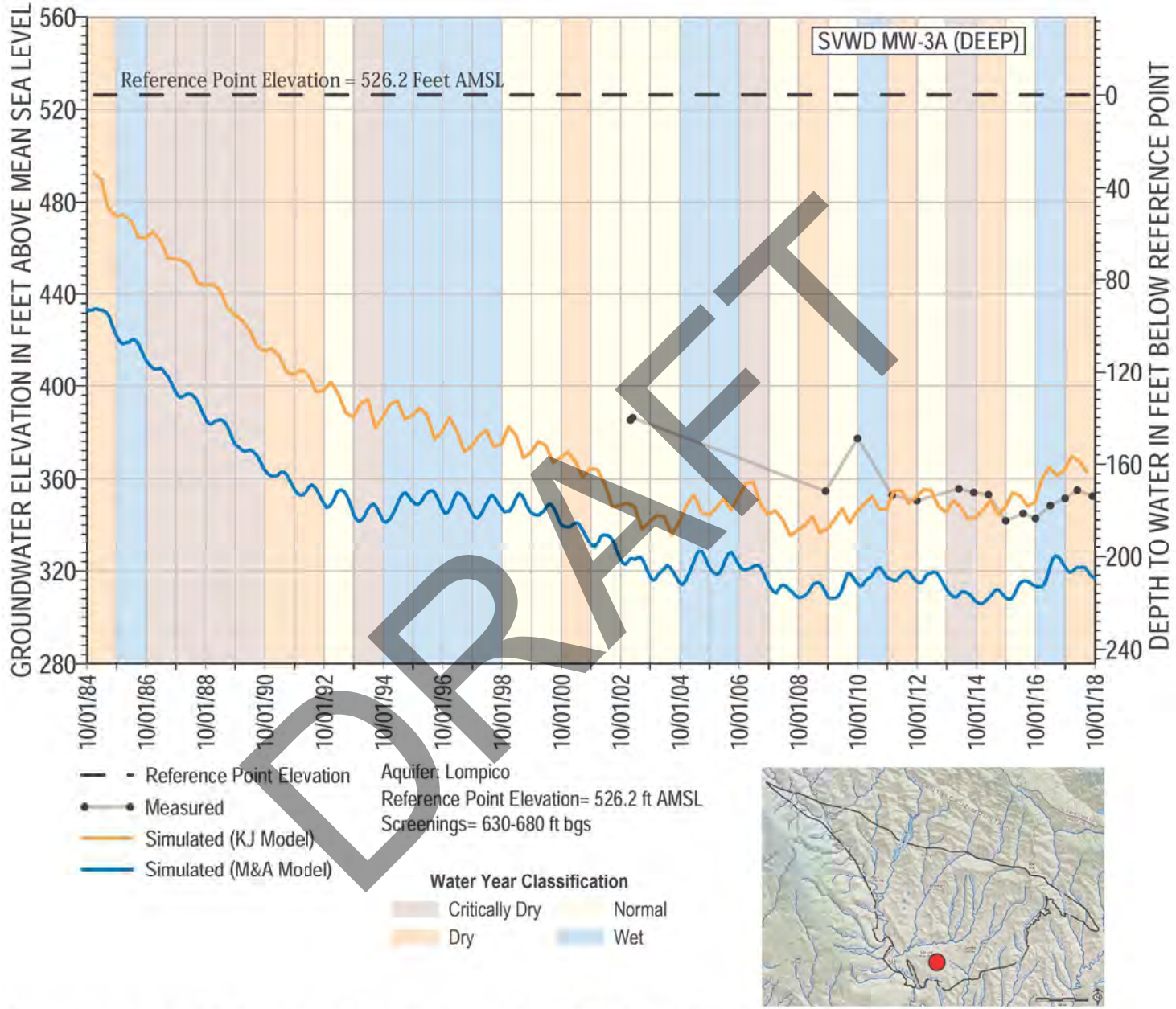
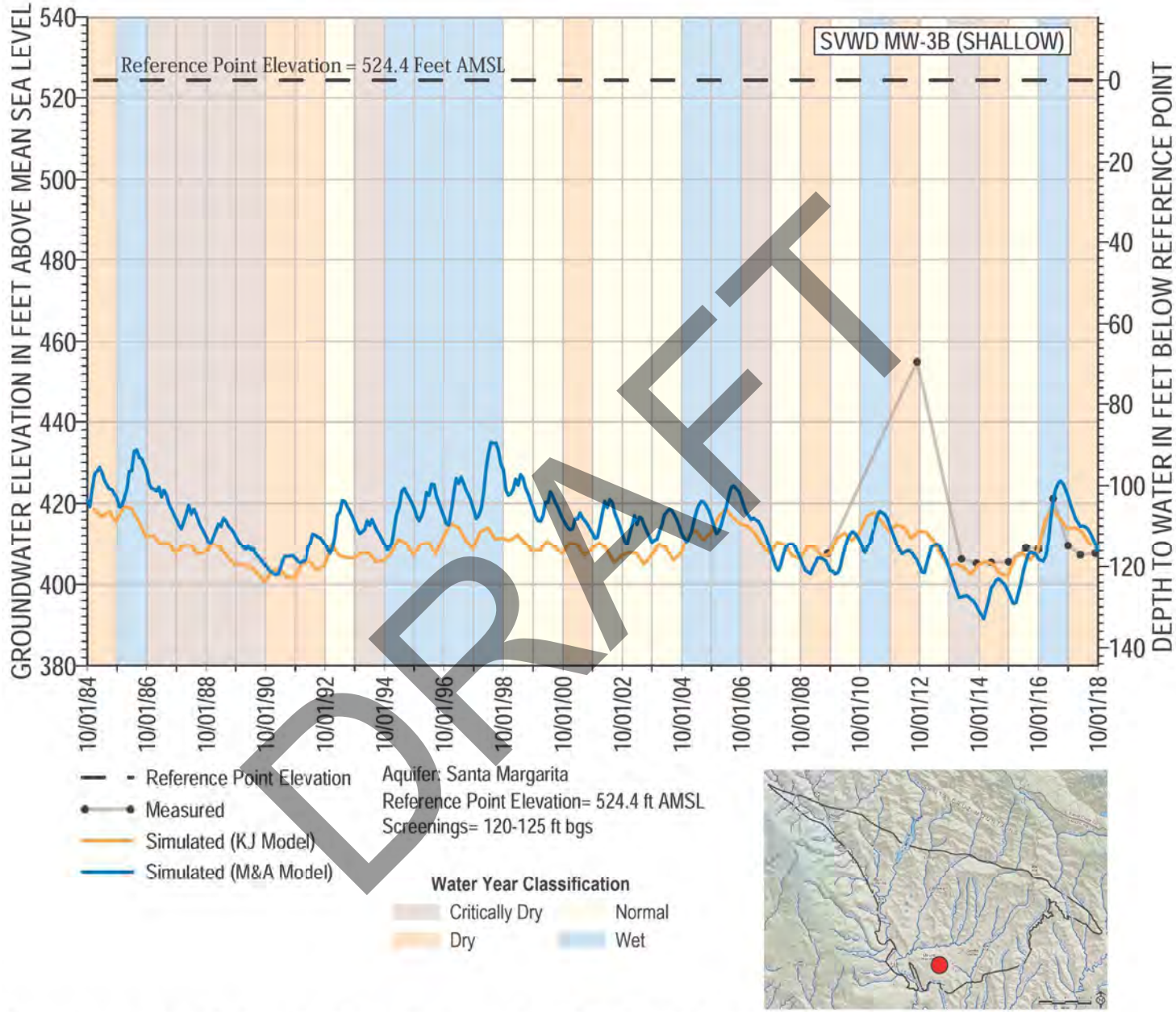
Groundwater Level Calibration Target Hydrograph for SVWD AB303 MW-2



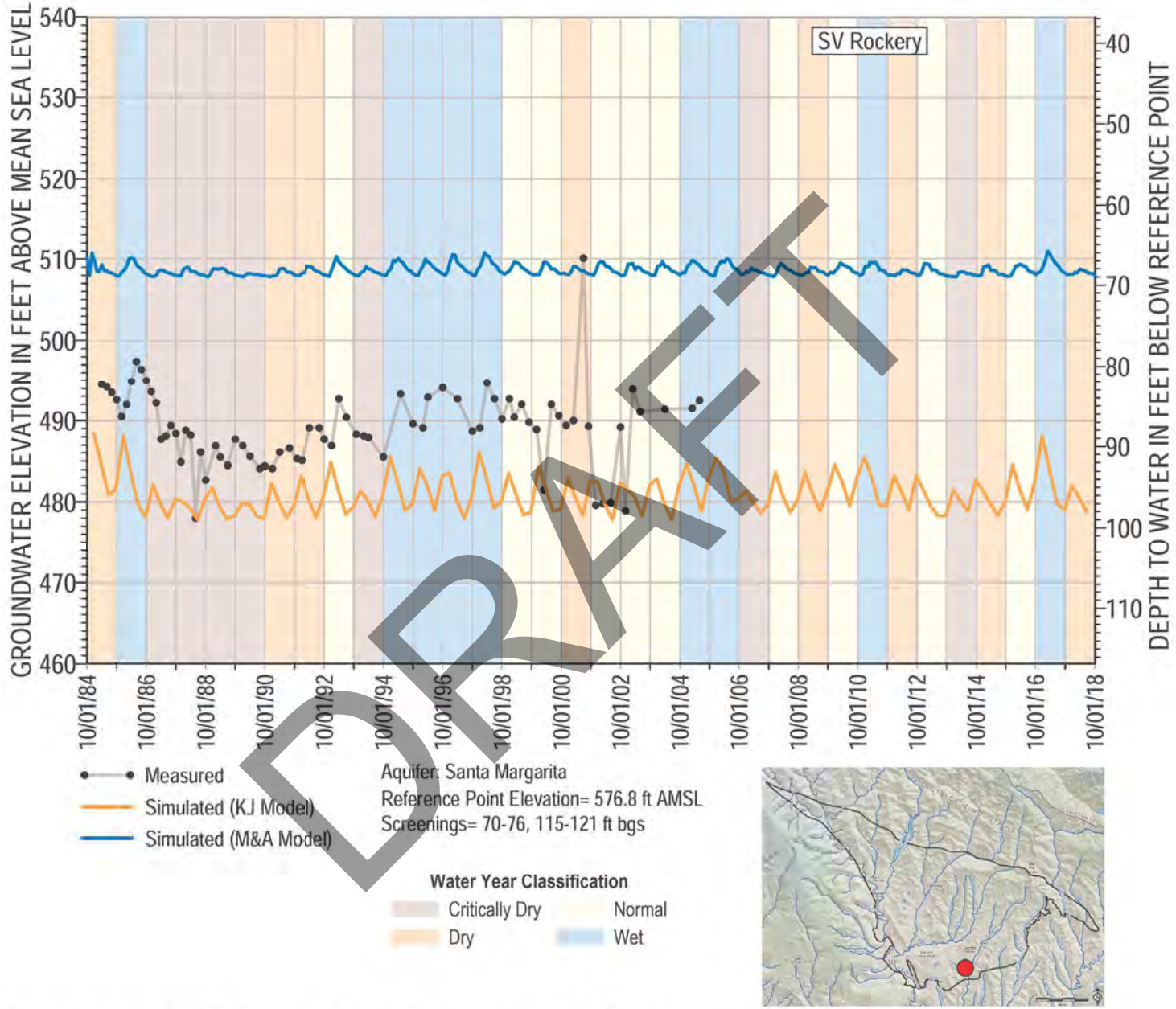
DRAFT

Groundwater Level Calibration Target Hydrograph for SVWD MW-3A (DEEP)



DRAFT

Groundwater Level Calibration Target Hydrograph for SVWD MW-3B (SHALLOW)



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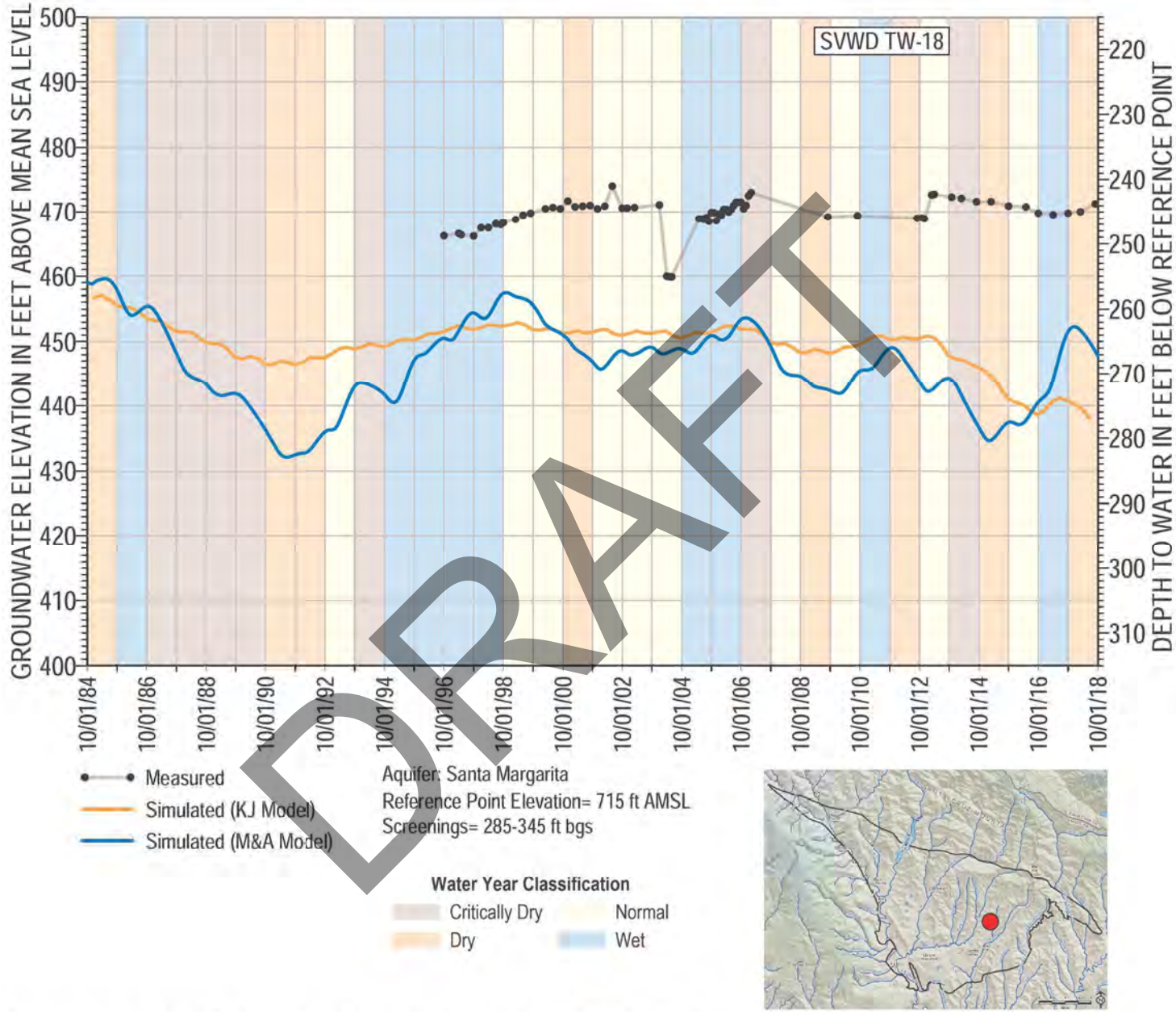
Groundwater Level Calibration Target Hydrograph for SV Rockery



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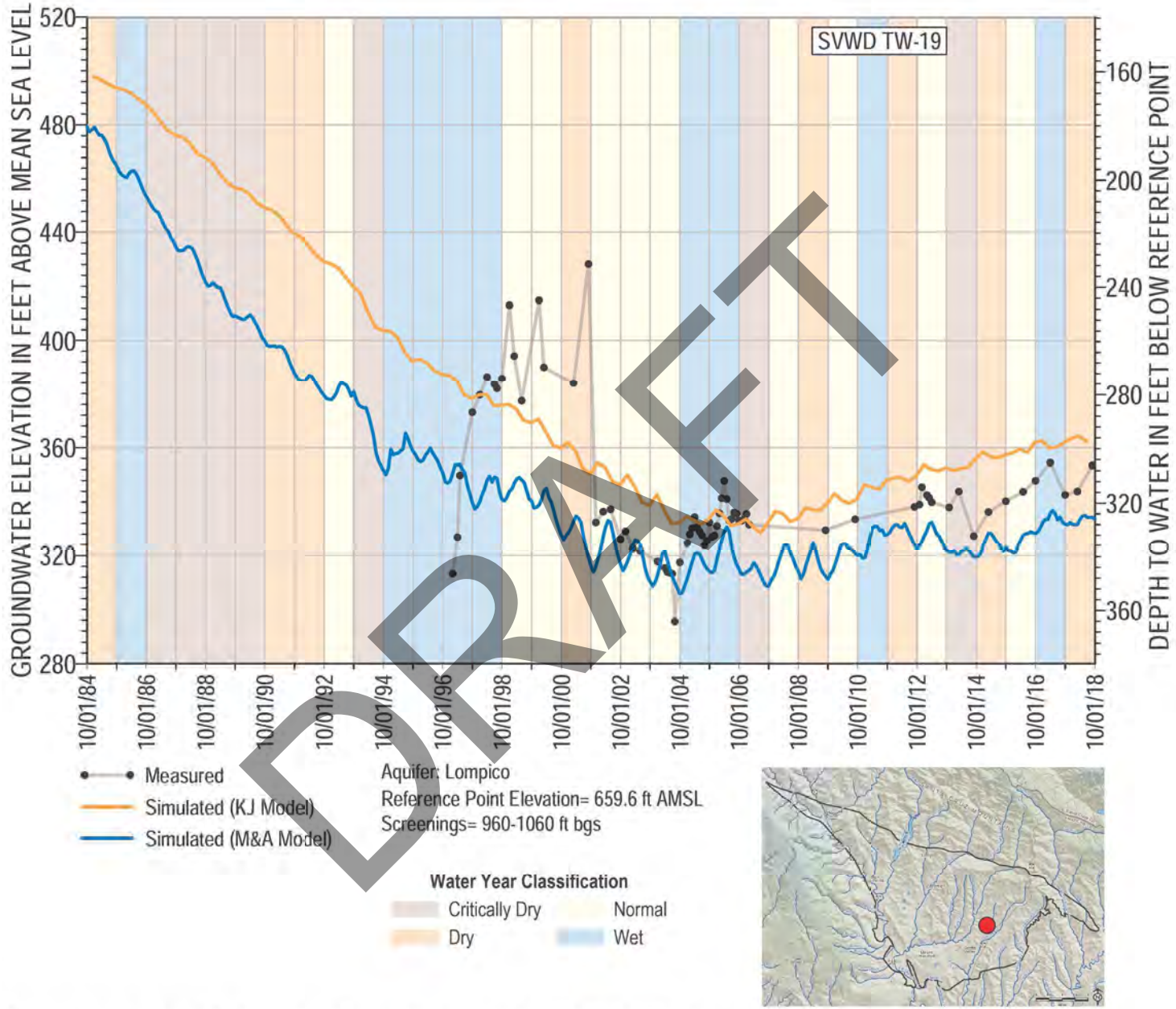
Groundwater Level Calibration Target Hydrograph for SVWD TW-18



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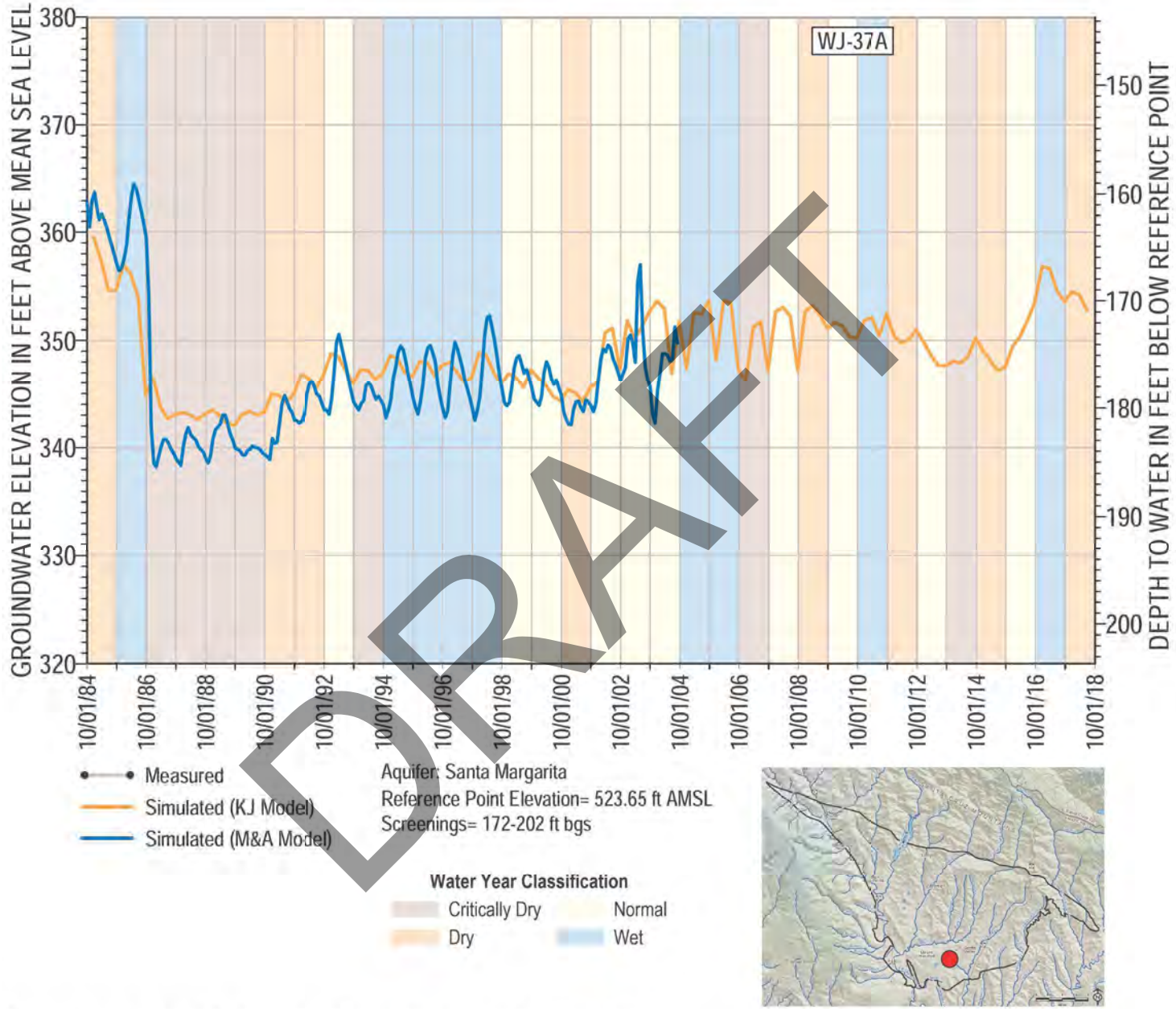
Groundwater Level Calibration Target Hydrograph for SVWD TW-19



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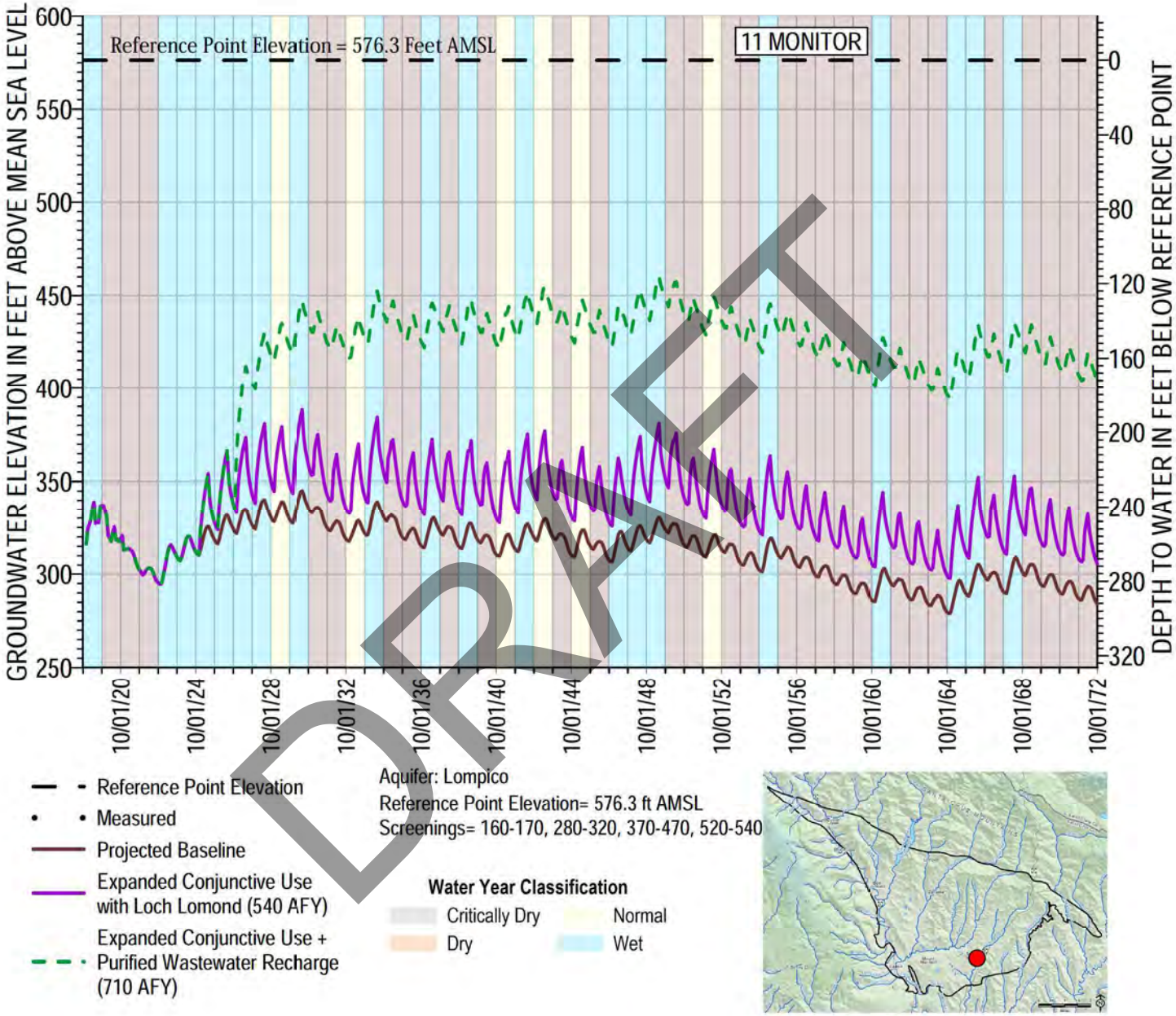
Groundwater Level Calibration Target Hydrograph for WJ-37A

Santa Margarita Basin
Groundwater Model
Updates and Simulations for Groundwater Sustainability Planning

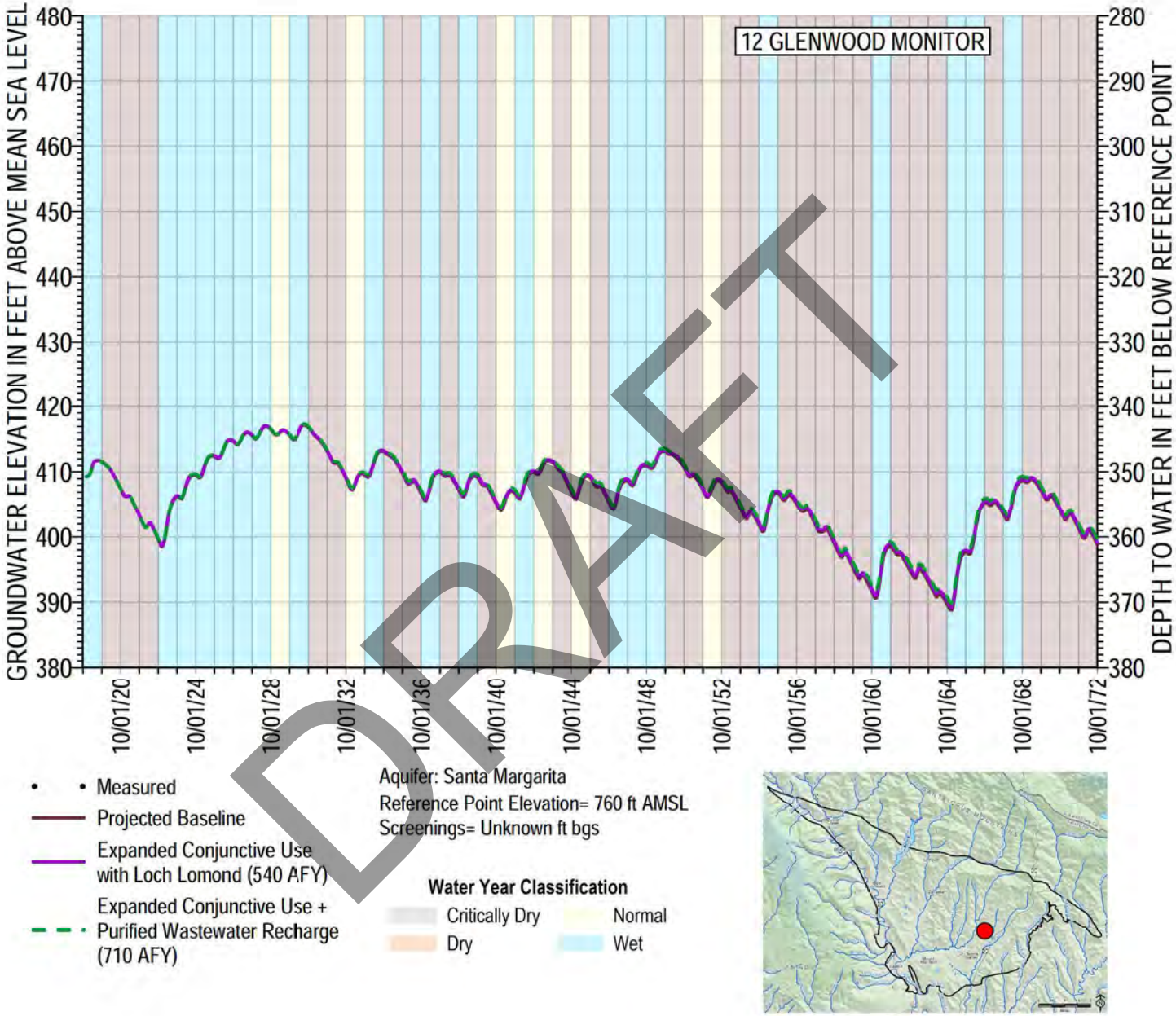
Appendix B
Projected Groundwater Level Target Hydrographs for Predictive Scenarios

DRAFT



DRAFT

Projected Groundwater Level Target Hydrograph for 11 MONITOR



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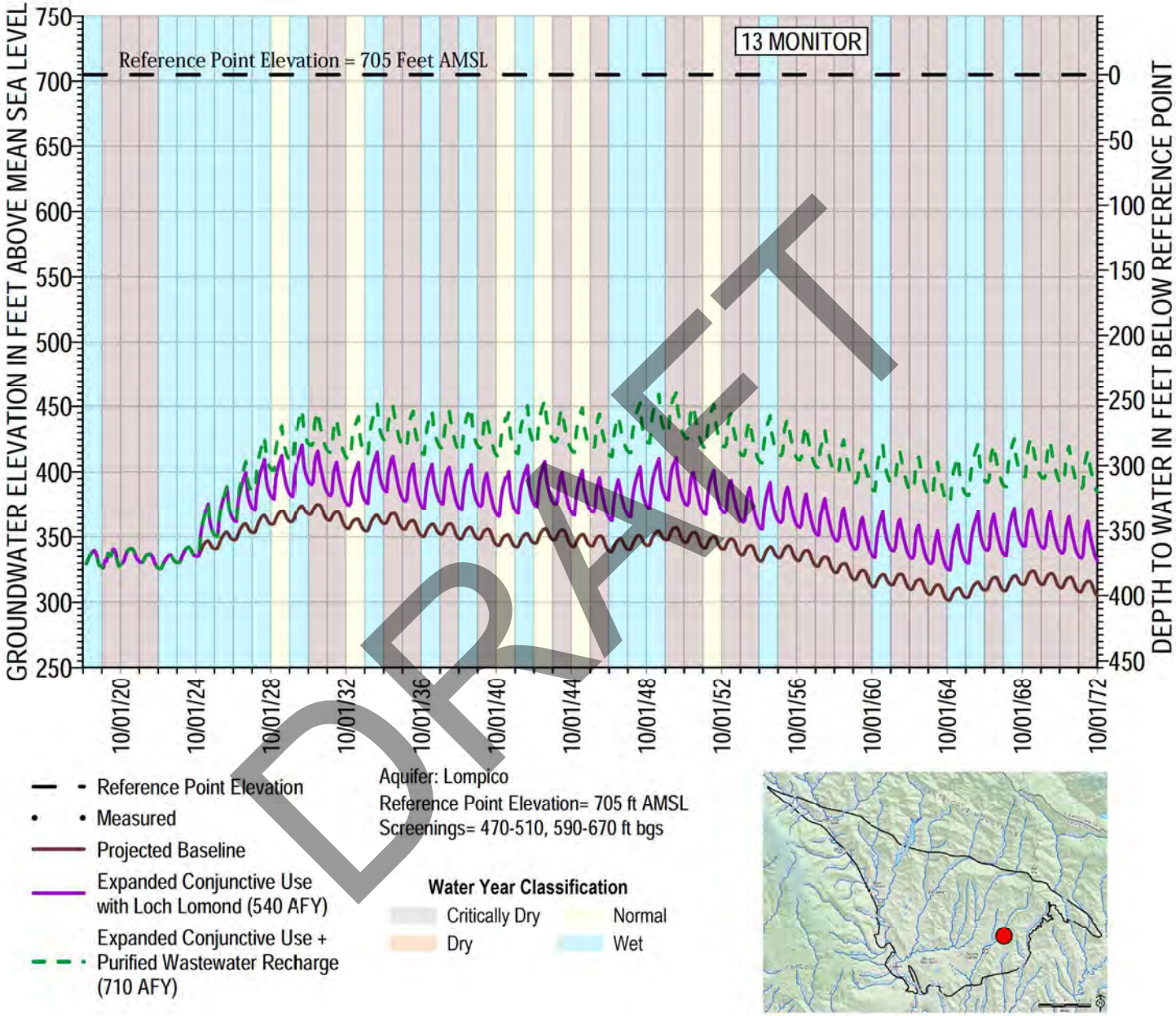
Projected Groundwater Level Target Hydrograph for 12 GLENWOOD MONITOR



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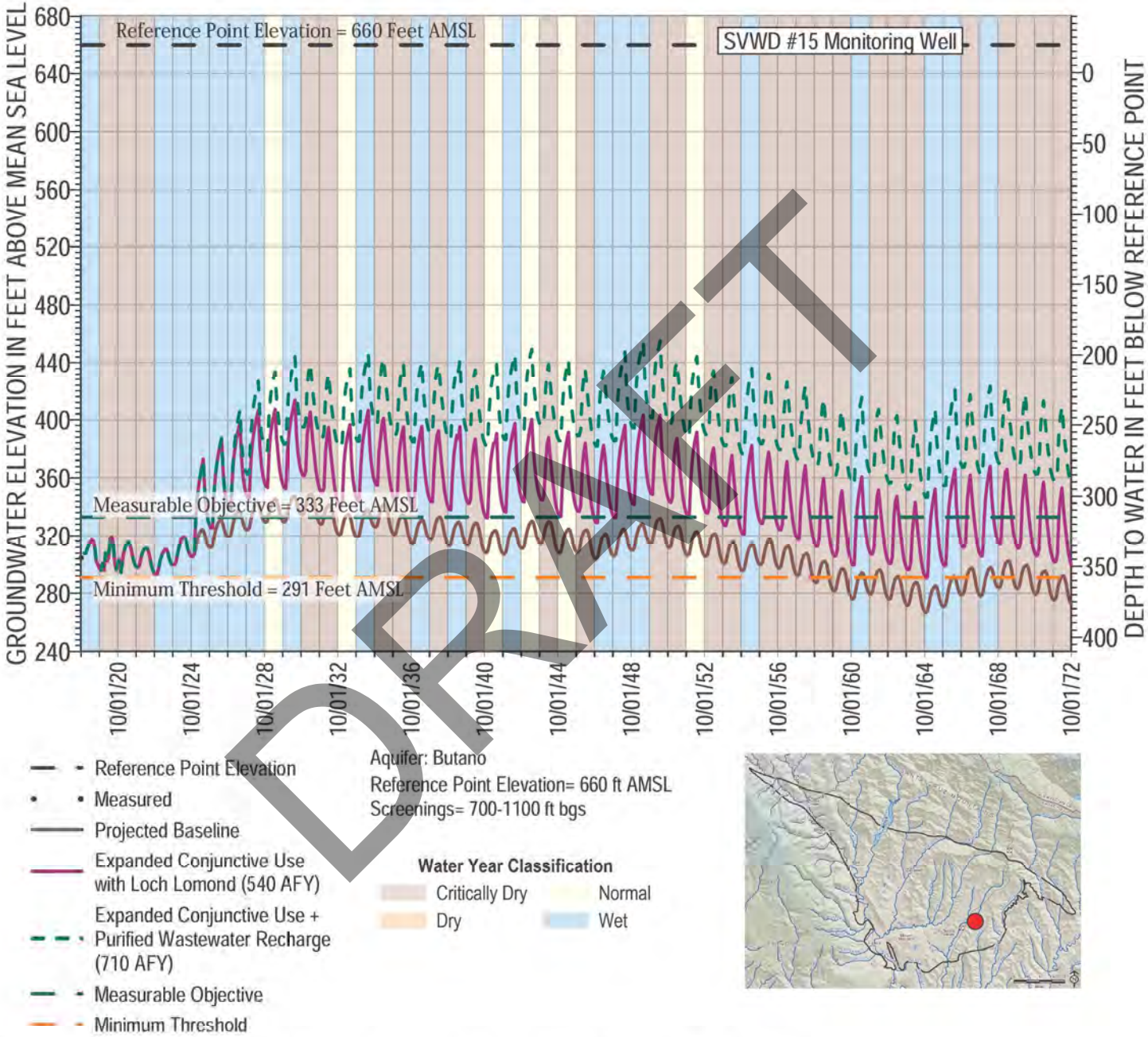
Projected Groundwater Level Target Hydrograph for 13 MONITOR



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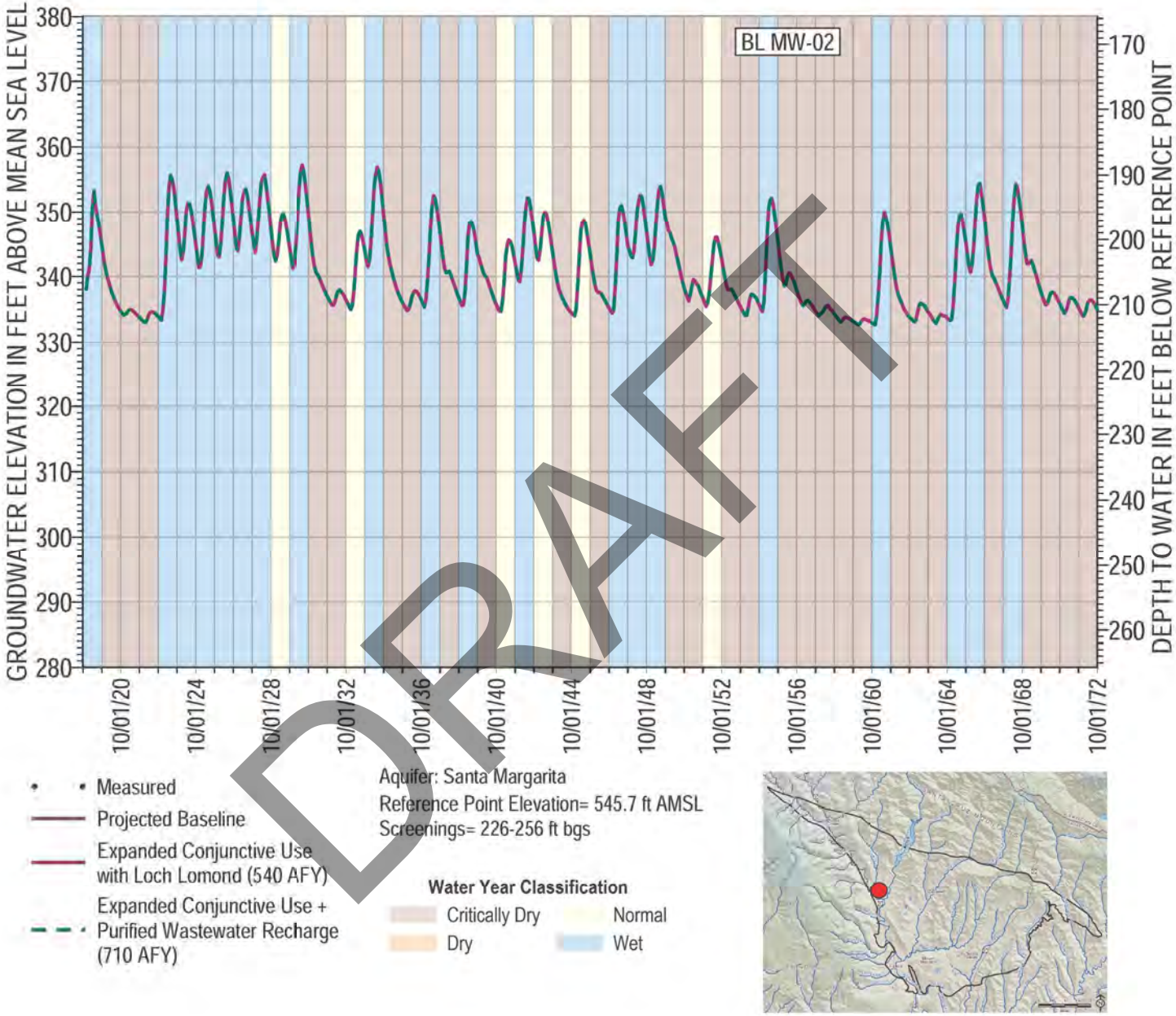
Projected Groundwater Level Target Hydrograph for SVWD #15 Monitoring Well



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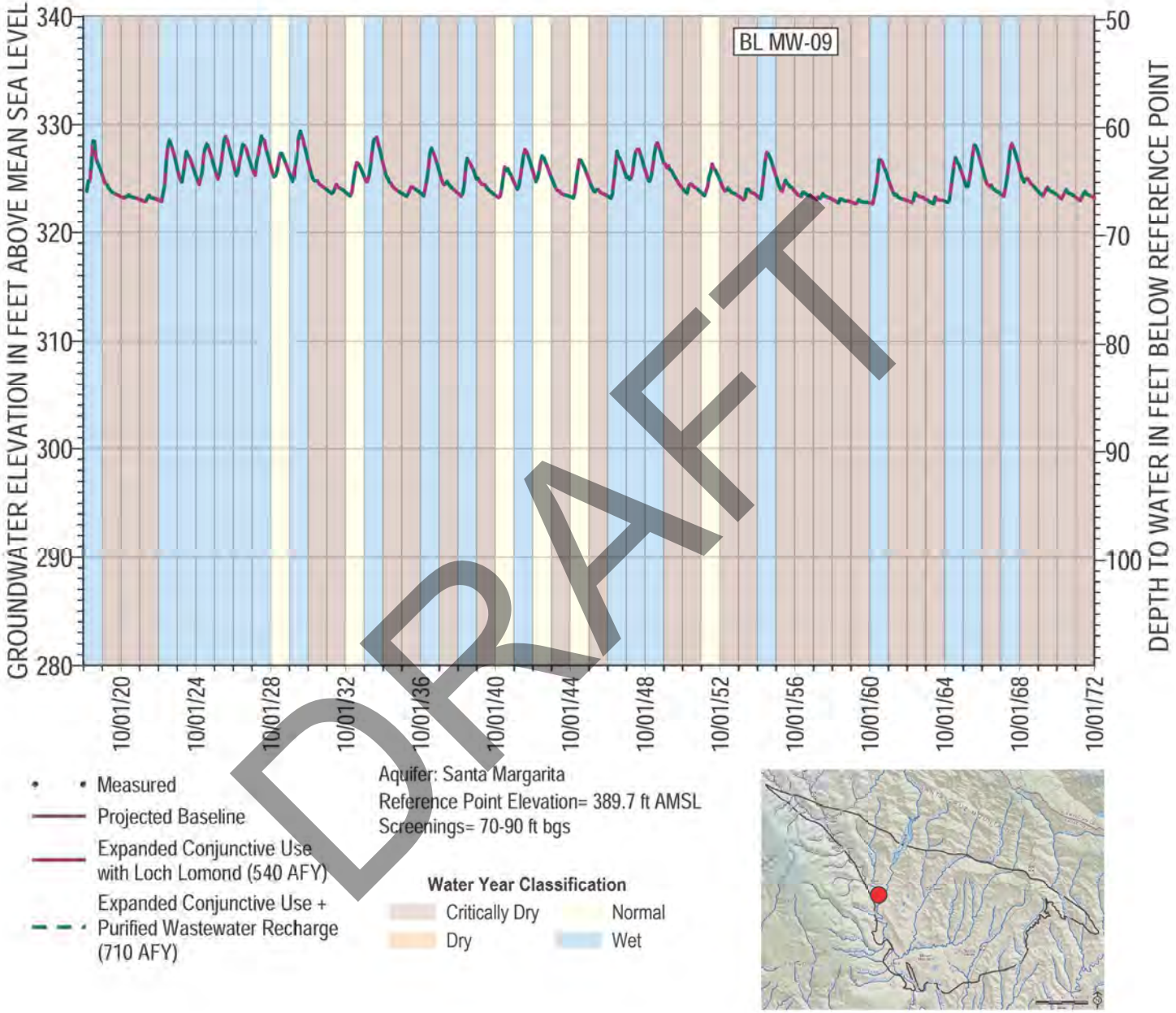
Projected Groundwater Level Target Hydrograph for BL MW-02



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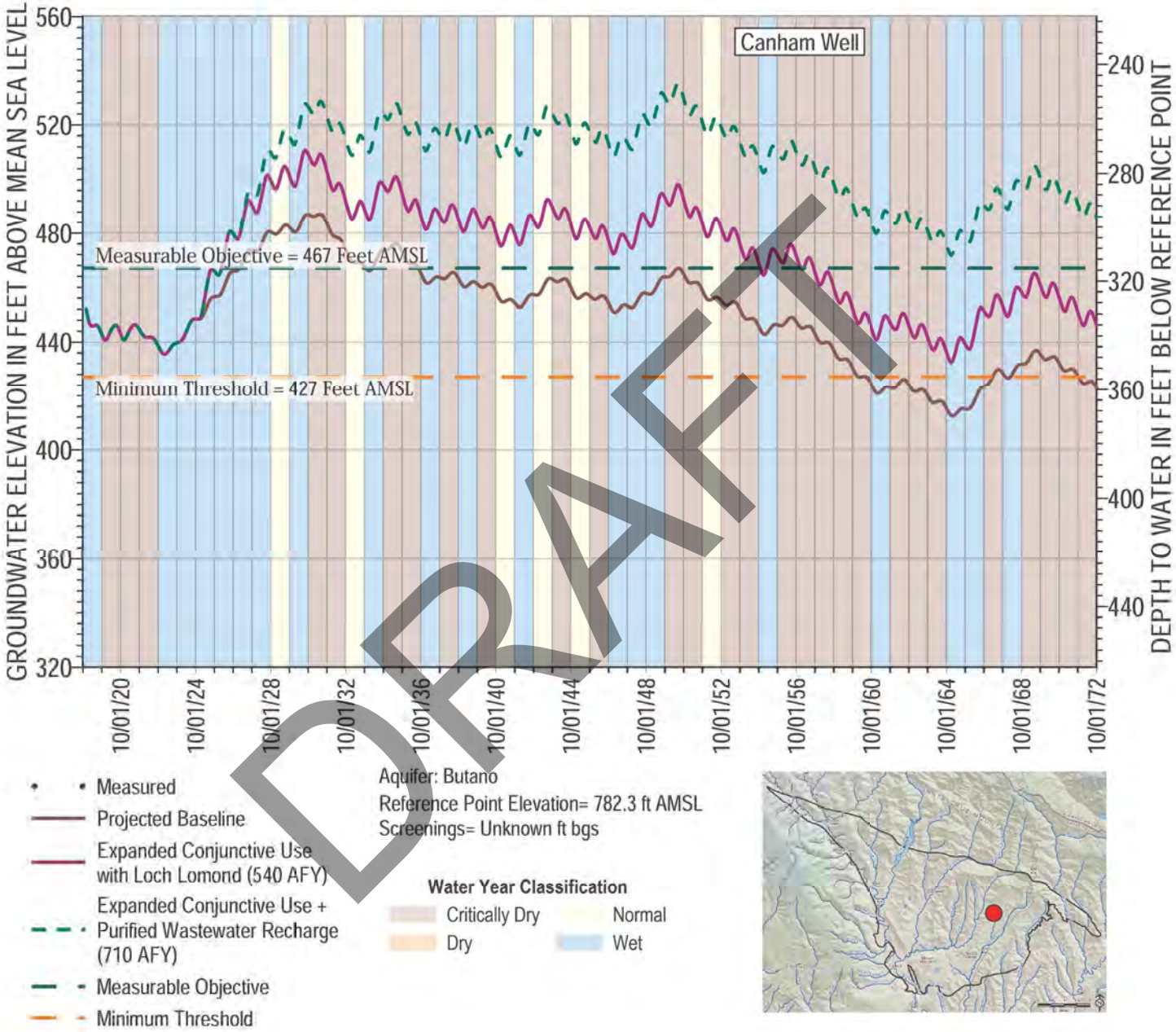
Projected Groundwater Level Target Hydrograph for BL MW-09



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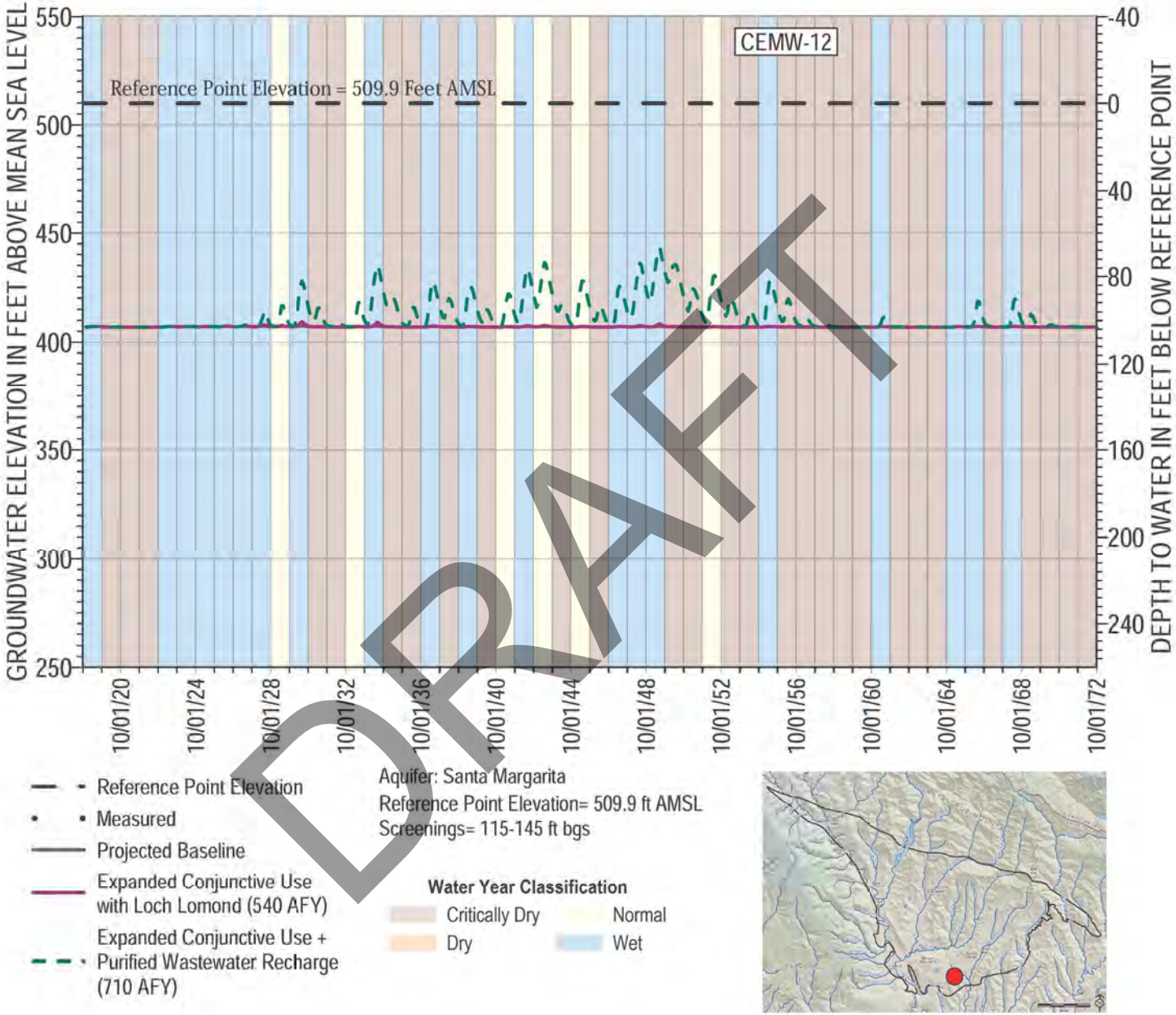
Projected Groundwater Level Target Hydrograph for Canham Well



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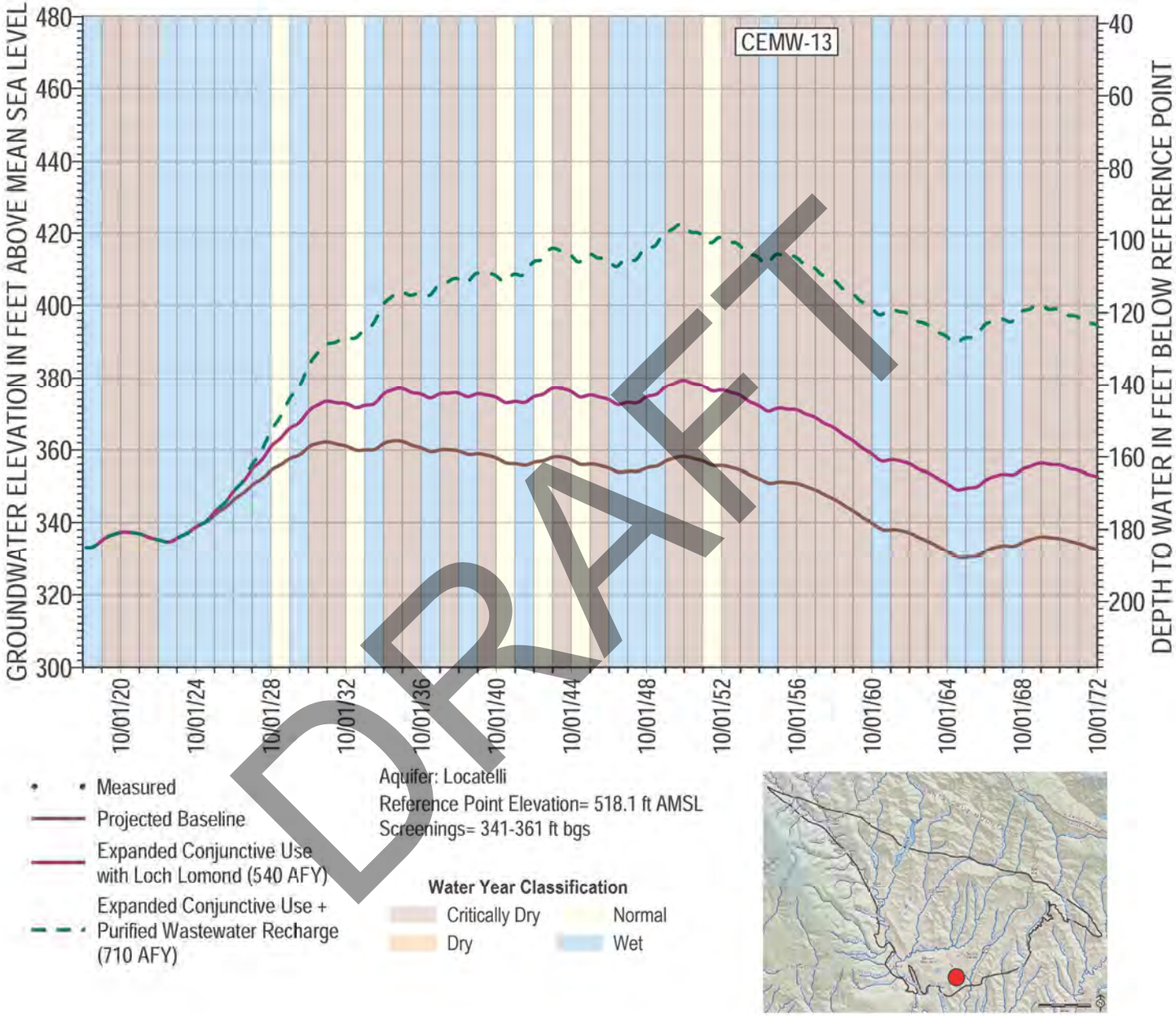
Projected Groundwater Level Target Hydrograph for CEMW-12



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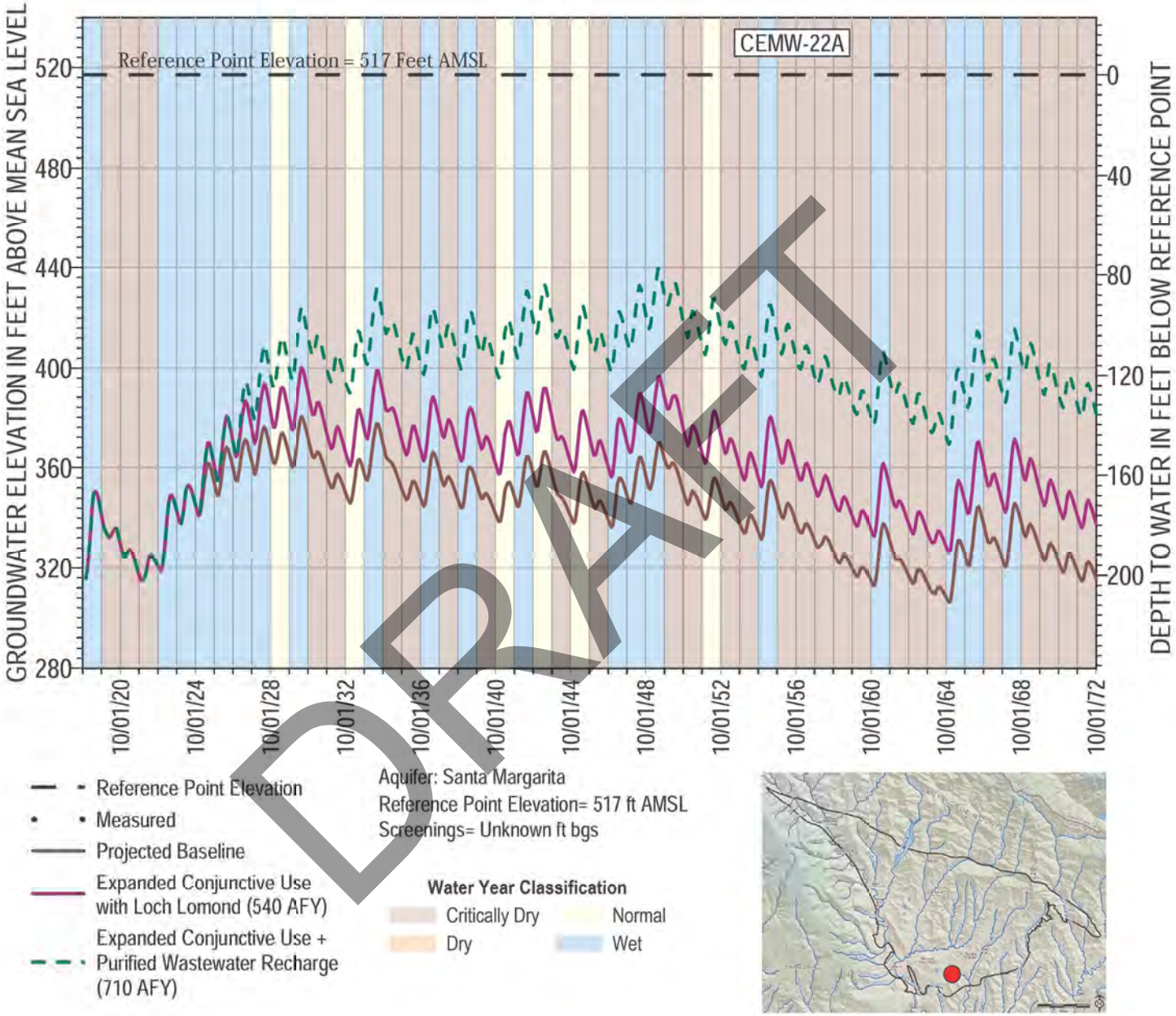
Projected Groundwater Level Target Hydrograph for CEMW-13



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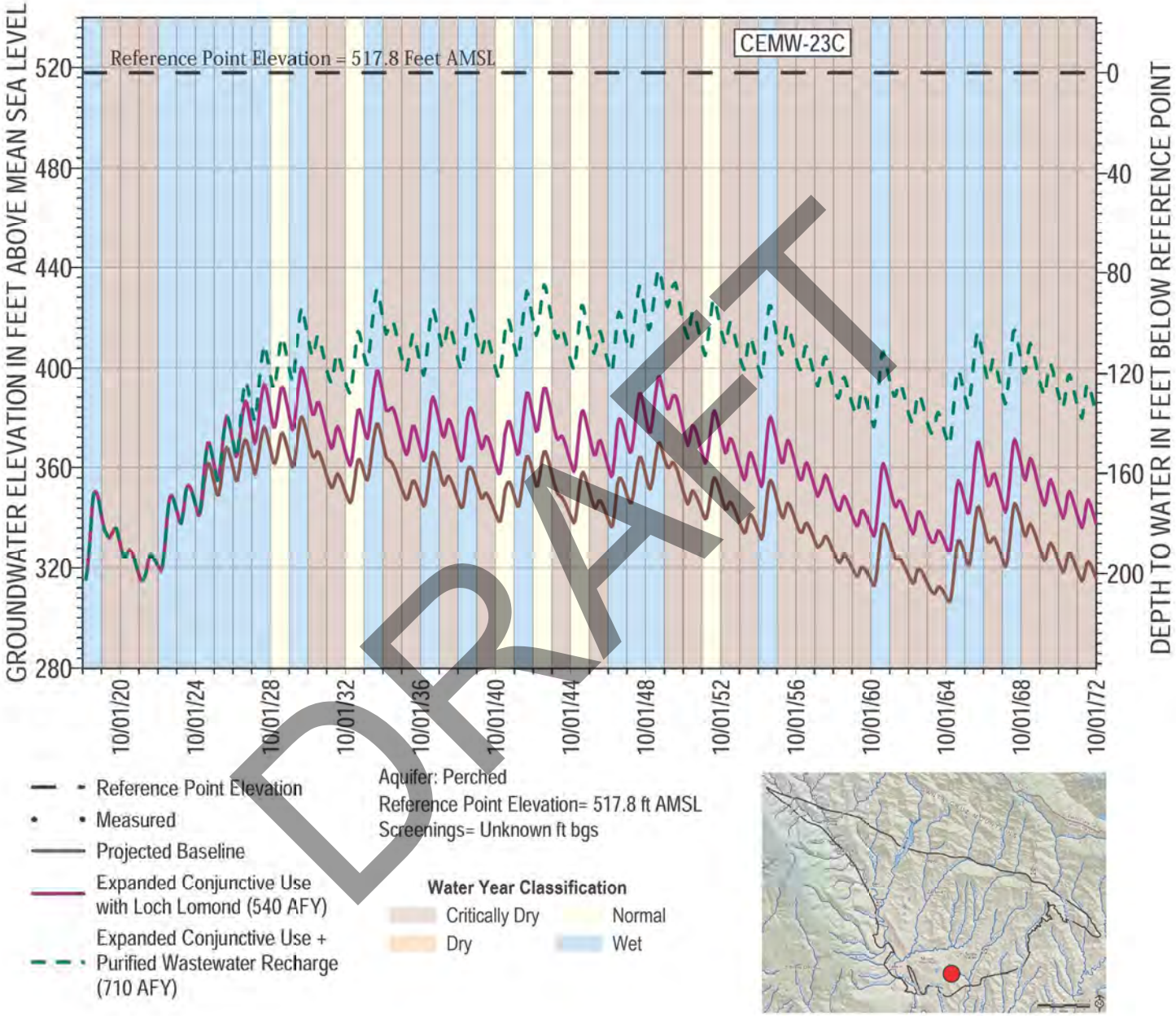
Projected Groundwater Level Target Hydrograph for CEMW-22A



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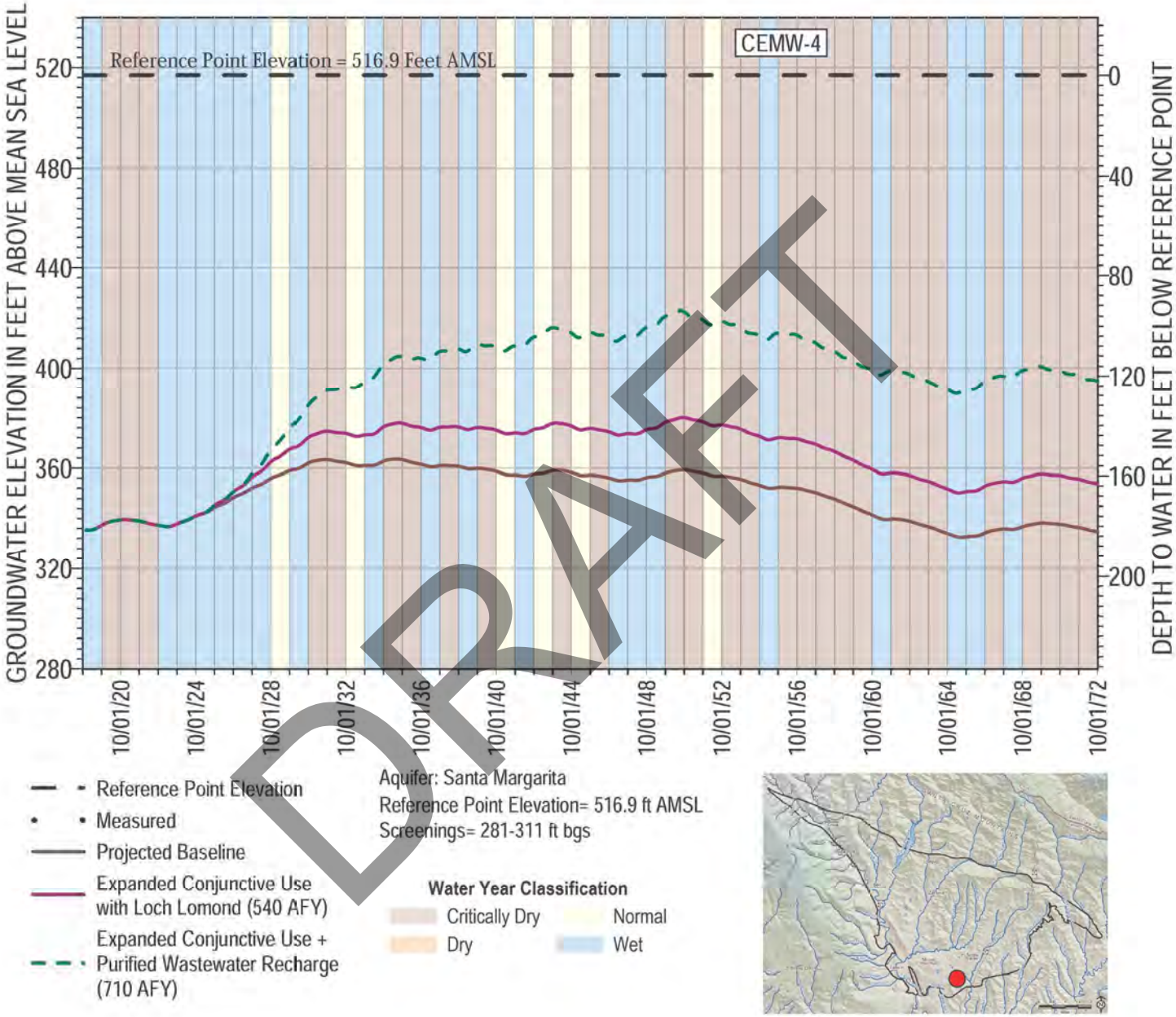
Projected Groundwater Level Target Hydrograph for CEMW-23C



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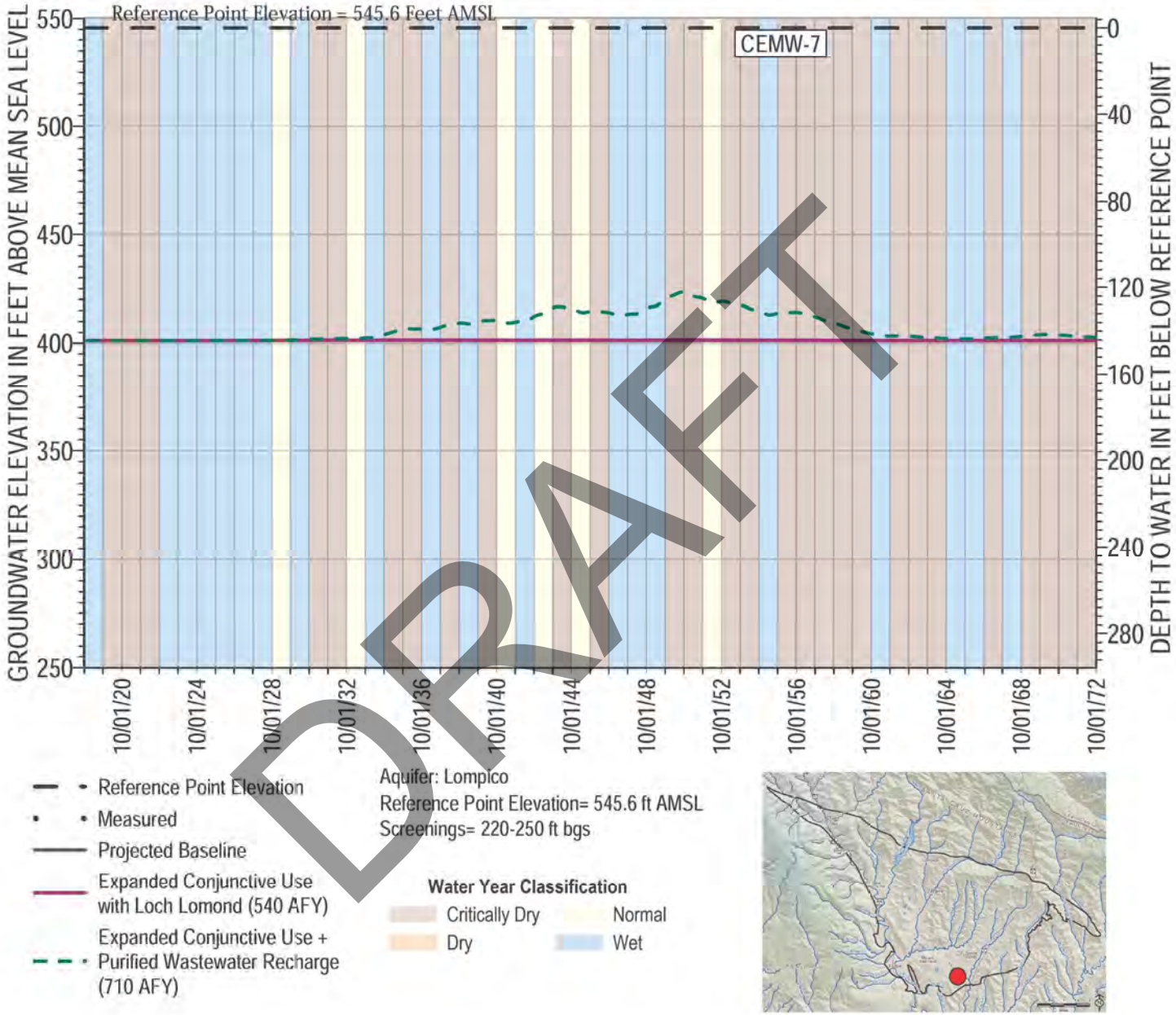
Projected Groundwater Level Target Hydrograph for CEMW-4



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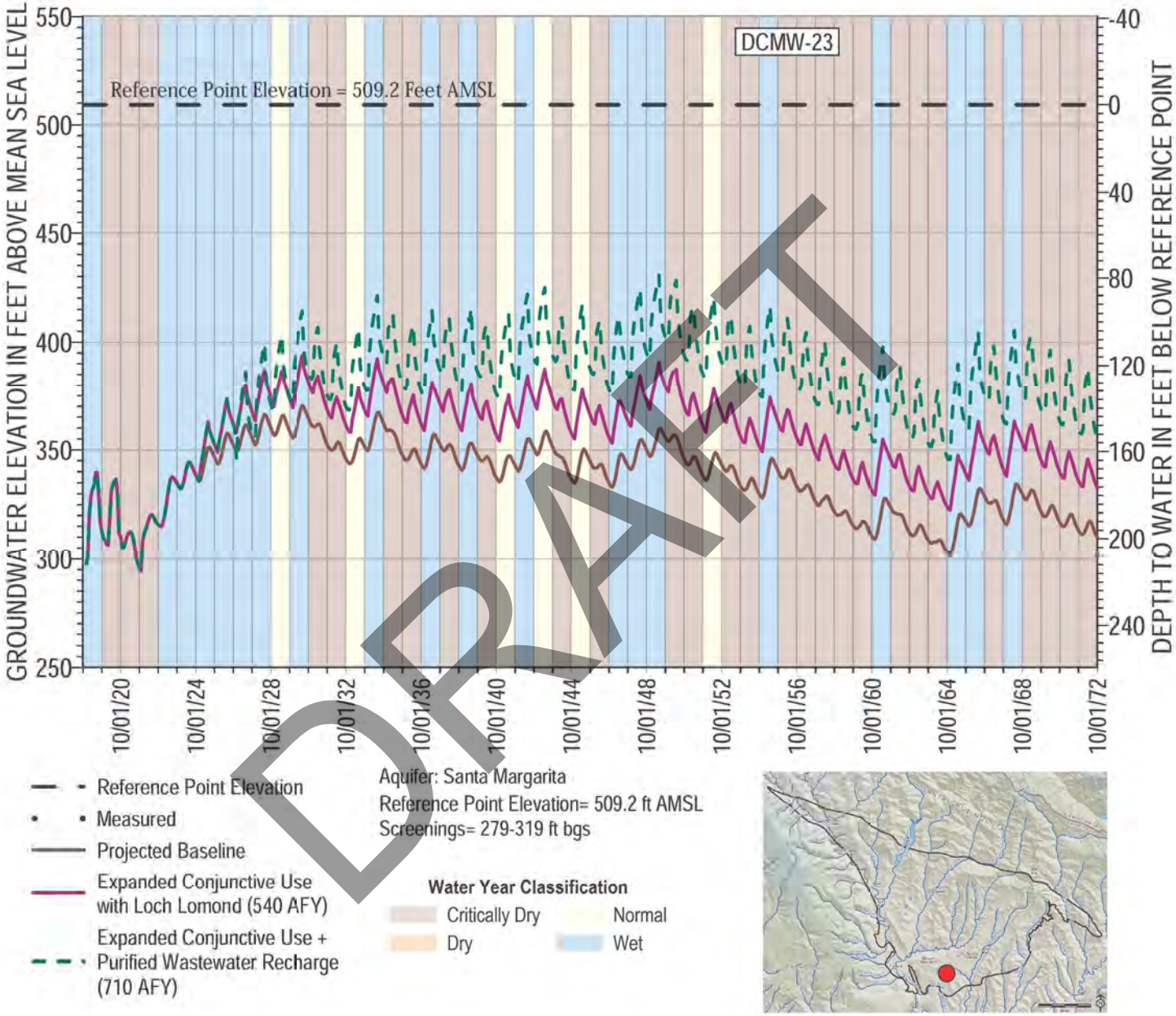
Projected Groundwater Level Target Hydrograph for CEMW-7



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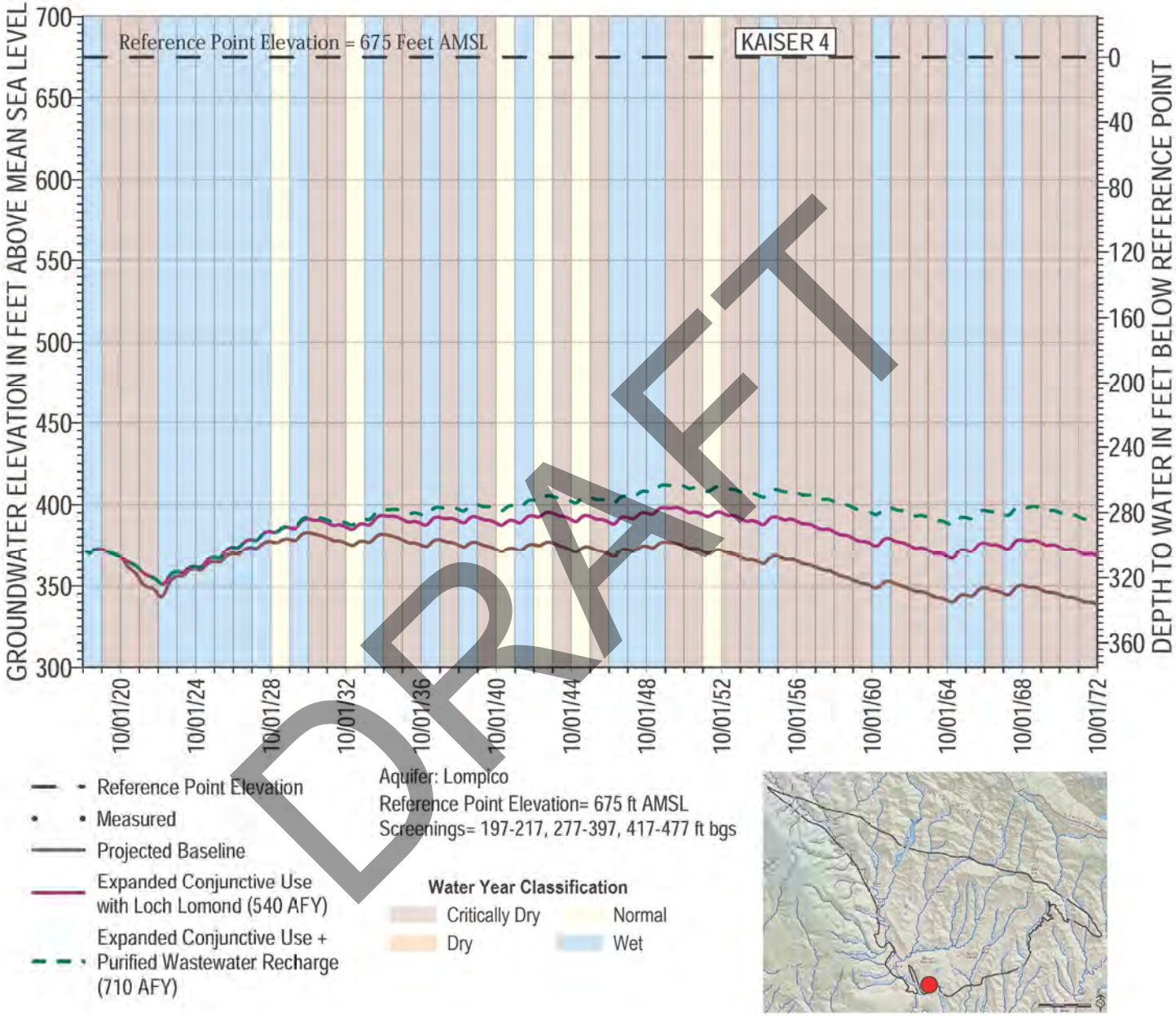
Projected Groundwater Level Target Hydrograph for DCMW-23



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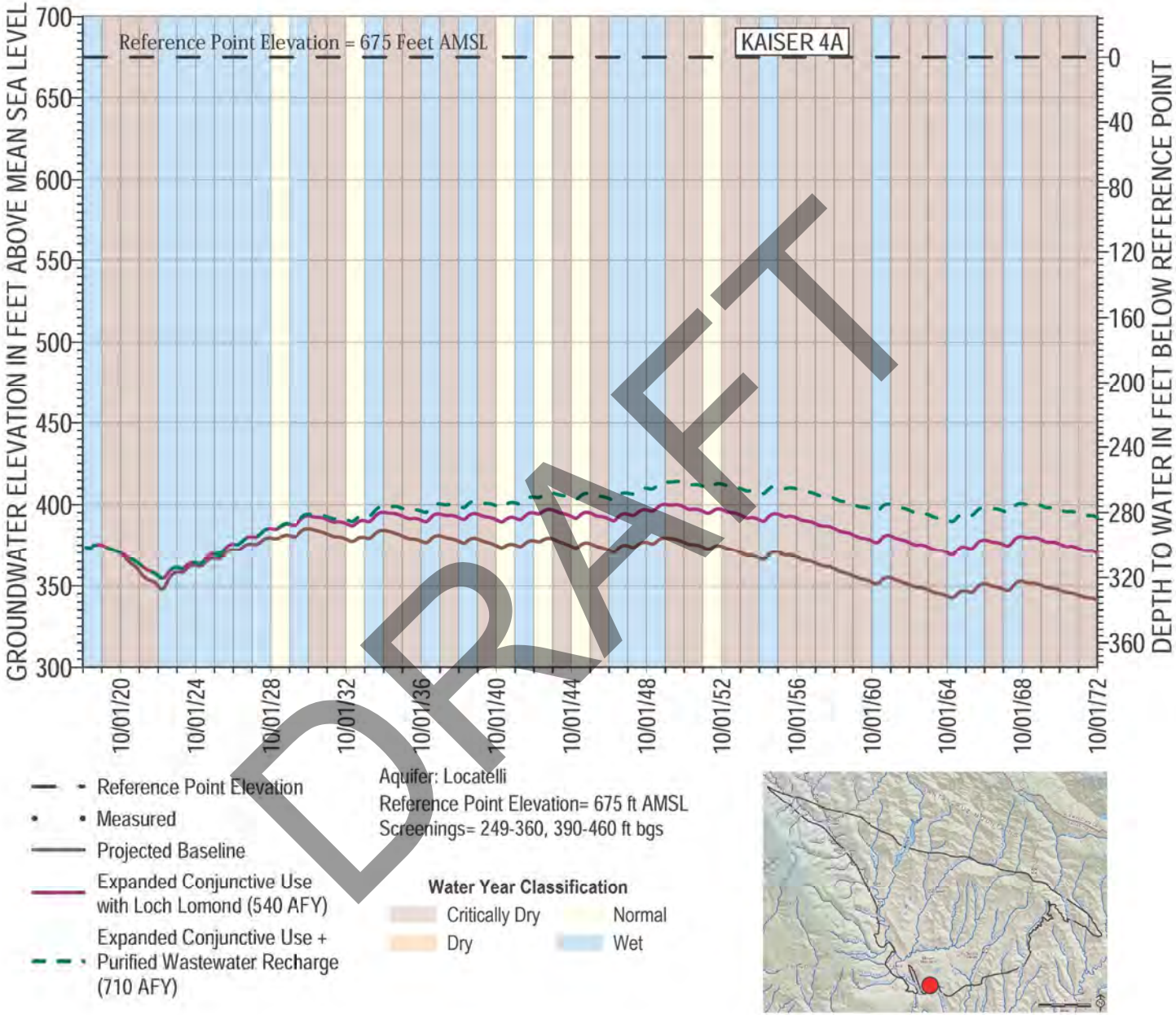
Projected Groundwater Level Target Hydrograph for KAISER 4



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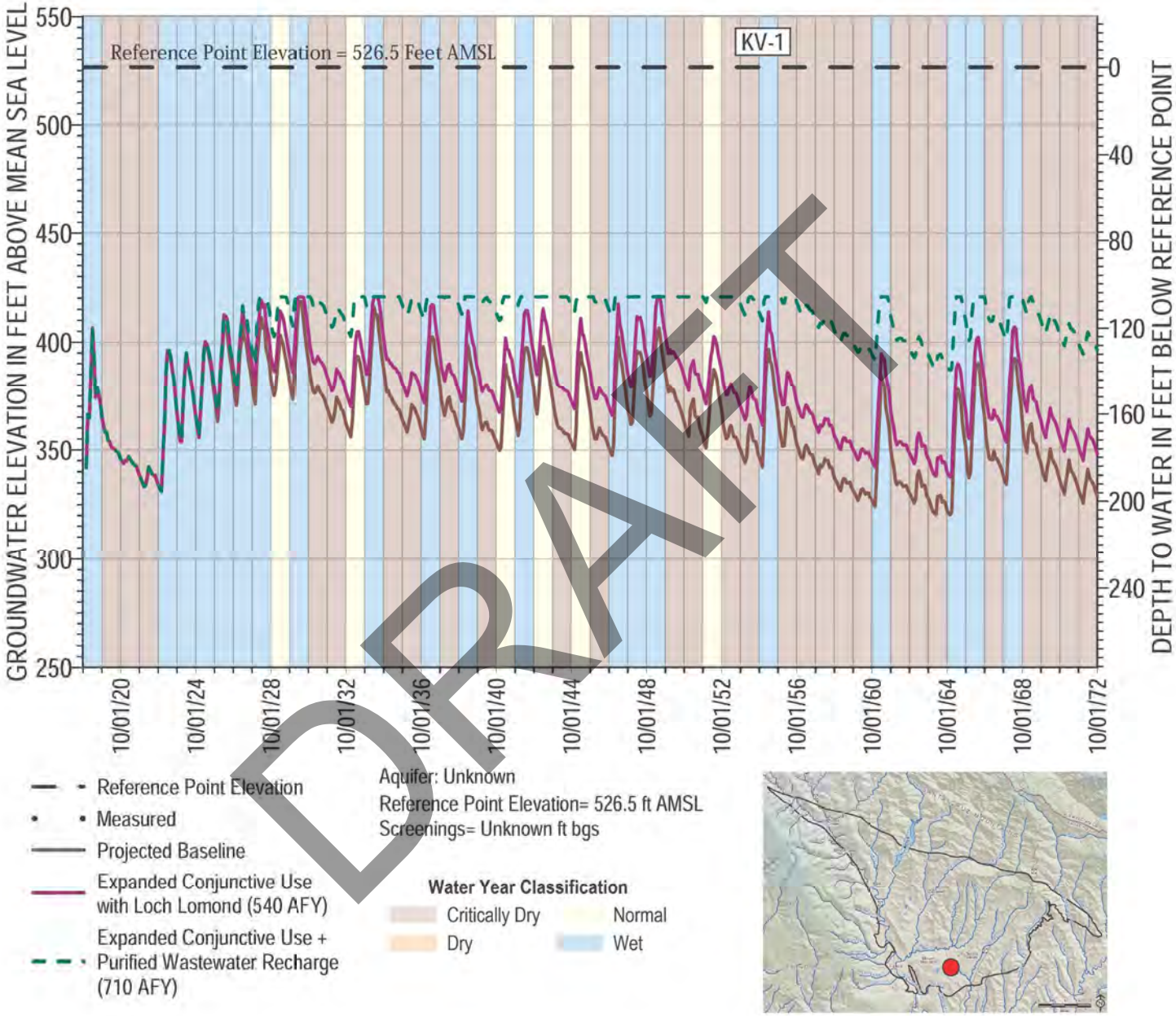
Projected Groundwater Level Target Hydrograph for KAISER 4A



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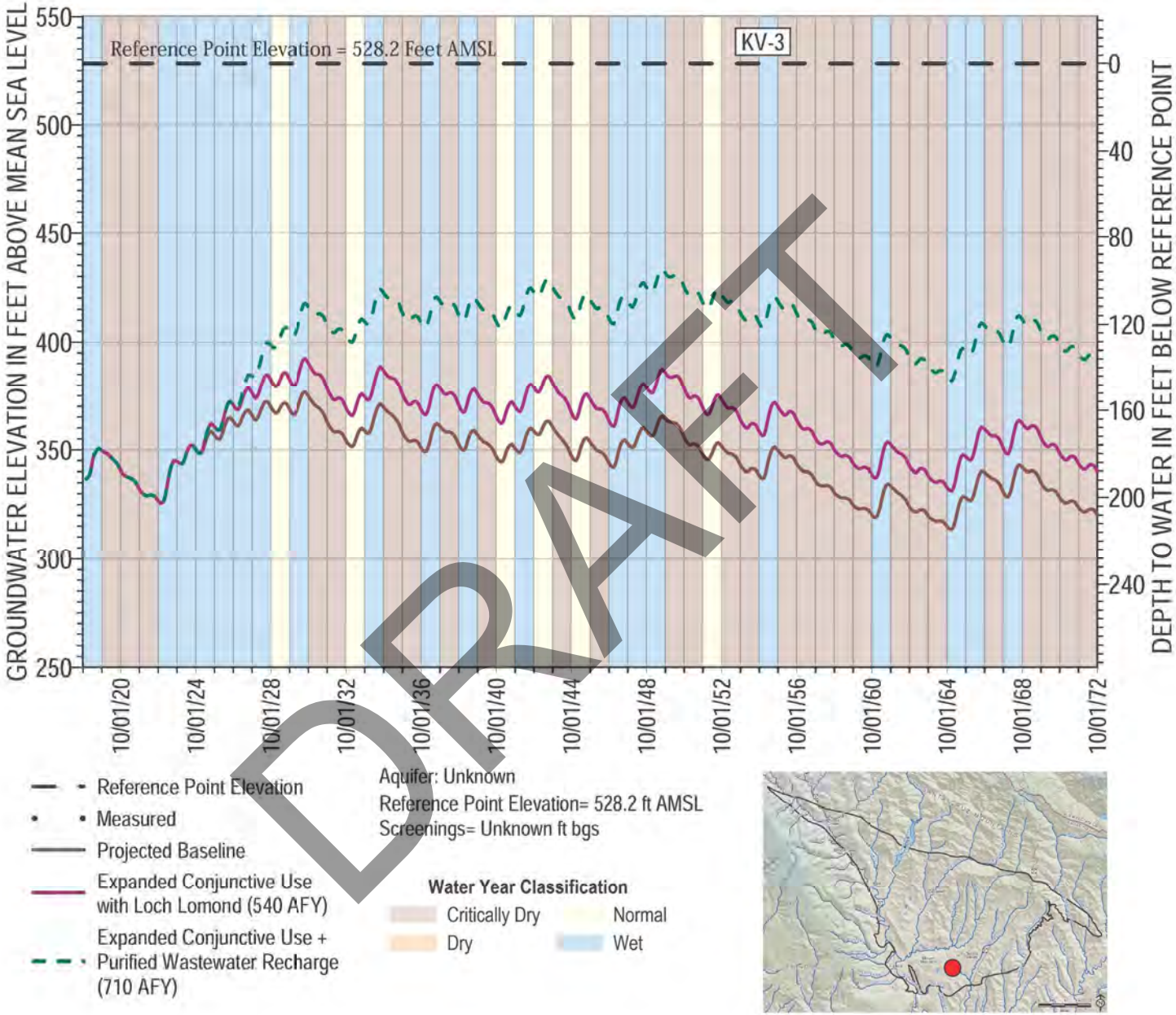
Projected Groundwater Level Target Hydrograph for KV-1



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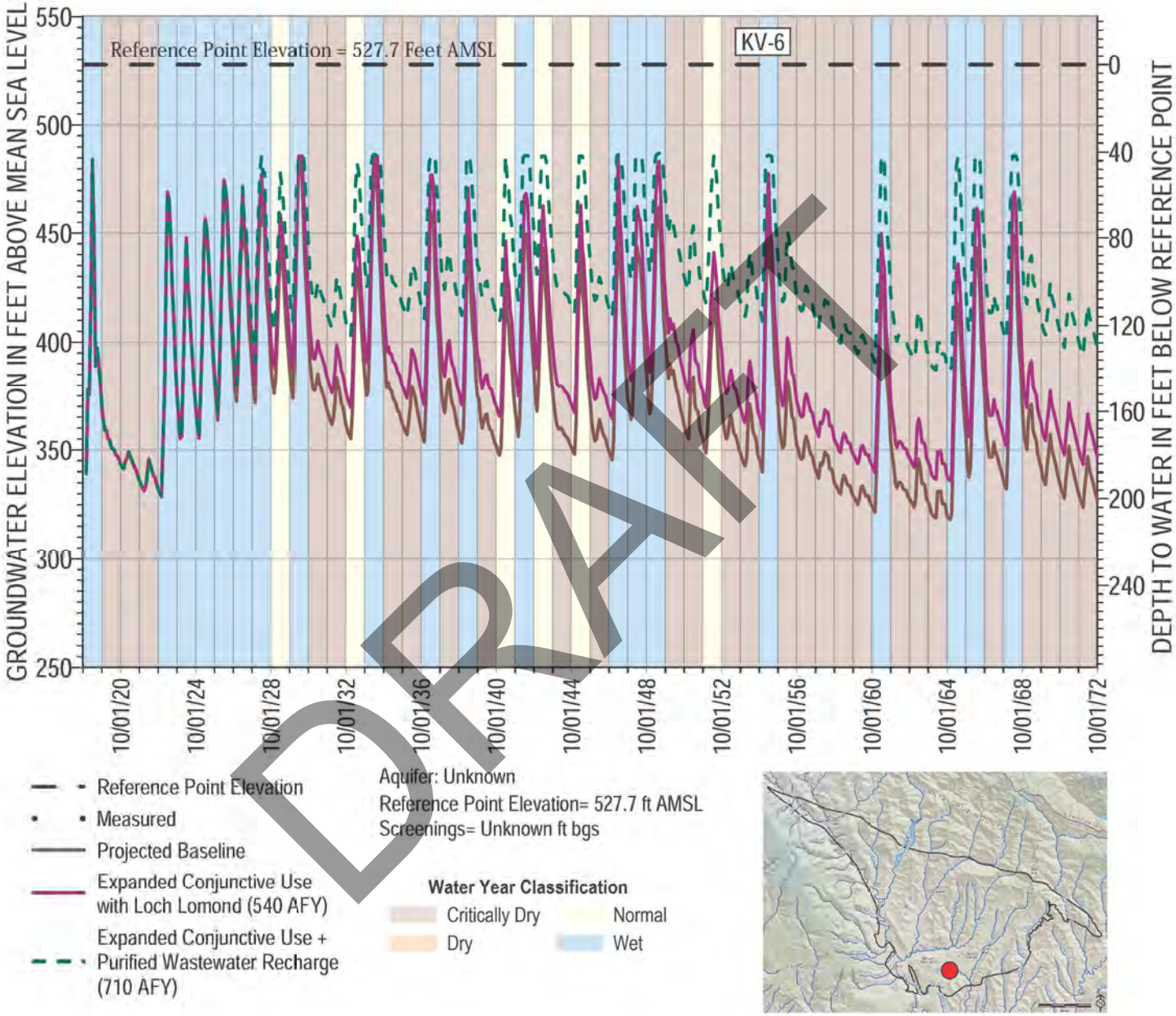
Projected Groundwater Level Target Hydrograph for KV-3



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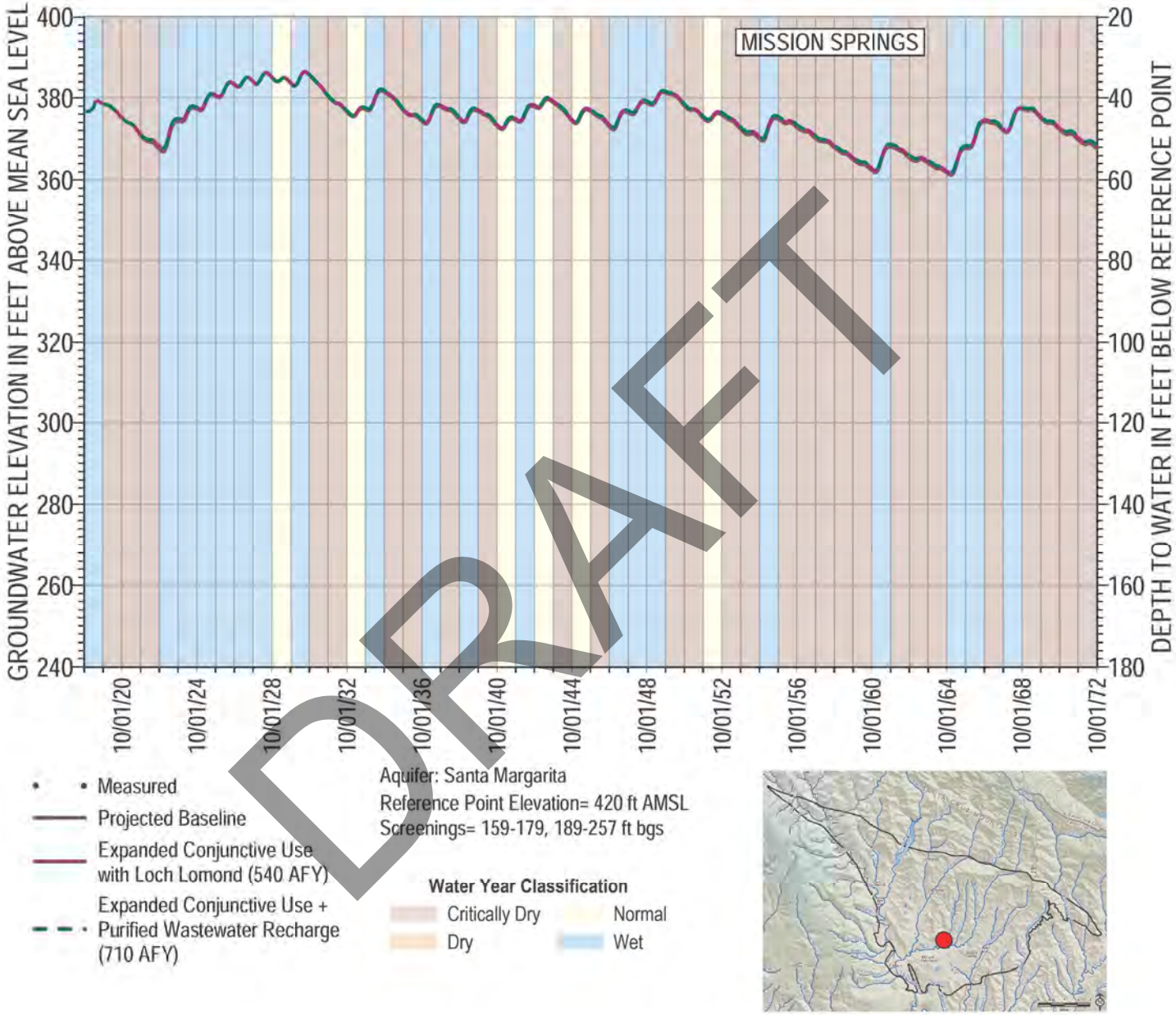
Projected Groundwater Level Target Hydrograph for KV-6



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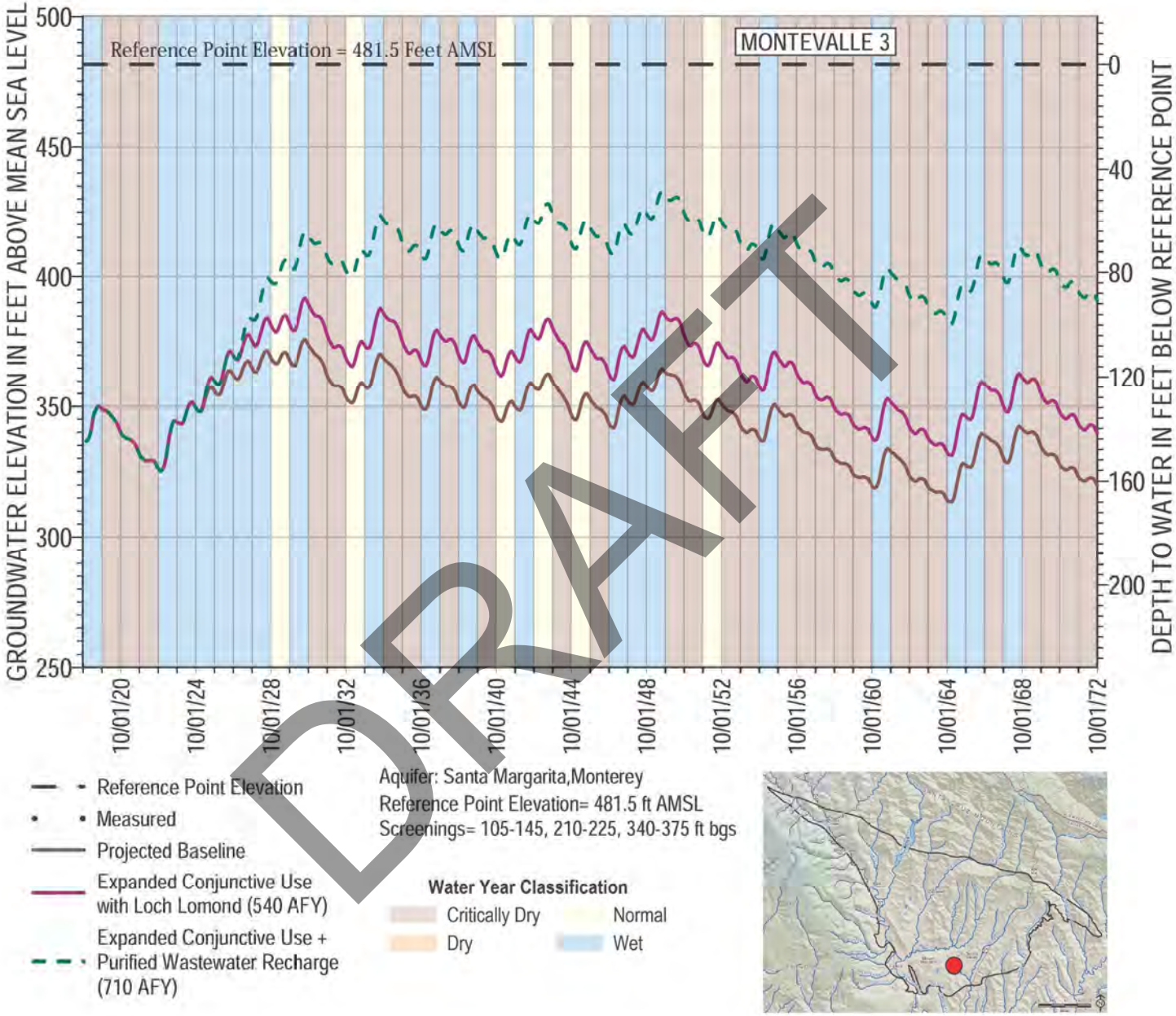
Projected Groundwater Level Target Hydrograph for MISSION SPRINGS



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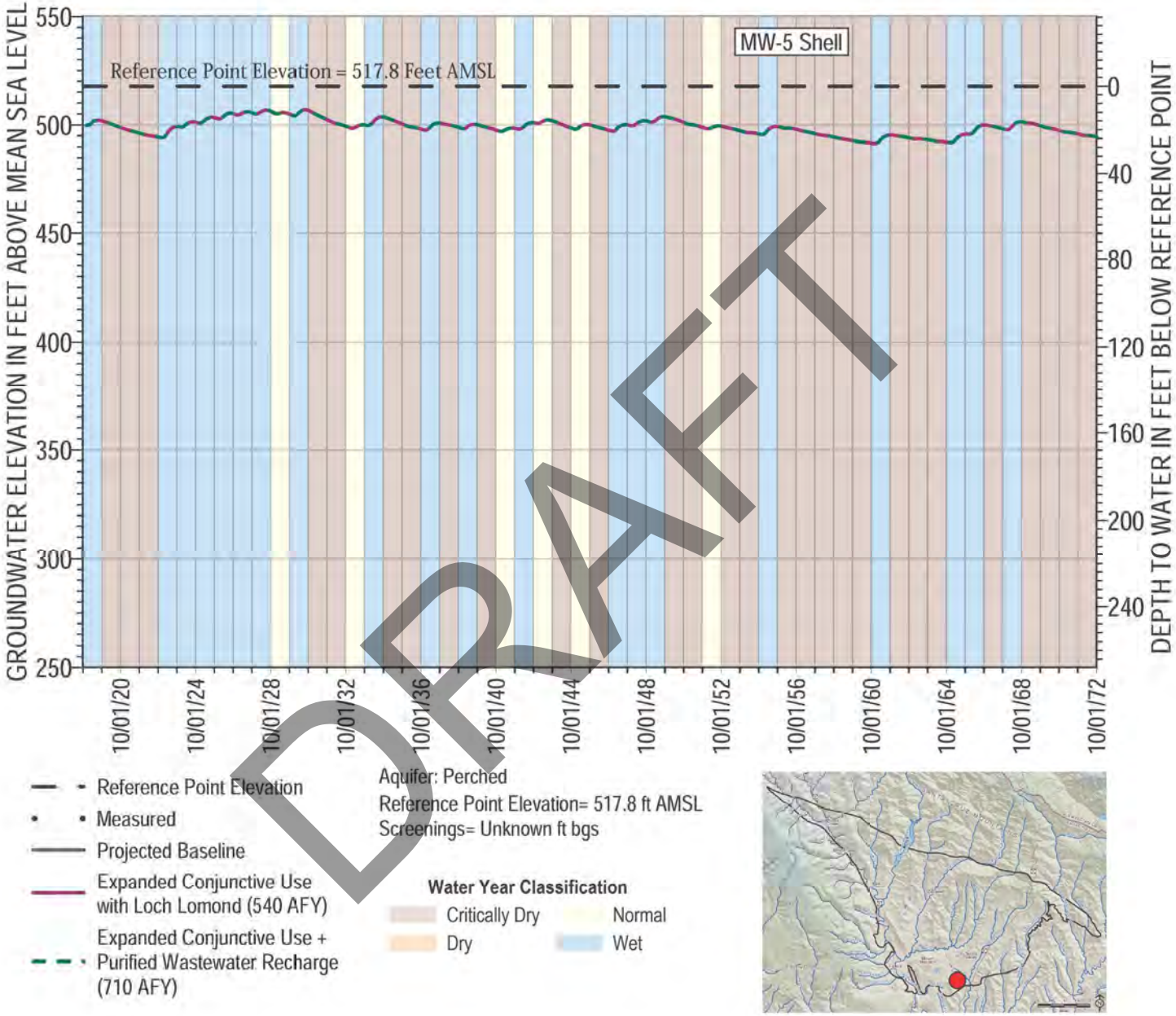
Projected Groundwater Level Target Hydrograph for MONTEVALLE 3



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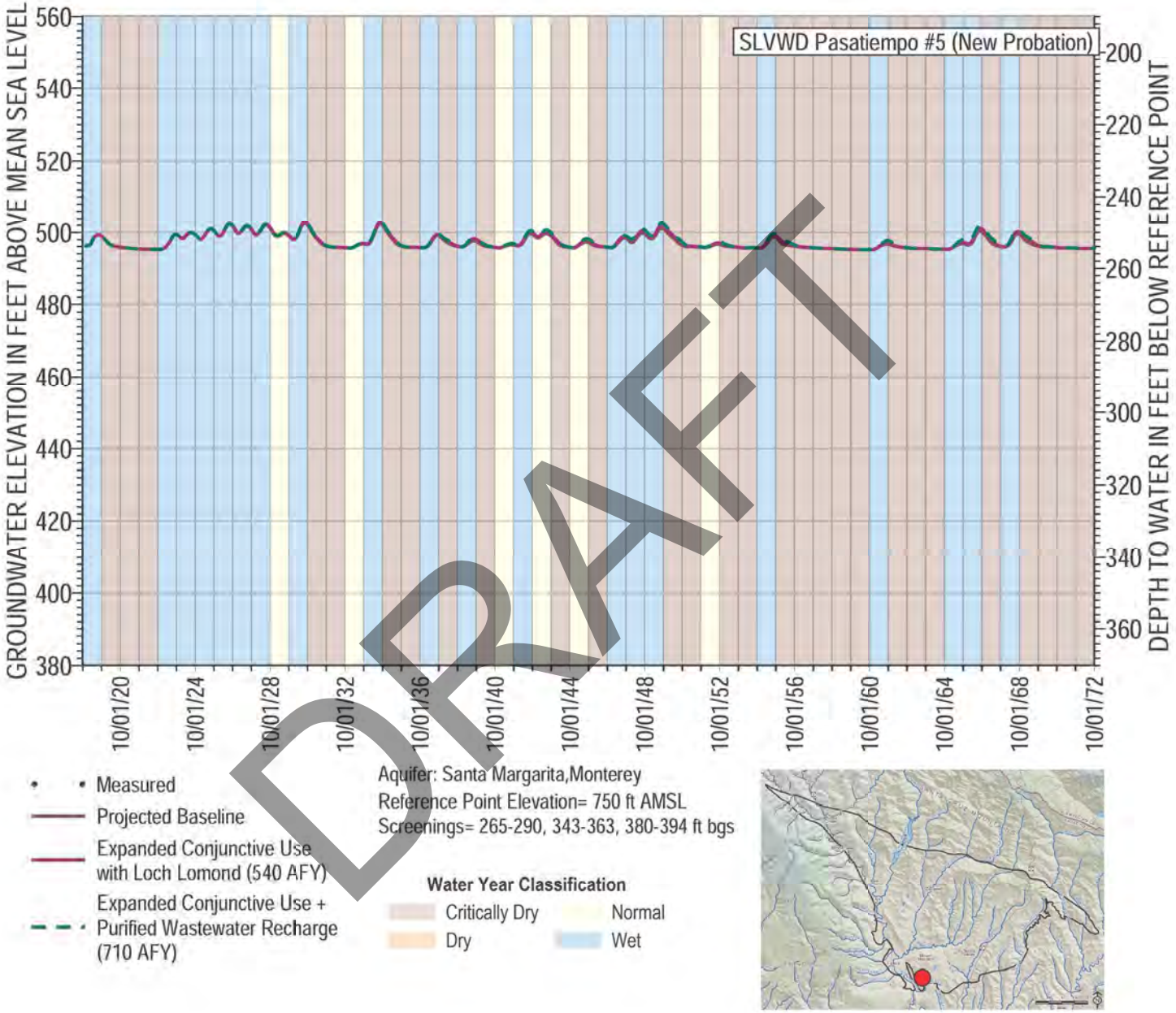
Projected Groundwater Level Target Hydrograph for MW-5 Shell



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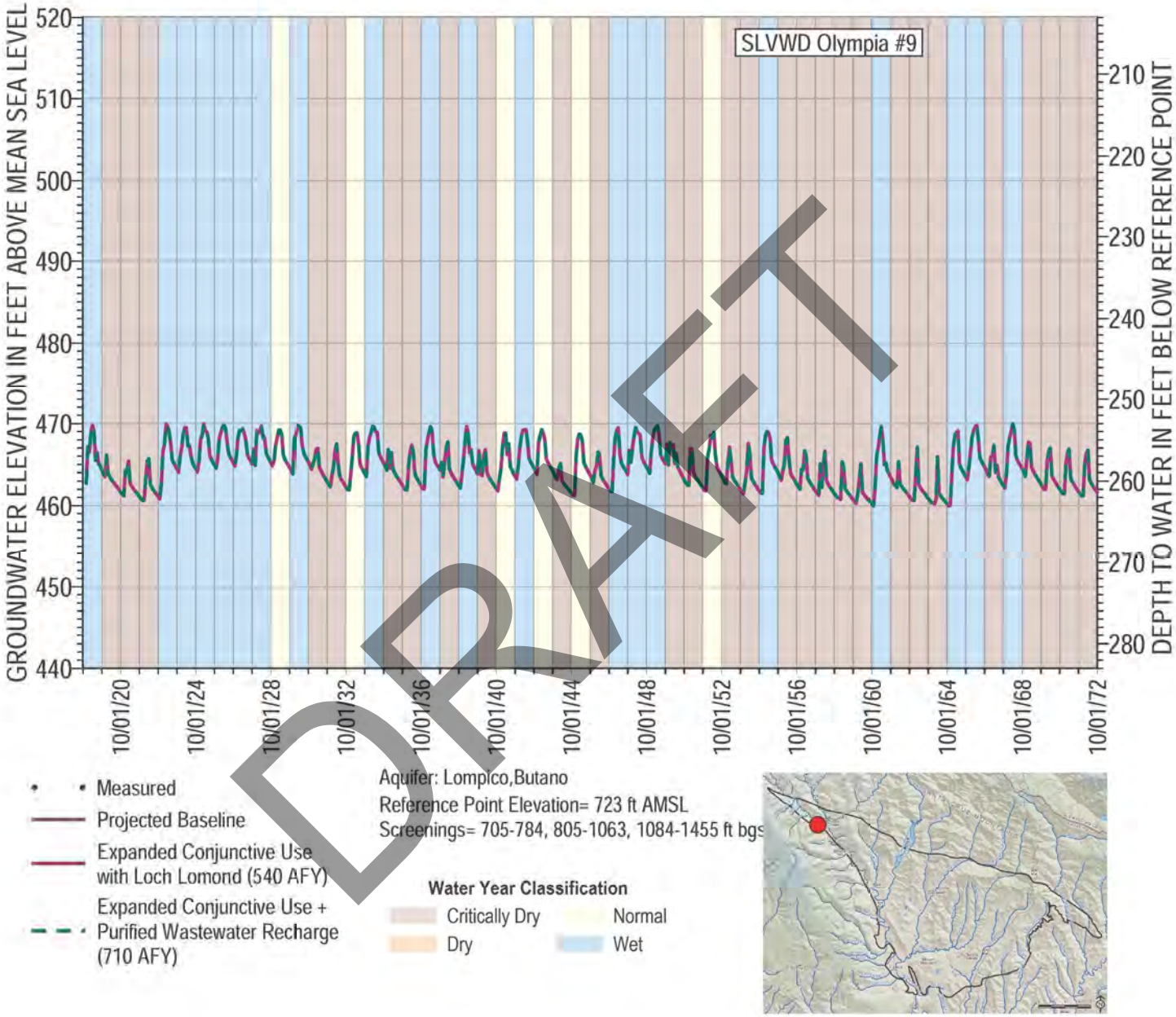
Projected Groundwater Level Target Hydrograph for SLVWD Pasatiempo #5 (New Probation)



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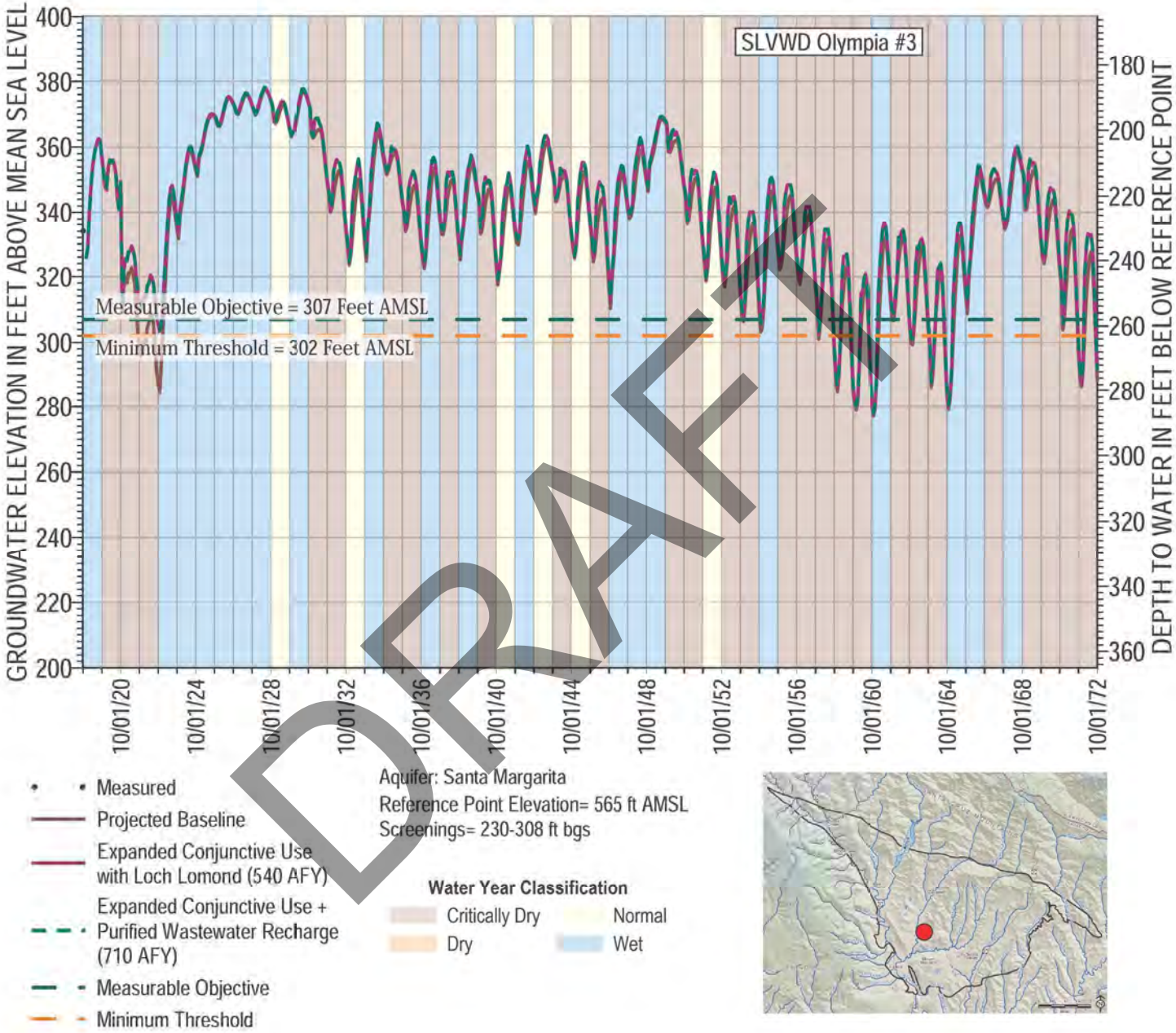
Projected Groundwater Level Target Hydrograph for SLVWD Olympia #9



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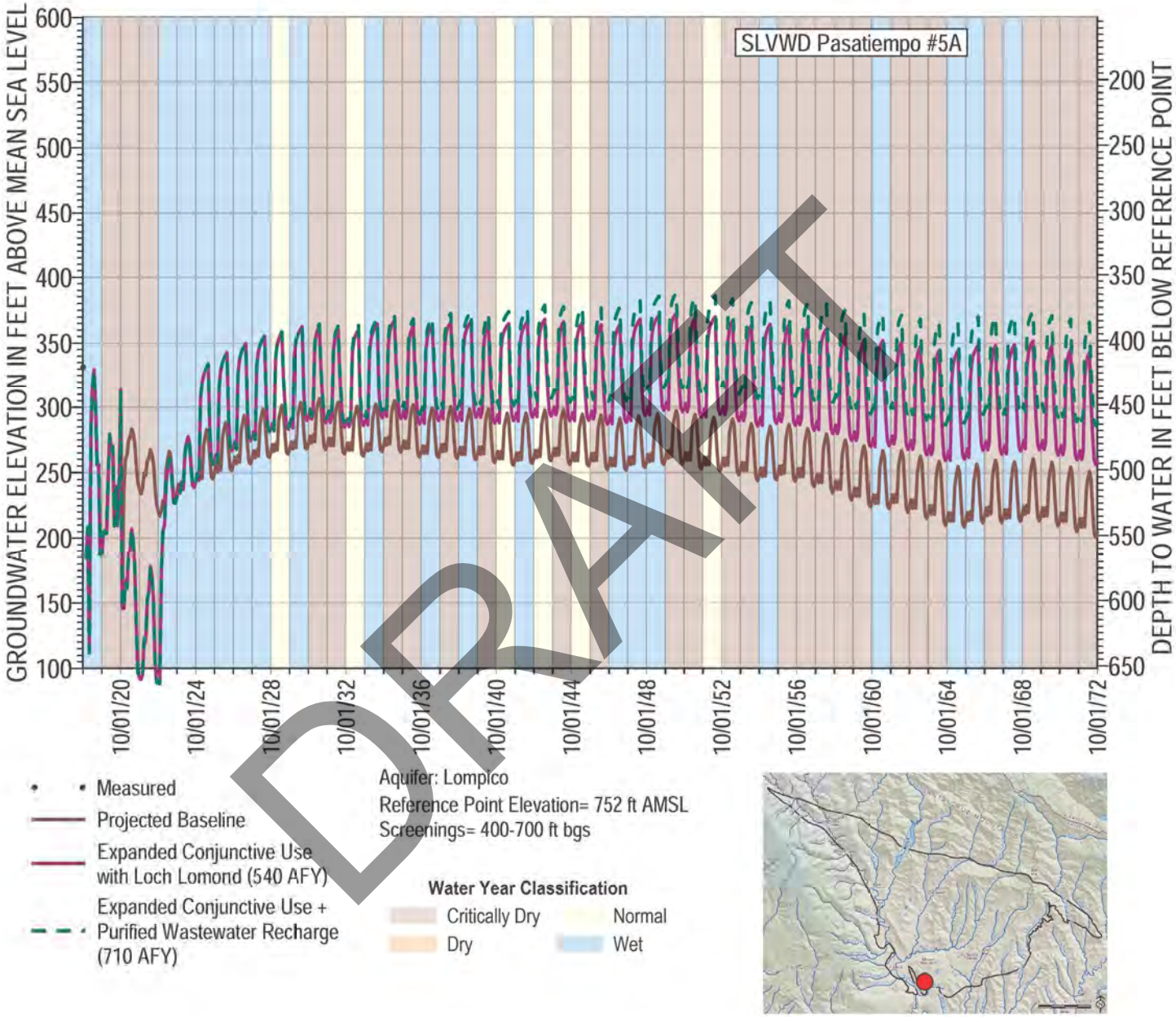
Projected Groundwater Level Target Hydrograph for SLVWD Olympia #3



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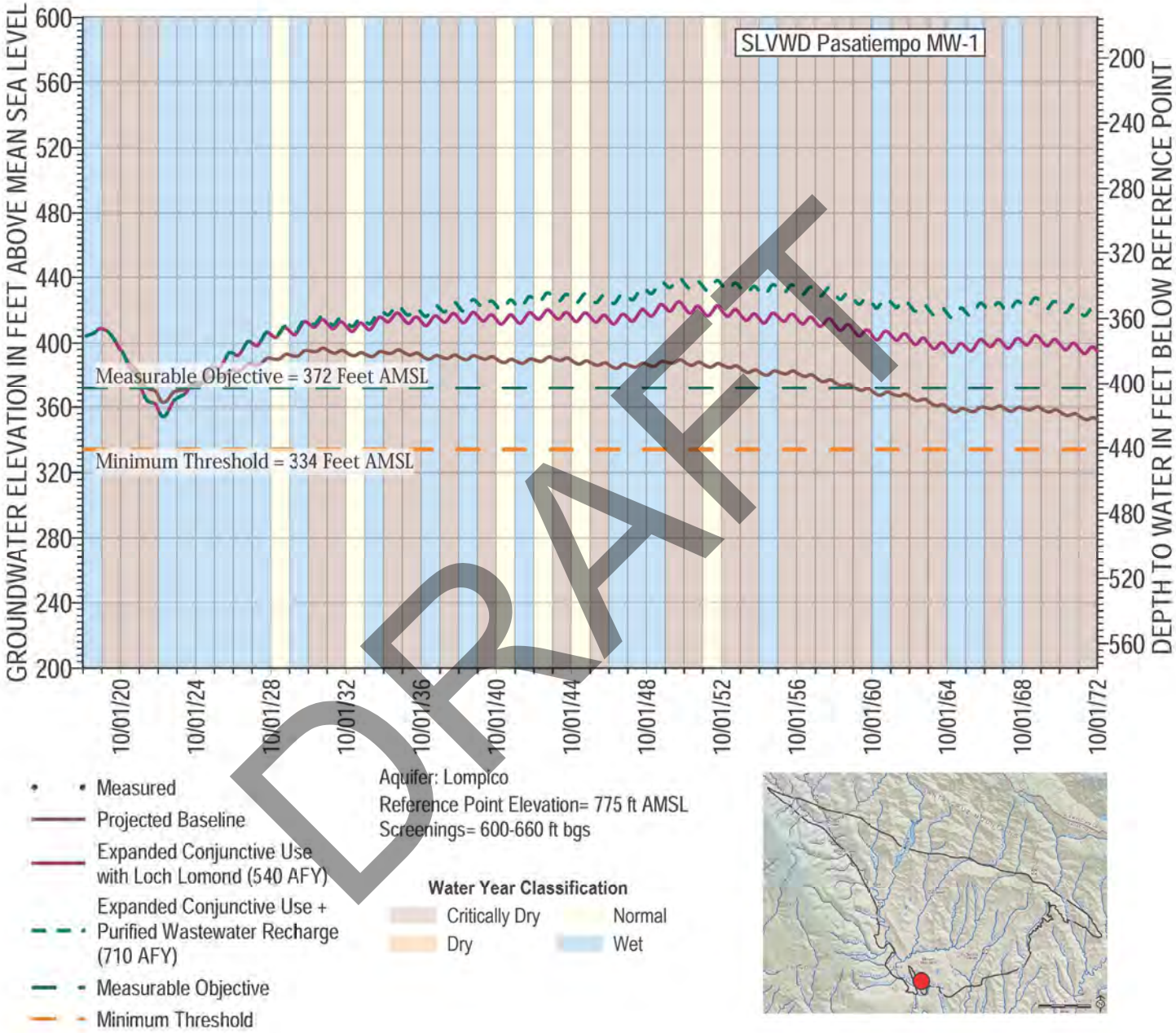
Projected Groundwater Level Target Hydrograph for SLVWD Pasatiempo #5A



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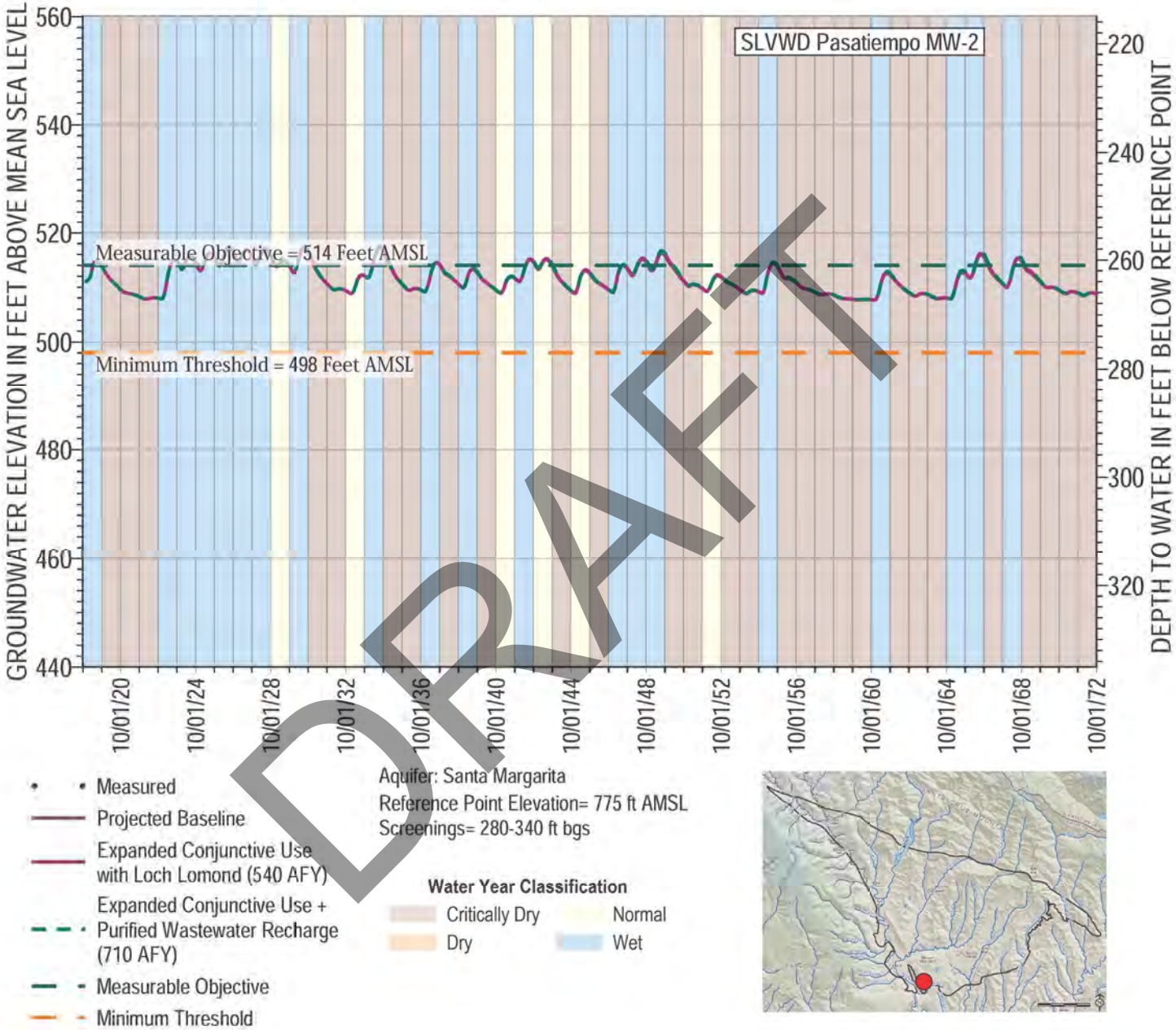
Projected Groundwater Level Target Hydrograph for SLVWD Pasatiempo MW-1



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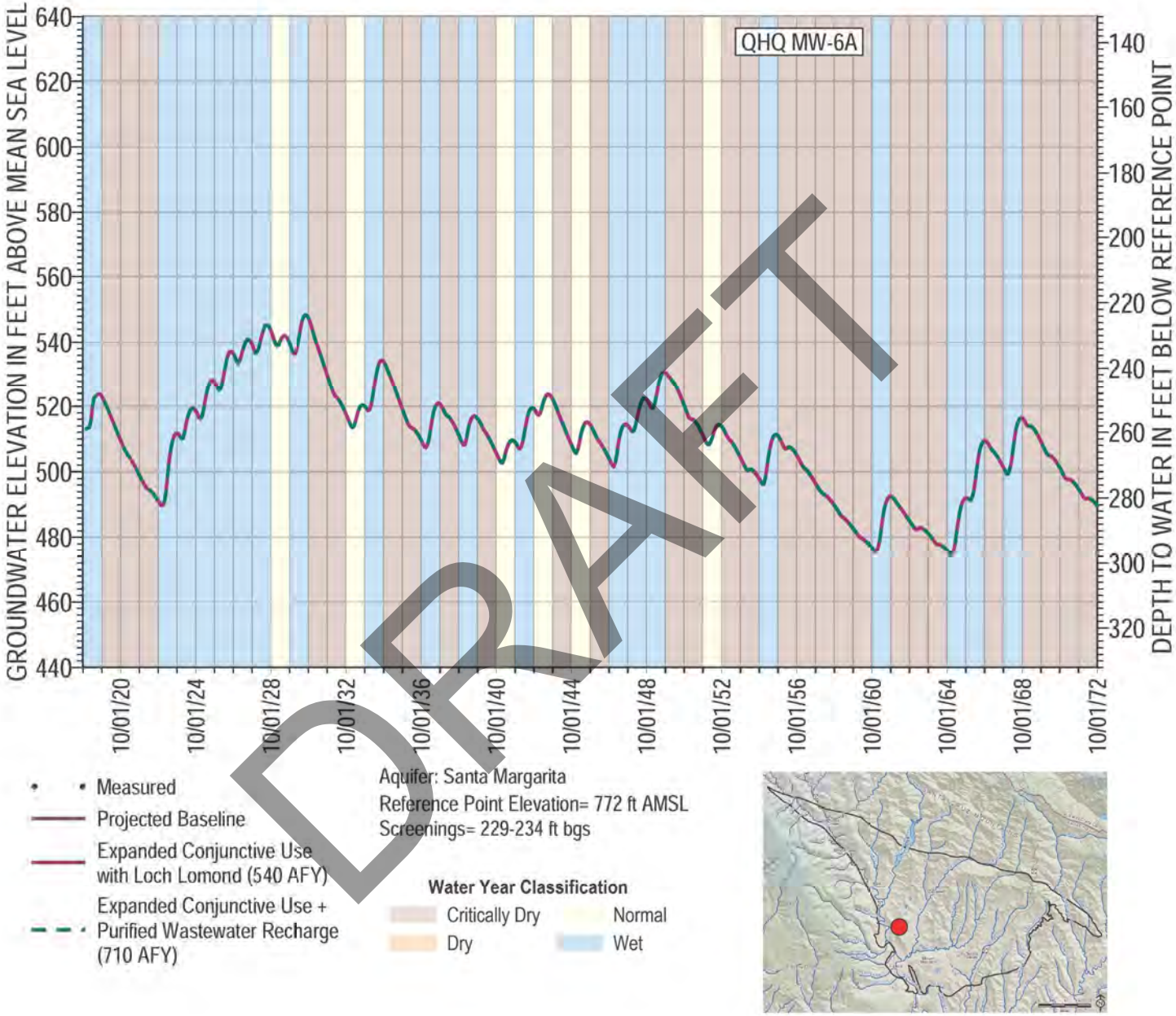
Projected Groundwater Level Target Hydrograph for SLVWD Pasatiempo MW-2



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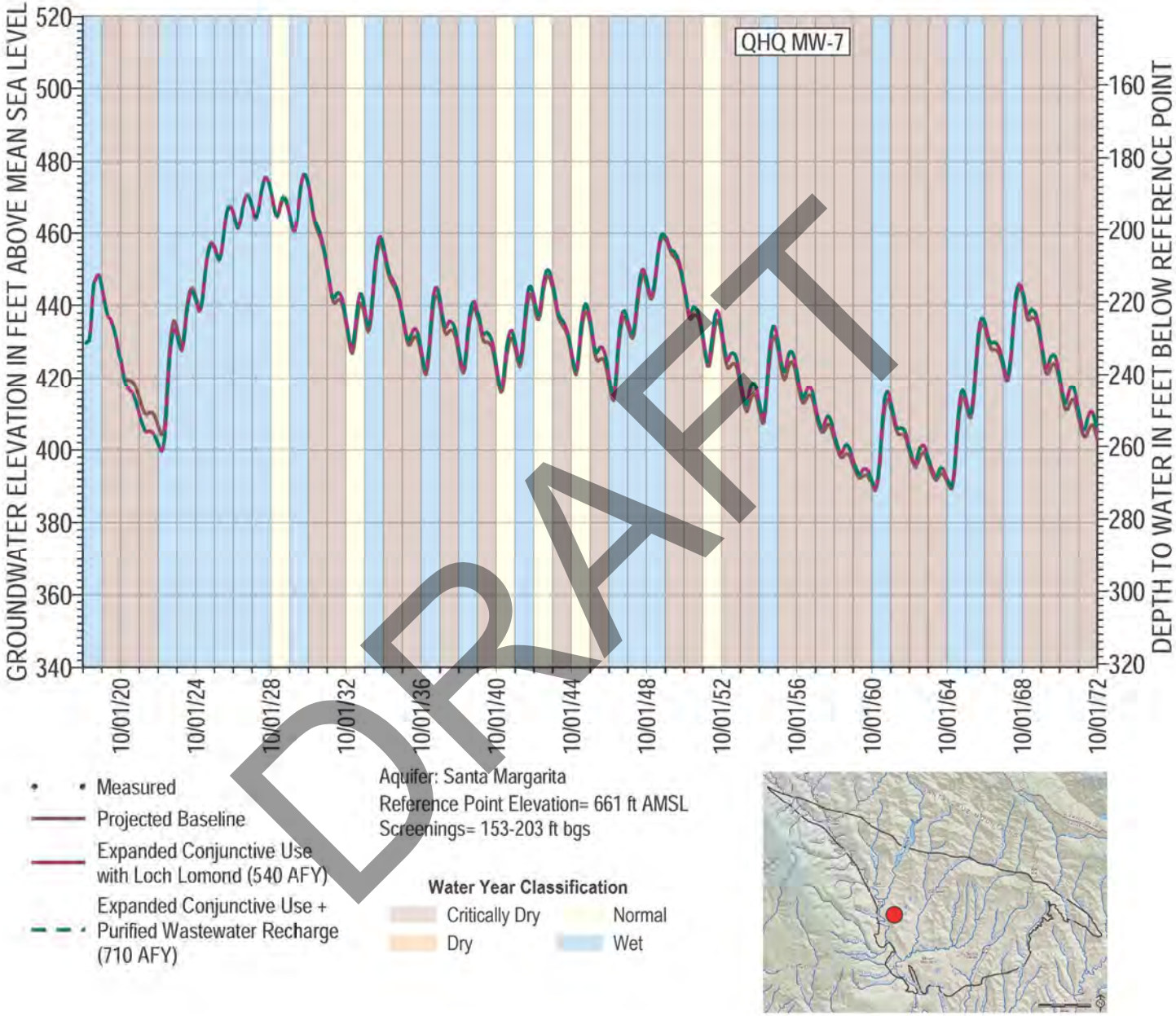
Projected Groundwater Level Target Hydrograph for QHQ MW-6A



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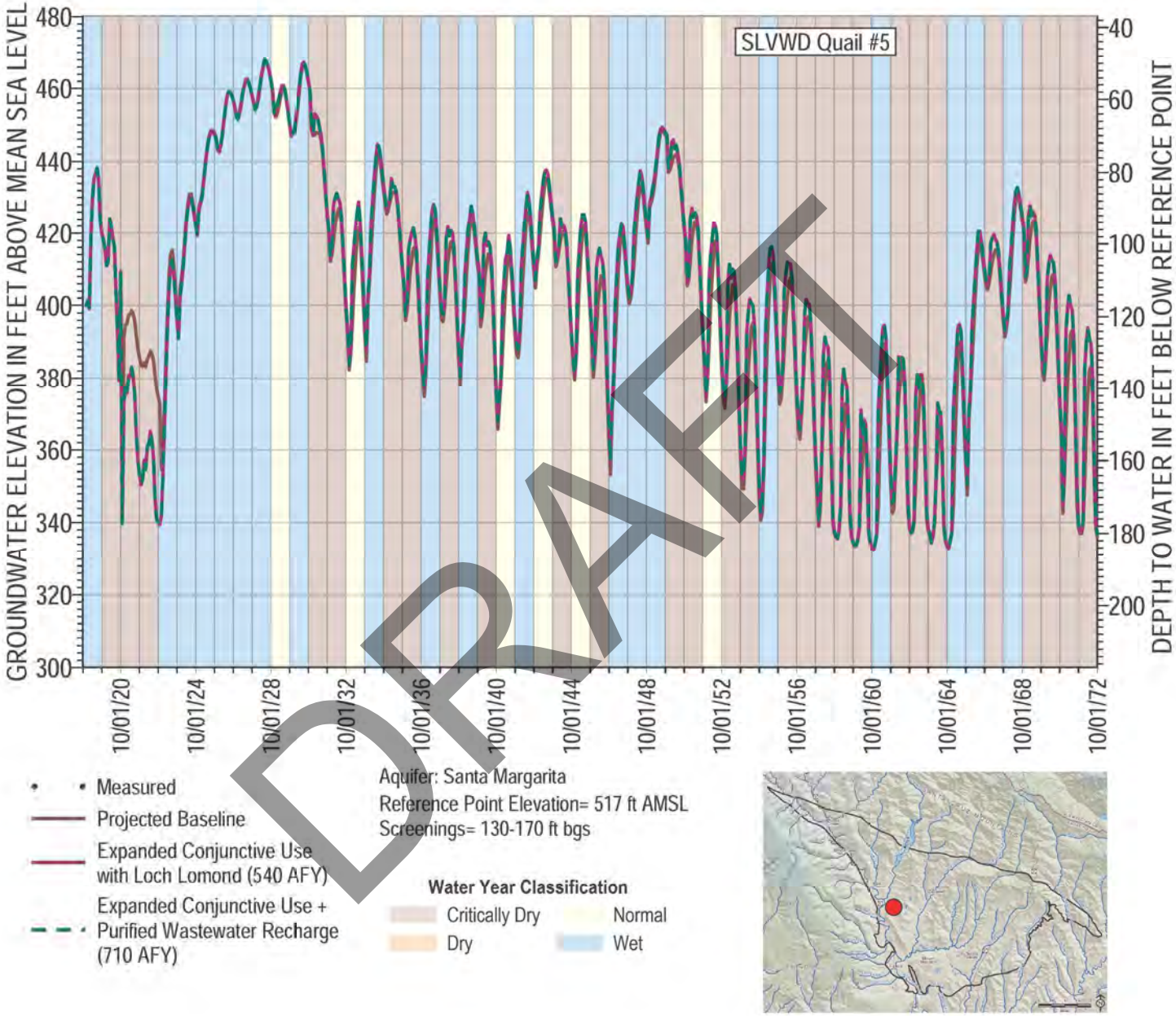
Projected Groundwater Level Target Hydrograph for QHQ MW-7



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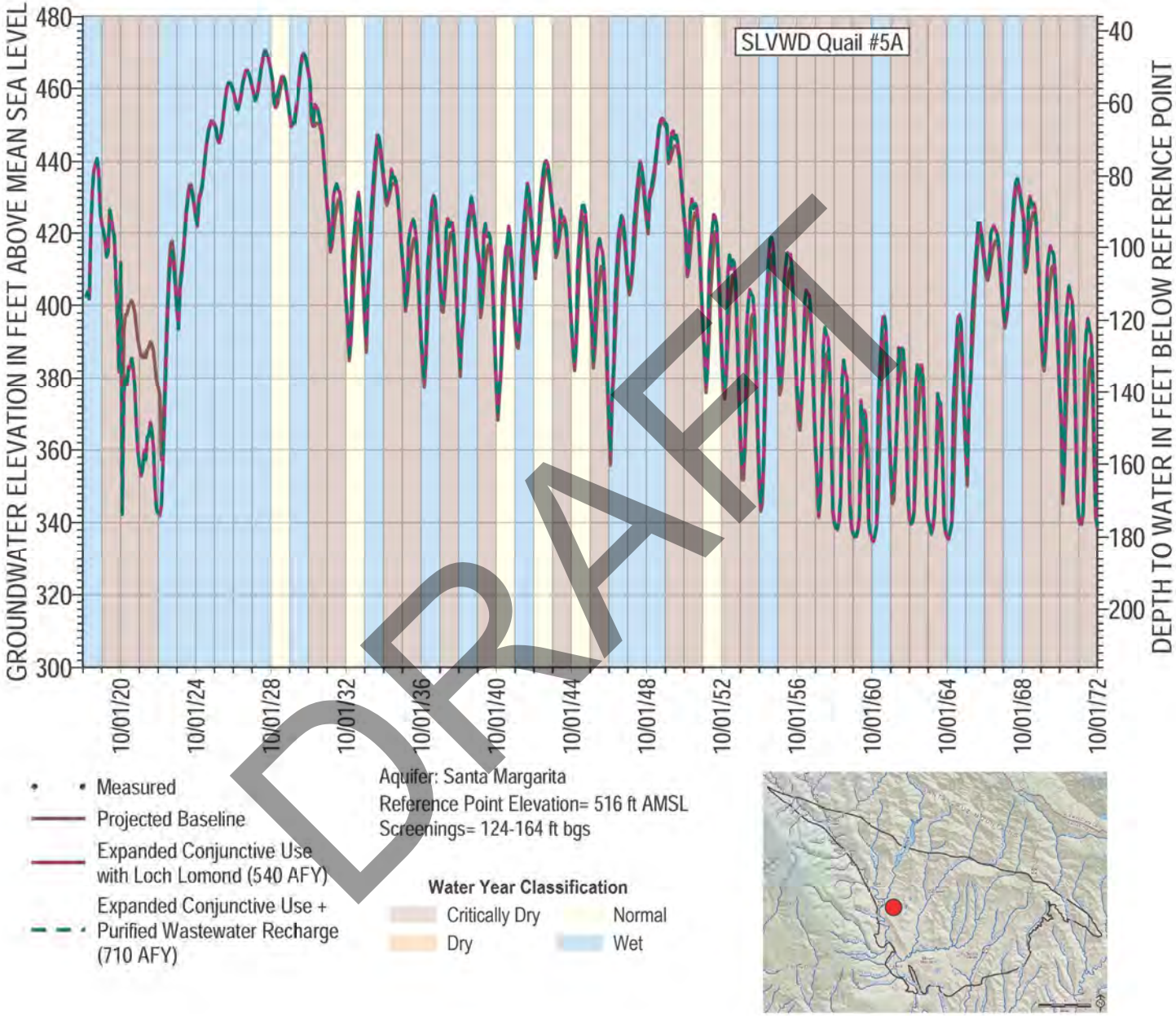
Projected Groundwater Level Target Hydrograph for SLVWD Quail #5



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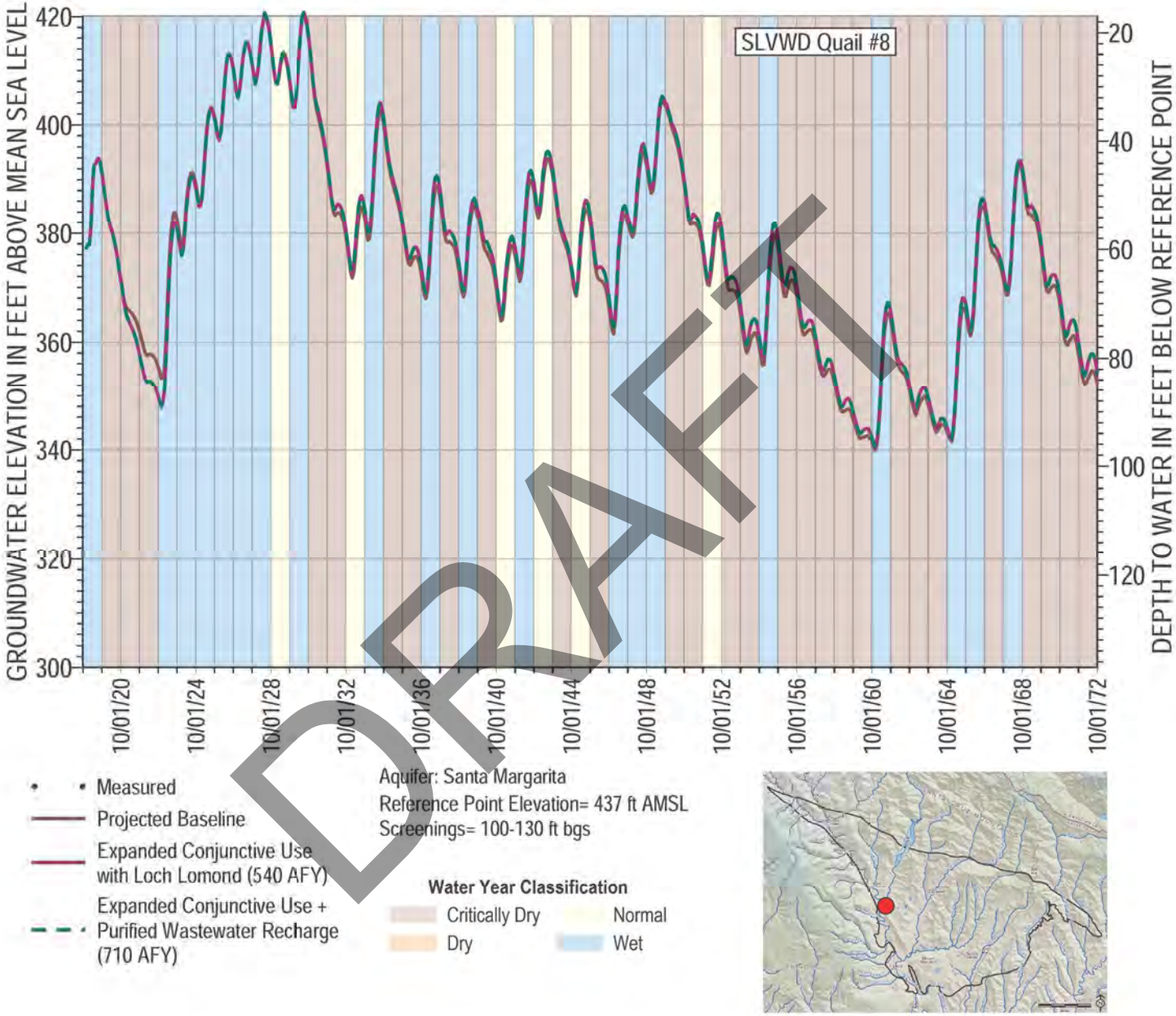
Projected Groundwater Level Target Hydrograph for SLVWD Quail #5A



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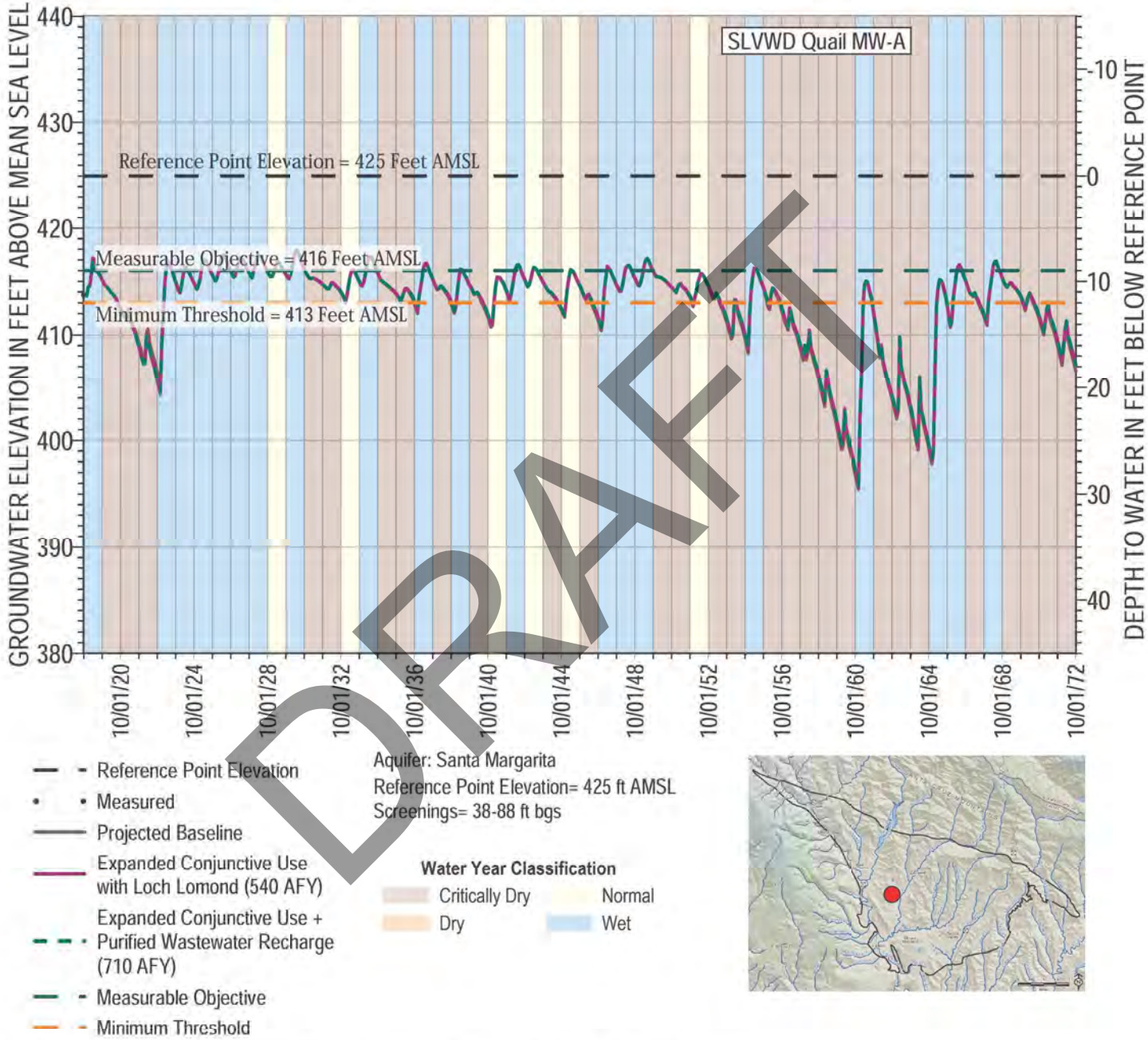
Projected Groundwater Level Target Hydrograph for SLVWD Quail #8



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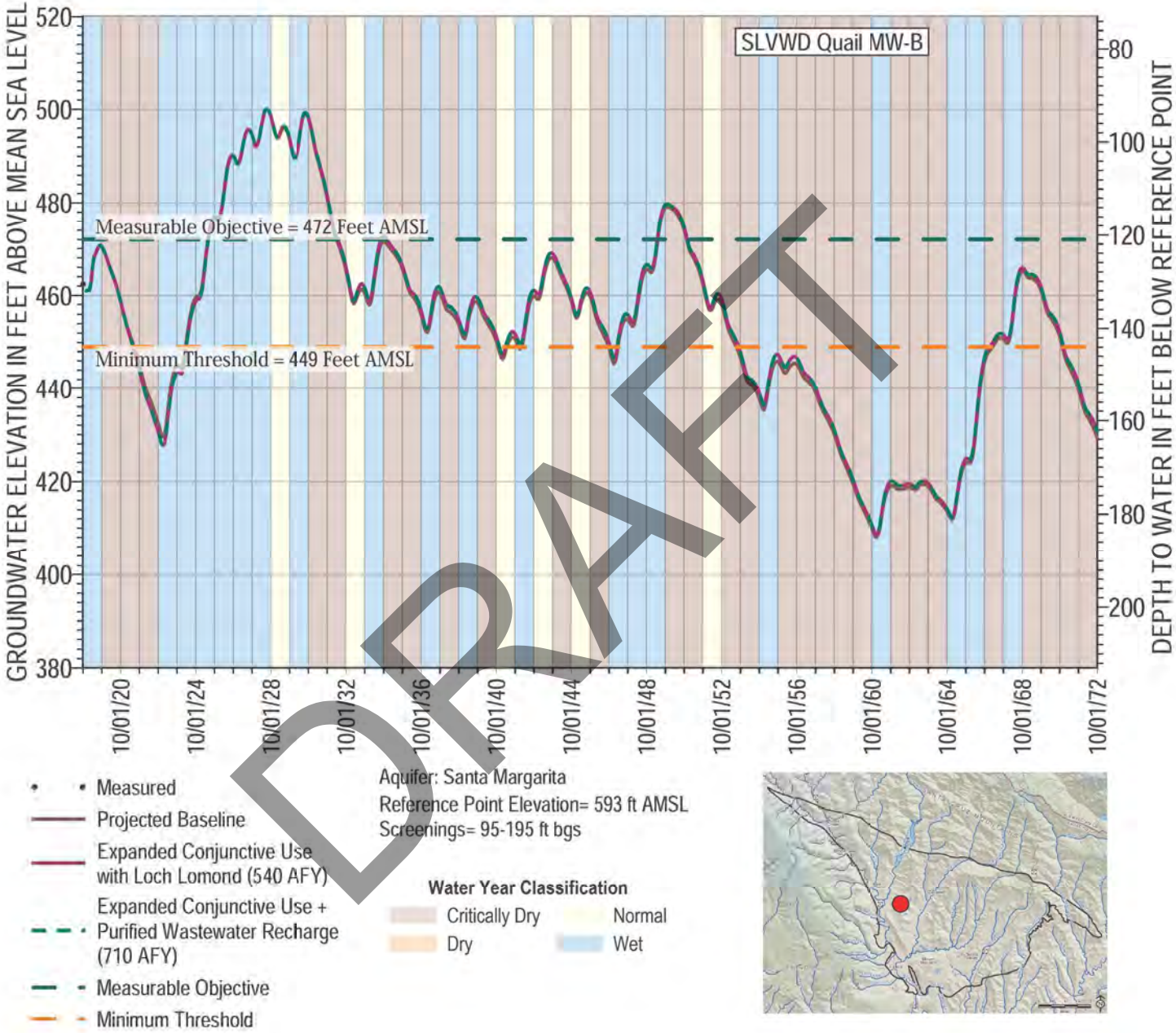
Projected Groundwater Level Target Hydrograph for SLVWD Quail MW-A



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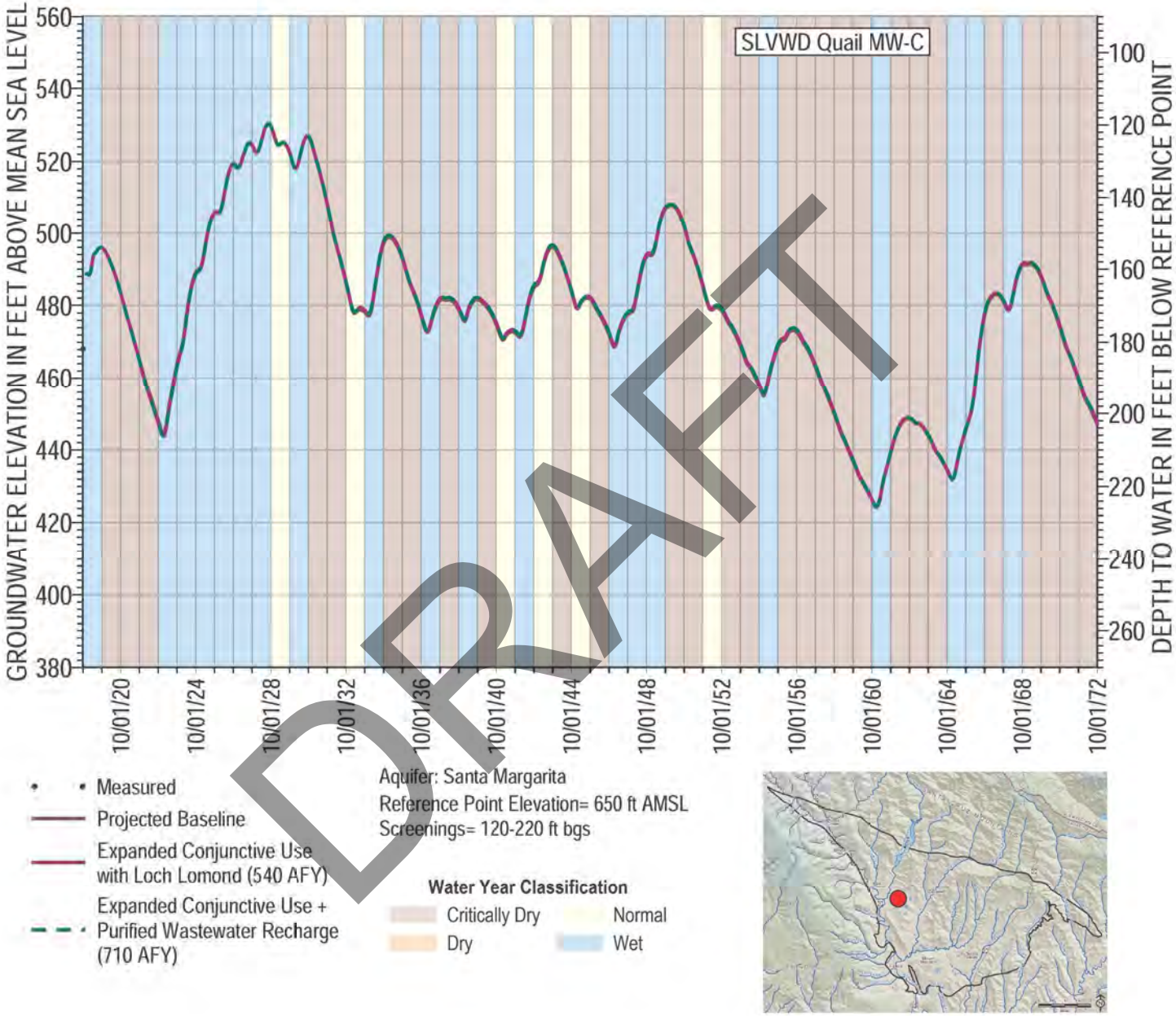
Projected Groundwater Level Target Hydrograph for SLVWD Quail MW-B



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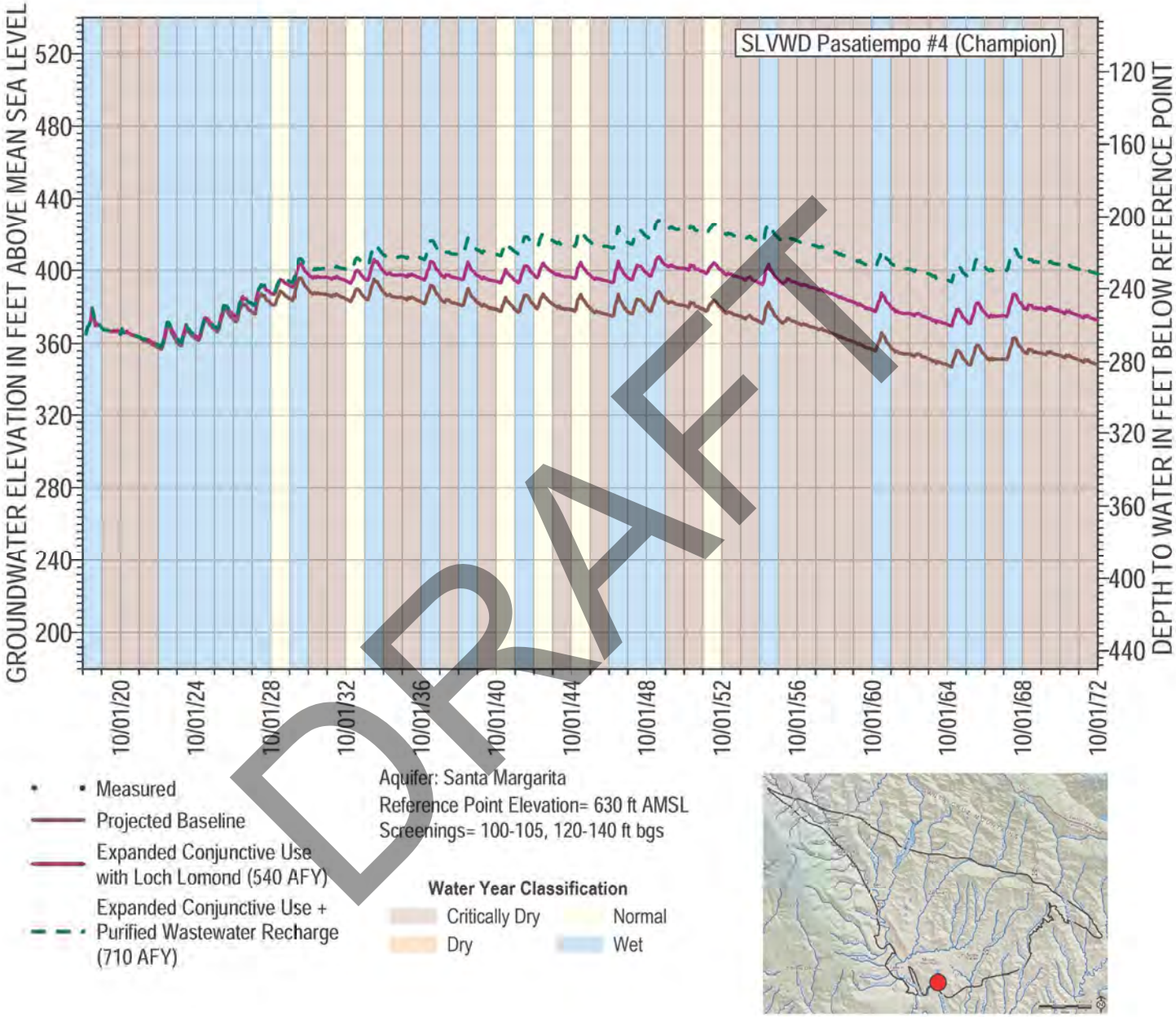
Projected Groundwater Level Target Hydrograph for SLVWD Quail MW-C



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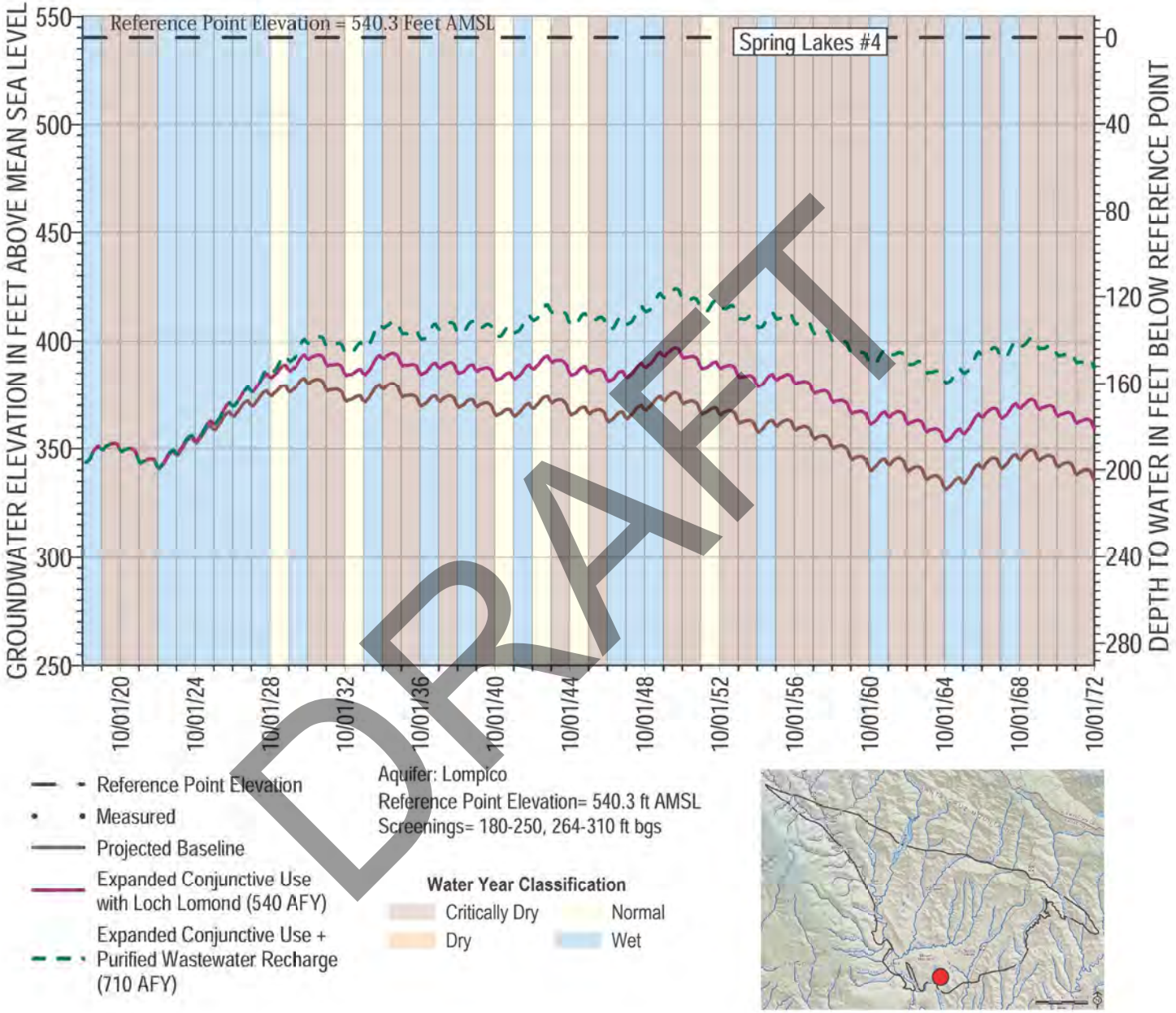
Projected Groundwater Level Target Hydrograph for SLVWD Pasatiempo #4 (Champion)



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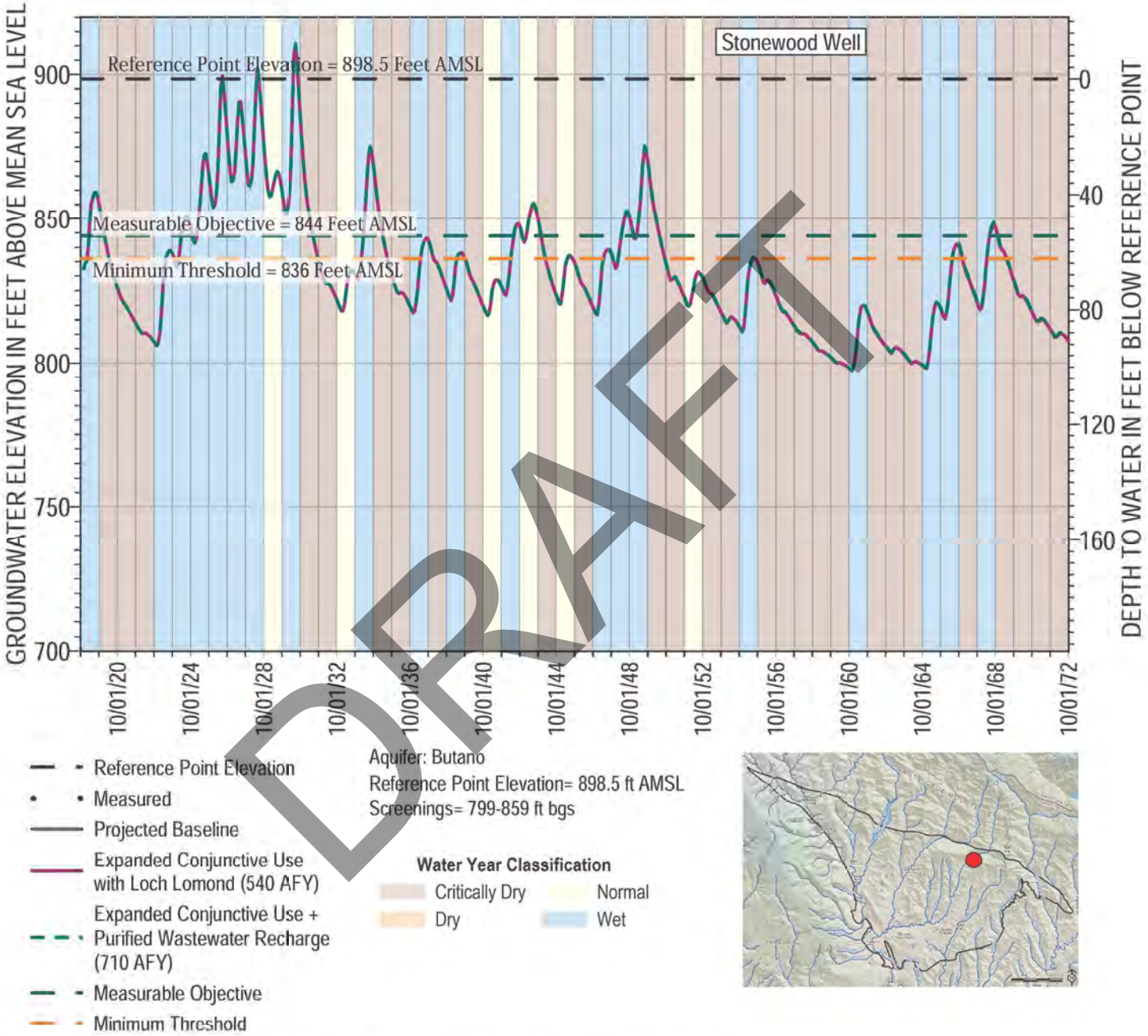
Projected Groundwater Level Target Hydrograph for Spring Lakes #4



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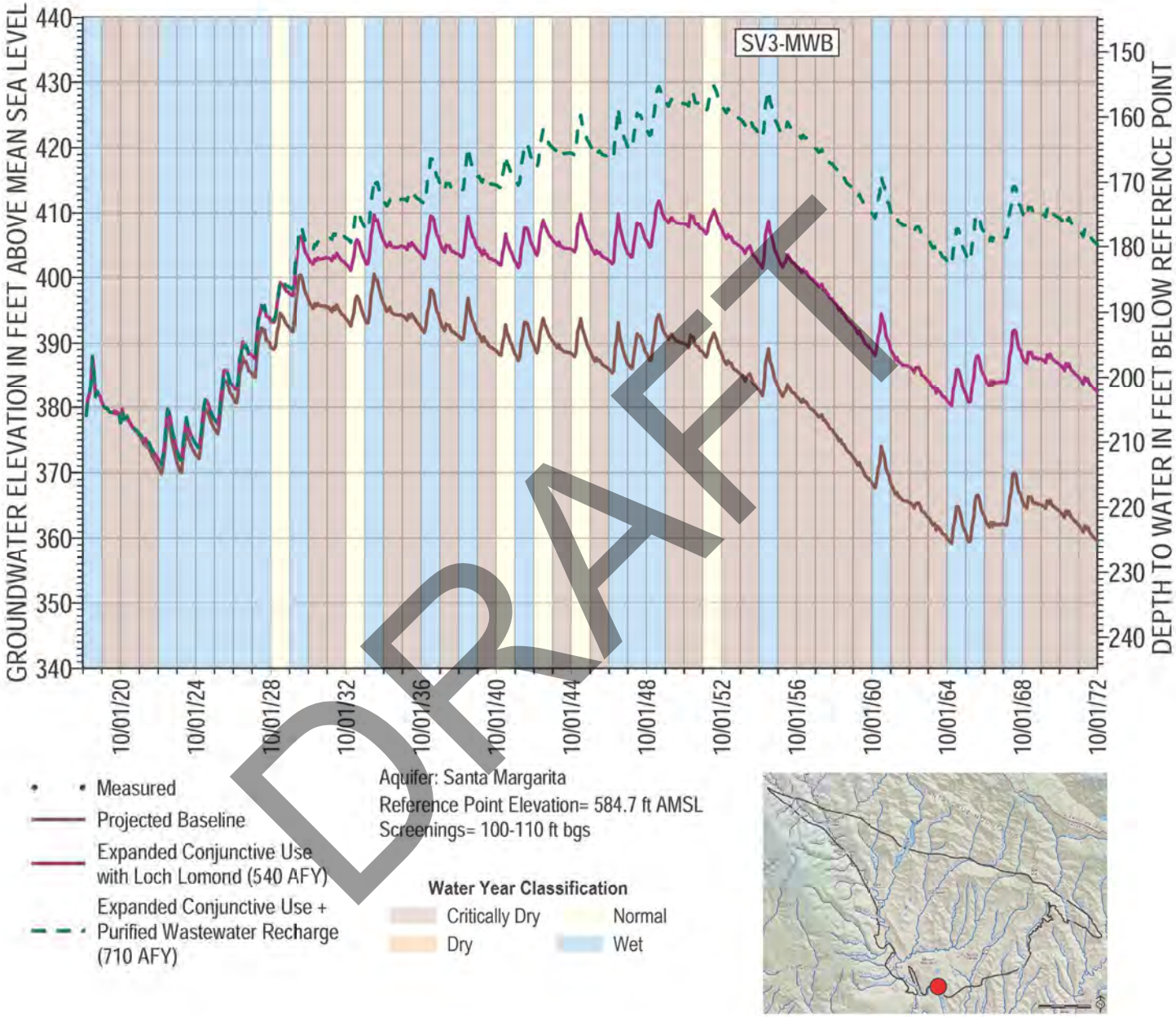
Projected Groundwater Level Target Hydrograph for Stonewood Well



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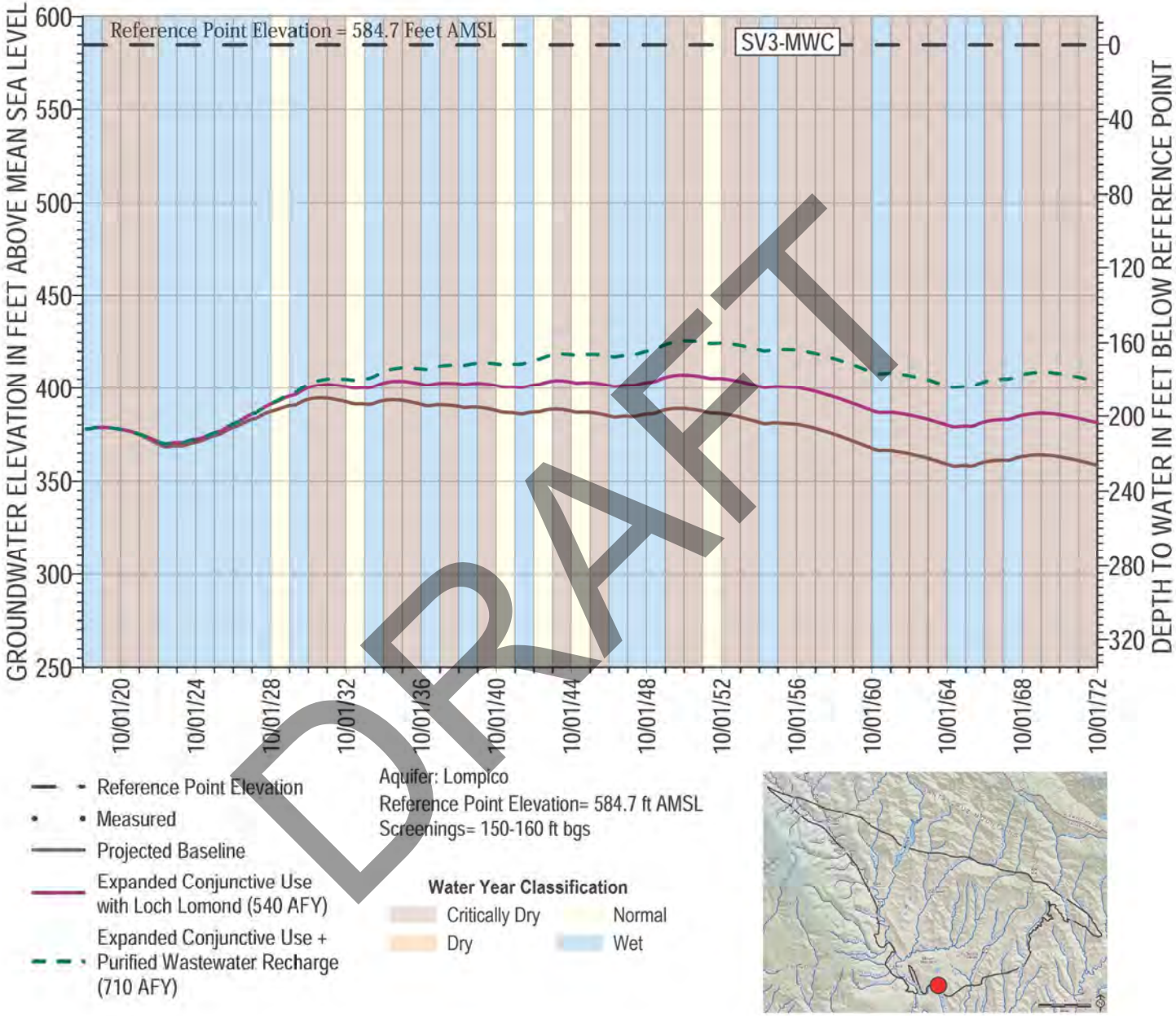
Projected Groundwater Level Target Hydrograph for SV3-MWB



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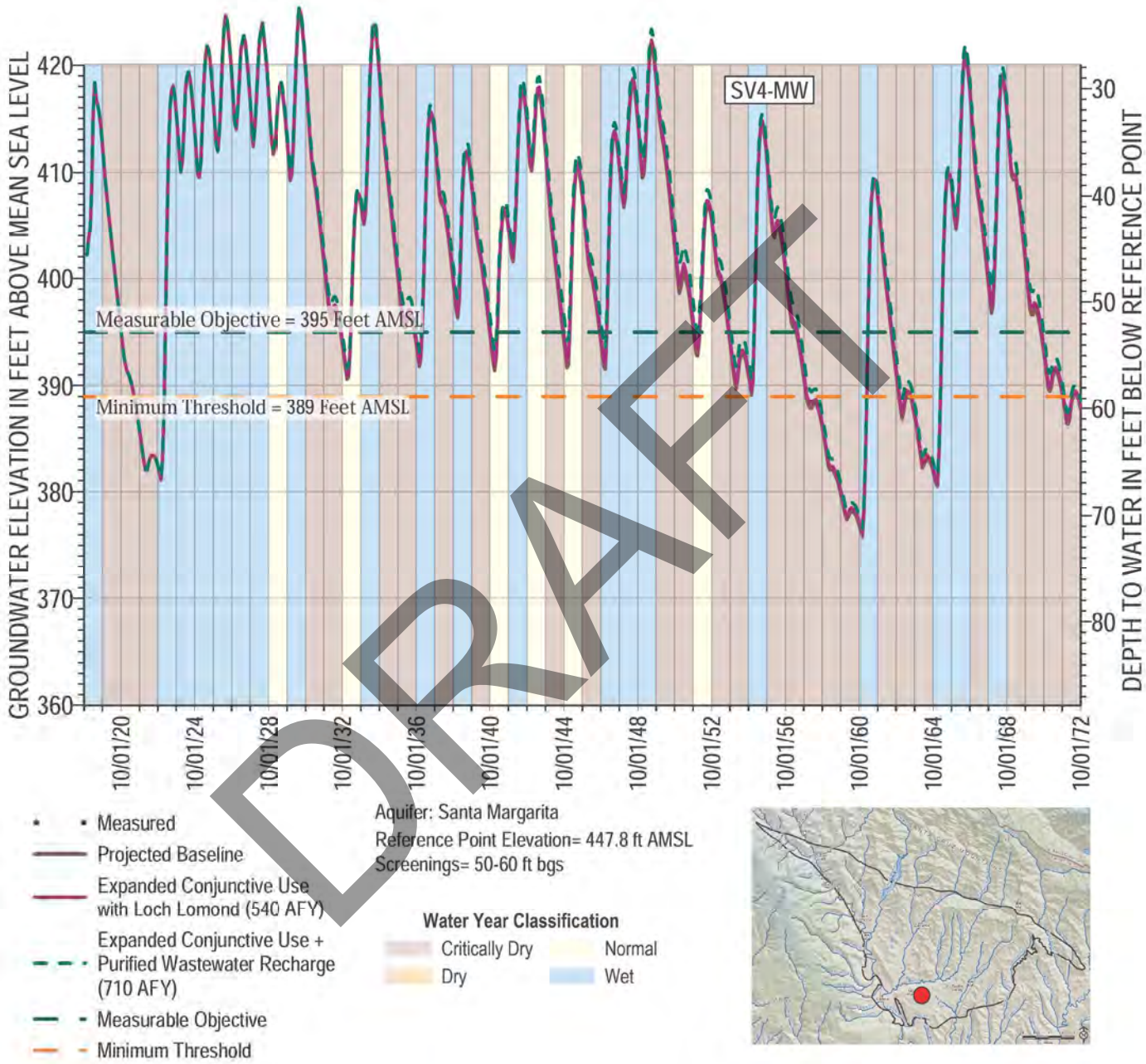
Projected Groundwater Level Target Hydrograph for SV3-MWC



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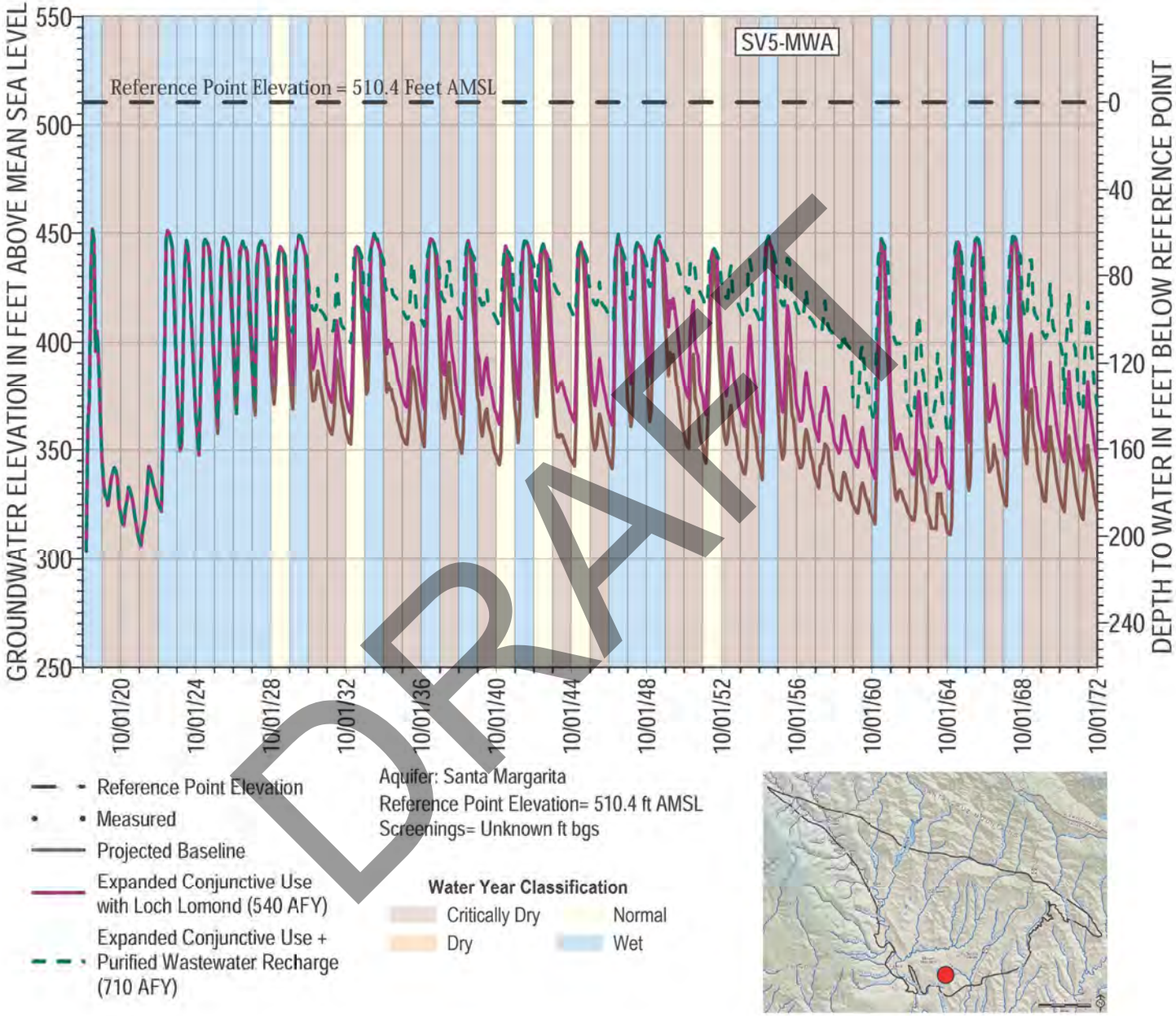
Projected Groundwater Level Target Hydrograph for SV4-MW



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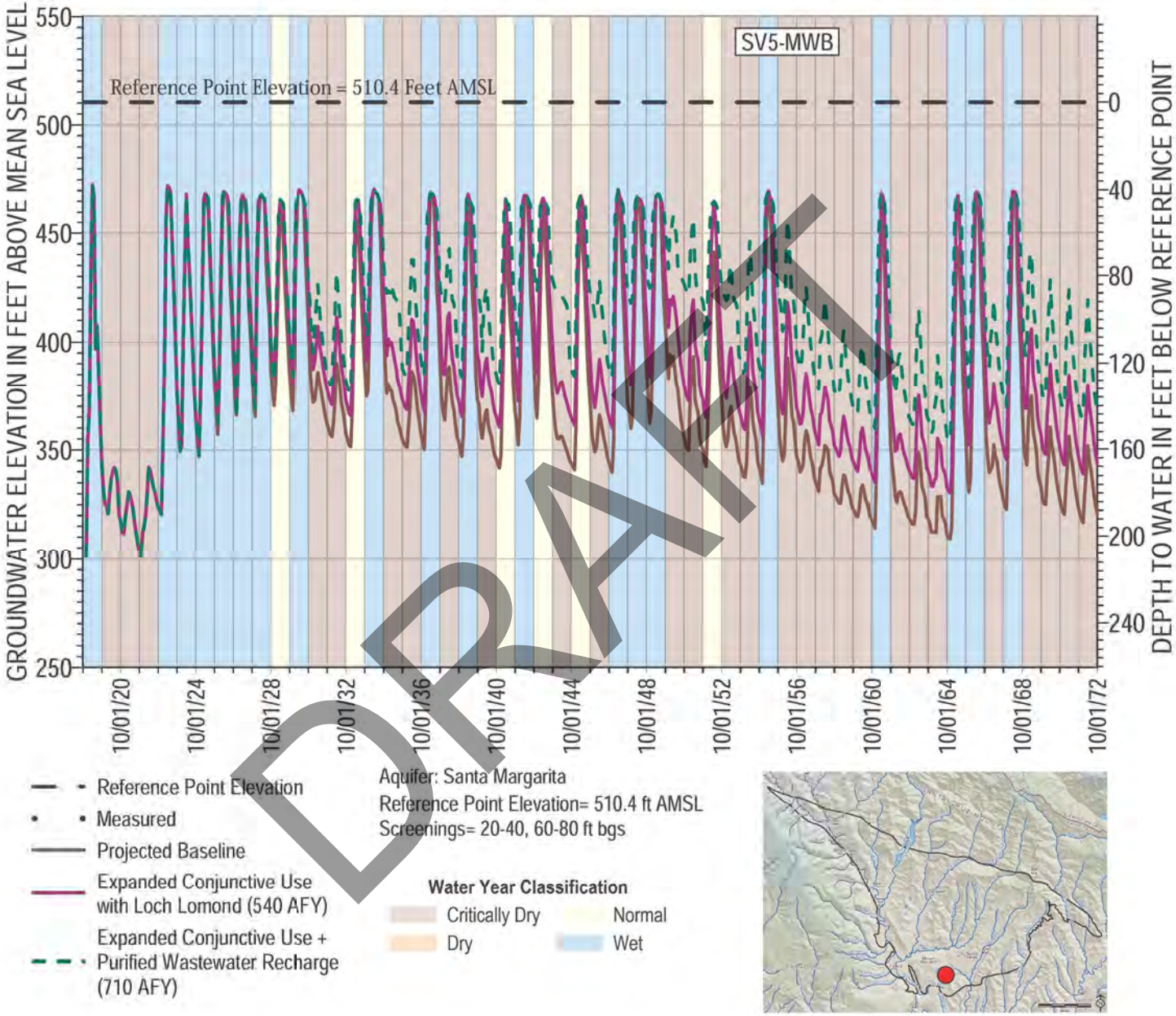
Projected Groundwater Level Target Hydrograph for SV5-MWA



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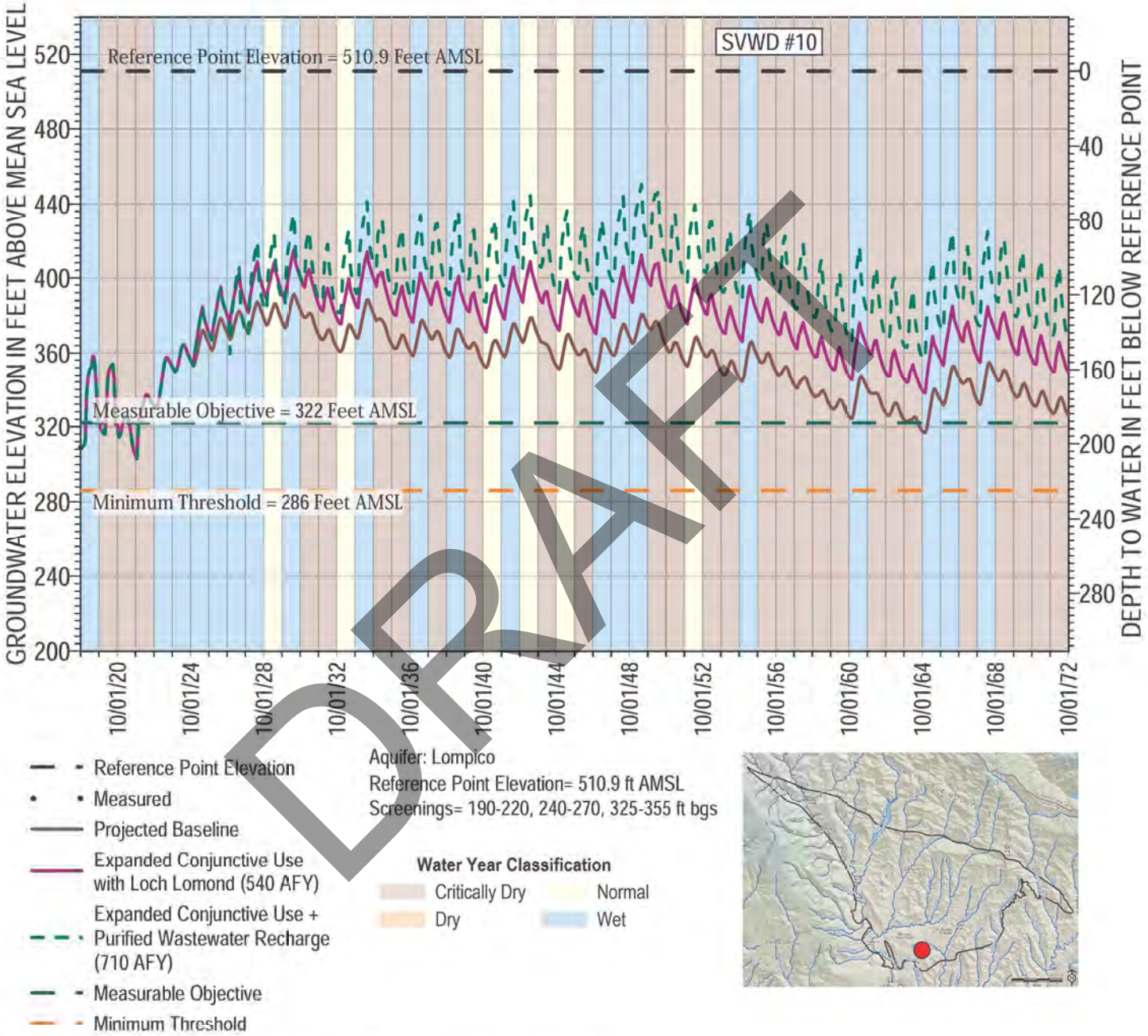
Projected Groundwater Level Target Hydrograph for SV5-MWB



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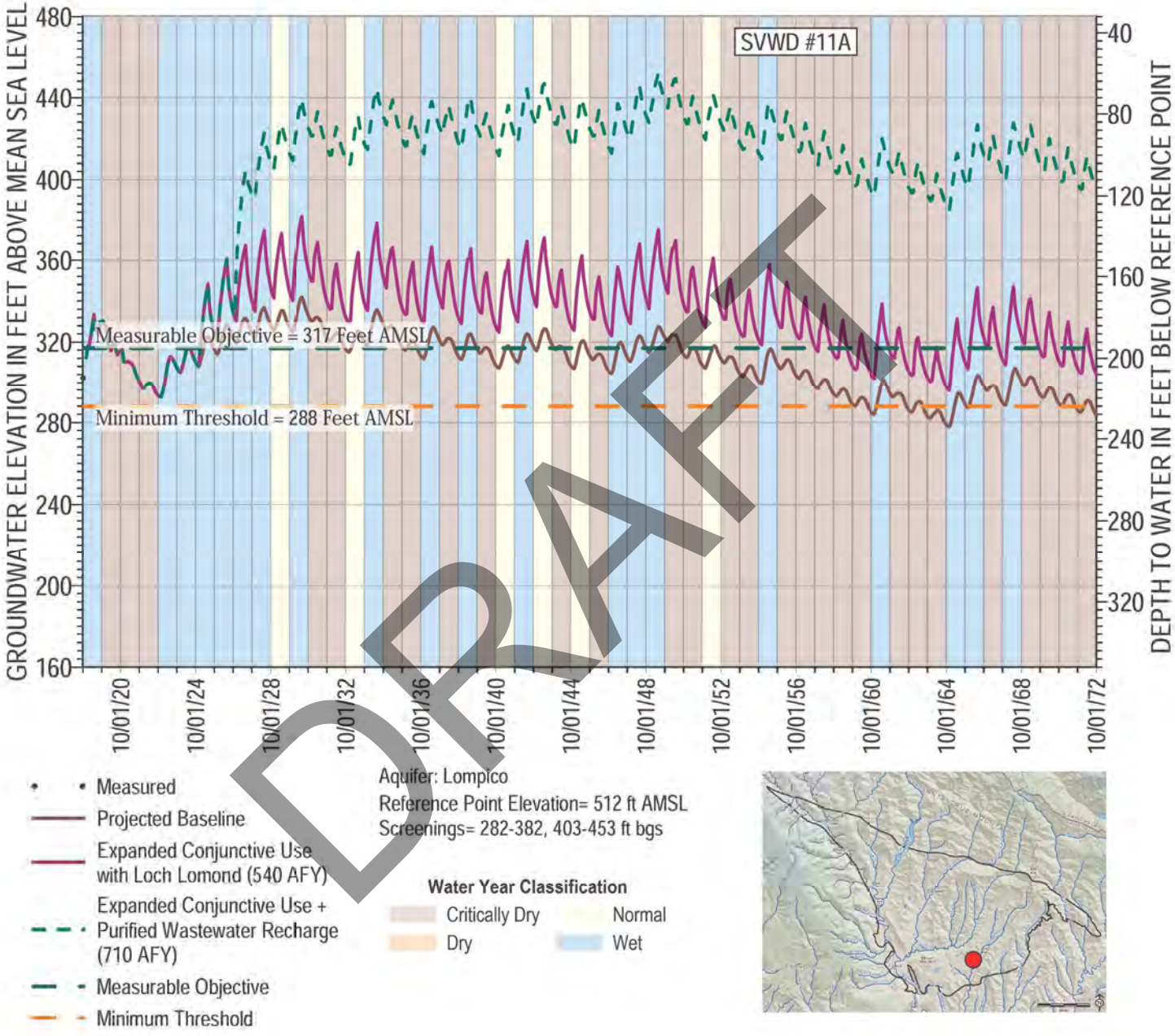
Projected Groundwater Level Target Hydrograph for SVWD #10



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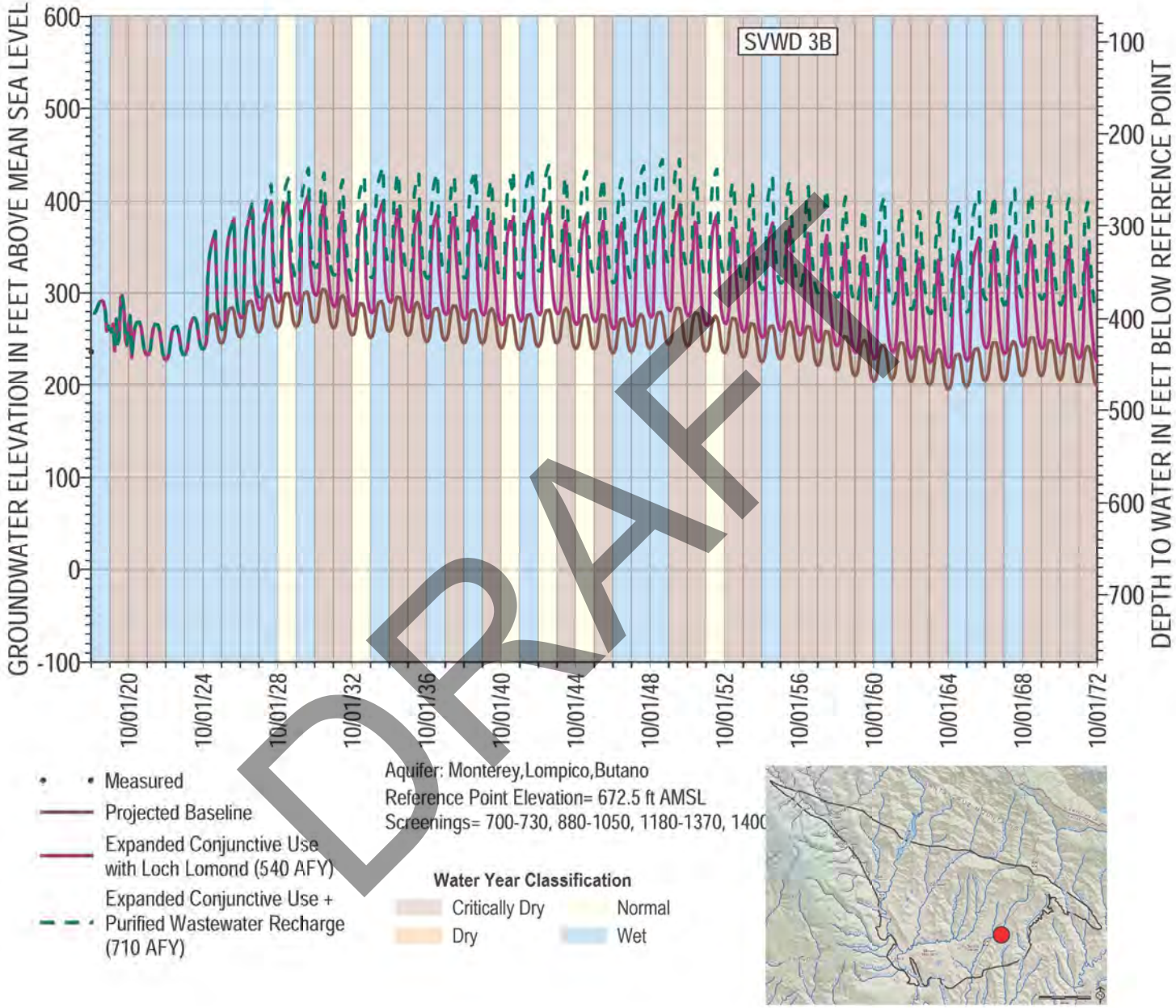
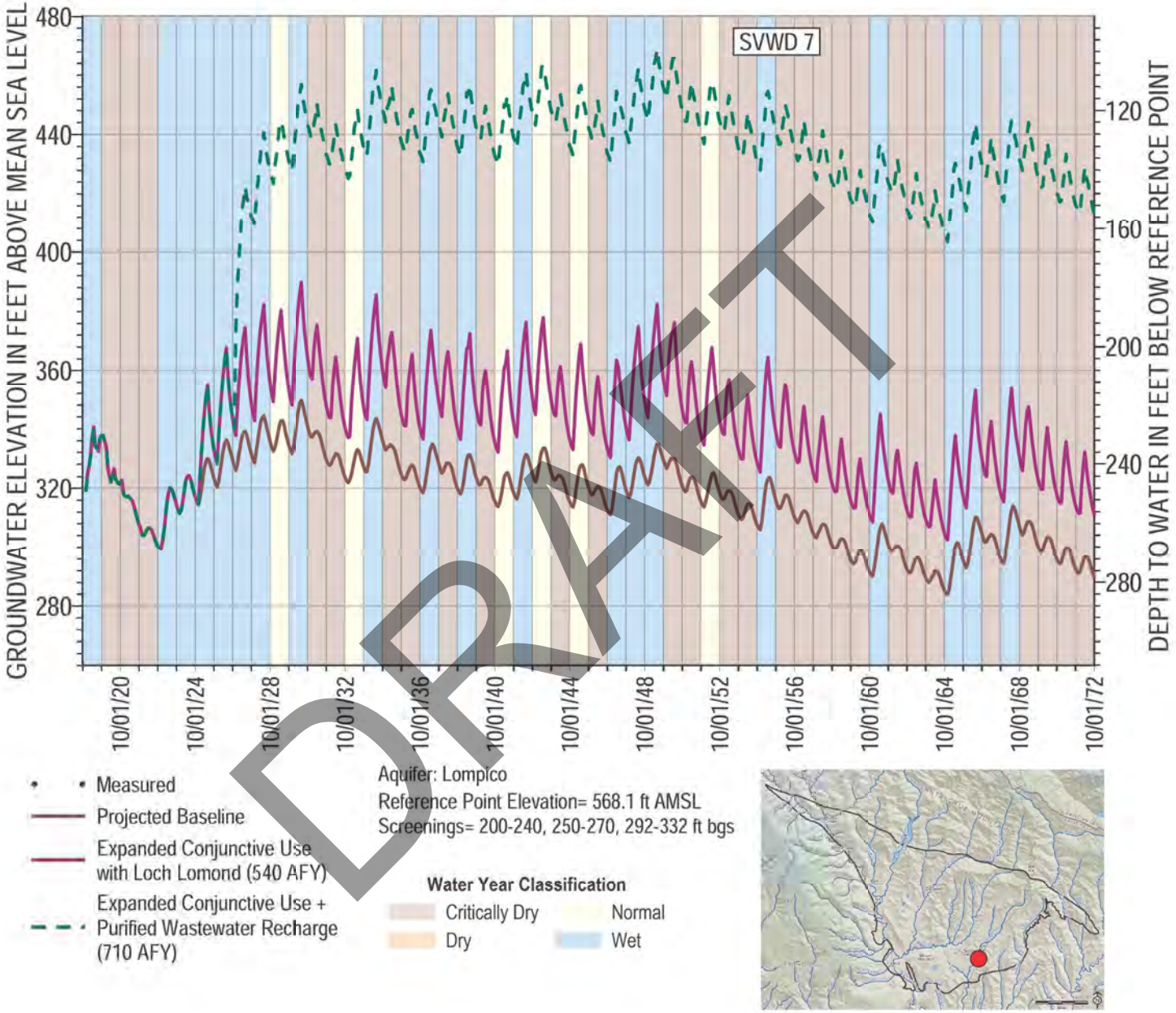
Projected Groundwater Level Target Hydrograph for SVWD #11A



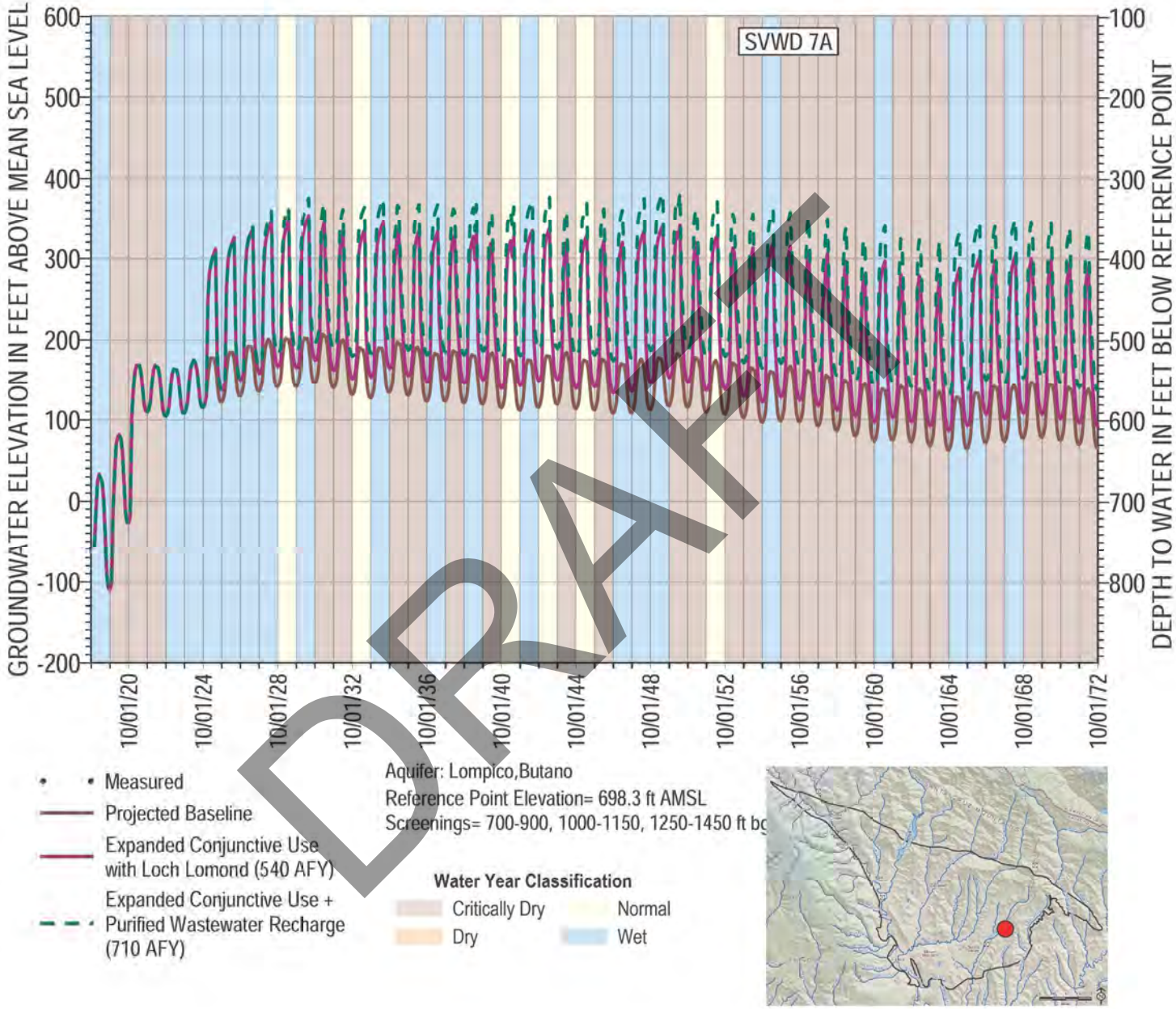
DRAFT

Projected Groundwater Level Target Hydrograph for SVWD 3B



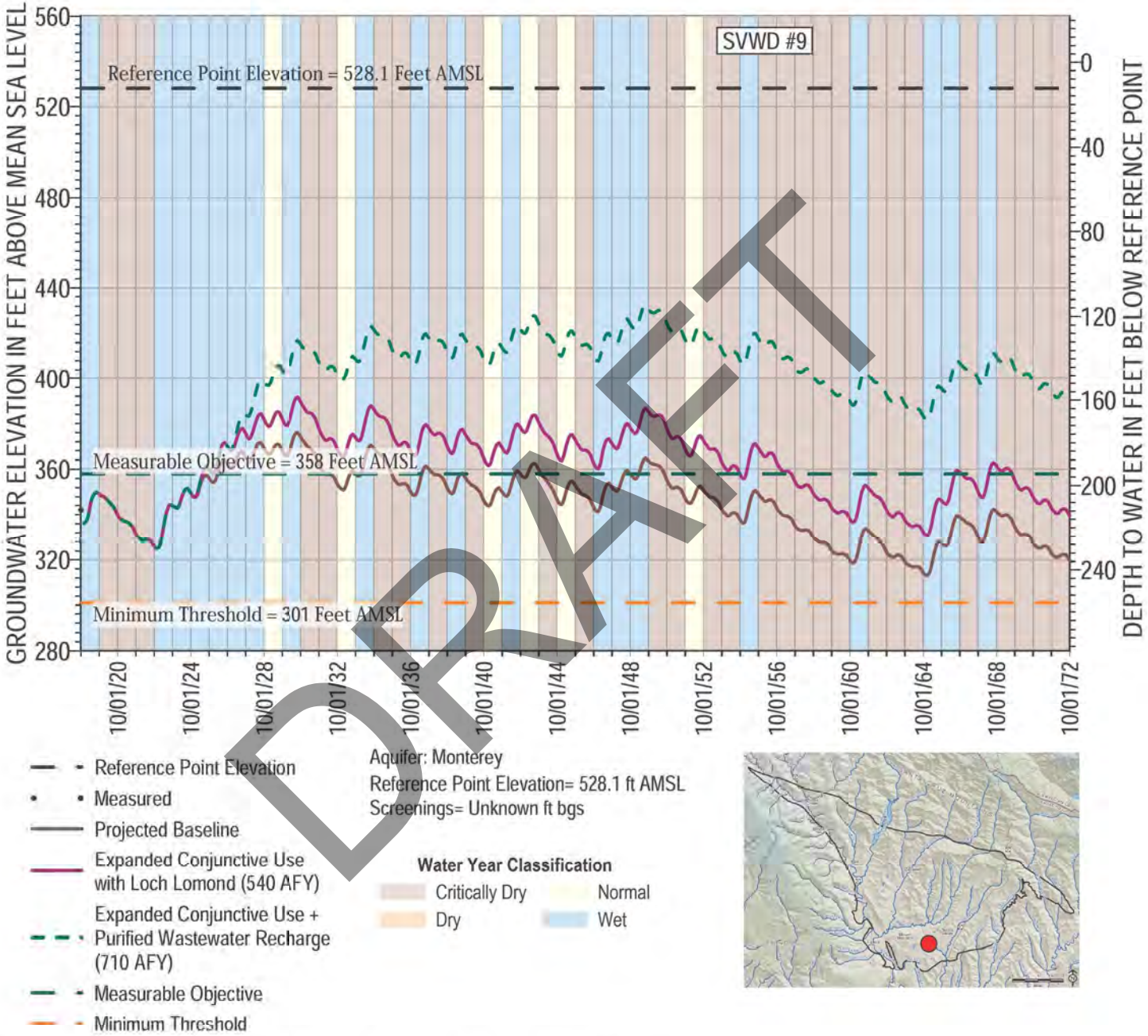
DRAFT

Projected Groundwater Level Target Hydrograph for SVWD 7



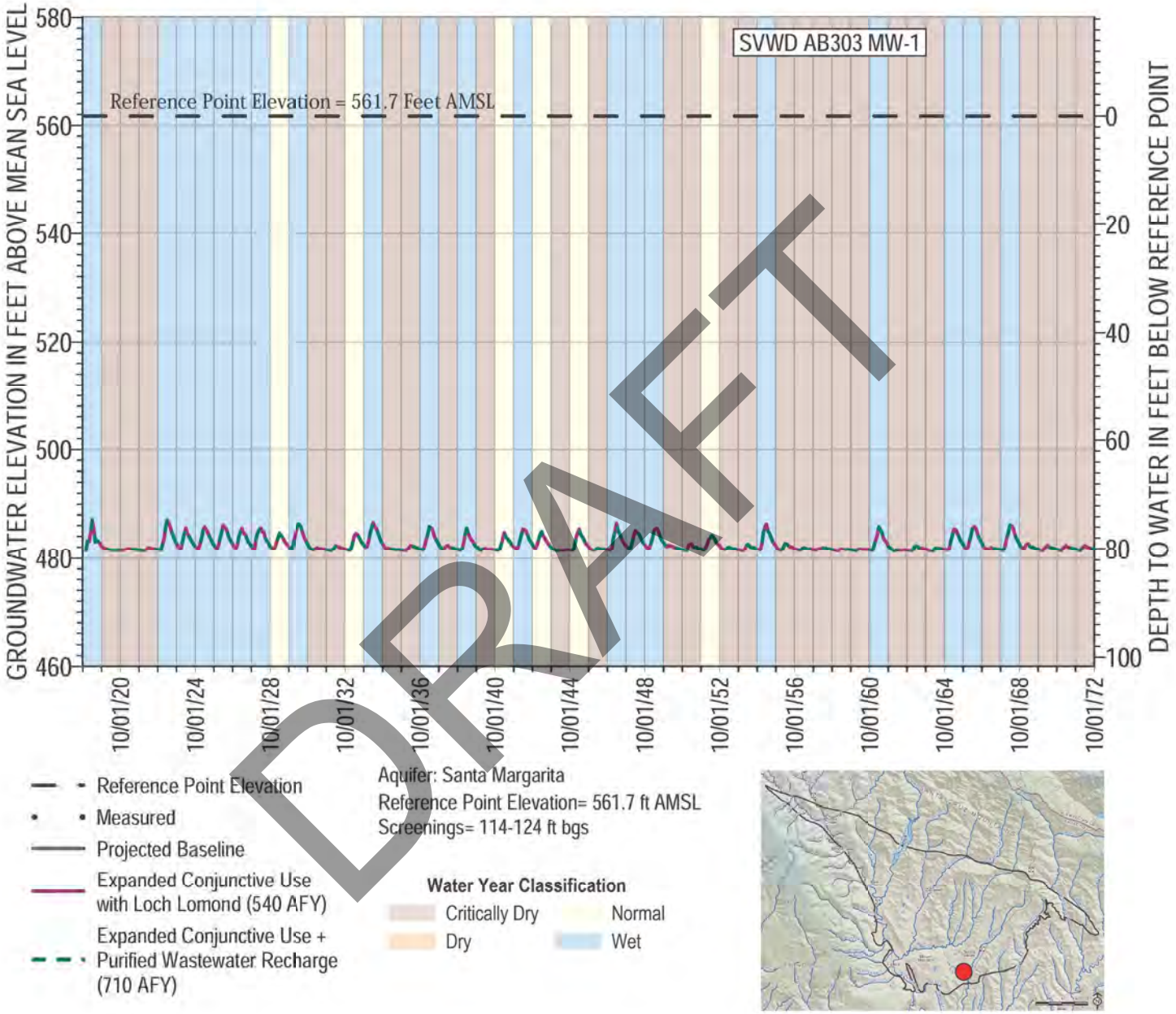
DRAFT

Projected Groundwater Level Target Hydrograph for SVWD 7A



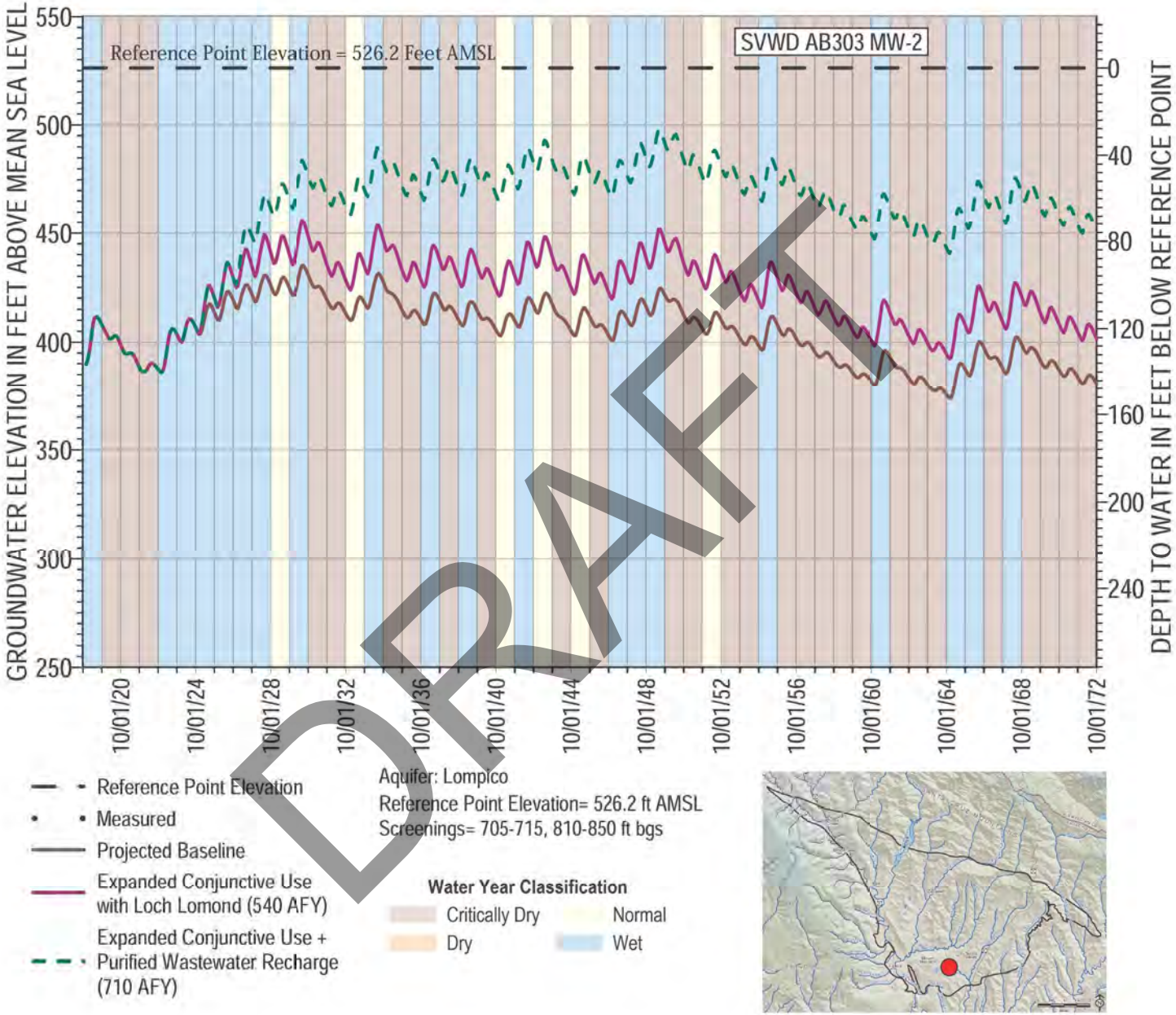
DRAFT

Projected Groundwater Level Target Hydrograph for SVWD #9



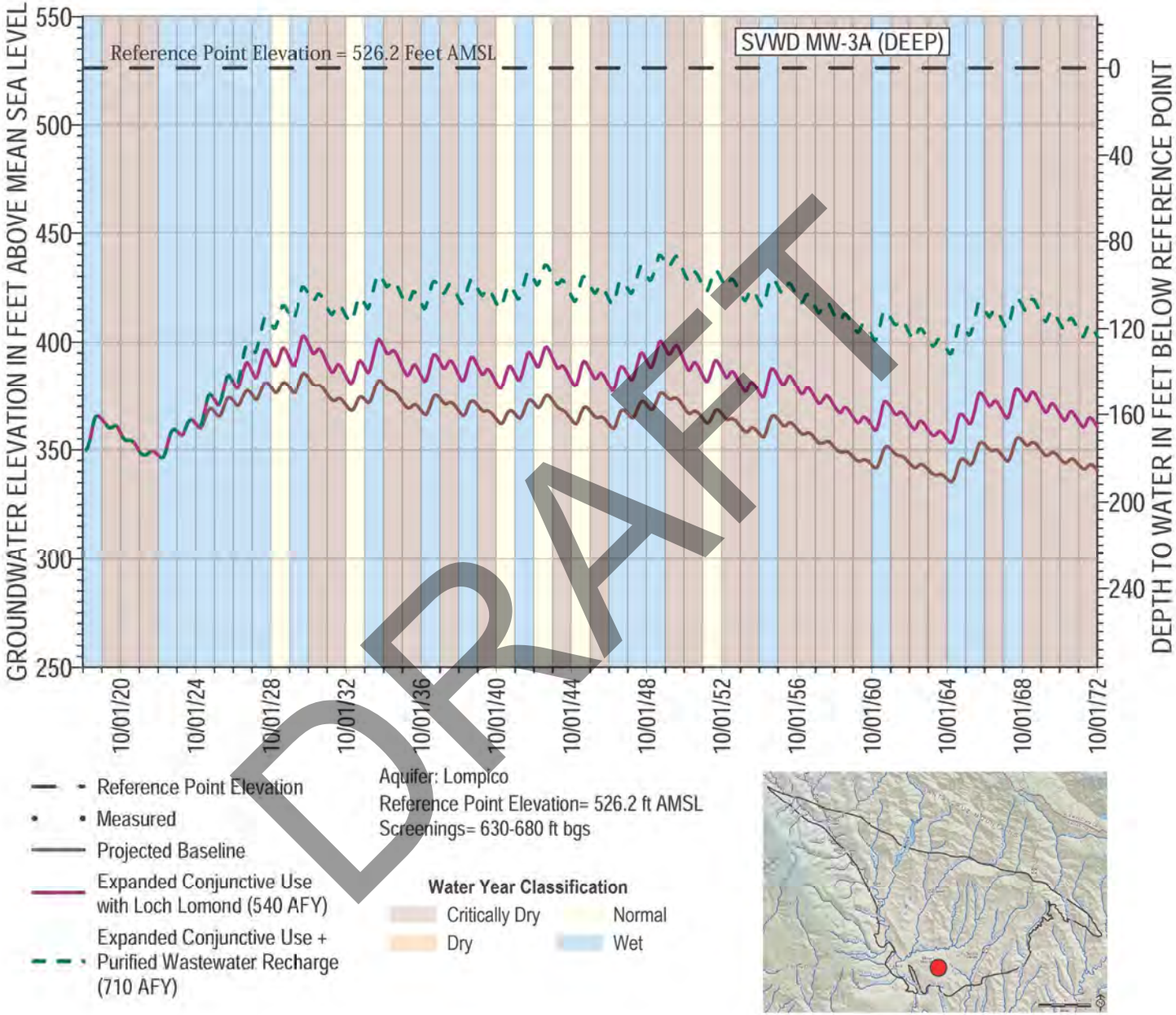
DRAFT

Projected Groundwater Level Target Hydrograph for SVWD AB303 MW-1



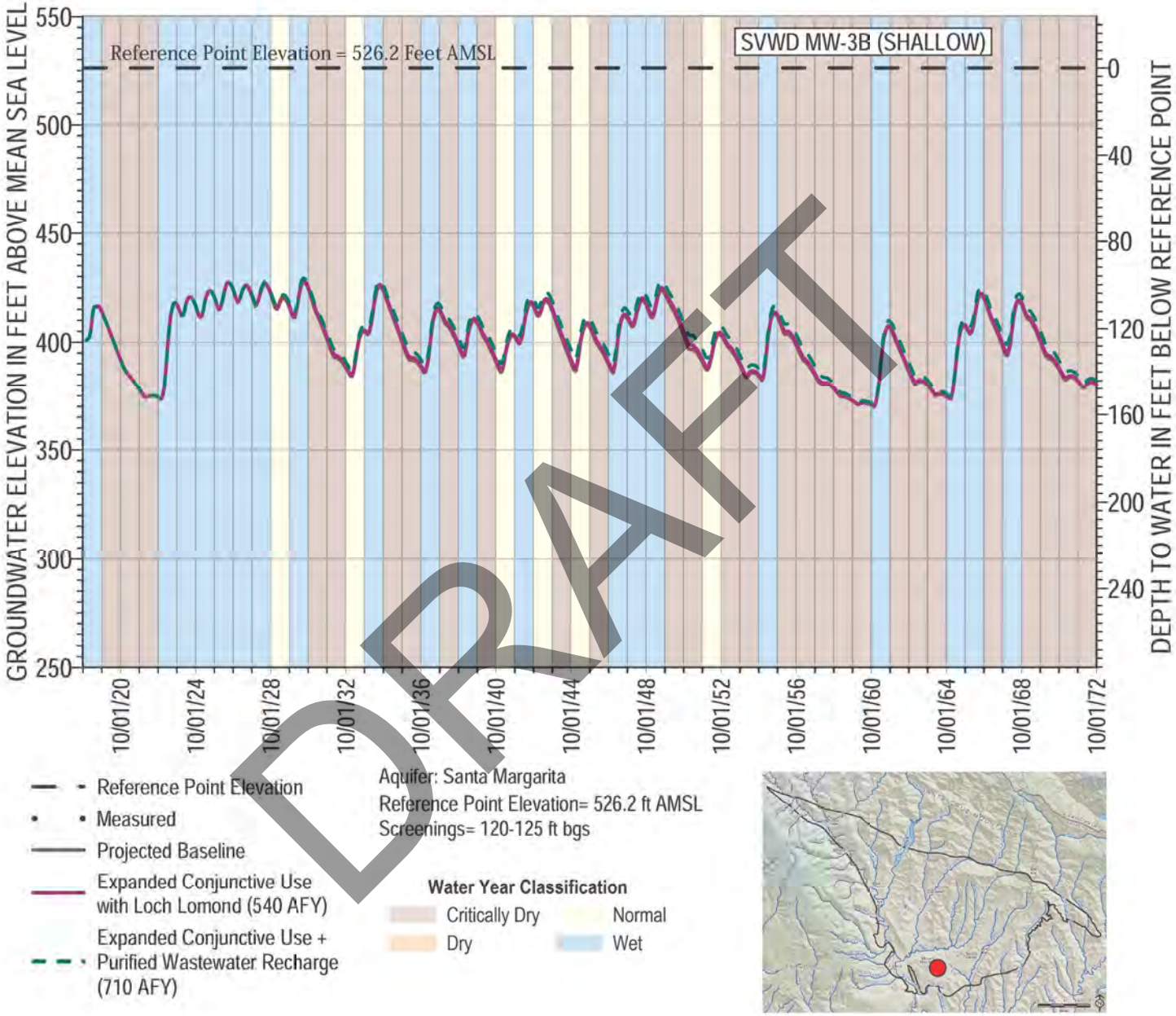
DRAFT

Projected Groundwater Level Target Hydrograph for SVWD AB303 MW-2



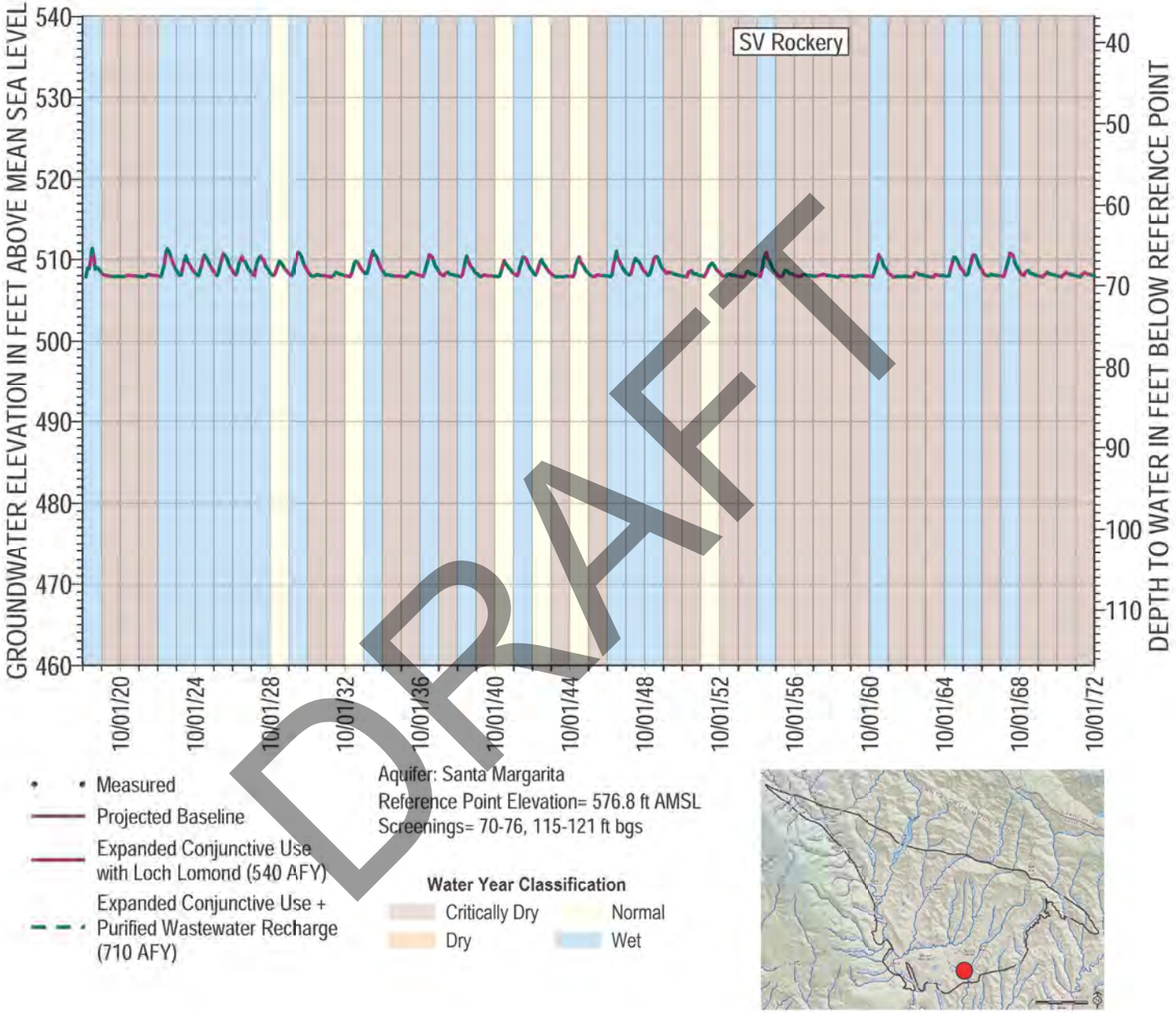
DRAFT

Projected Groundwater Level Target Hydrograph for SVWD MW-3A (DEEP)



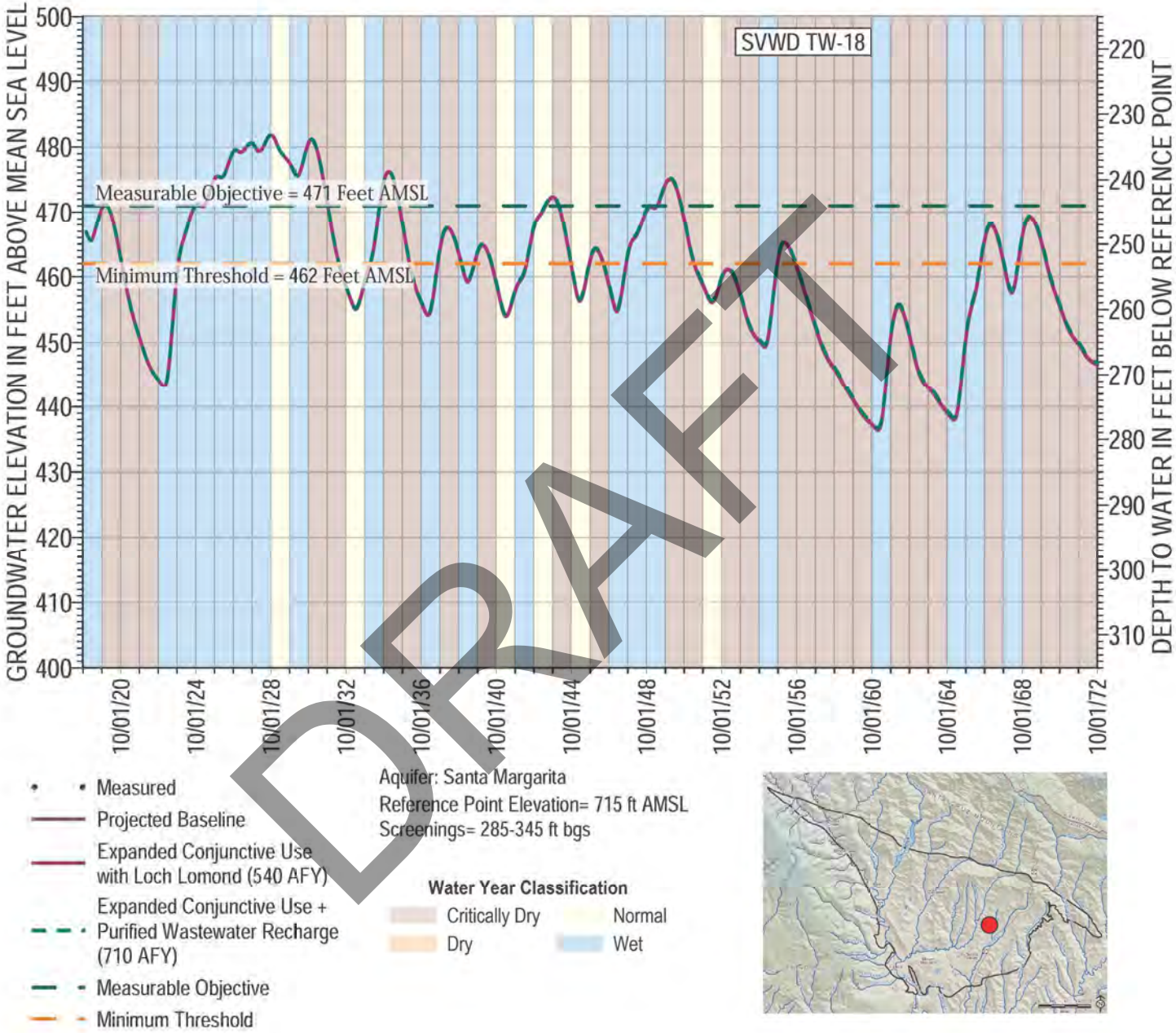
DRAFT

Projected Groundwater Level Target Hydrograph for SVWD MW-3B (SHALLOW)



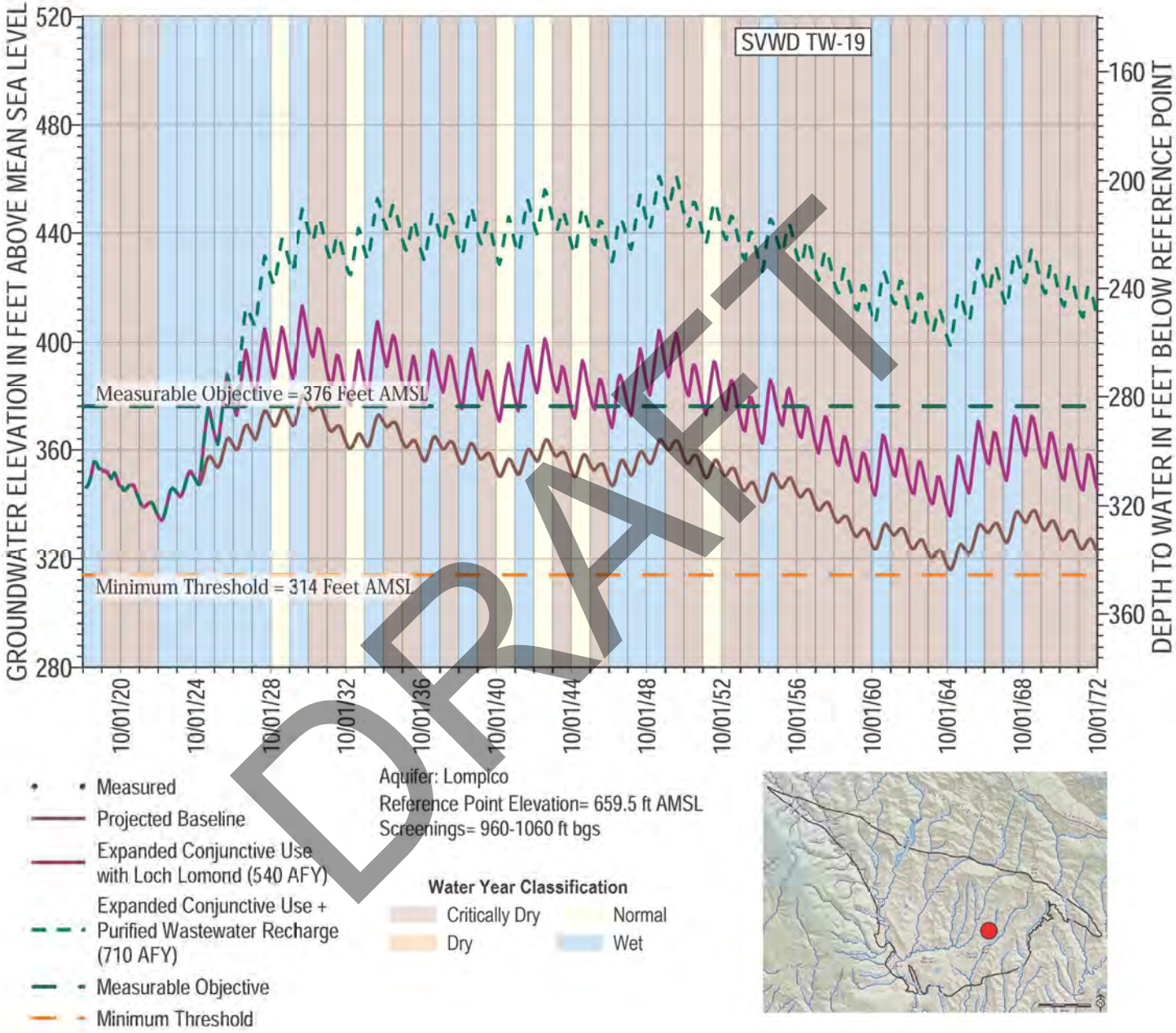
DRAFT

Projected Groundwater Level Target Hydrograph for SV Rockery



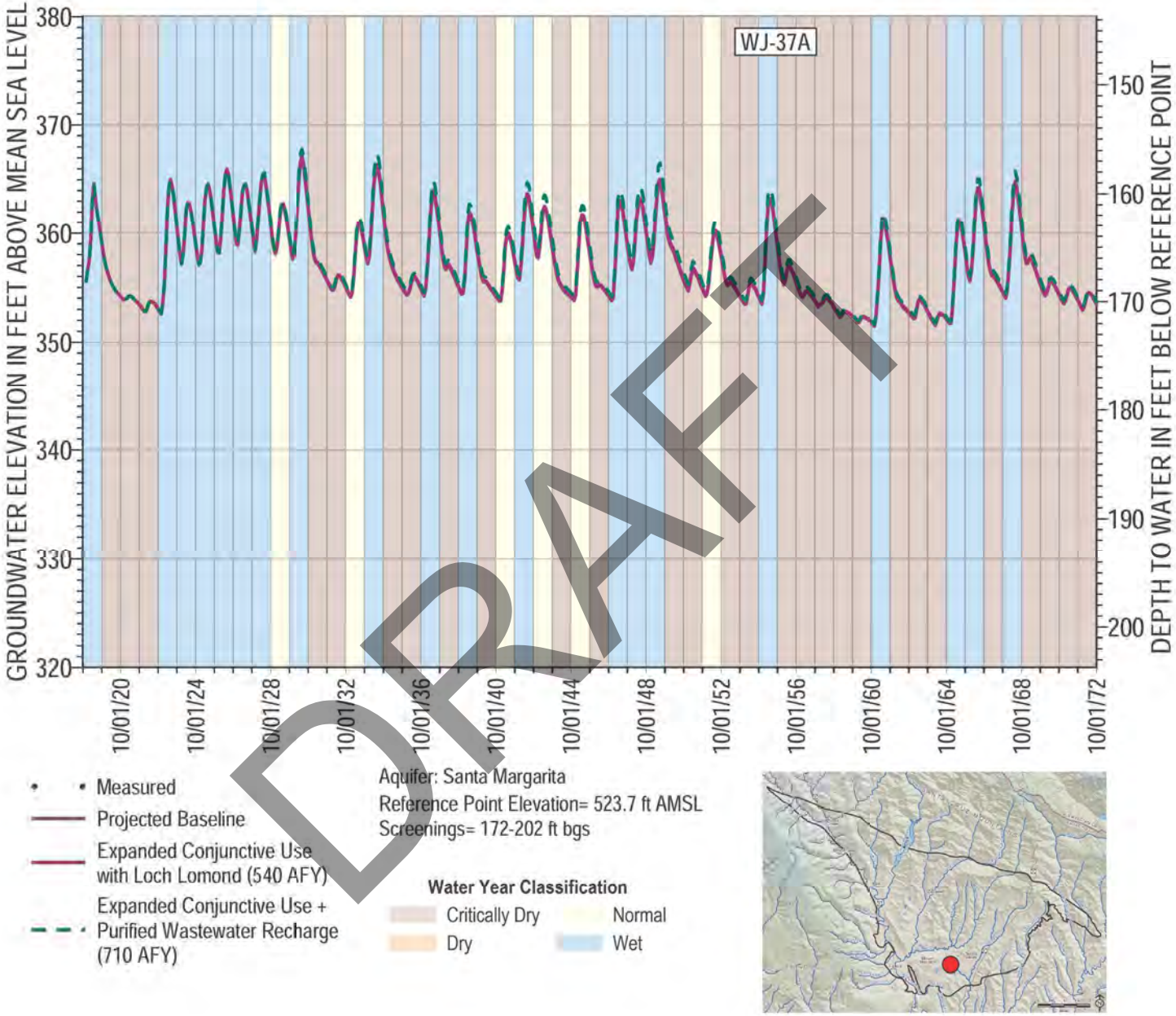
DRAFT

Projected Groundwater Level Target Hydrograph for SVWD TW-18



DRAFT

Projected Groundwater Level Target Hydrograph for SVWD TW-19



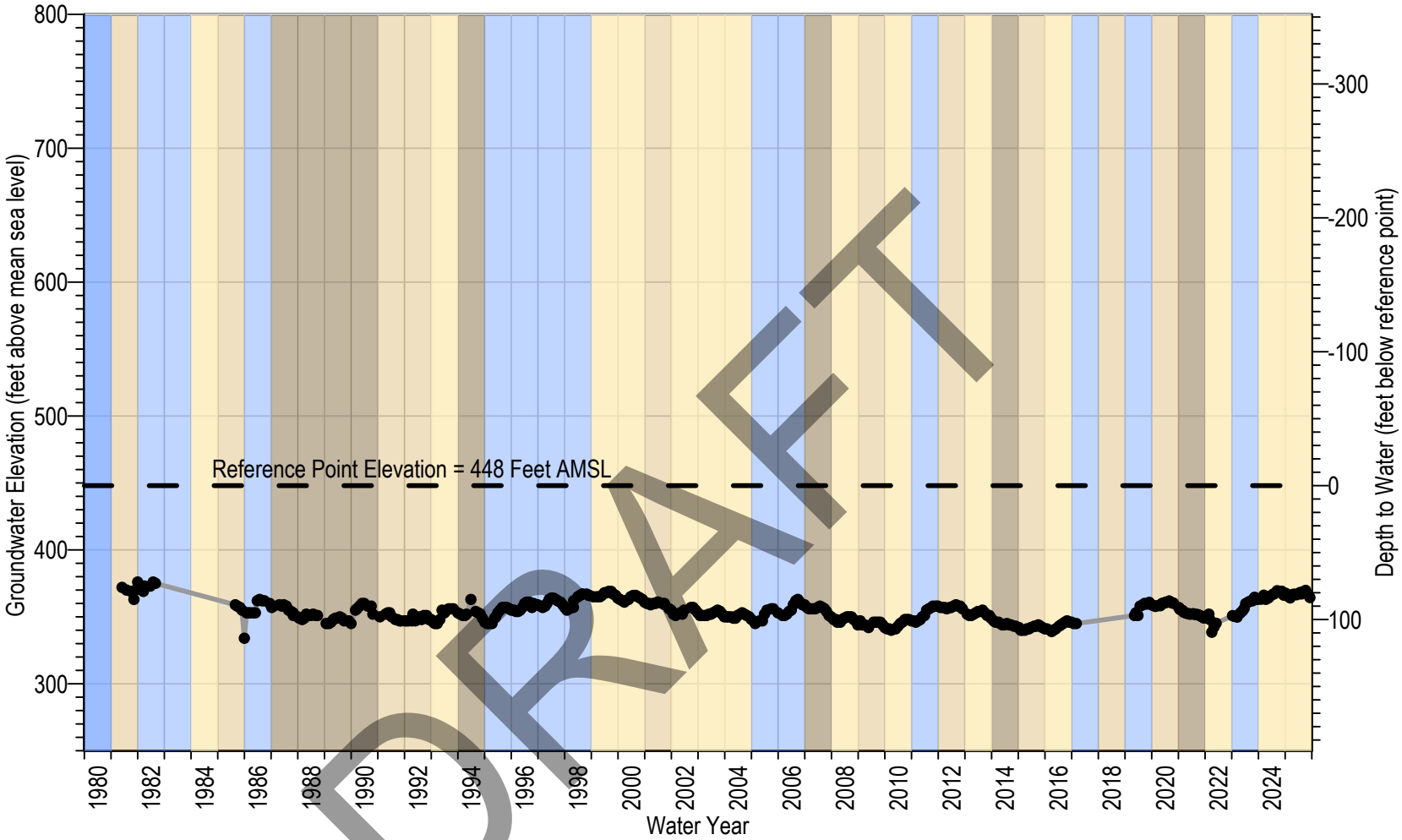
DRAFT

Projected Groundwater Level Target Hydrograph for WJ-37A

Appendix 4A

Well Hydrographs

DRAFT



SLVWD Olympia #1 (Ferrari)

Reference Point Elevation

Formation: Unconfined - Santa Margarita

Reference Point Elevation: 448 ft AMSL

Screen Interval: 131-159, 127-157 ft bgs

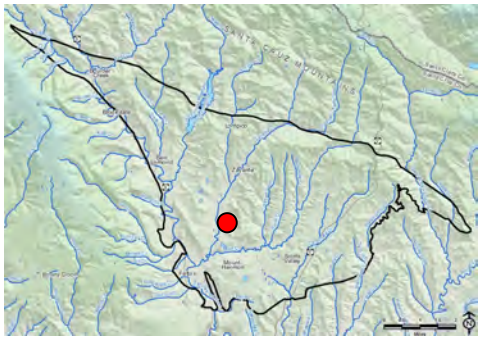
Water Year Classification

Wet

Dry

Normal

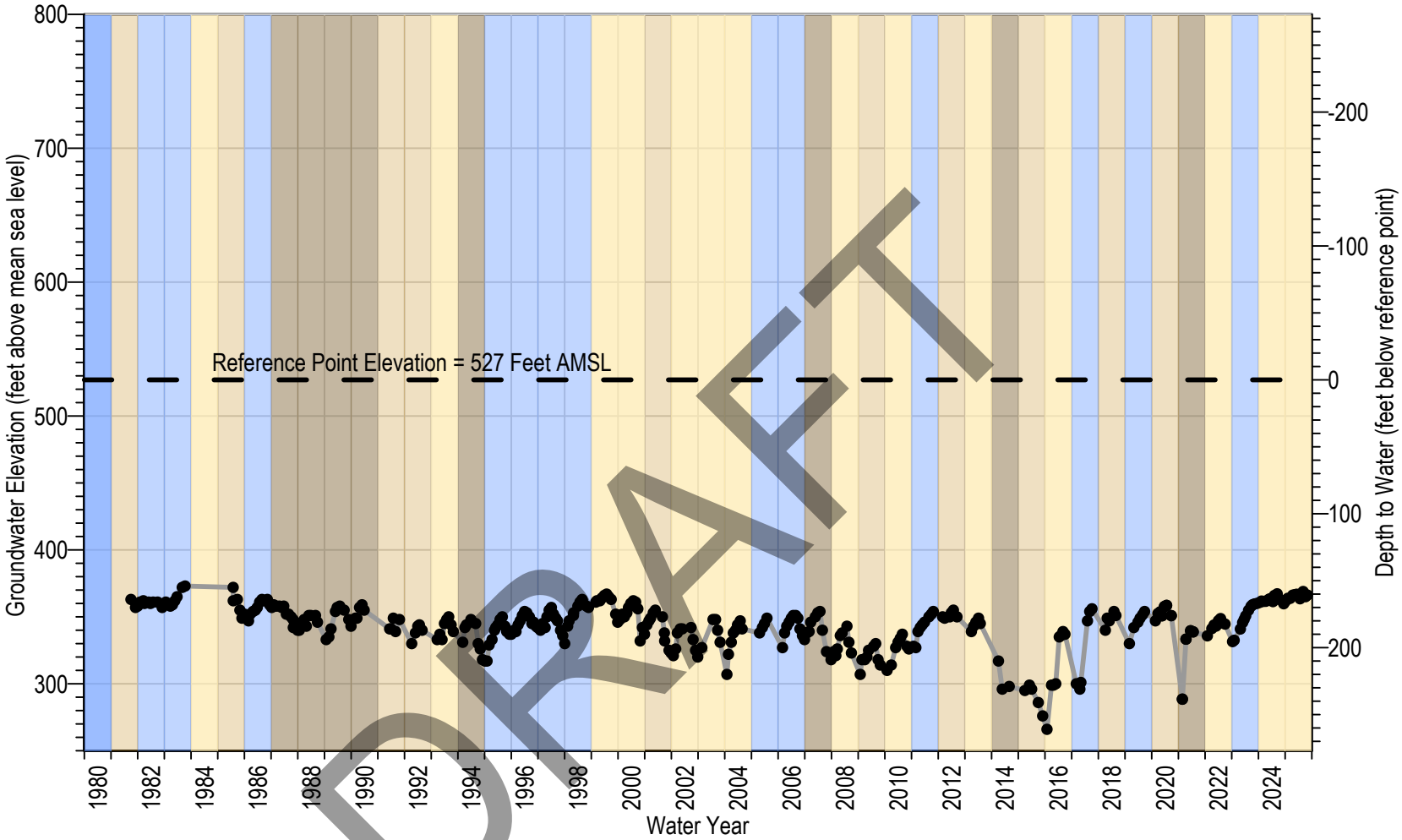
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-1. Hydrograph of SLVWD Olympia #1 (Ferrari)

MONTGOMERY & ASSOCIATES



SLVWD Olympia #2

Reference Point Elevation

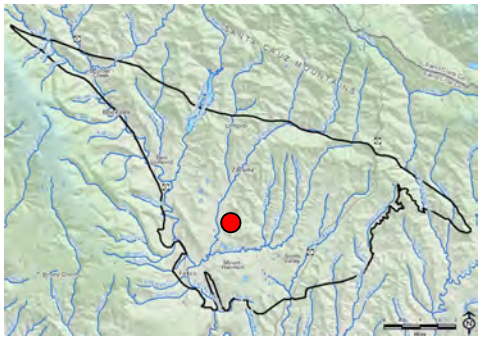
Formation: Unconfined - Santa Margarita

Reference Point Elevation: 527 ft AMSL

Screen Interval: 225-245, 275-298 ft bgs

Water Year Classification

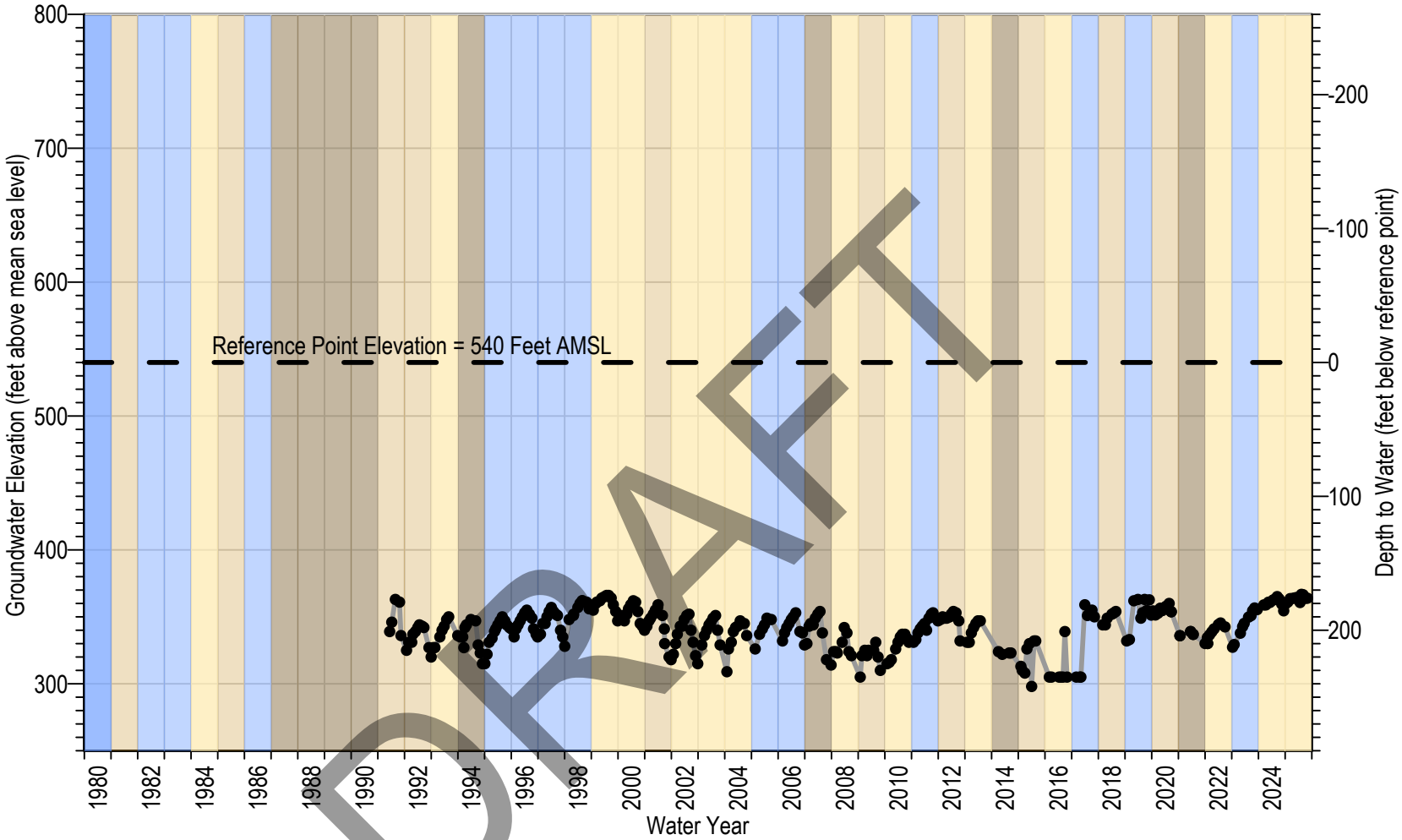
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-2. Hydrograph of SLVWD Olympia #2

MONTGOMERY & ASSOCIATES



DRAFT

SLVWD Olympia #3

Reference Point Elevation

Formation: Unconfined - Santa Margarita

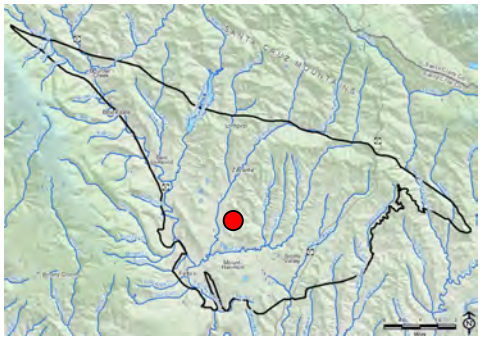
Reference Point Elevation: 540 ft AMSL

Screen Interval: 230-308 ft bgs

Water Year Classification

Wet | Dry

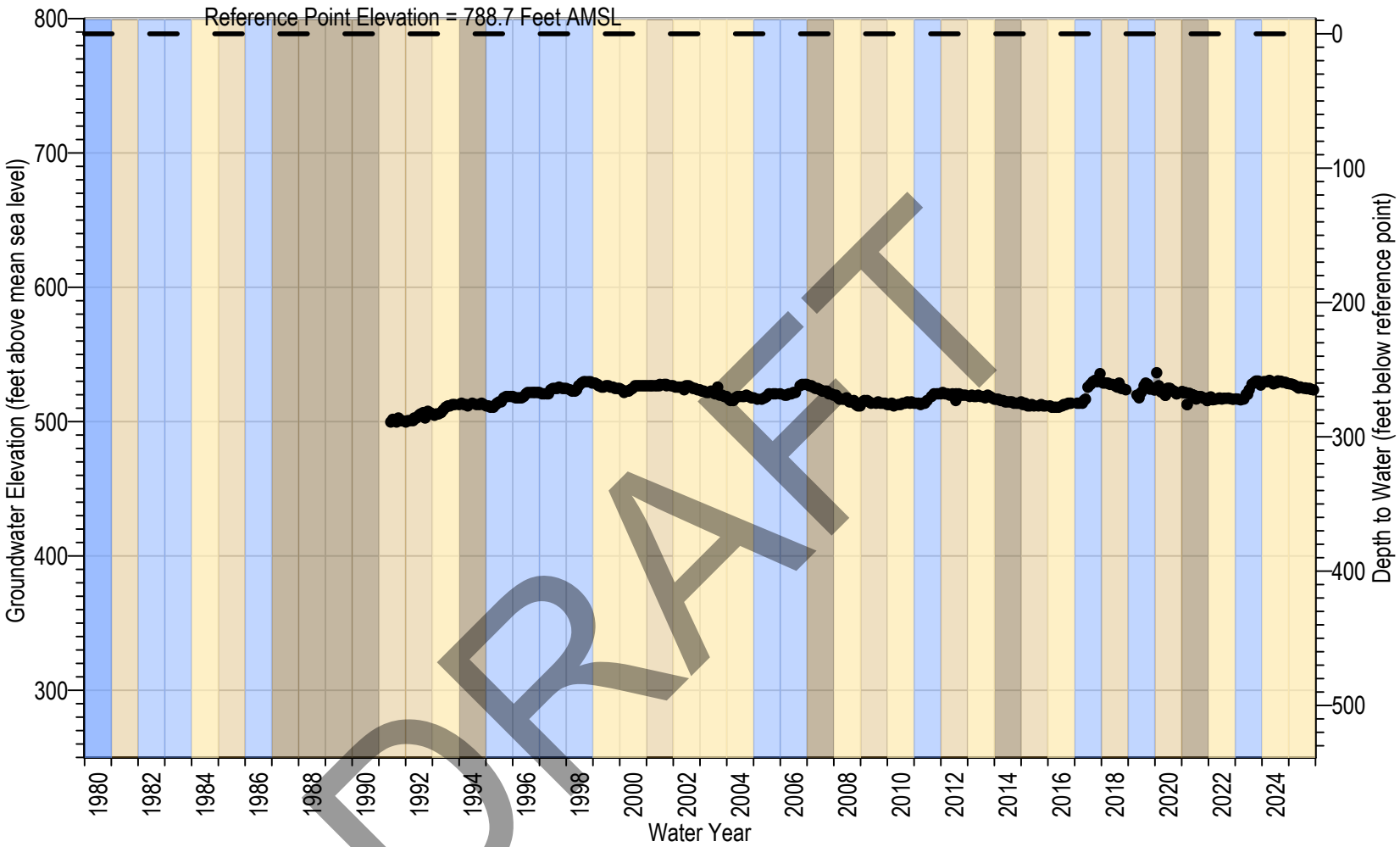
Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-3. Hydrograph of SLVWD Olympia #3

MONTGOMERY & ASSOCIATES



SLVWD Pasatiempo MW-2

Reference Point Elevation

Formation: Unconfined - Santa Margarita

Reference Point Elevation: 788.7 ft AMSL

Screen Interval: 280-340 ft bgs

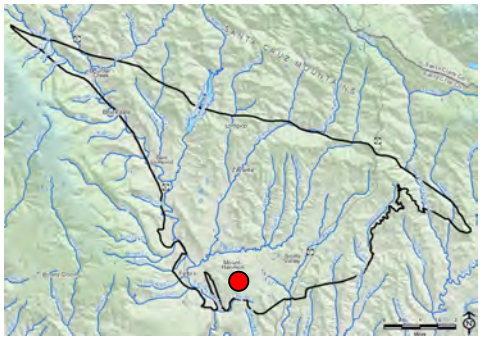
Water Year Classification

Wet

Dry

Normal

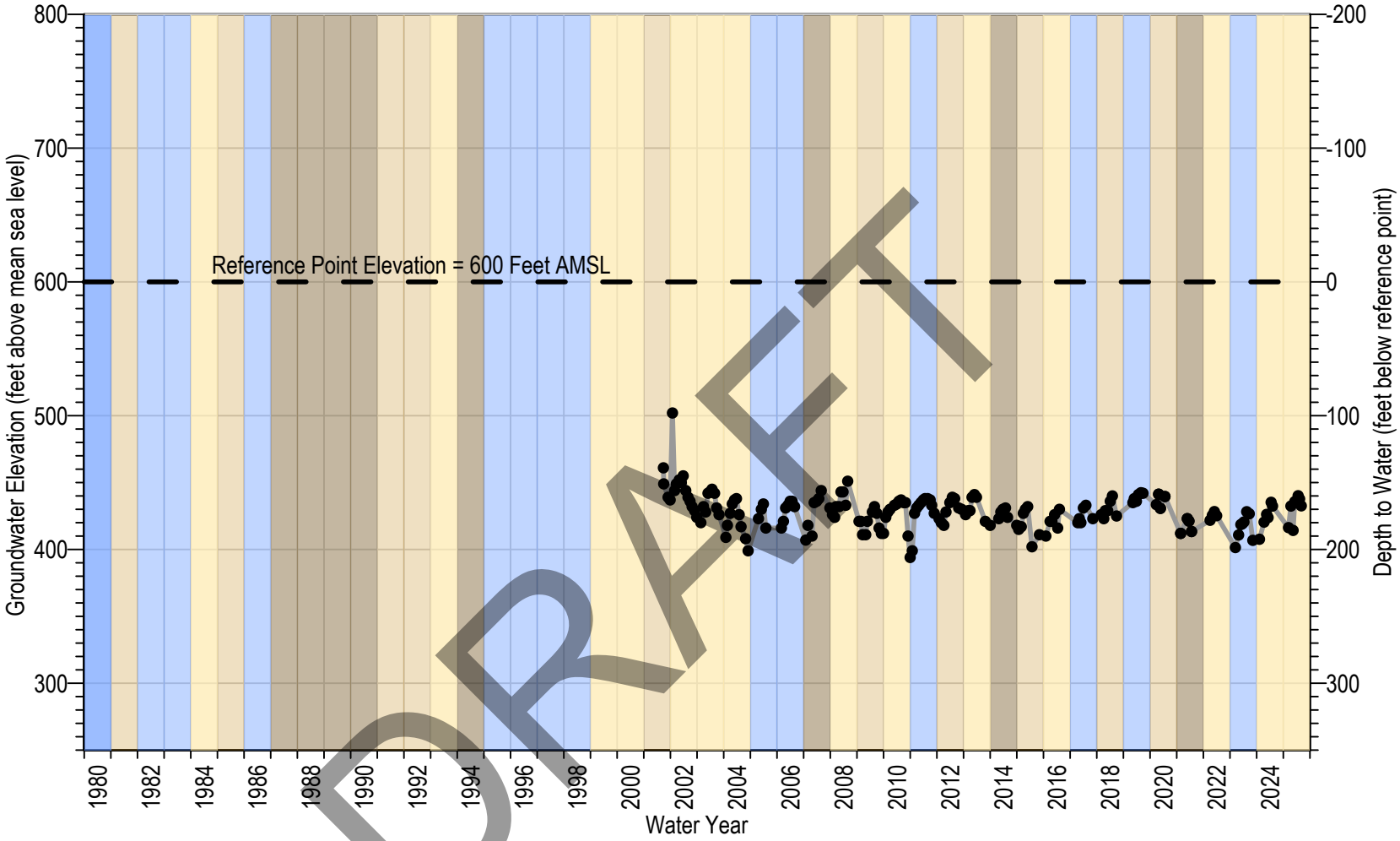
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-4. Hydrograph of SLVWD Pasatiempo MW-2

MONTGOMERY & ASSOCIATES



DRAFT

SLVWD Quail #4A

Reference Point Elevation

Formation: Unconfined - Santa Margarita

Reference Point Elevation: 600 ft AMSL

Screen Interval: 180-250 ft bgs

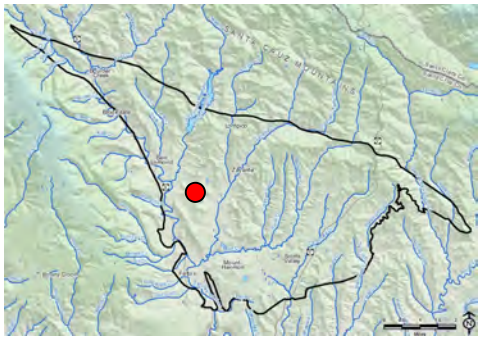
Water Year Classification

Wet

Dry

Normal

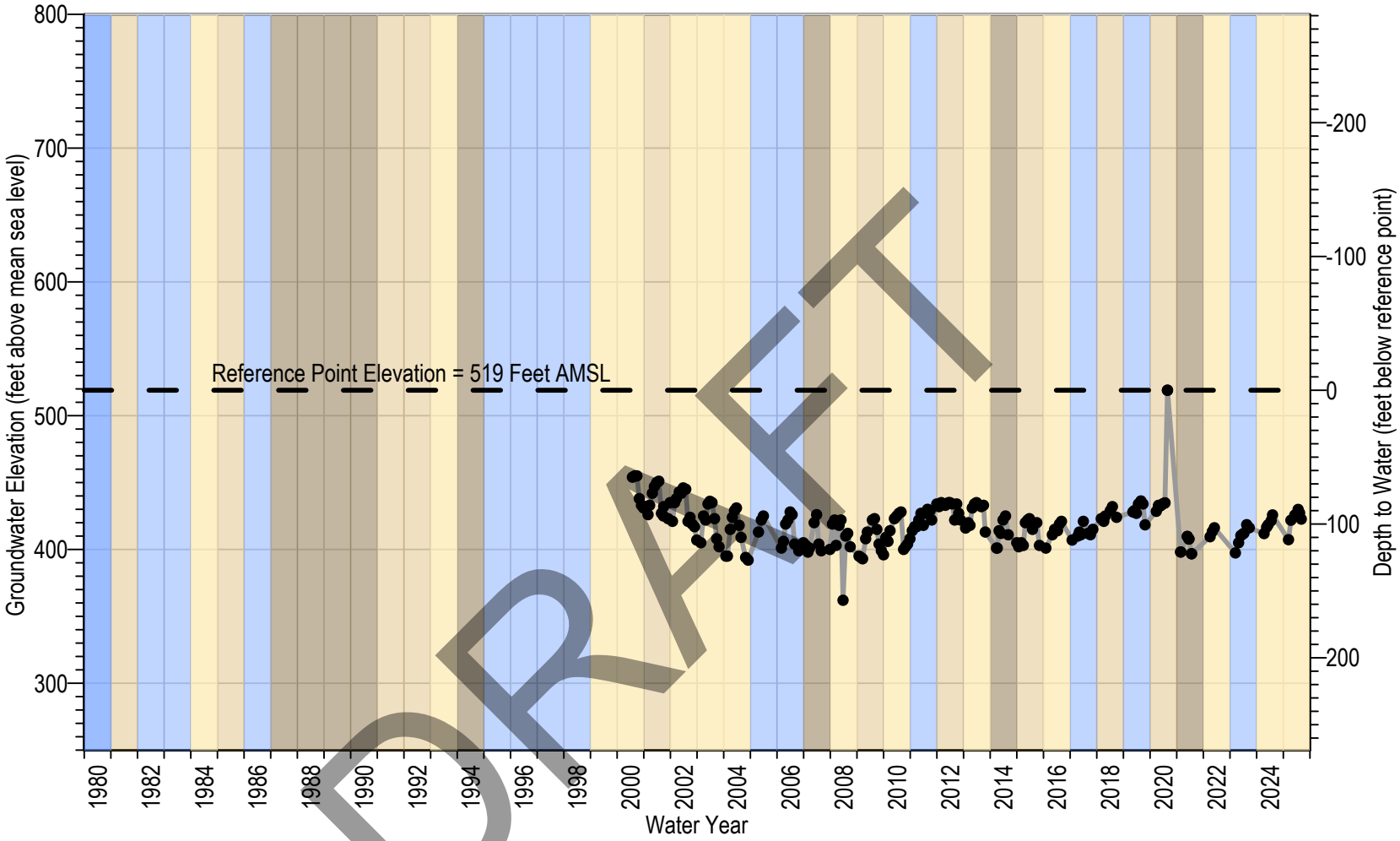
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-5. Hydrograph of SLVWD Quail #4A

MONTGOMERY & ASSOCIATES



SLVWD Quail #5A

Reference Point Elevation

Formation: Unconfined - Santa Margarita

Reference Point Elevation: 519 ft AMSL

Screen Interval: 124-164 ft bgs

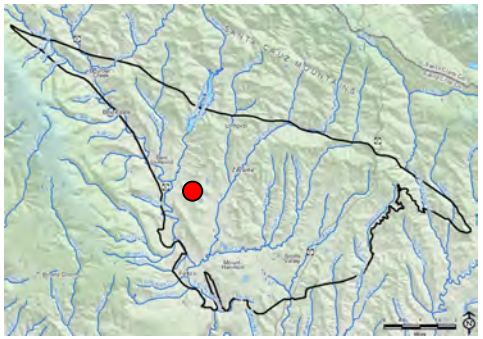
Water Year Classification

Wet

Dry

Normal

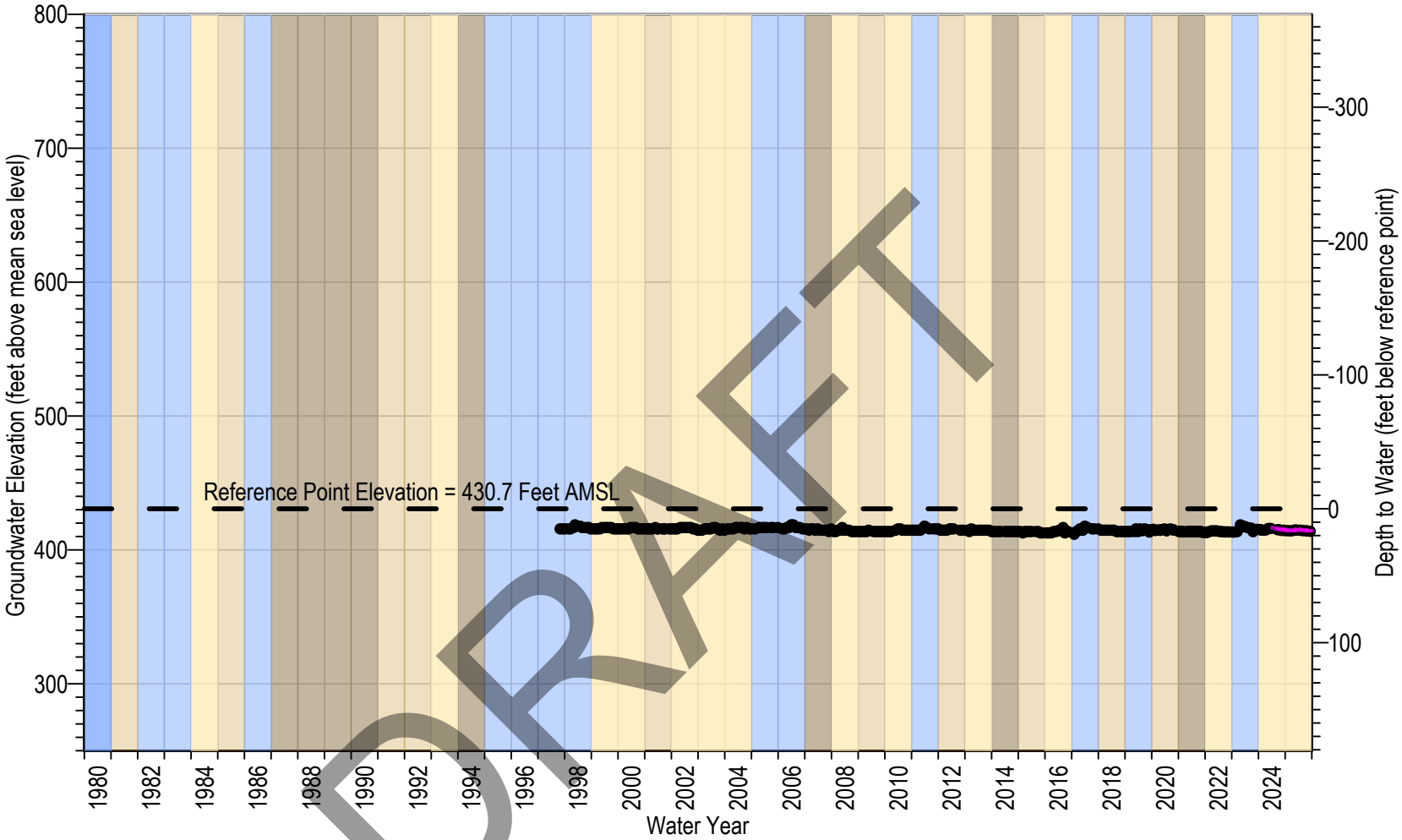
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-6. Hydrograph of SLVWD Quail #5A

MONTGOMERY & ASSOCIATES



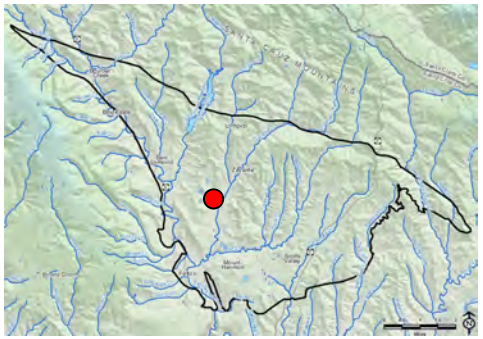
DRAFT

SLVWD Quail MW-A
Transducer
Reference Point Elevation

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 430.7 ft AMSL
Screen Interval: 38-88 ft bgs

Water Year Classification

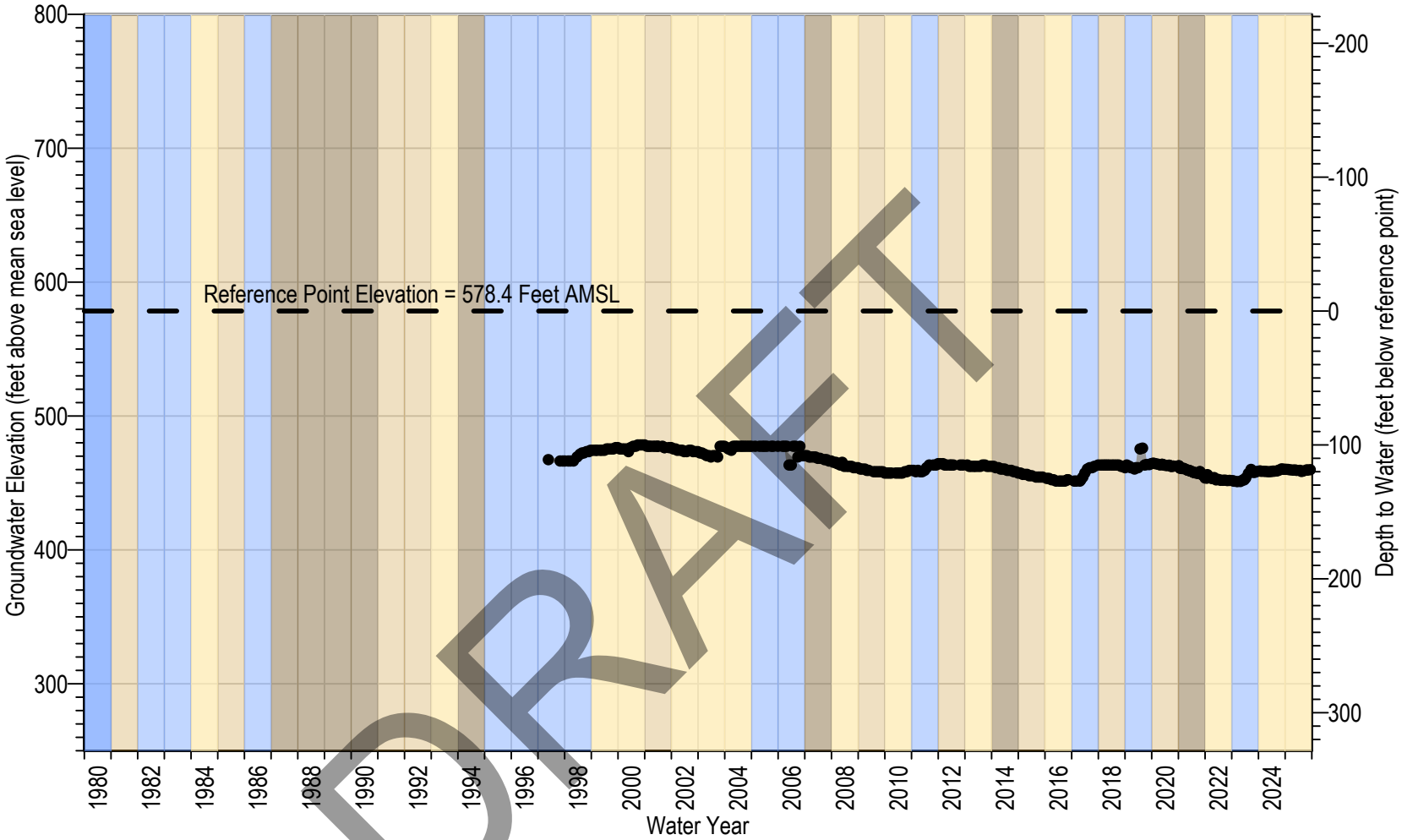
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-7. Hydrograph of SLVWD Quail MW-A

MONTGOMERY & ASSOCIATES



SLVWD Quail MW-B

Reference Point Elevation

Formation: Unconfined - Santa Margarita

Reference Point Elevation: 578.4 ft AMSL

Screen Interval: 95-195 ft bgs

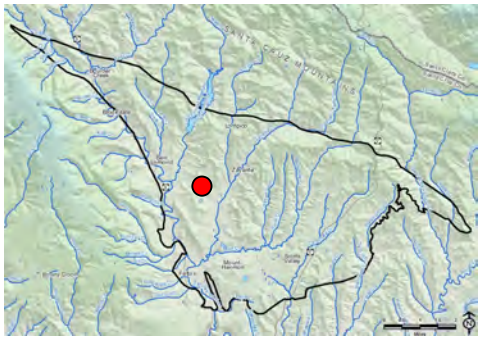
Water Year Classification

Wet

Dry

Normal

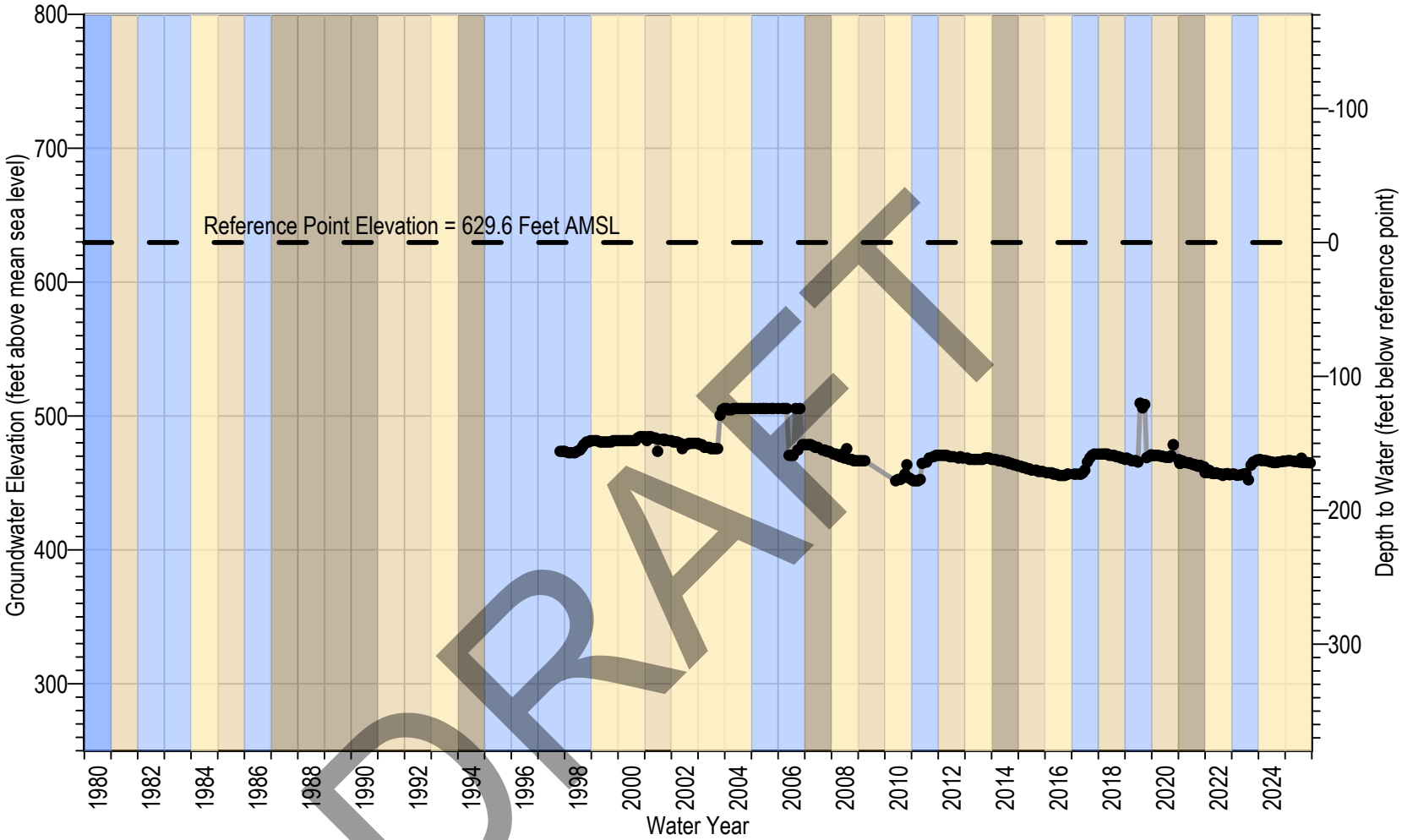
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-8. Hydrograph of SLVWD Quail MW-B

MONTGOMERY & ASSOCIATES



DRAFT

SLVWD Quail MW-C

Reference Point Elevation

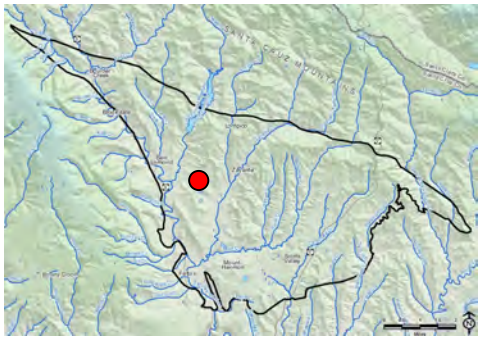
Formation: Unconfined - Santa Margarita

Reference Point Elevation: 629.6 ft AMSL

Screen Interval: 120-220 ft bgs

Water Year Classification

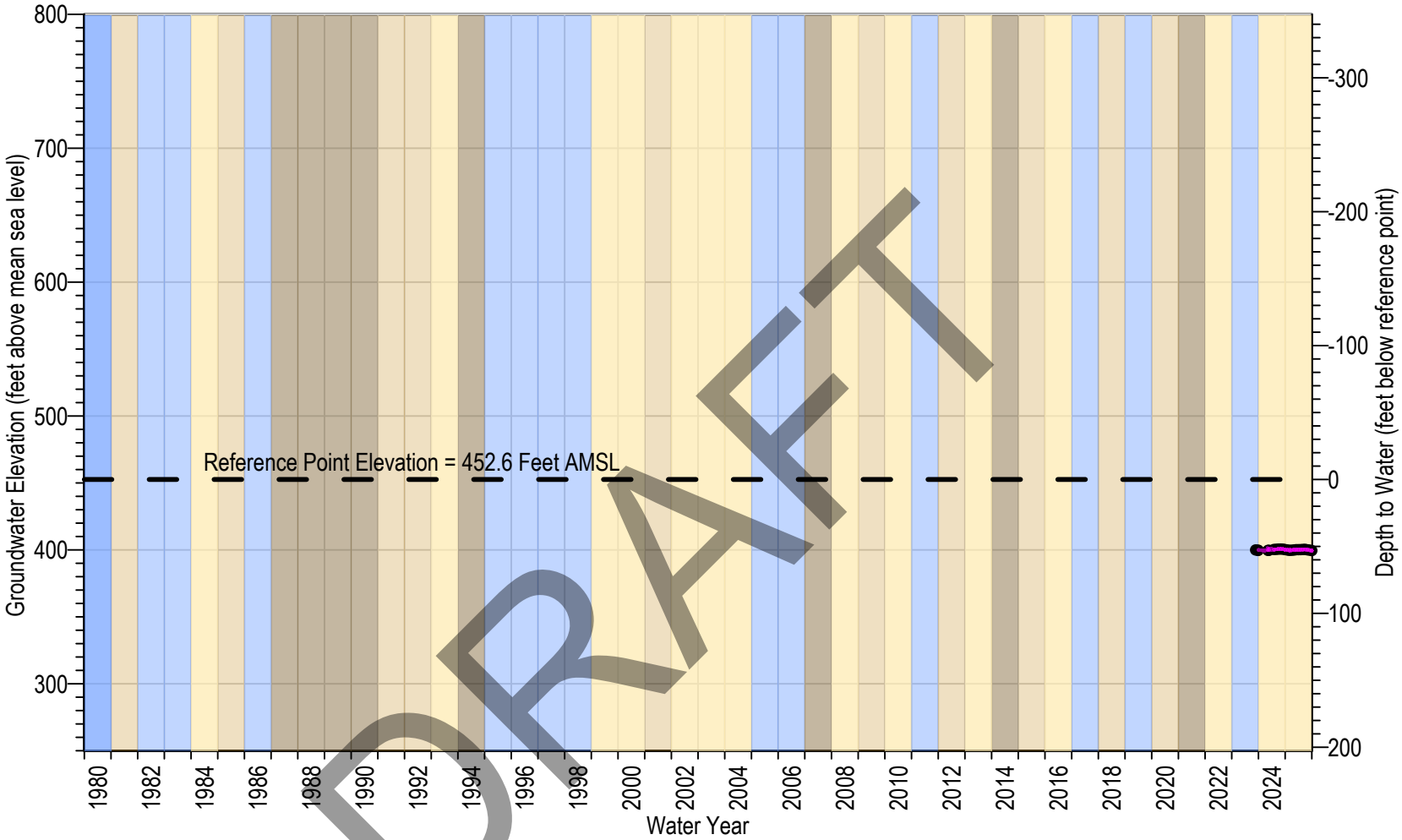
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-9. Hydrograph of SLVWD Quail MW-C

MONTGOMERY & ASSOCIATES



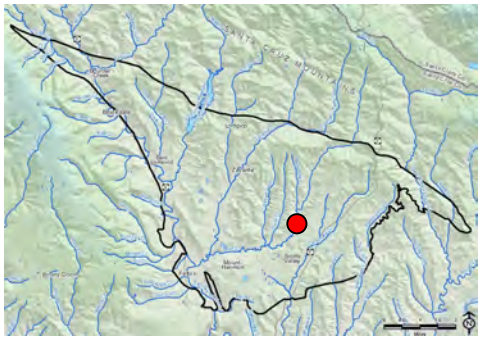
DRAFT

SMGWA-2 Bean Creek
Transducer
Reference Point Elevation

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 452.6 ft AMSL
Screen Interval: 53-68 ft bgs

Water Year Classification

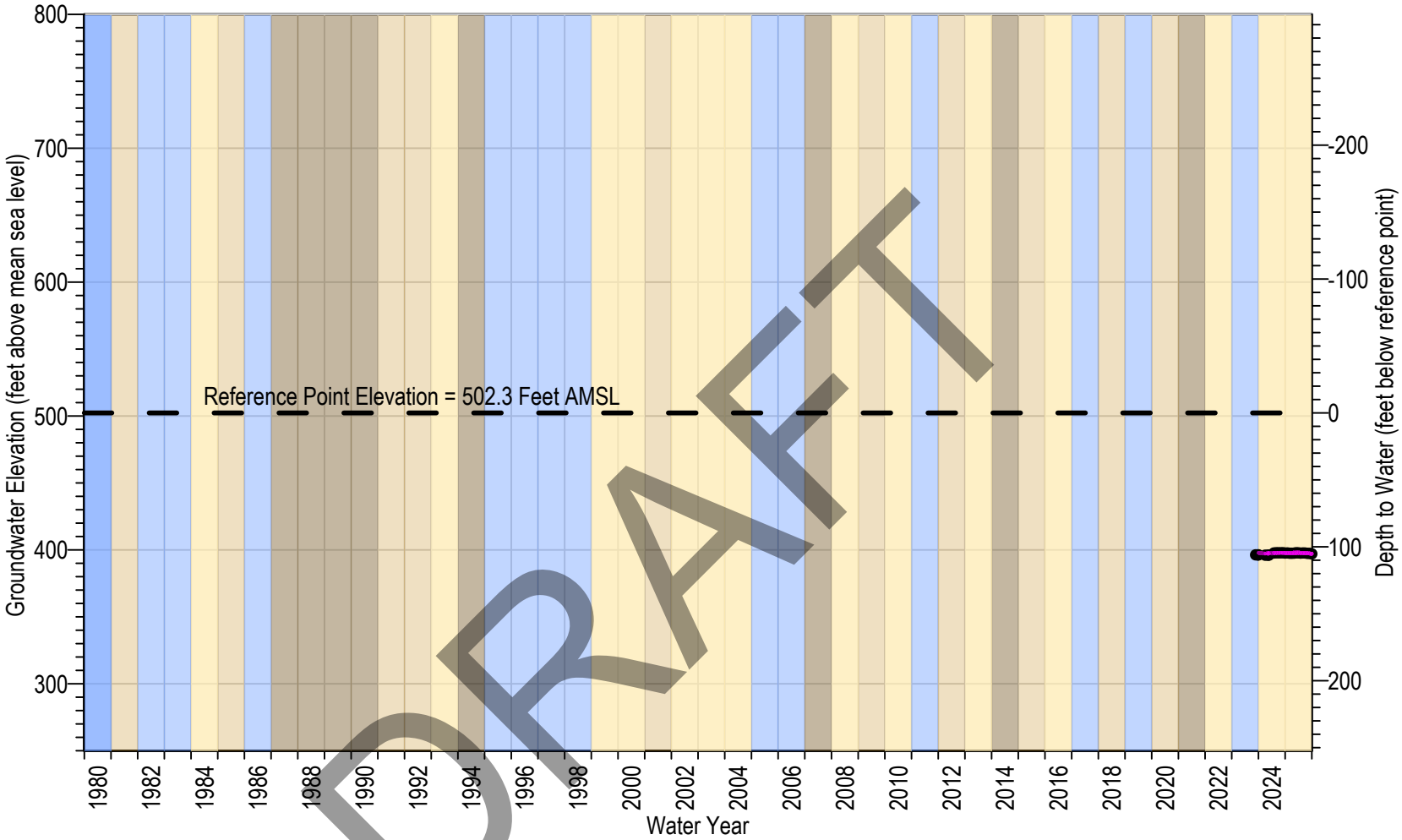
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-10. Hydrograph of SMGWA-2 Bean Creek

MONTGOMERY & ASSOCIATES



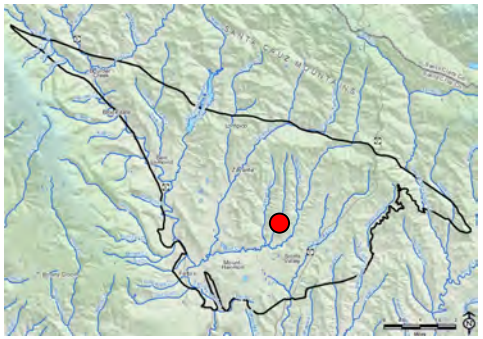
DRAFT

SMGWA-3 Ruins Creek
Transducer
Reference Point Elevation

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 502.3 ft AMSL
Screen Interval: 145-160 ft bgs

Water Year Classification

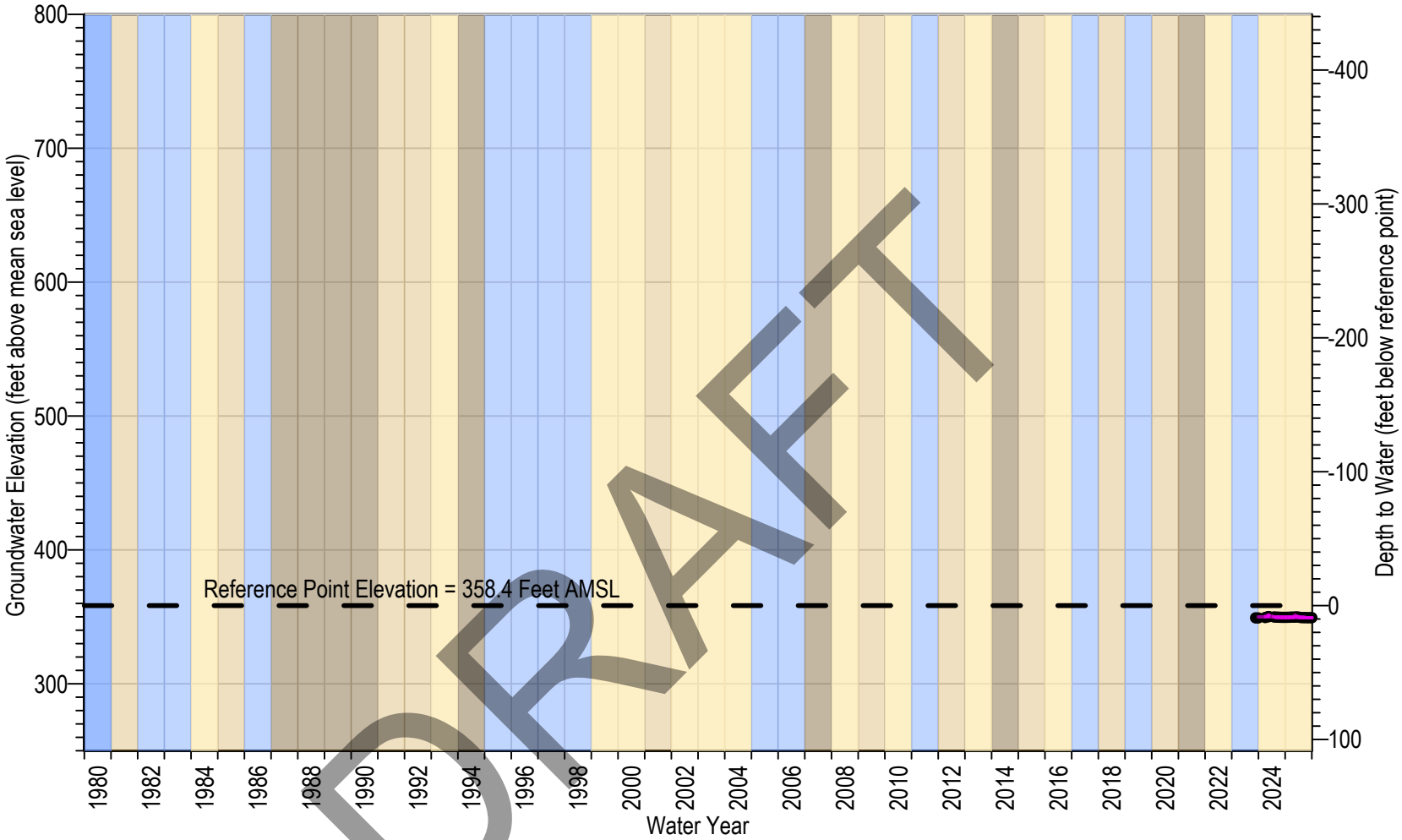
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-11. Hydrograph of SMGWA-3 Ruins Creek

MONTGOMERY & ASSOCIATES



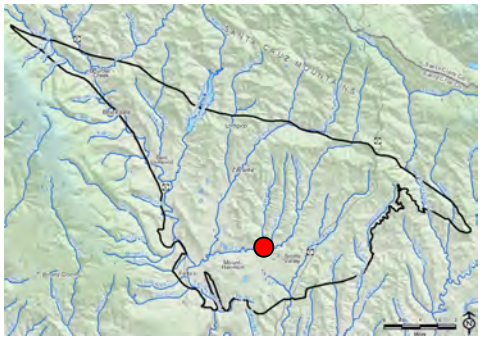
DRAFT

SMGWA-4 Nelson Road
Transducer
Reference Point Elevation

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 358.4 ft AMSL
Screen Interval: 54-69 ft bgs

Water Year Classification

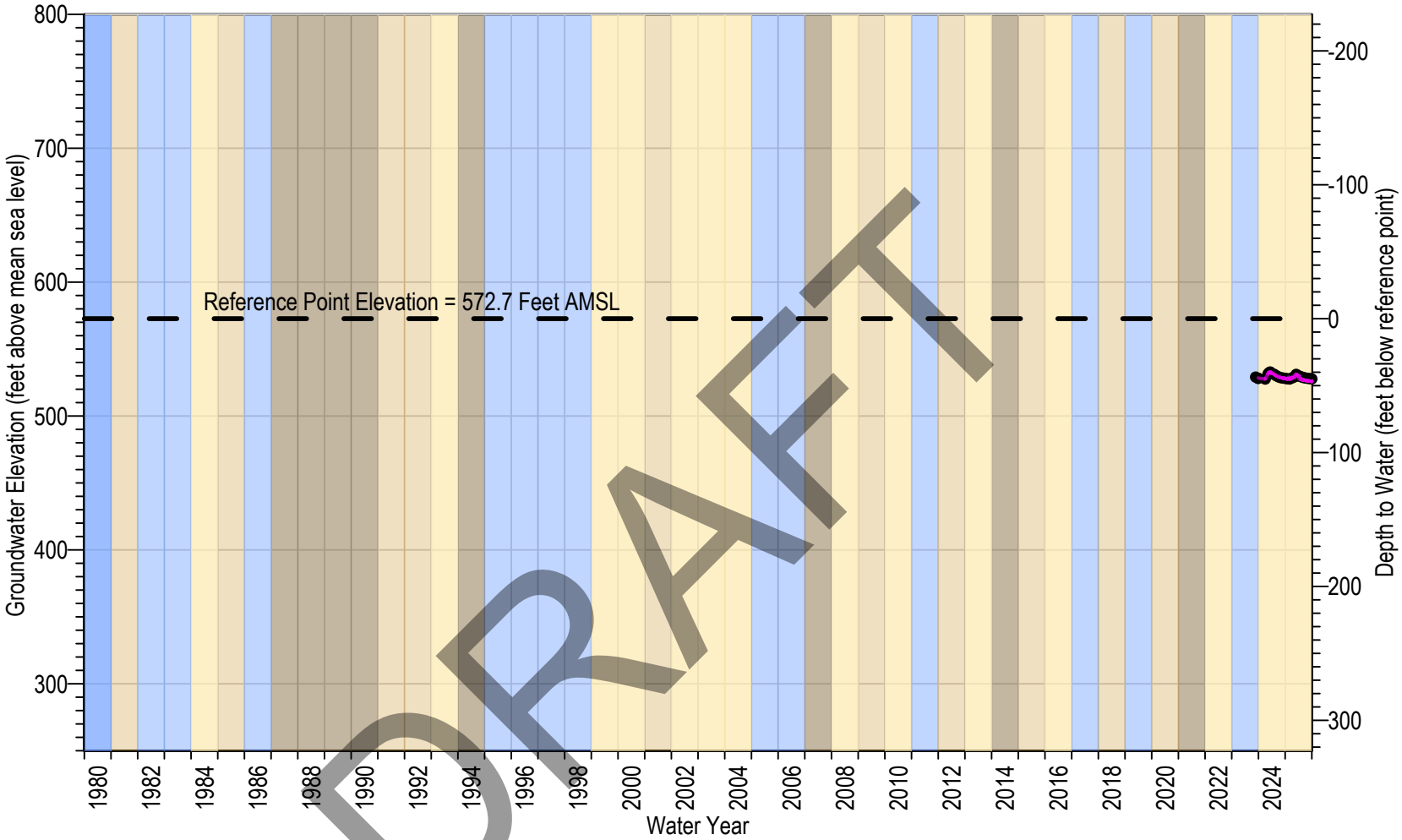
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-12. Hydrograph of SMGWA-4 Nelson Road

MONTGOMERY & ASSOCIATES



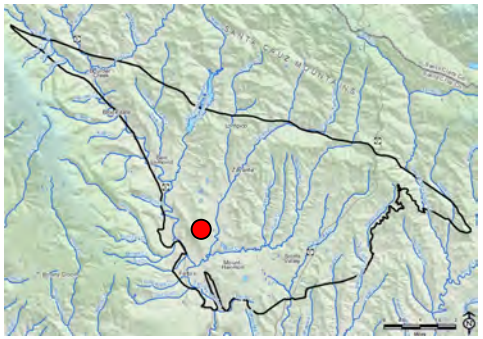
DRAFT

SMGWA-5 Bahr Drive
Transducer
Reference Point Elevation

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 572.7 ft AMSL
Screen Interval: 40-55 ft bgs

Water Year Classification

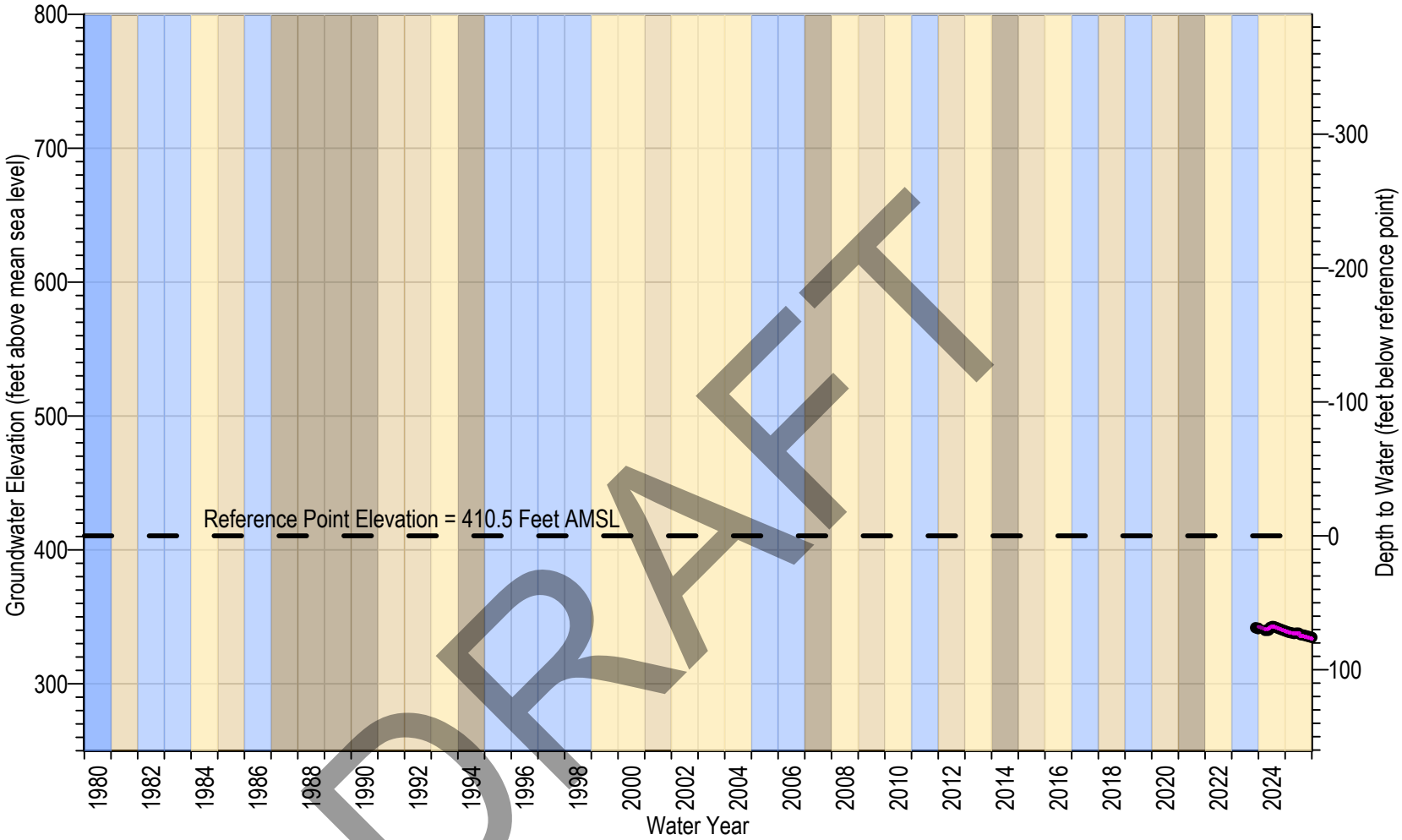
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-13. Hydrograph of SMGWA-5 Bahr Drive

MONTGOMERY & ASSOCIATES



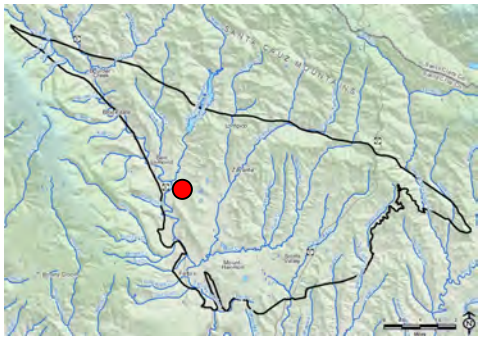
DRAFT

SMGWA-6 Quail Hollow
Transducer
Reference Point Elevation

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 410.5 ft AMSL
Screen Interval: 115-130 ft bgs

Water Year Classification

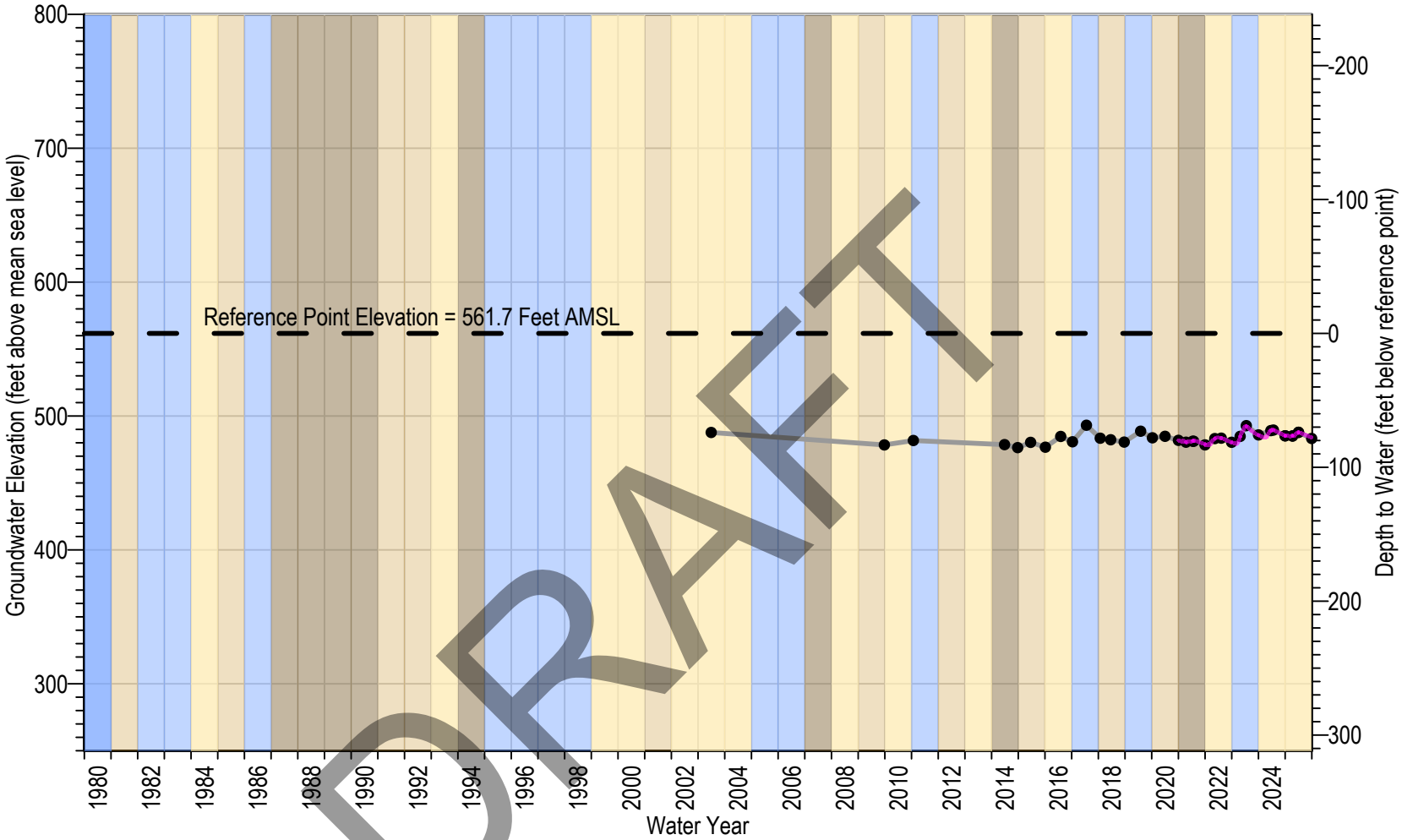
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-14. Hydrograph of SMGWA-6 Quail Hollow

MONTGOMERY & ASSOCIATES



SVWD AB303 MW-1

Transducer

Reference Point Elevation

Formation: Unconfined - Santa Margarita

Reference Point Elevation: 561.7 ft AMSL

Screen Interval: 114-124 ft bgs

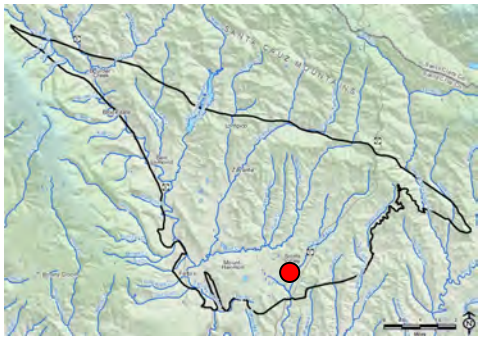
Water Year Classification

Wet

Dry

Normal

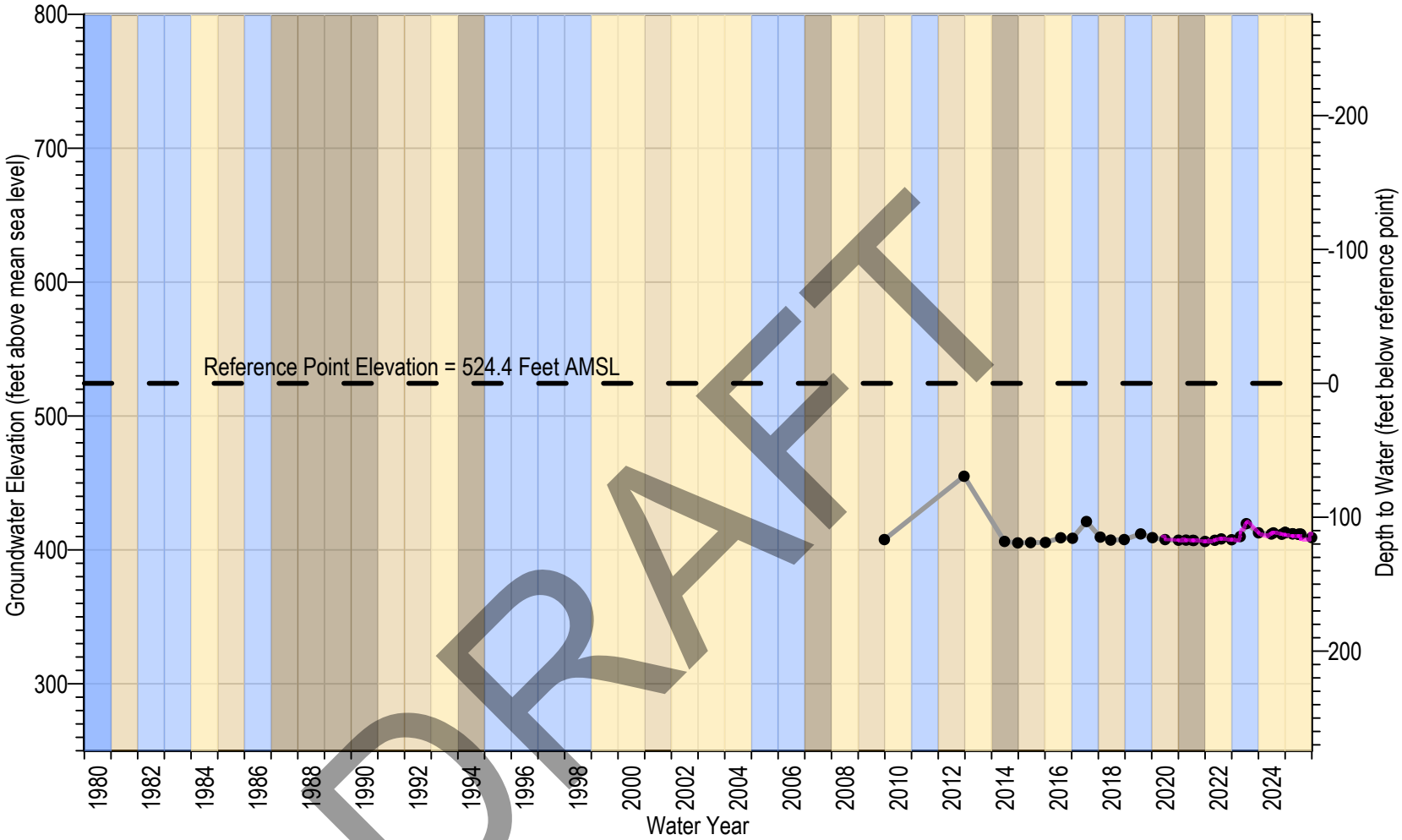
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-15. Hydrograph of SVWD AB303 MW-1

MONTGOMERY & ASSOCIATES



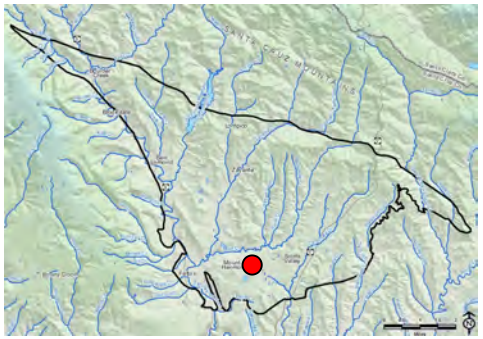
DRAFT

SVWD AB303 MW-3B
Transducer
Reference Point Elevation

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 524.4 ft AMSL
Screen Interval: 120-125 ft bgs

Water Year Classification

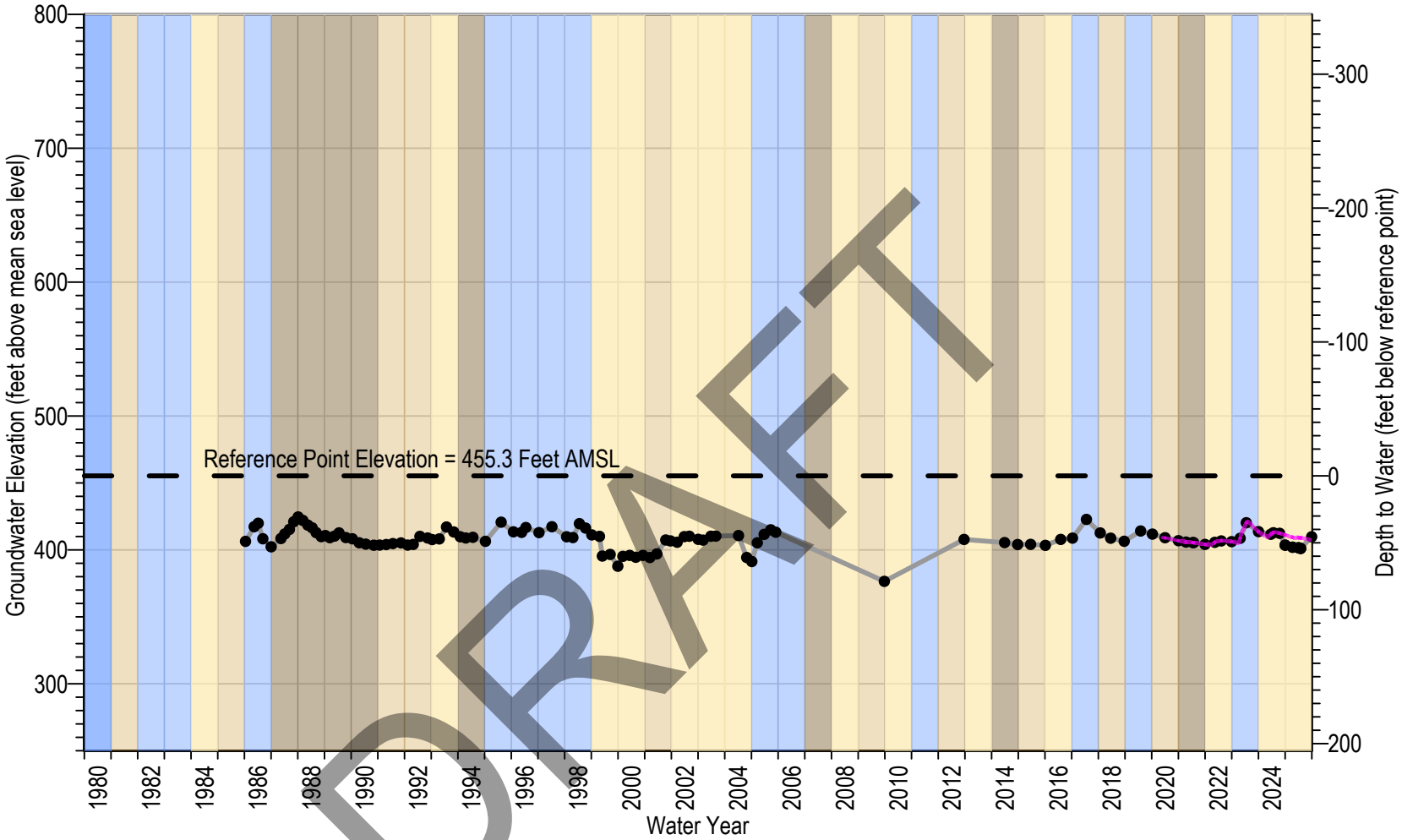
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-16. Hydrograph of SVWD AB303 MW-3B

MONTGOMERY & ASSOCIATES



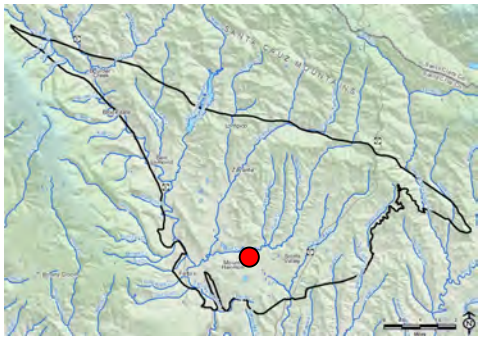
DRAFT

SVWD SV4-MW
Transducer
Reference Point Elevation

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 455.3 ft AMSL
Screen Interval: 50-60 ft bgs

Water Year Classification

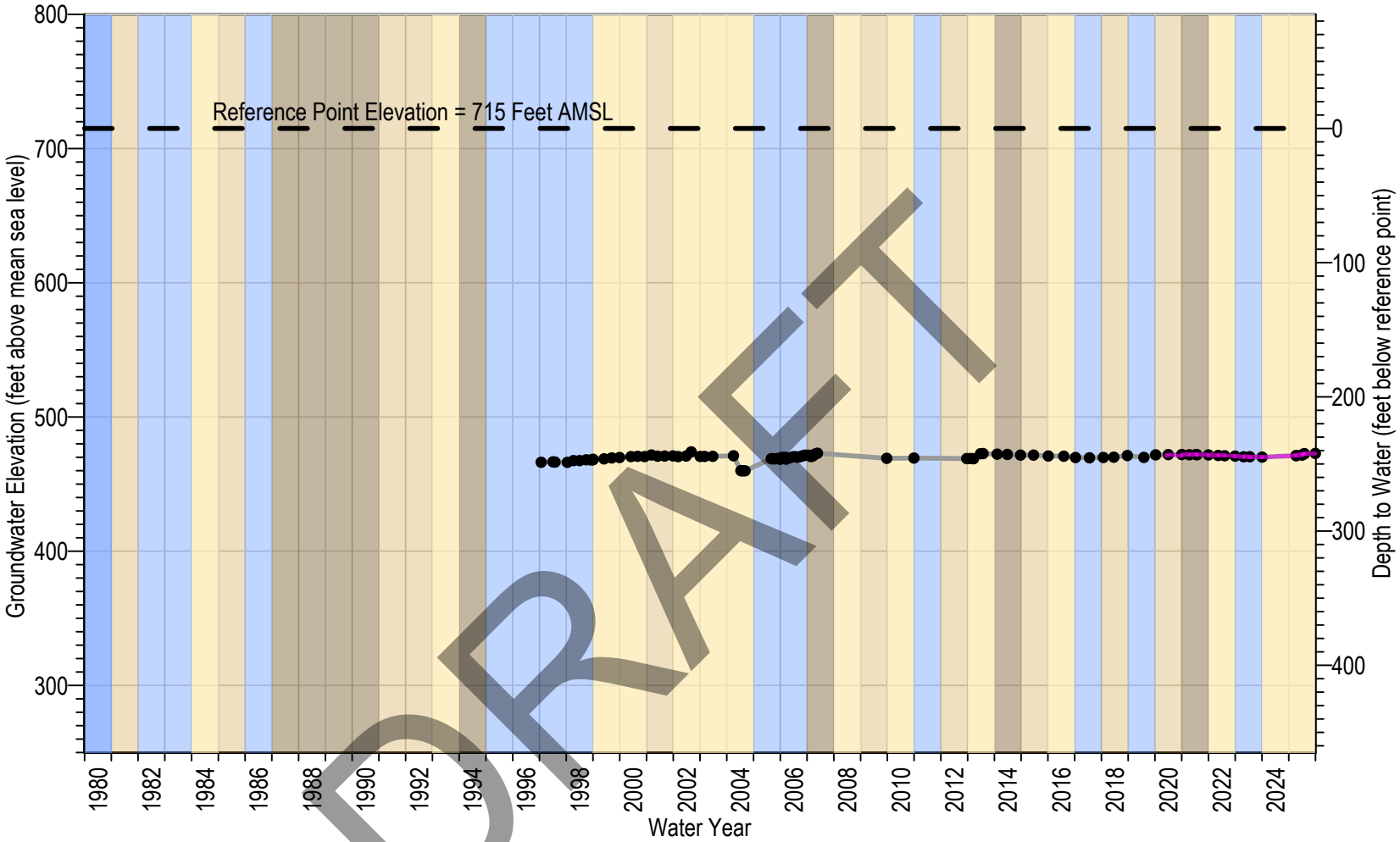
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-17. Hydrograph of SVWD SV4-MW

MONTGOMERY & ASSOCIATES



DRAFT

SVWD TW-18

Transducer

Reference Point Elevation

Formation: Unconfined - Santa Margarita

Reference Point Elevation: 715 ft AMSL

Screen Interval: 285-345 ft bgs

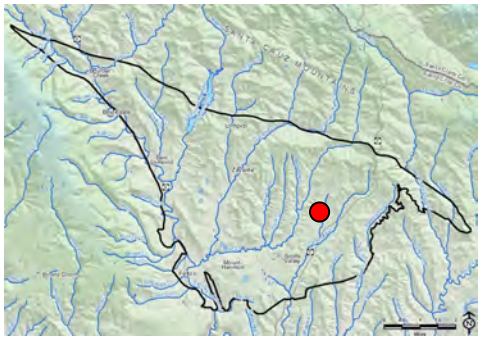
Water Year Classification

Wet

Dry

Normal

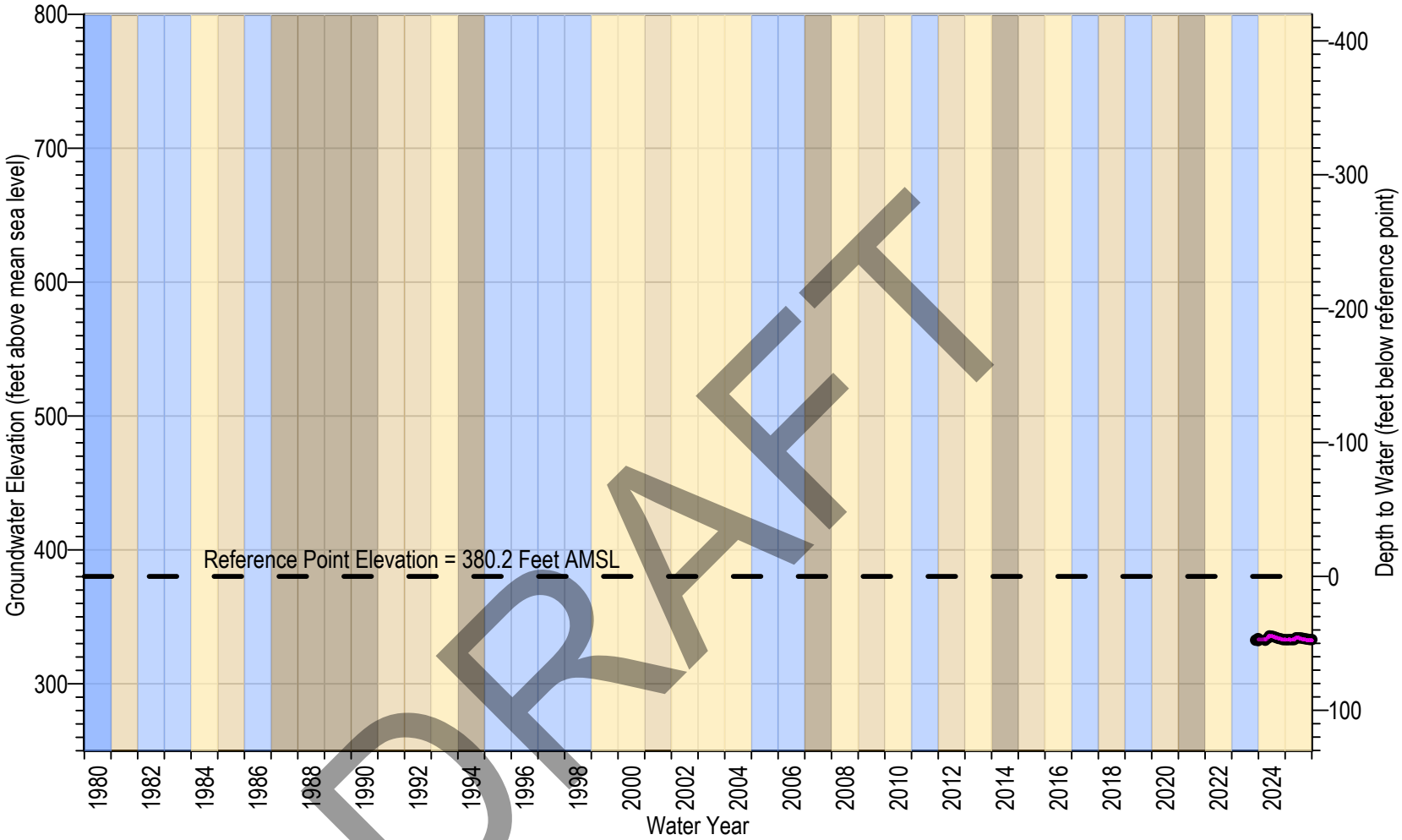
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-18. Hydrograph of SVWD TW-18

MONTGOMERY & ASSOCIATES



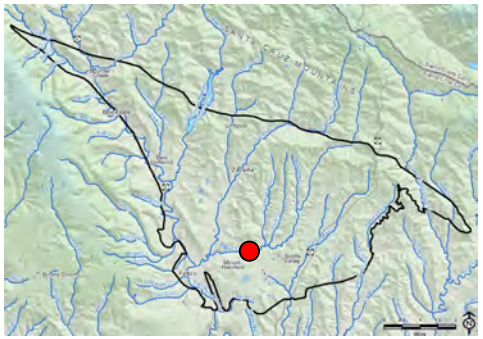
DRAFT

SMGWA-8 Randall Morgan Sandhills Preserve
Transducer
Reference Point Elevation

Formation: Confined - Monterey
Reference Point Elevation: 380.2 ft AMSL
Screen Interval: 155-170 ft bgs

Water Year Classification

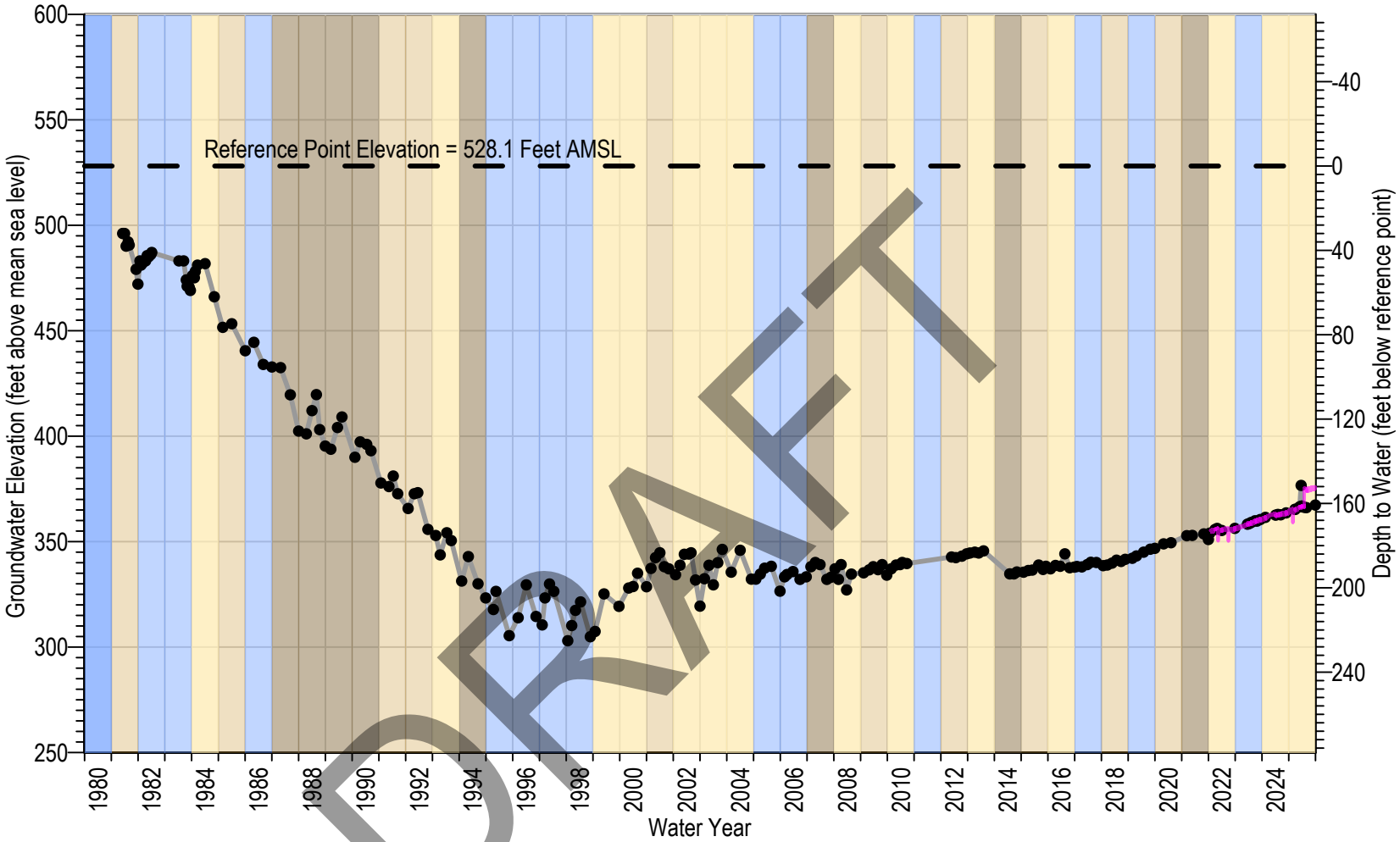
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-19. Hydrograph of SMGWA-8 Randall Morgan Sandhills Preserve

MONTGOMERY & ASSOCIATES



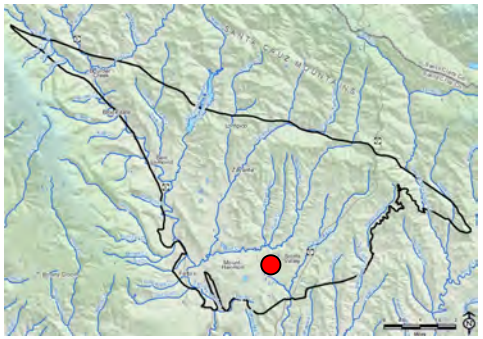
DRAFT

SVWD #9
Transducer
Reference Point Elevation

Formation: Confined - Monterey
Reference Point Elevation: 528.1 ft AMSL
Screen Interval: 155-195, 315-365 ft bgs

Water Year Classification

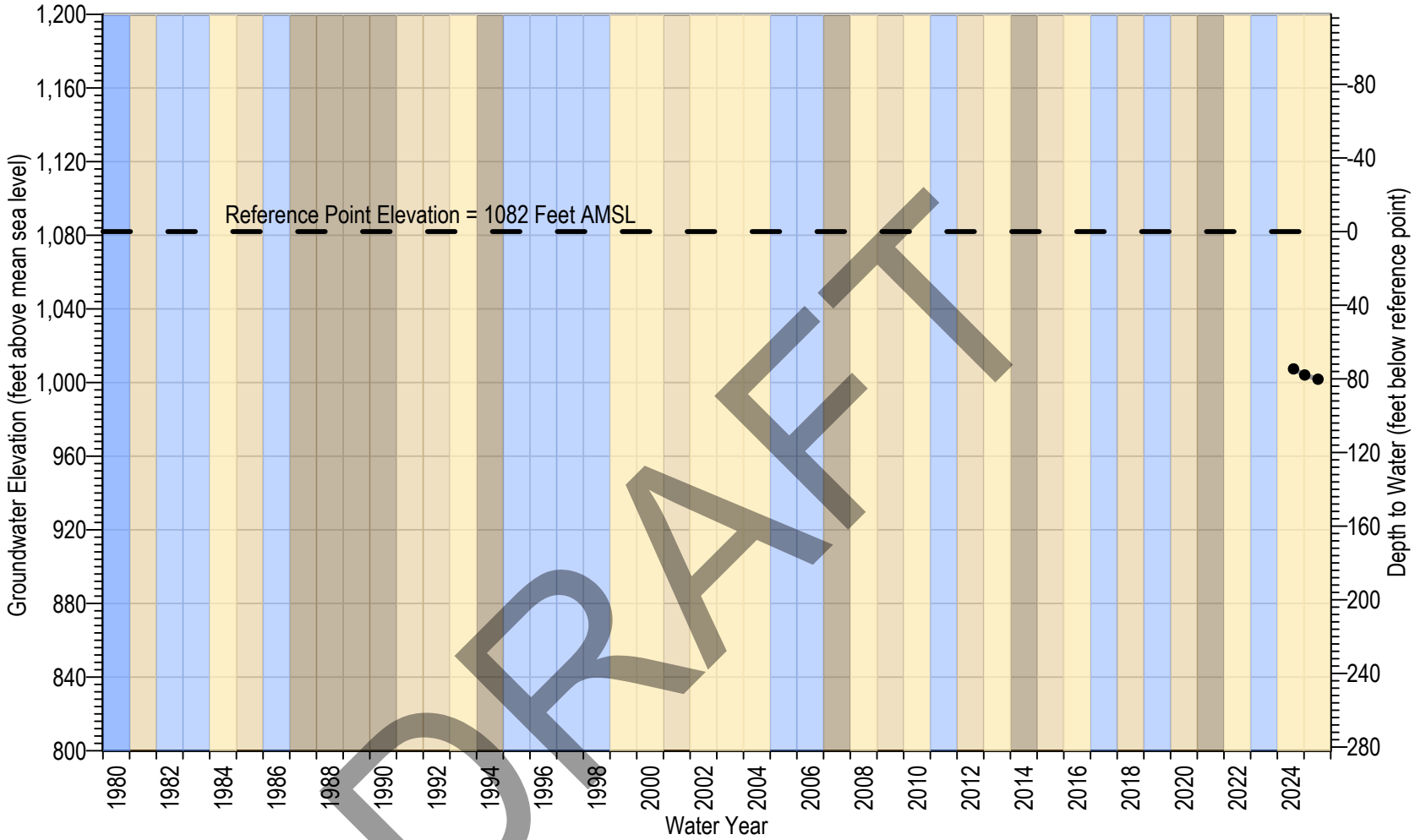
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-20. Hydrograph of SVWD #9

MONTGOMERY & ASSOCIATES



DRAFT

Weston Road

Reference Point Elevation

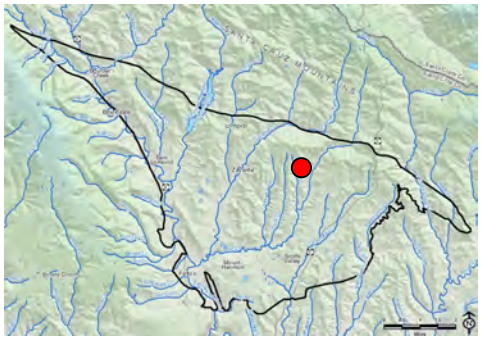
Formation: Confined - Monterey

Reference Point Elevation: 1082 ft AMSL

Screen Interval: Unknown ft bgs

Water Year Classification

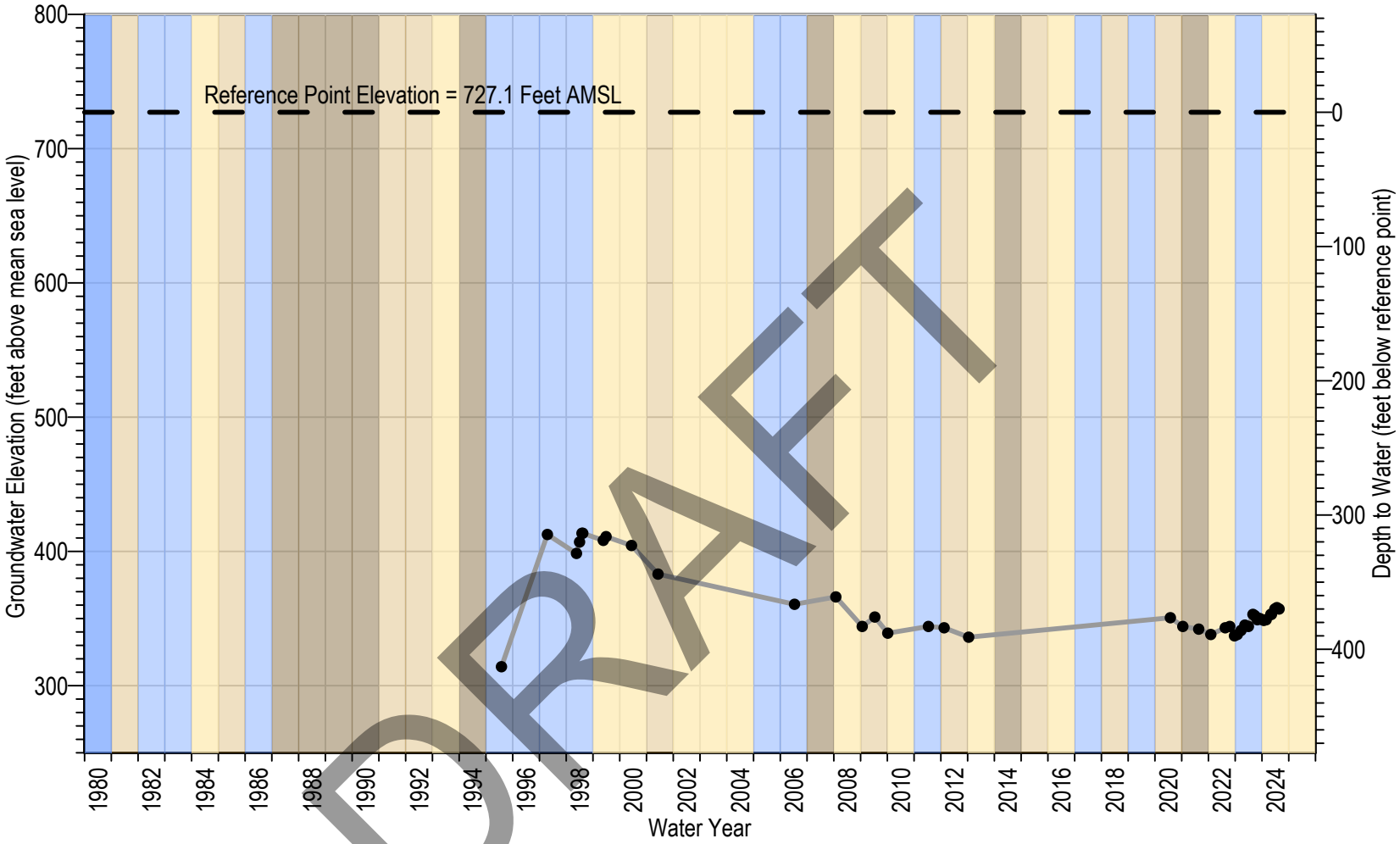
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-21. Hydrograph of Weston Road

MONTGOMERY & ASSOCIATES



DRAFT

MHA #1

Reference Point Elevation

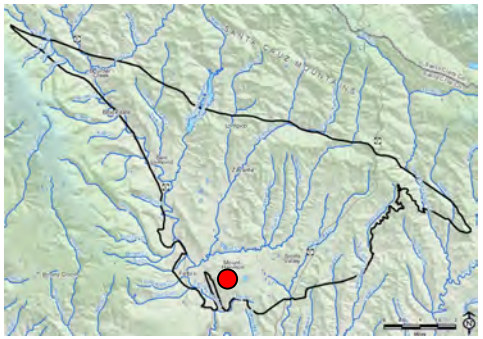
Formation: Unconfined - Santa Margarita,Lompico

Reference Point Elevation: 727.1 ft AMSL

Screen Interval: 255-265, 285-395, 435-495 ft bgs

Water Year Classification

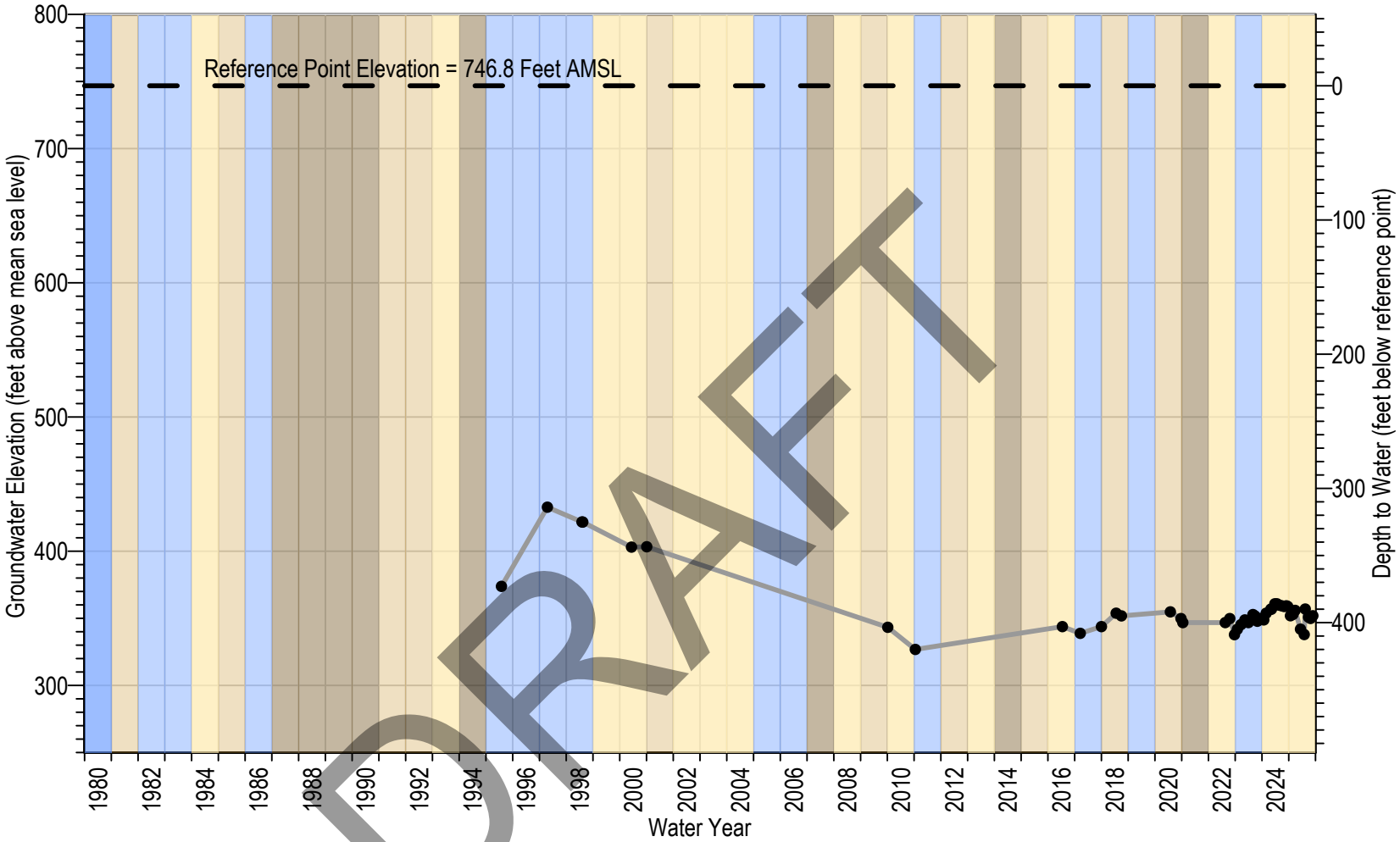
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-22. Hydrograph of MHA #1

MONTGOMERY & ASSOCIATES



DRAFT

MHA #2

Reference Point Elevation

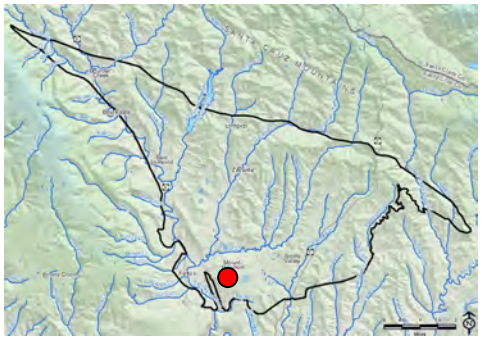
Formation: Confined - Lompico

Reference Point Elevation: 746.8 ft AMSL

Screen Interval: 290-300, 400-415, 430-460, 490-590, 600-725 ft bgs

Water Year Classification

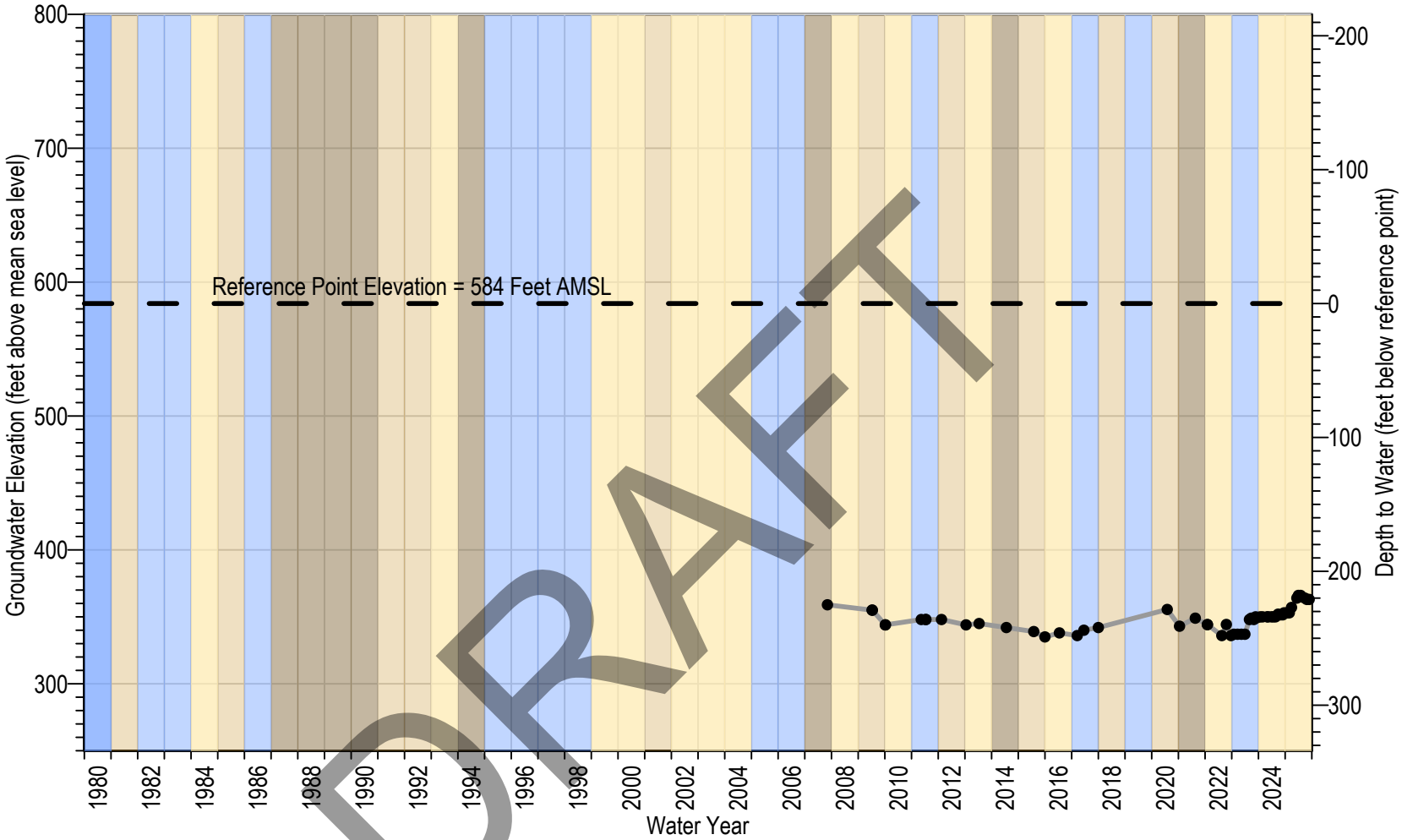
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-23. Hydrograph of MHA #2

MONTGOMERY & ASSOCIATES



DRAFT

MHA #3

Reference Point Elevation

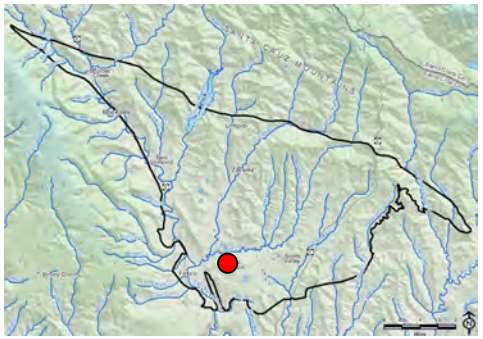
Formation: Confined - Lompico

Reference Point Elevation: 584 ft AMSL

Screen Interval: 680-800, 860-980 ft bgs

Water Year Classification

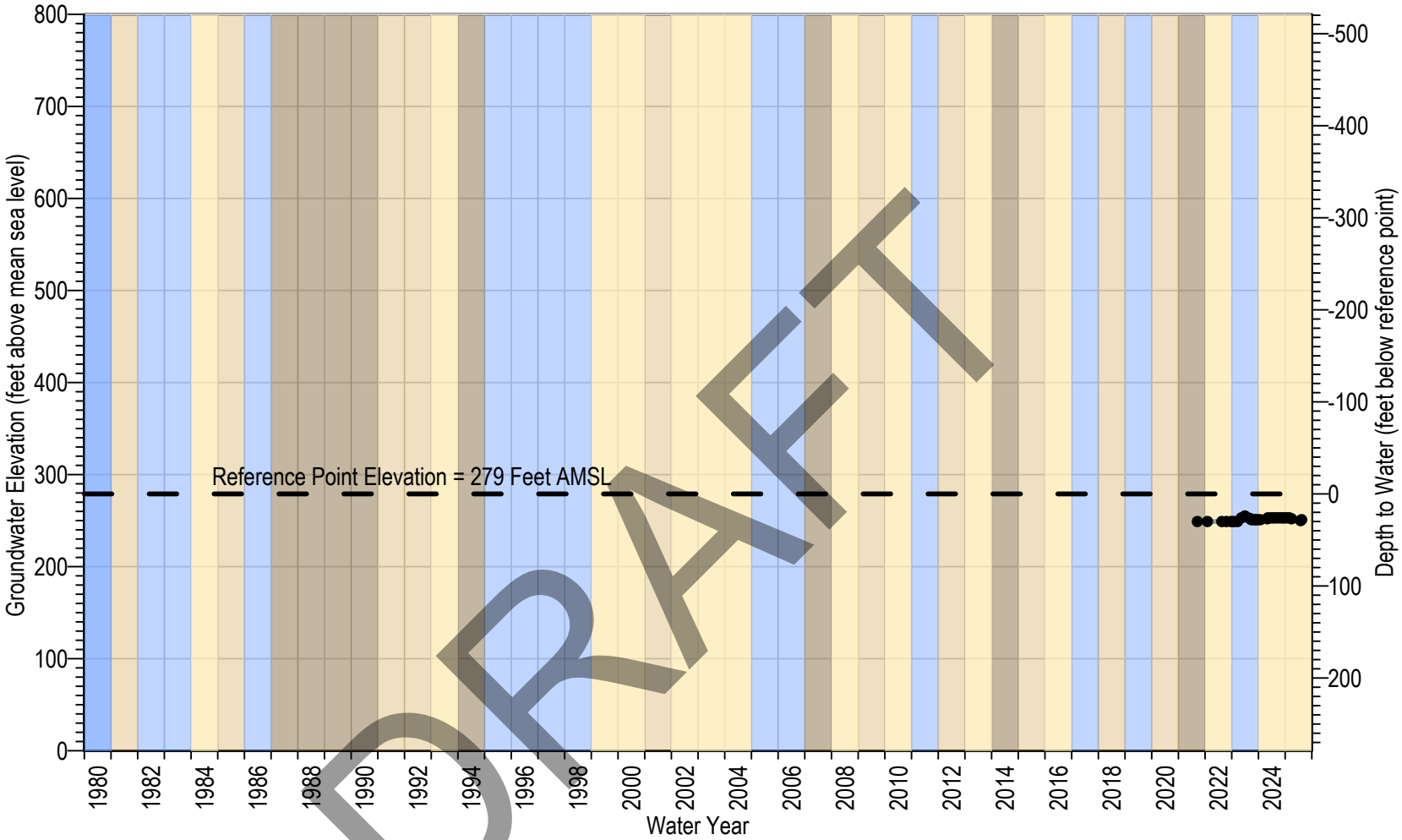
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-24. Hydrograph of MHA #3

MONTGOMERY & ASSOCIATES



DRAFT

MHA-MW1

Reference Point Elevation

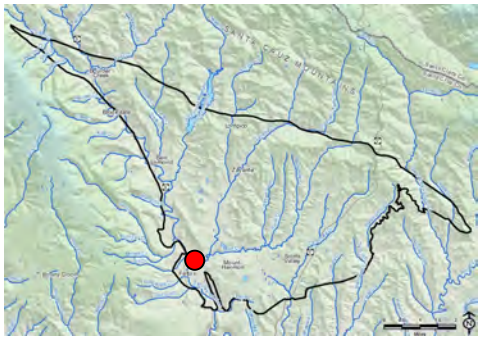
Formation: Confined - Lompico

Reference Point Elevation: 279 ft AMSL

Screen Interval: 120-300 ft bgs

Water Year Classification

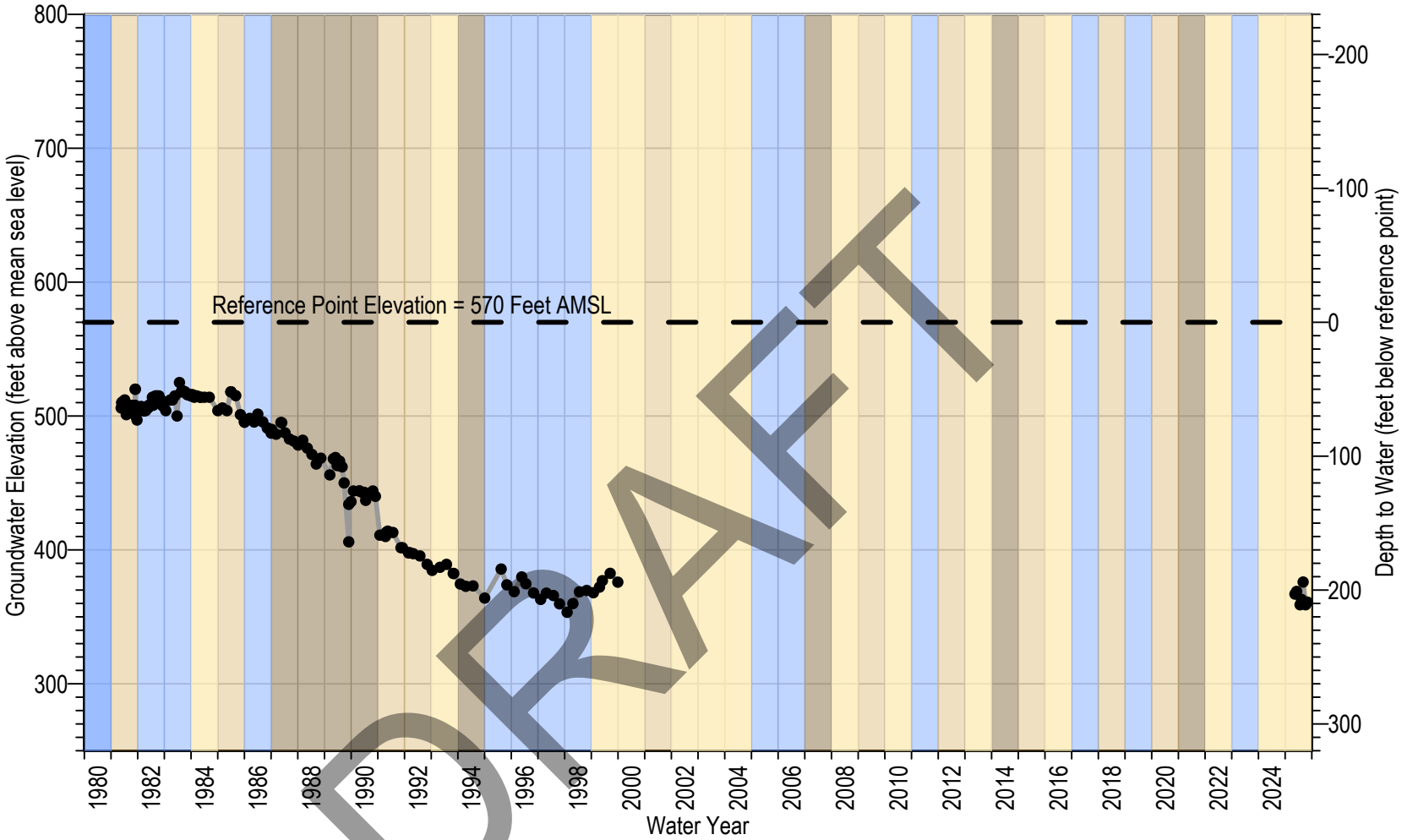
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-25. Hydrograph of MHA-MW1

MONTGOMERY & ASSOCIATES



SLVWD Pasatiempo #3 (Estrella)

Reference Point Elevation

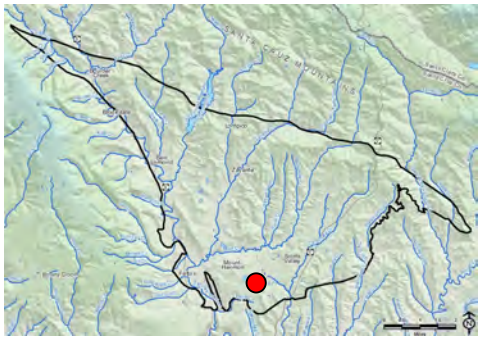
Formation: Confined - Lompico

Reference Point Elevation: 570 ft AMSL

Screen Interval: 23-147, 169-260 ft bgs

Water Year Classification

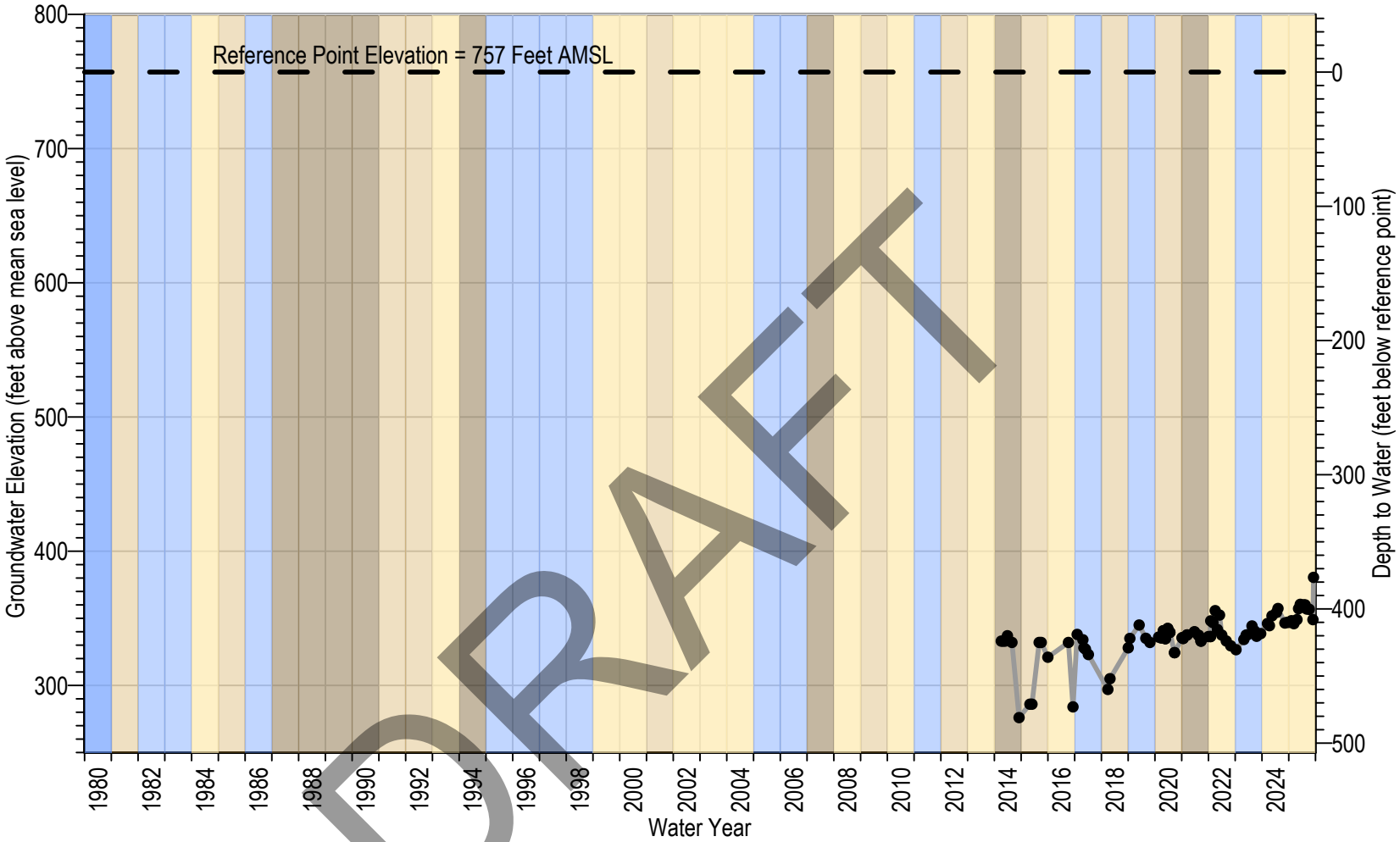
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-26. Hydrograph of SLVWD Pasatiempo #3 (Estrella)

MONTGOMERY & ASSOCIATES



DRAFT

SLVWD Pasatiempo #5A

Reference Point Elevation

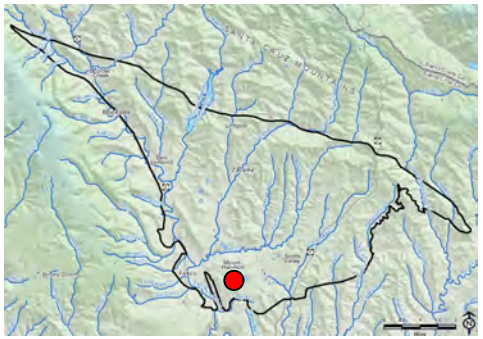
Formation: Confined - Lompico

Reference Point Elevation: 757 ft AMSL

Screen Interval: 400-700 ft bgs

Water Year Classification

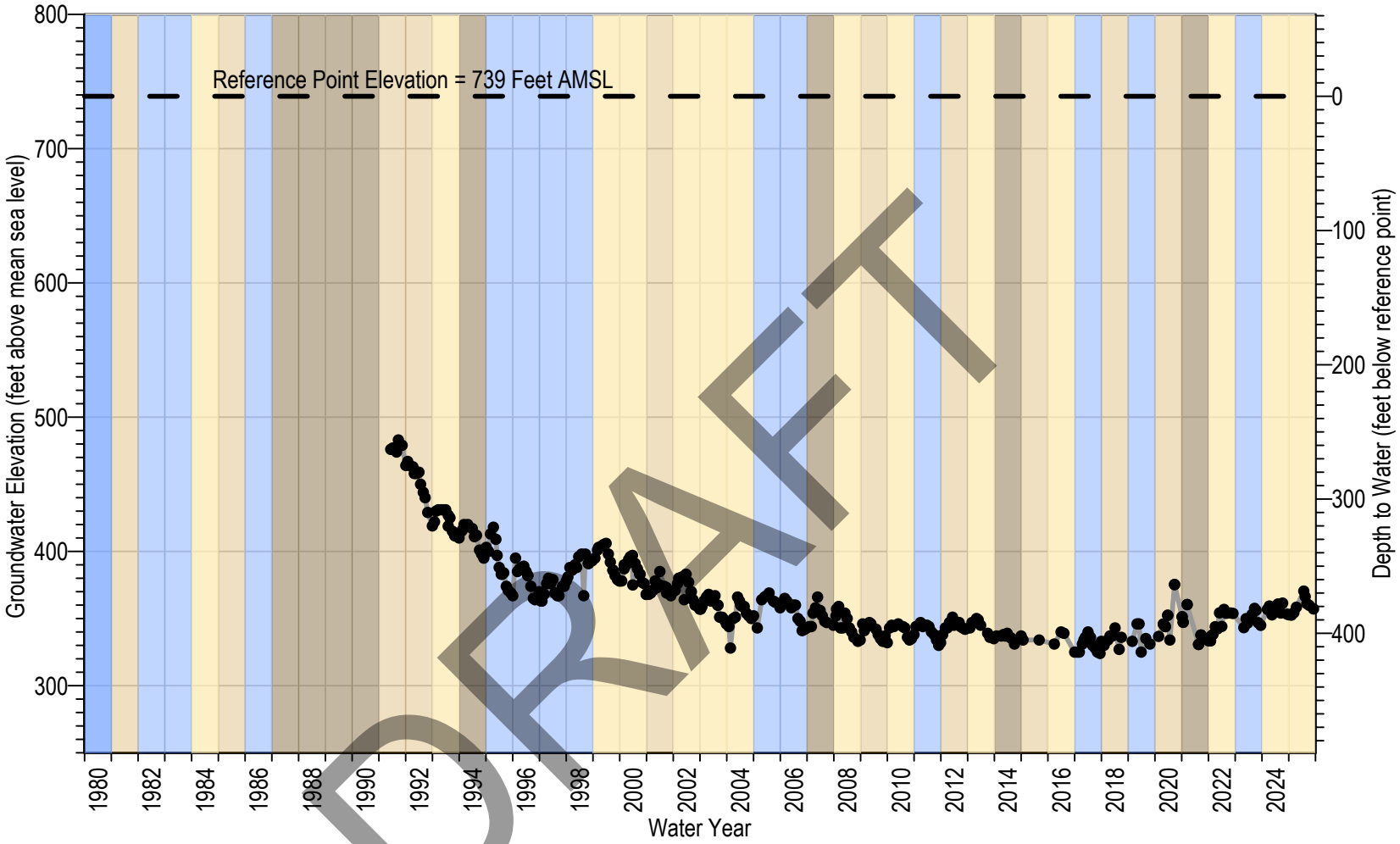
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-27. Hydrograph of SLVWD Pasatiempo #5A

MONTGOMERY & ASSOCIATES



DRAFT

SLVWD Pasatiempo #7

Reference Point Elevation

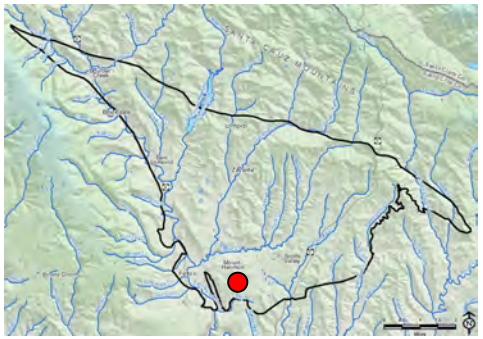
Formation: Confined - Lompico

Reference Point Elevation: 739 ft AMSL

Screen Interval: 380-440, 495-525 ft bgs

Water Year Classification

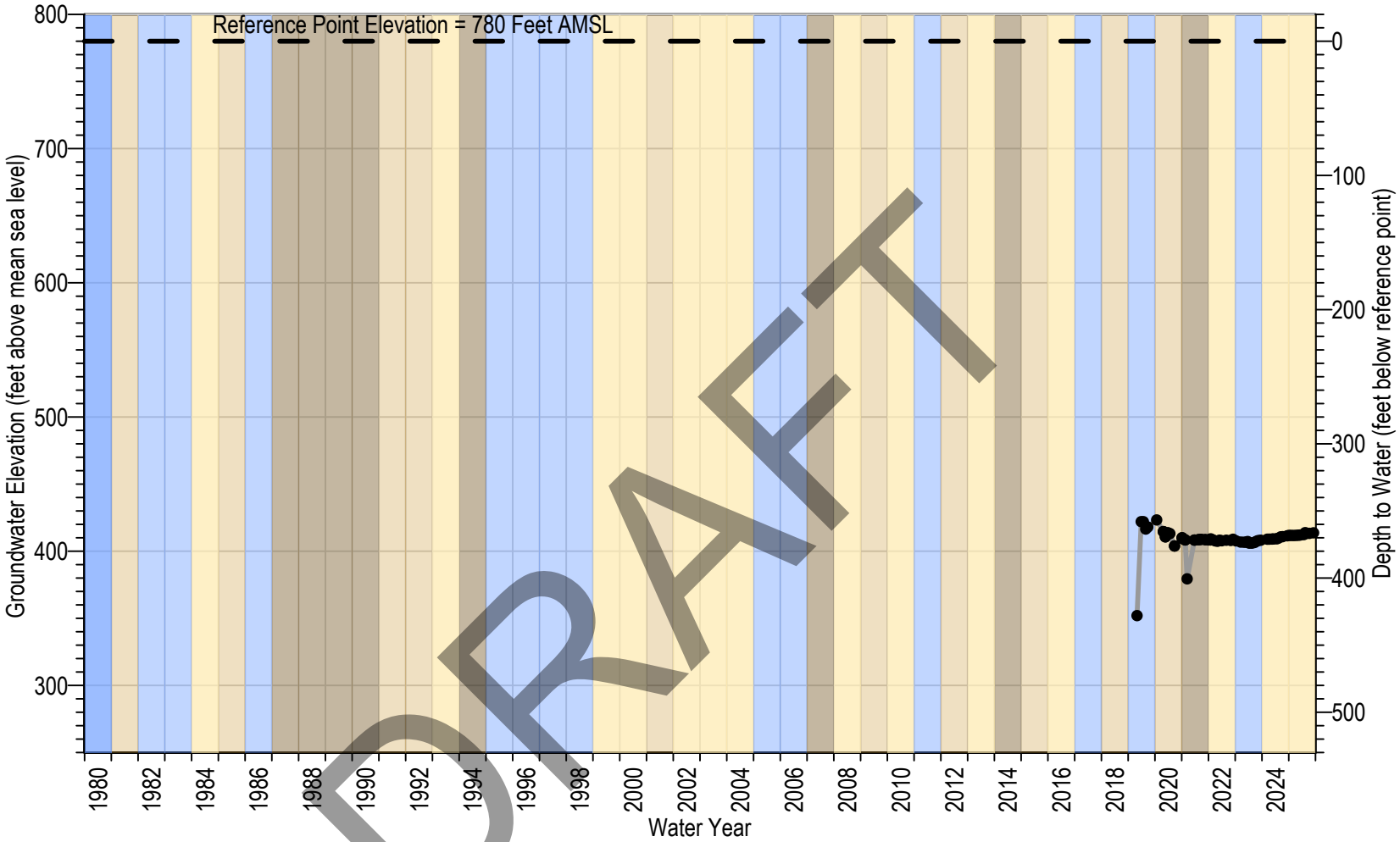
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-28. Hydrograph of SLVWD Pasatiempo #7

MONTGOMERY & ASSOCIATES



DRAFT

SLVWD Pasatiempo #8

Reference Point Elevation

Formation: Confined - Lompico

Reference Point Elevation: 780 ft AMSL

Screen Interval: 560-660,680-780 ft bgs

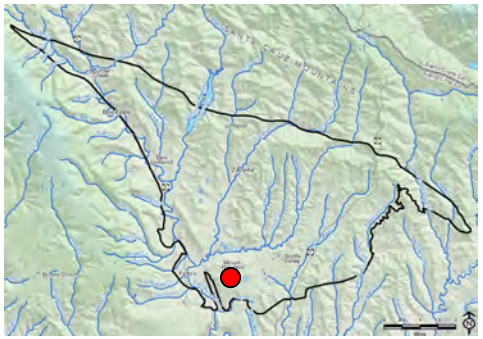
Water Year Classification

Wet

Dry

Normal

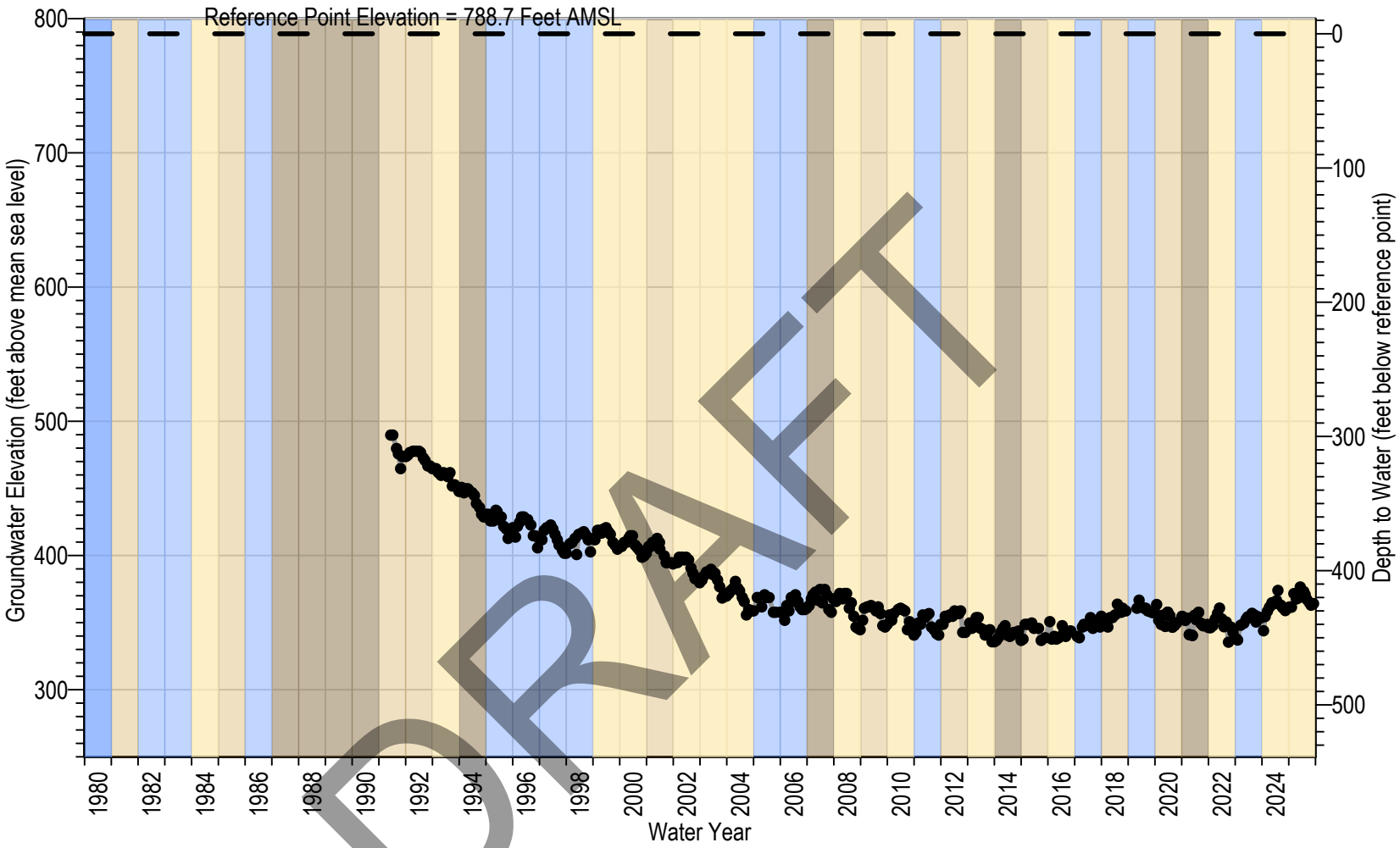
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-29. Hydrograph of SLVWD Pasatiempo #8

MONTGOMERY & ASSOCIATES



SLVWD Pasatiempo MW-1

Reference Point Elevation

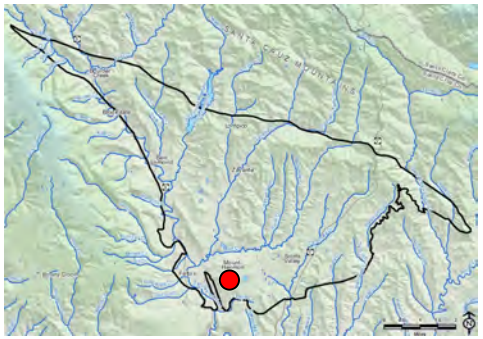
Formation: Confined - Lompico

Reference Point Elevation: 788.7 ft AMSL

Screen Interval: 600-660 ft bgs

Water Year Classification

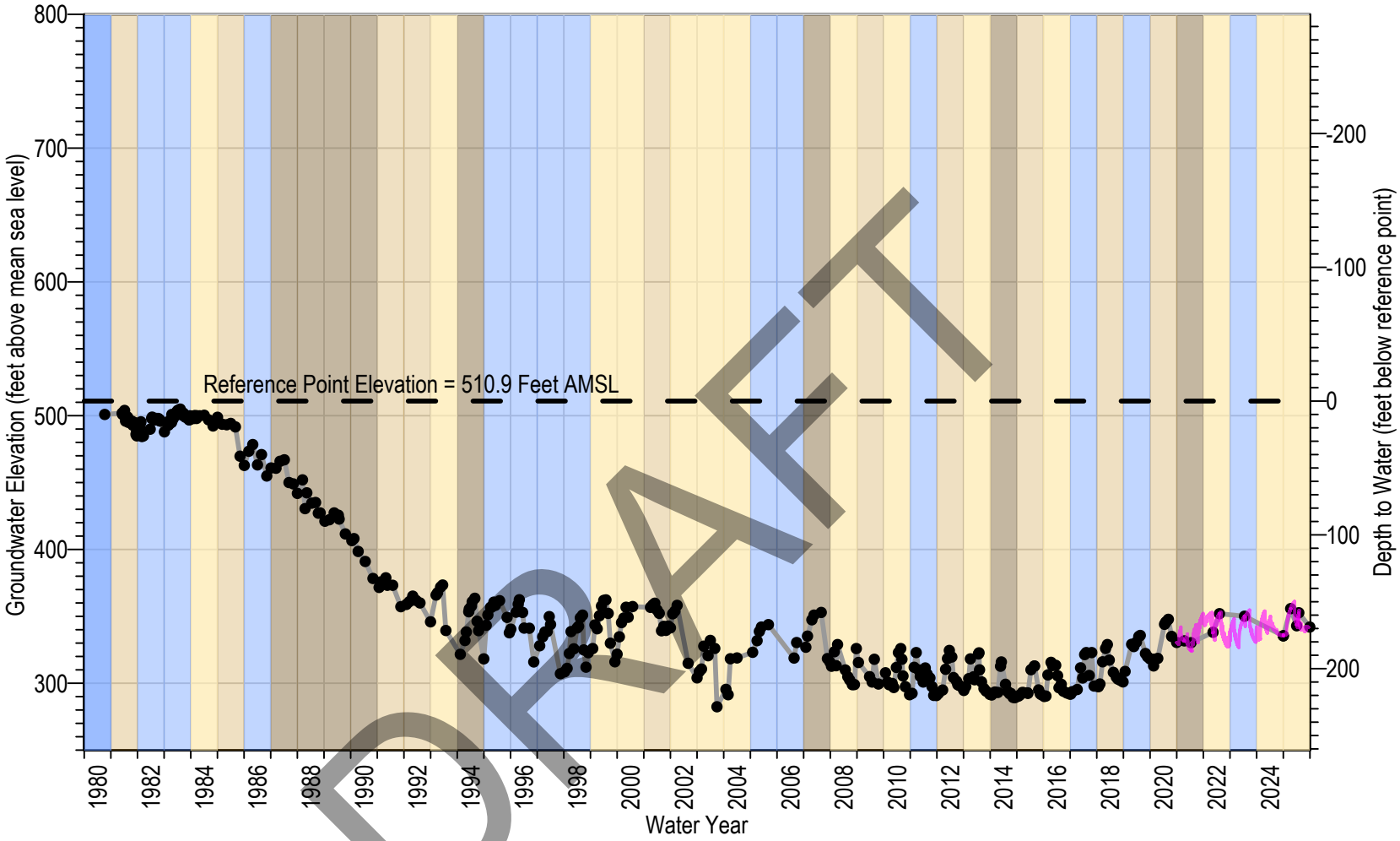
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-30. Hydrograph of SLVWD Pasatiempo MW-1

MONTGOMERY & ASSOCIATES



SVWD #10

Transducer

Reference Point Elevation

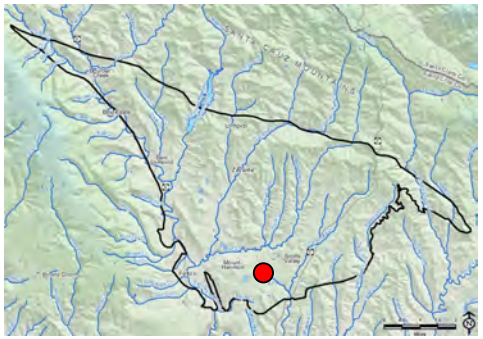
Formation: Confined - Lompico

Reference Point Elevation: 510.9 ft AMSL

Screen Interval: 190-220, 240-270, 325-355 ft bgs

Water Year Classification

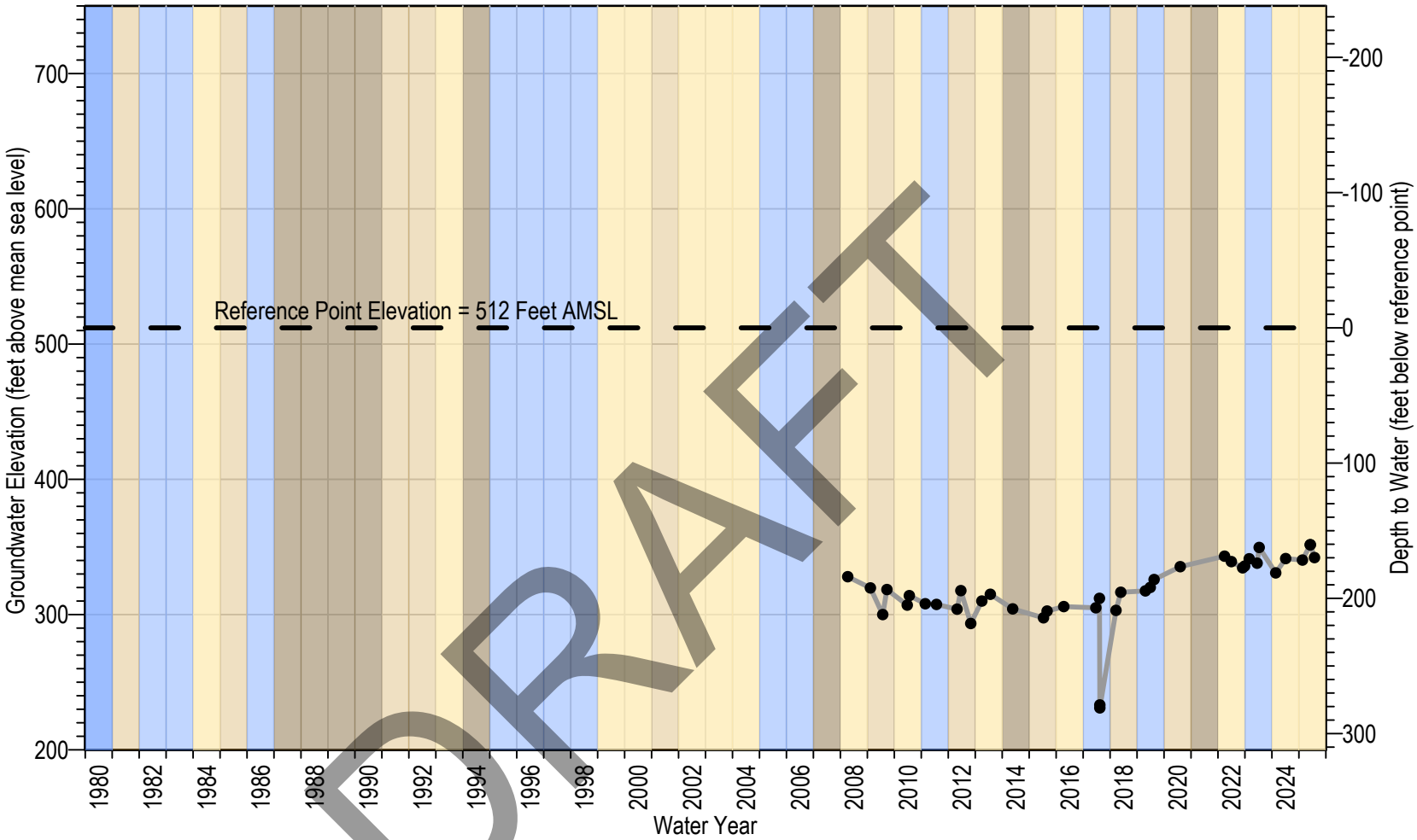
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-31. Hydrograph of SVWD #10

MONTGOMERY & ASSOCIATES



DRAFT

SVWD #10A

Reference Point Elevation

Formation: Confined - Lompico

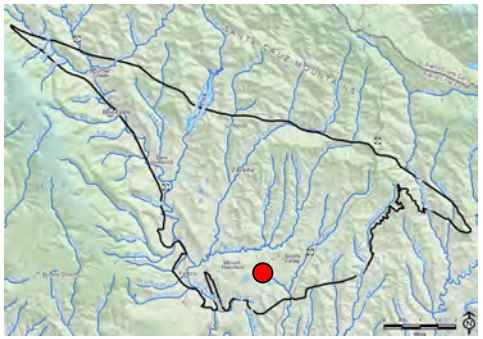
Reference Point Elevation: 512 ft AMSL

Screen Interval: 282-382, 403-453 ft bgs

Water Year Classification

Wet | Dry

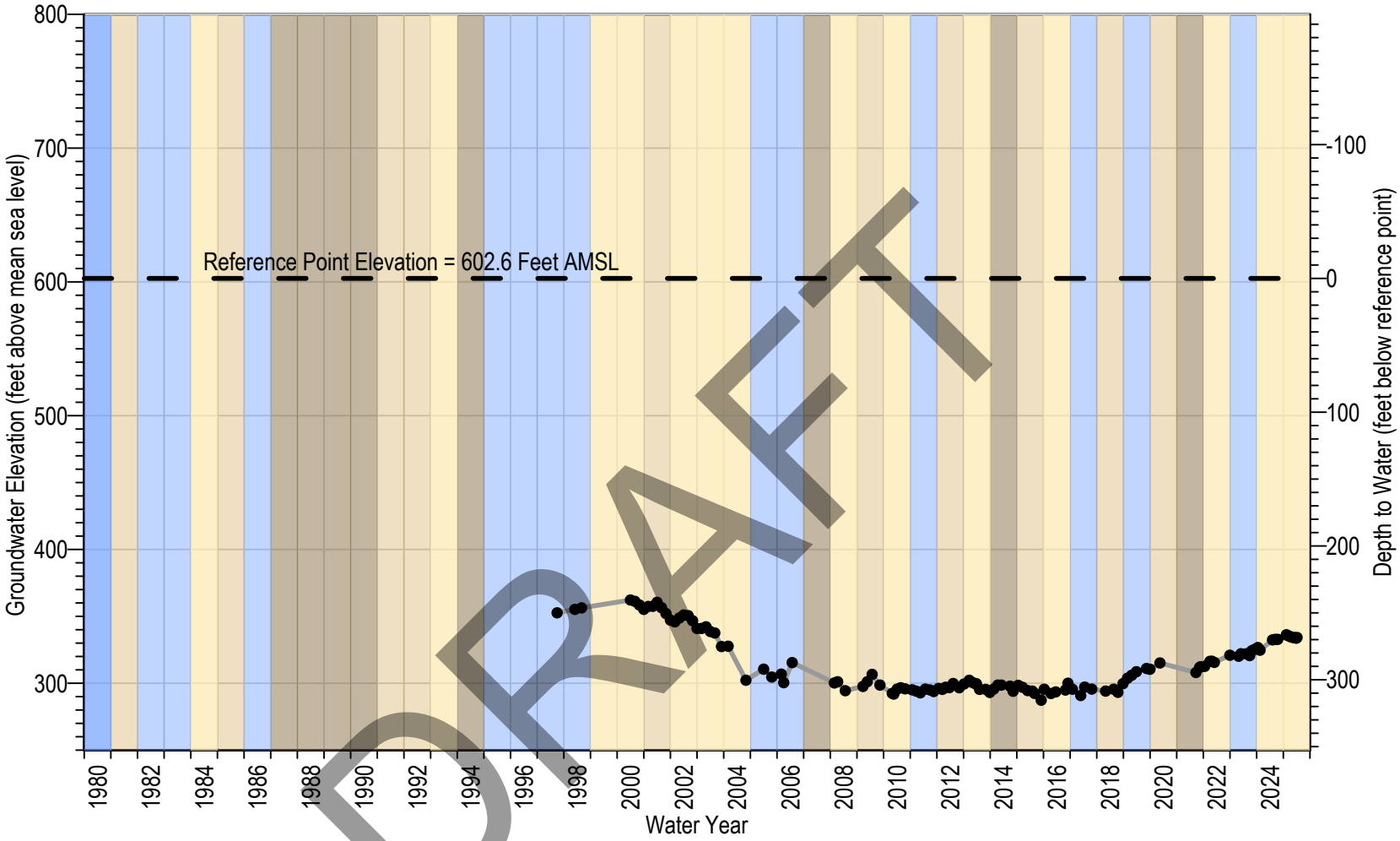
Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-32. Hydrograph of SVWD #10A

MONTGOMERY & ASSOCIATES



DRAFT

SVWD #11A

Reference Point Elevation

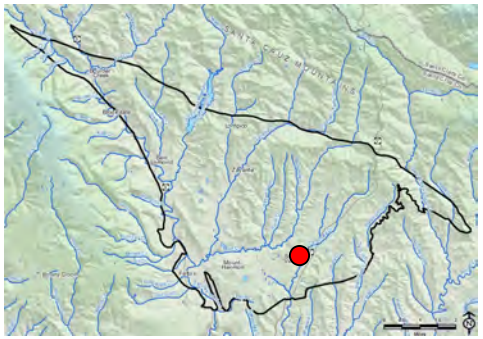
Formation: Confined - Lompico

Reference Point Elevation: 602.6 ft AMSL

Screen Interval: 399-419, 459-469, 495-515 ft bgs

Water Year Classification

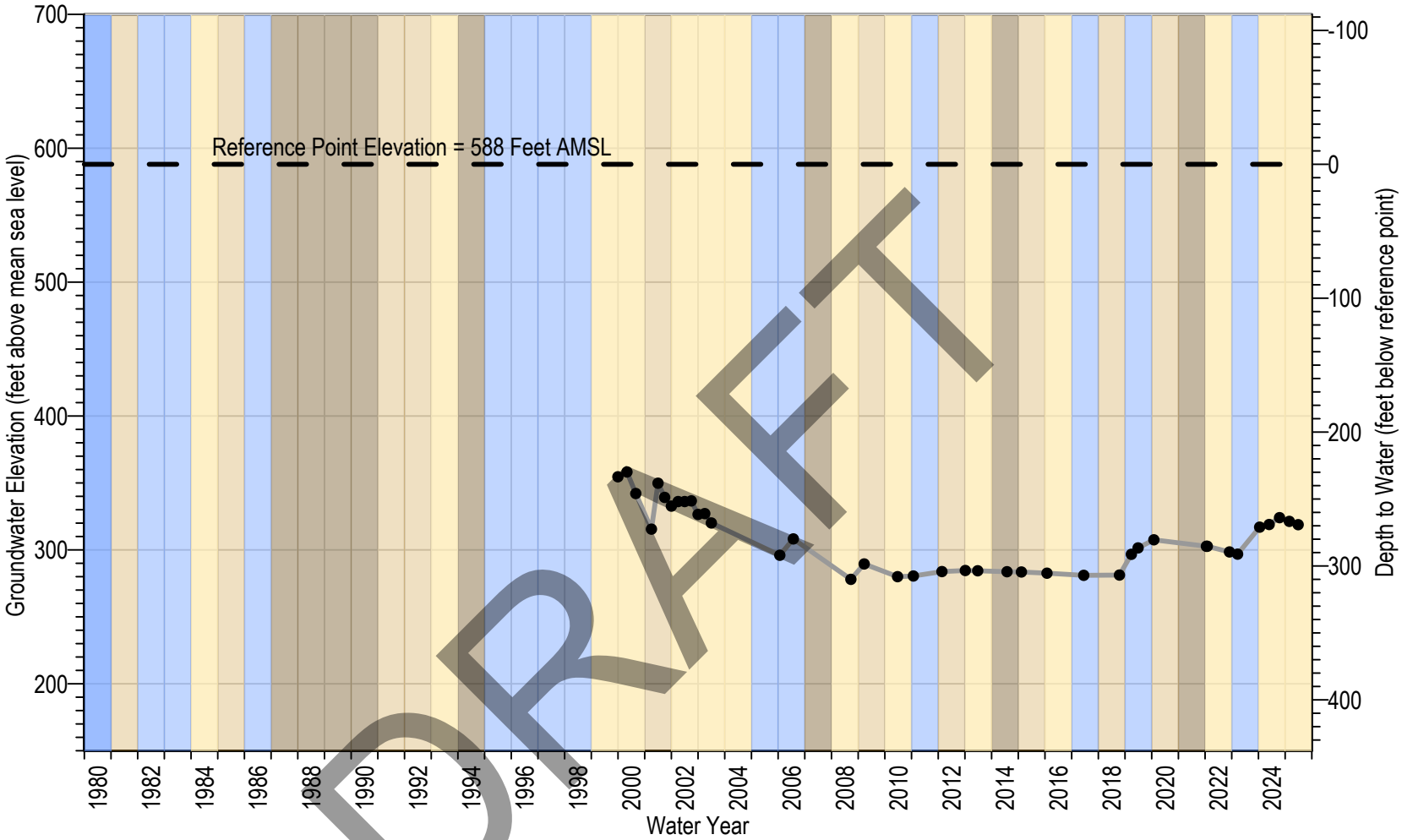
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-33. Hydrograph of SVWD #11A

MONTGOMERY & ASSOCIATES



DRAFT

SVWD #11B

Reference Point Elevation

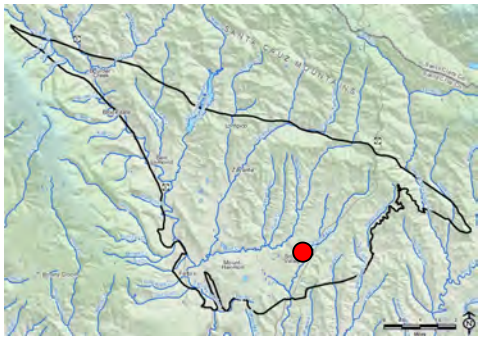
Formation: Confined - Lompico

Reference Point Elevation: 588 ft AMSL

Screen Interval: 348-388 ft bgs

Water Year Classification

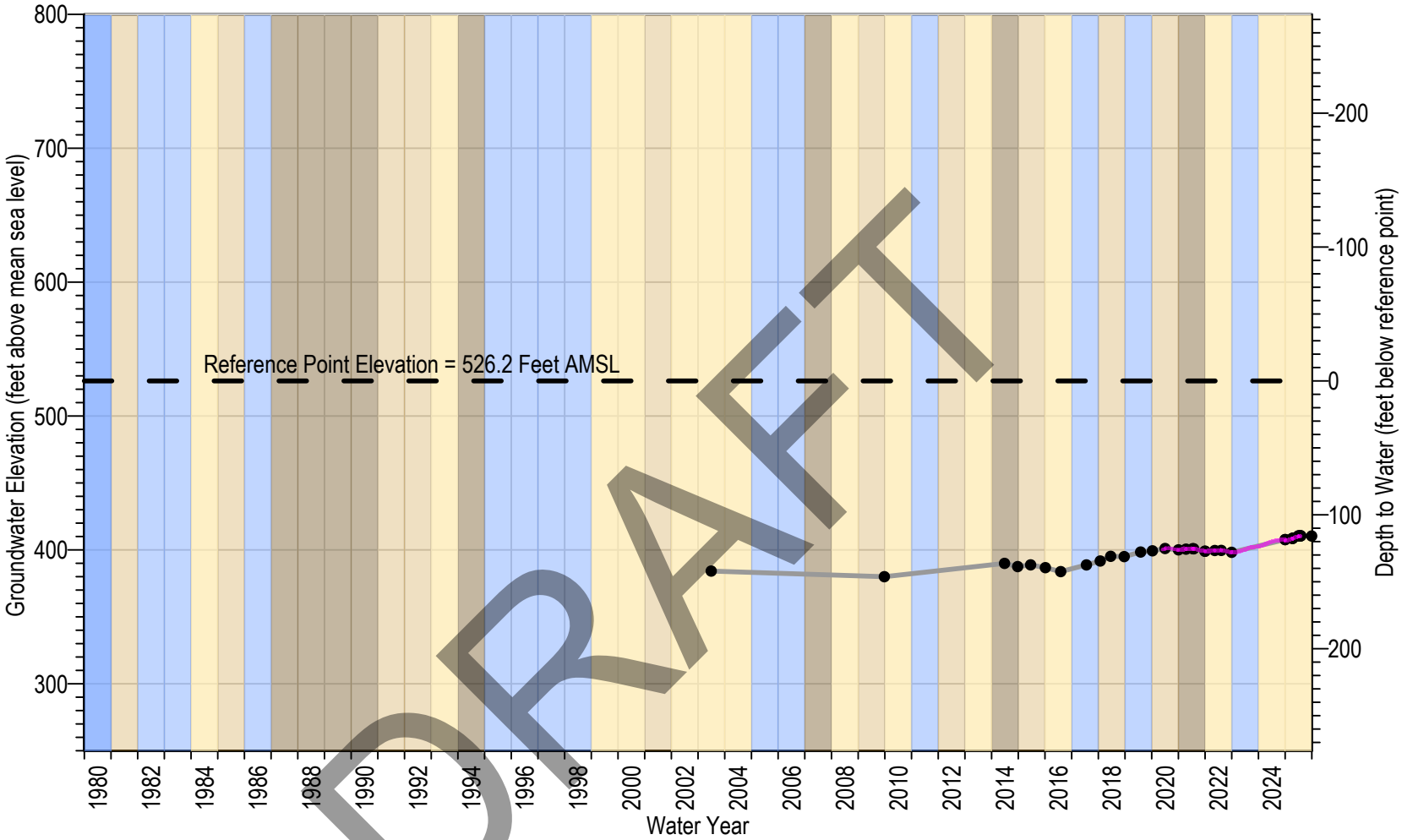
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-34. Hydrograph of SVWD #11B

MONTGOMERY & ASSOCIATES



DRAFT

SVWD AB303 MW-2
Transducer
Reference Point Elevation

Formation: Confined - Lompico
Reference Point Elevation: 526.2 ft AMSL
Screen Interval: 705-715, 810-850 ft bgs

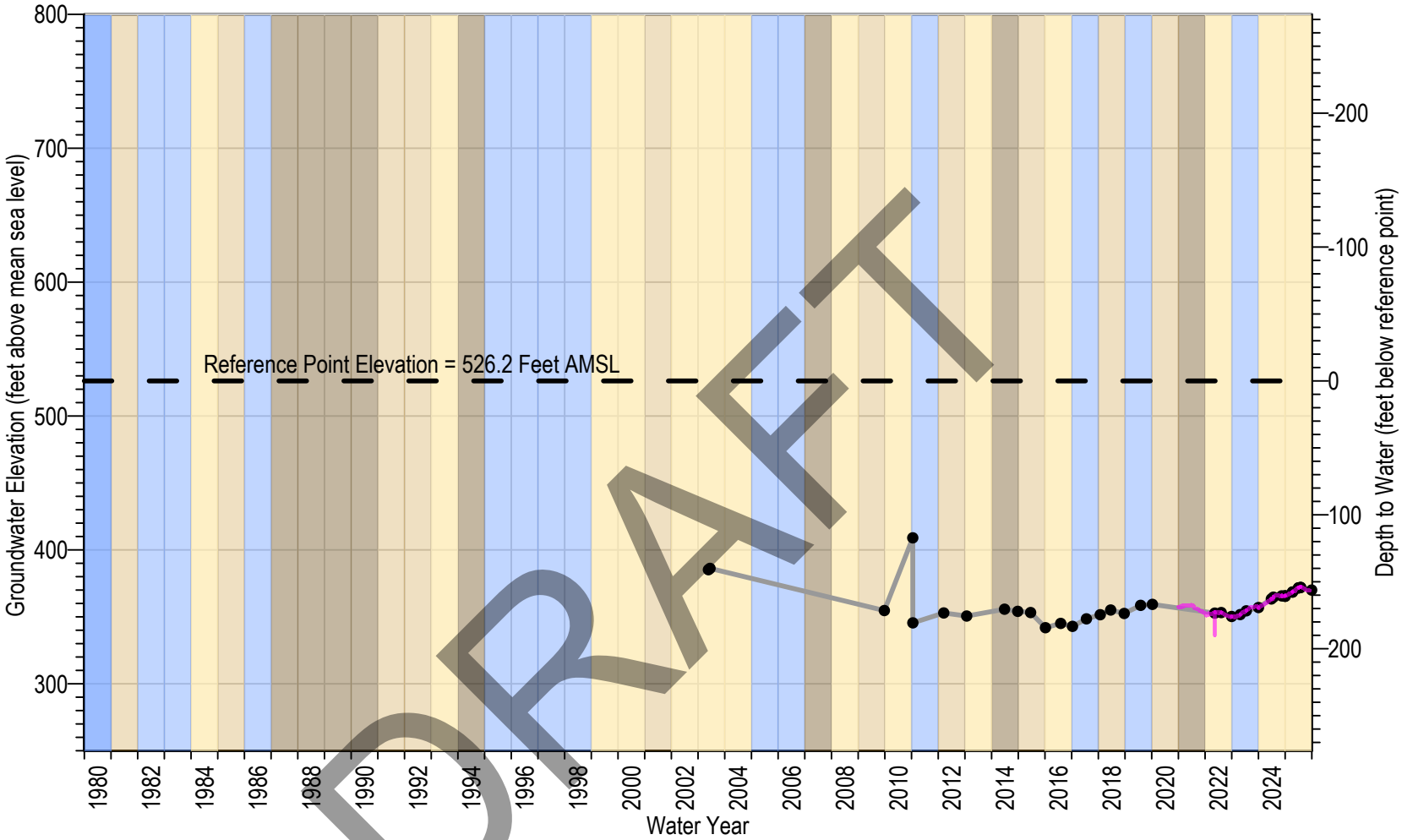
Water Year Classification

Wet	Dry
Normal	Critically Dry

Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-35. Hydrograph of SVWD AB303 MW-2

MONTGOMERY & ASSOCIATES

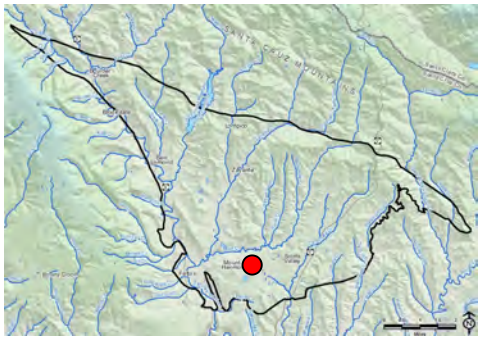


SVWD AB303 MW-3A
Transducer
Reference Point Elevation

Formation: Confined - Lompico
Reference Point Elevation: 526.2 ft AMSL
Screen Interval: 630-680 ft bgs

Water Year Classification

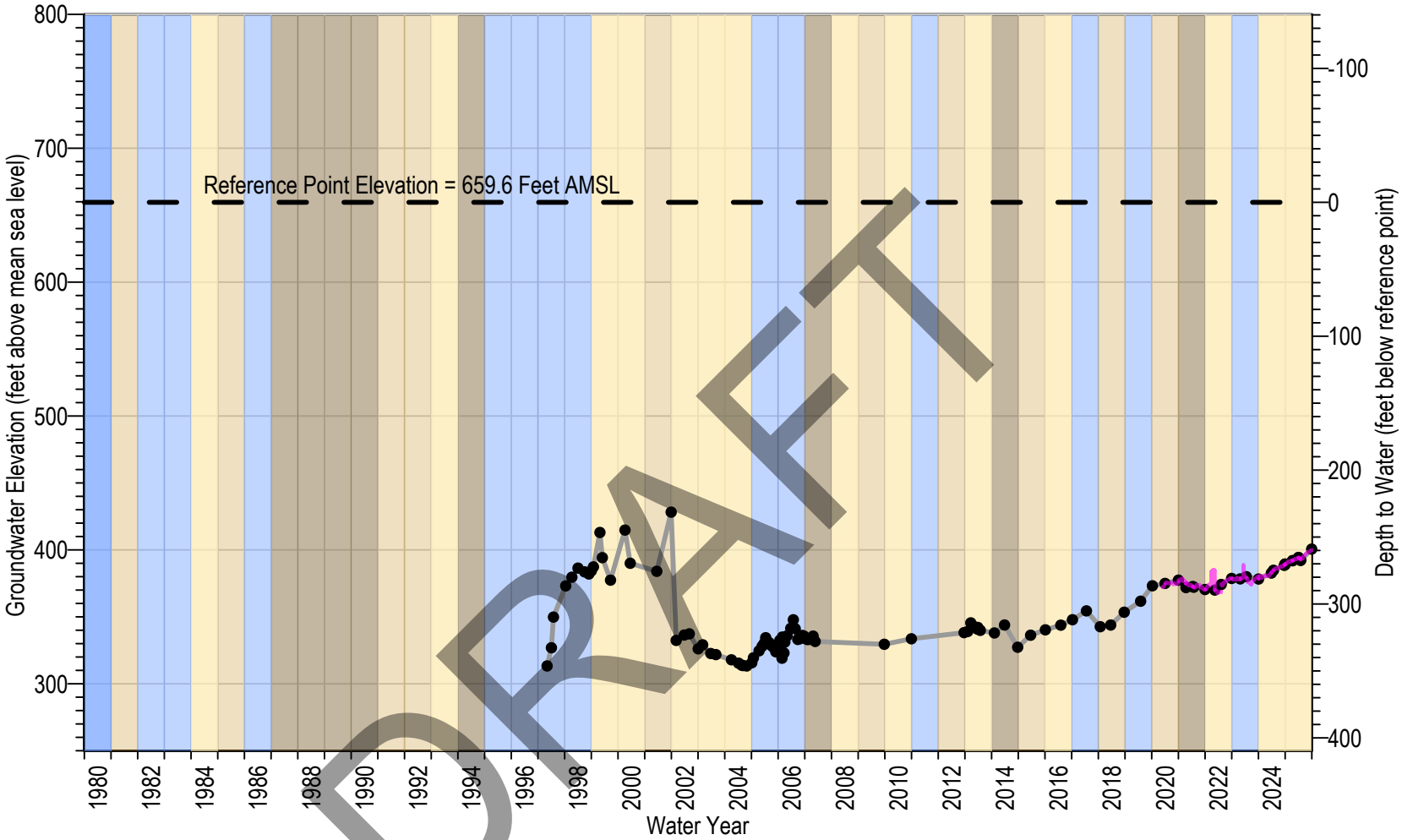
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-36. Hydrograph of SVWD AB303 MW-3A

MONTGOMERY & ASSOCIATES



DRAFT

SVWD TW-19

Transducer

Reference Point Elevation

Formation: Confined - Lompico

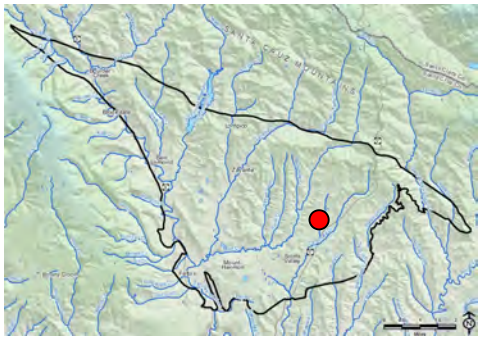
Reference Point Elevation: 659.6 ft AMSL

Screen Interval: 960-1060 ft bgs

Water Year Classification

Wet | Dry

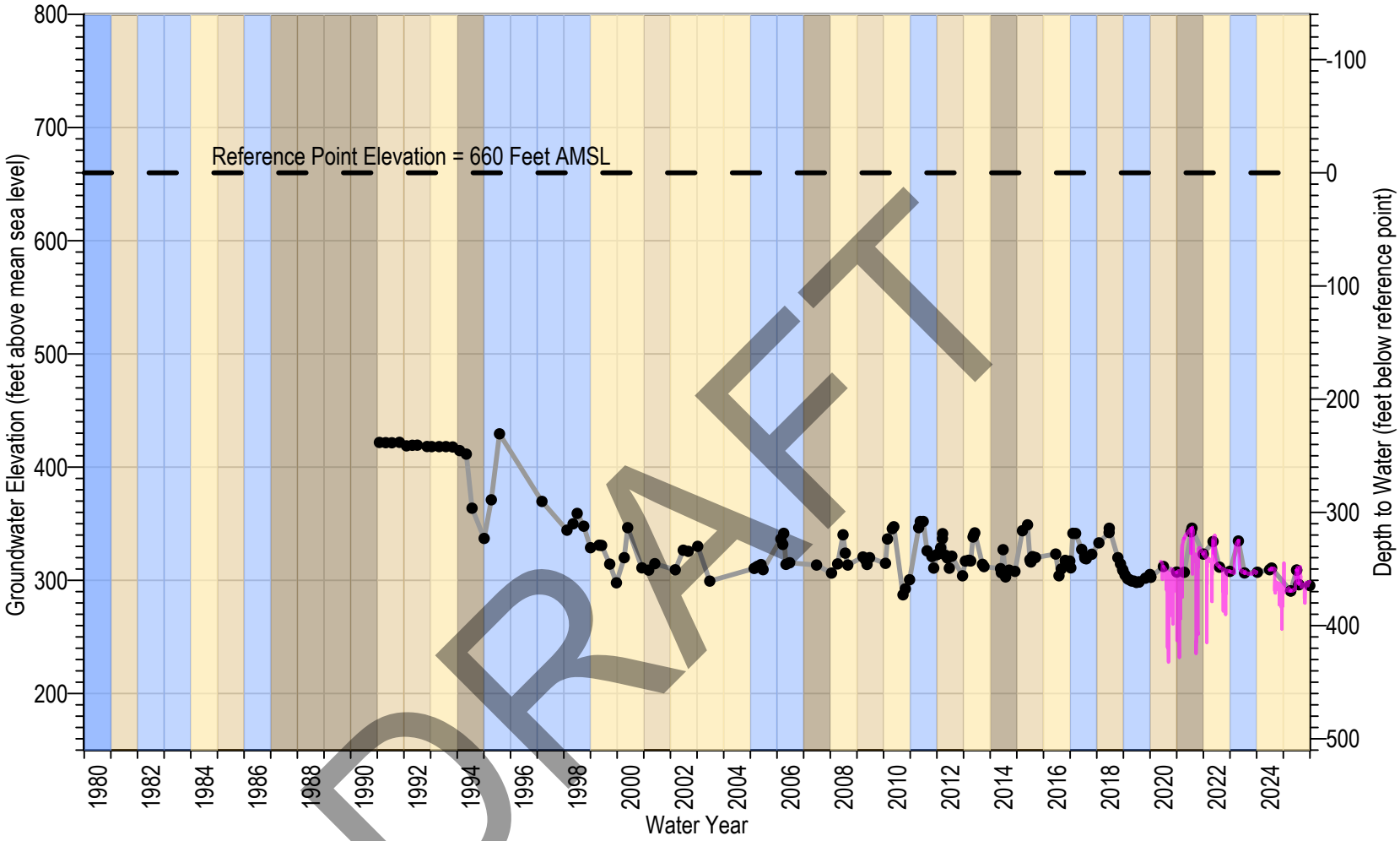
Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-37. Hydrograph of SVWD TW-19

MONTGOMERY & ASSOCIATES



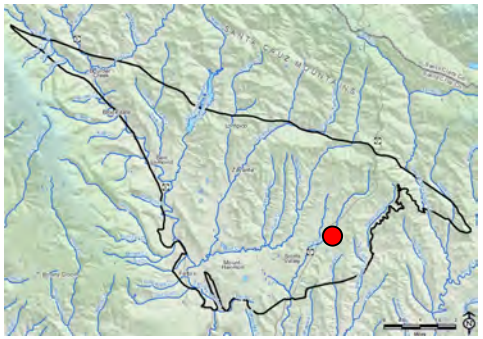
DRAFT

SVWD #15 Monitoring Well
Transducer
Reference Point Elevation

Formation: Confined - Lompico,Butano
Reference Point Elevation: 660 ft AMSL
Screen Interval: 700-1100 ft bgs

Water Year Classification

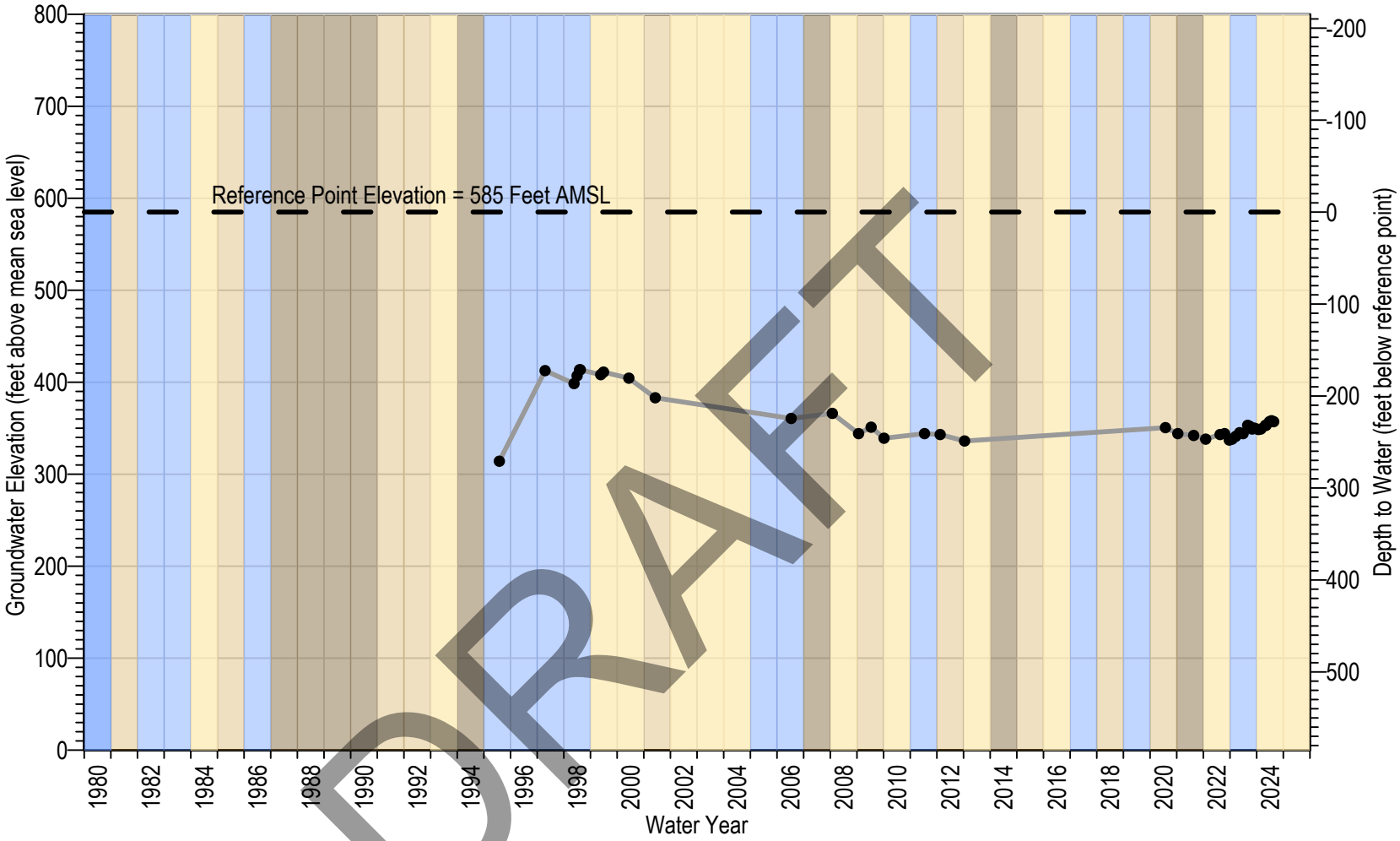
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-38. Hydrograph of SVWD #15 Monitoring Well

MONTGOMERY & ASSOCIATES



DRAFT

SVWD Grace Way

Reference Point Elevation

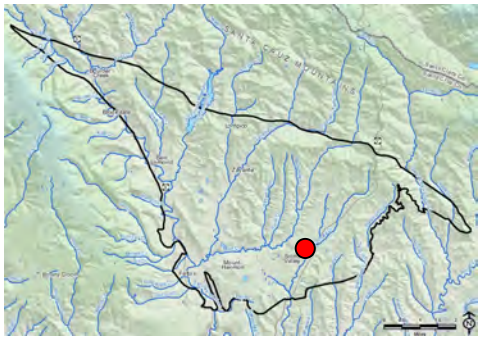
Formation: Confined - Lompico,Butano

Reference Point Elevation: 585 ft AMSL

Screen Interval: 570-700, 720-950 ft bgs

Water Year Classification

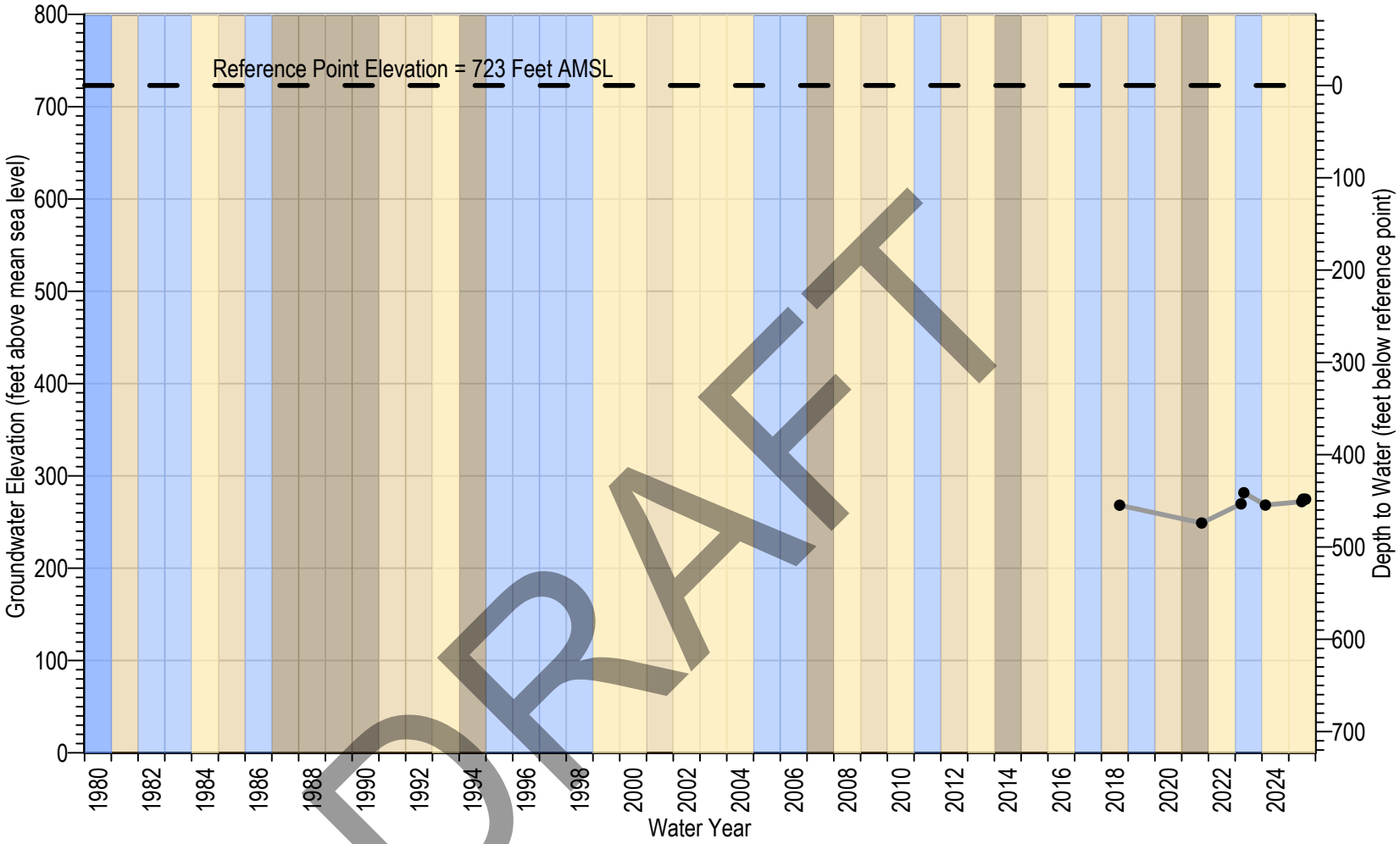
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-39. Hydrograph of SVWD Grace Way

MONTGOMERY & ASSOCIATES



DRAFT

SVWD Orchard Well

Reference Point Elevation

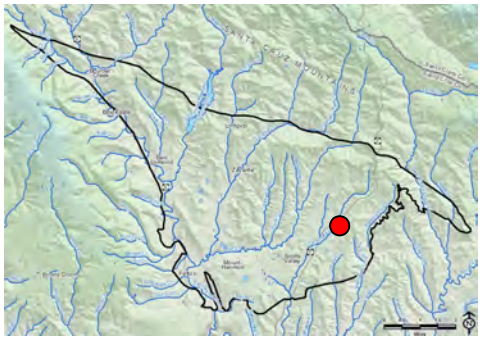
Formation: Confined - Lompico,Butano

Reference Point Elevation: 723 ft AMSL

Screen Interval: 705-784, 805-1063, 1084-1455 ft bgs

Water Year Classification

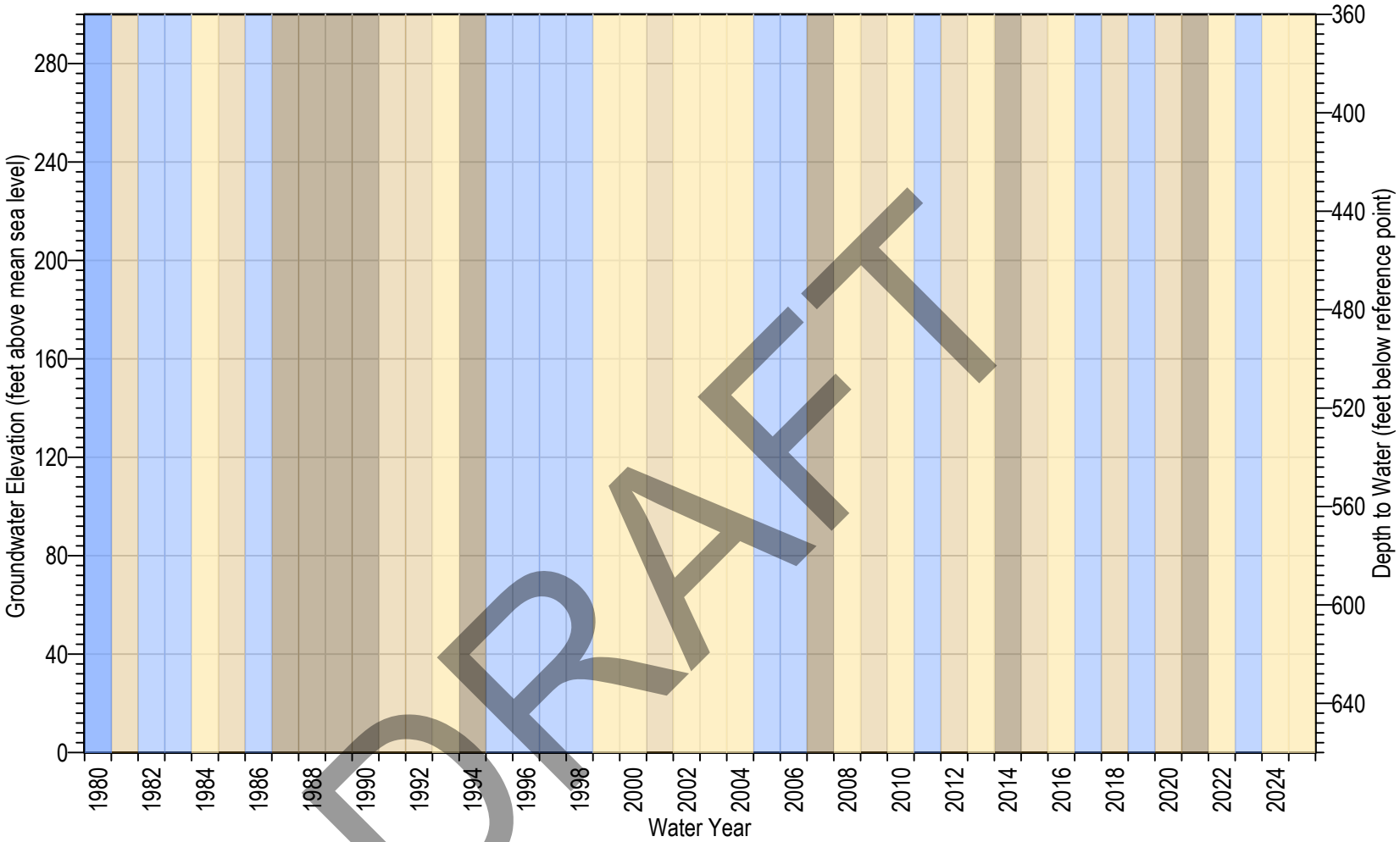
Wet | Dry | Normal | Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-40. Hydrograph of SVWD Orchard Well

MONTGOMERY & ASSOCIATES



DRAFT

SVWD Sucinto Well

Transducer

Reference Point Elevation

Formation: Confined - Lompico,Butano

Reference Point Elevation: 660 ft AMSL

Screen Interval: 700-730, 780-1050, 1070-1390 ft bgs

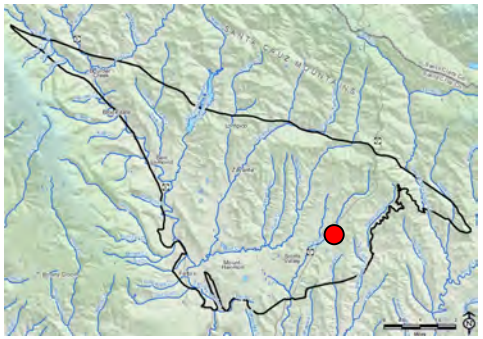
Water Year Classification

Wet

Dry

Normal

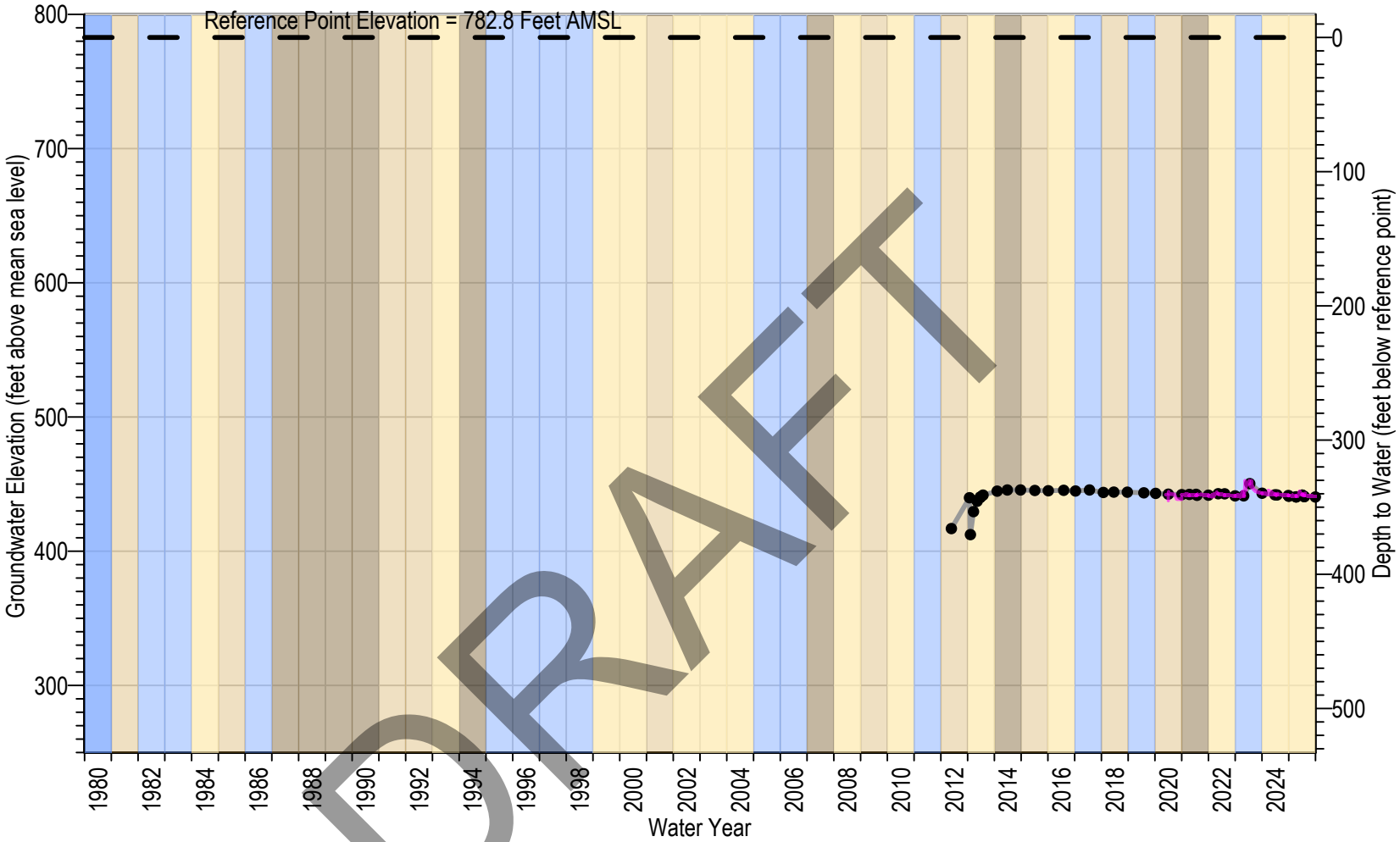
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-41. Hydrograph of SVWD Sucinto Well

MONTGOMERY & ASSOCIATES



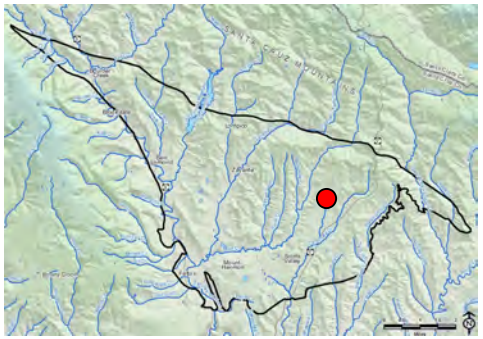
DRAFT

SVWD Canham Well
Transducer
Reference Point Elevation

Formation: Confined - Butano
Reference Point Elevation: 782.8 ft AMSL
Screen Interval: 1,281-1,381 ft bgs

Water Year Classification

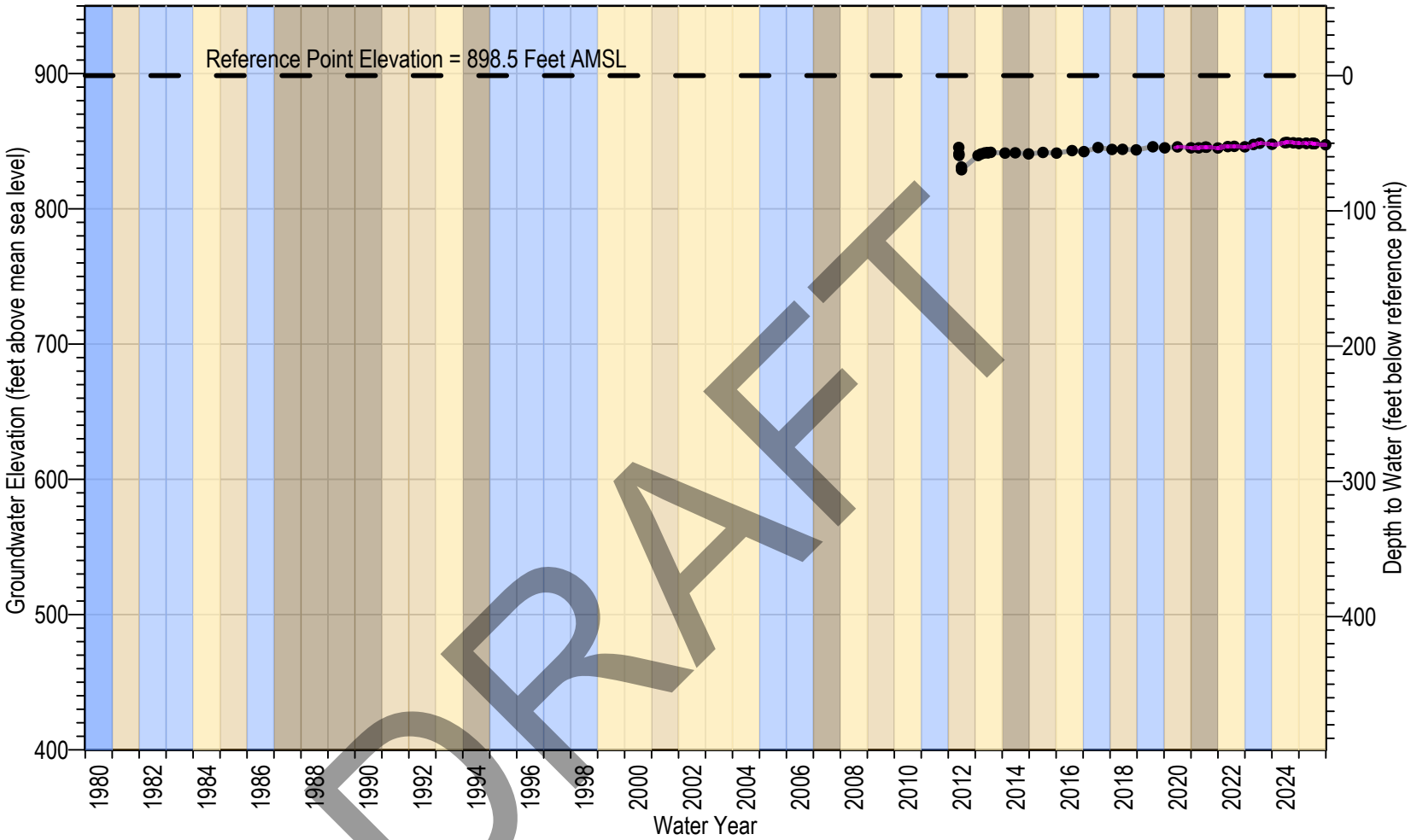
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-42. Hydrograph of SVWD Canham Well

MONTGOMERY & ASSOCIATES



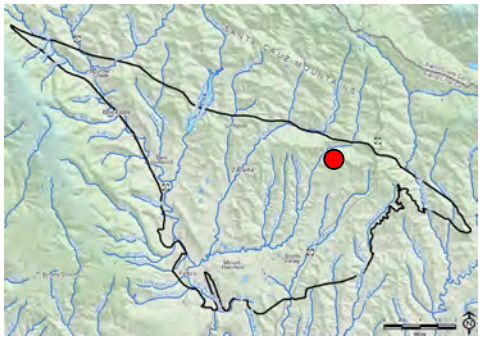
DRAFT

SVWD Stonewood Well
Transducer
Reference Point Elevation

Formation: Confined - Butano
Reference Point Elevation: 898.5 ft AMSL
Screen Interval: 799-859 ft bgs

Water Year Classification

Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 4A-43. Hydrograph of SVWD Stonewood Well

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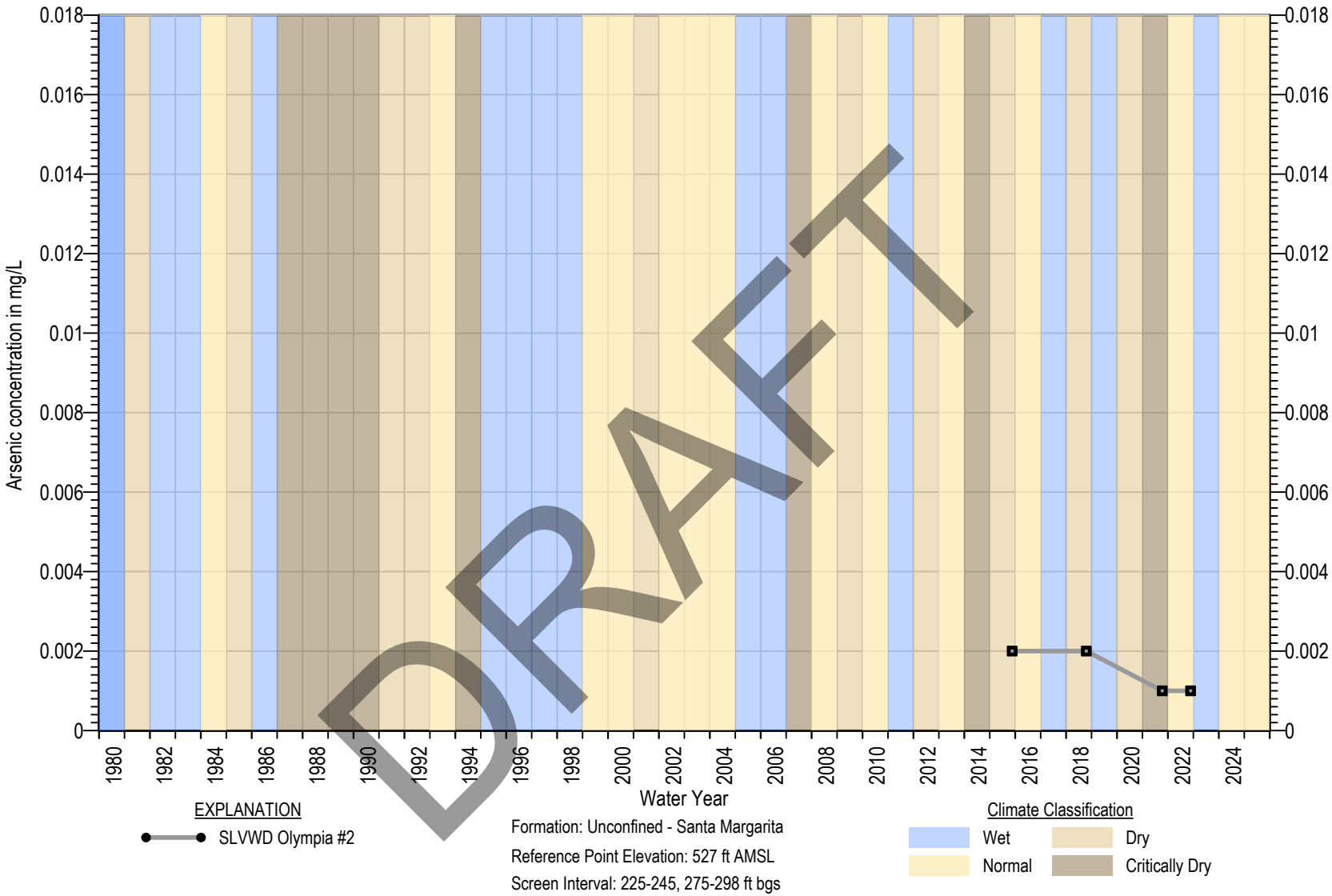
Appendix 4B

Well Chemographs

DRAFT

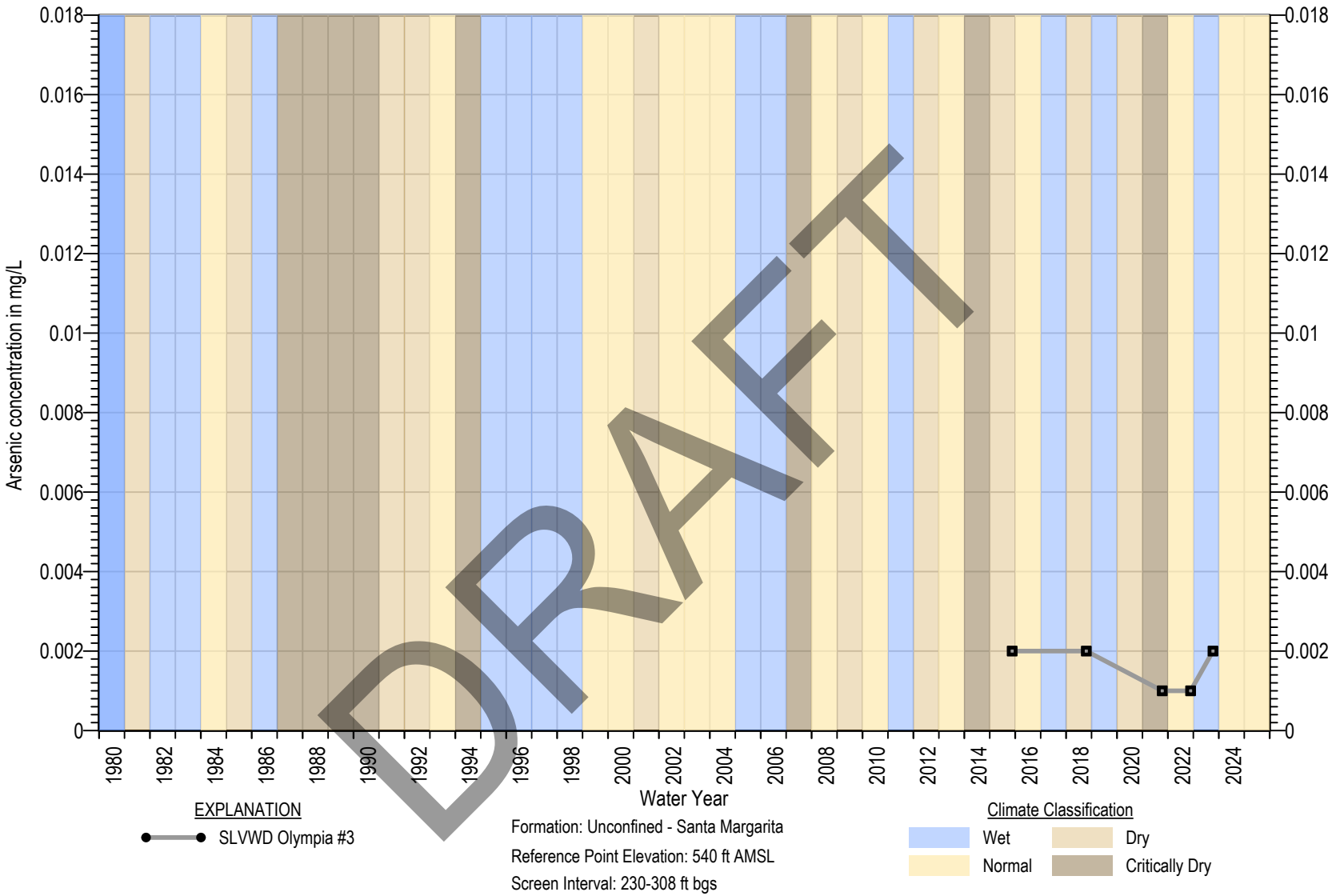


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-1. Arsenic Chemograph of SLVWD Olympia #2

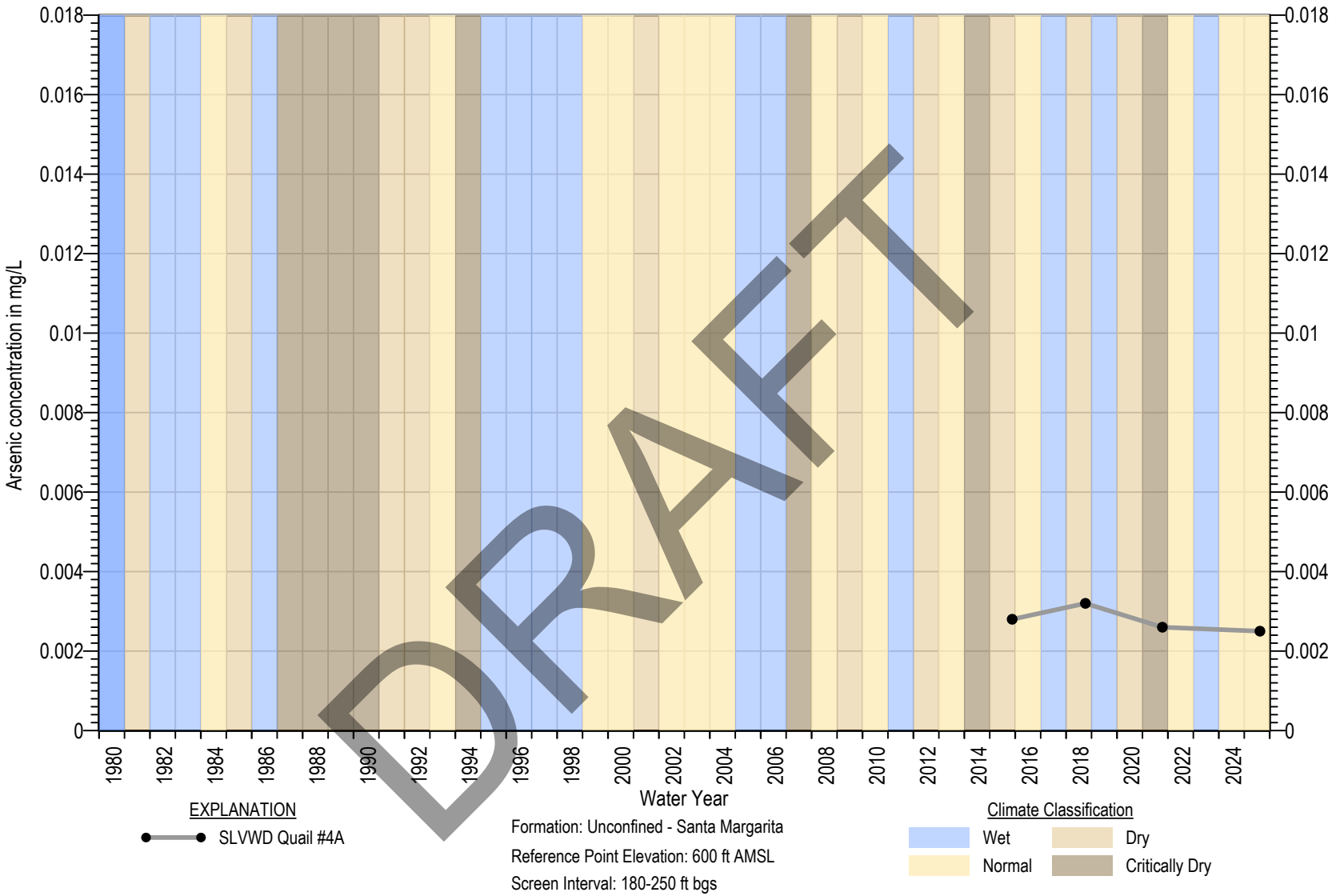
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-2. Arsenic Chemograph of SLVWD Olympia #3

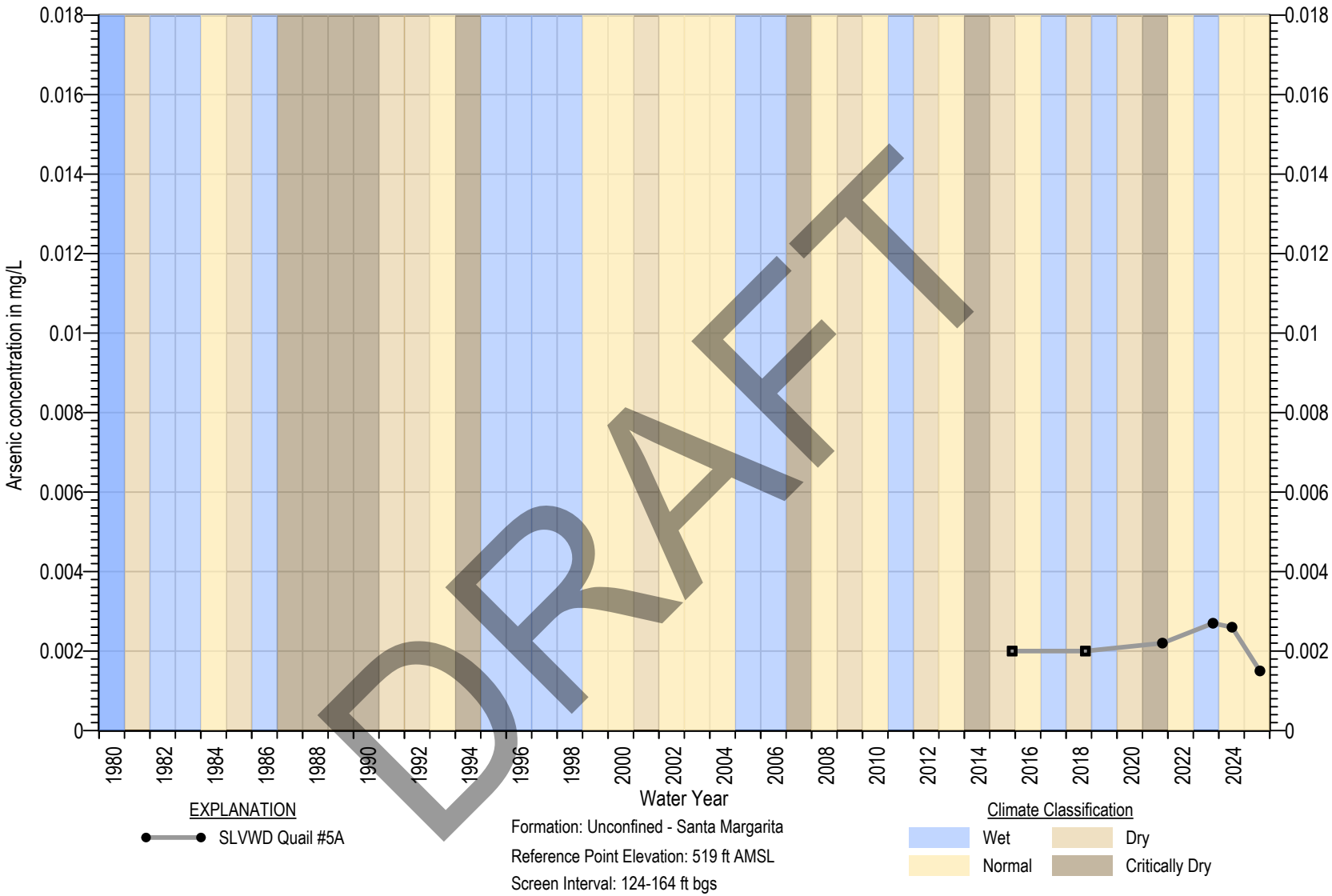
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-3. Arsenic Chemograph of SLVWD Quail #4A

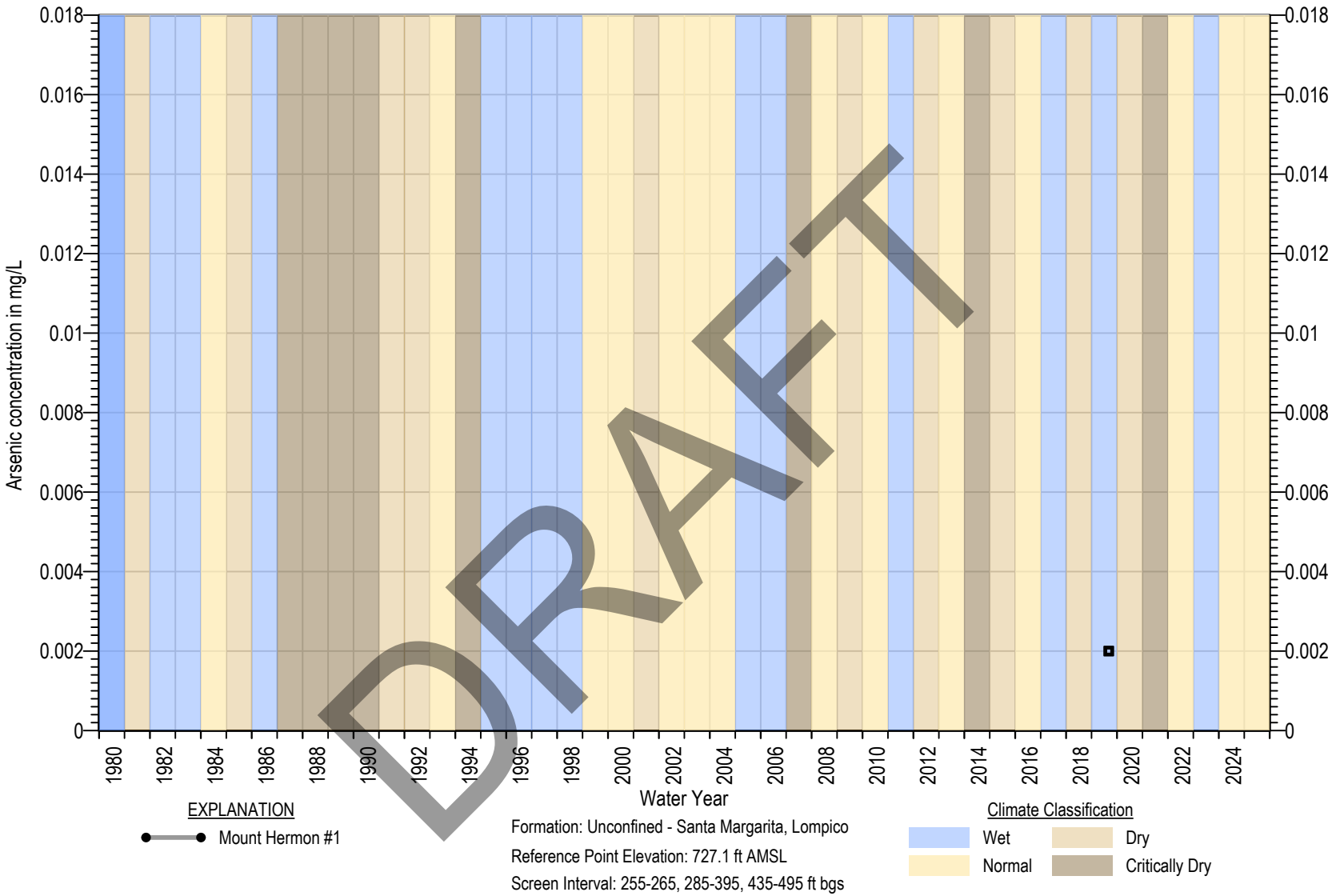
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-4. Arsenic Chemograph of SLVWD Quail #5A

MONTGOMERY & ASSOCIATES

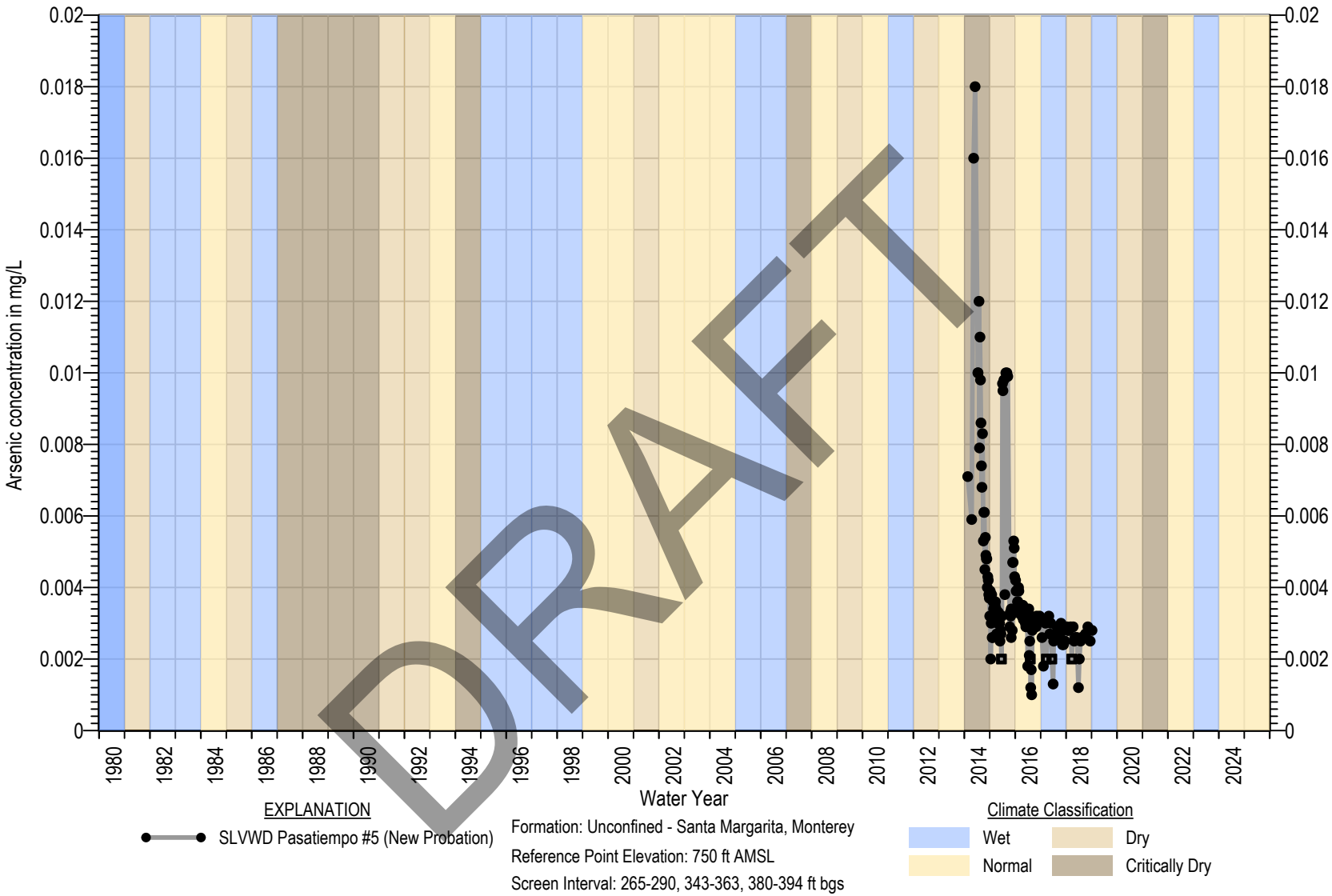


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-5. Arsenic Chemograph of Mount Hermon #1

MONTGOMERY & ASSOCIATES

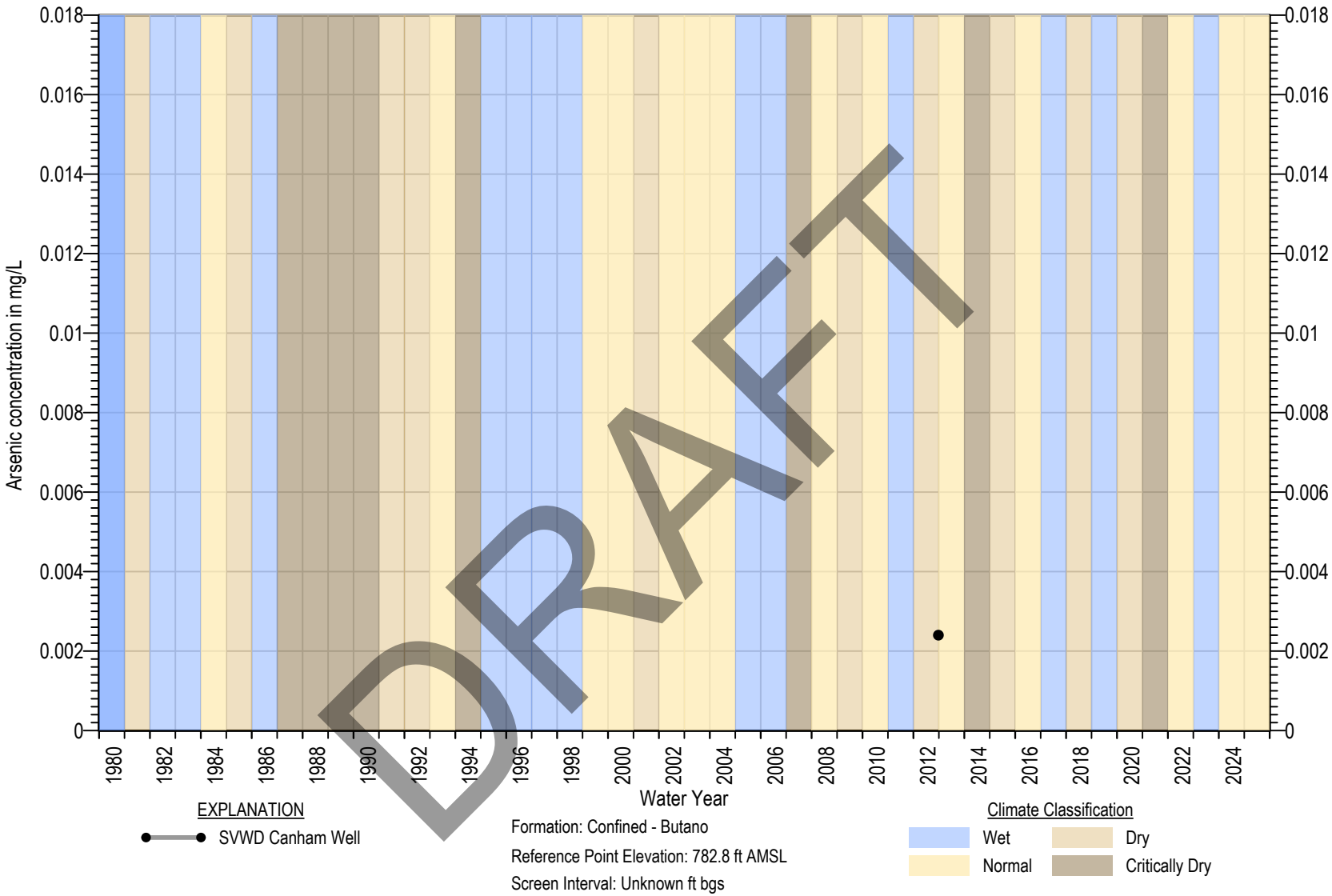


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-6. Arsenic Chemograph of SLVWD Pasatiempo #5 (New Probation)

MONTGOMERY & ASSOCIATES

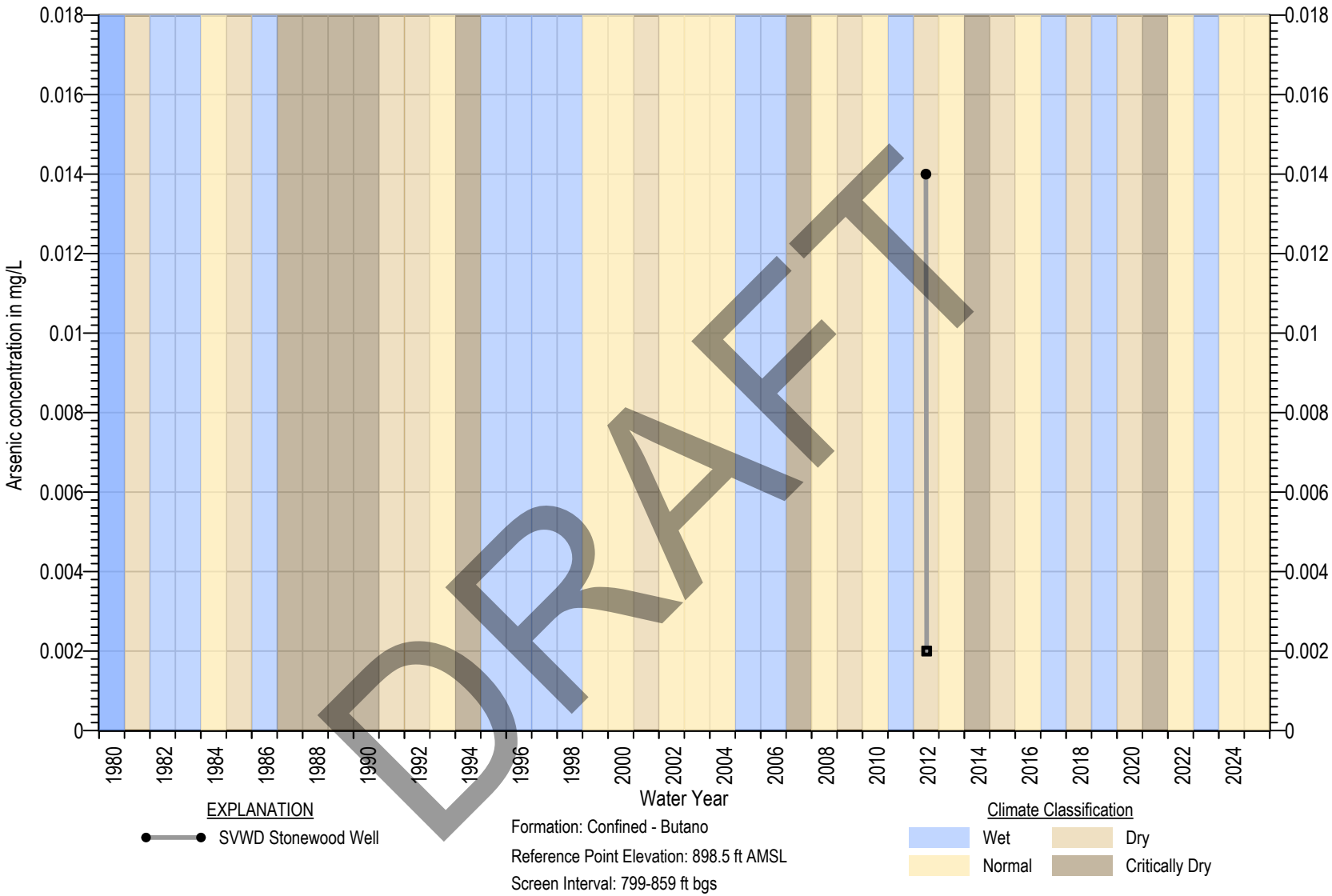


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-7. Arsenic Chemograph of SVWD Canham Well

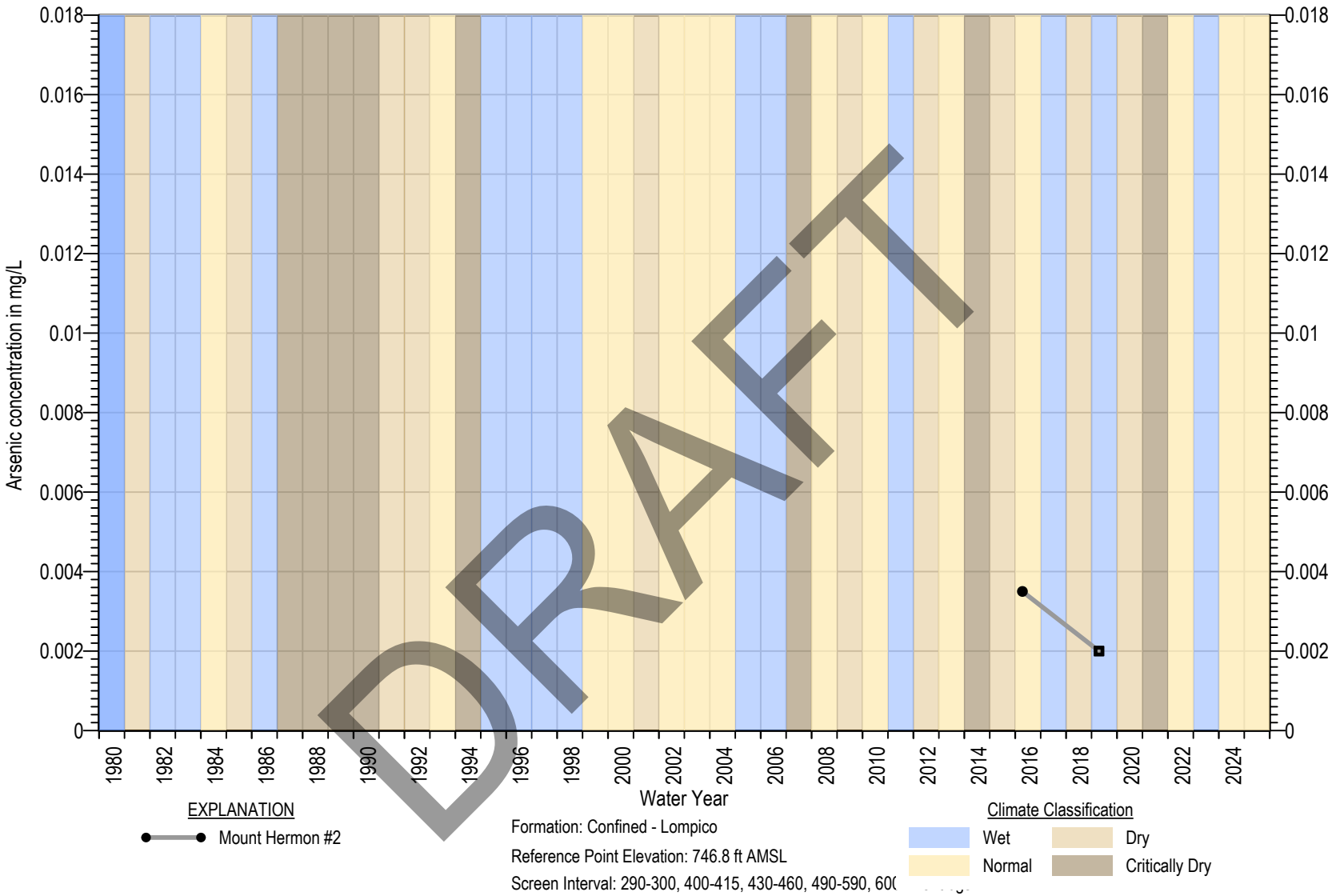
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-8. Arsenic Chemograph of SVWD Stonewood Well

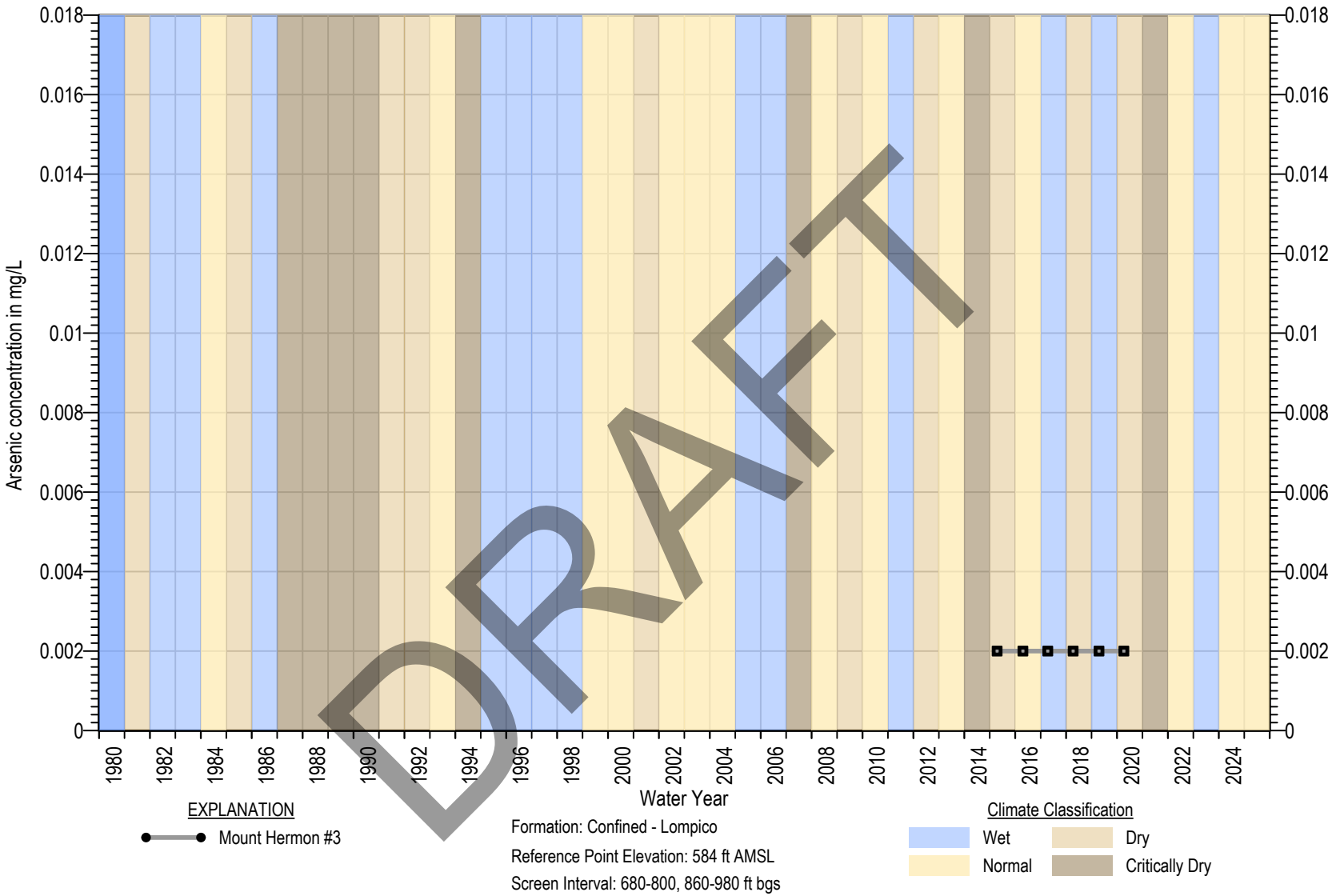
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-9. Arsenic Chemograph of Mount Hermon #2

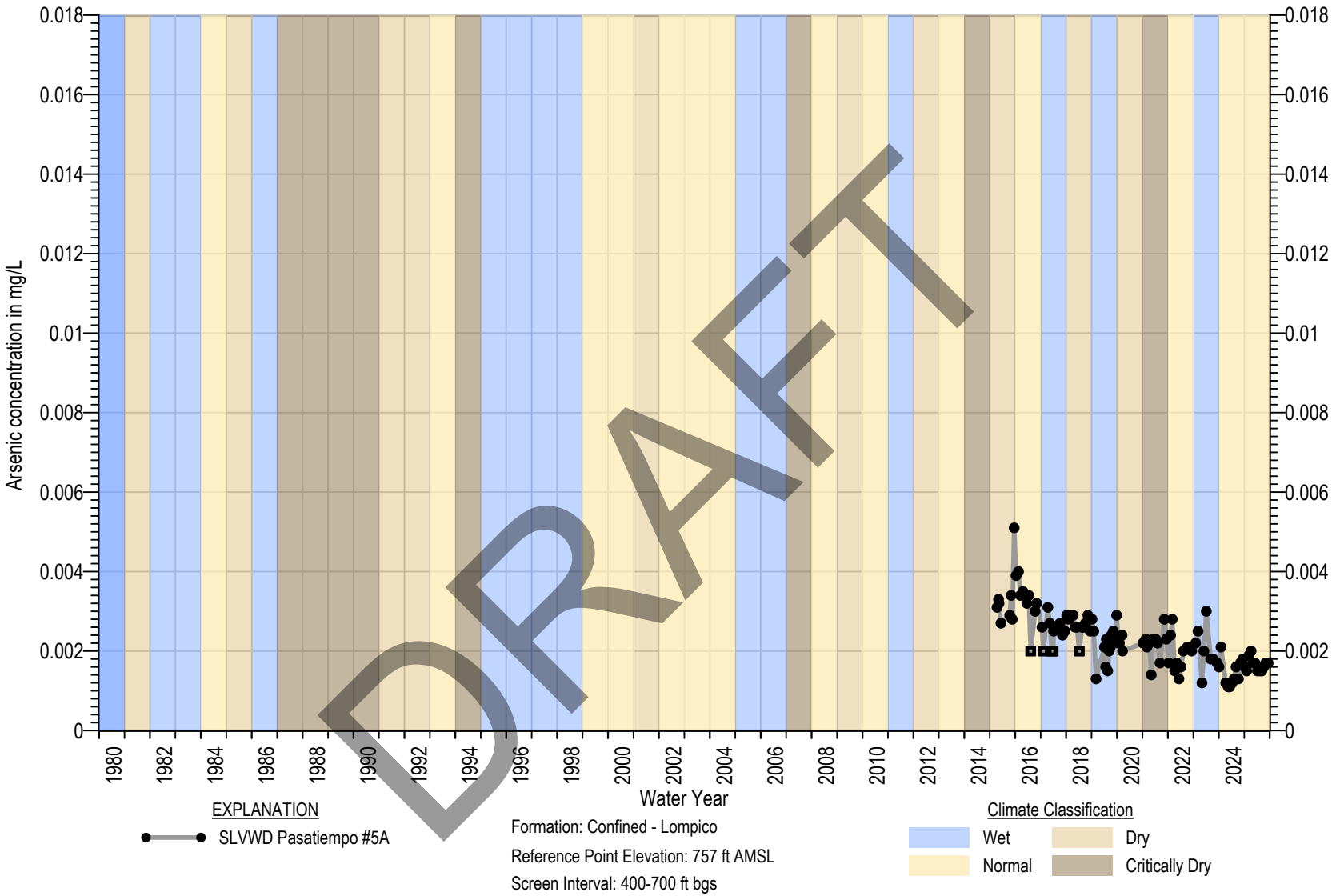
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-10. Arsenic Chemograph of Mount Hermon #3

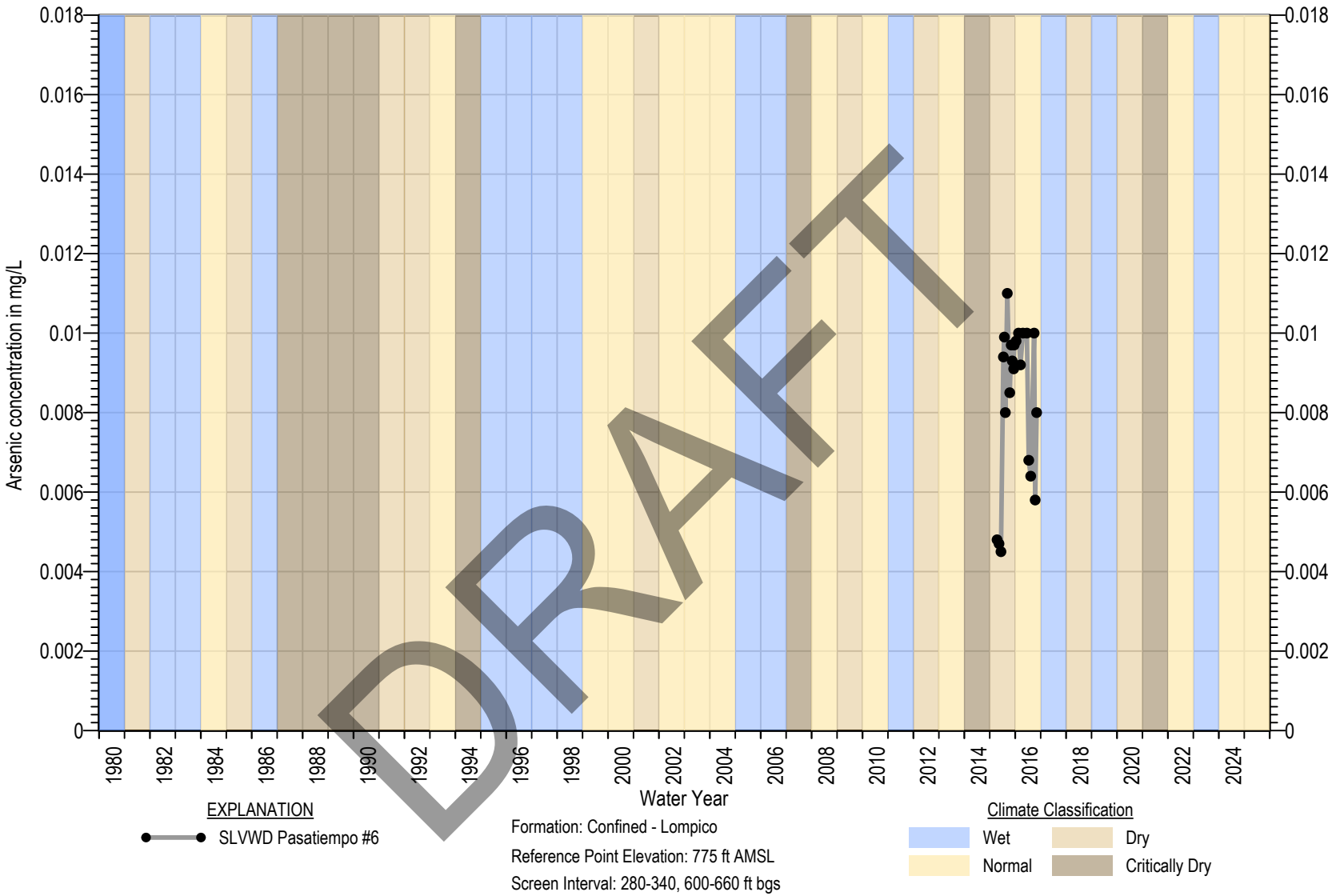
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-11. Arsenic Chemograph of SLVWD Pasatiempo #5A

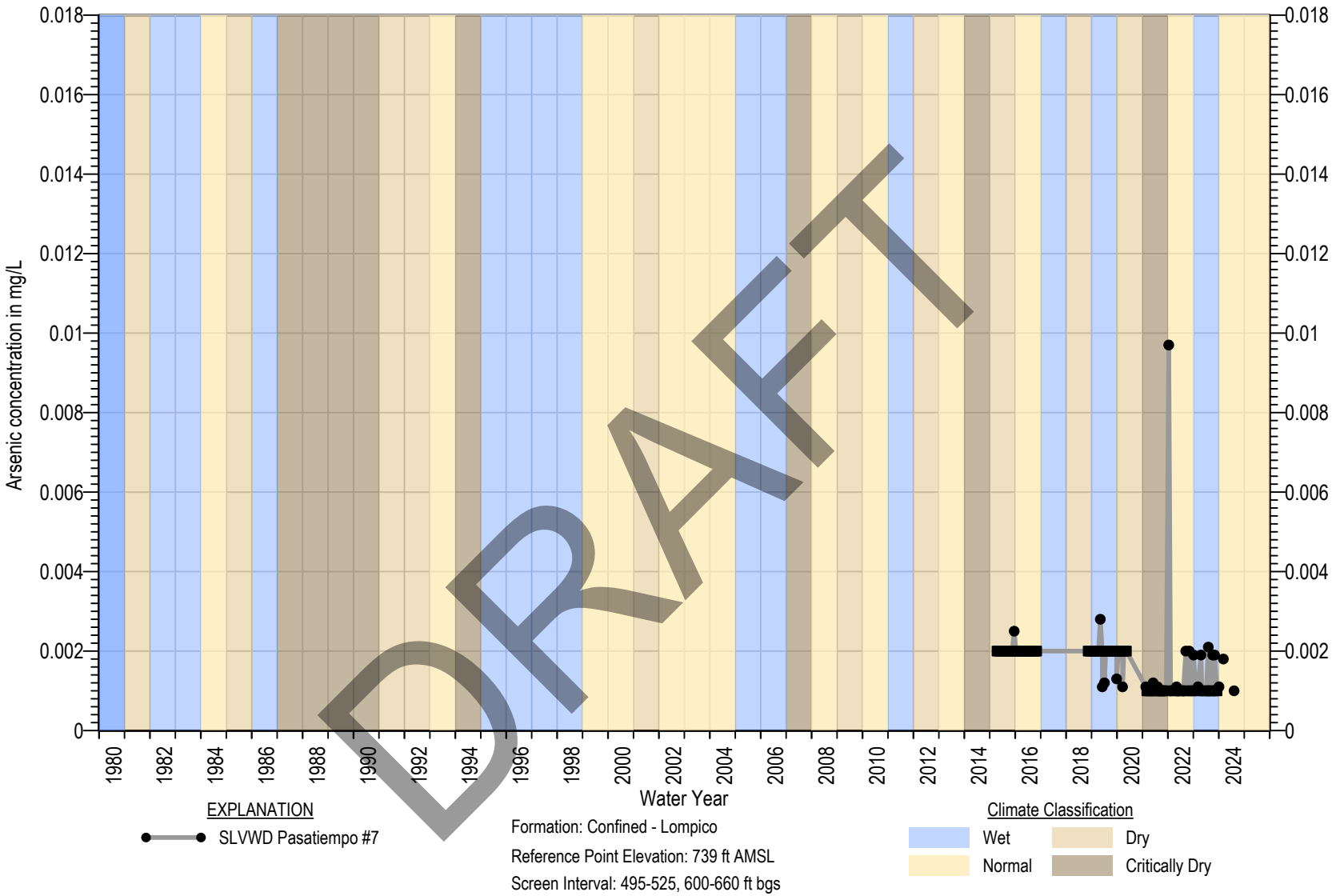
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-12. Arsenic Chemograph of SLVWD Pasatiempo #6

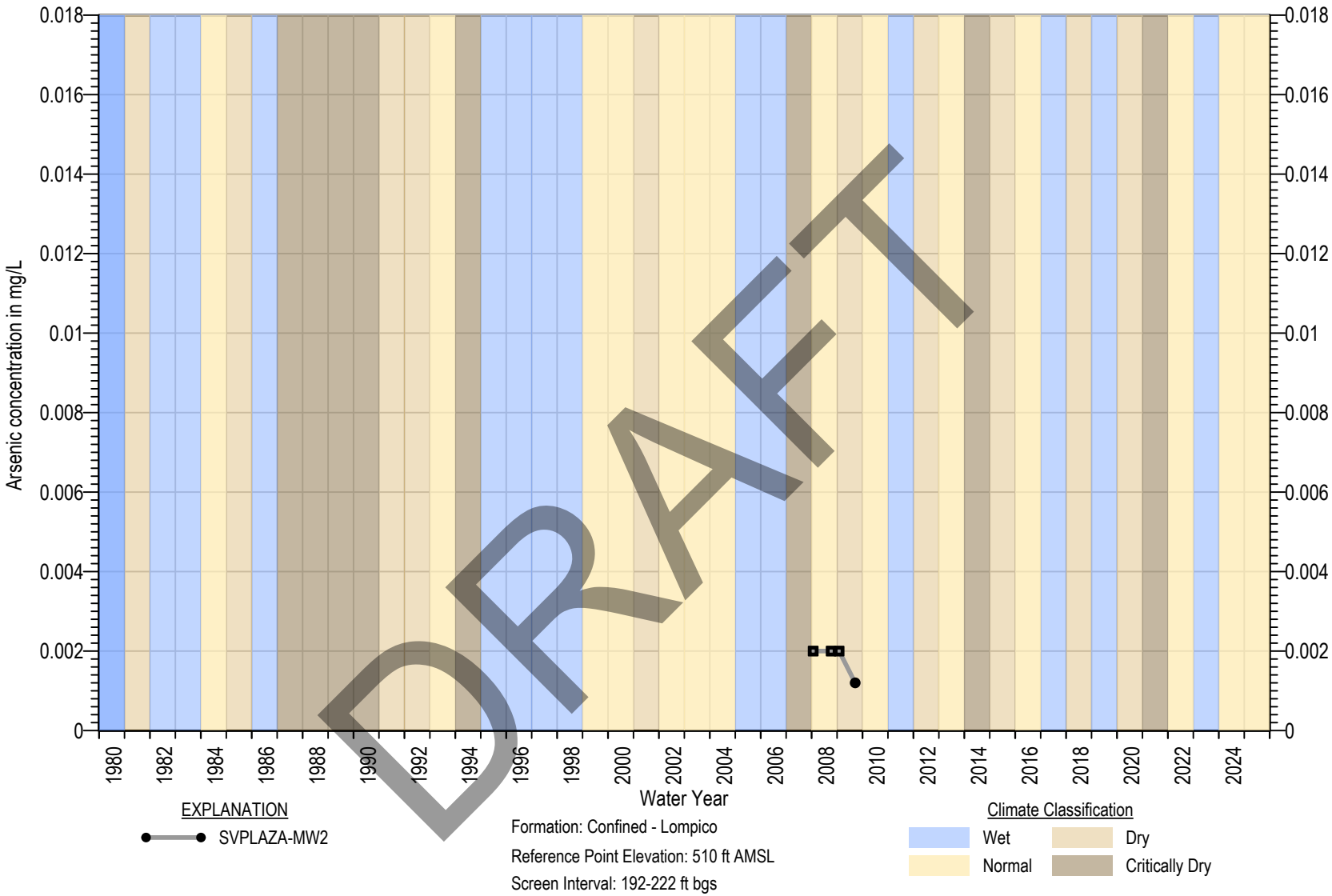
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-13. Arsenic Chemograph of SLVWD Pasatiempo #7

MONTGOMERY & ASSOCIATES

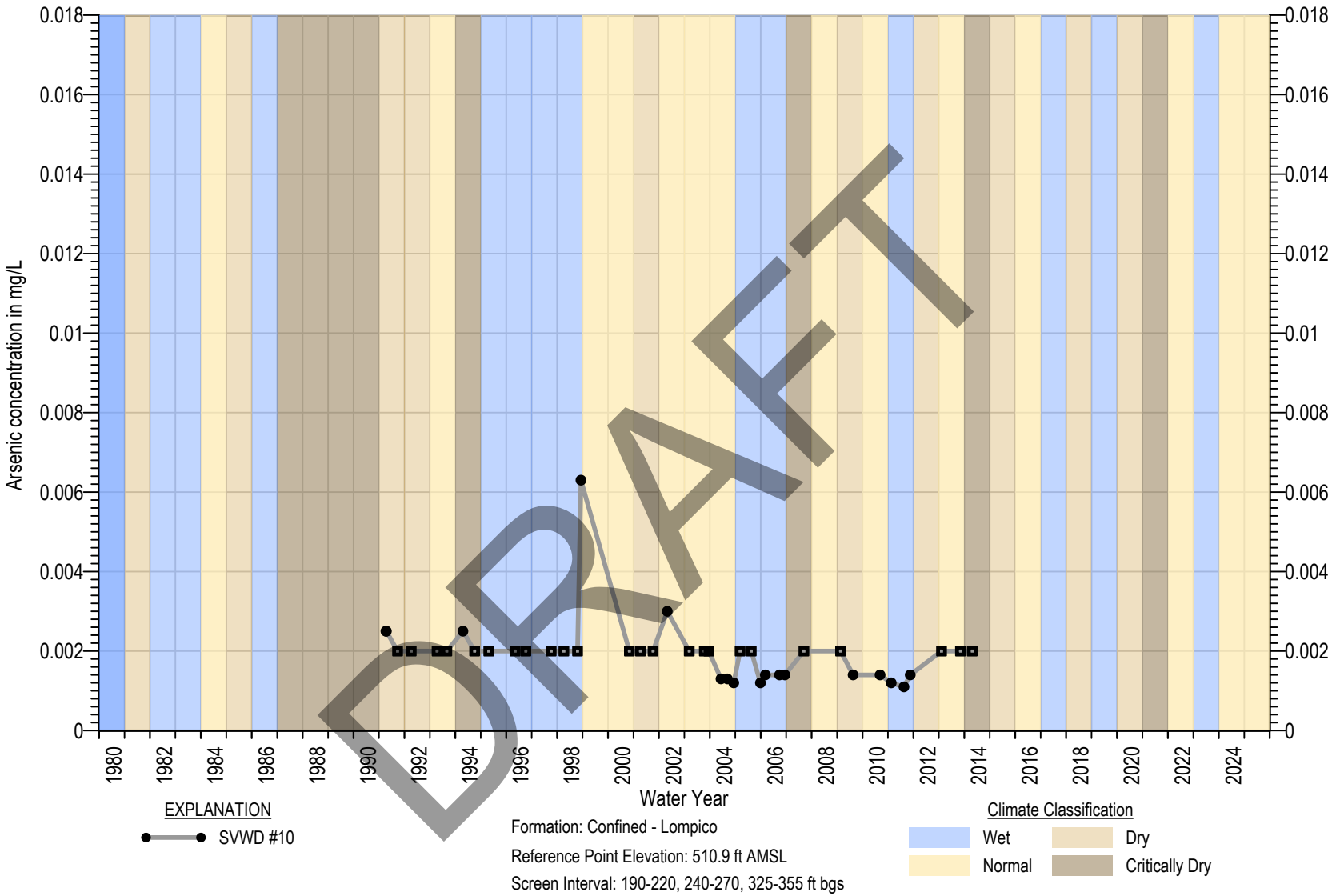


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-14. Arsenic Chemograph of SVPLAZA-MW2

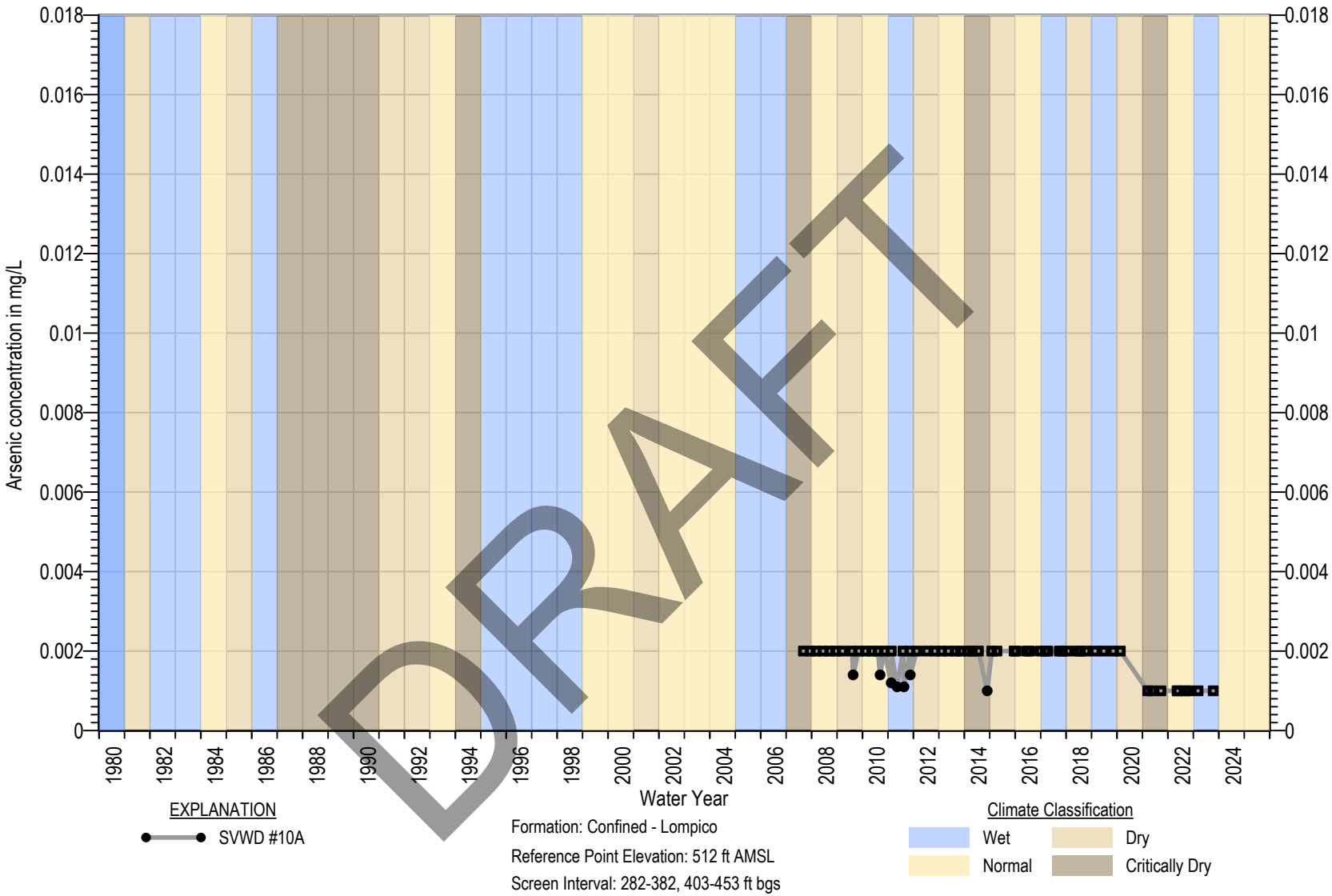
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-15. Arsenic Chemograph of SVWD #10

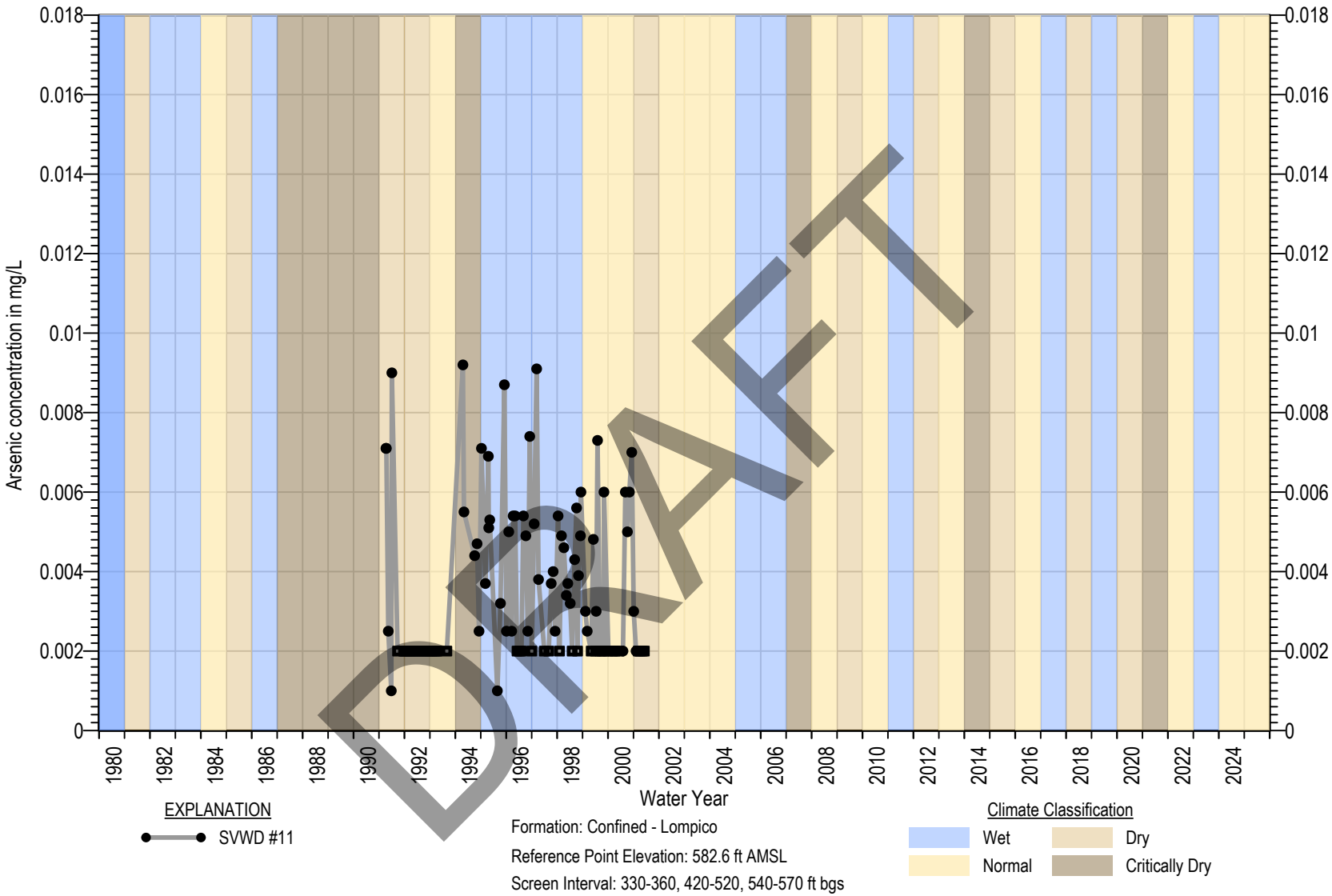
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-16. Arsenic Chemograph of SVWD #10A

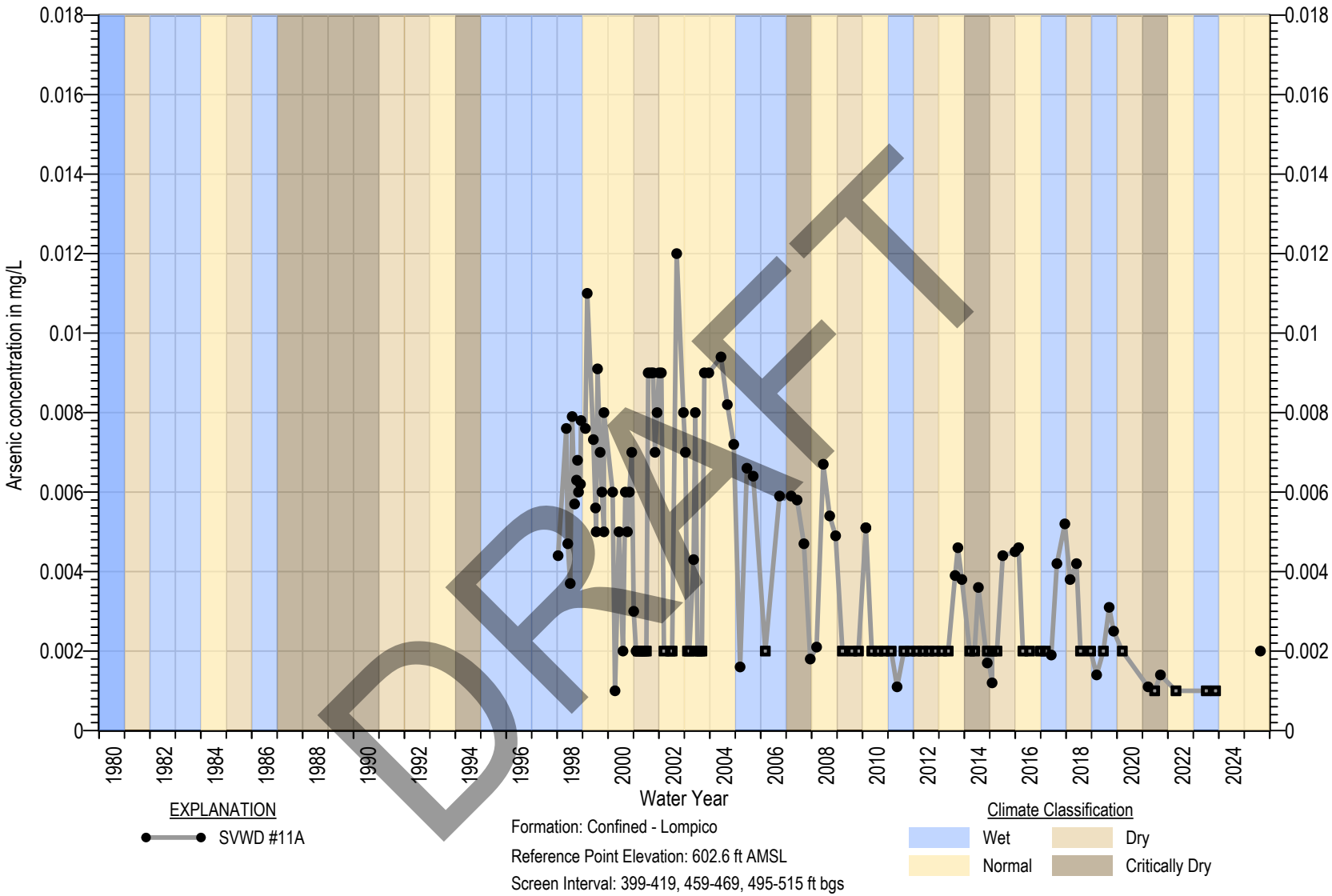
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-17. Arsenic Chemograph of SVWD #11

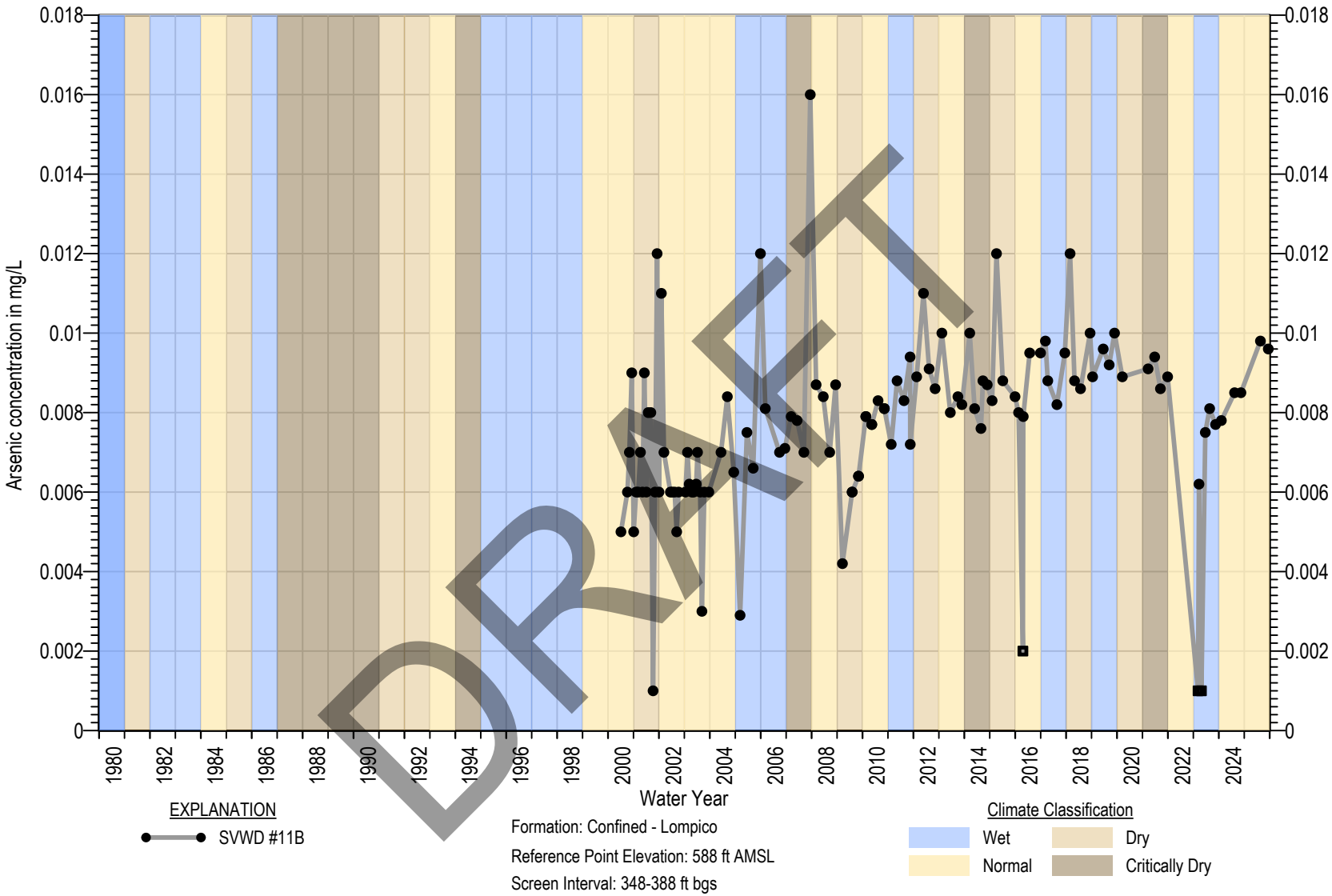
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-18. Arsenic Chemograph of SVWD #11A

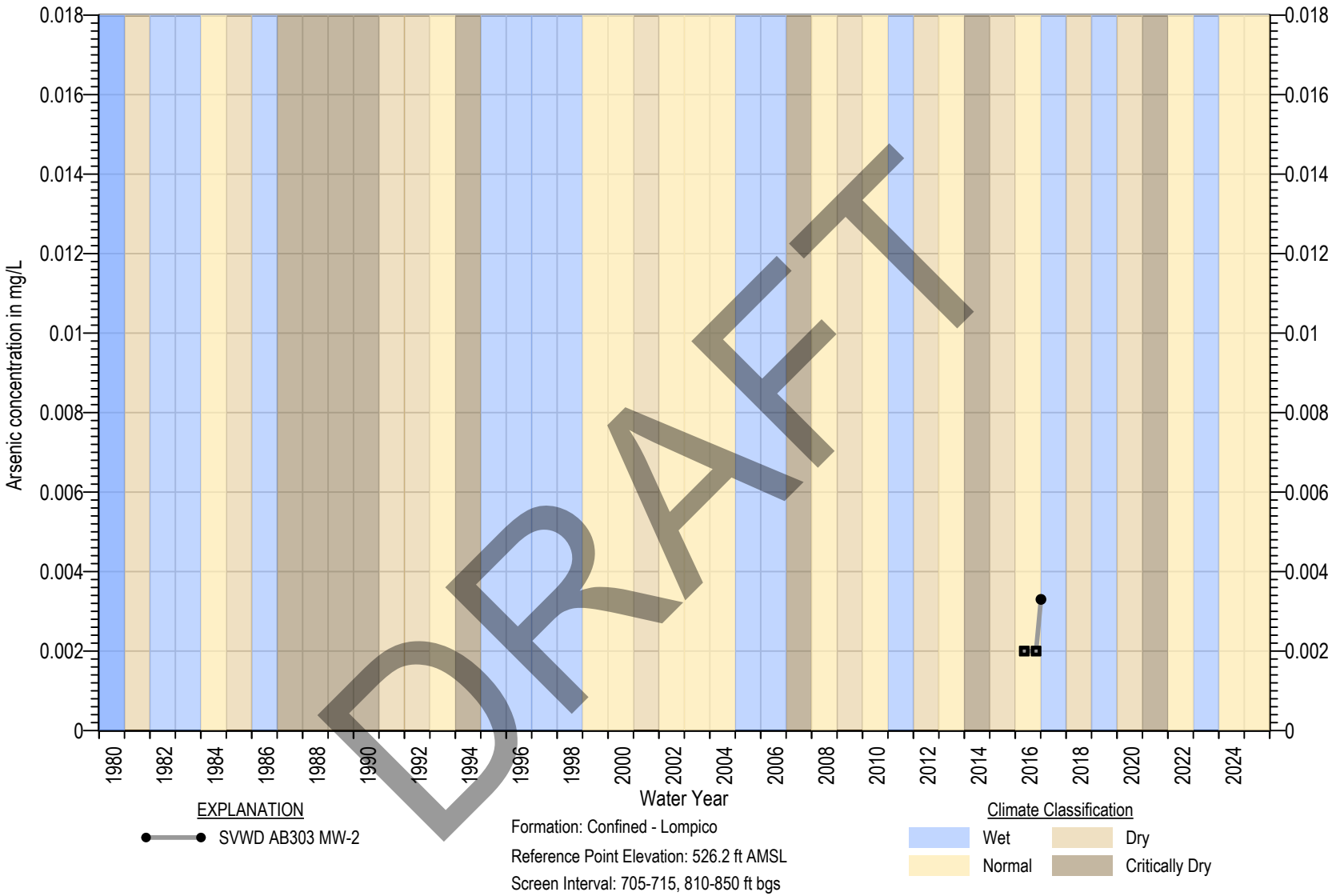
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-19. Arsenic Chemograph of SVWD #11B

MONTGOMERY & ASSOCIATES



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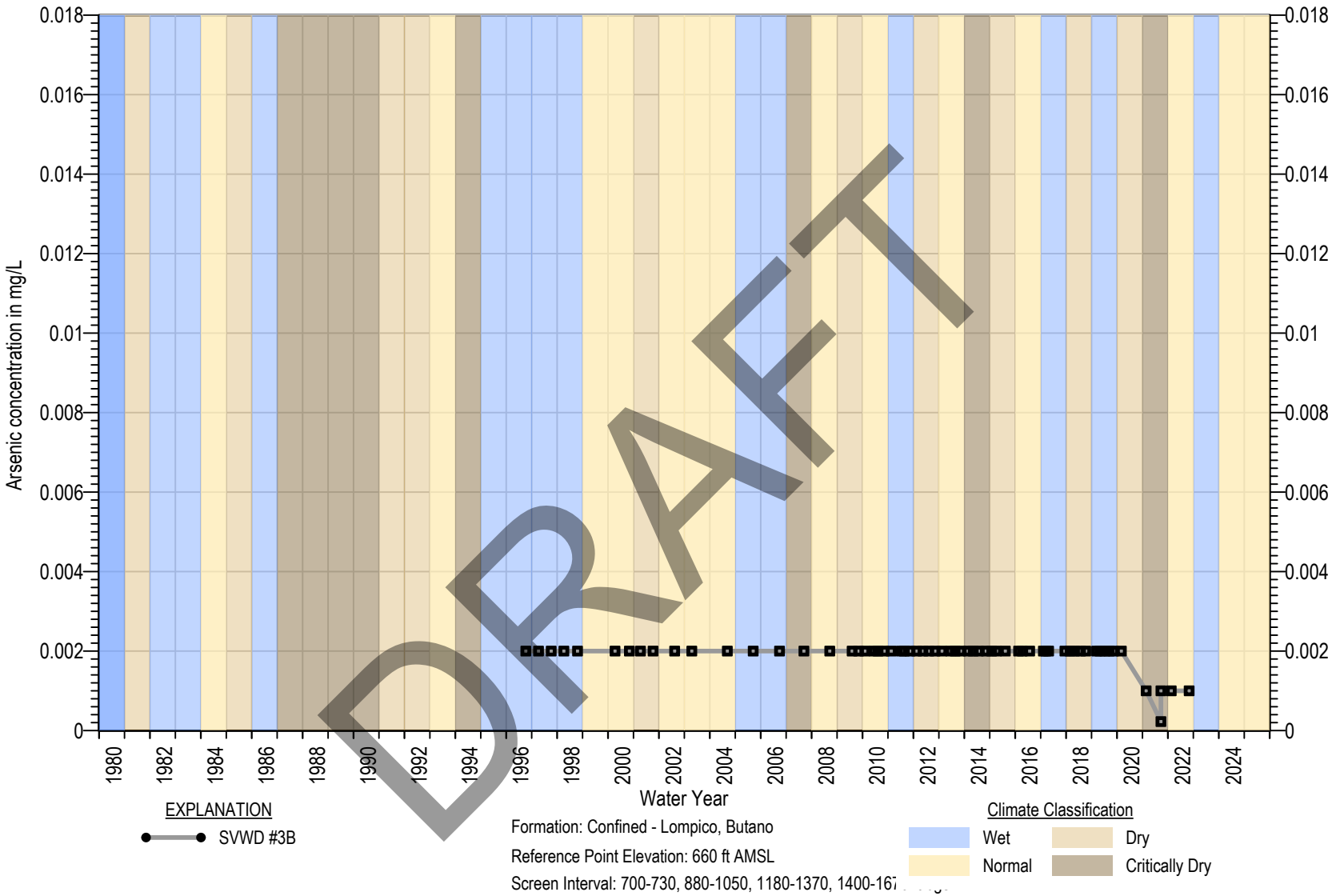
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-20. Arsenic Chemograph of SVWD AB303 MW-2

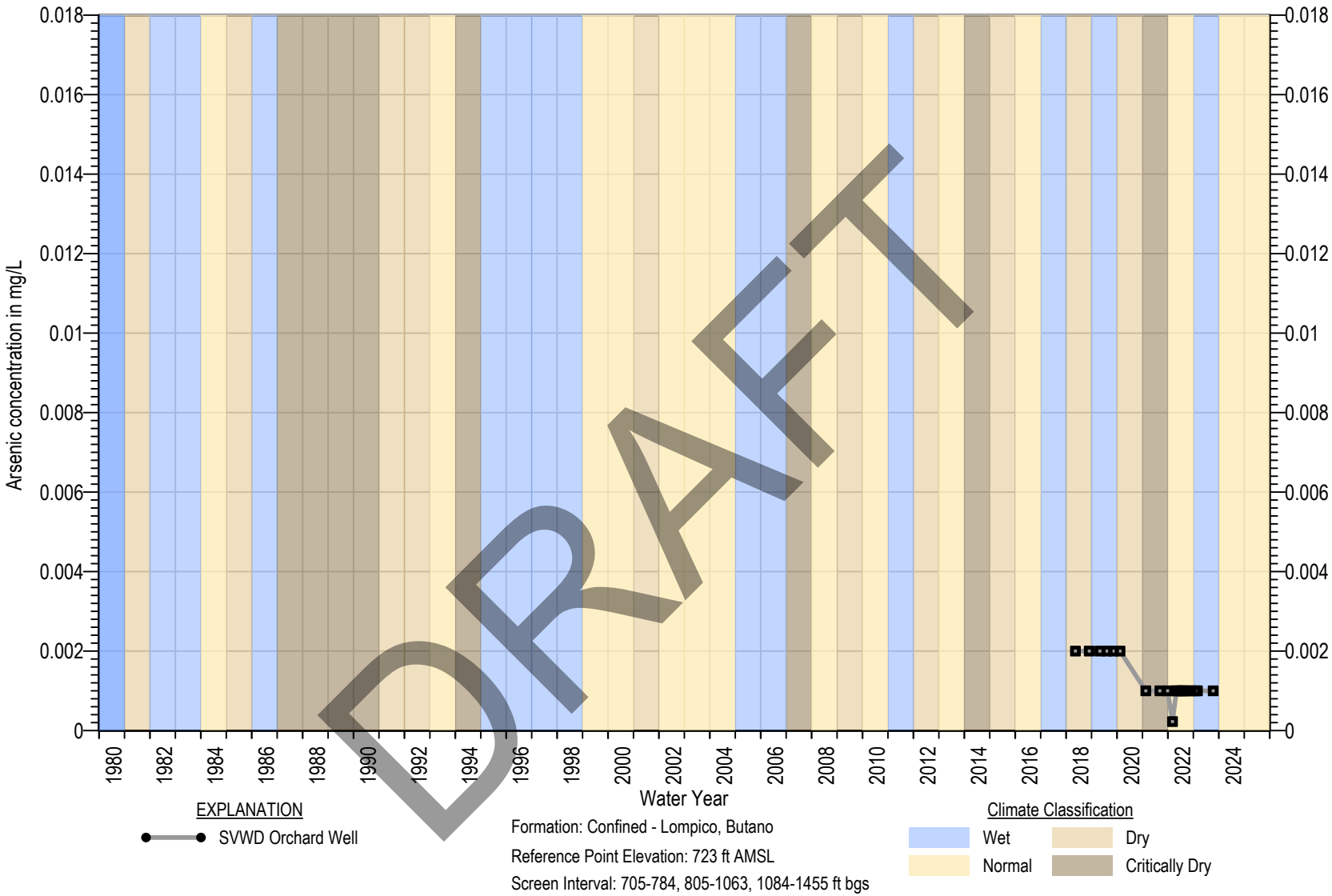
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-21. Arsenic Chemograph of SVWD #3B

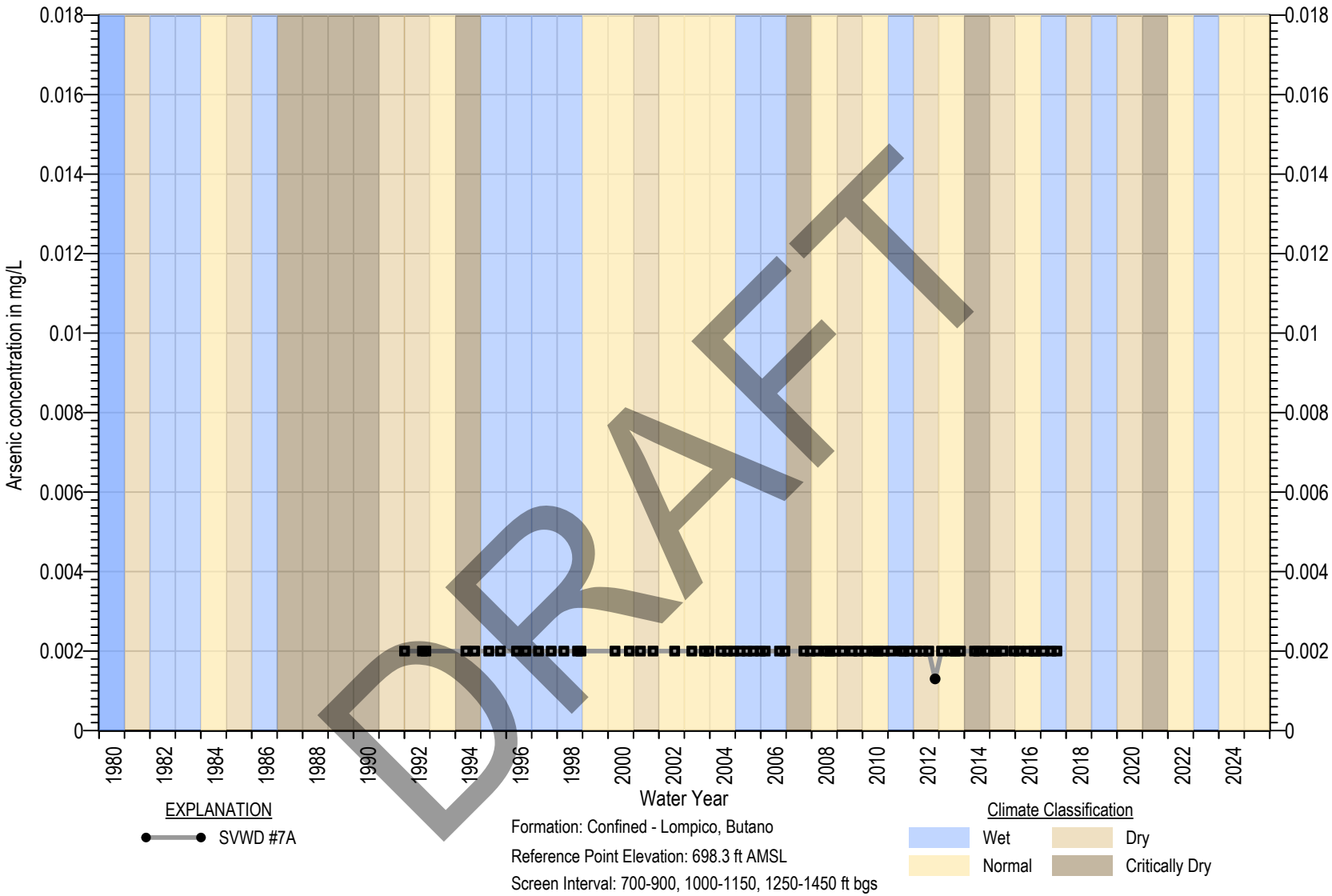
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-22. Arsenic Chemograph of SVWD Orchard Well

MONTGOMERY & ASSOCIATES



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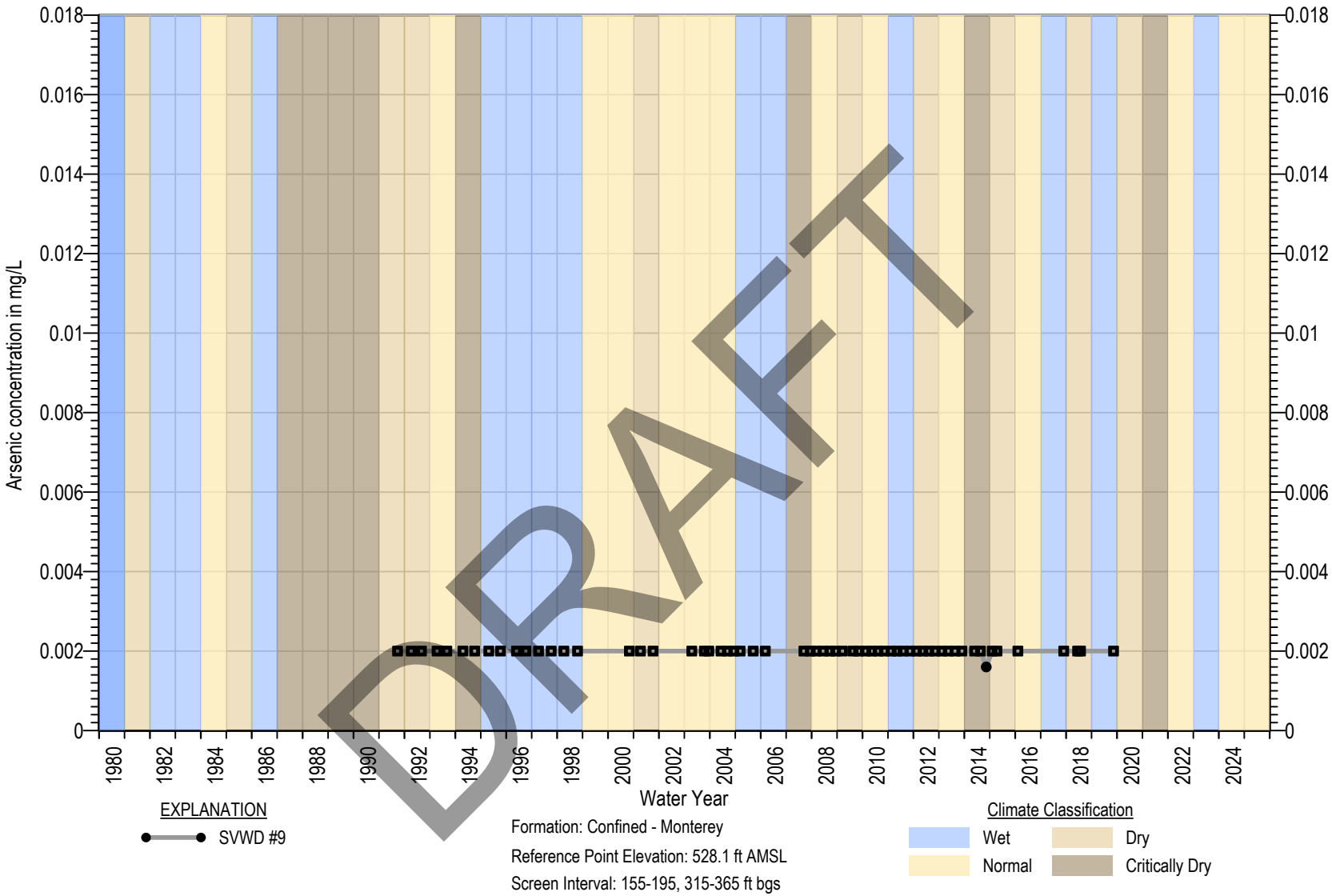
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-23. Arsenic Chemograph of SVWD #7A

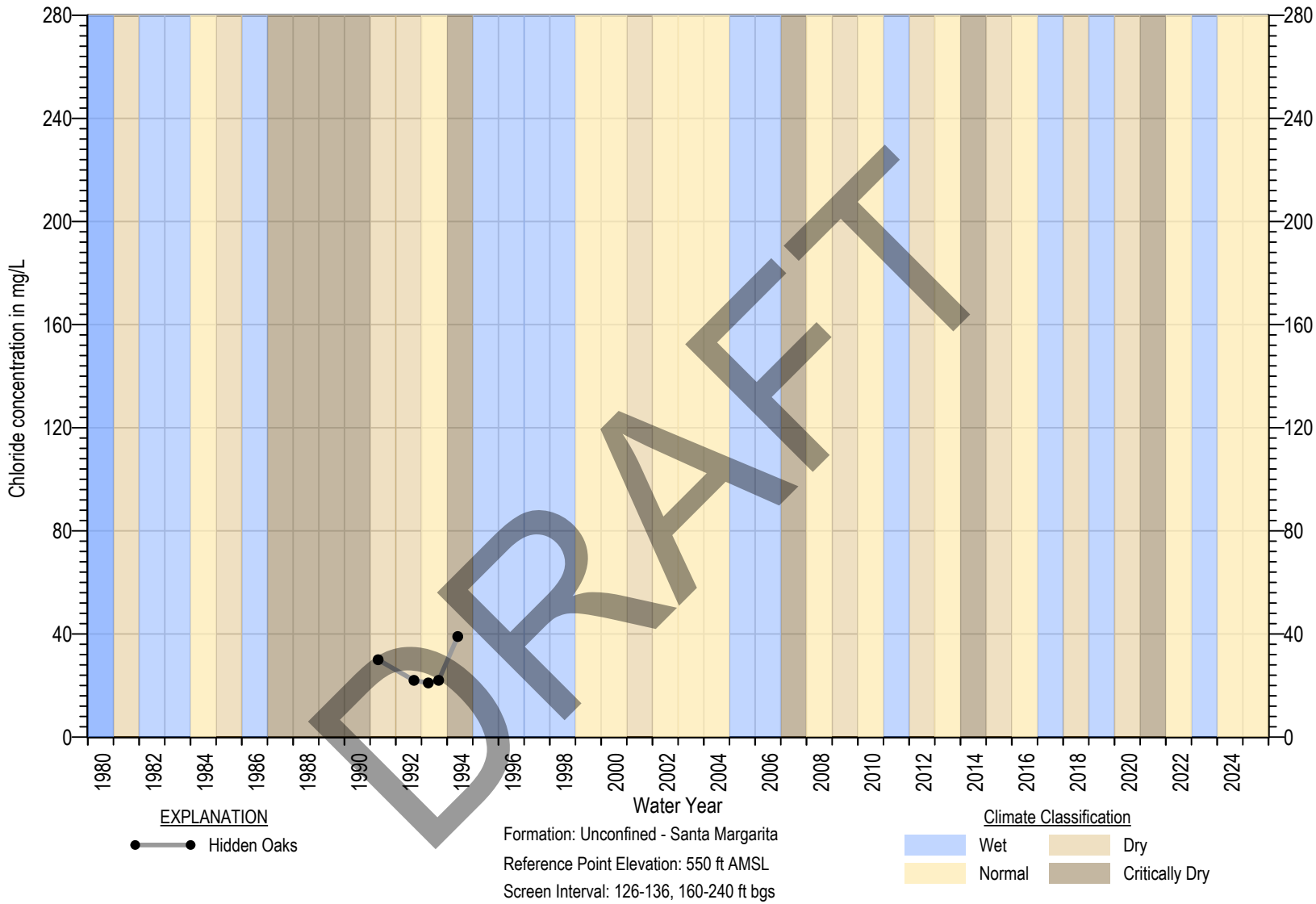
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-24. Arsenic Chemograph of SVWD #9

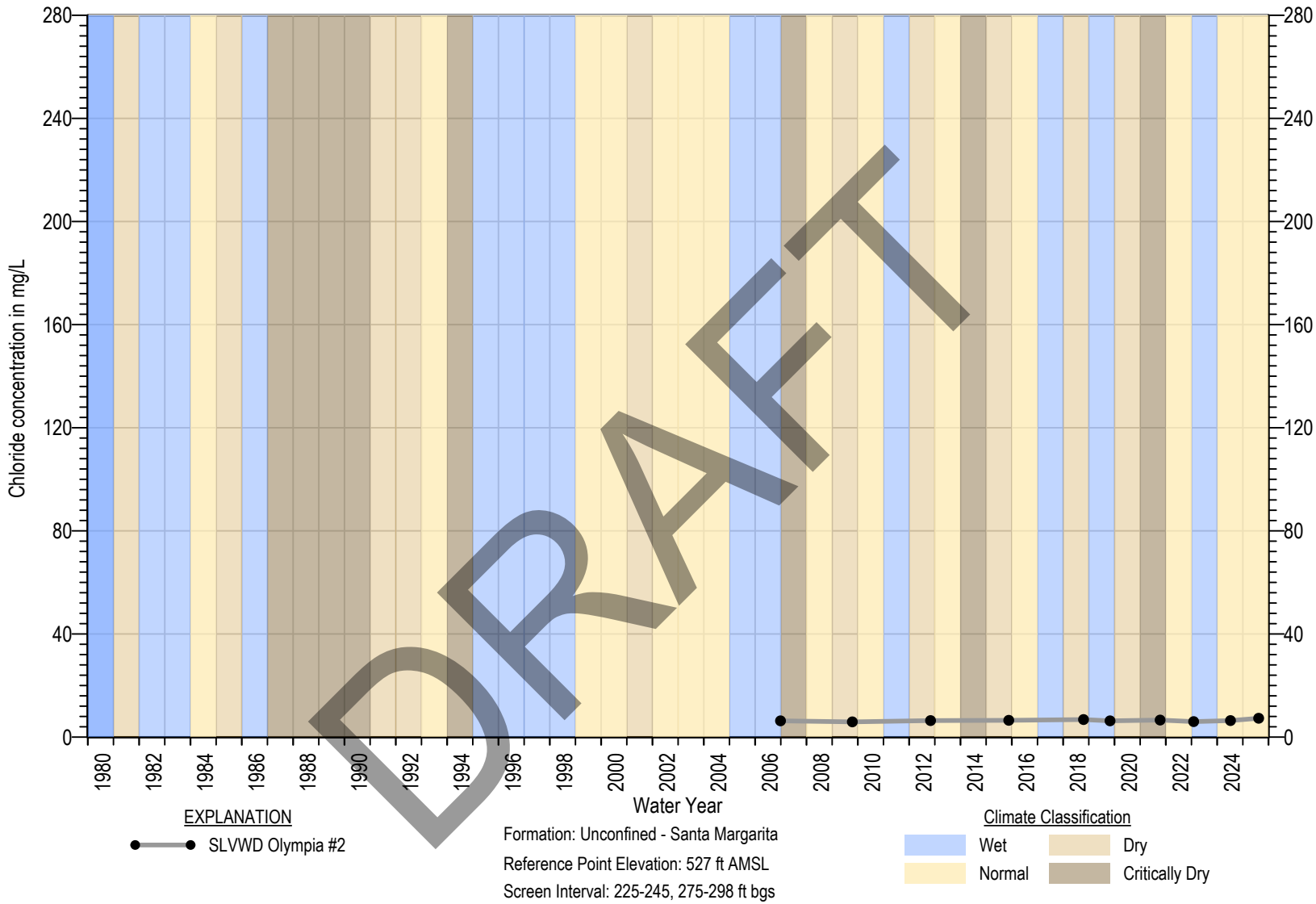
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-25. Chloride Chemograph of Hidden Oaks

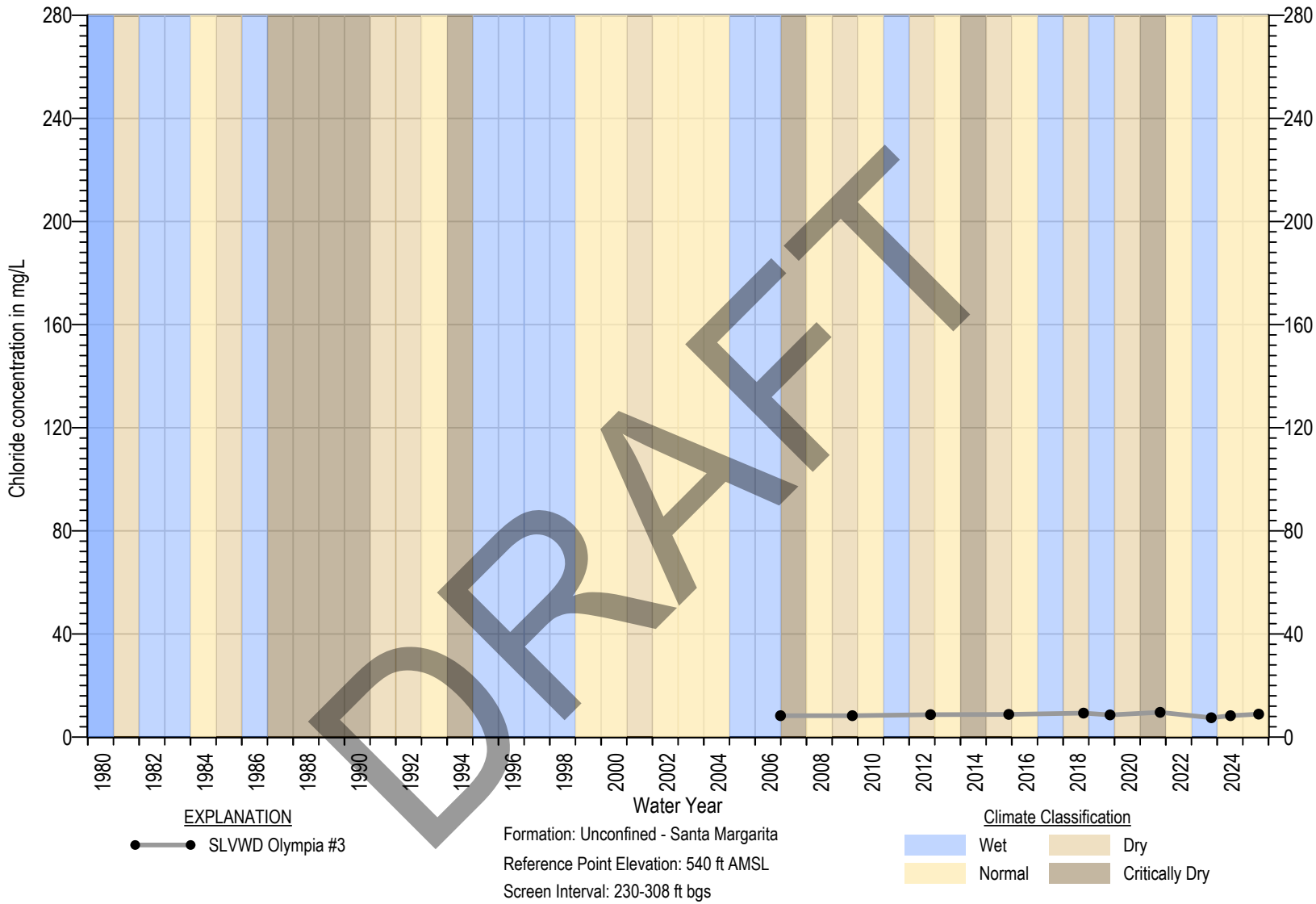
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-26. Chloride Chemograph of SLVWD Olympia #2

MONTGOMERY & ASSOCIATES



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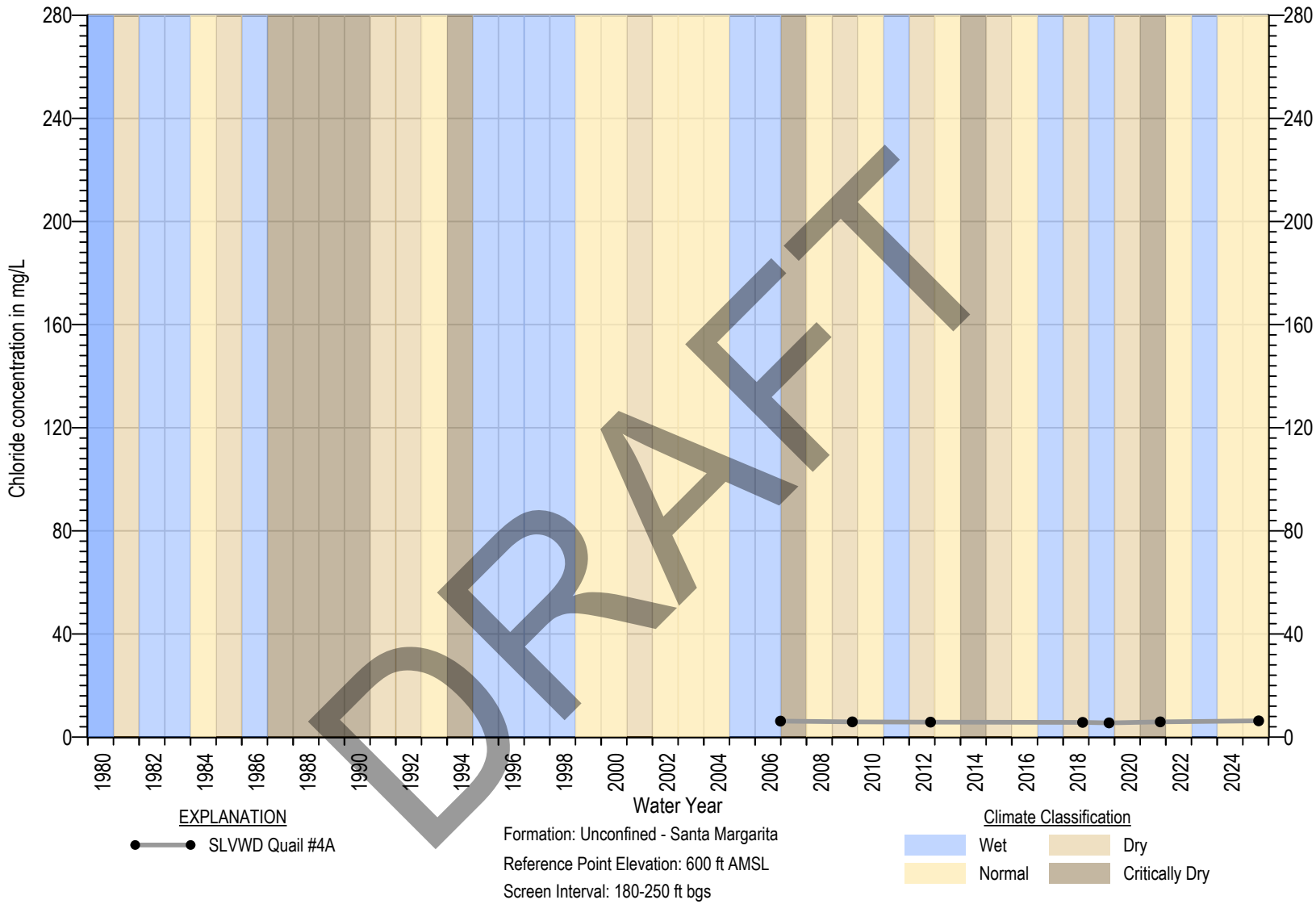
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-27. Chloride Chemograph of SLVWD Olympia #3

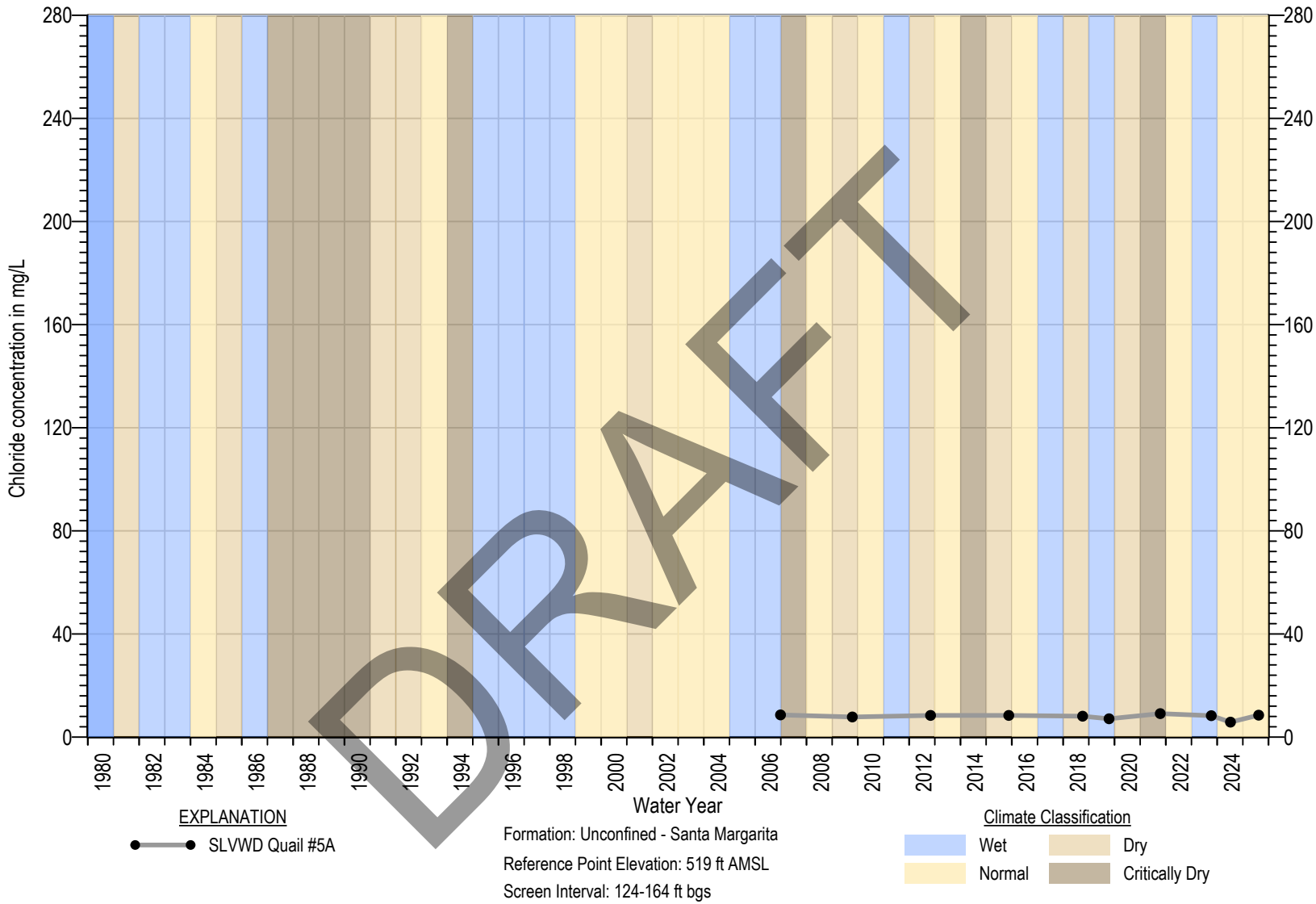
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-28. Chloride Chemograph of SLVWD Quail #4A

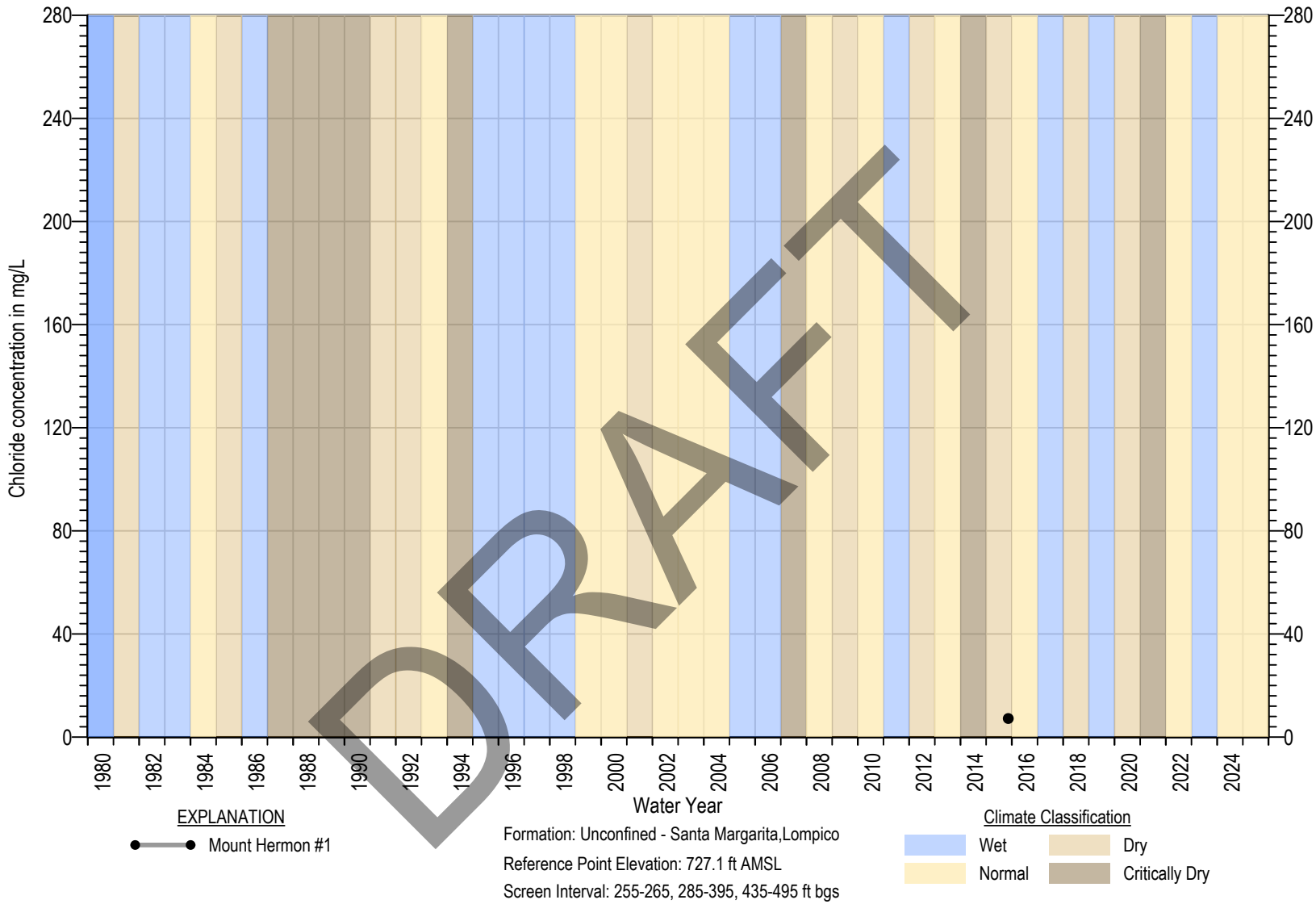
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-29. Chloride Chemograph of SLVWD Quail #5A

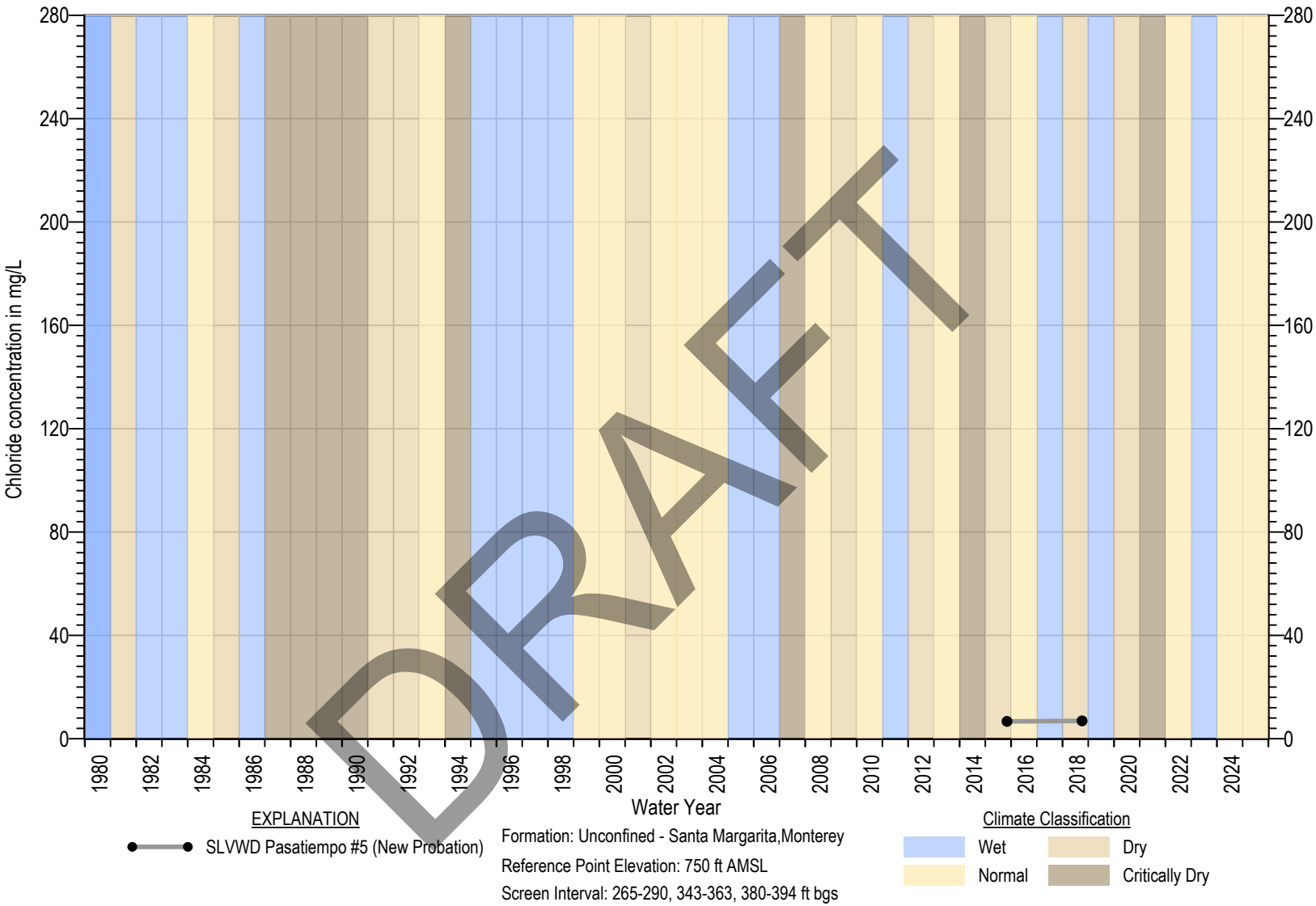
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-30. Chloride Chemograph of Mount Hermon #1

MONTGOMERY & ASSOCIATES



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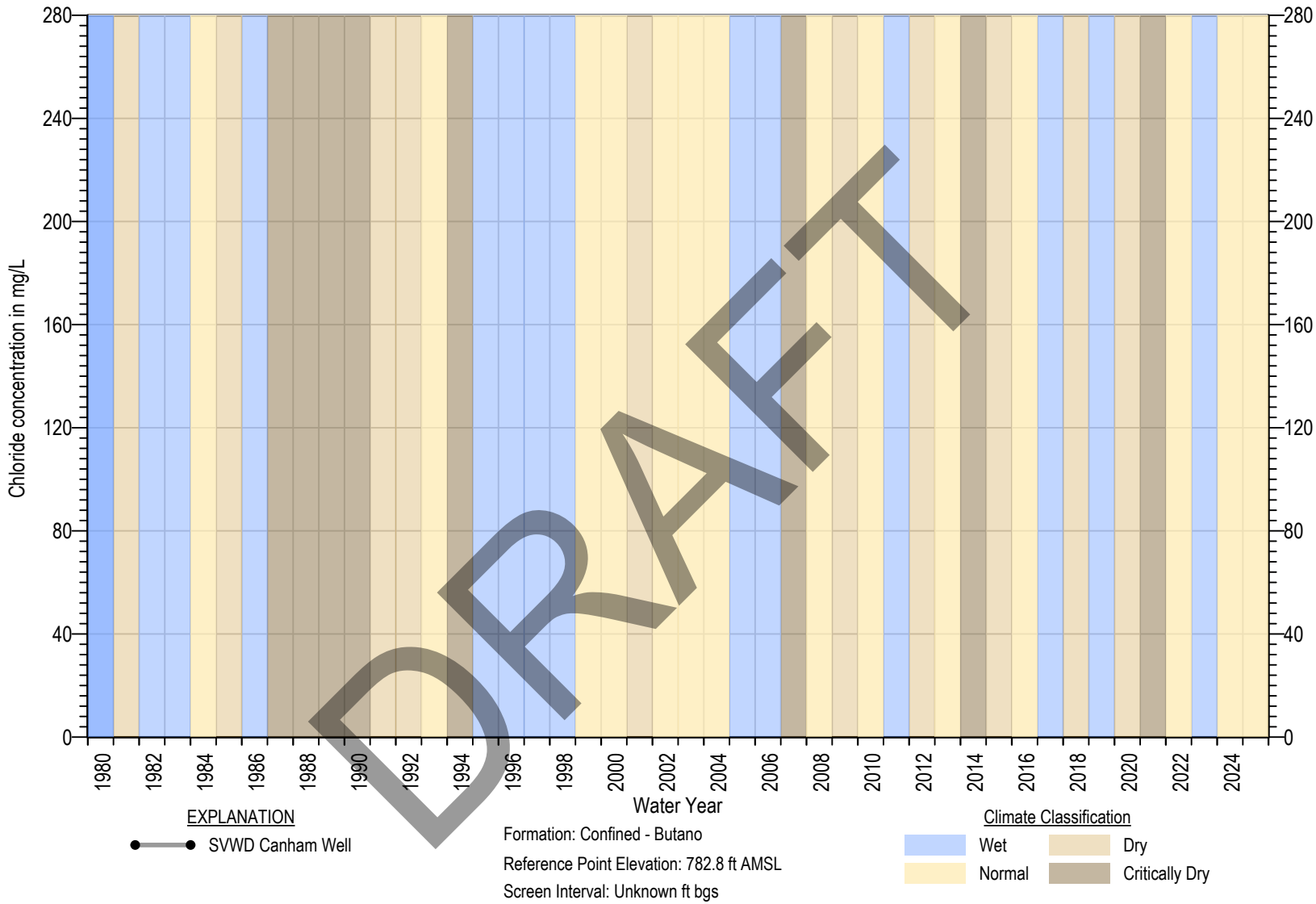
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-31. Chloride Chemograph of SLVWD Pasatiempo #5 (New Probation)

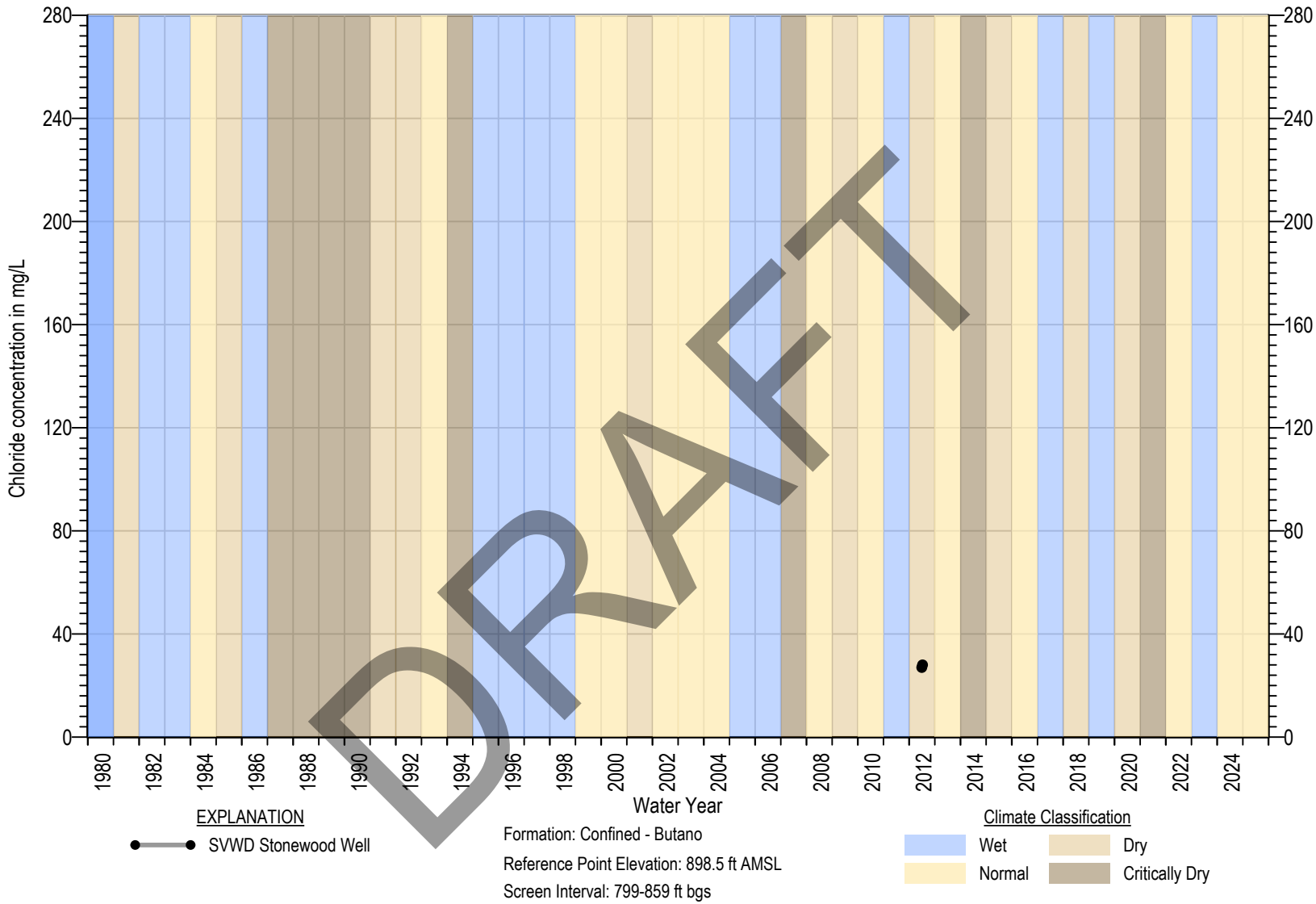
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-32. Chloride Chemograph of SVWD Canham Well

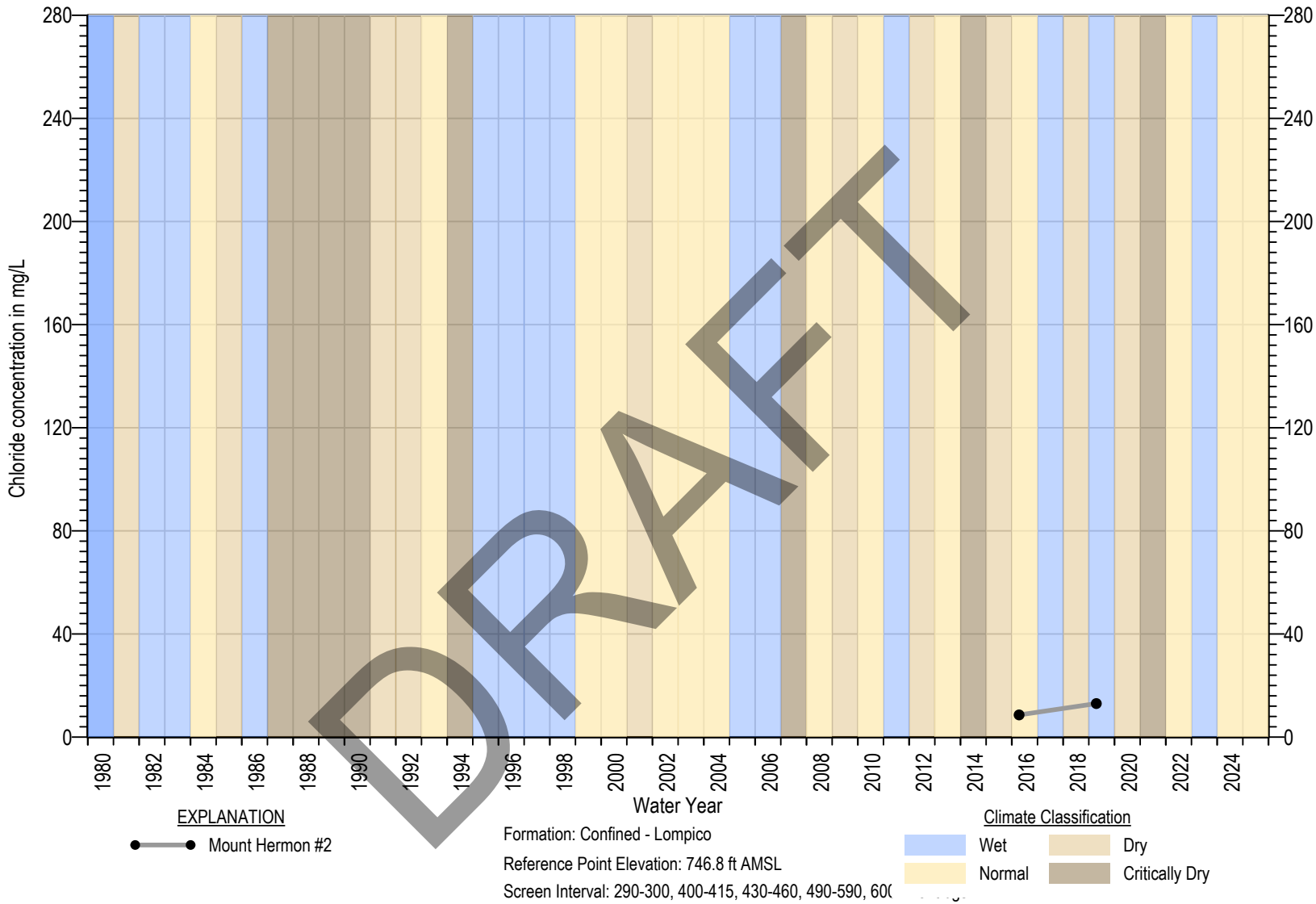
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-33. Chloride Chemograph of SVWD Stonewood Well

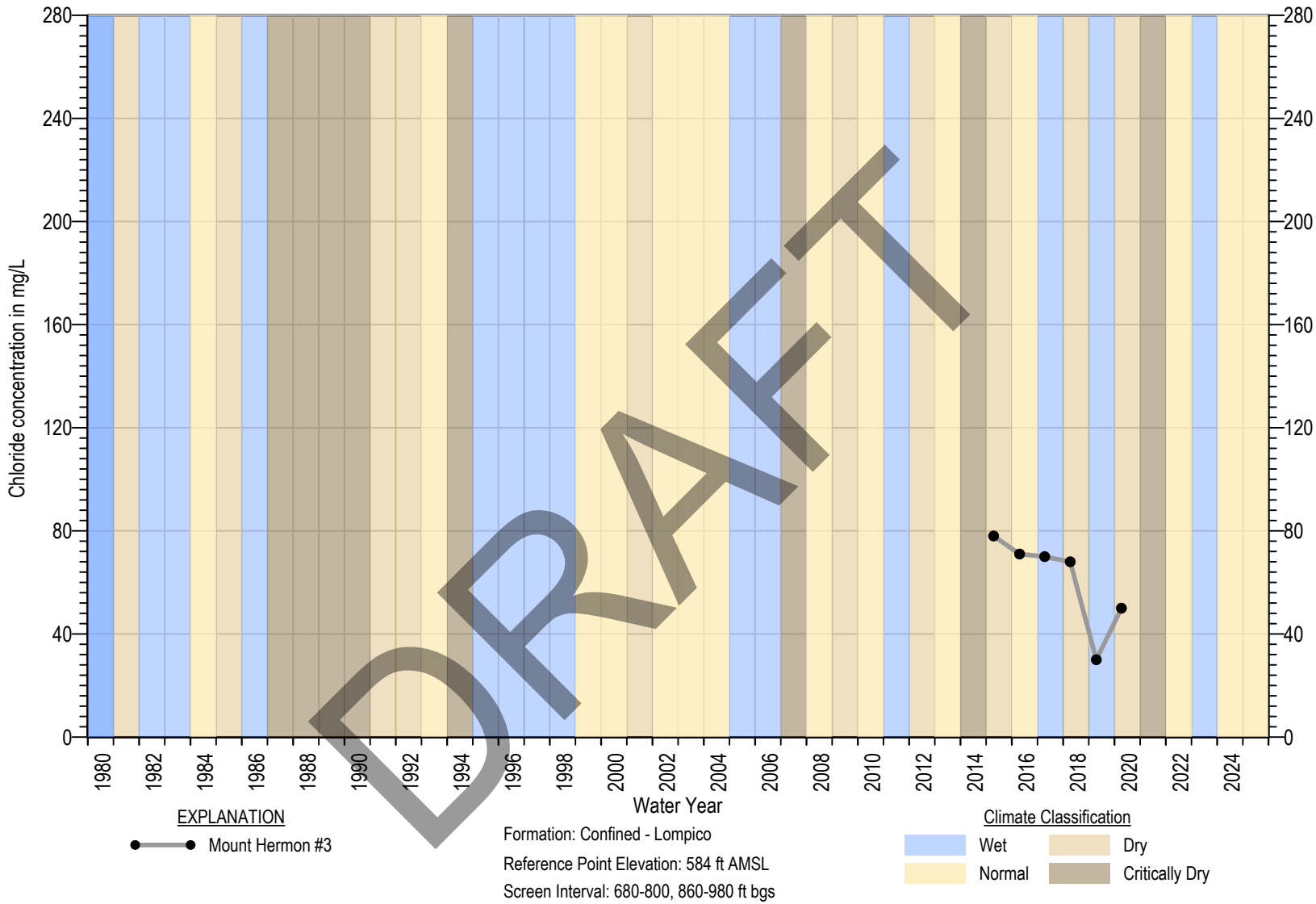
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-34. Chloride Chemograph of Mount Hermon #2

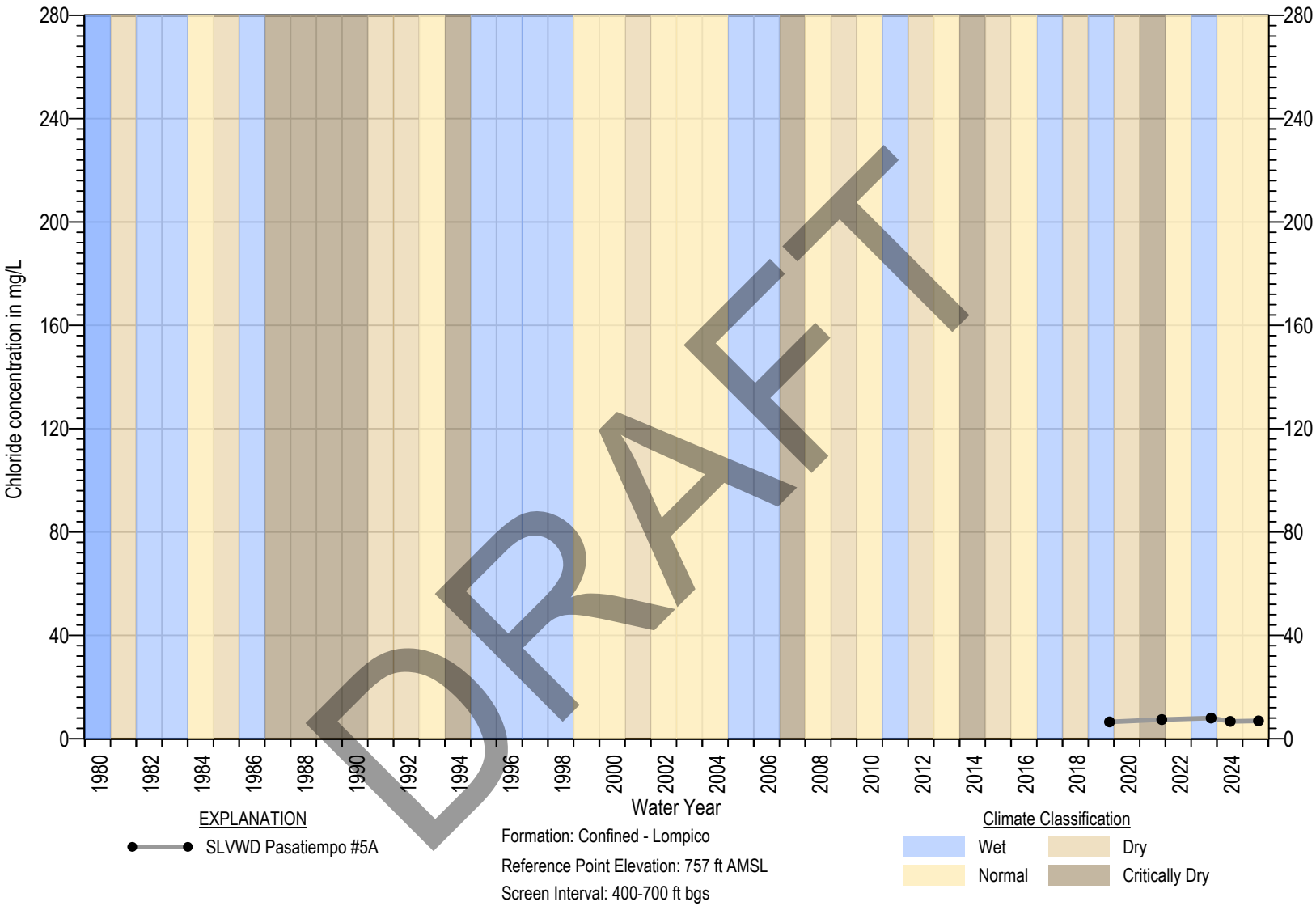
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-35. Chloride Chemograph of Mount Hermon #3

MONTGOMERY & ASSOCIATES



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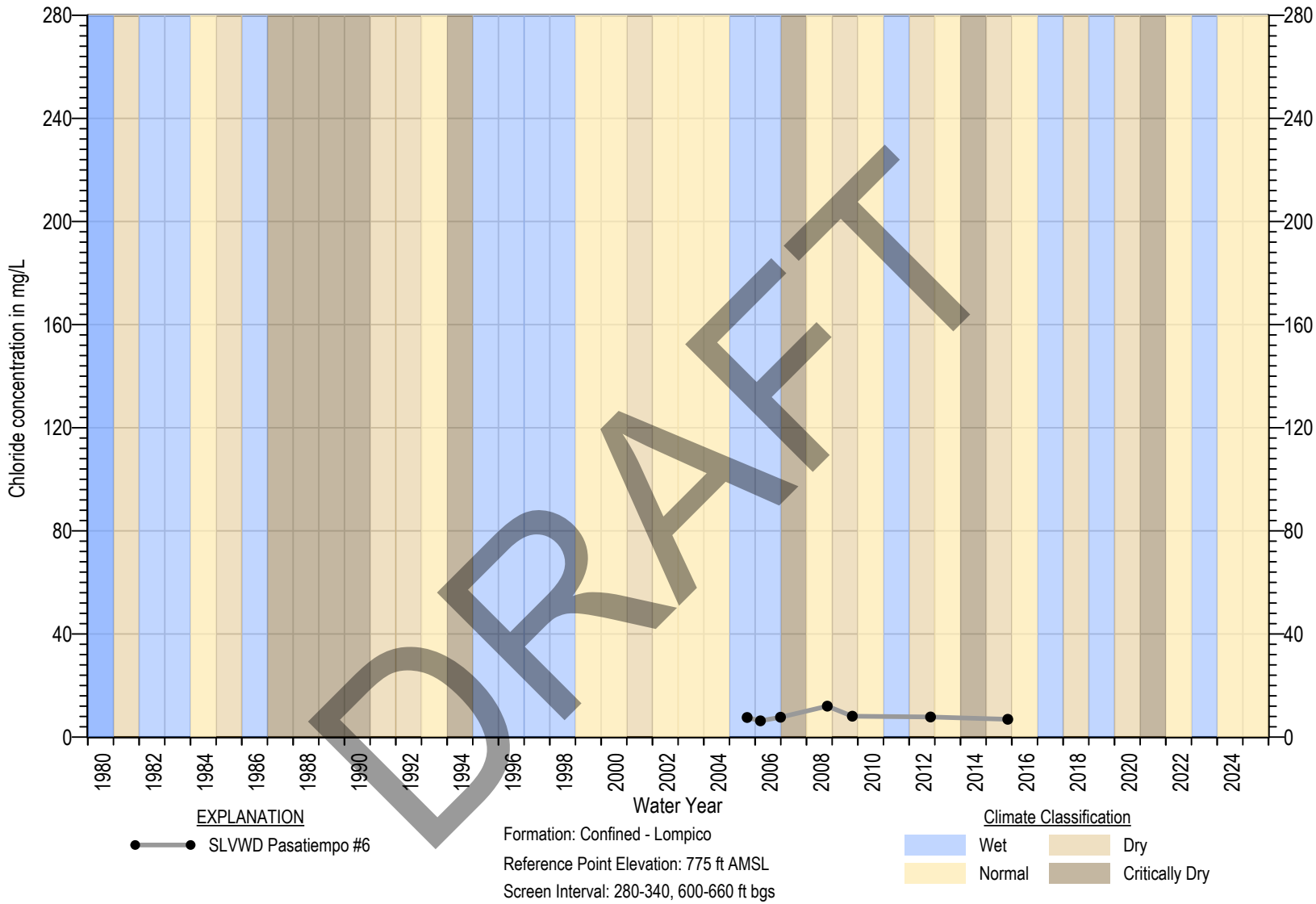
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-36. Chloride Chemograph of SLVWD Pasatiempo #5A

MONTGOMERY & ASSOCIATES



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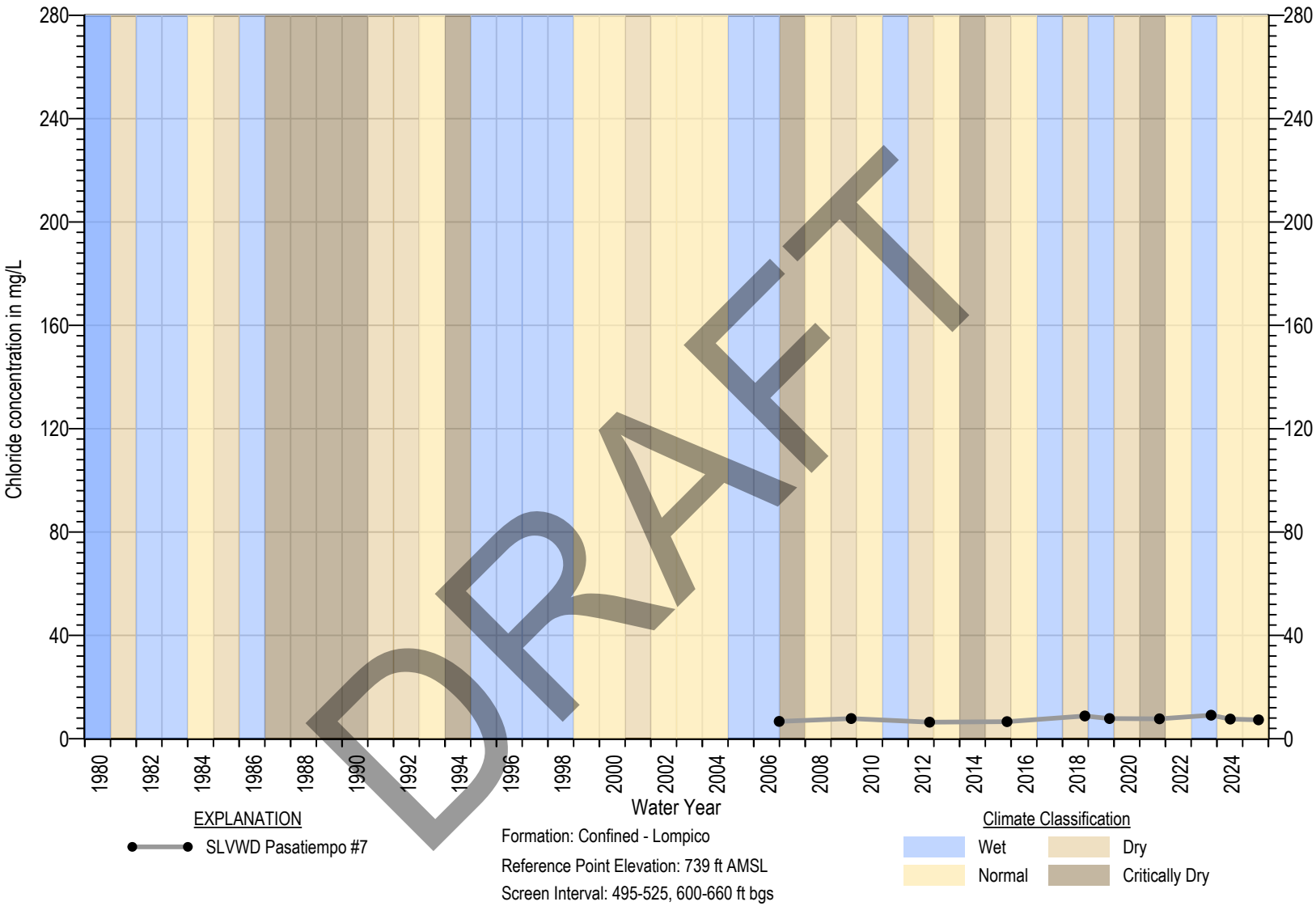
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-37. Chloride Chemograph of SLVWD Pasatiempo #6

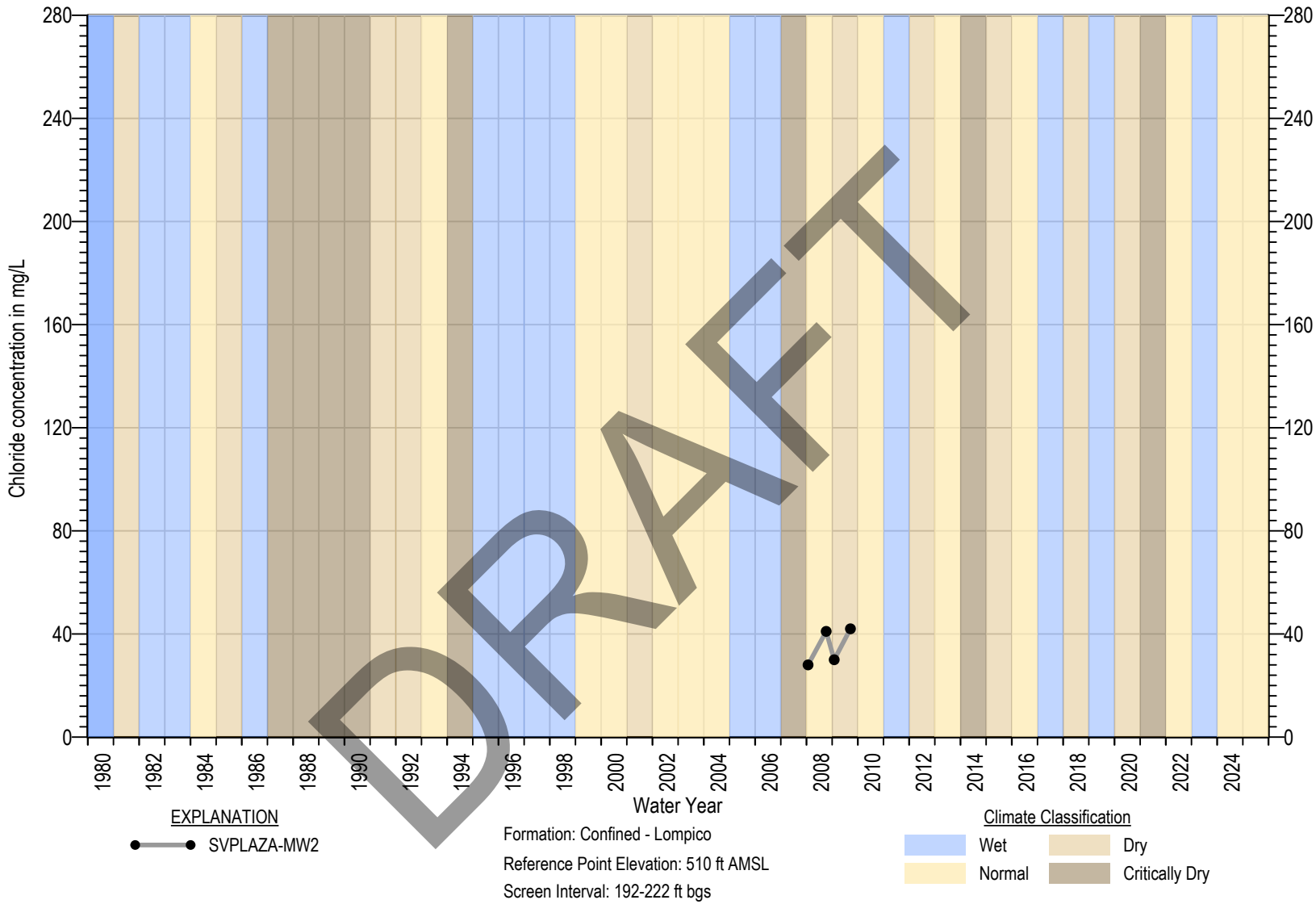
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-38. Chloride Chemograph of SLVWD Pasatiempo #7

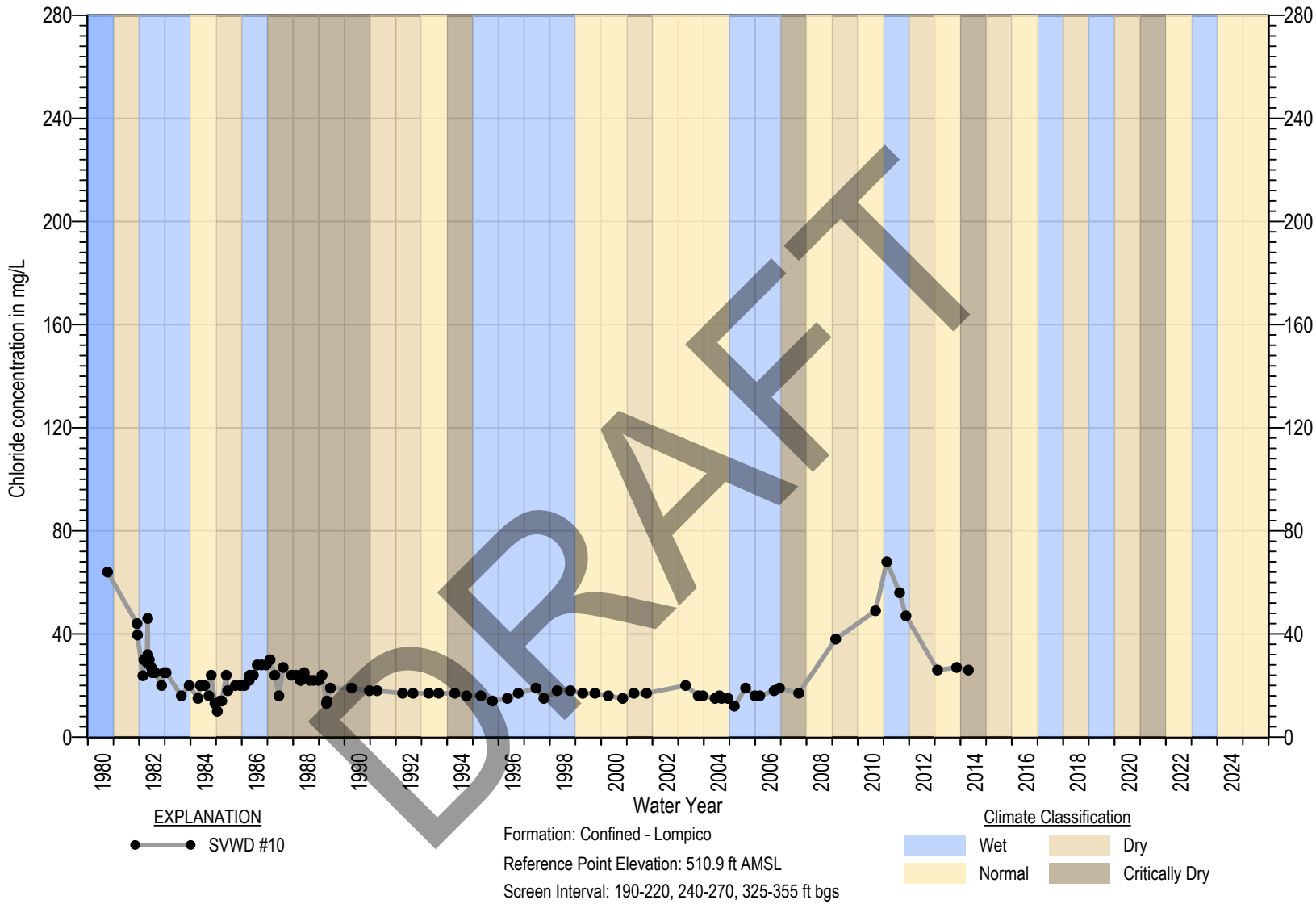
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-39. Chloride Chemograph of SVPLAZA-MW2

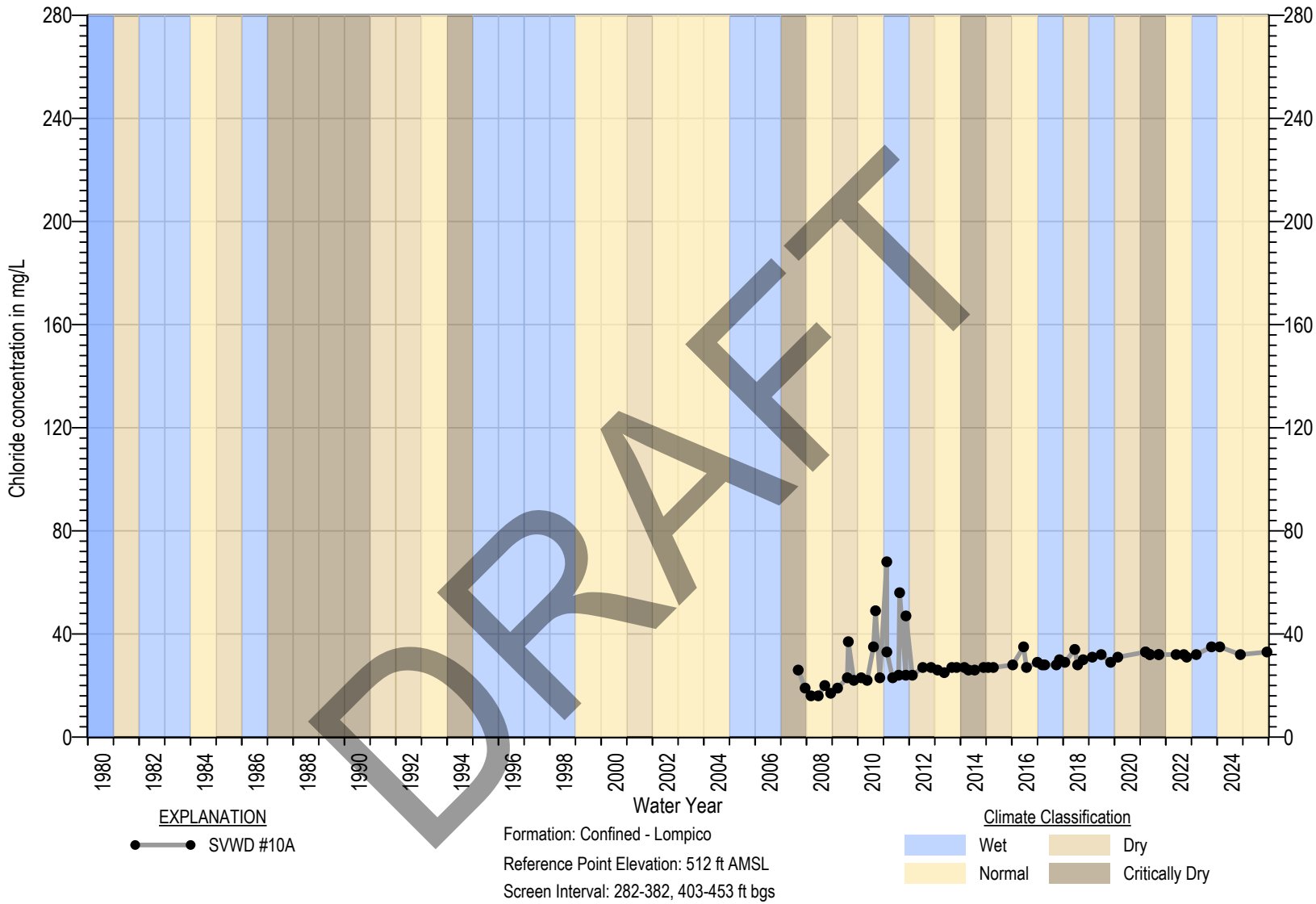
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-40. Chloride Chemograph of SVWD #10

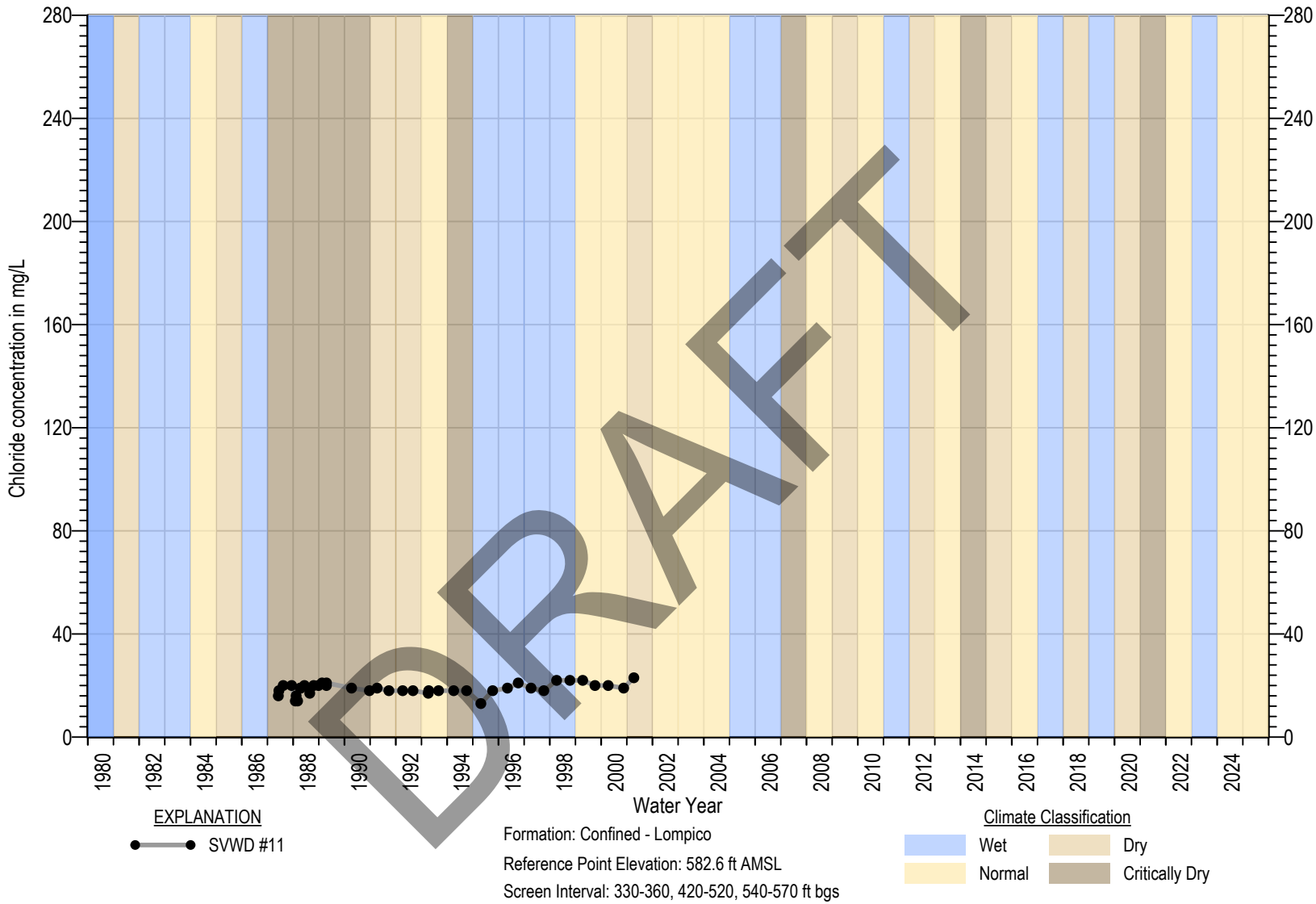
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-41. Chloride Chemograph of SVWD #10A

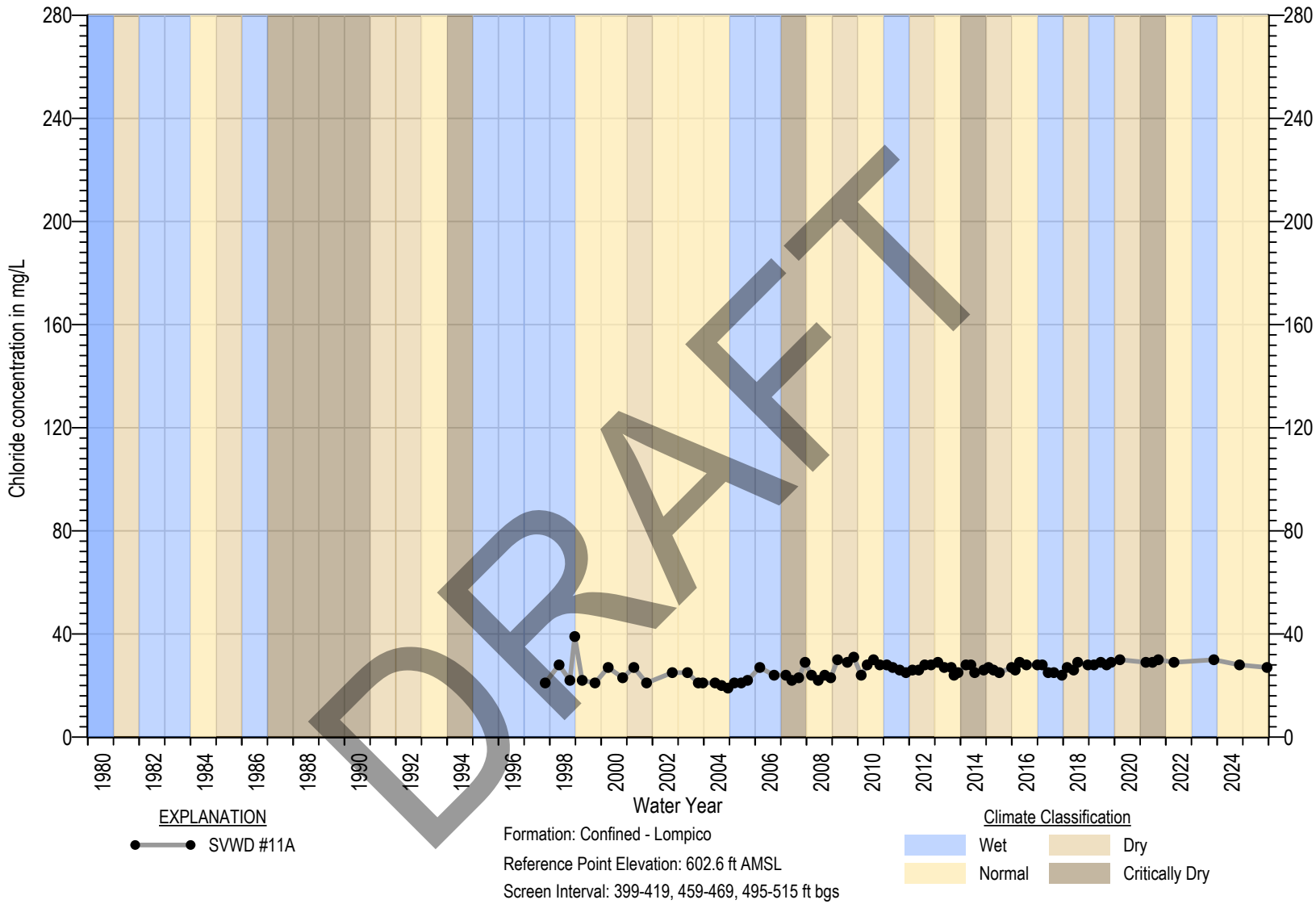
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-42. Chloride Chemograph of SVWD #11

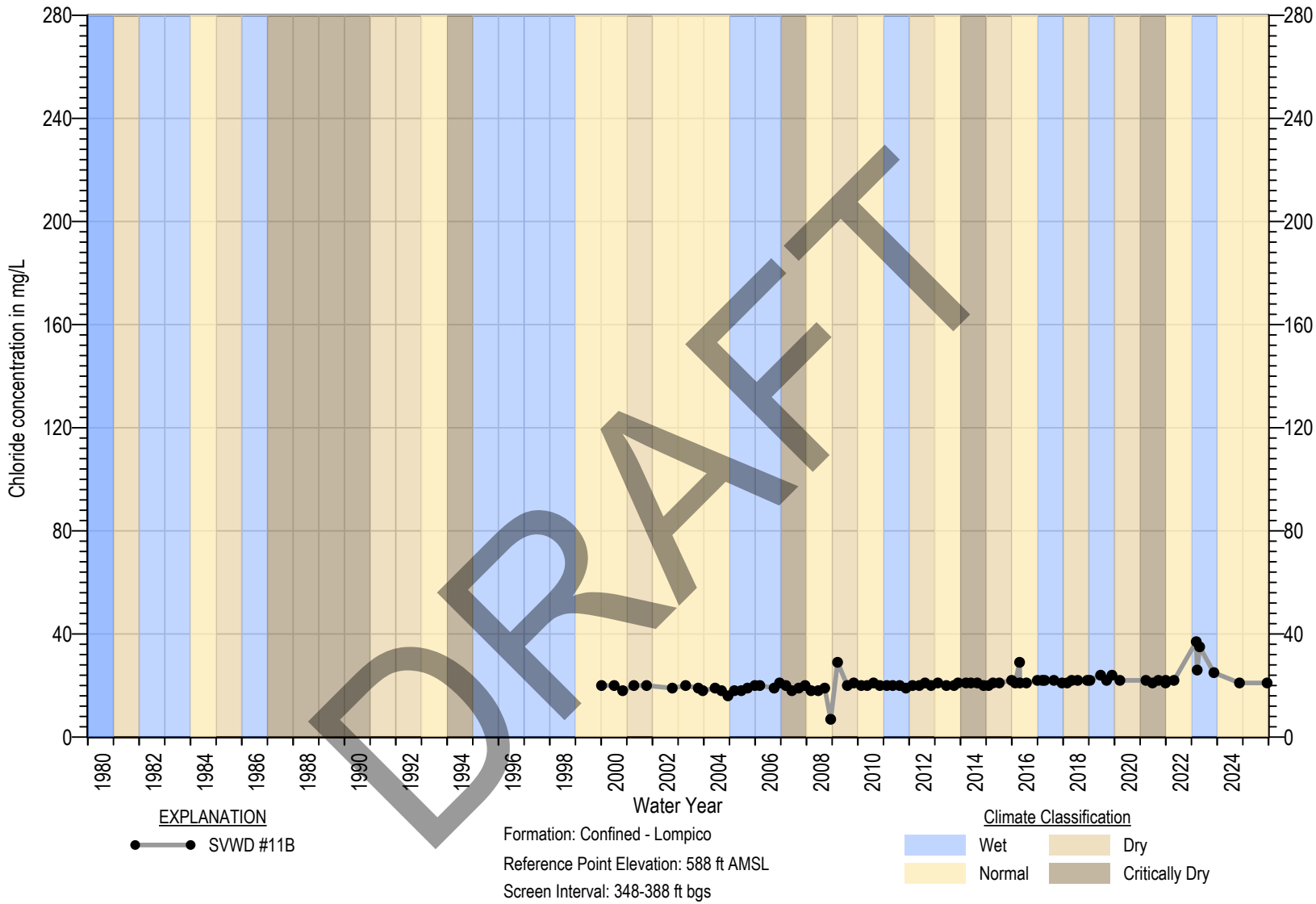
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-43. Chloride Chemograph of SVWD #11A

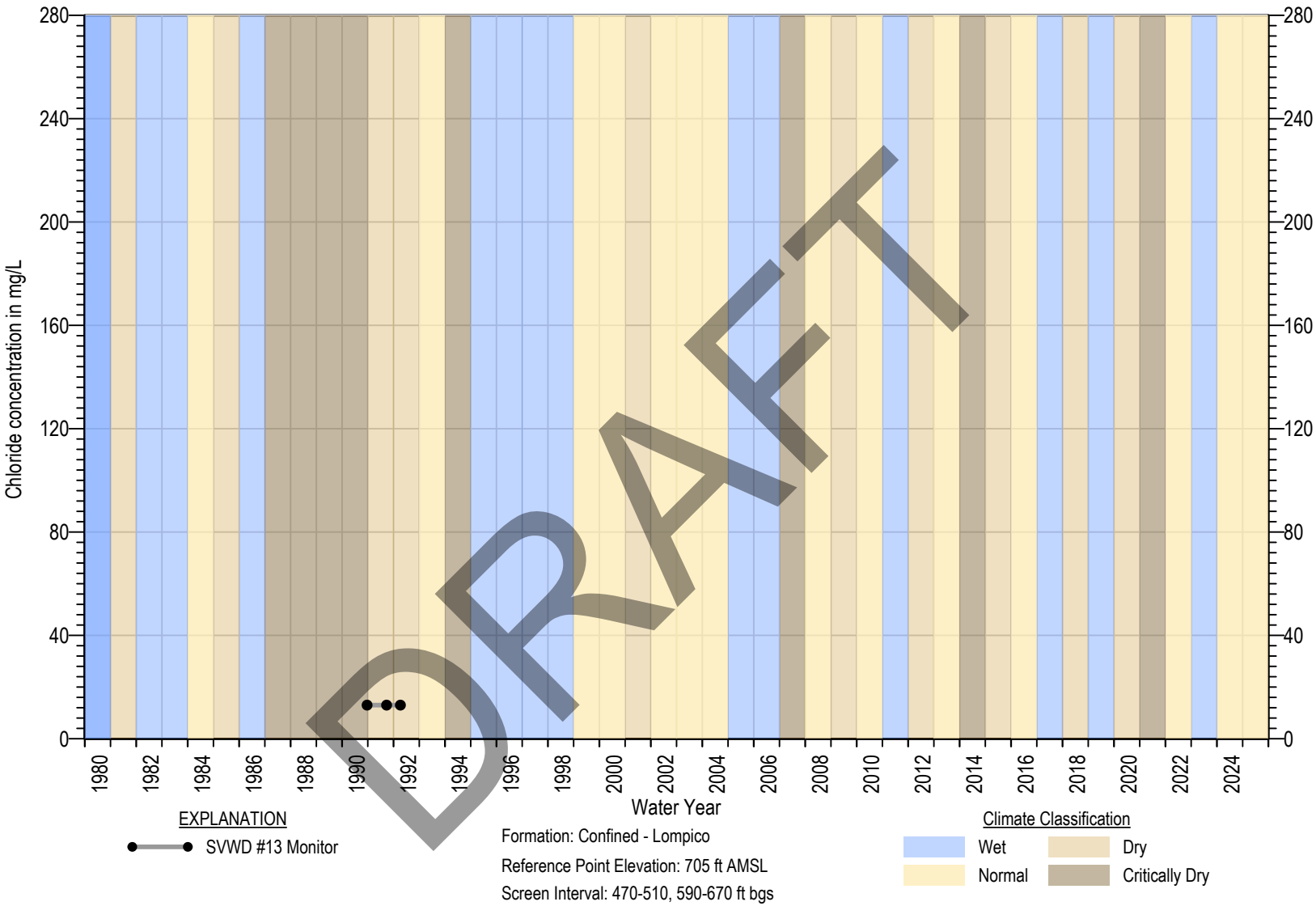
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-44. Chloride Chemograph of SVWD #11B

MONTGOMERY & ASSOCIATES



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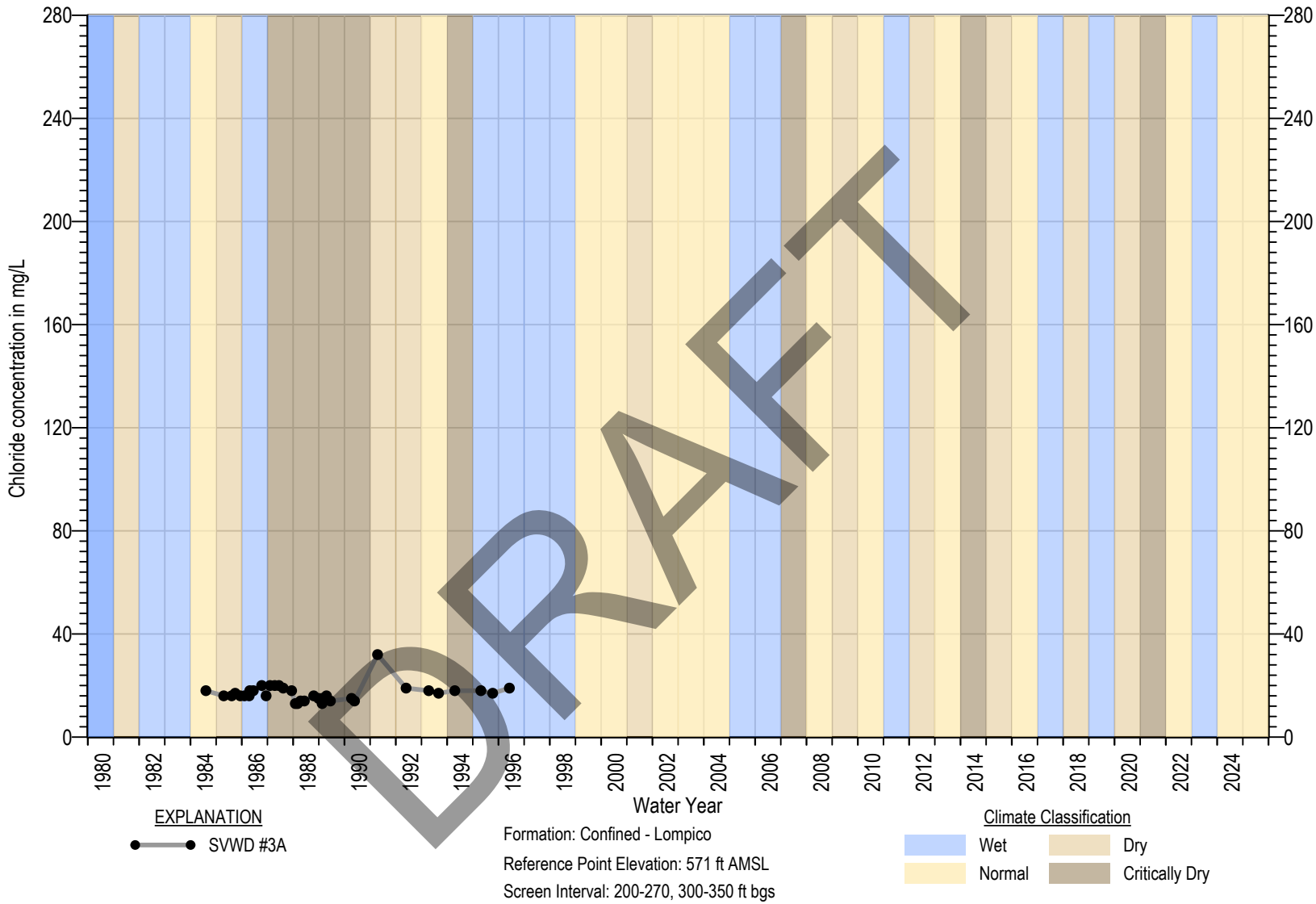
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-45. Chloride Chemograph of SVWD #13 Monitor

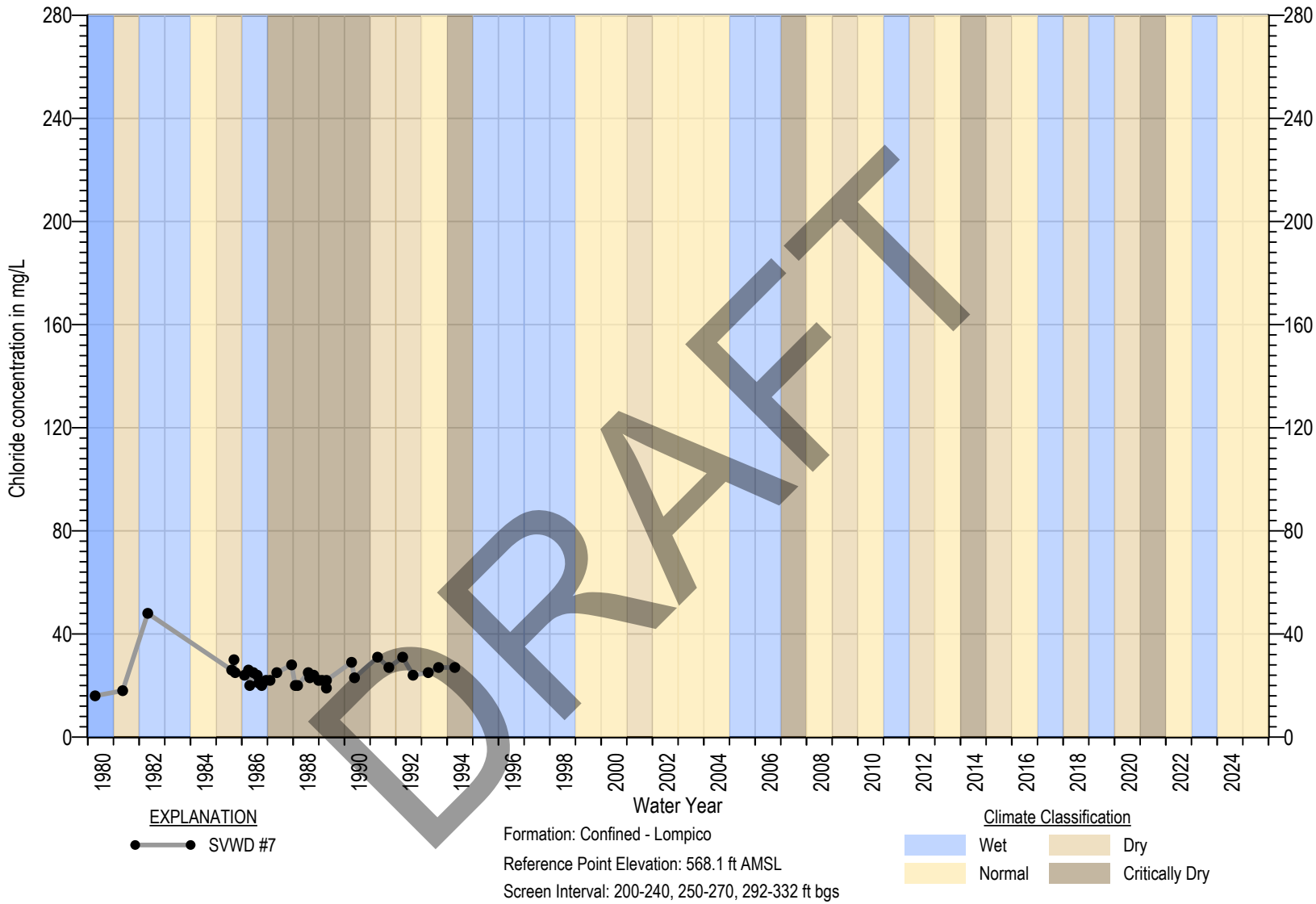
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-46. Chloride Chemograph of SVWD #3A

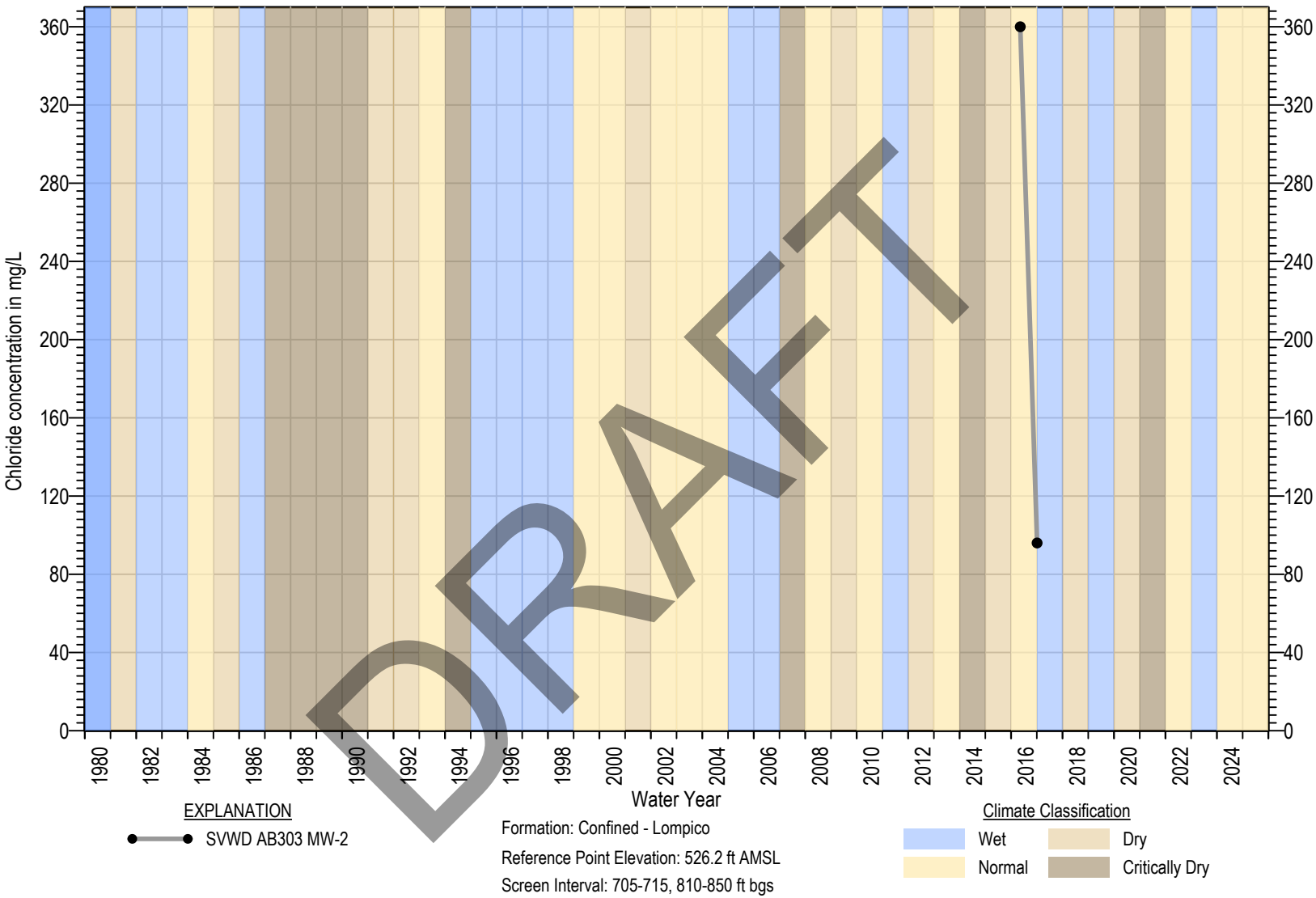
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-47. Chloride Chemograph of SVWD #7

MONTGOMERY & ASSOCIATES

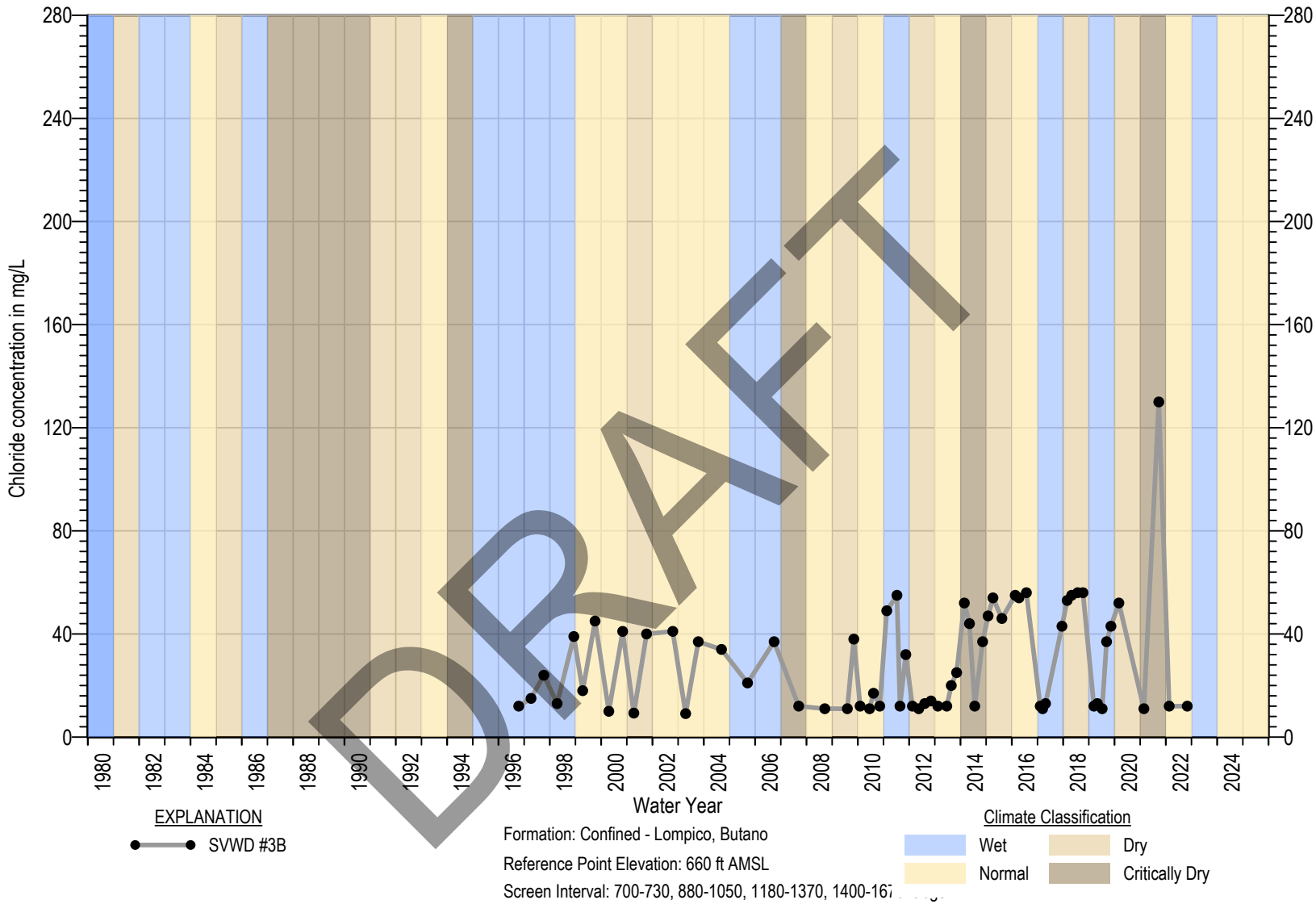


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-48. Chloride Chemograph of SVWD AB303 MW-2

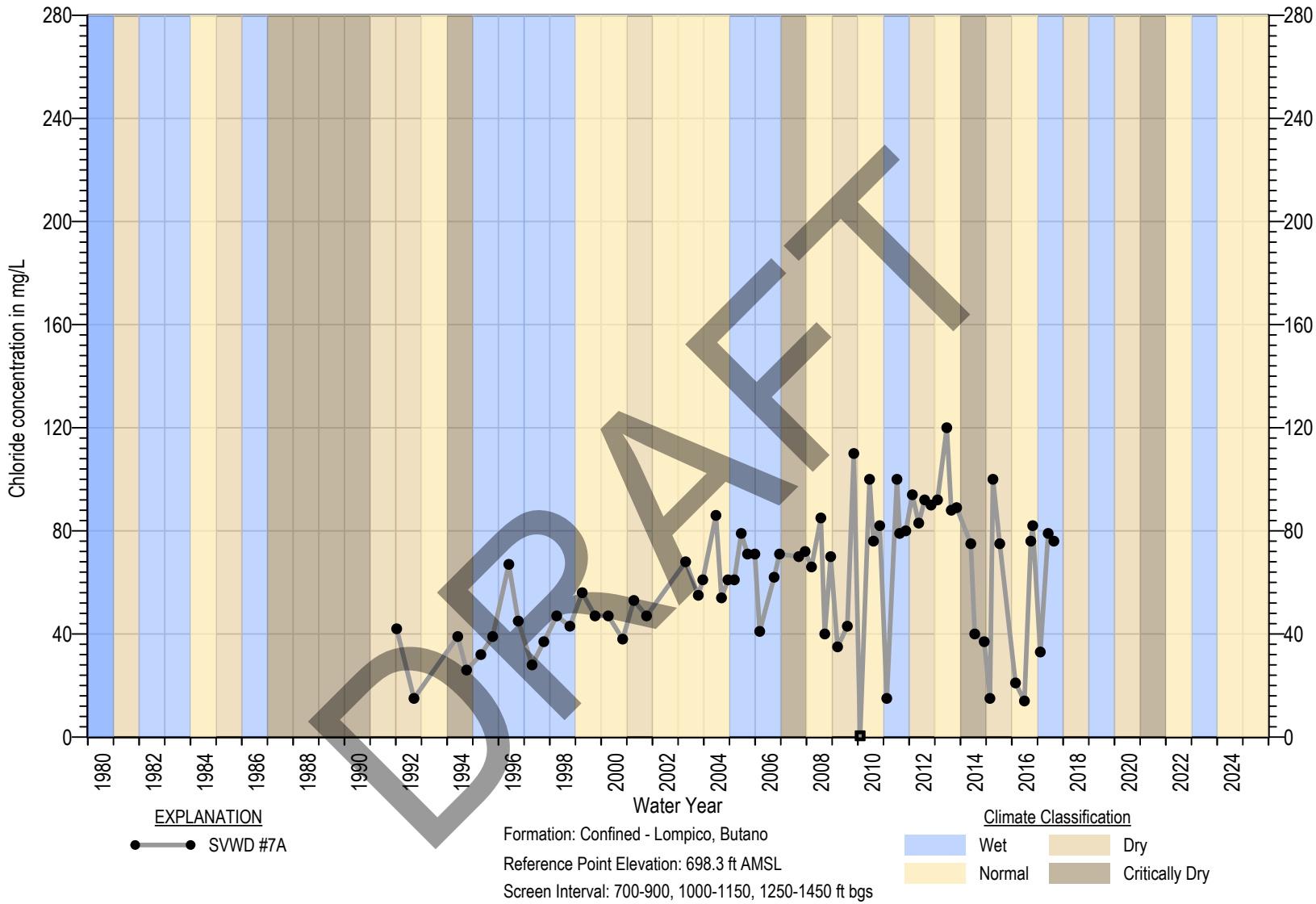
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-49. Chloride Chemograph of SVWD #3B

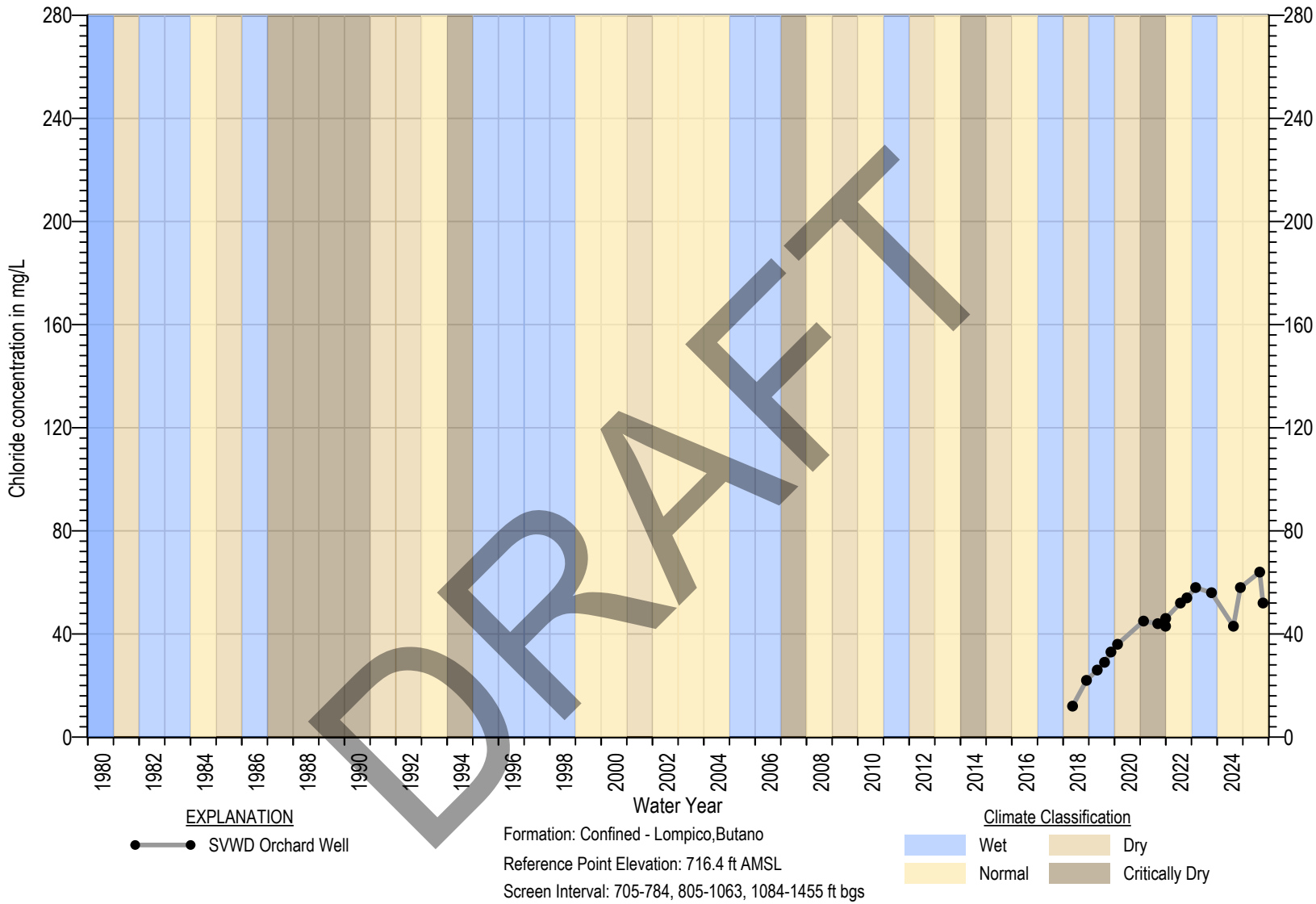
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-50. Chloride Chemograph of SVWD #7A

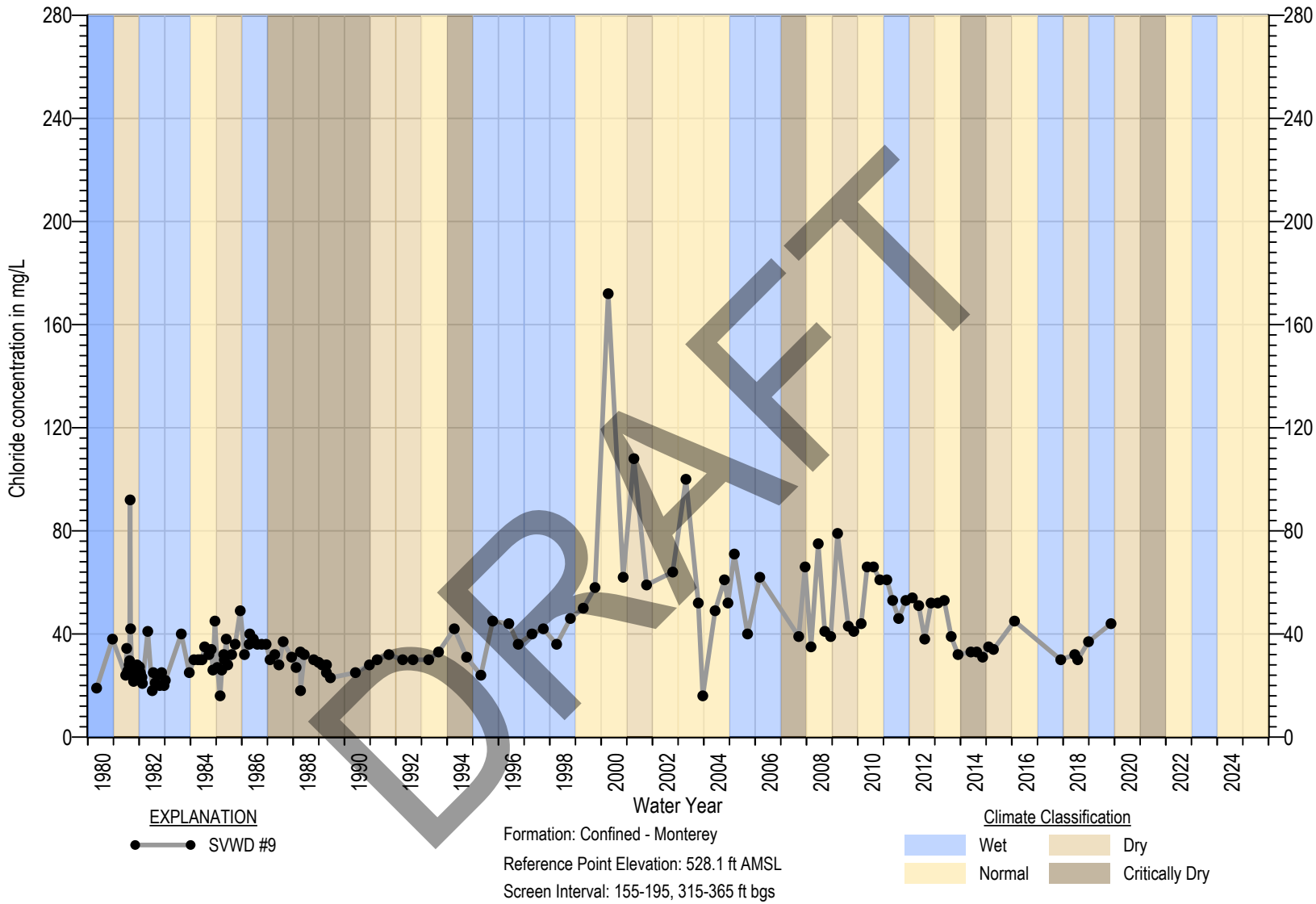
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-51. Chloride Chemograph of Orchard Well

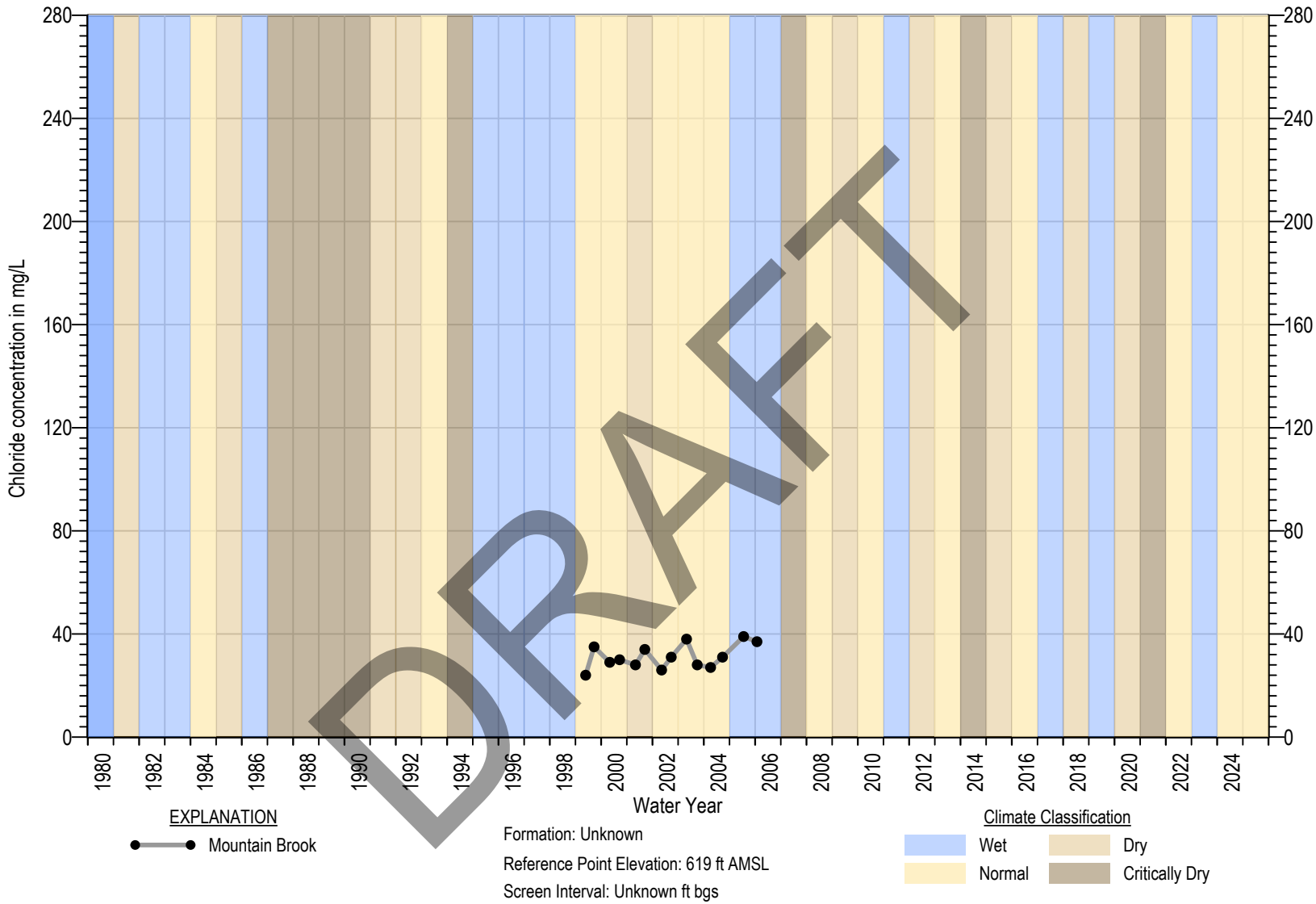
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-52. Chloride Chemograph of SVWD #9

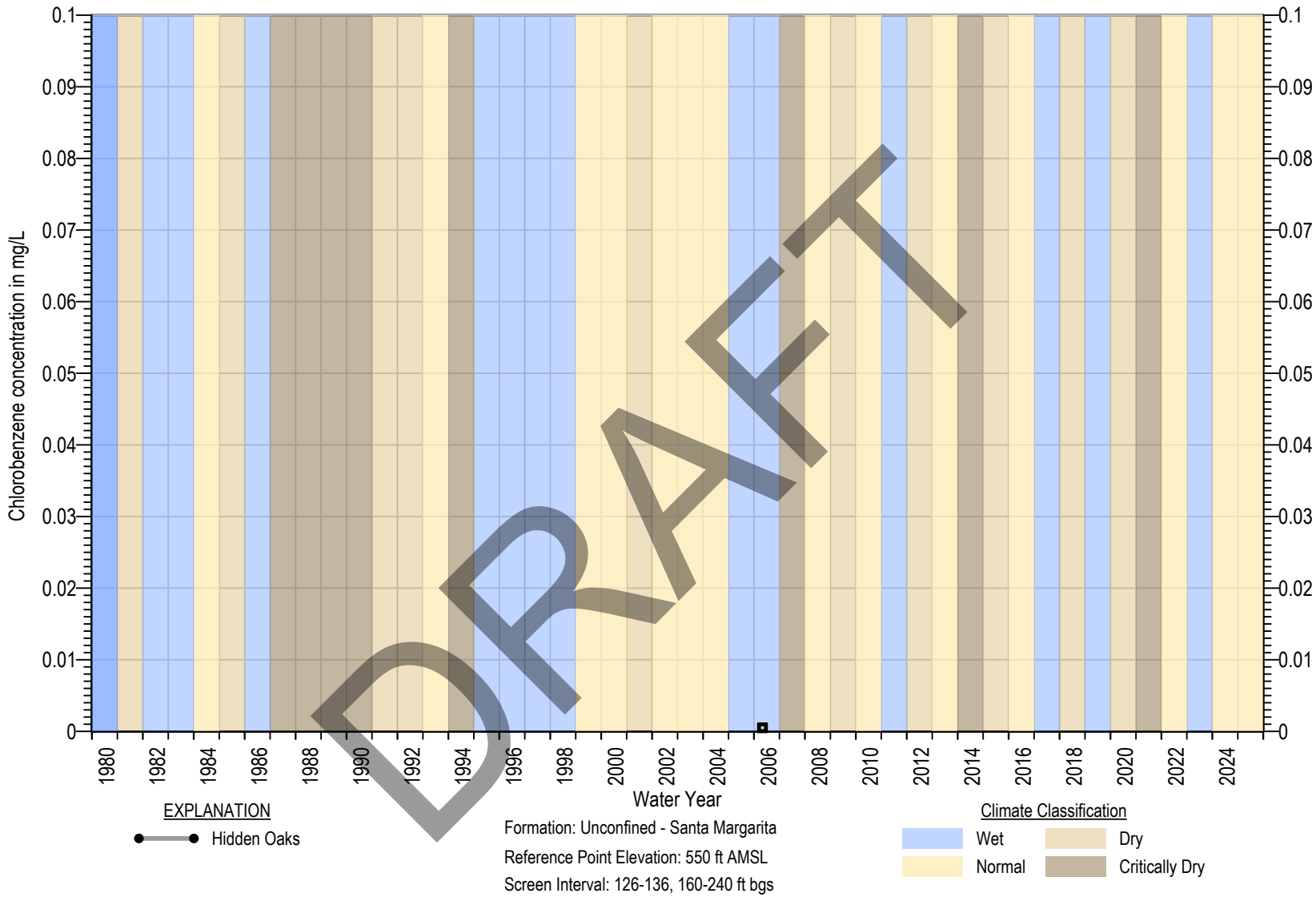
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-53. Chloride Chemograph of Mountain Brook

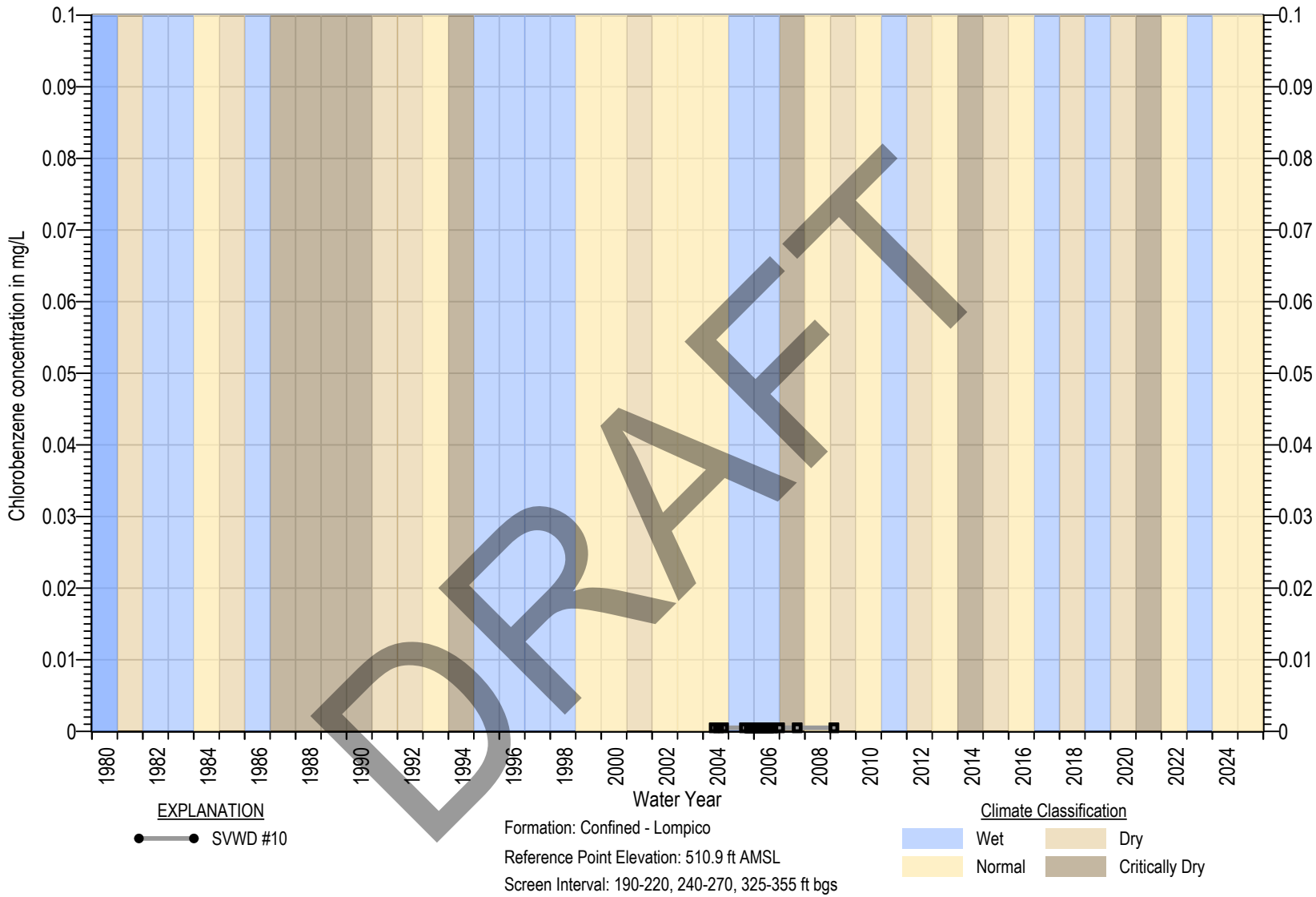
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-54. Chlorobenzene Chemograph of Hidden Oaks

MONTGOMERY & ASSOCIATES



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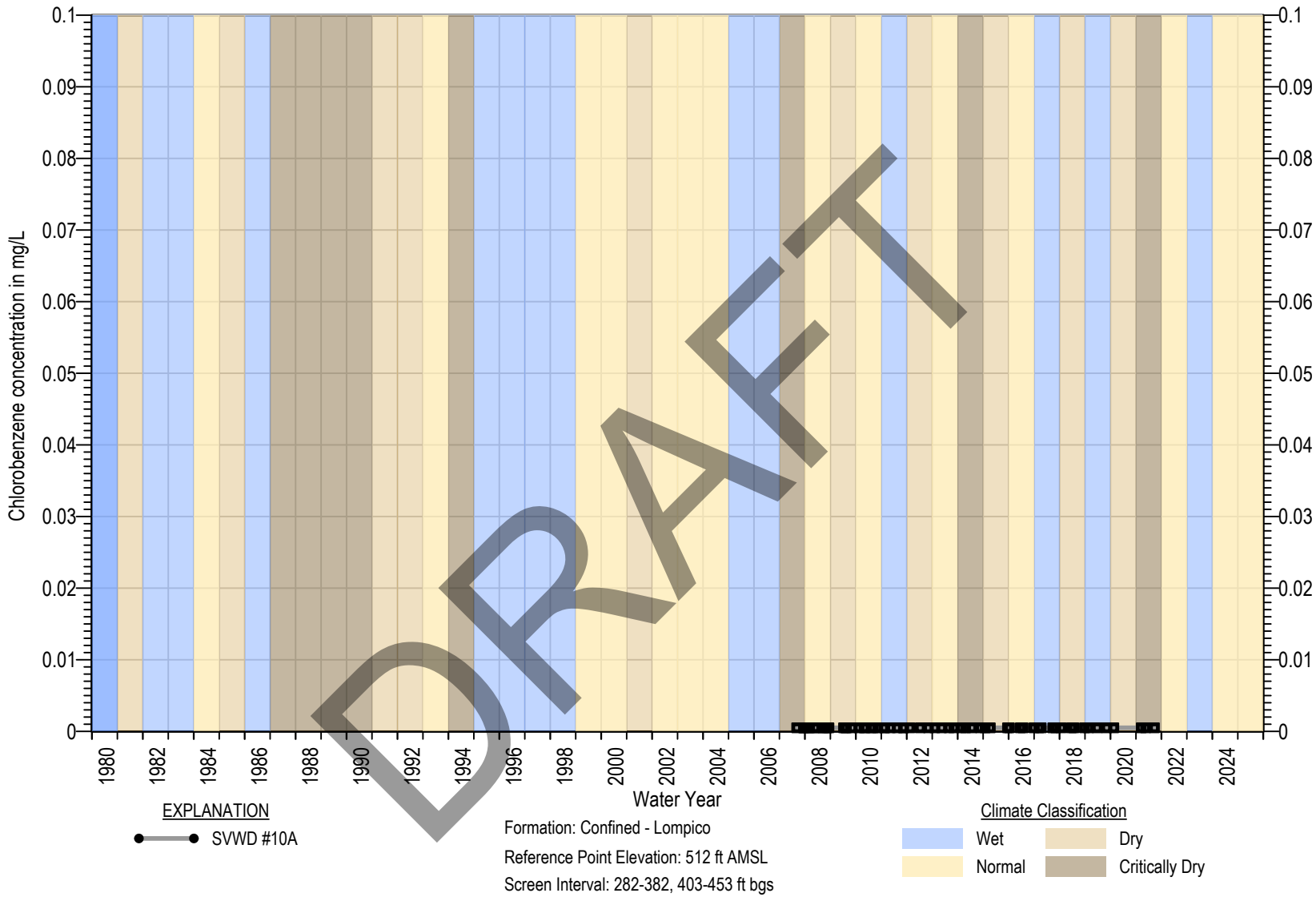
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-55. Chlorobenzene Chemograph of SVWD #10

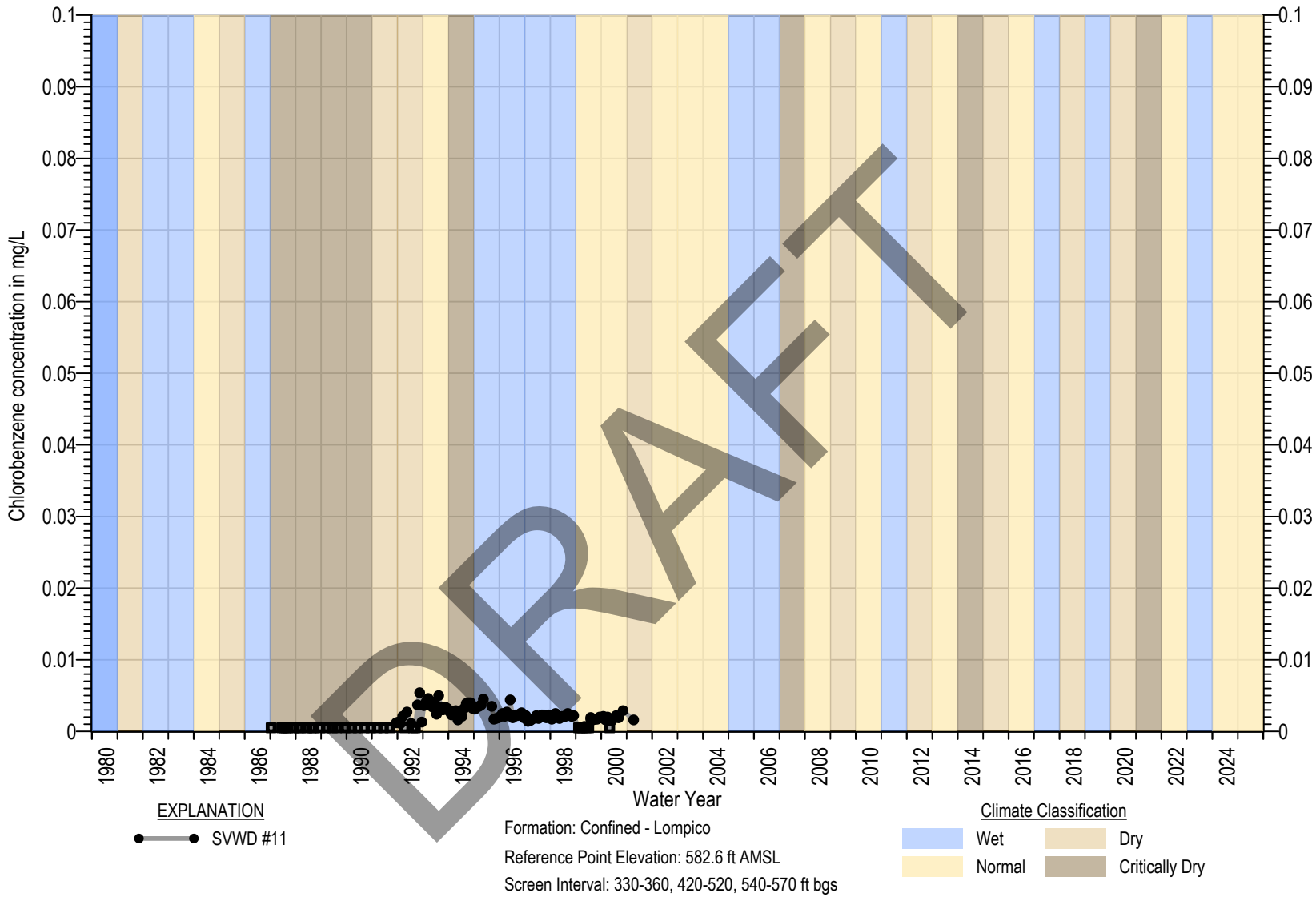
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-56. Chlorobenzene Chemograph of SVWD #10A

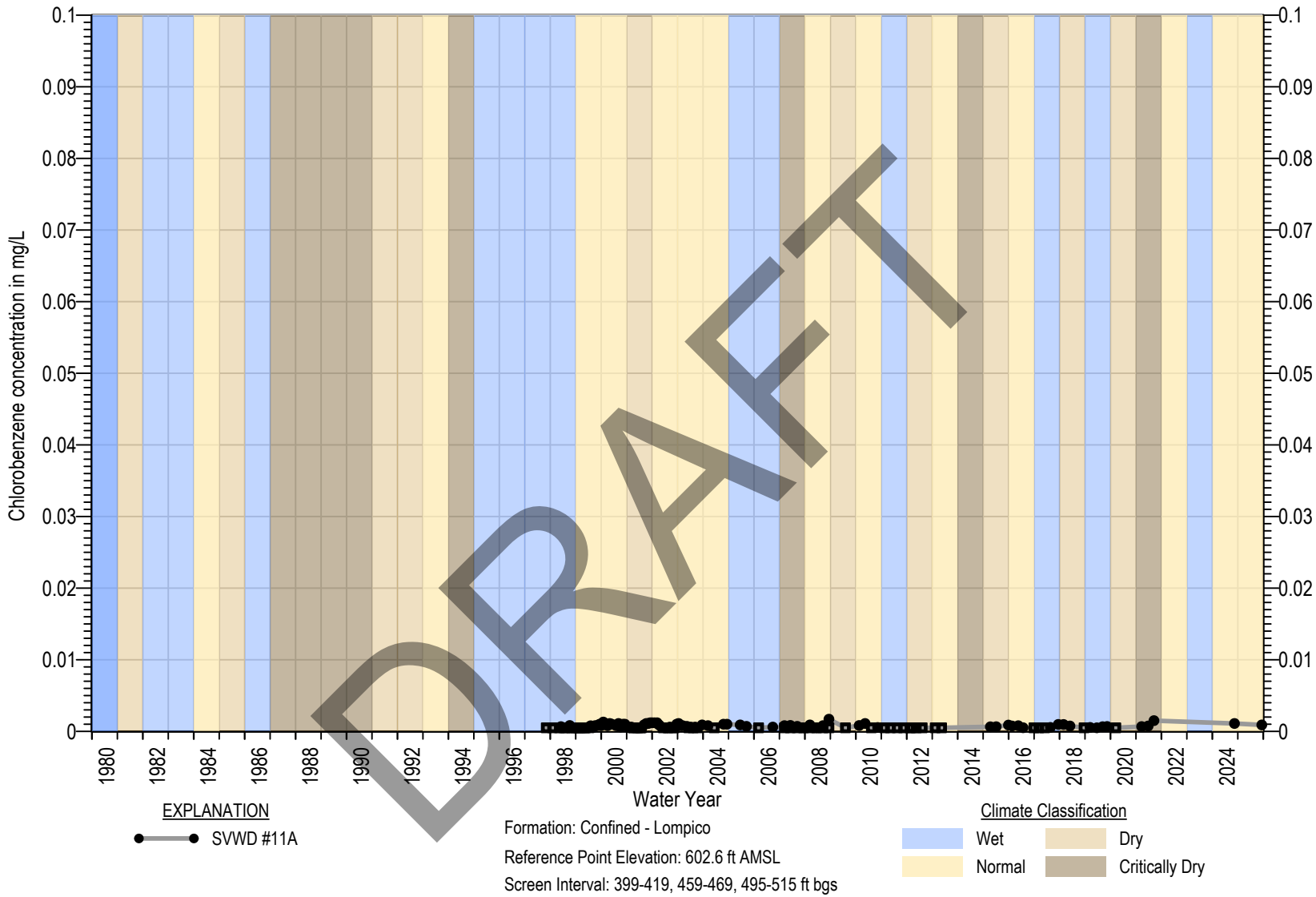
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-57. Chlorobenzene Chemograph of SVWD #11

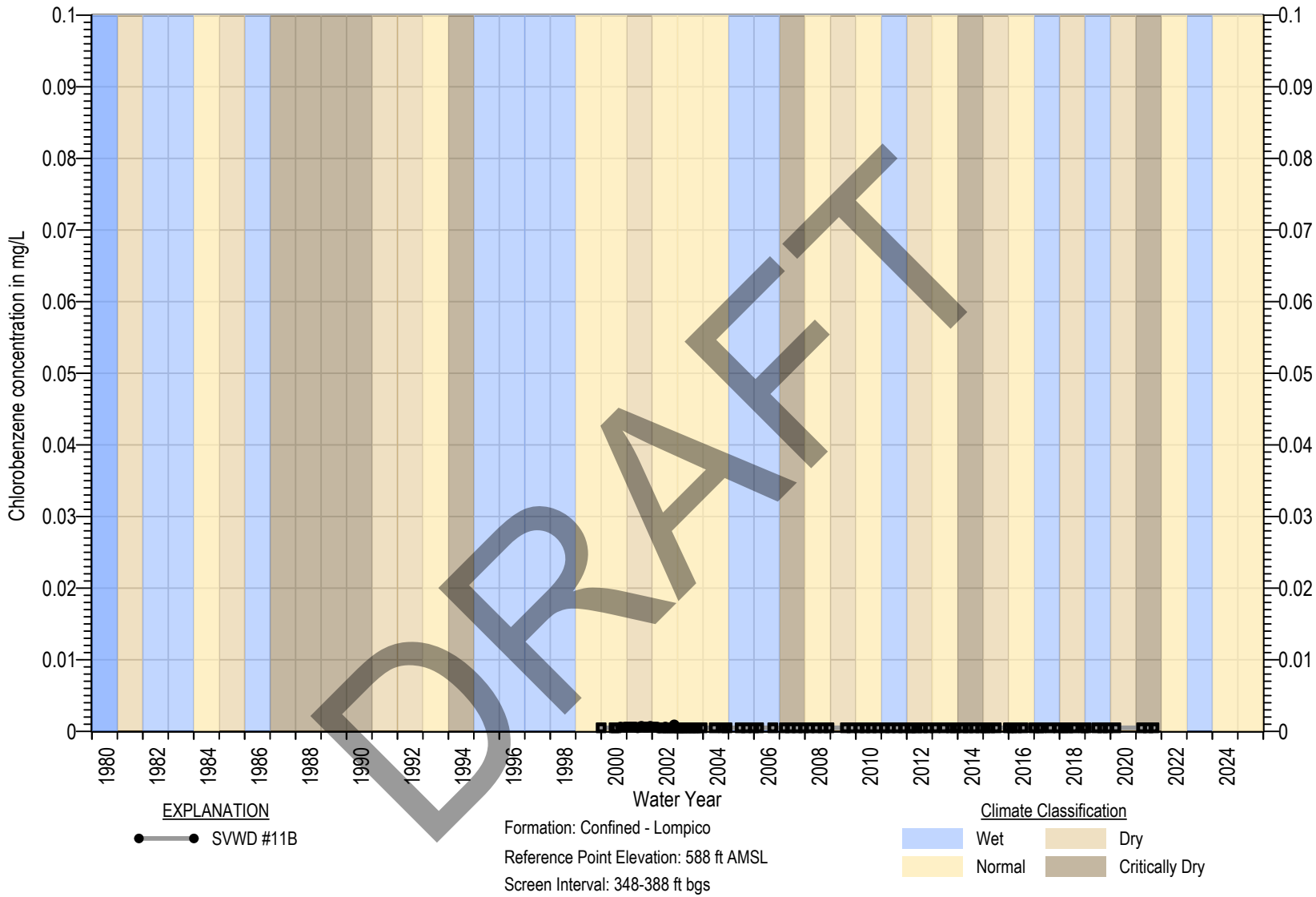
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-58. Chlorobenzene Chemograph of SVWD #11A

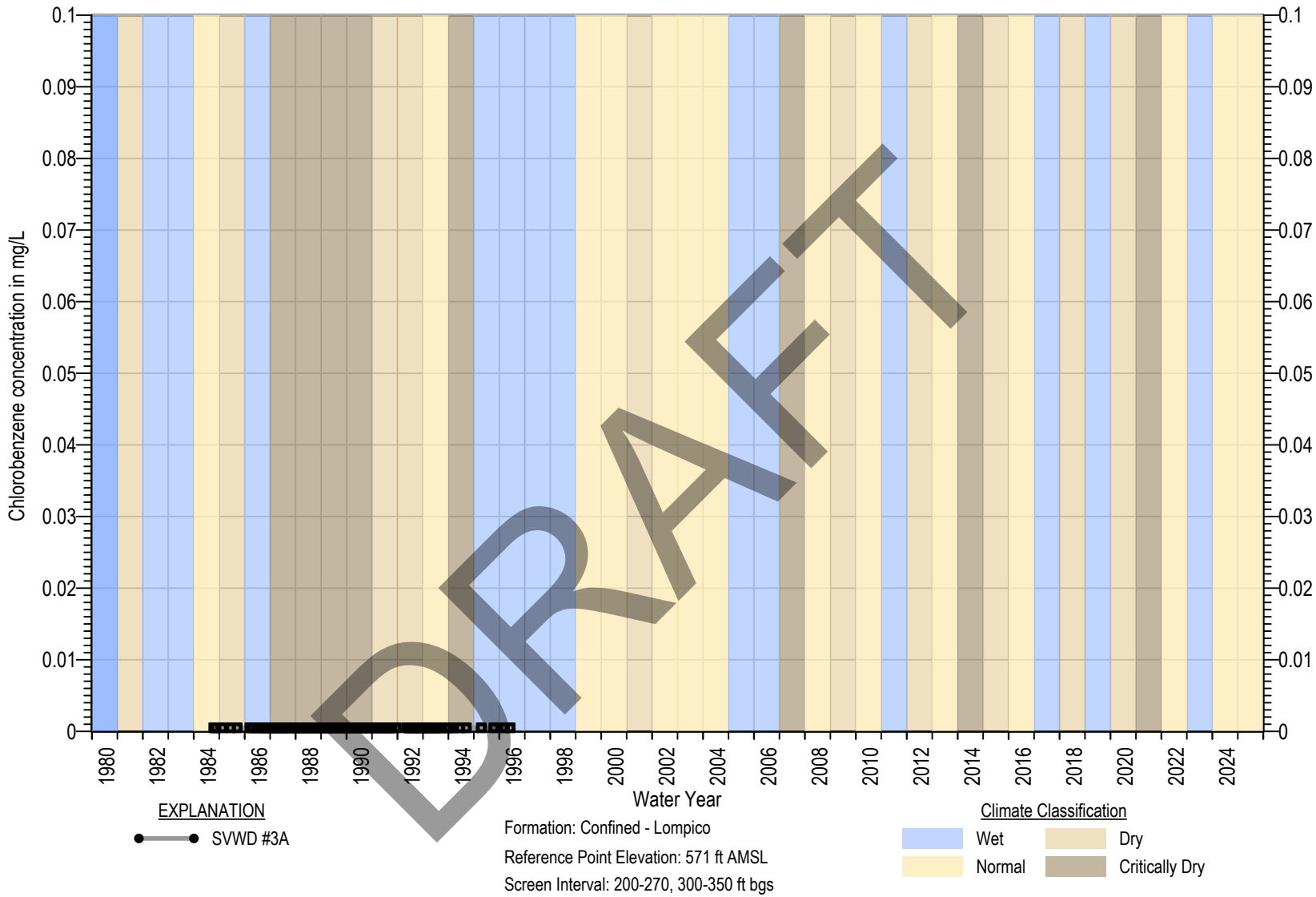
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-59. Chlorobenzene Chemograph of SVWD #11B

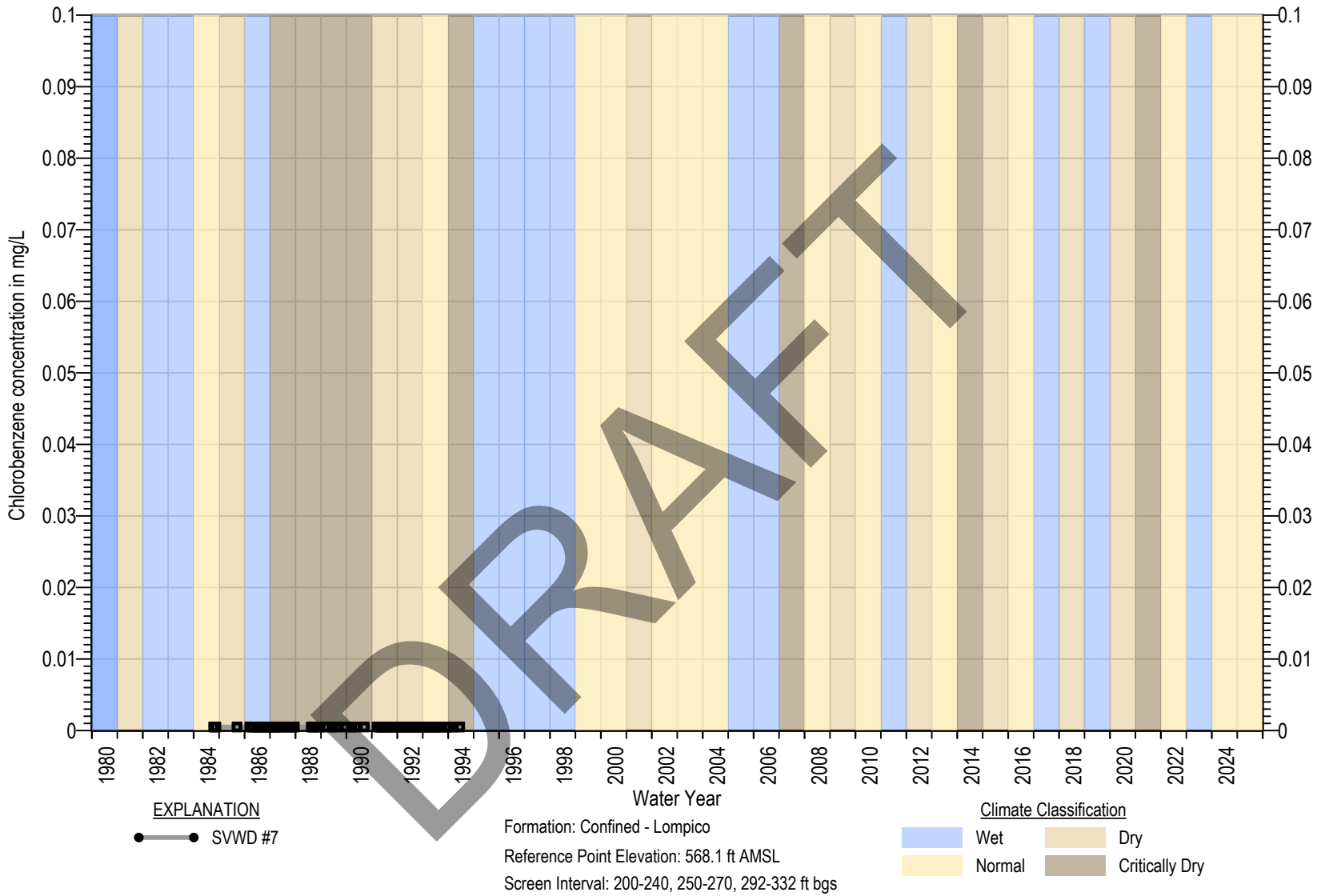
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-60. Chlorobenzene Chemograph of SVWD #3A

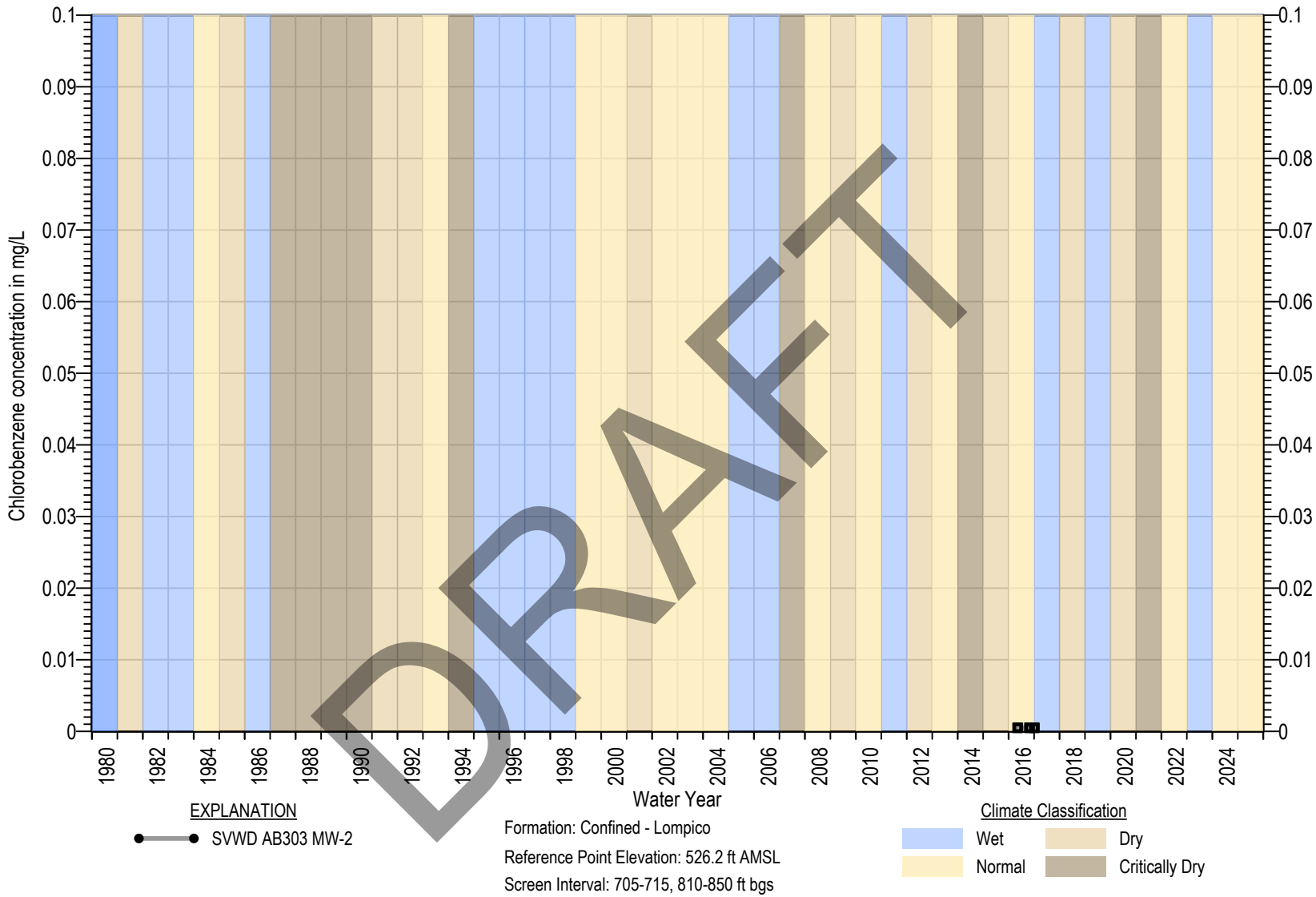
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-61. Chlorobenzene Chemograph of SVWD #7

MONTGOMERY & ASSOCIATES



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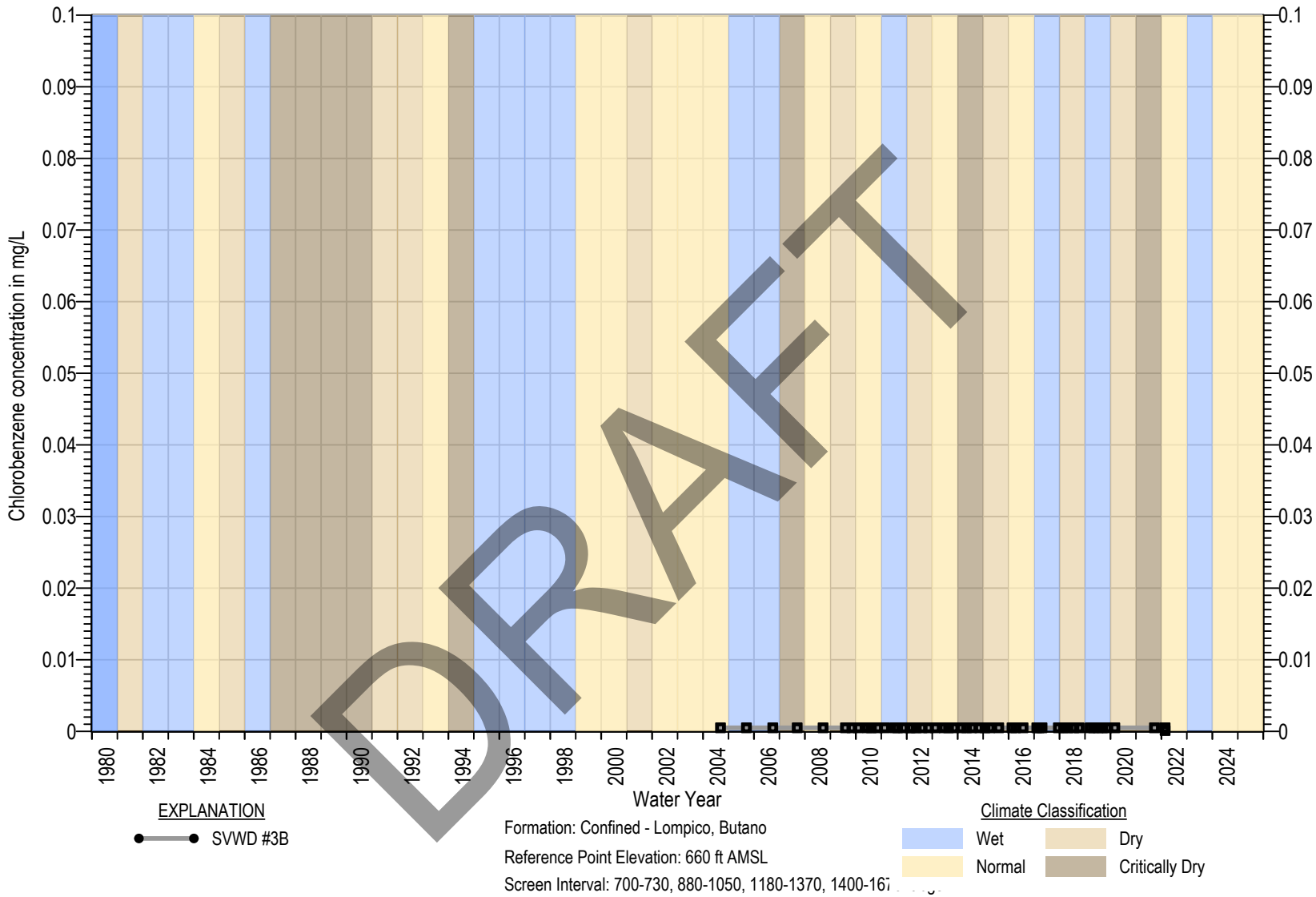
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-62. Chlorobenzene Chemograph of SVWD AB303 MW-2

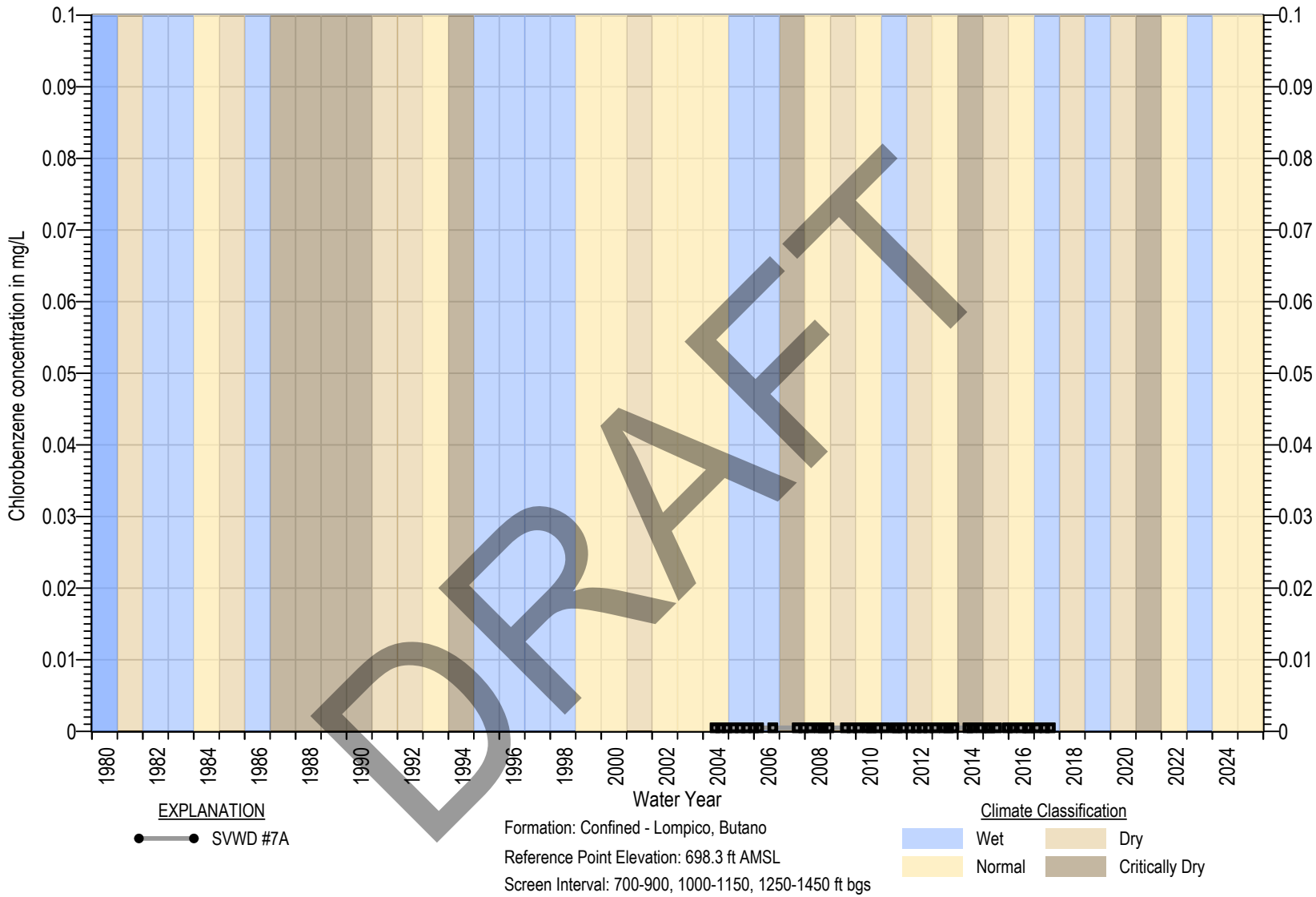
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-63. Chlorobenzene Chemograph of SVWD #3B

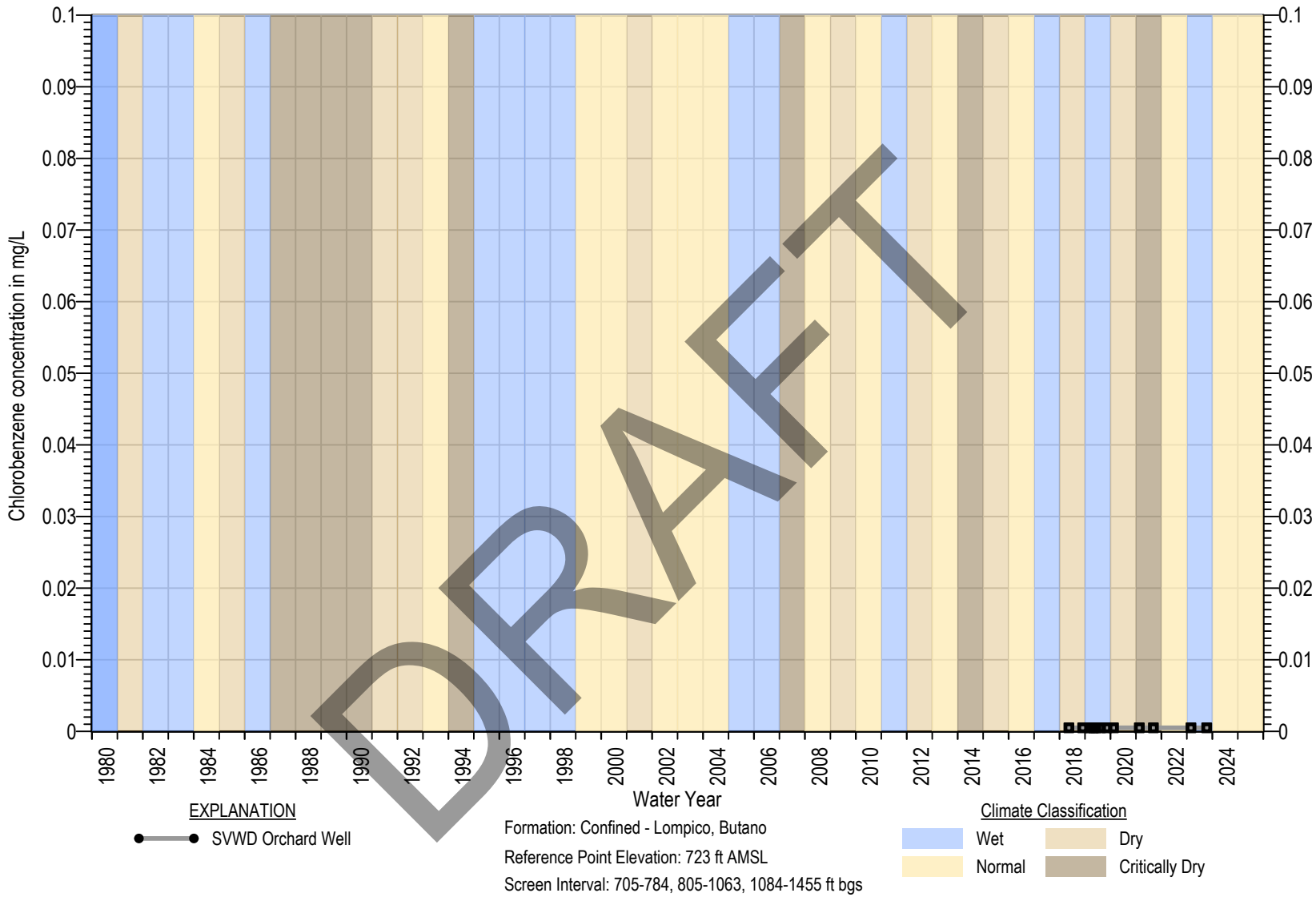
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-64. Chlorobenzene Chemograph of SVWD #7A

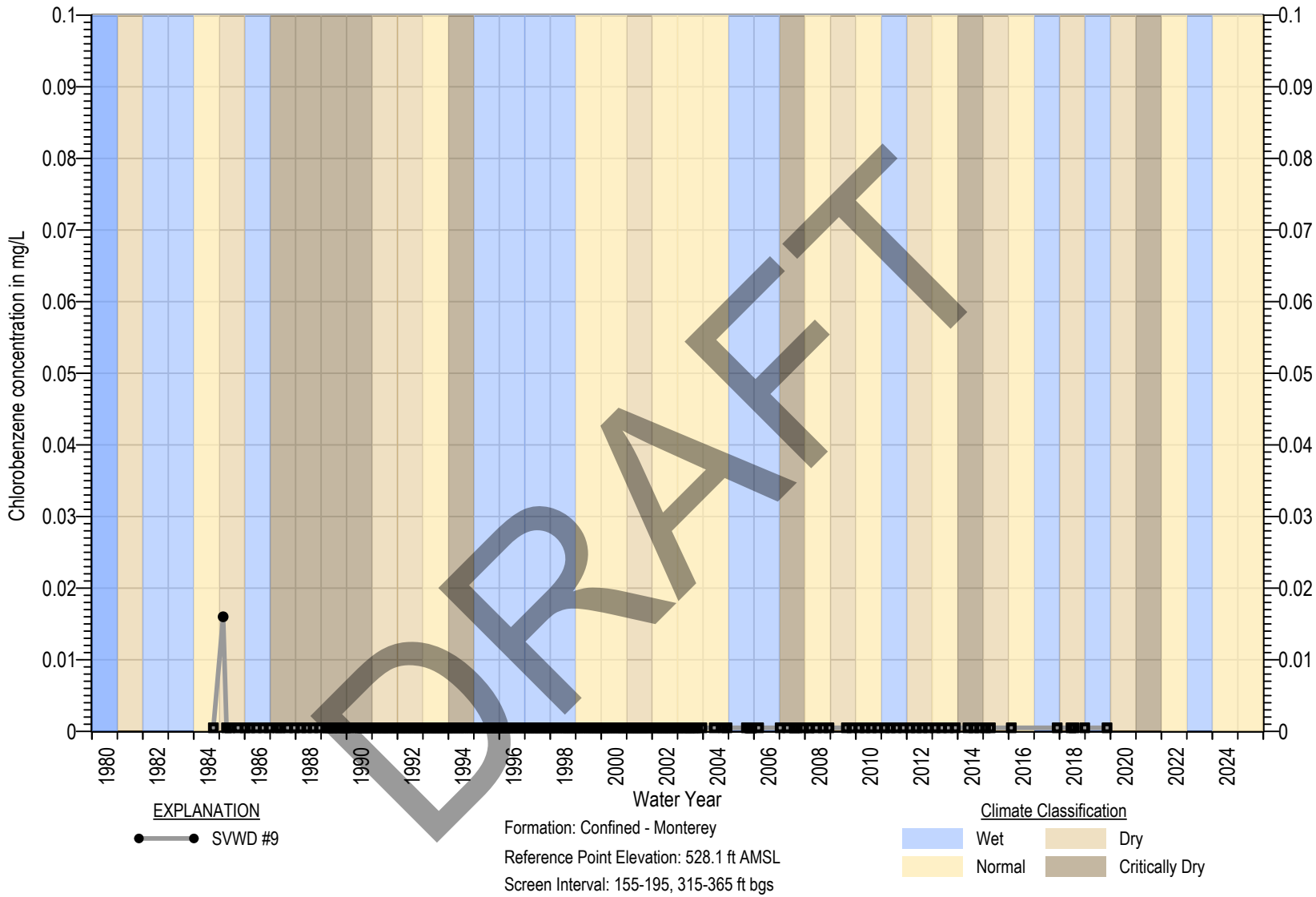
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-65. Chlorobenzene Chemograph of SVWD Orchard Well

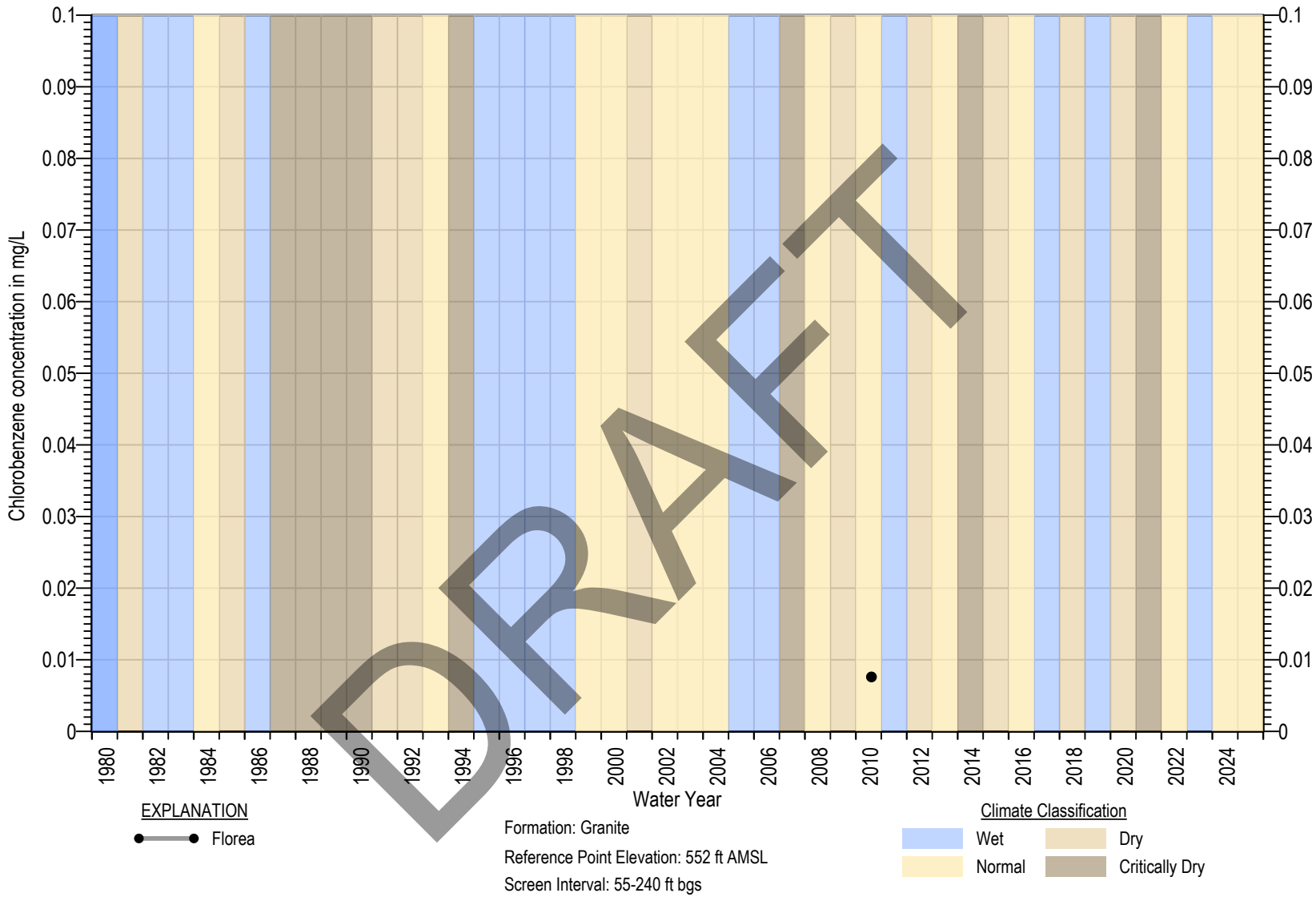
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-66. Chlorobenzene Chemograph of SVWD #9

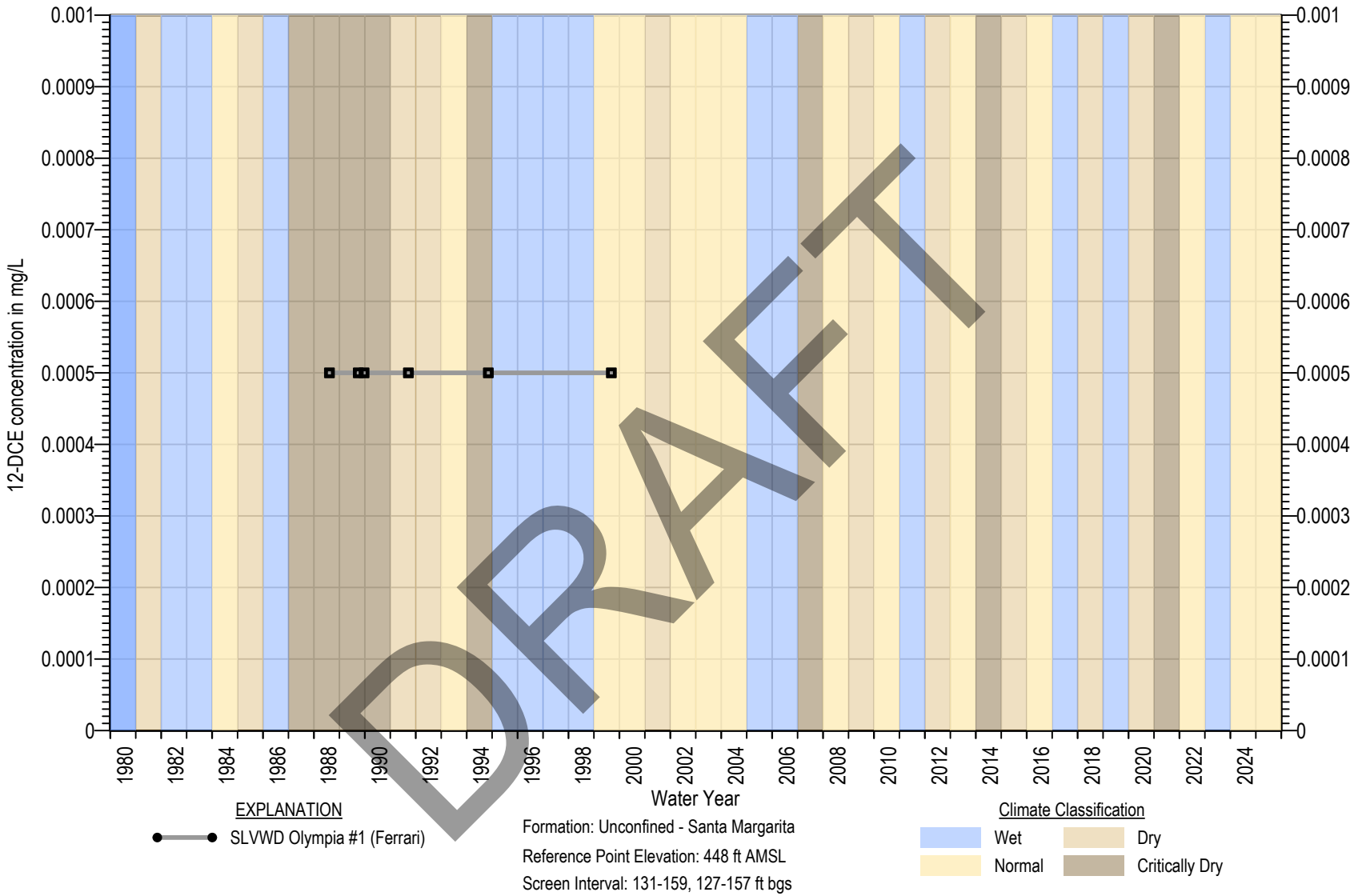
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-67. Chlorobenzene Chemograph of Florea

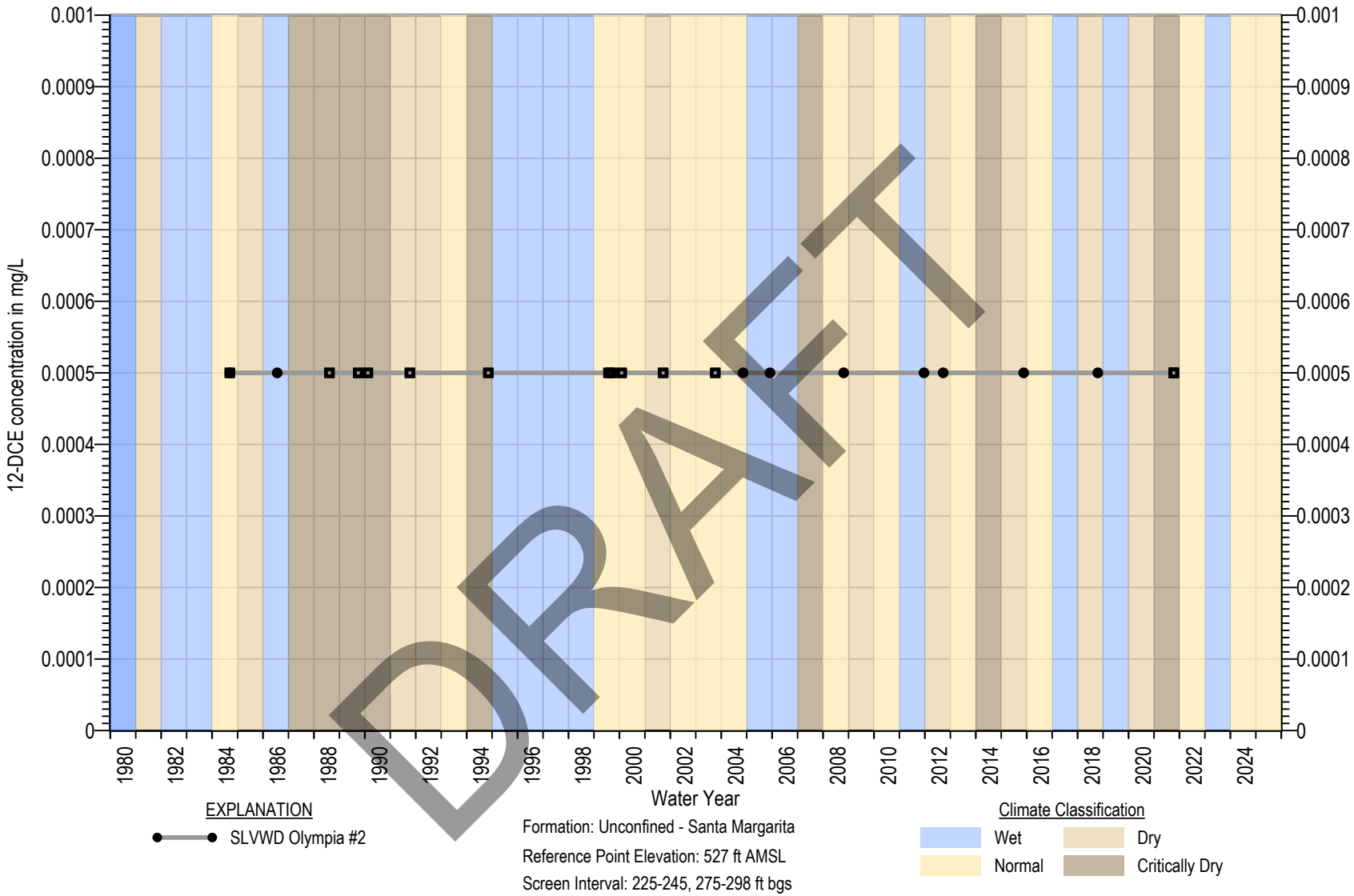
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-68. DCE Chemograph of SLVWD Olympia #1 (Ferrari)

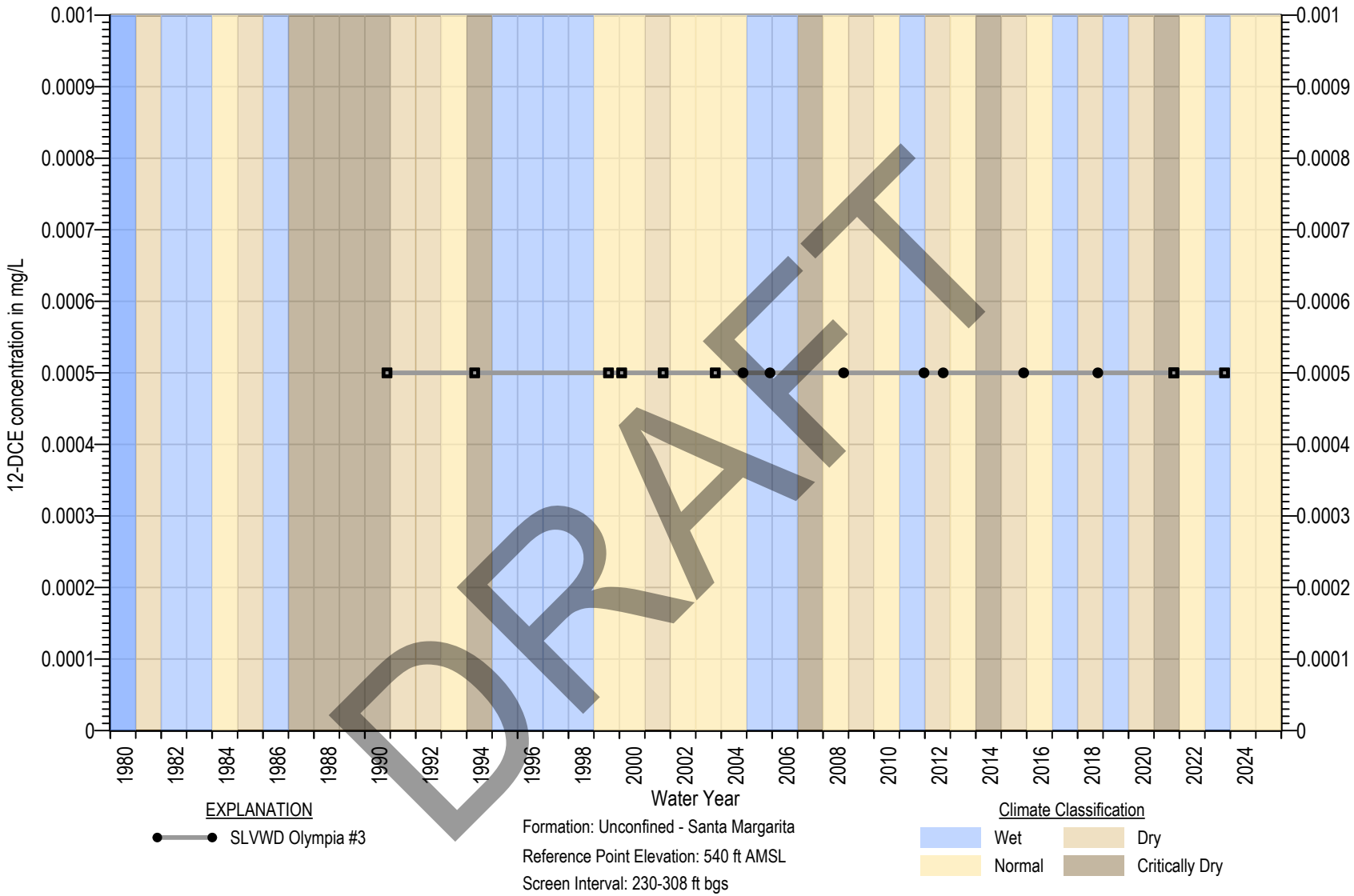
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-69. DCE Chemograph of SLVWD Olympia #2

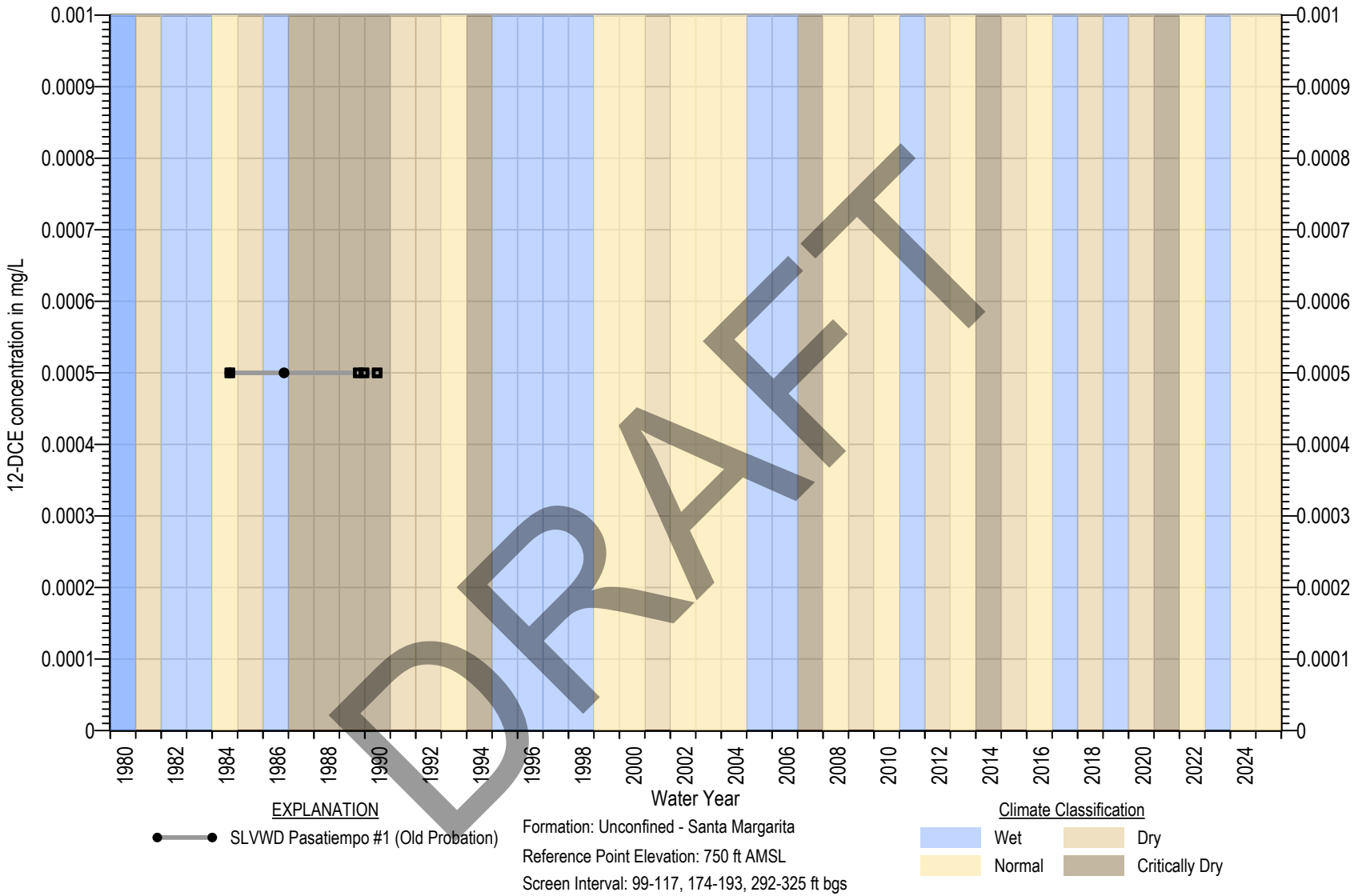
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-70. DCE Chemograph of SLVWD Olympia #3

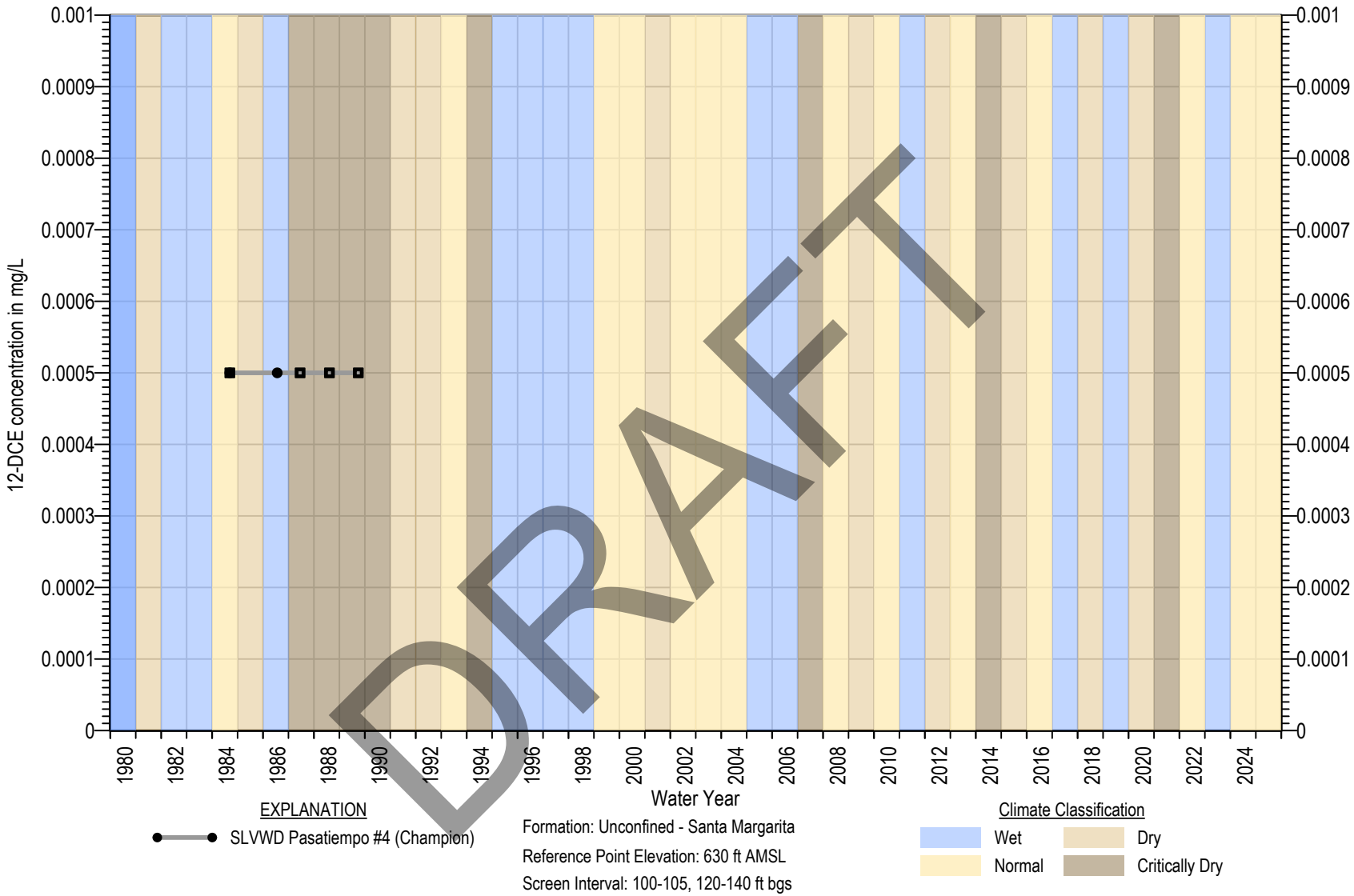
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-71. DCE Chemograph of SLVWD Pasatiempo #1 (Old Probation)

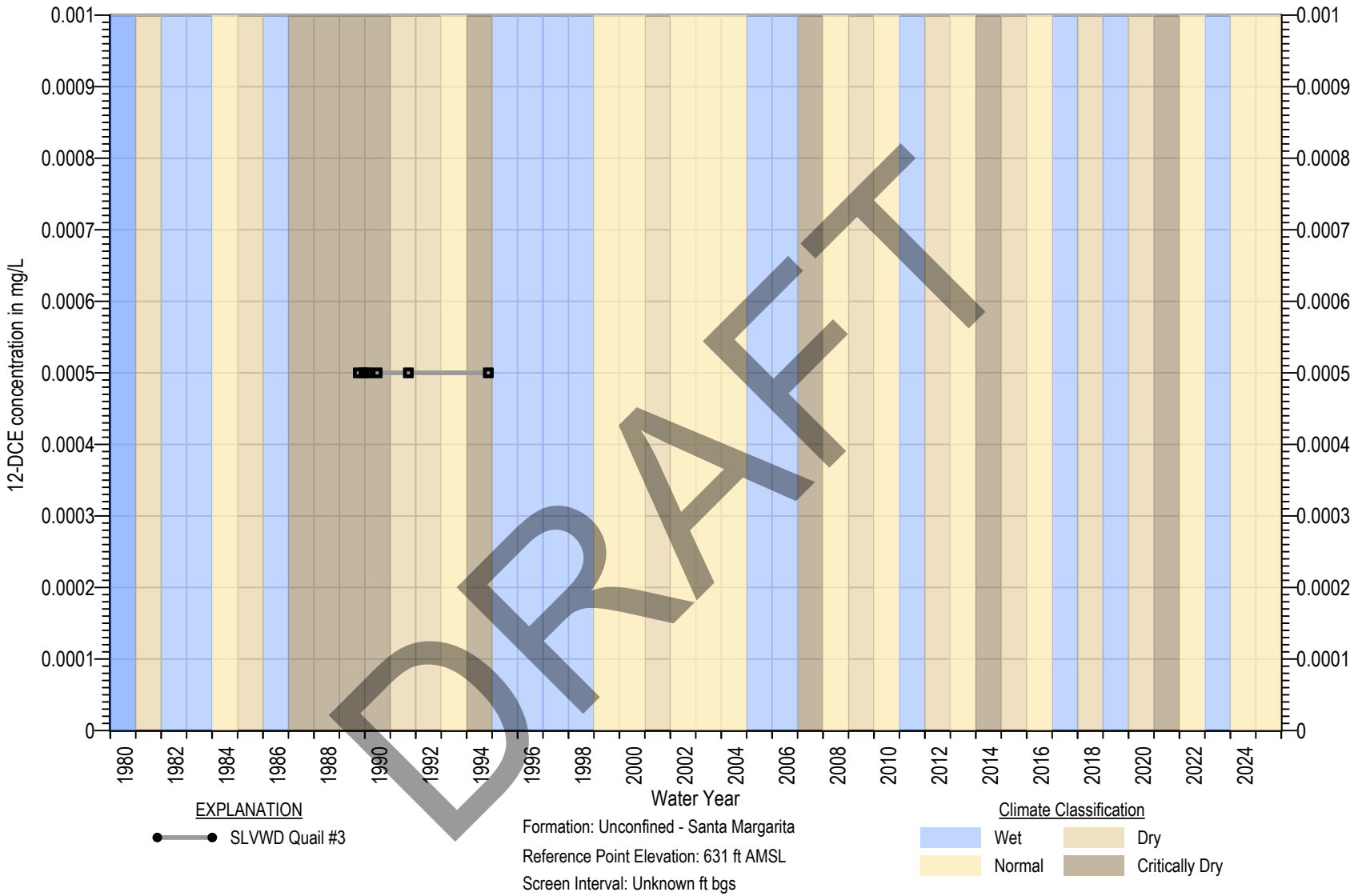
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-72. DCE Chemograph of SLVWD Pasatiempo #4 (Champion)

MONTGOMERY & ASSOCIATES



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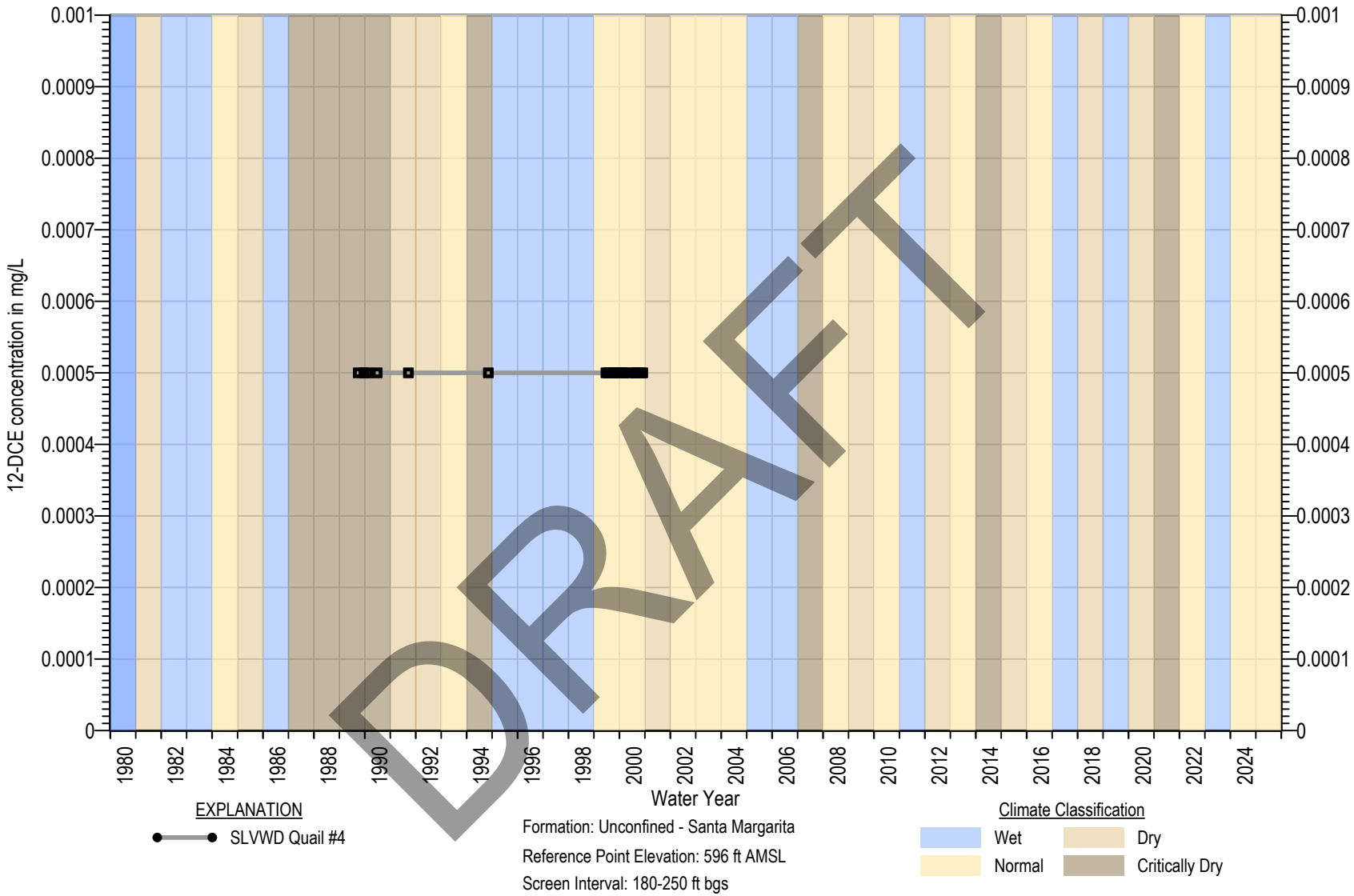
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-73. DCE Chemograph of SLVWD Quail #3



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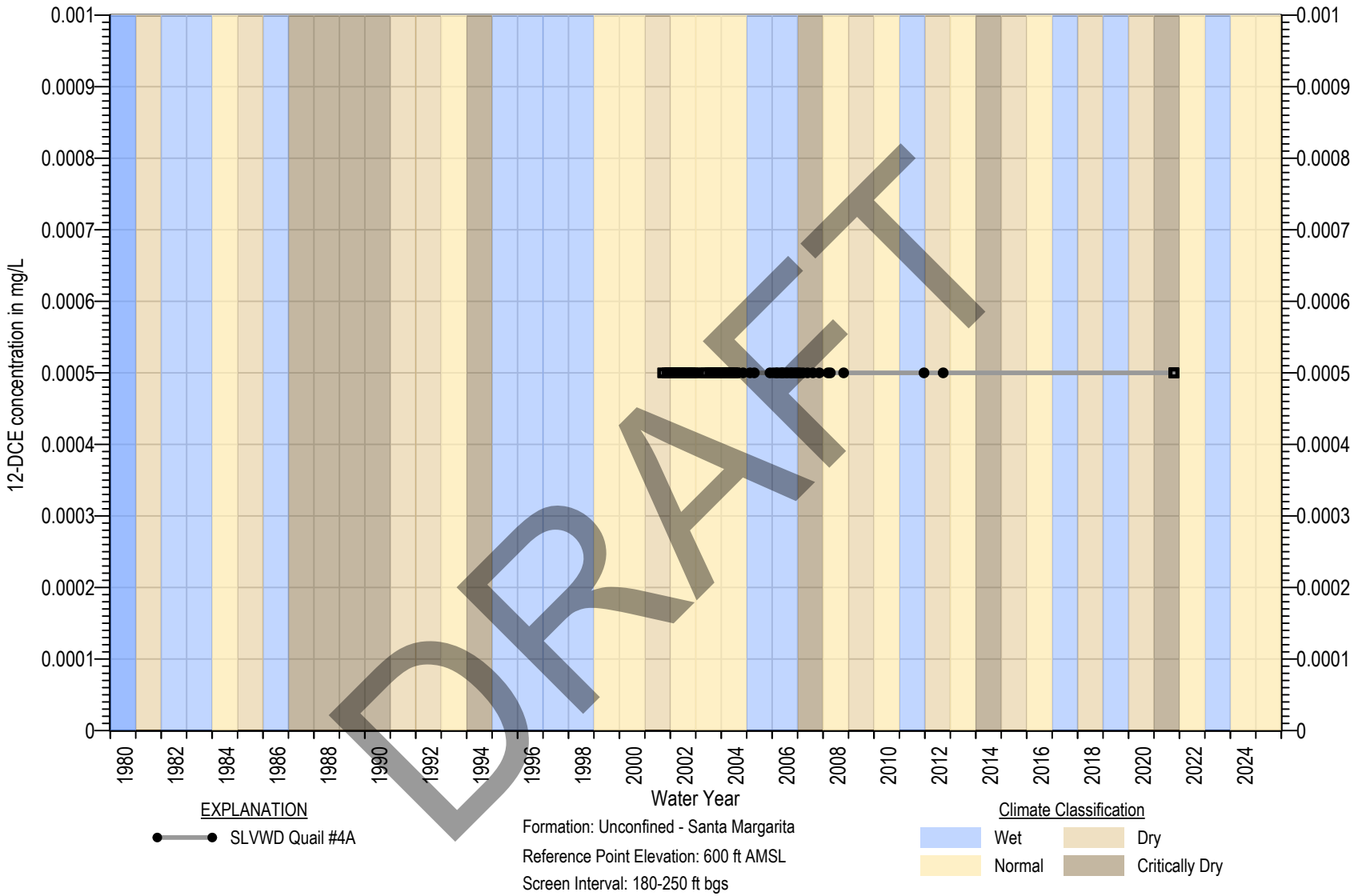
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-74. DCE Chemograph of SLVWD Quail #4

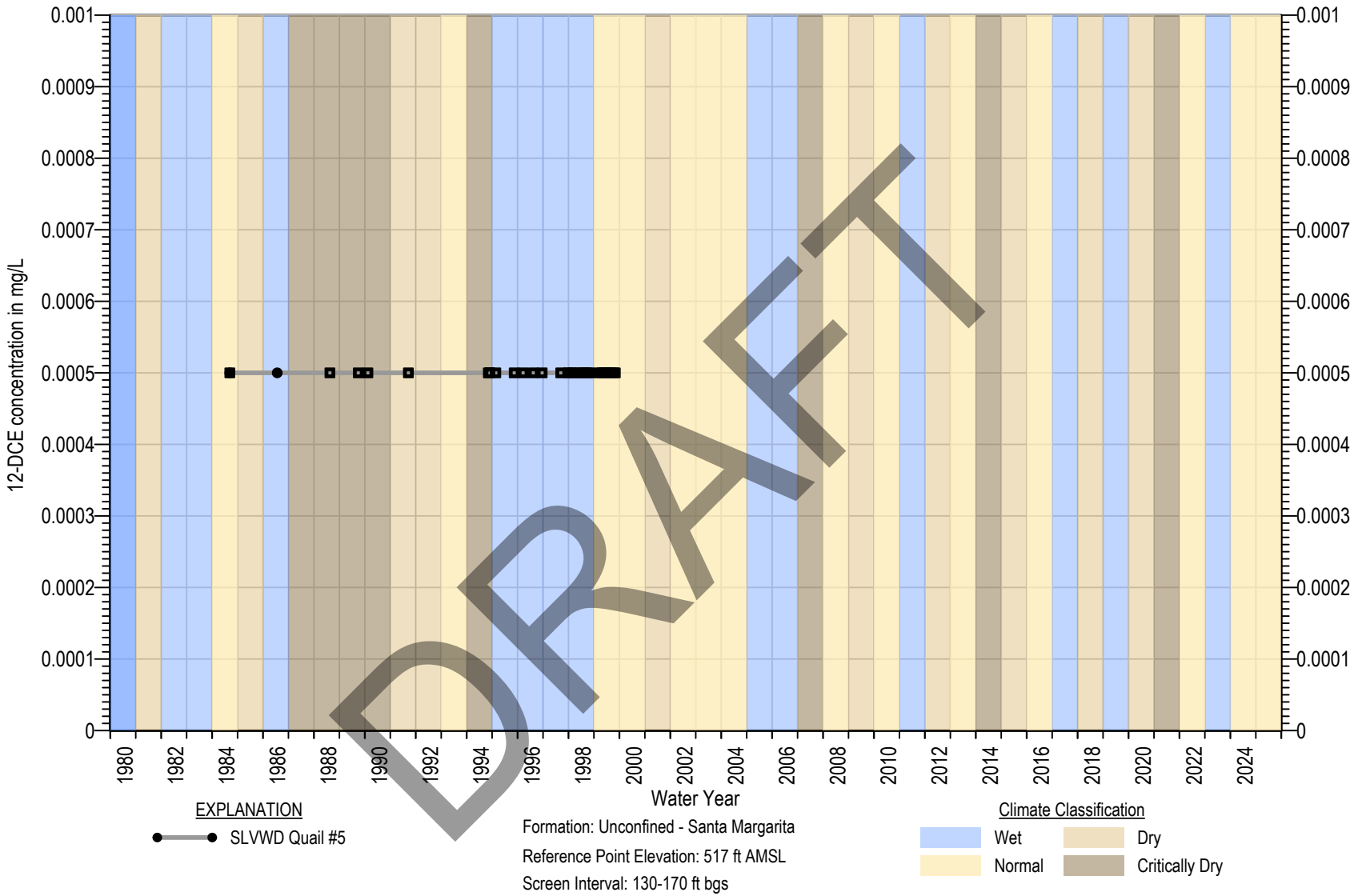
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-75. DCE Chemograph of SLVWD Quail #4A

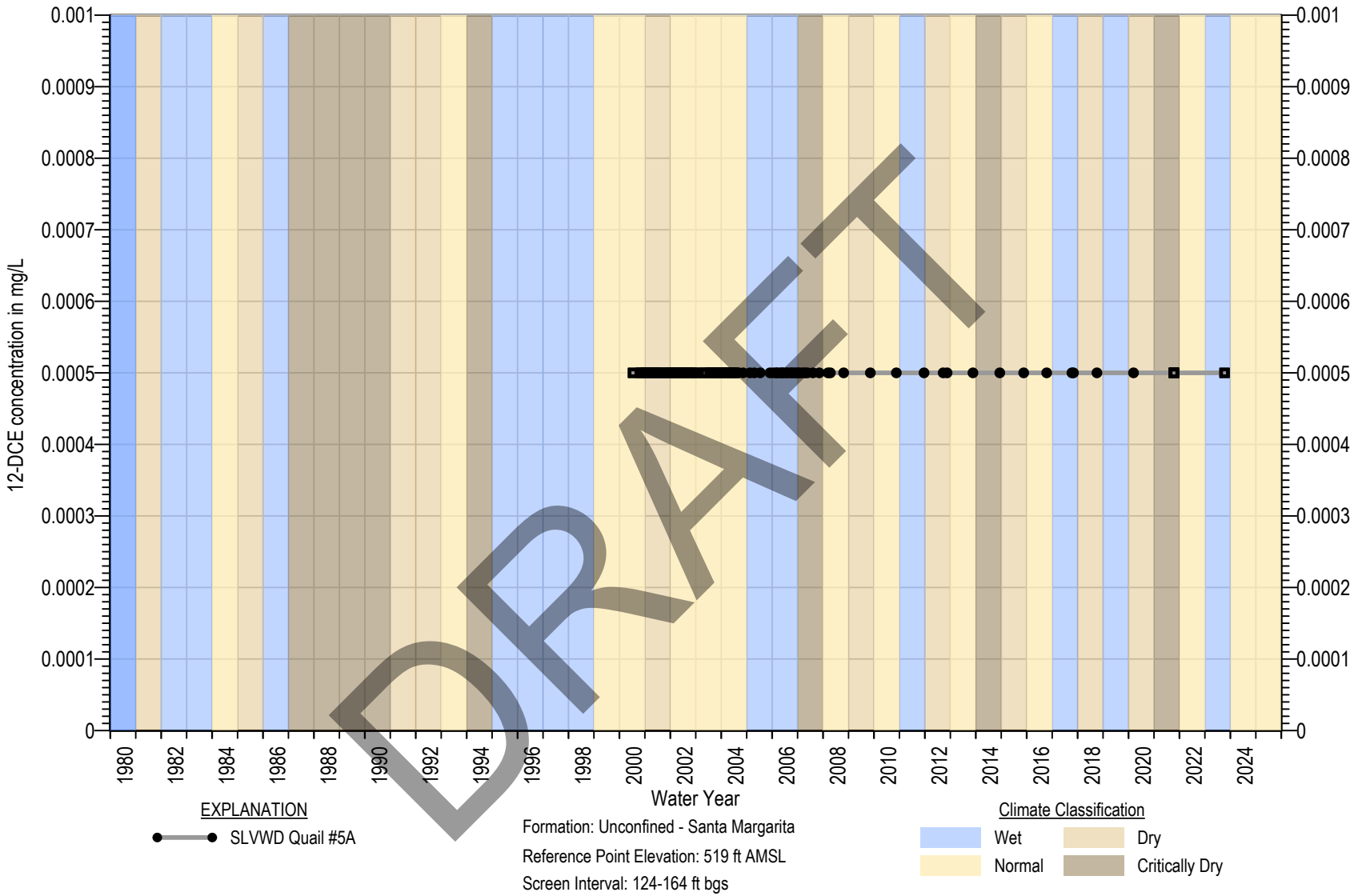
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-76. DCE Chemograph of SLVWD Quail #5

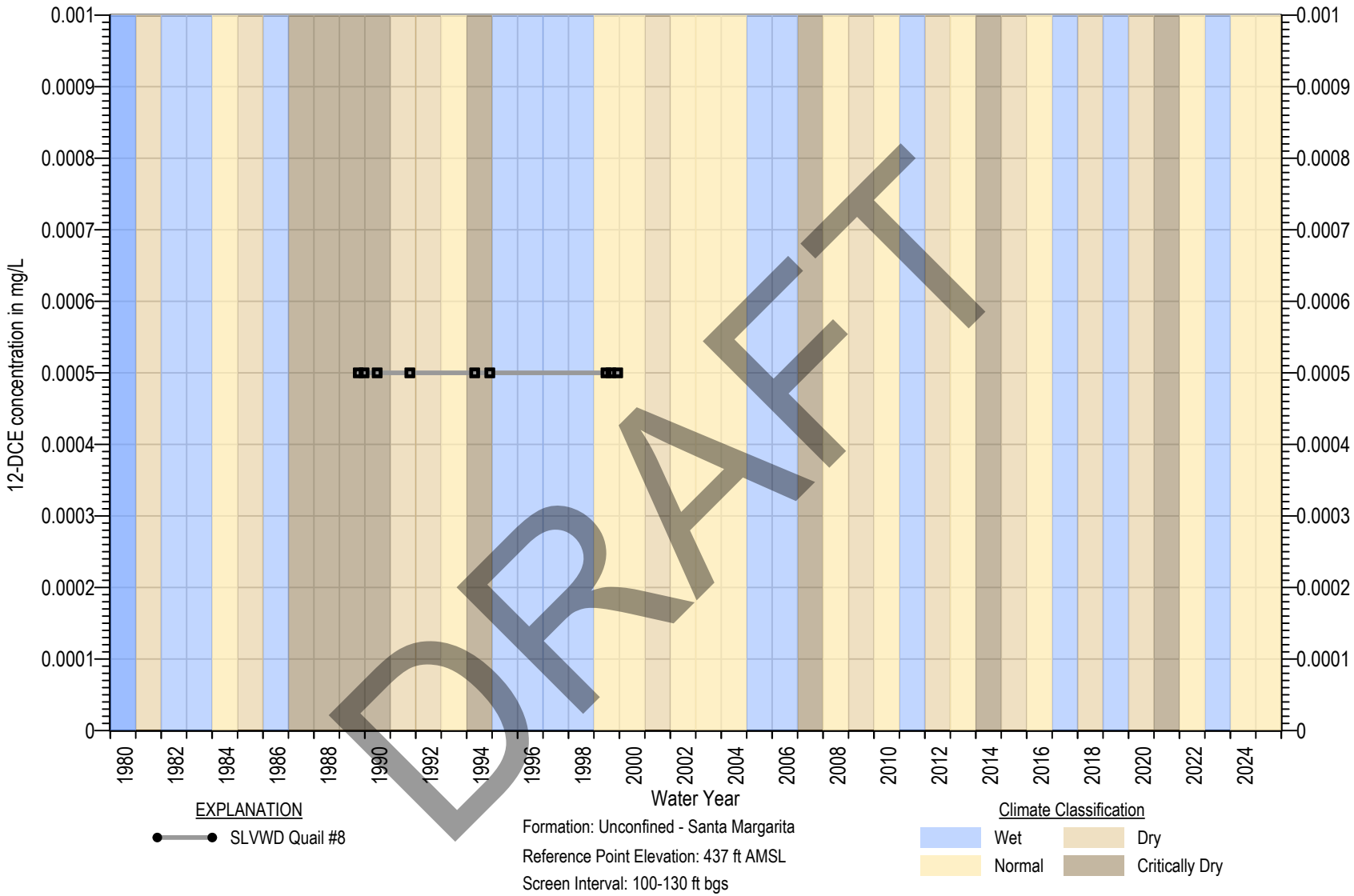
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-77. DCE Chemograph of SLVWD Quail #5A

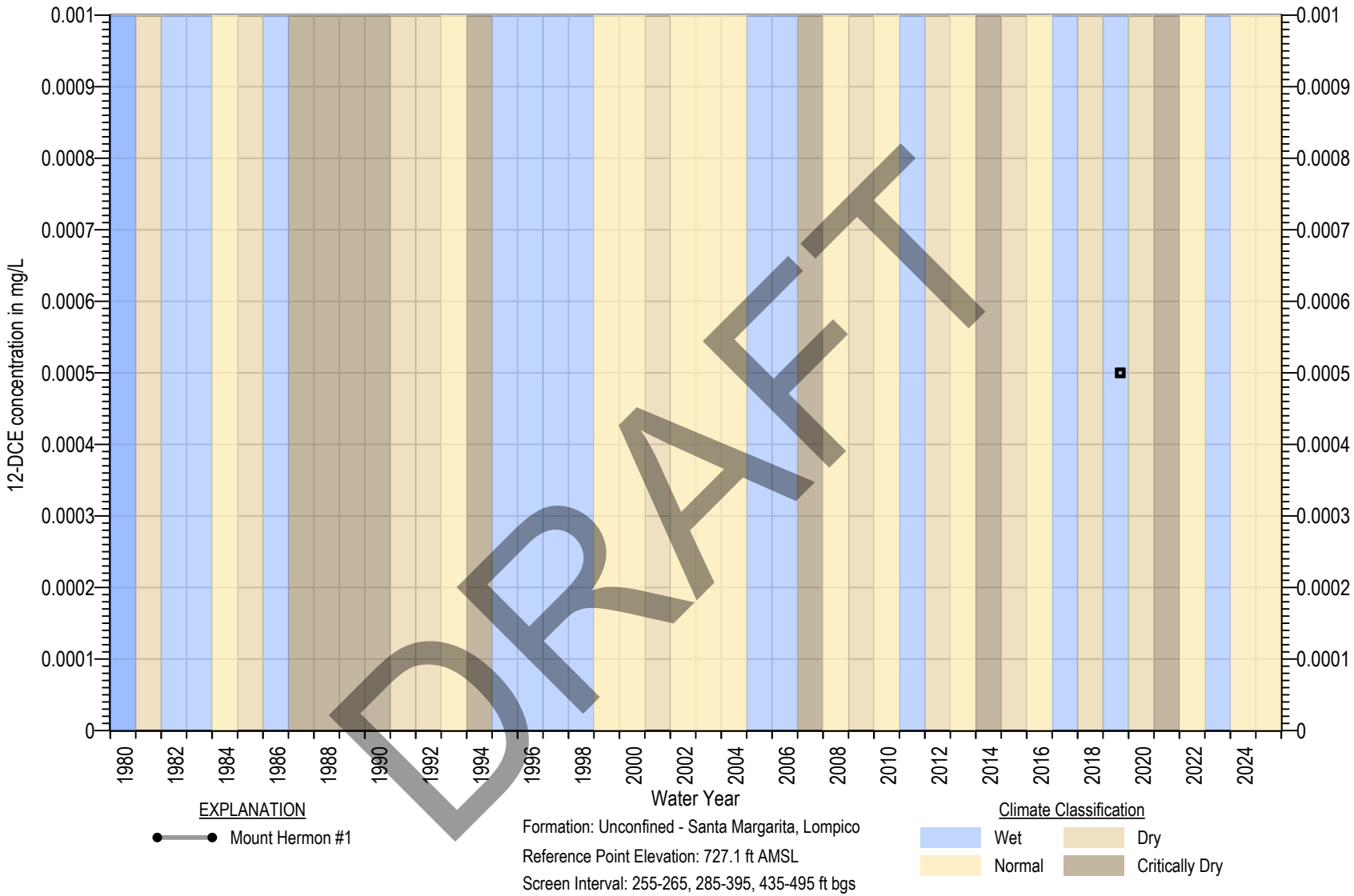
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-78. DCE Chemograph of SLVWD Quail #8

MONTGOMERY & ASSOCIATES



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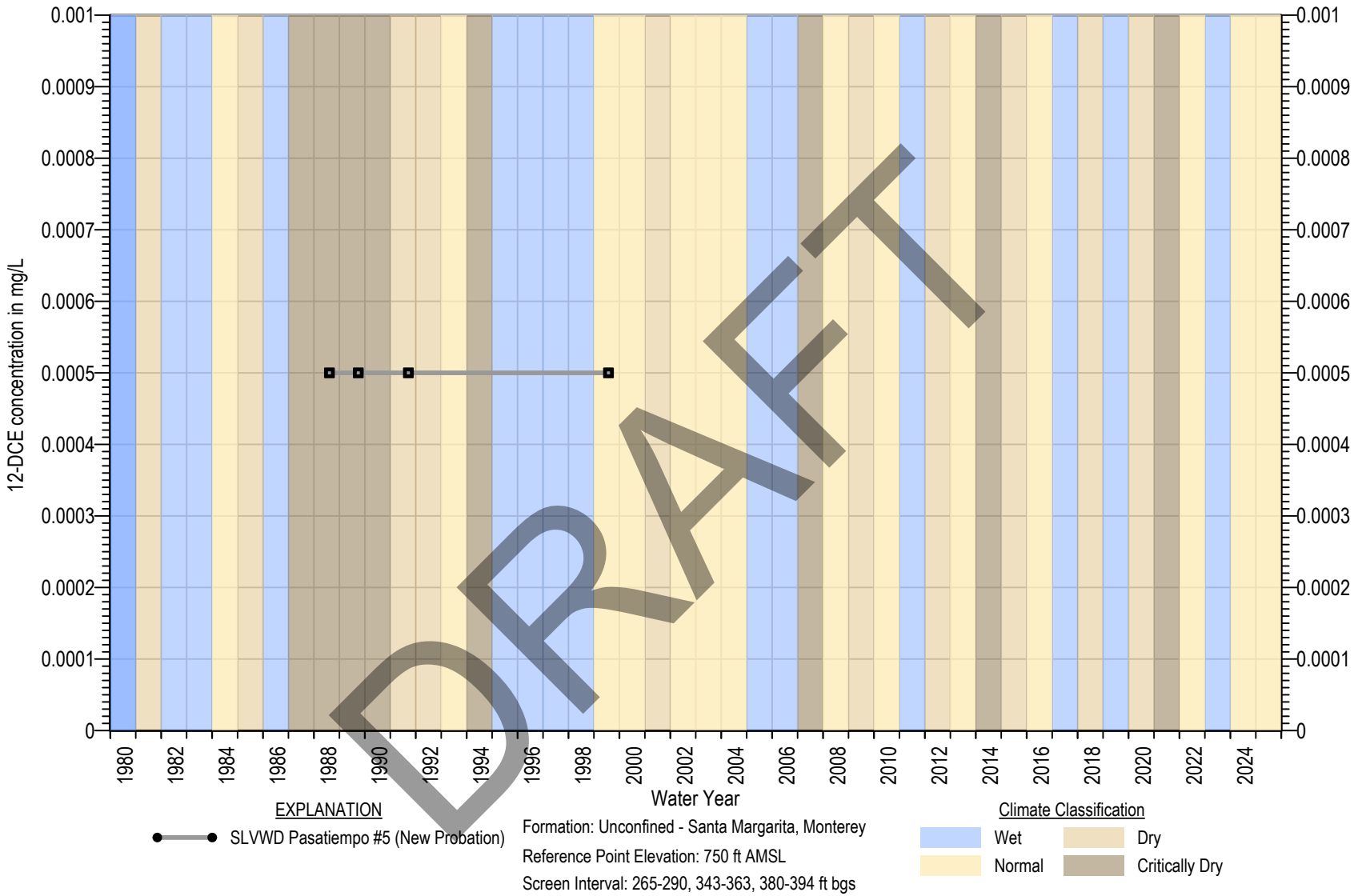
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-79. DCE Chemograph of Mount Hermon #1

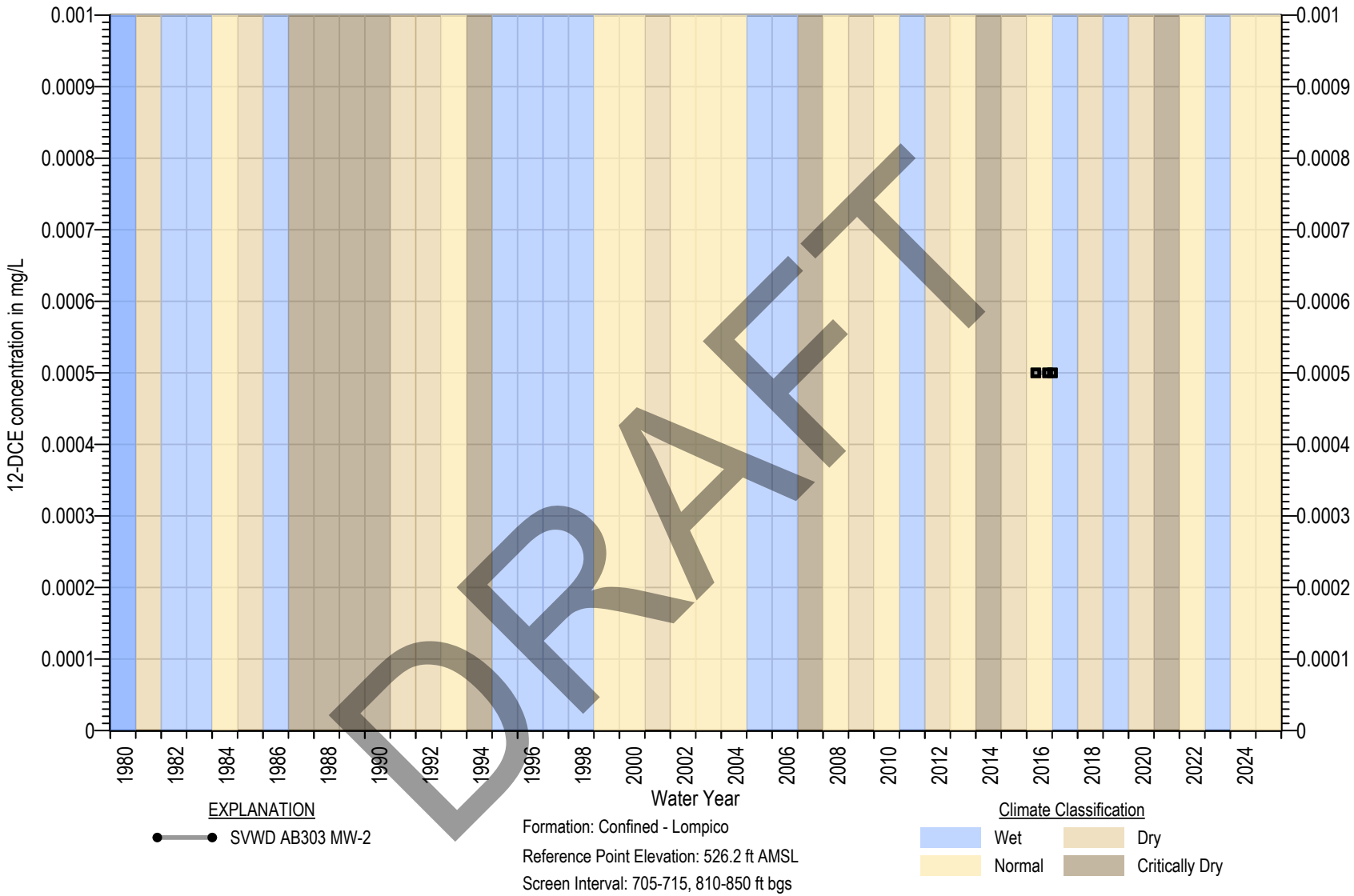
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-80. DCE Chemograph of SLVWD Pasatiempo #5 (New Probation)

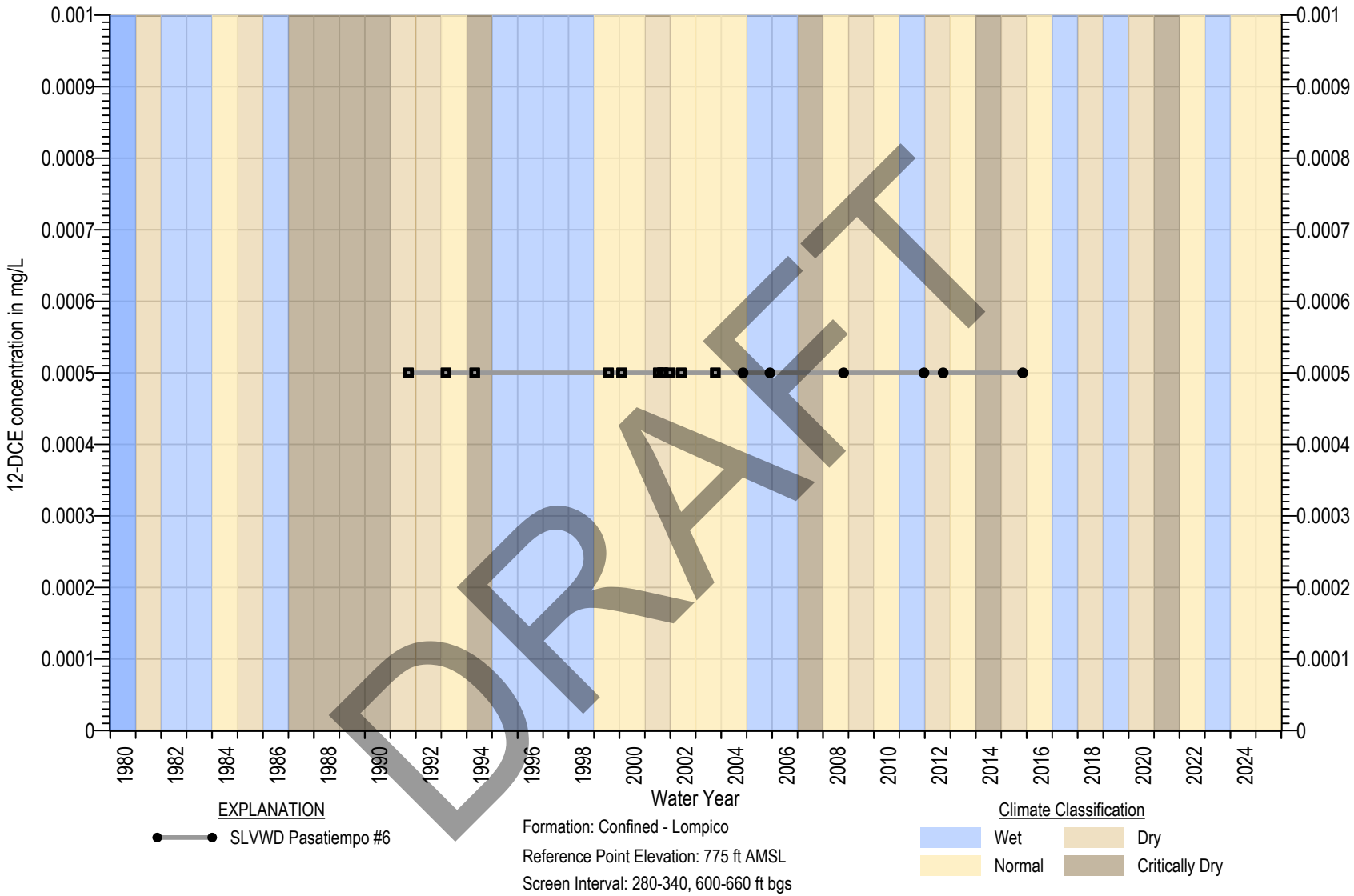
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-81. DCE Chemograph of SVWD AB303 MW-2

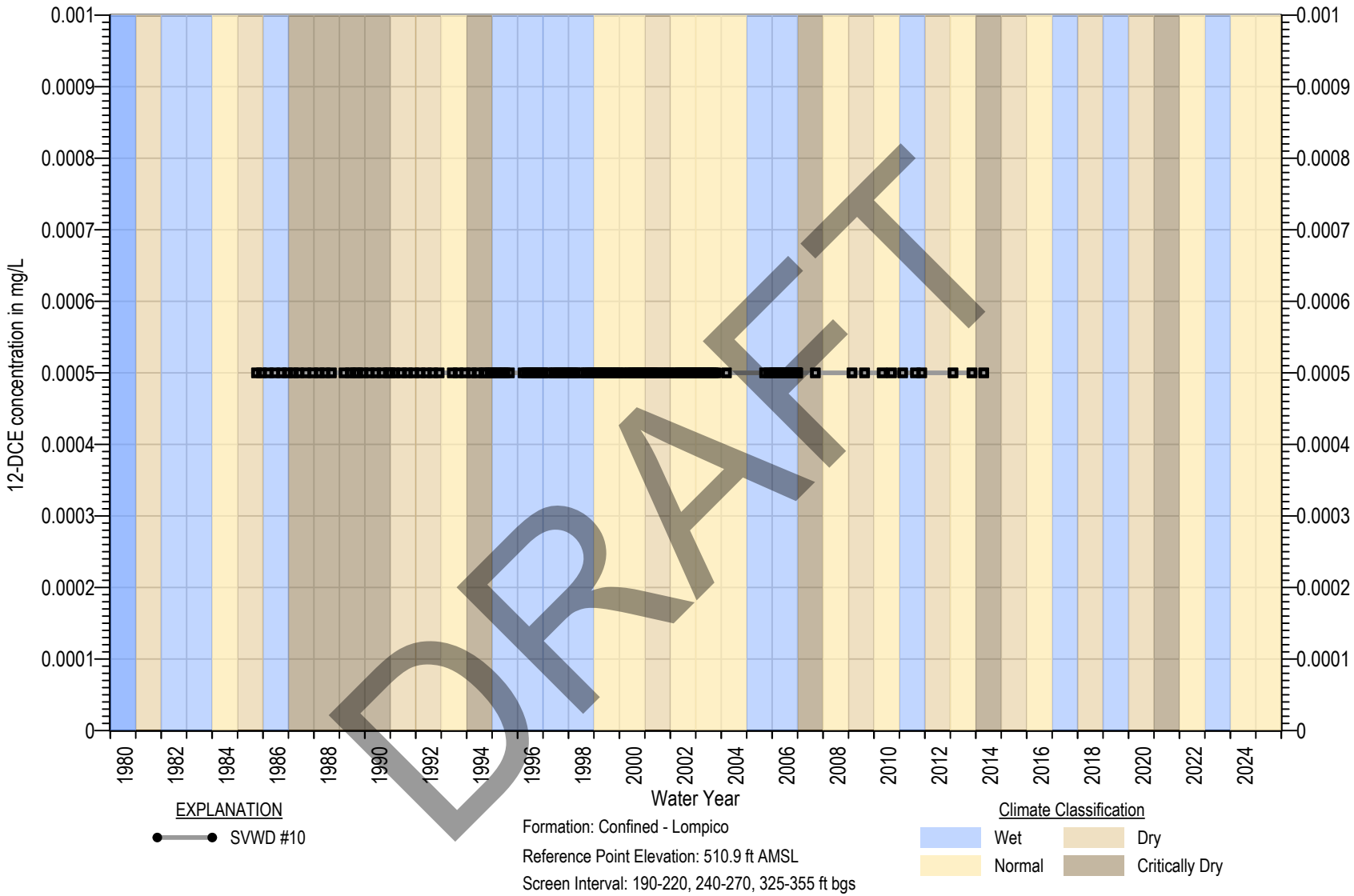
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-82. DCE Chemograph of SLVWD Pasatiempo #6

MONTGOMERY & ASSOCIATES



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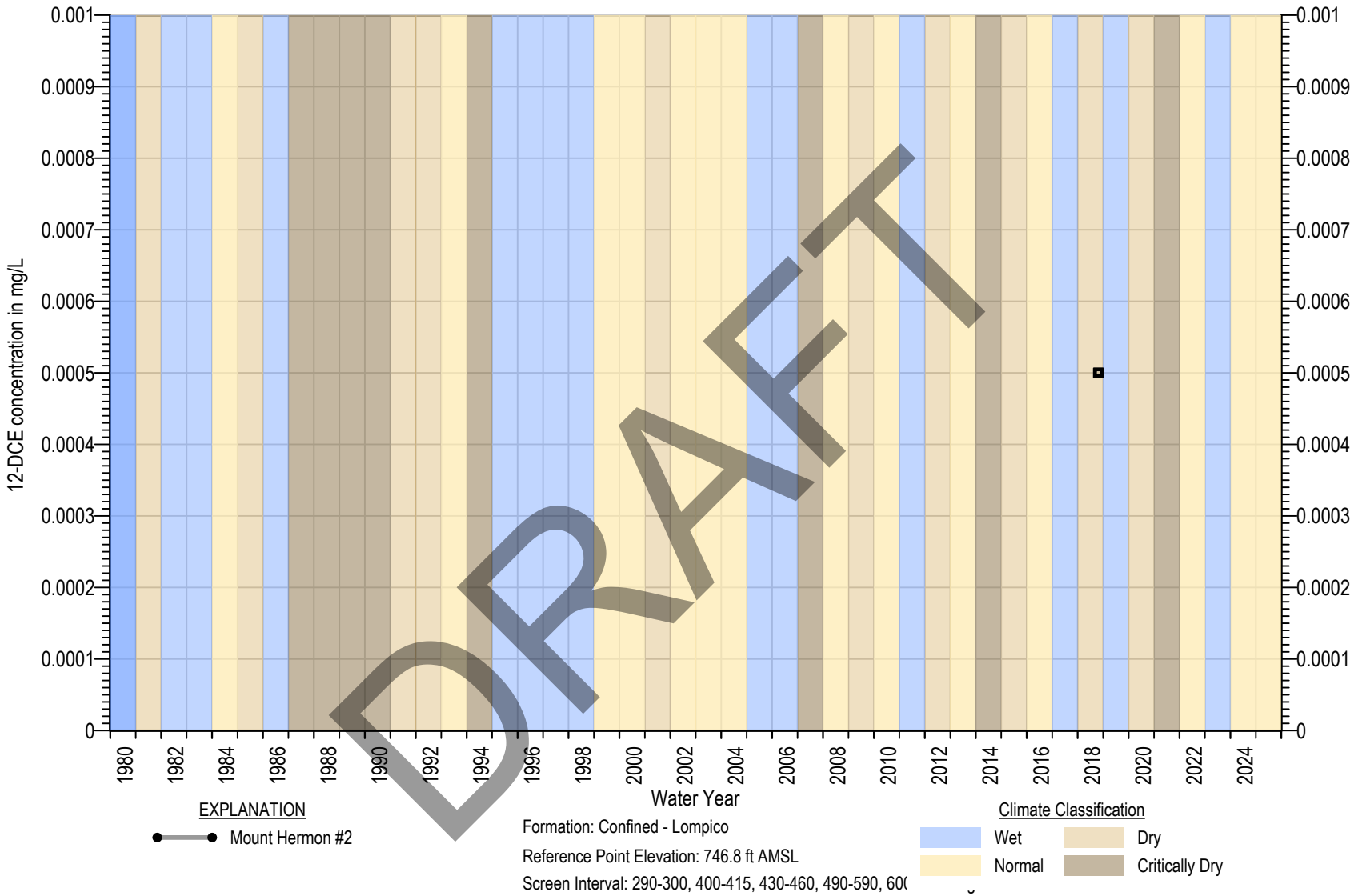
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-83. DCE Chemograph of SVWD #10

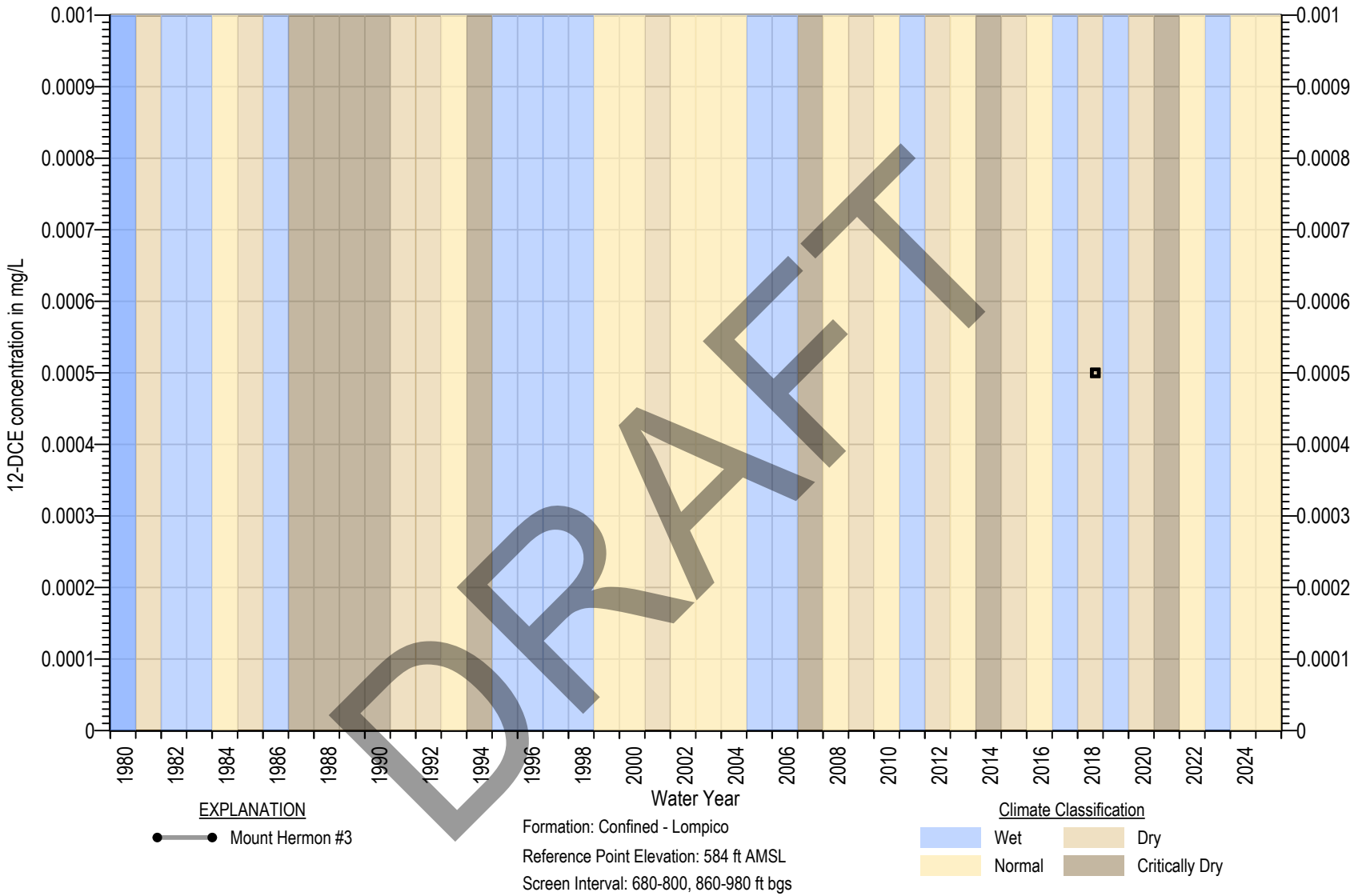
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-84. DCE Chemograph of Mount Hermon #2

MONTGOMERY & ASSOCIATES

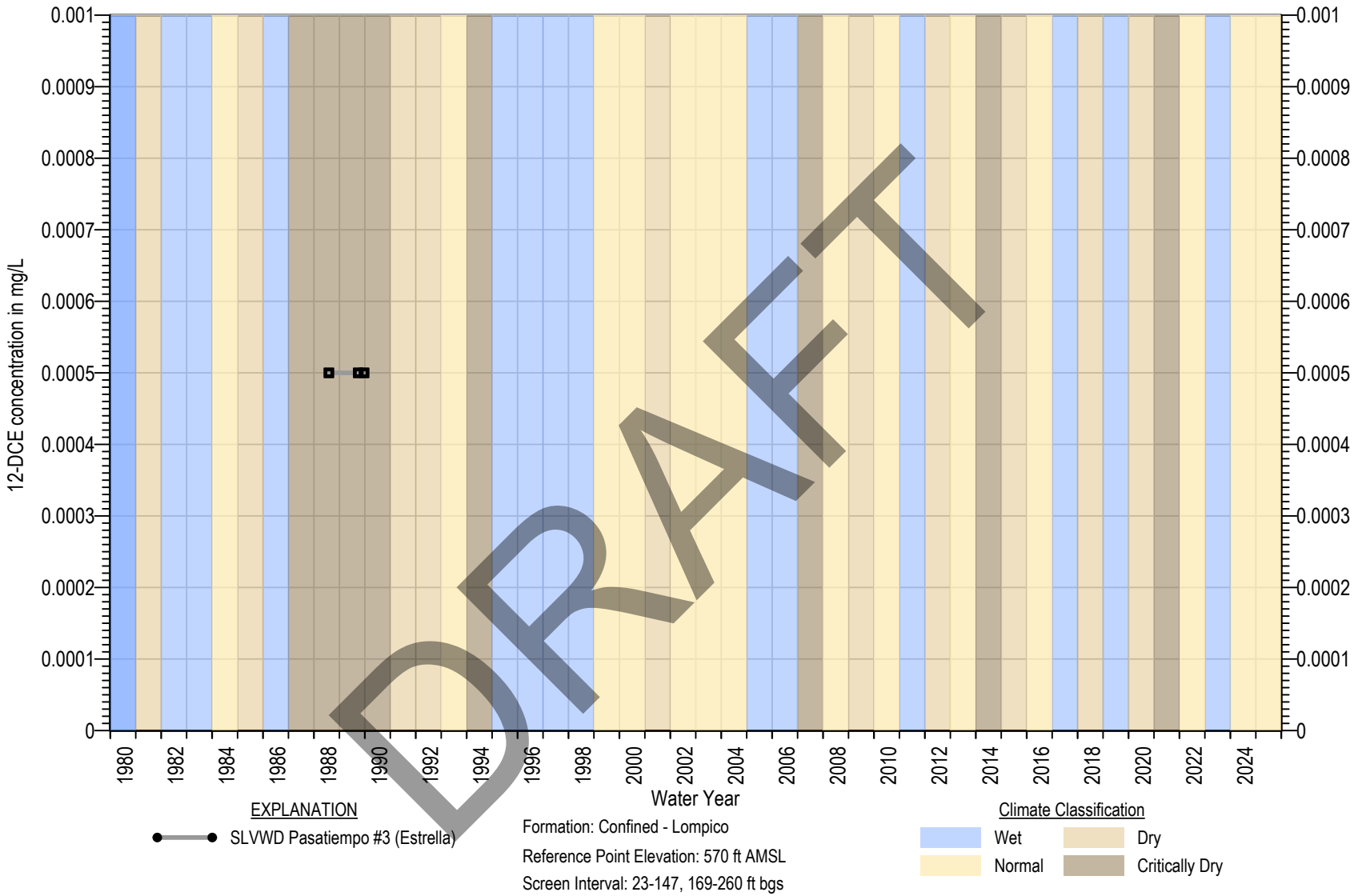


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-85. DCE Chemograph of Mount Hermon #3

MONTGOMERY & ASSOCIATES

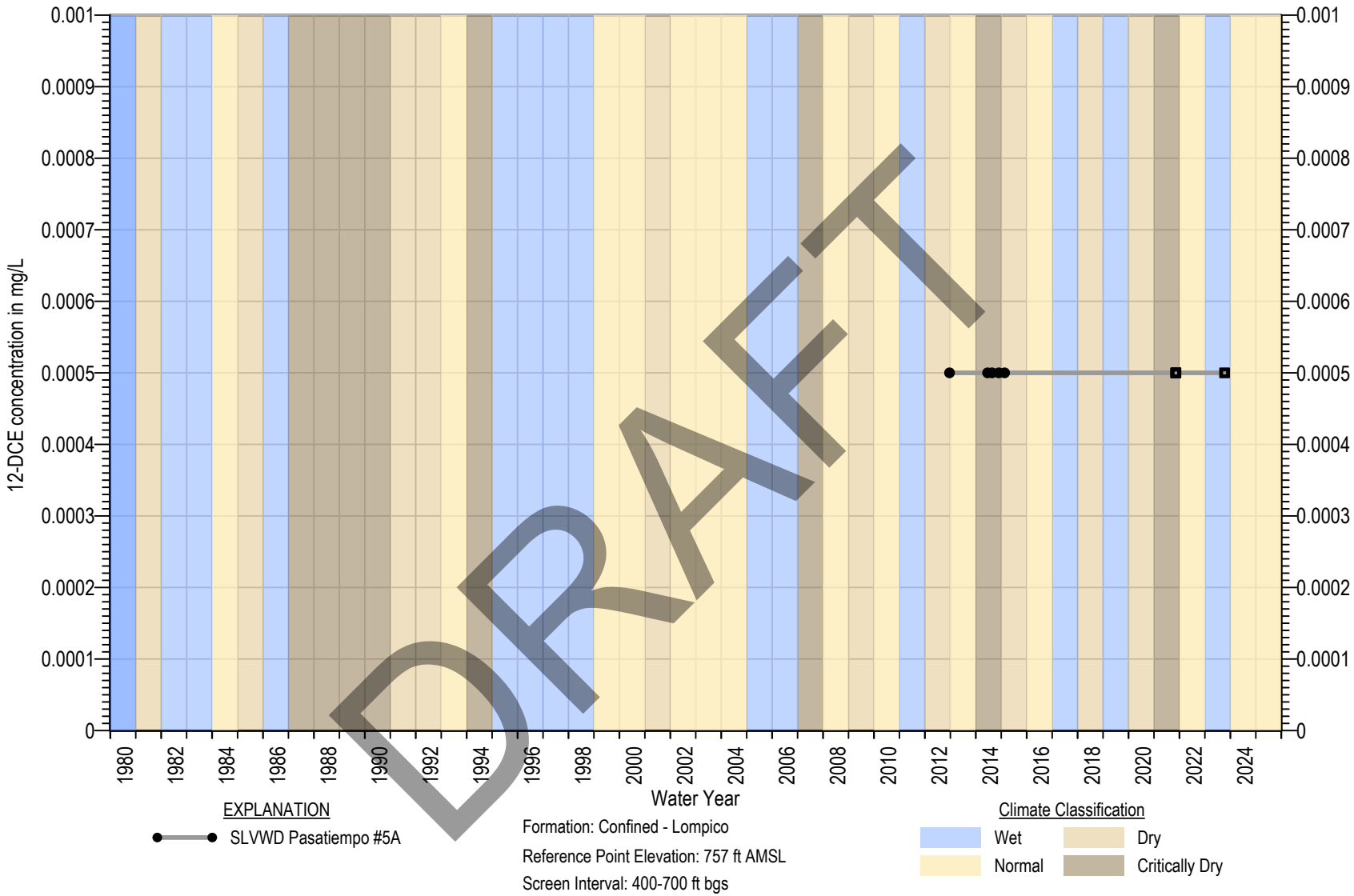


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-86. DCE Chemograph of SLVWD Pasatiempo #3 (Estrella)

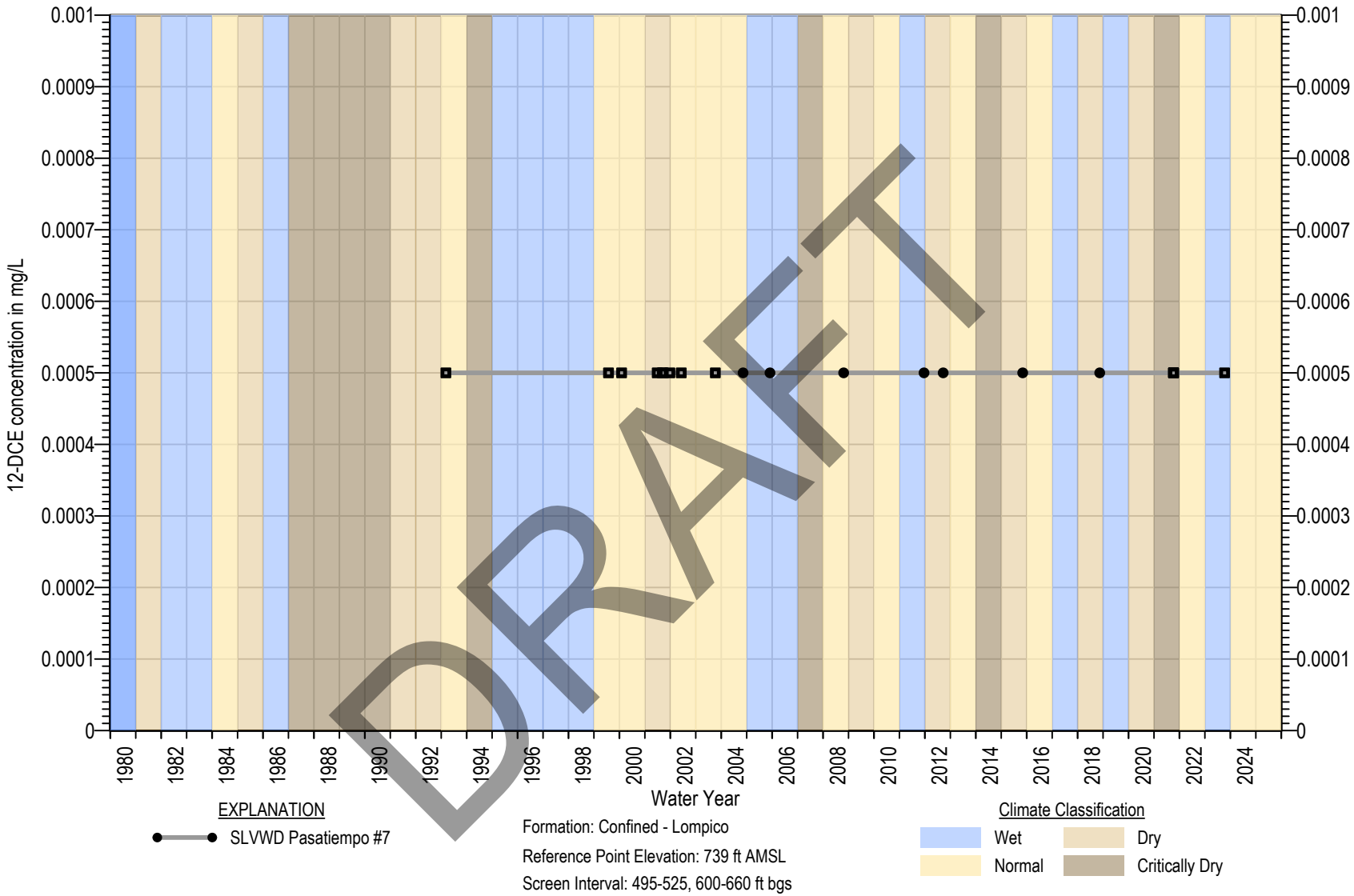
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-87. DCE Chemograph of SLVWD Pasatiempo #5A

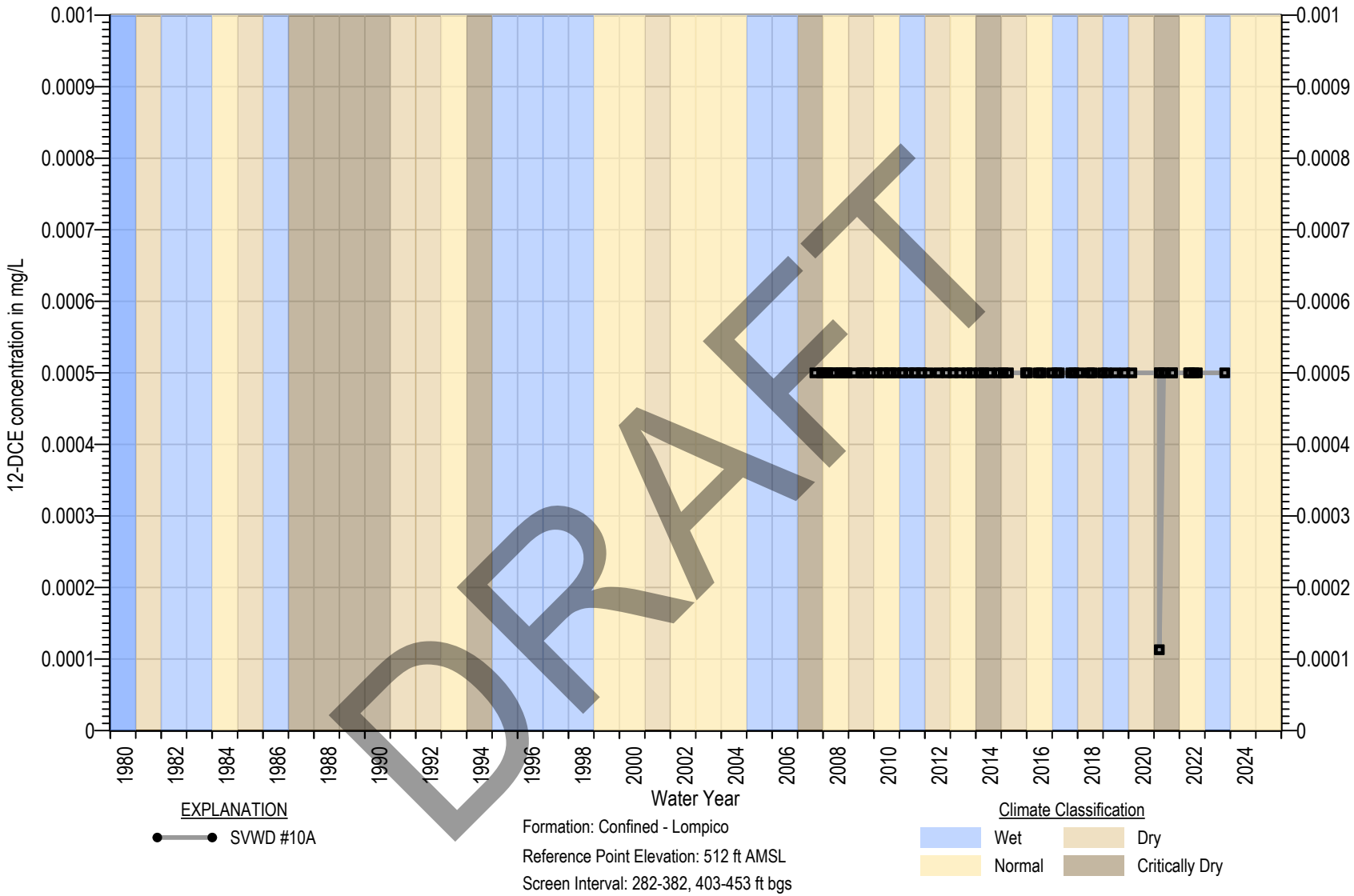
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-88. DCE Chemograph of SLVWD Pasatiempo #7

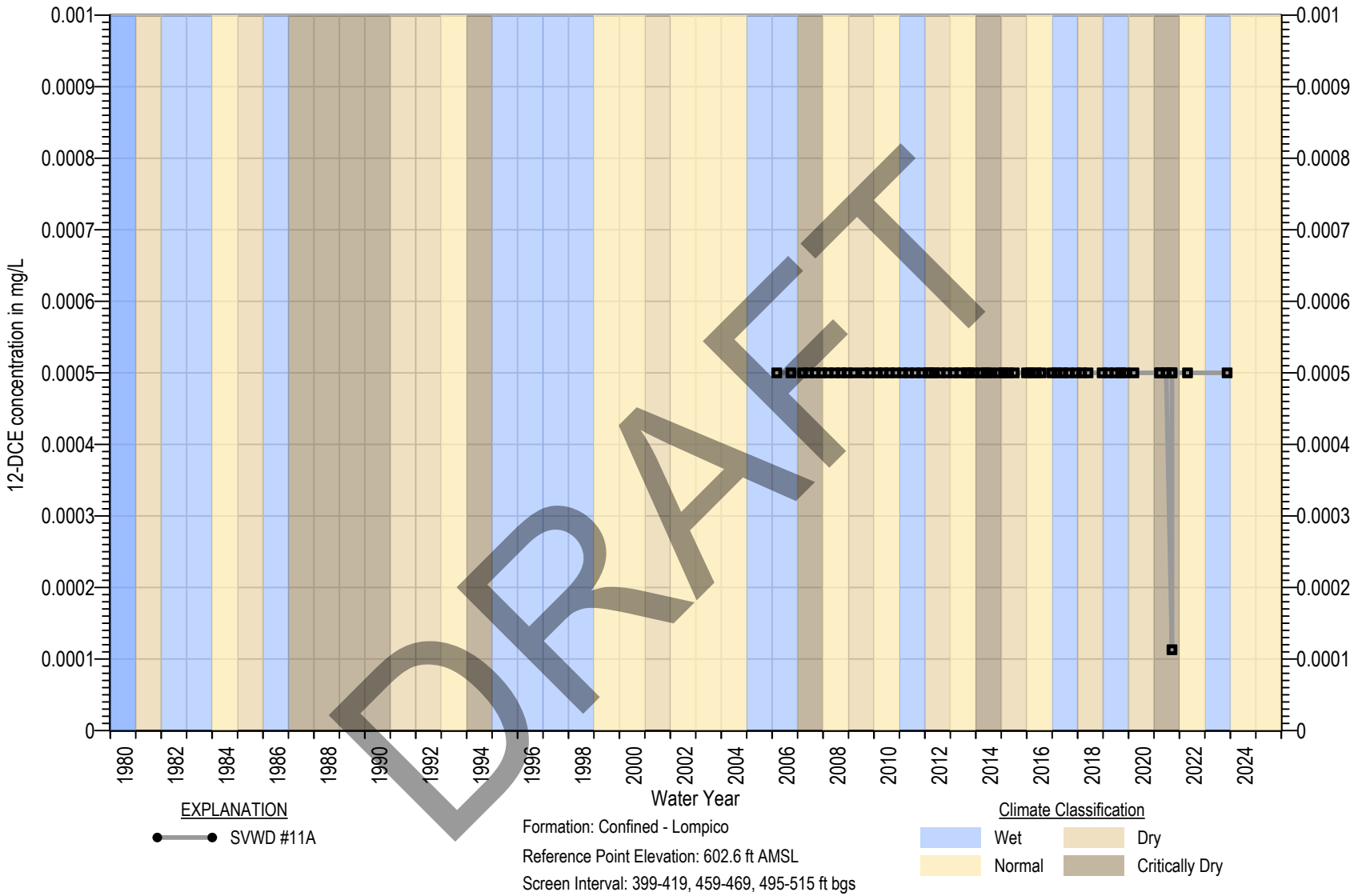
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-89. DCE Chemograph of SVWD #10A

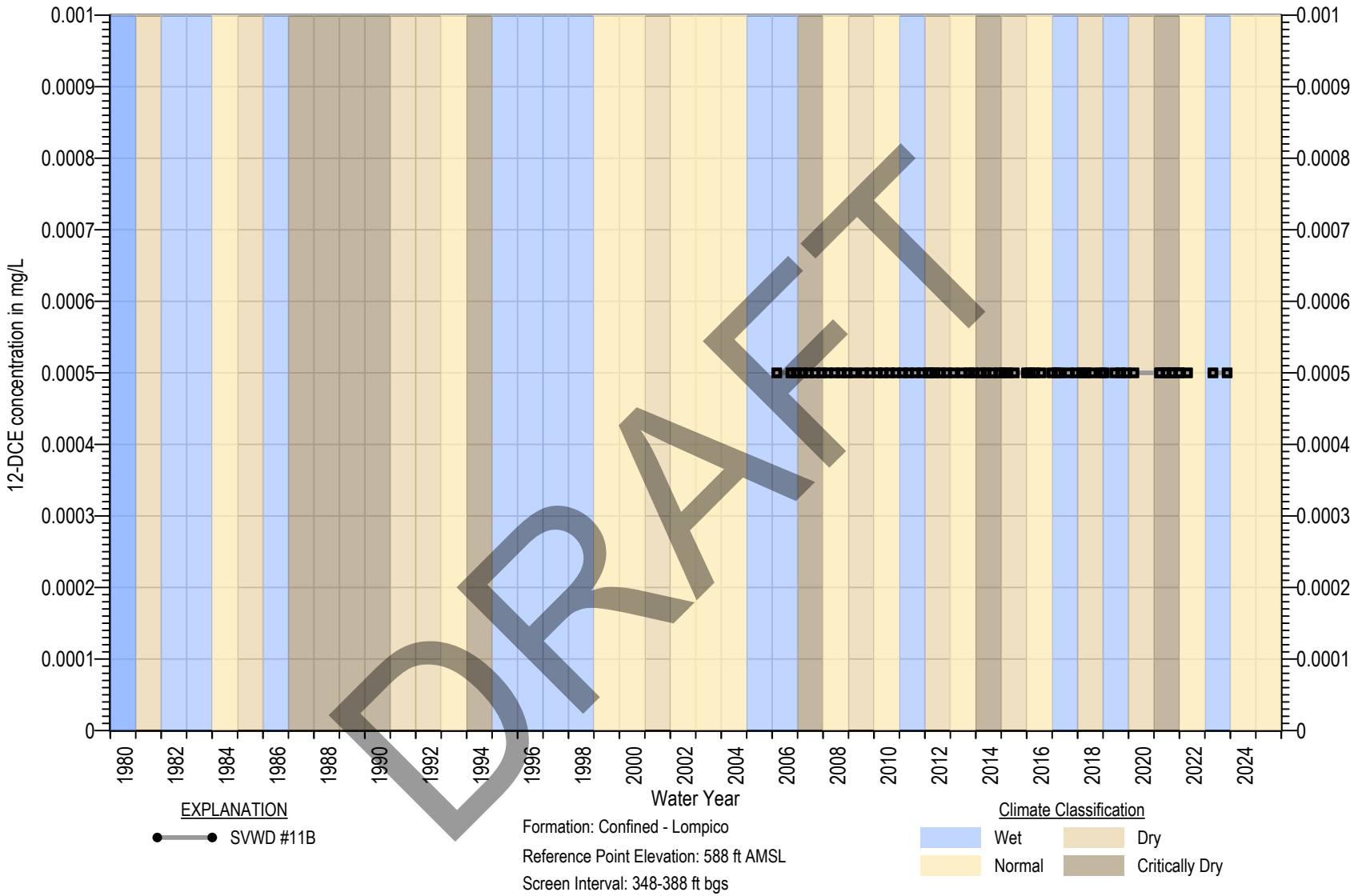
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-90. DCE Chemograph of SVWD #11A

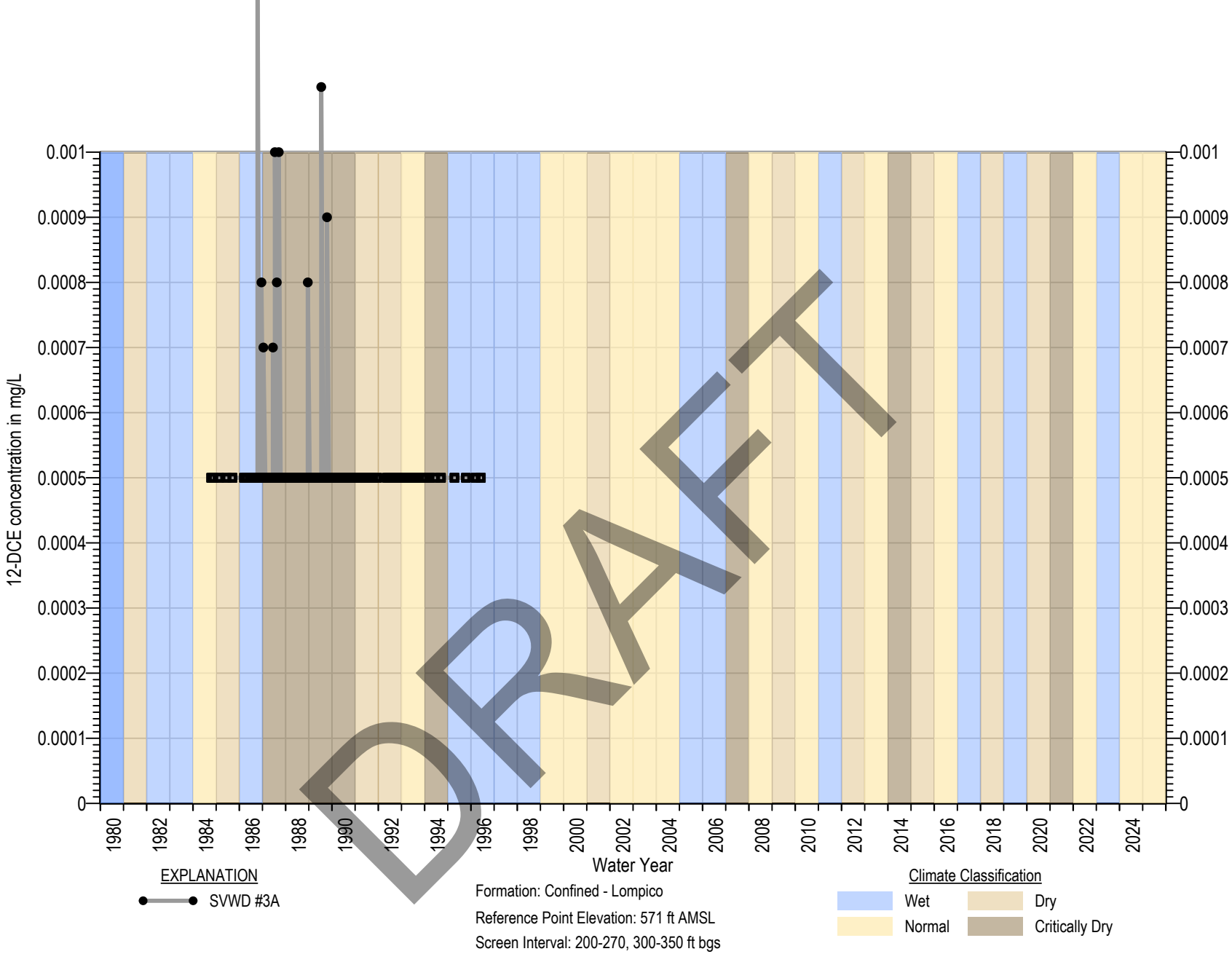
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-91. DCE Chemograph of SVWD #11B

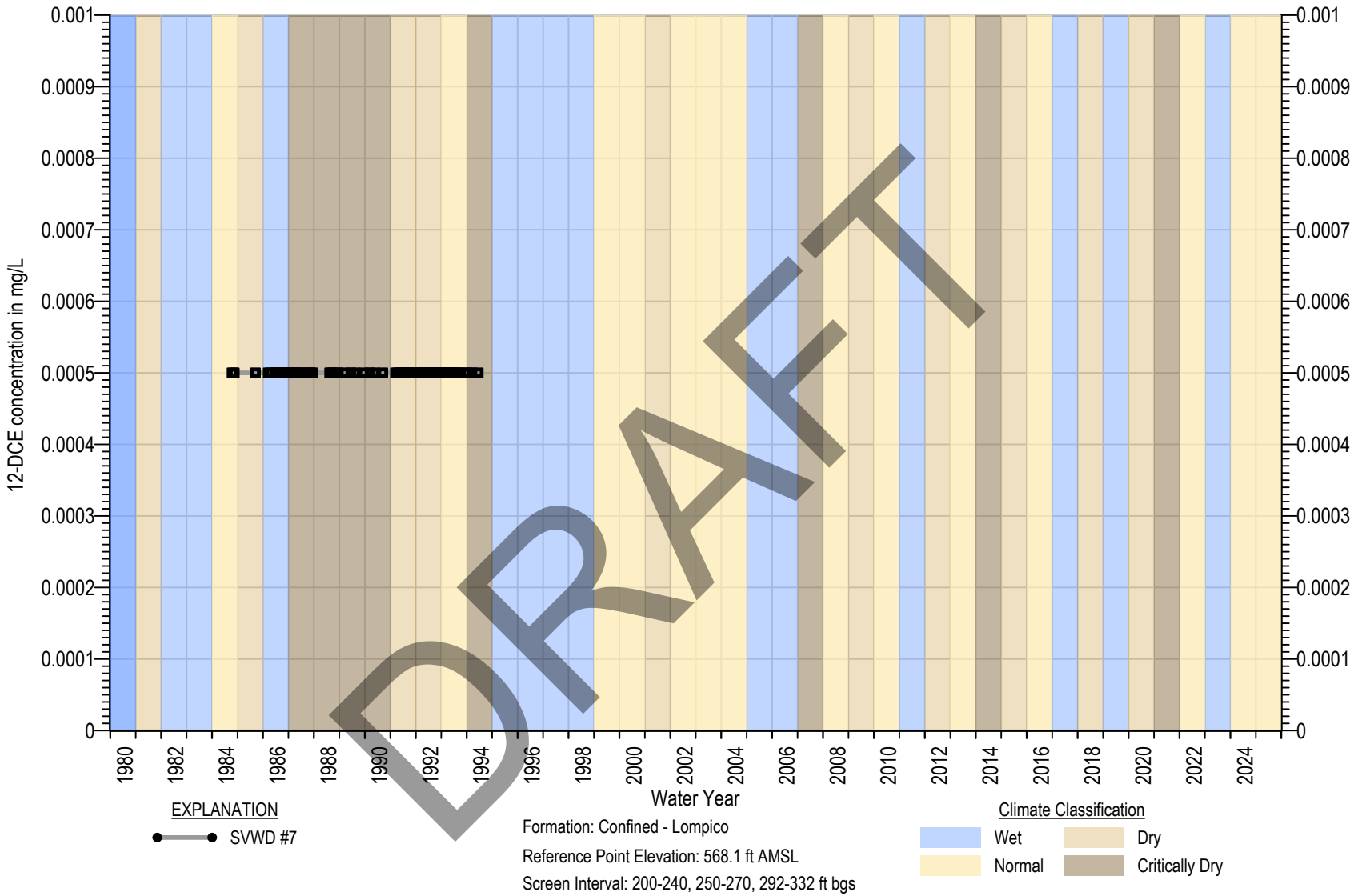
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-92. DCE Chemograph of SVWD #3A

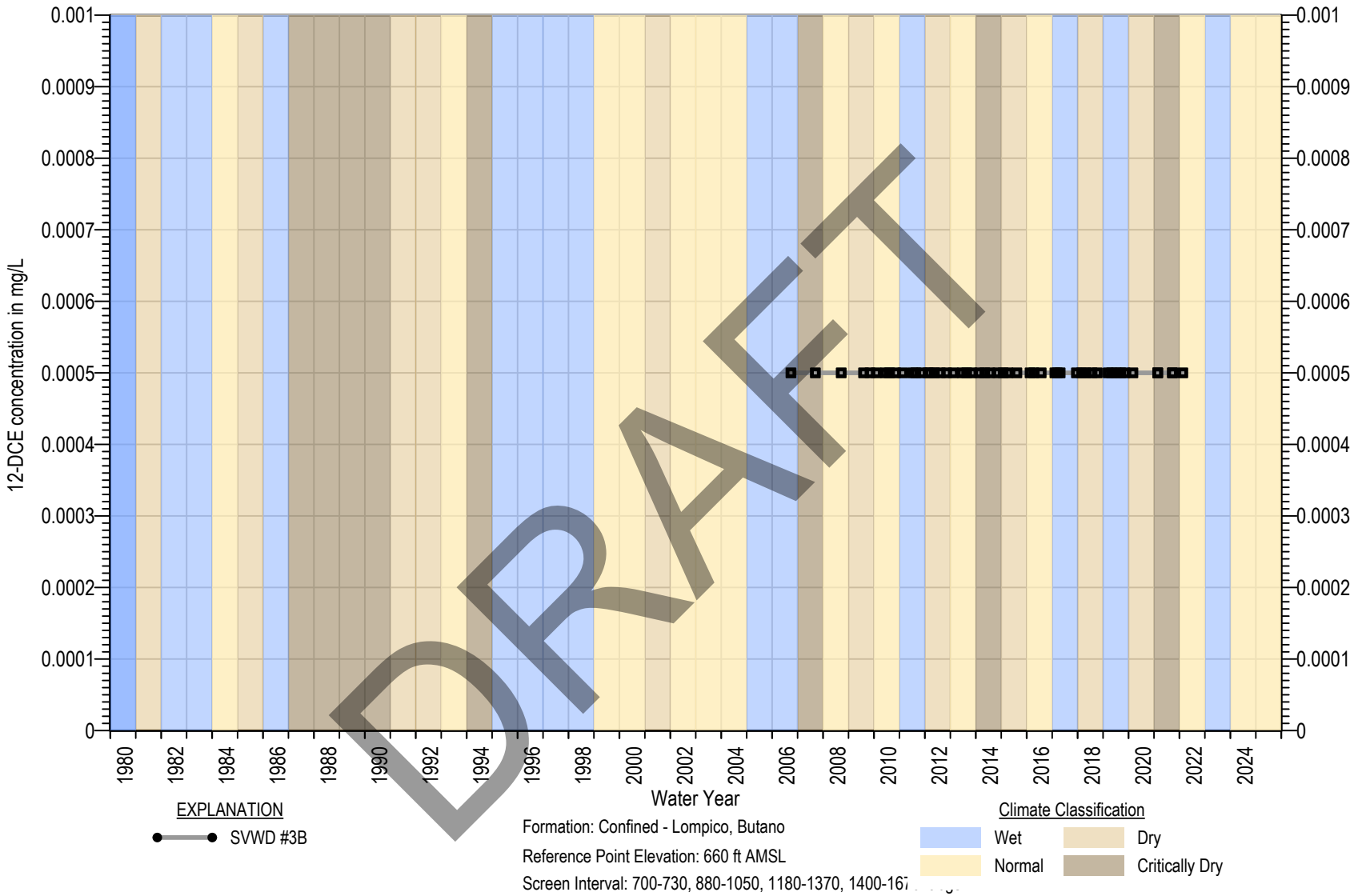
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-93. DCE Chemograph of SVWD #7

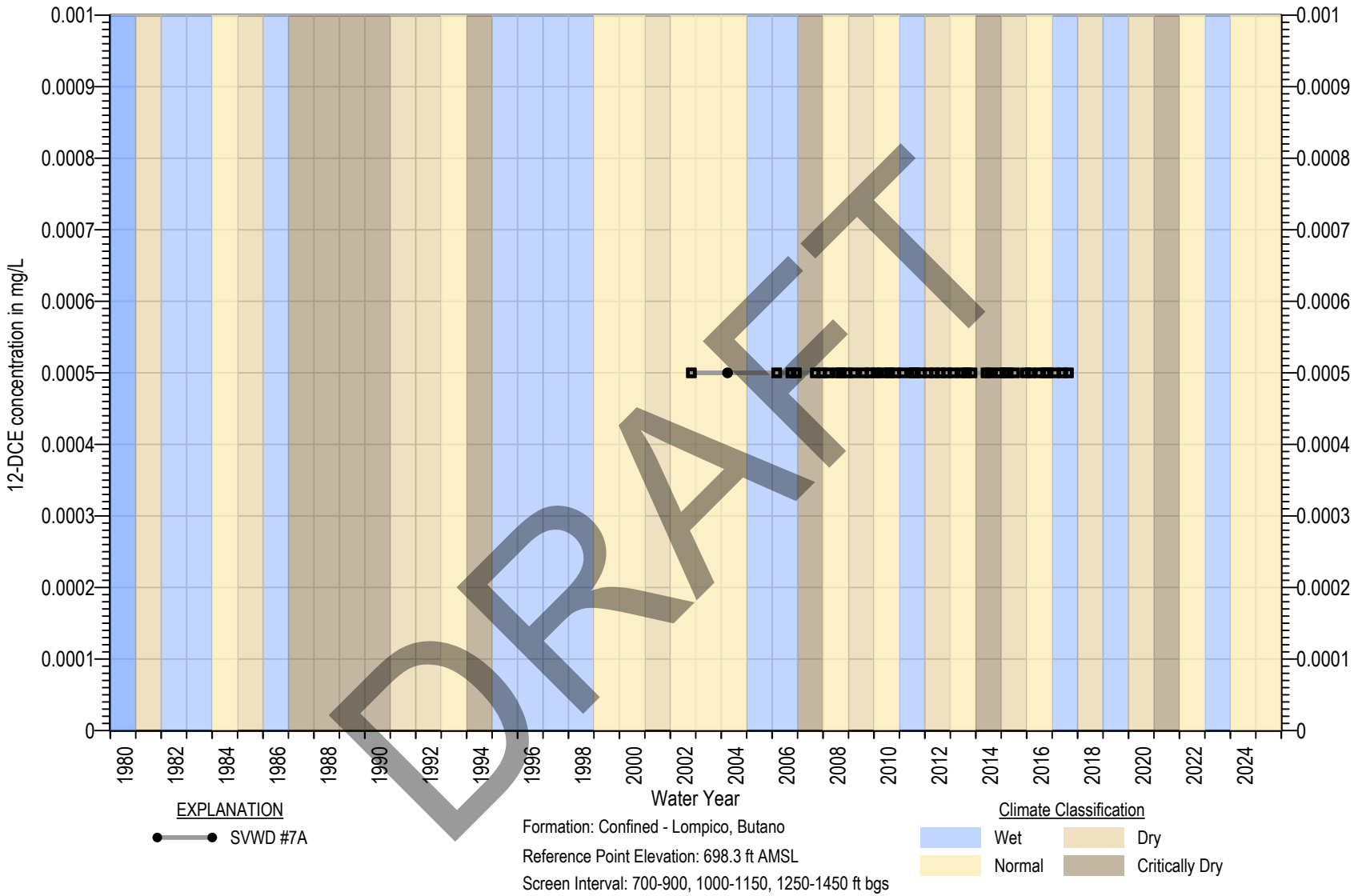
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-94. DCE Chemograph of SVWD #3B

MONTGOMERY & ASSOCIATES

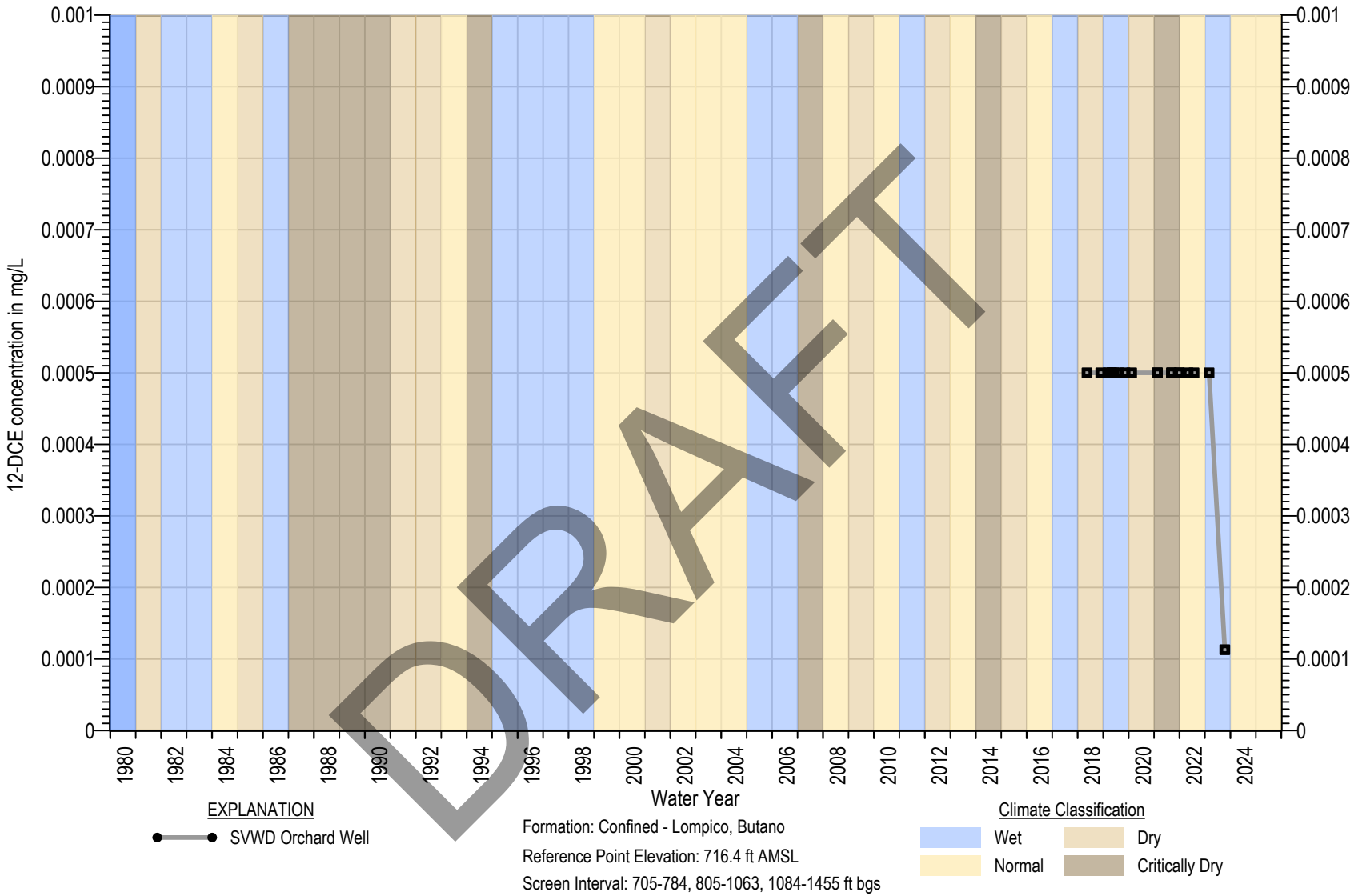


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-95. DCE Chemograph of SVWD #7A

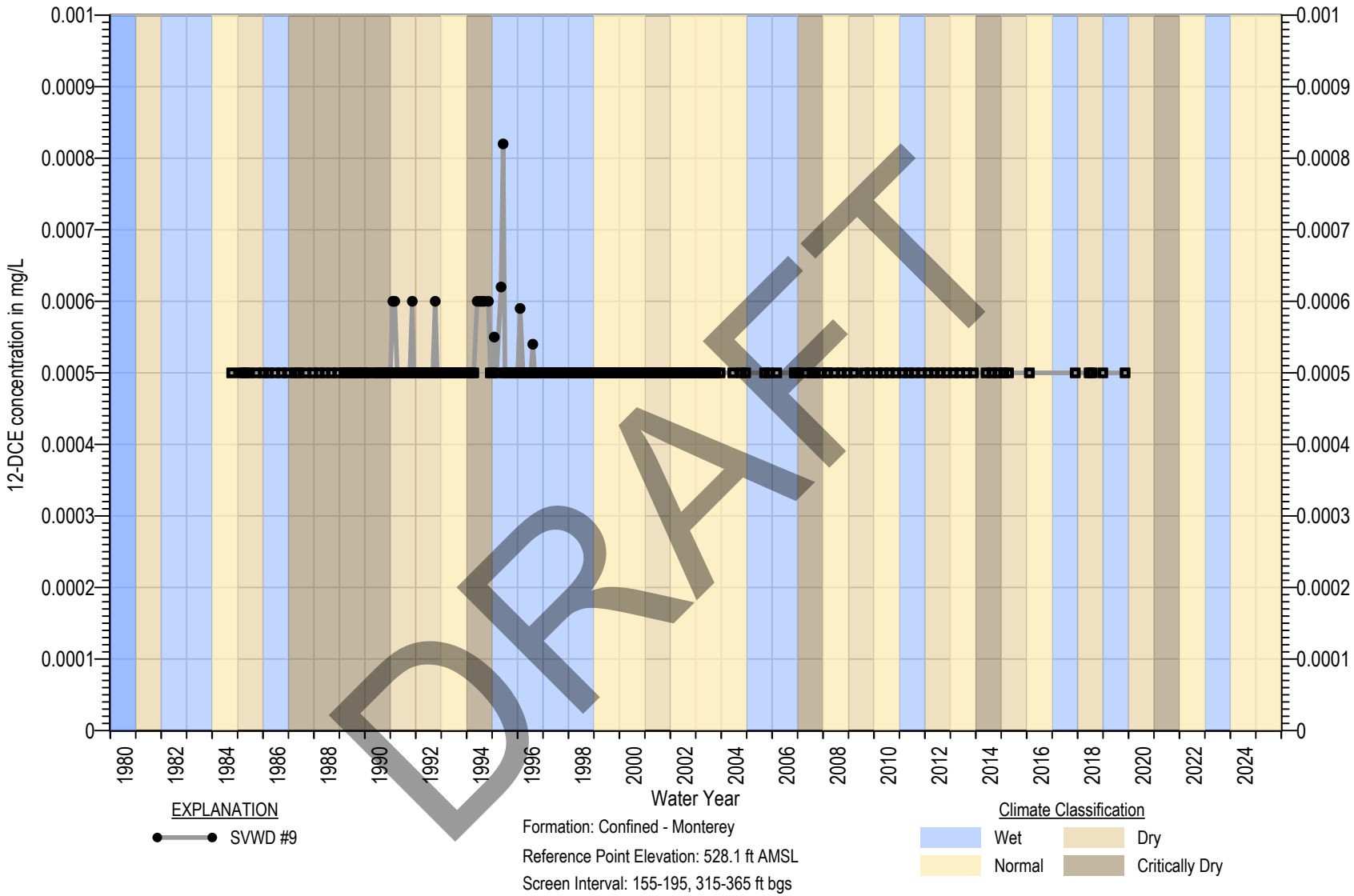
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-96. DCE Chemograph of SVWD Orchard Well

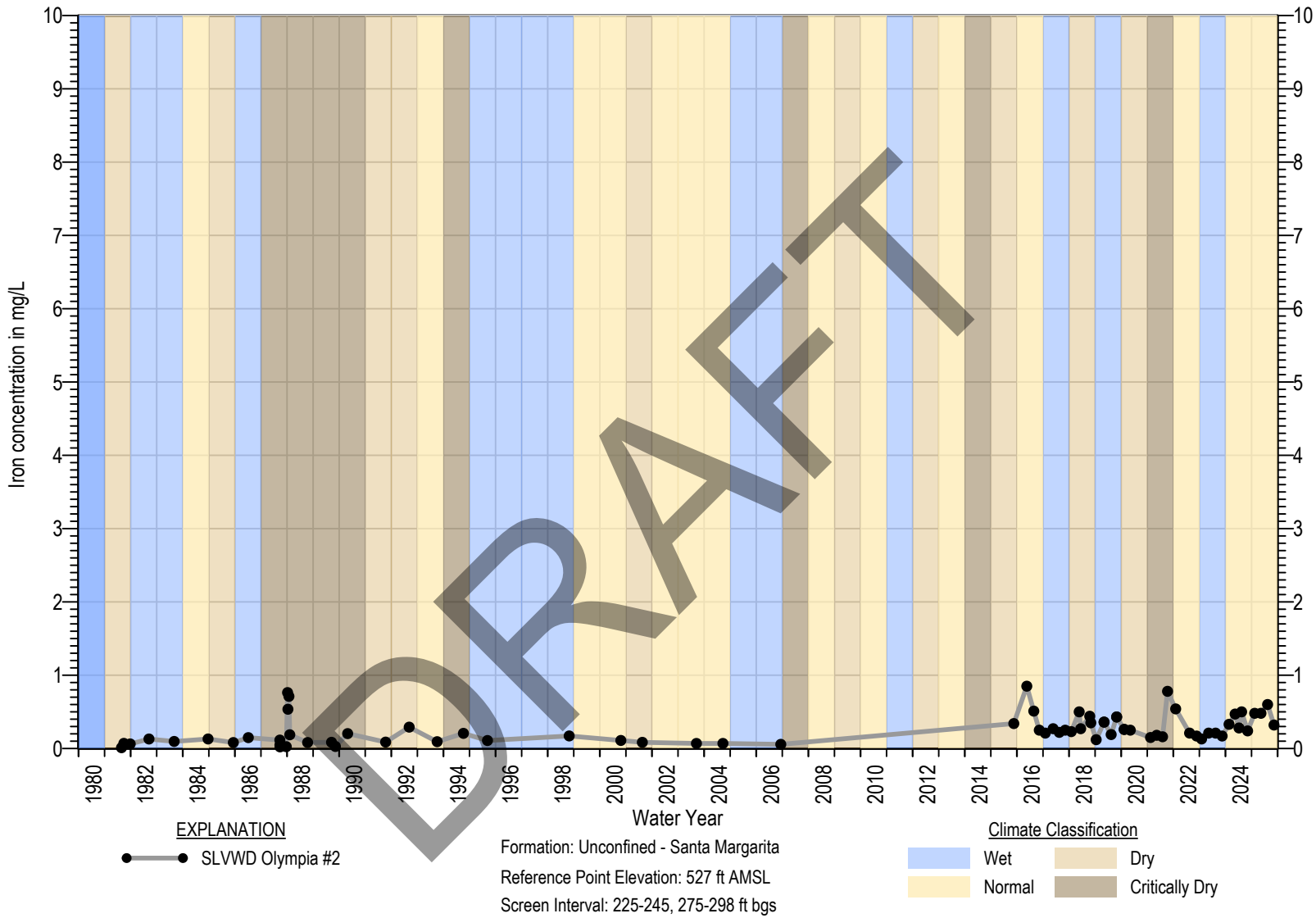
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-97. DCE Chemograph of SVWD #9

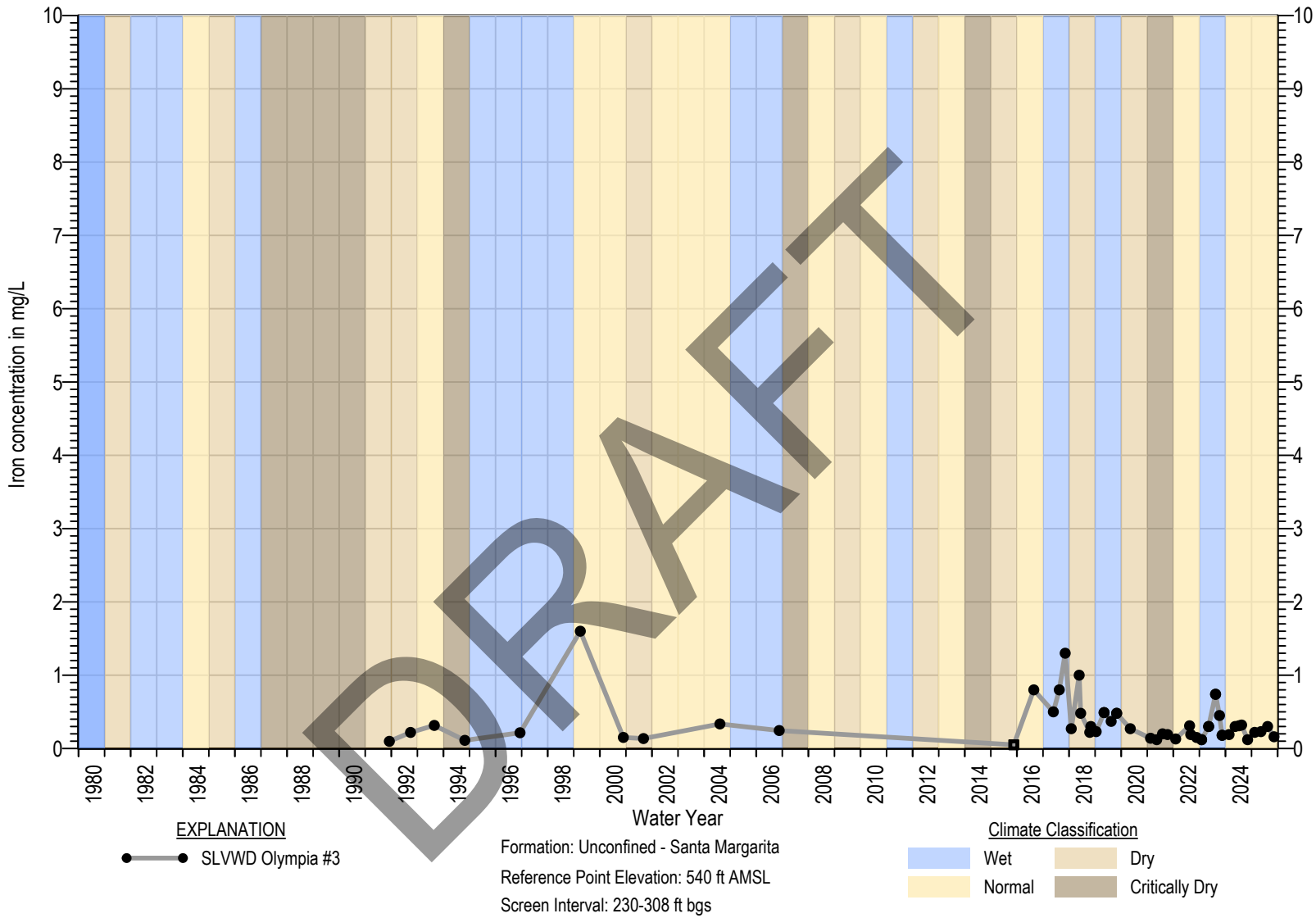
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-98. Iron Chemograph of SLVWD Olympia #2

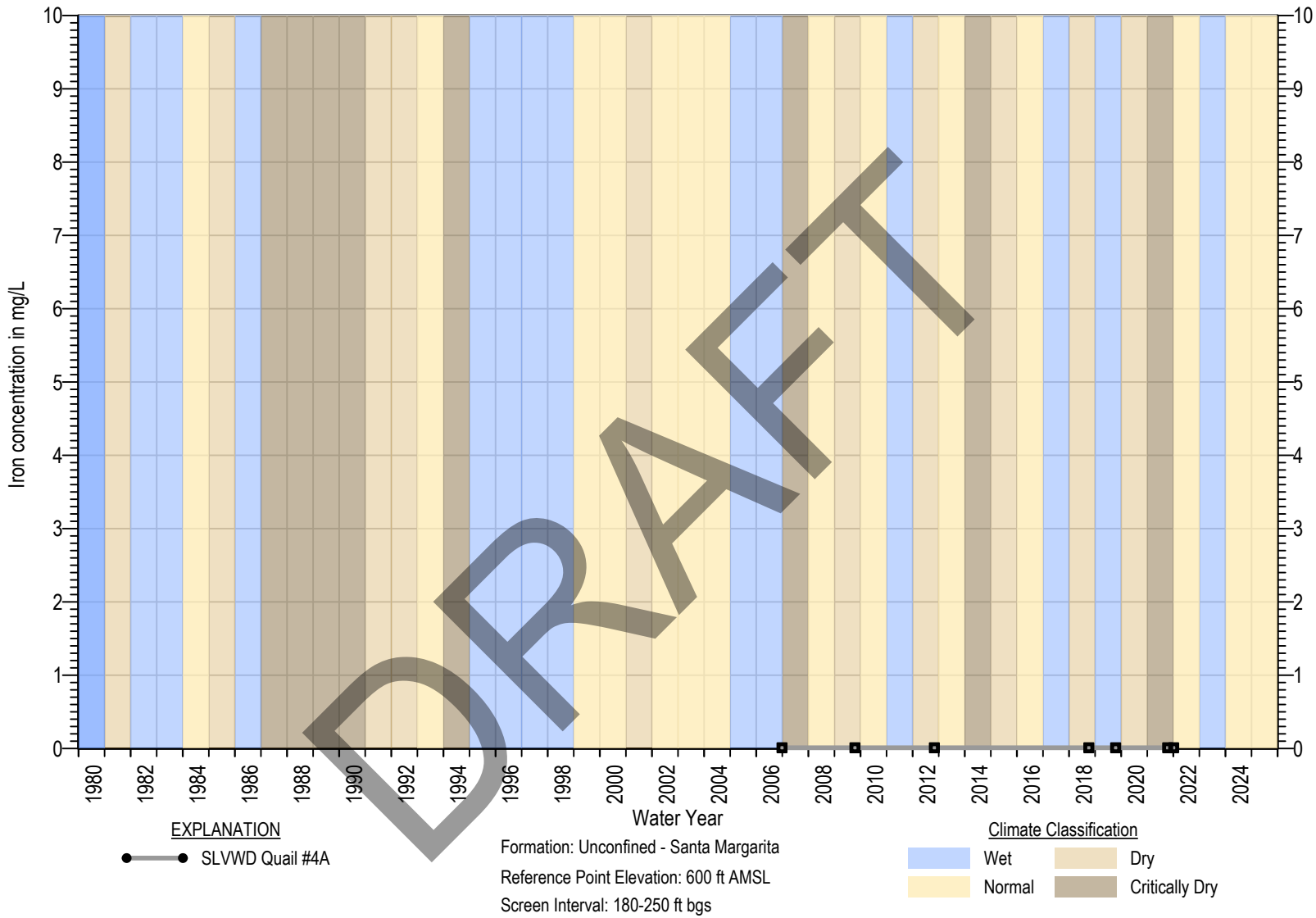
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-99. Iron Chemograph of SLVWD Olympia #3

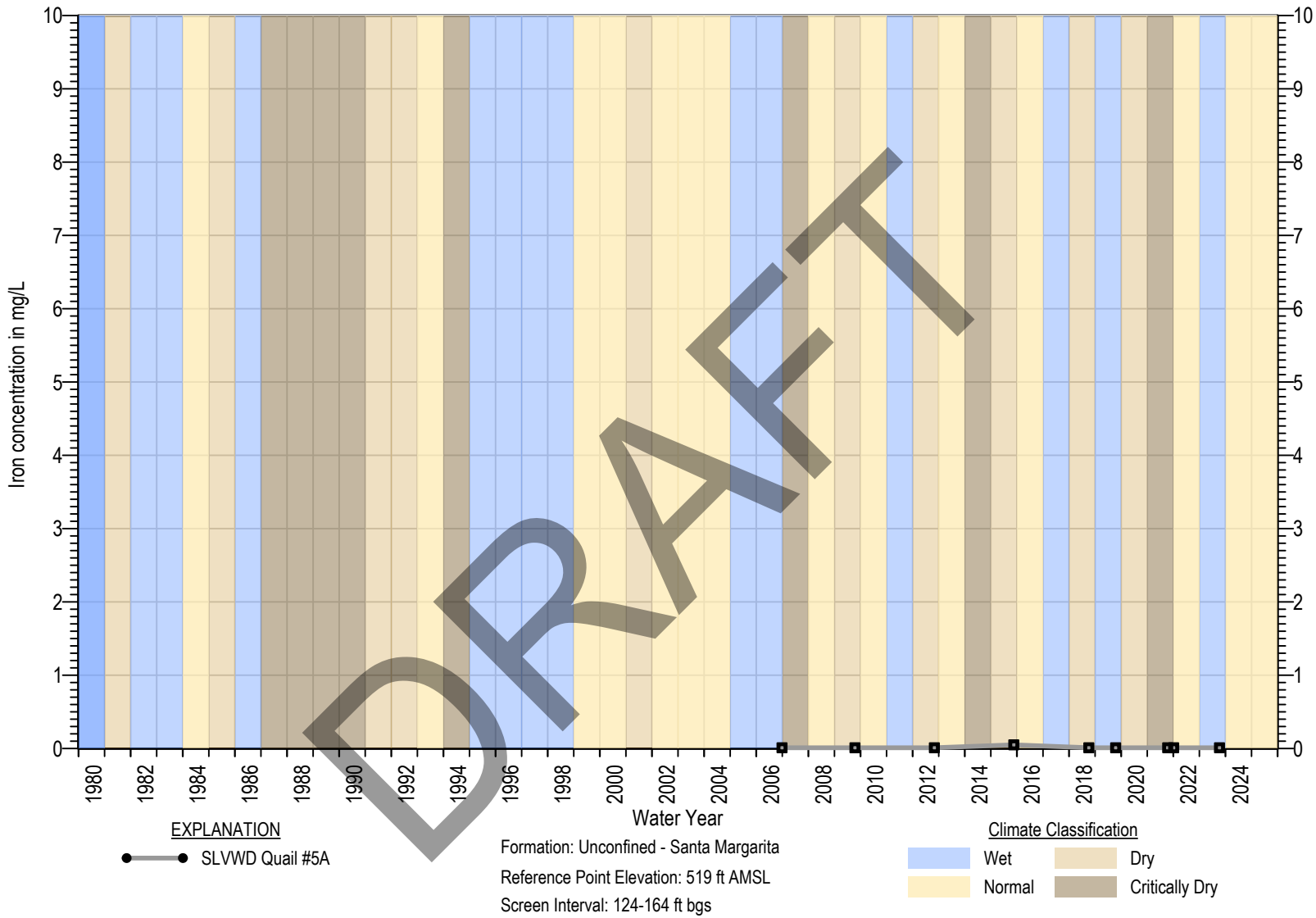
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-100. Iron Chemograph of SLVWD Quail #4A

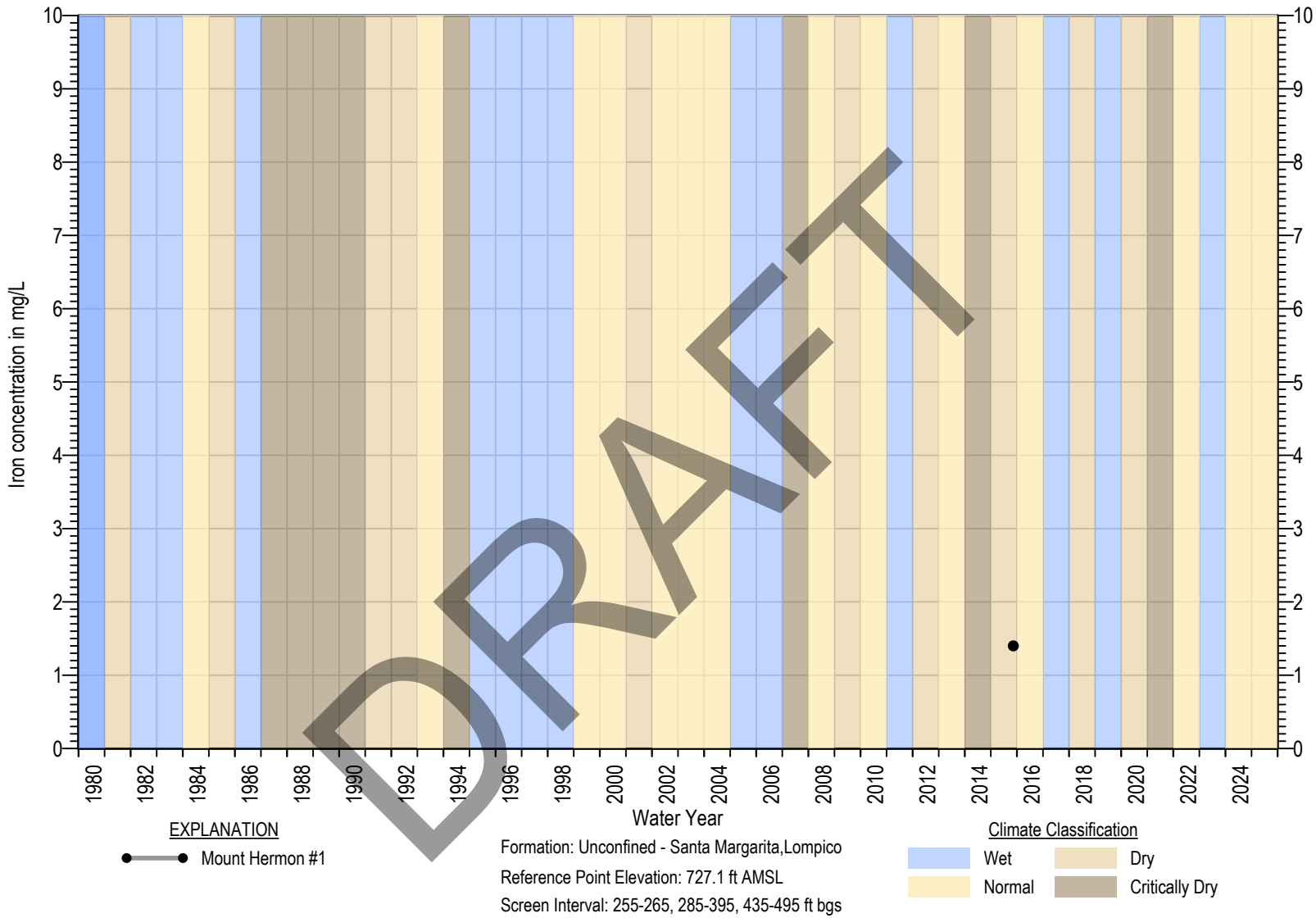
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-101. Iron Chemograph of SLVWD Quail #5A

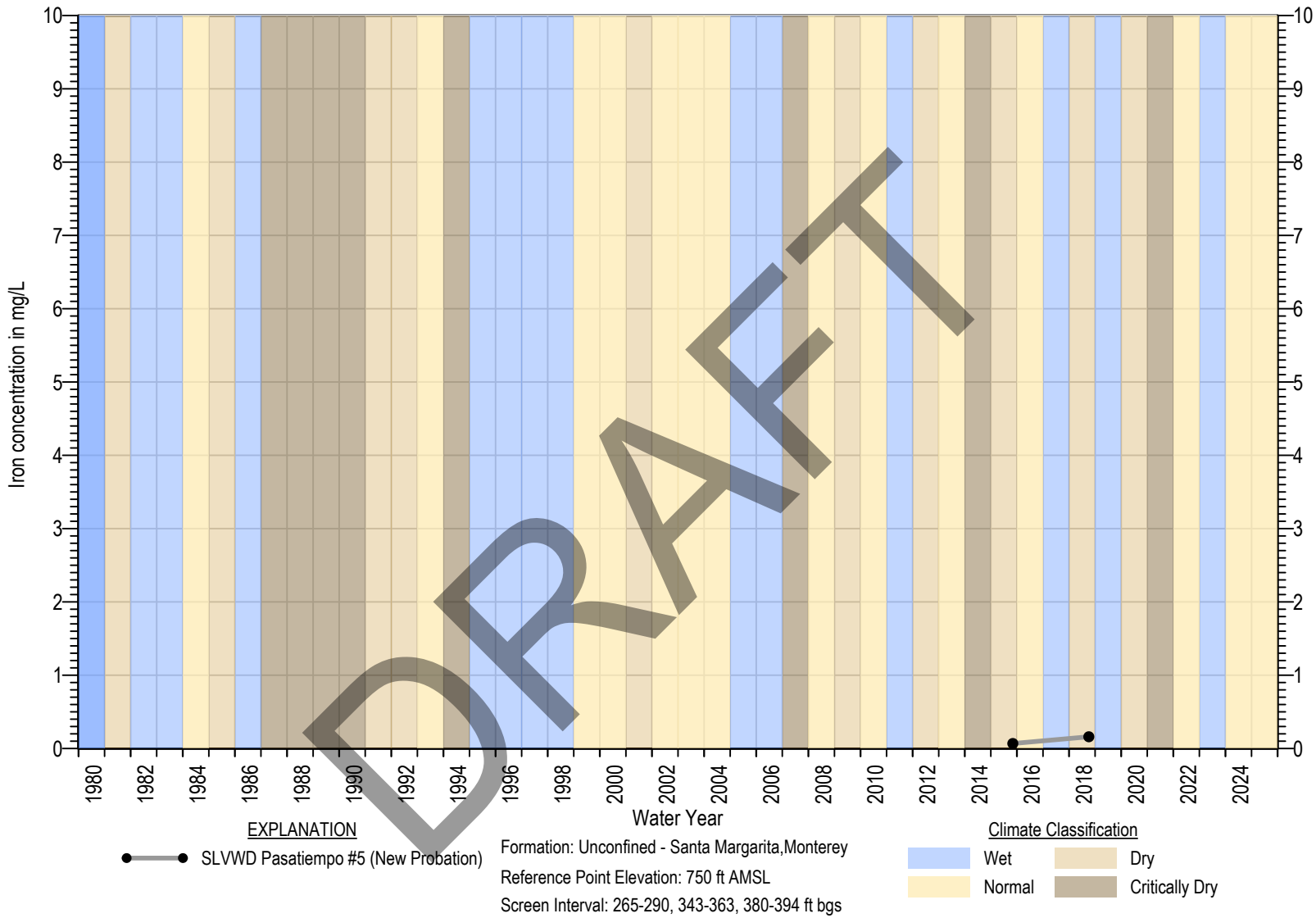
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-102. Iron Chemograph of Mount Hermon #1

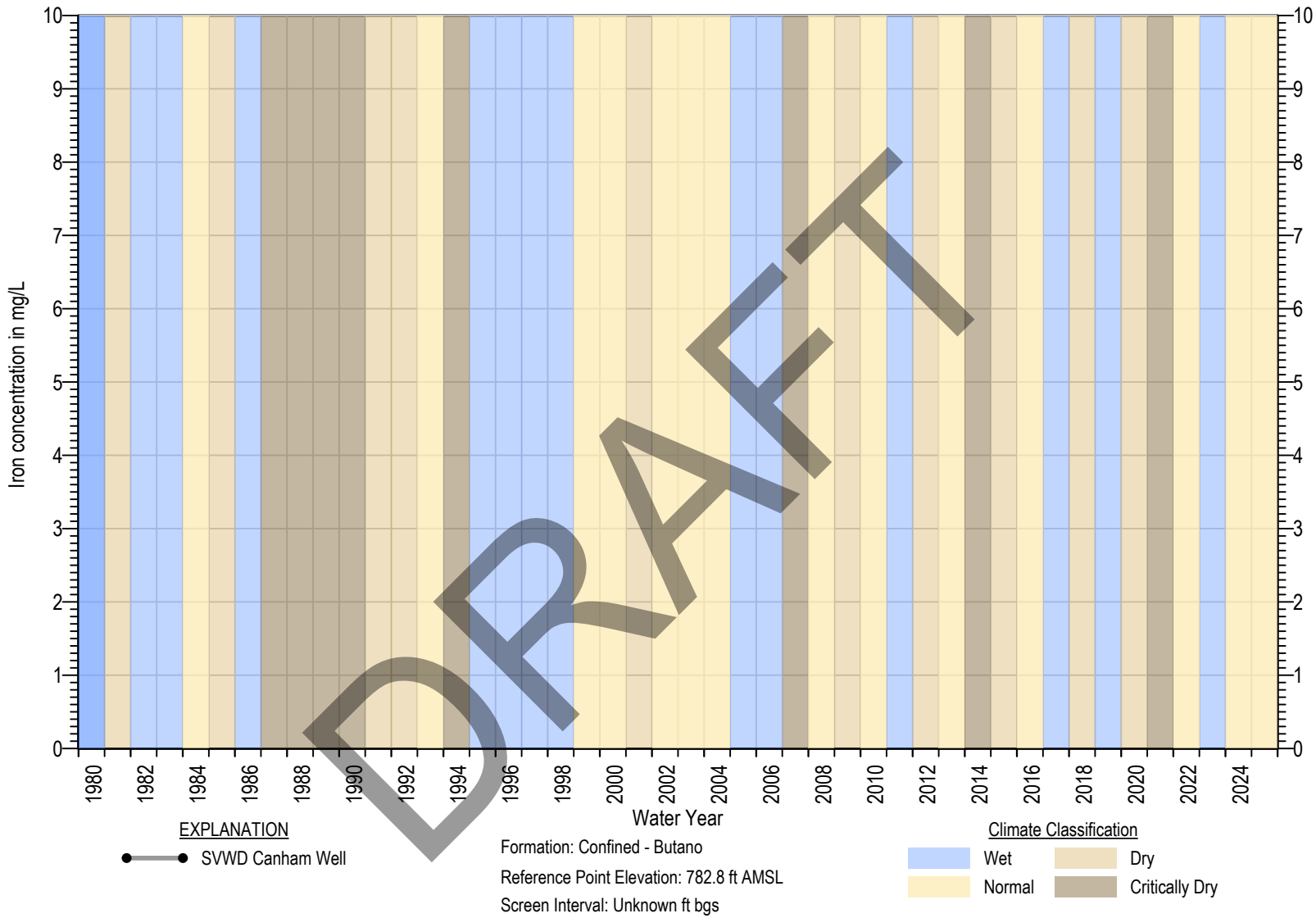
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-103. Iron Chemograph of SLVWD Pasatiempo #5 (New Probation)

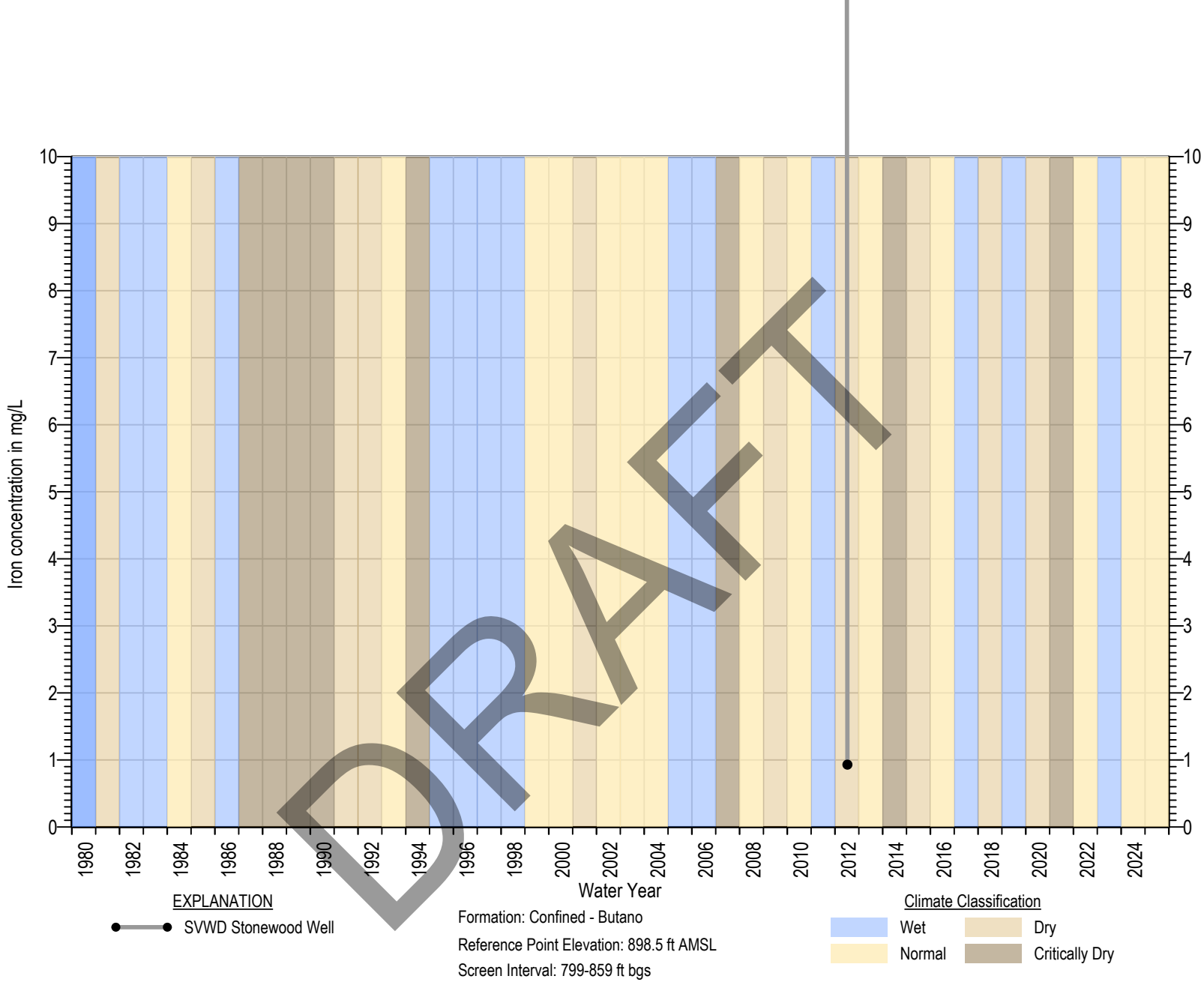
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-104. Iron Chemograph of SVWD Canham Well

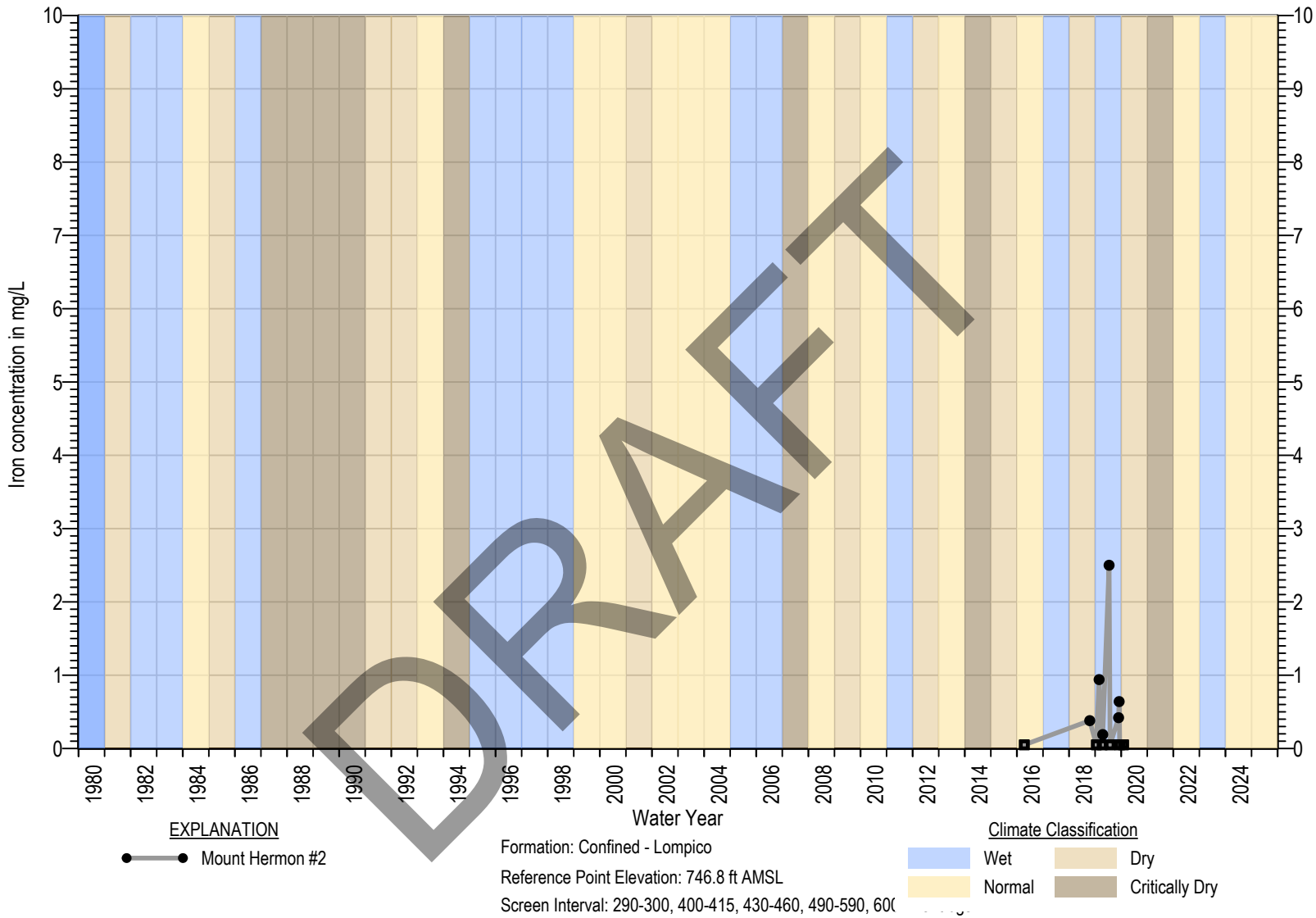
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-105. Iron Chemograph of SVWD Stonewood Well

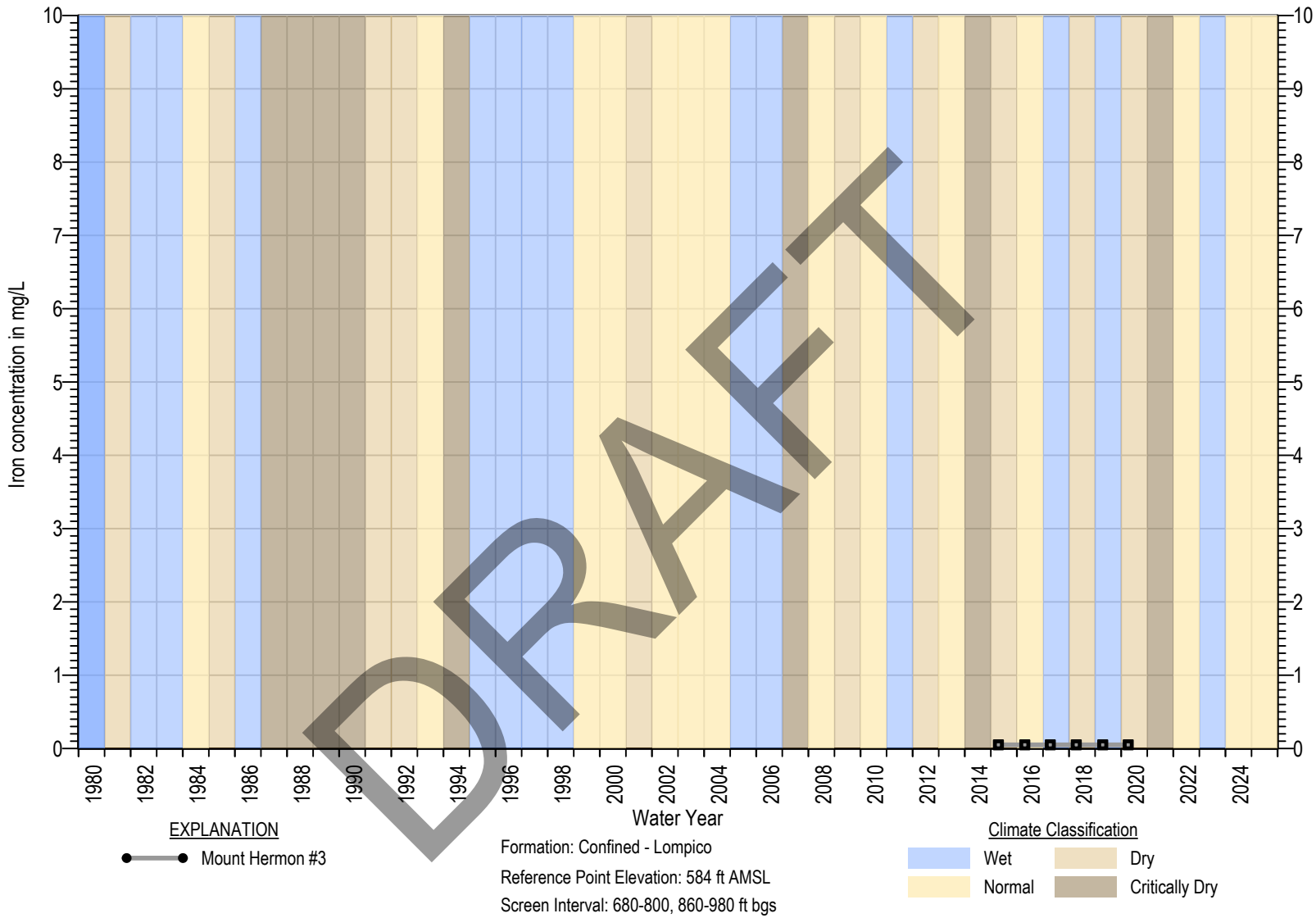
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-106. Iron Chemograph of Mount Hermon #2

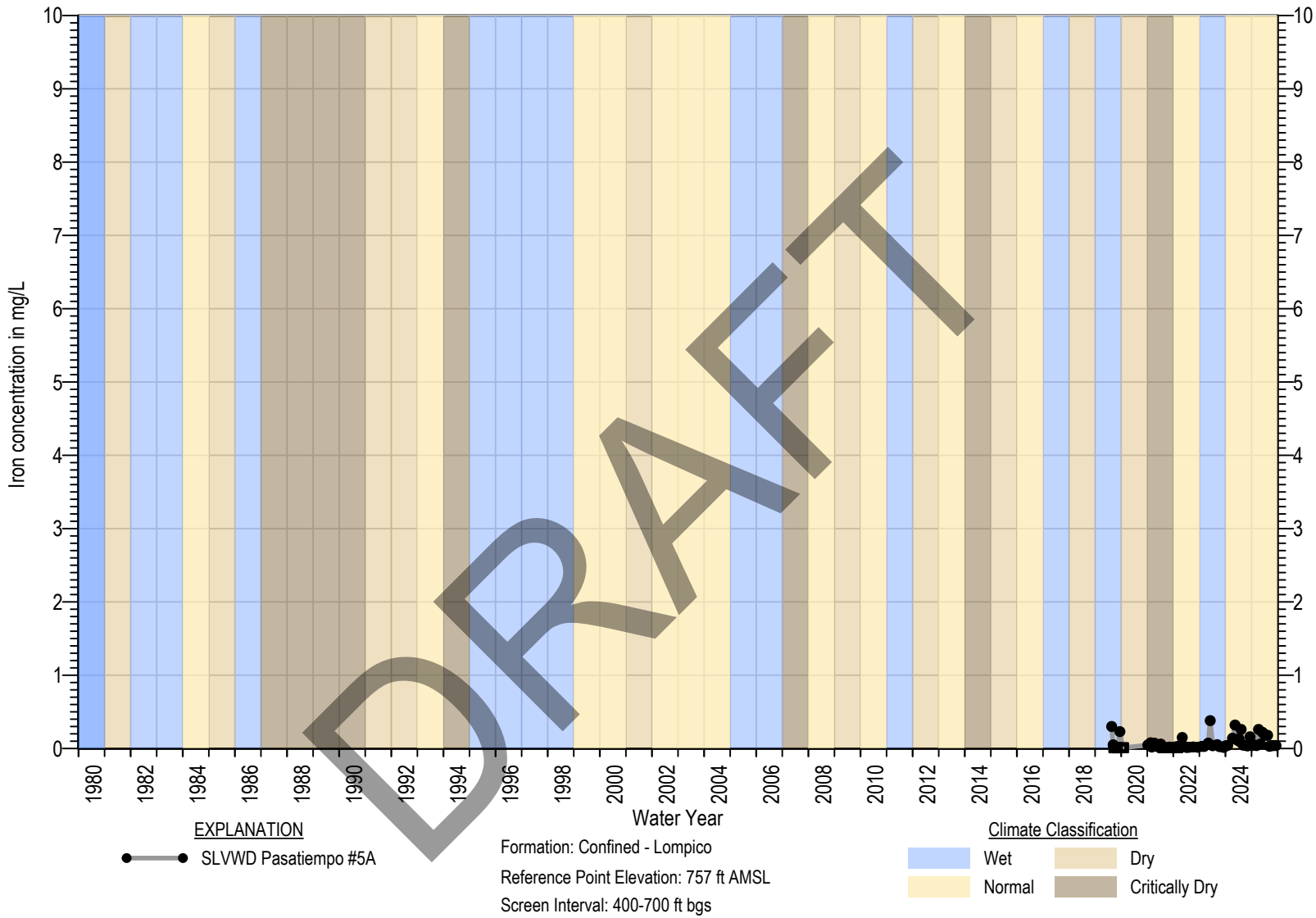
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-107. Iron Chemograph of Mount Hermon #3

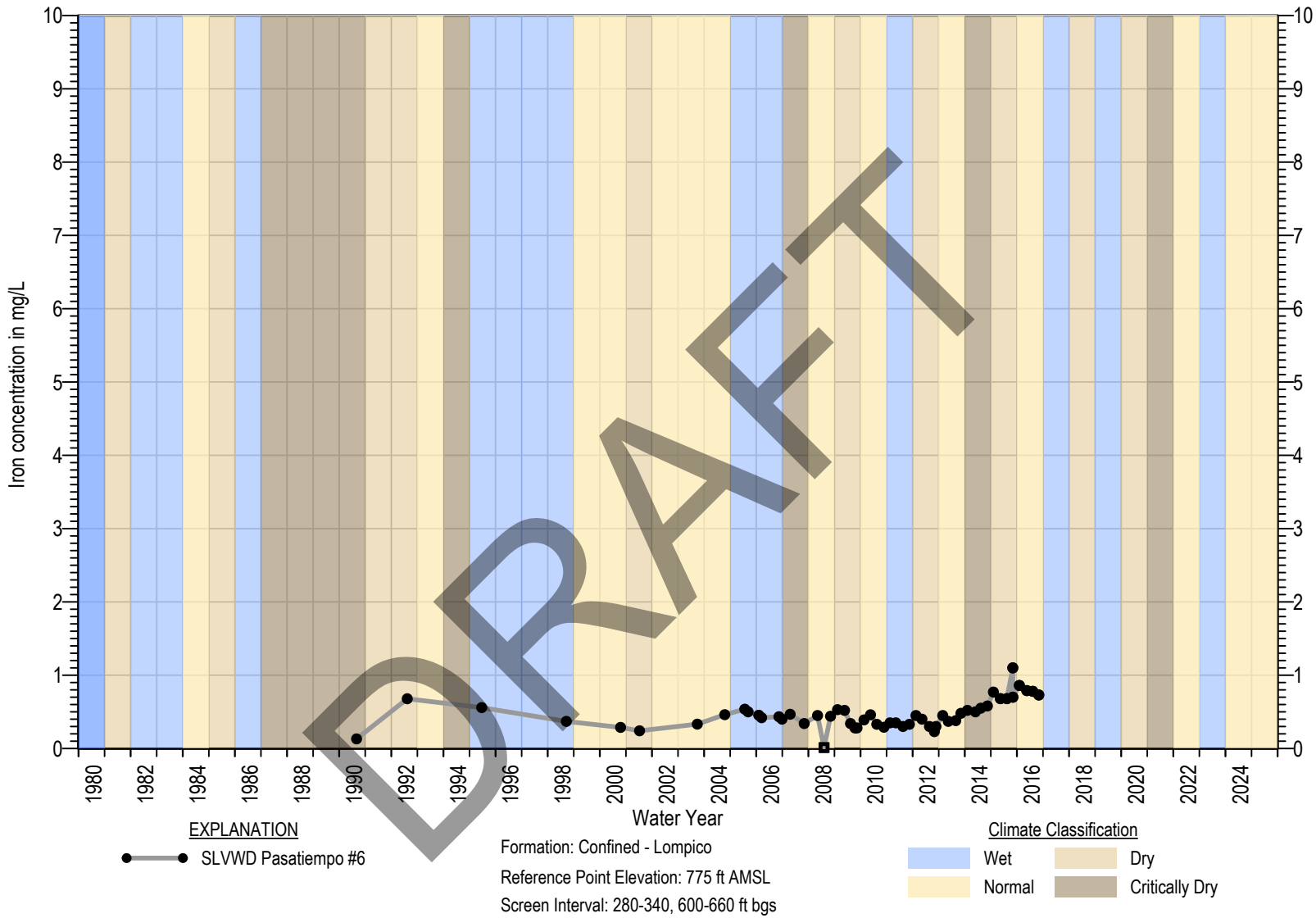
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-108. Iron Chemograph of SLVWD Pasatiempo #5A

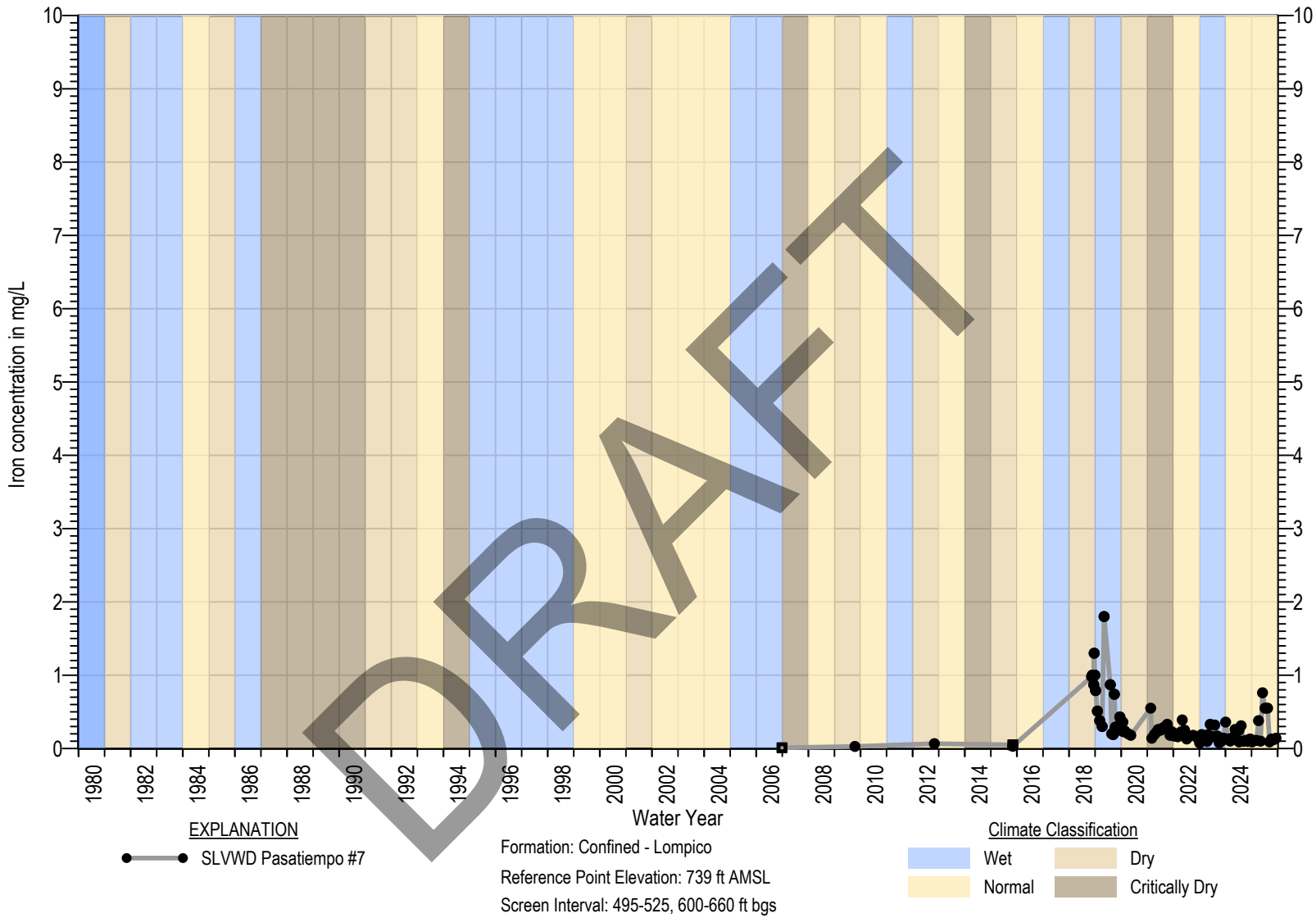
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-109. Iron Chemograph of SLVWD Pasatiempo #6

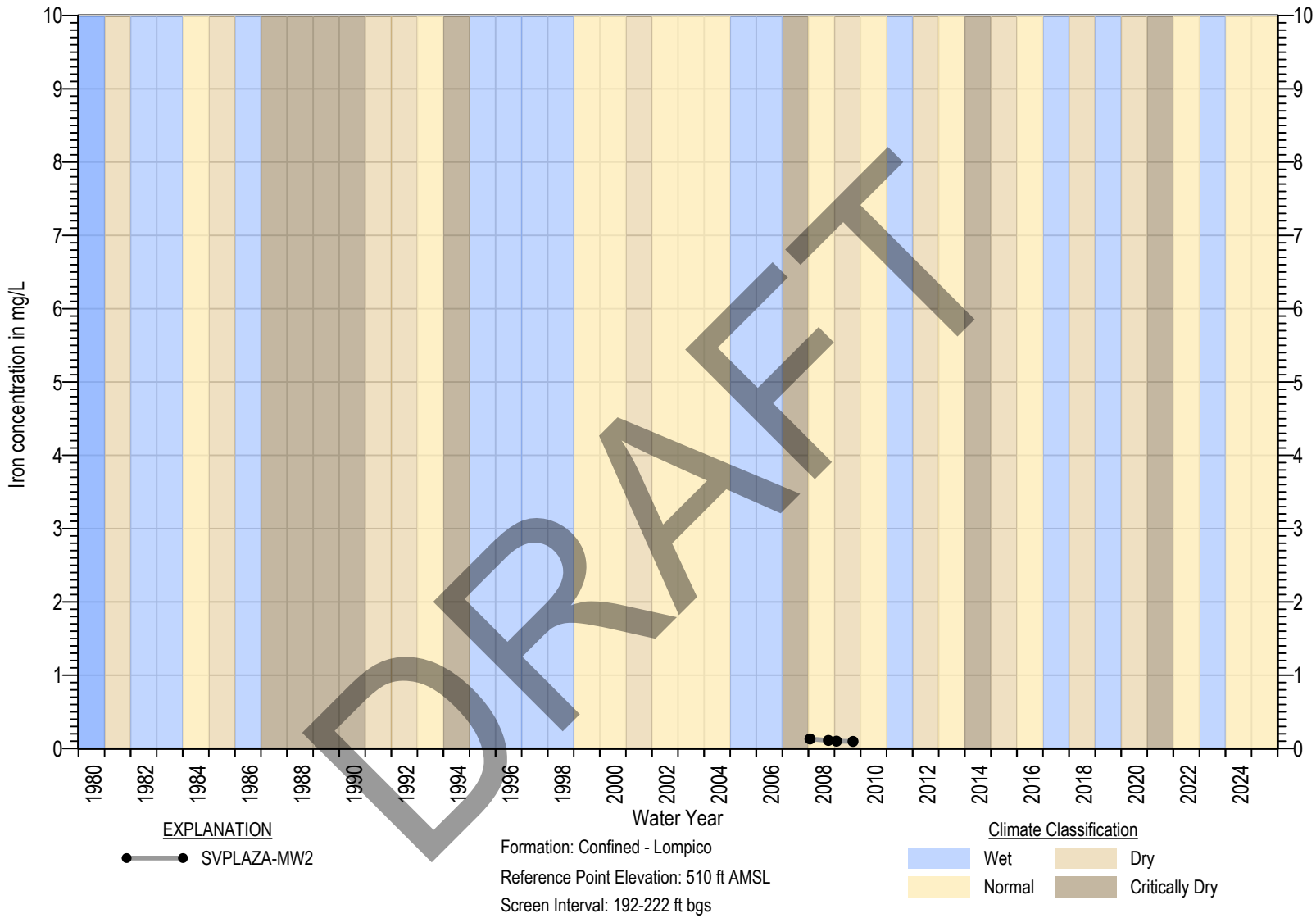
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-110. Iron Chemograph of SLVWD Pasatiempo #7

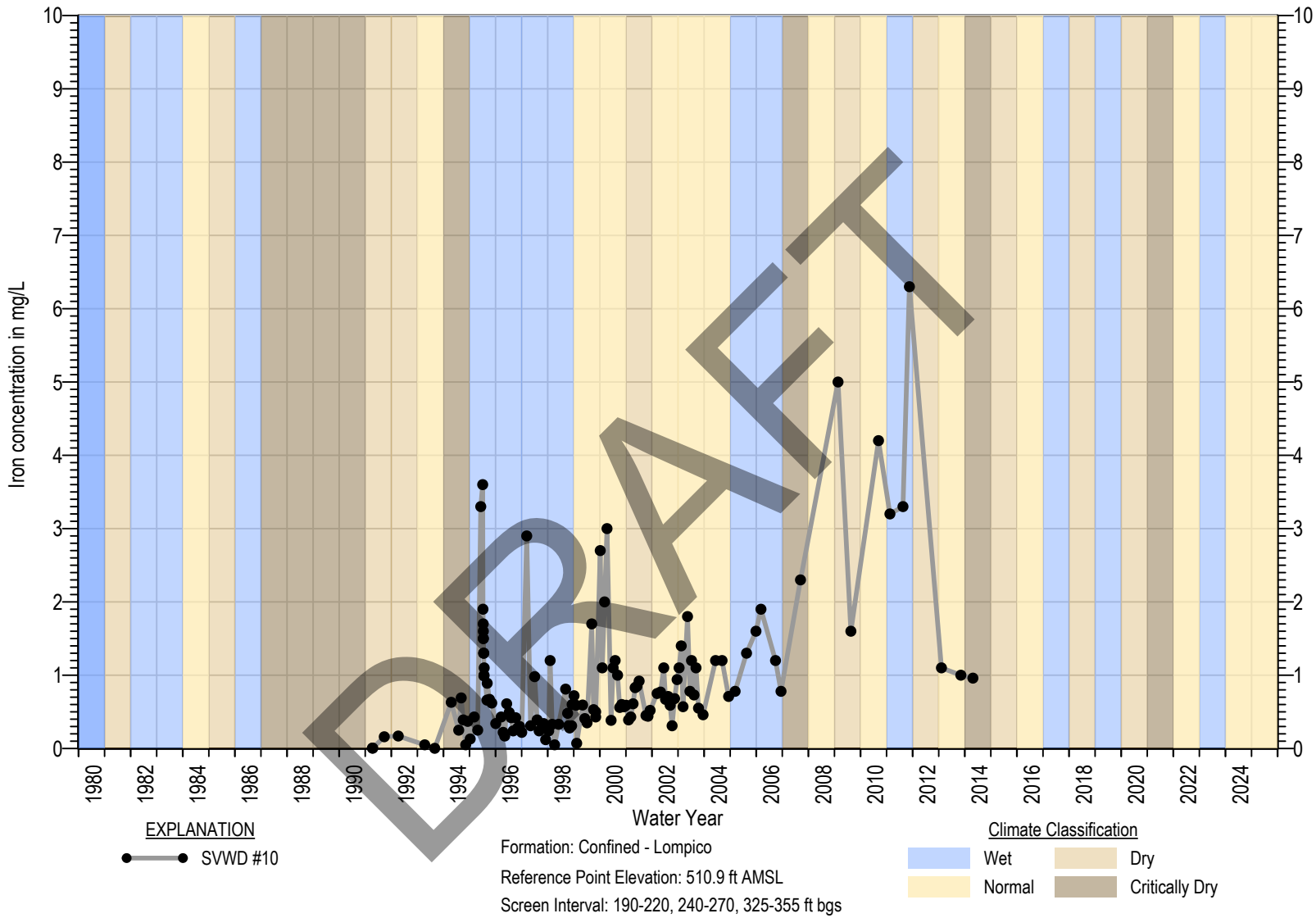
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-111. Iron Chemograph of SVPLAZA-MW2

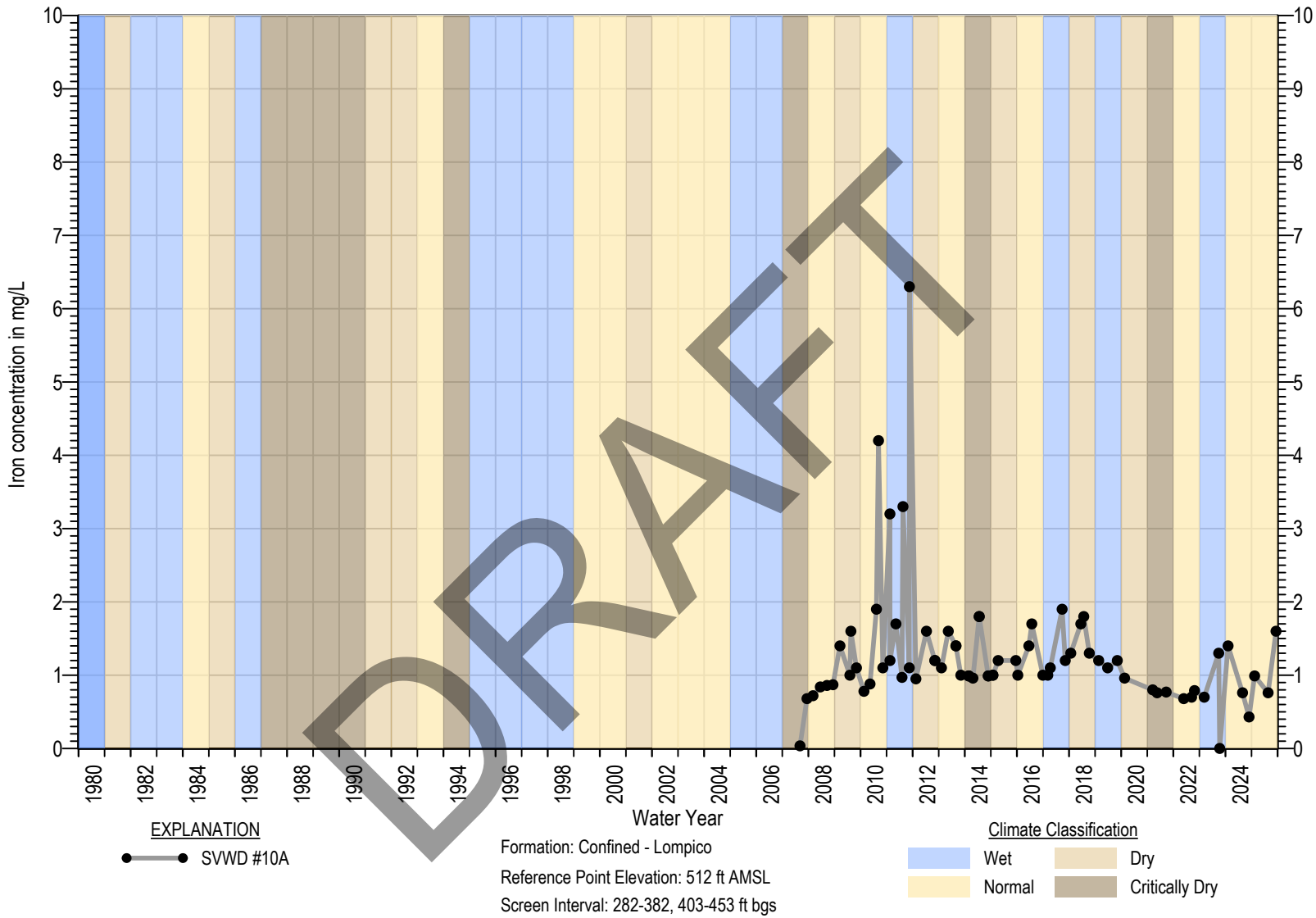
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-112. Iron Chemograph of SVWD #10

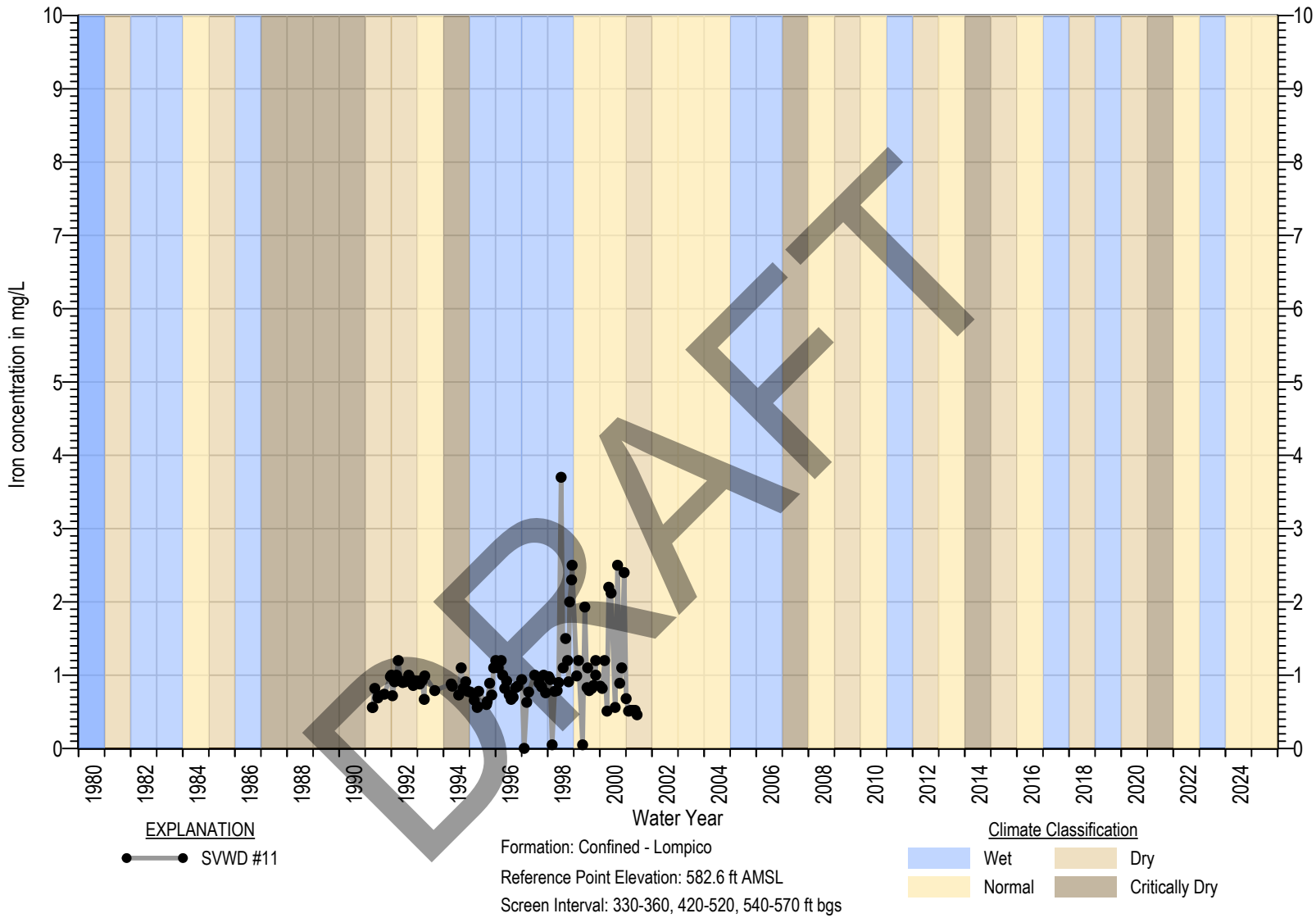
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-113. Iron Chemograph of SVWD #10A

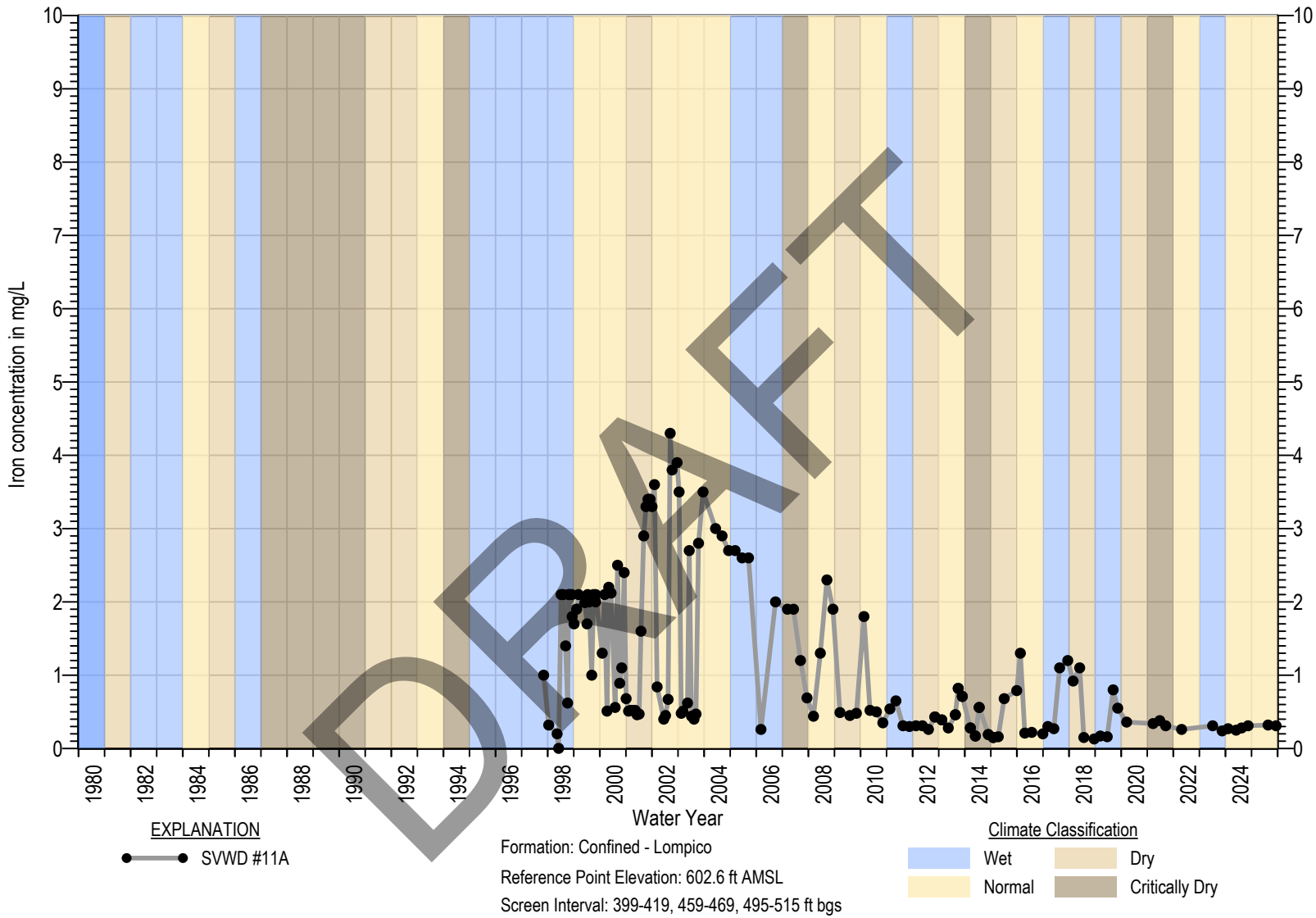
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-114. Iron Chemograph of SVWD #11

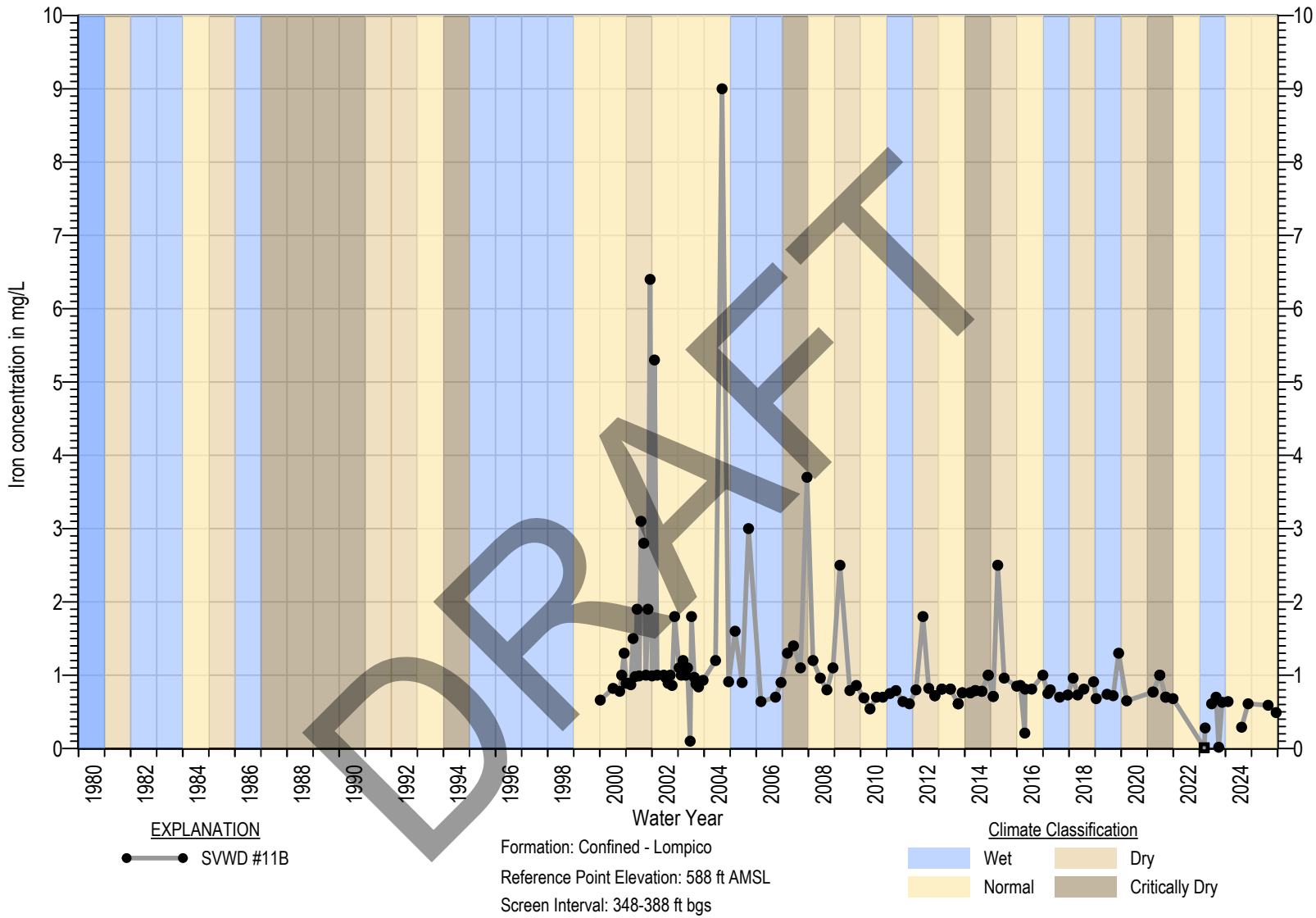
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-115. Iron Chemograph of SVWD #11A

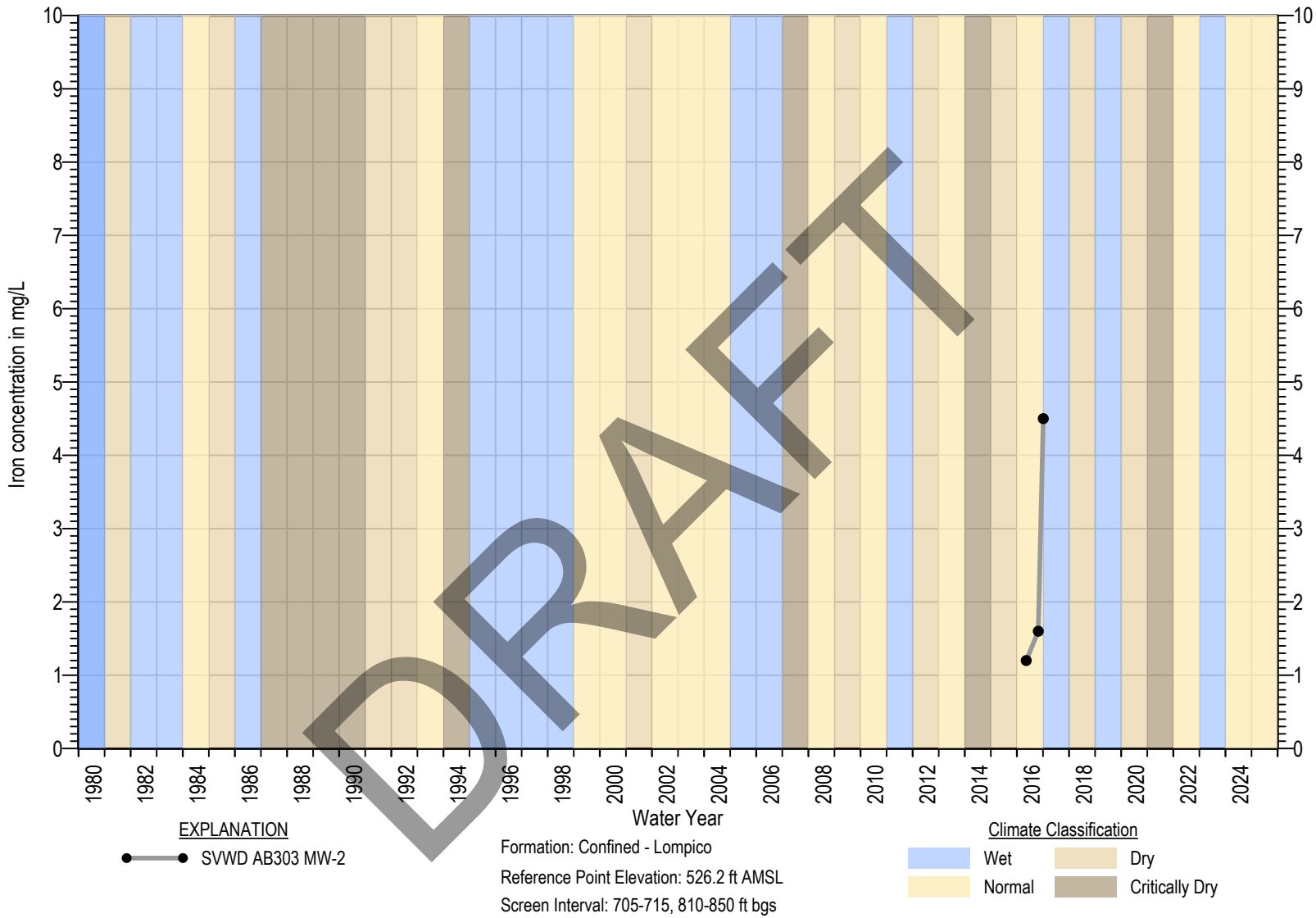
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-116. Iron Chemograph of SVWD #11B

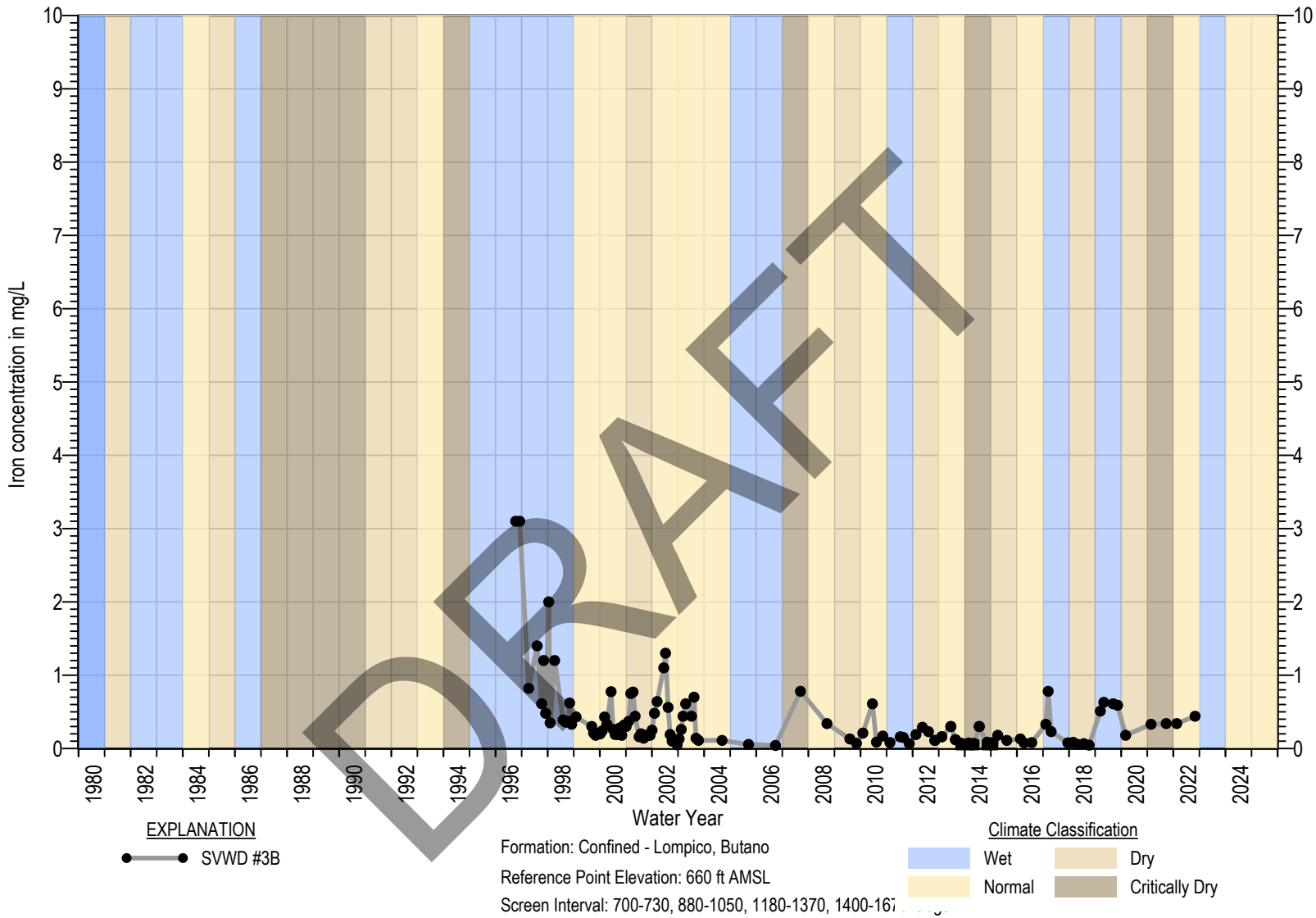
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-117. Iron Chemograph of SVWD AB303 MW-2

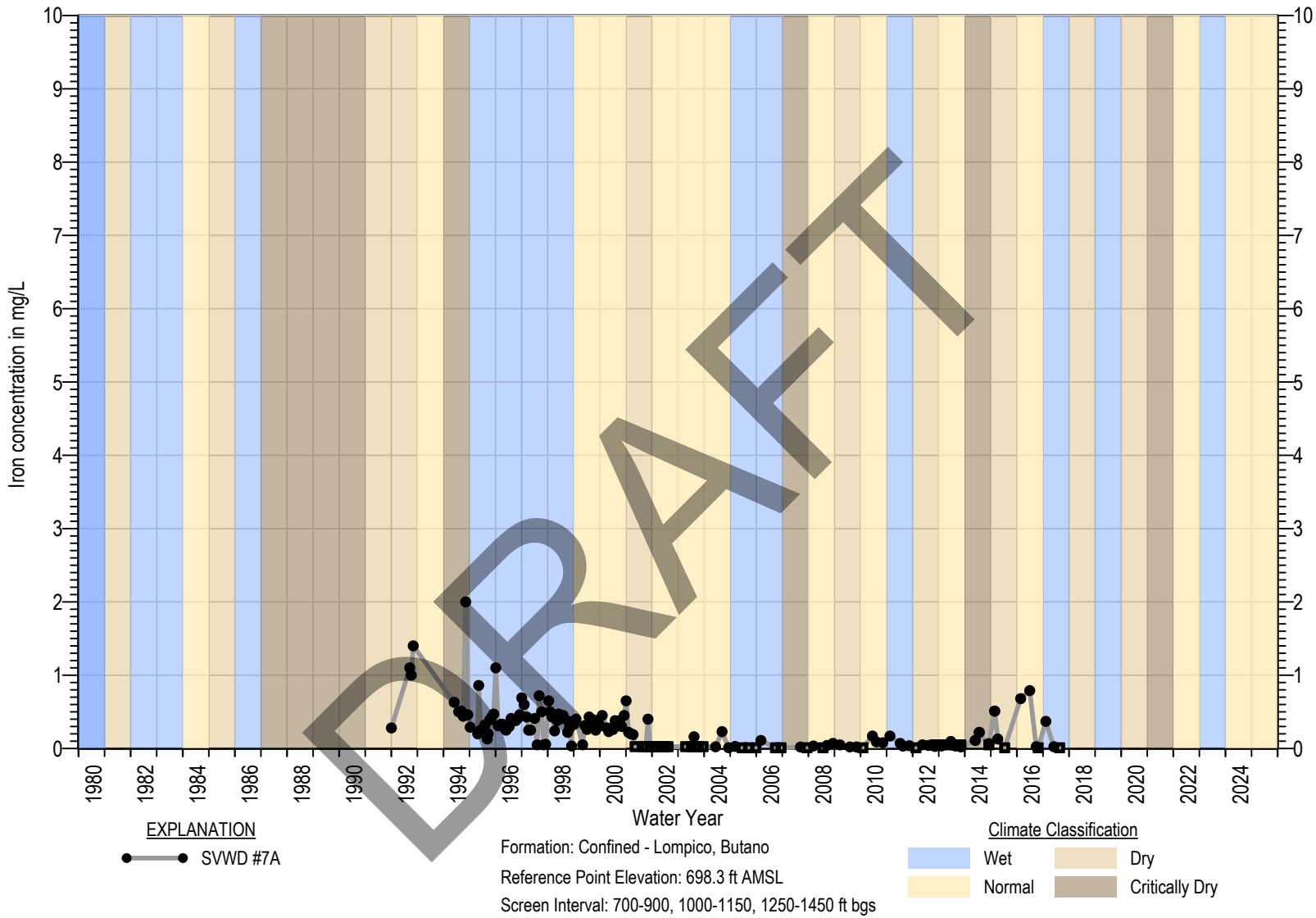
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-118. Iron Chemograph of SVWD #3B

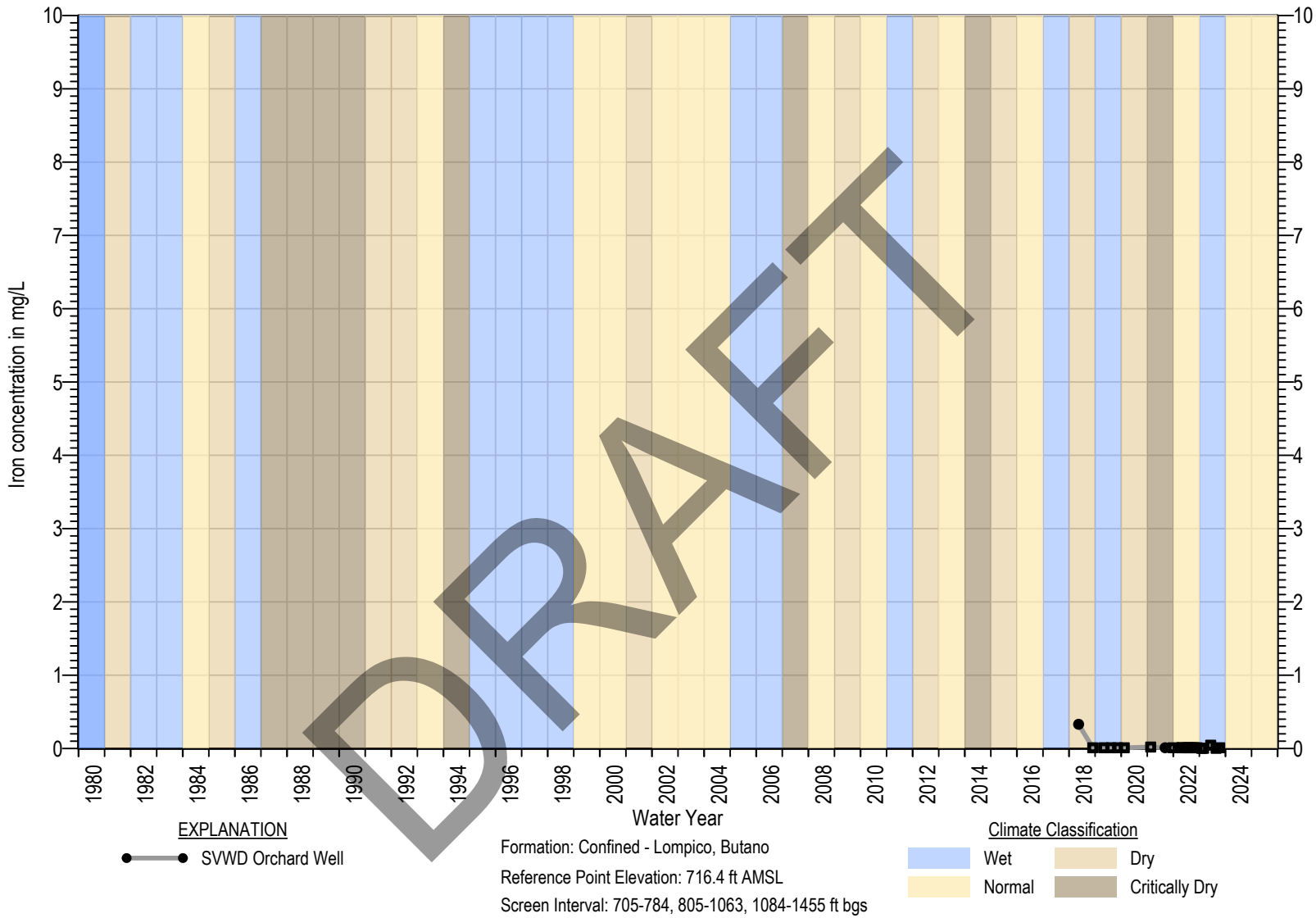
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-119. Iron Chemograph of SVWD #7A

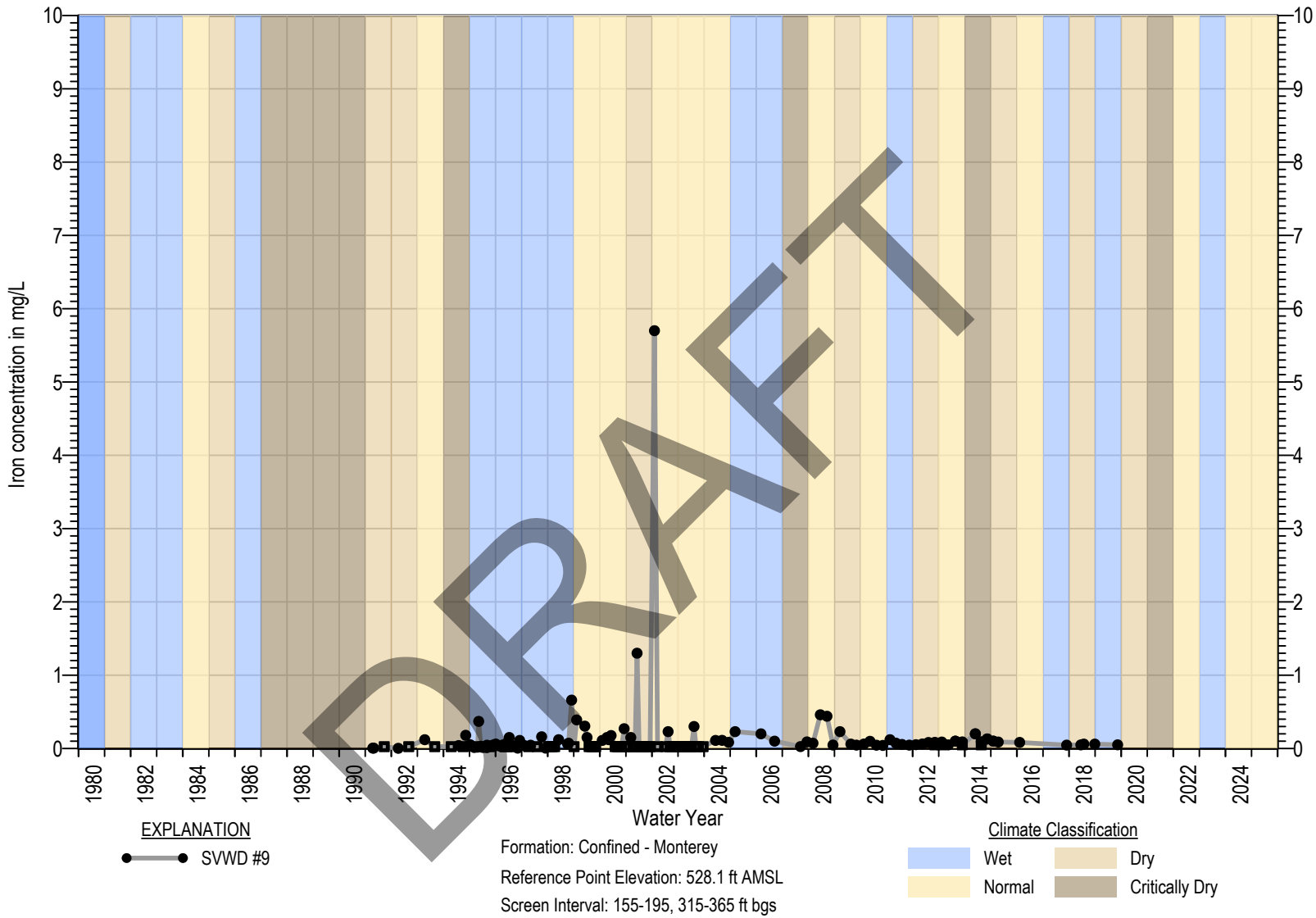
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-120. Iron Chemograph of SVWD Orchard Well

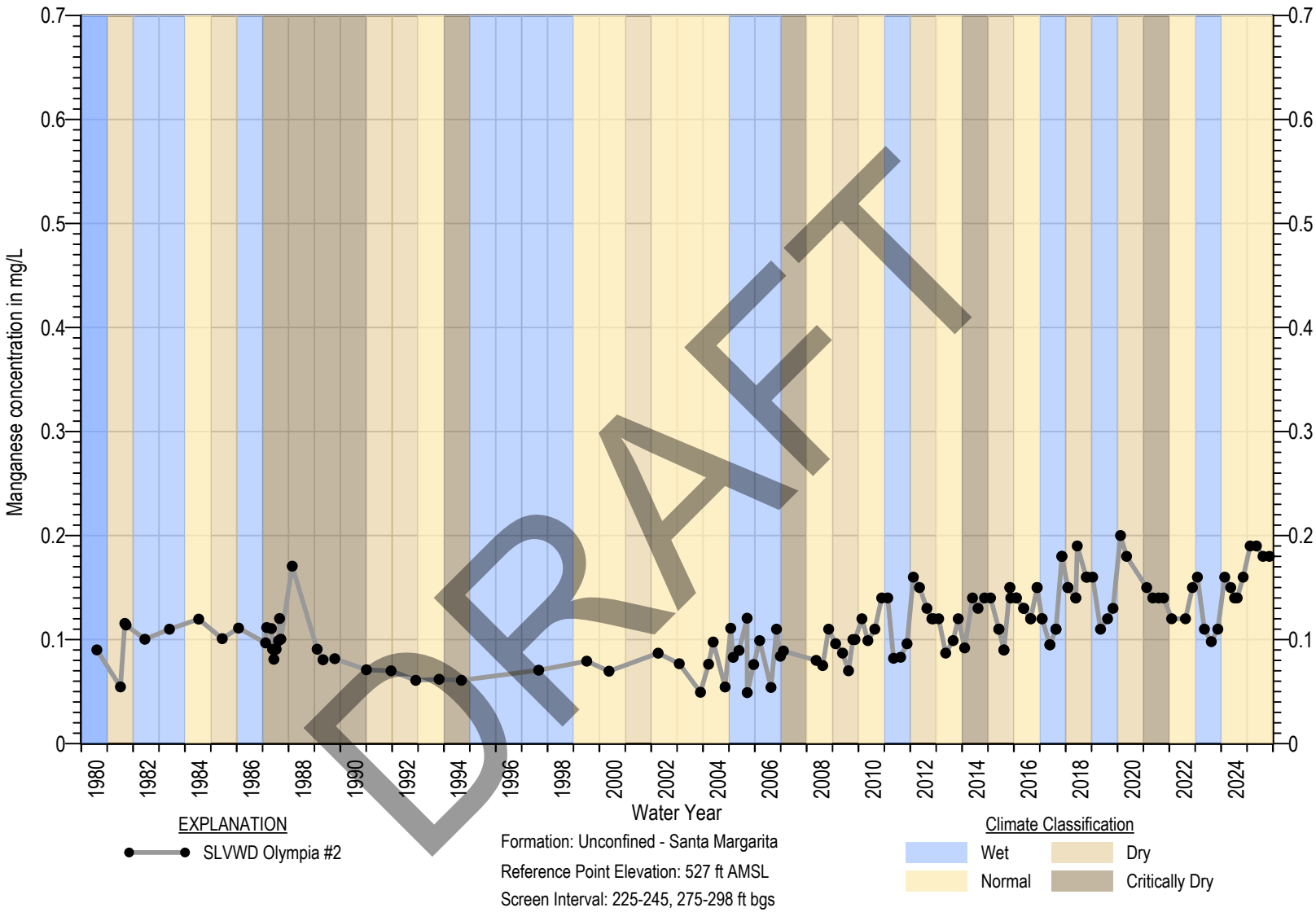
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-121. Iron Chemograph of SVWD #9

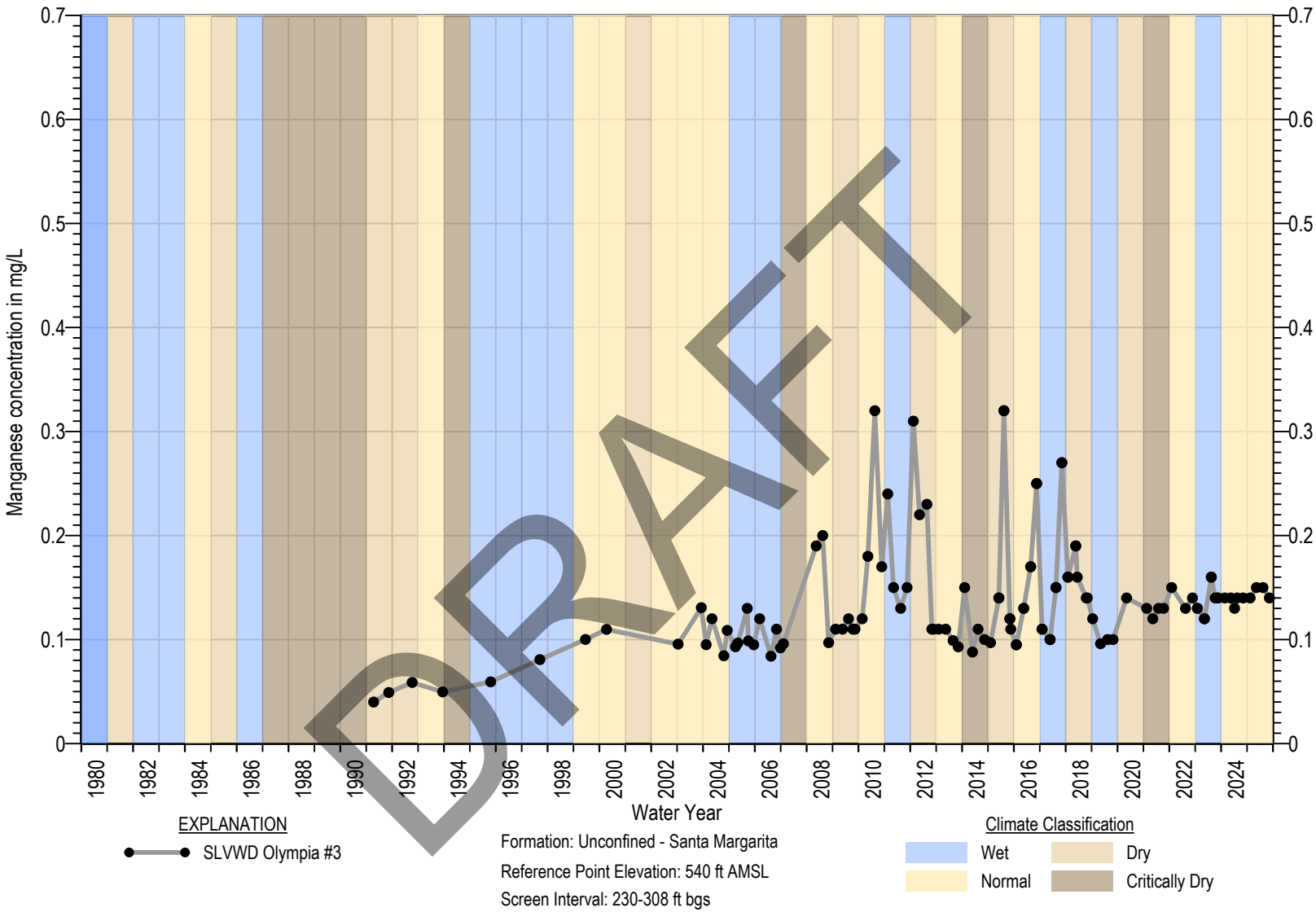
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-122. Manganese Hydrograph of SLVWD Olympia #2

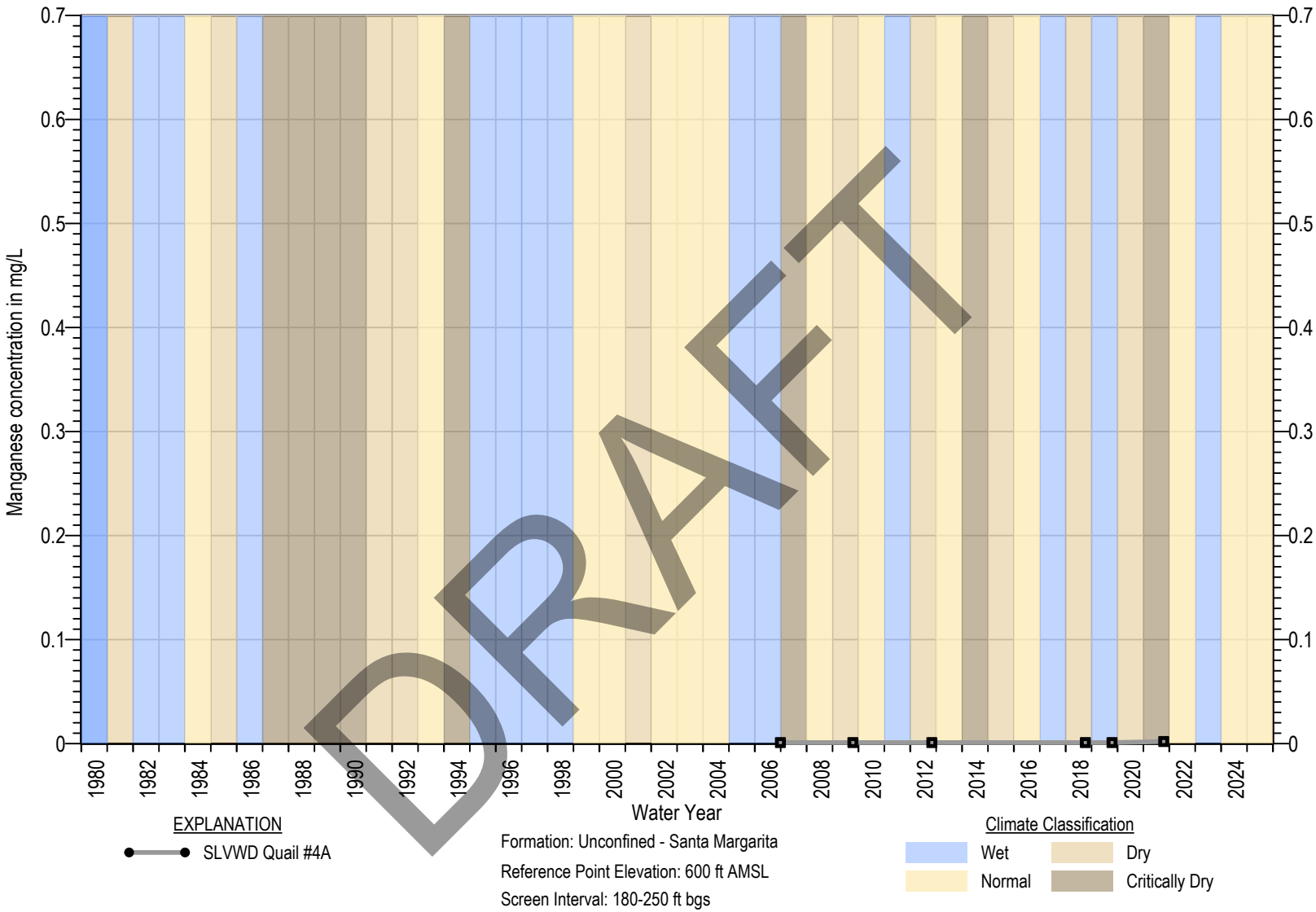
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-123. Manganese Hydrograph of SLVWD Olympia #3

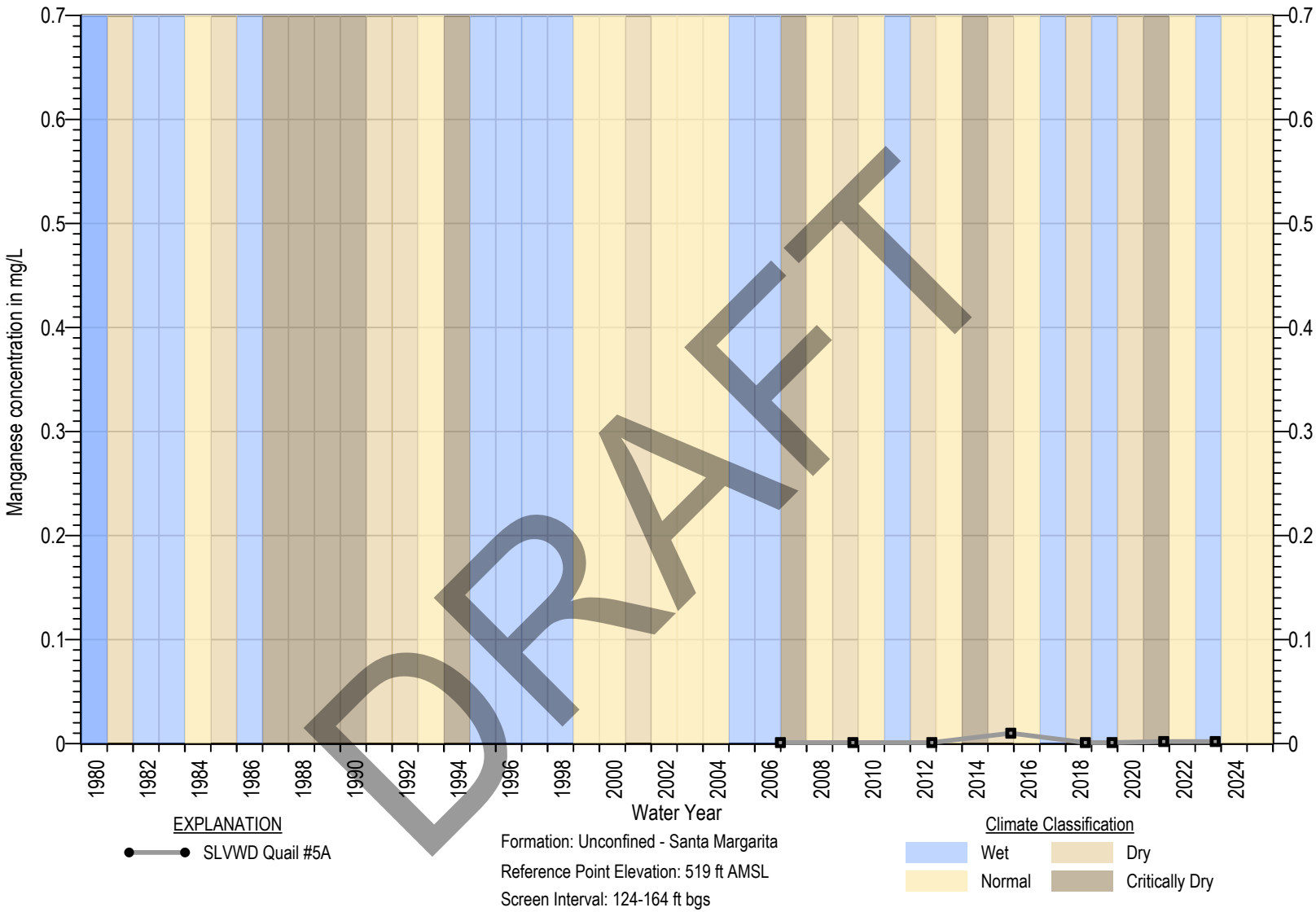
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-124. Manganese Hydrograph of SLVWD Quail #4A

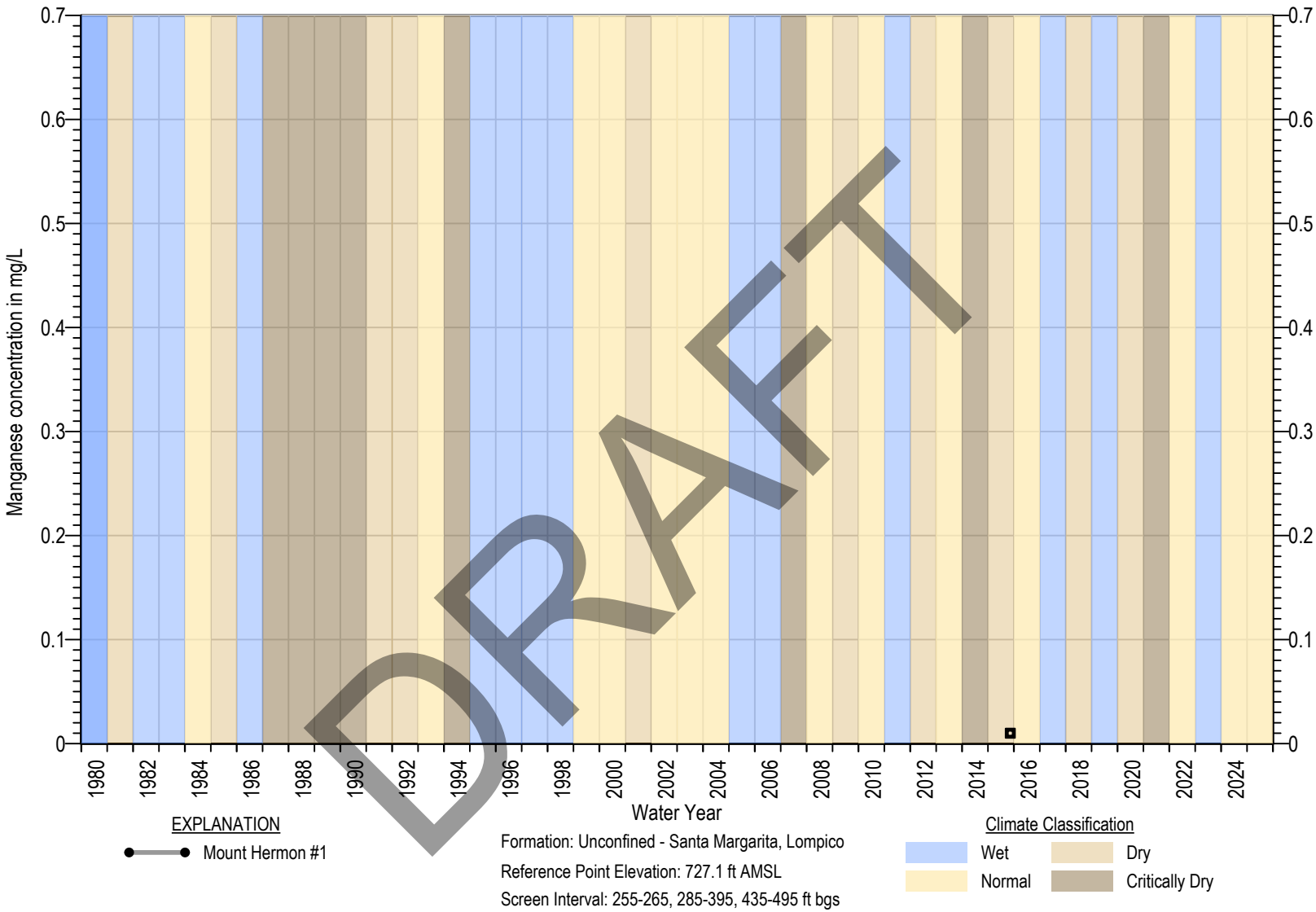
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-125. Manganese Hydrograph of SLVWD Quail #5A

MONTGOMERY & ASSOCIATES



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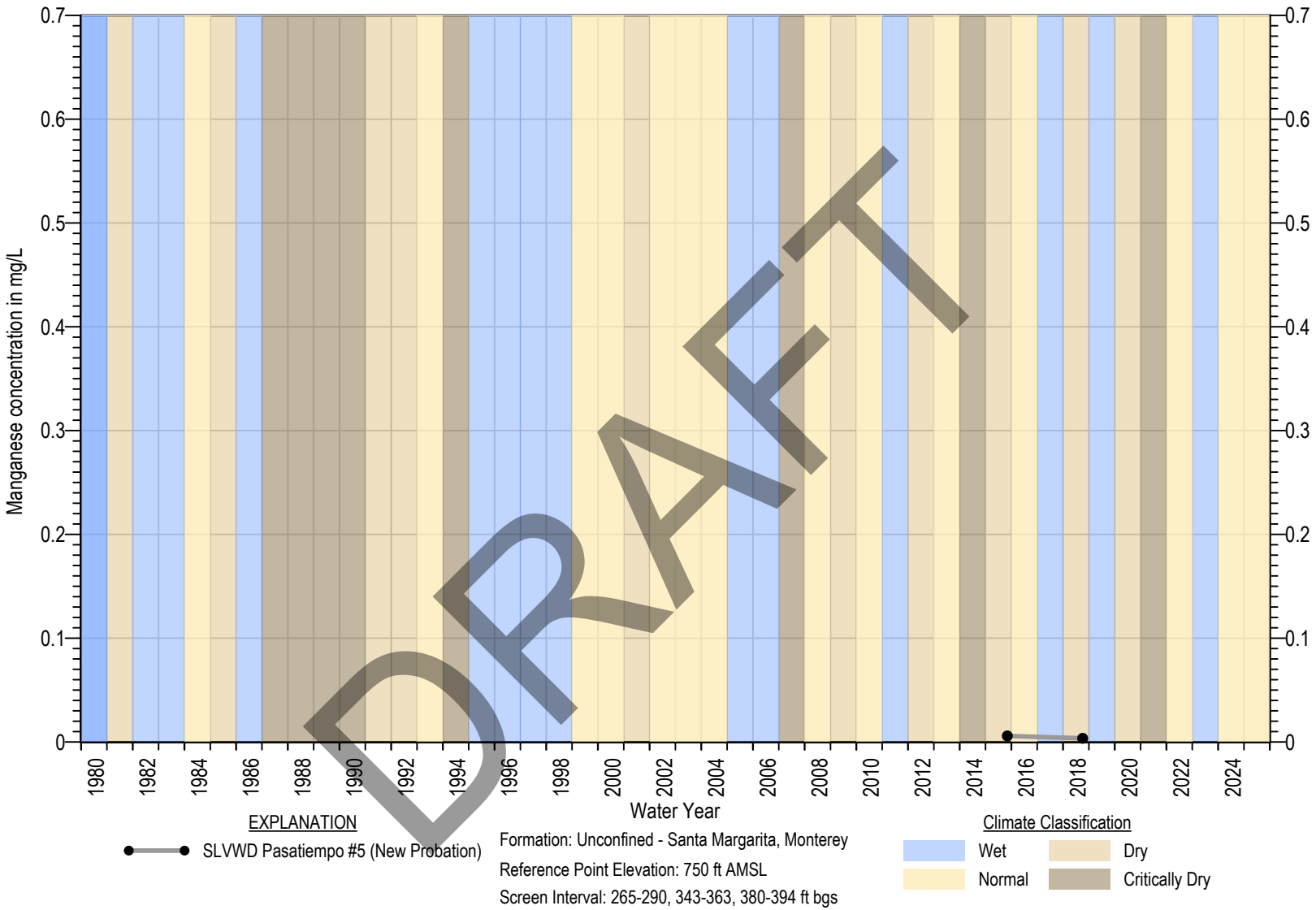
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-126. Manganese Hydrograph of Mount Hermon #1

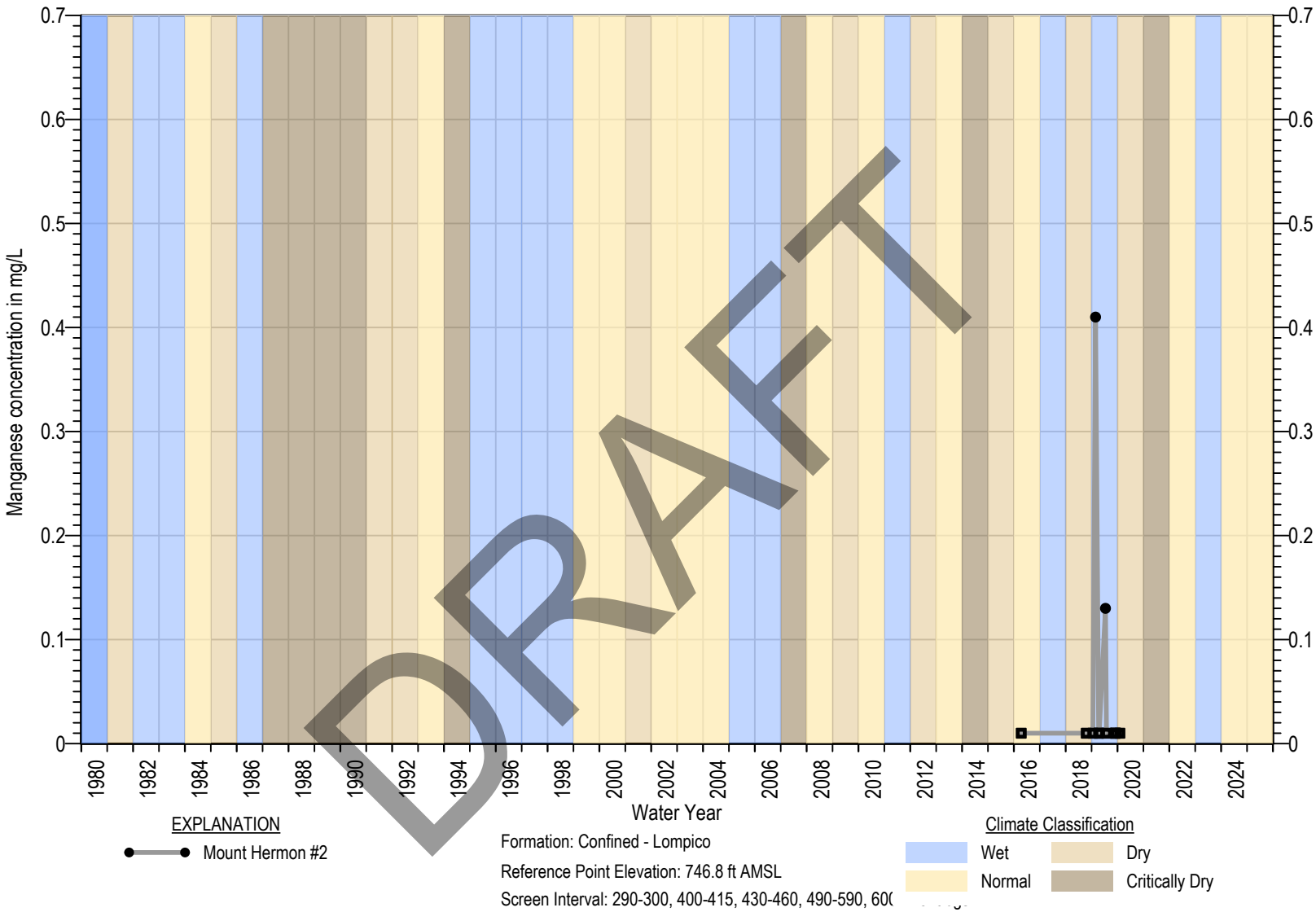
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-127. Manganese Hydrograph of SLVWD Pasatiempo #5 (New Probation)

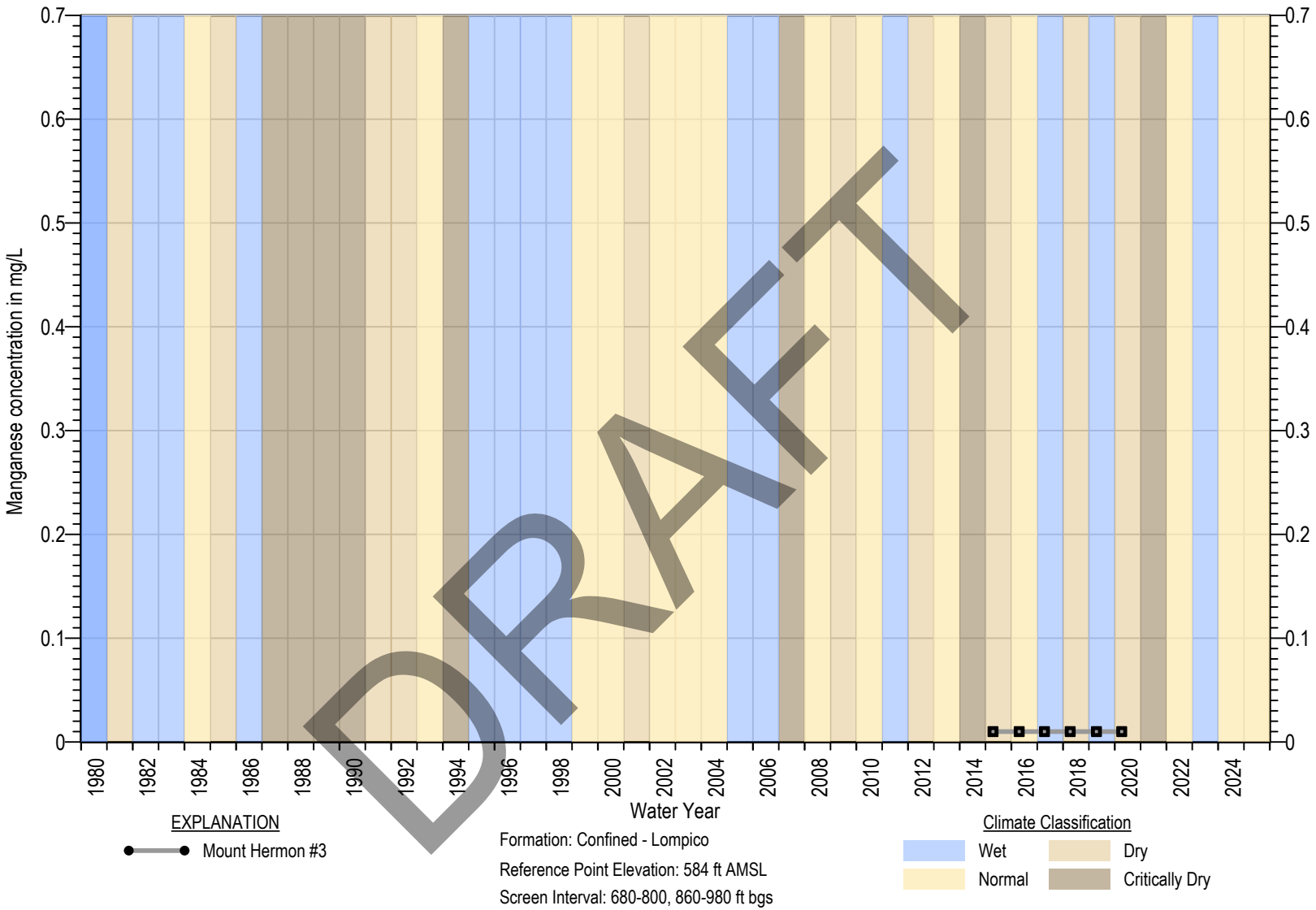
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-128. Manganese Hydrograph of Mount Hermon #2

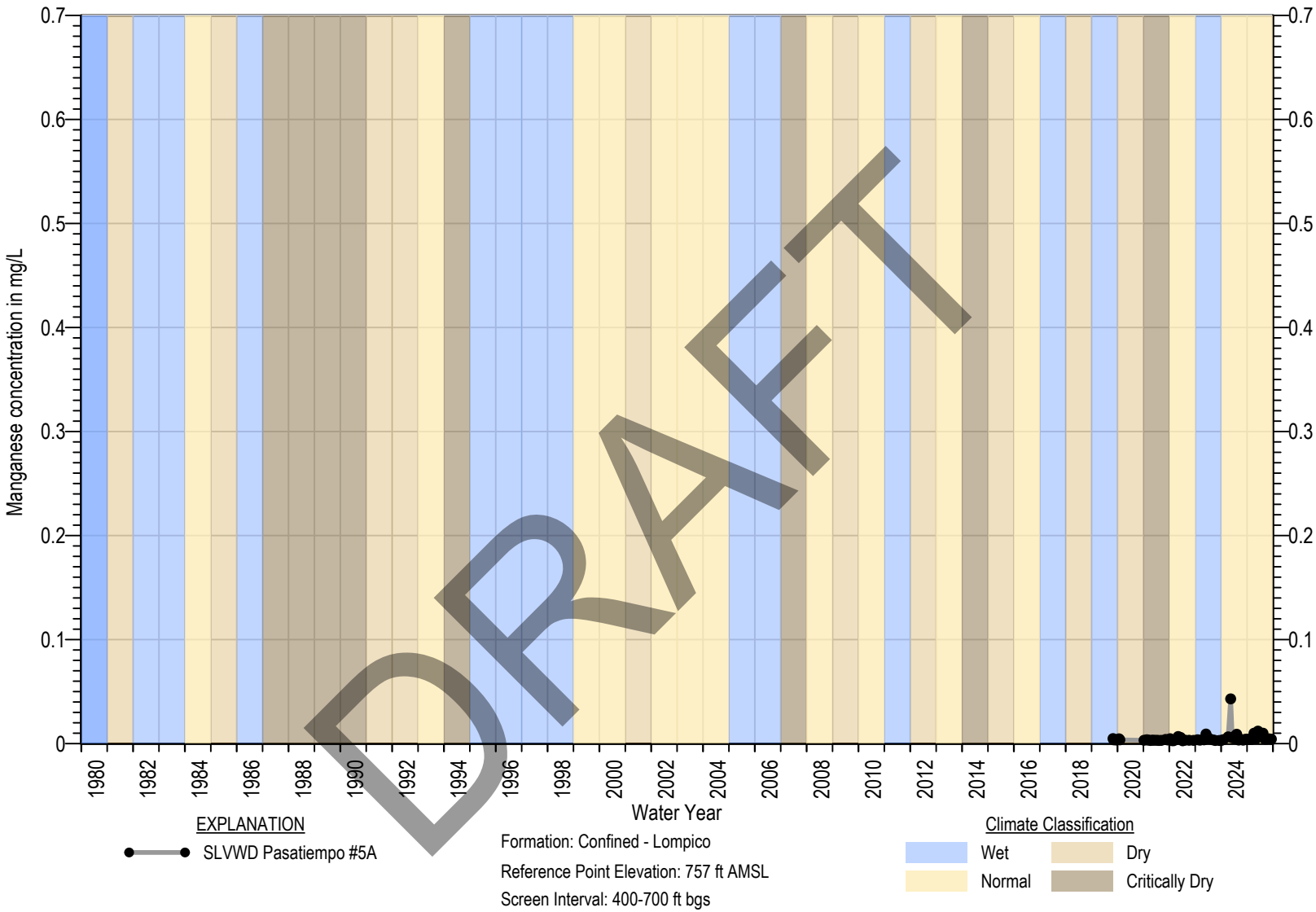
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-129. Manganese Hydrograph of Mount Hermon #3

MONTGOMERY & ASSOCIATES



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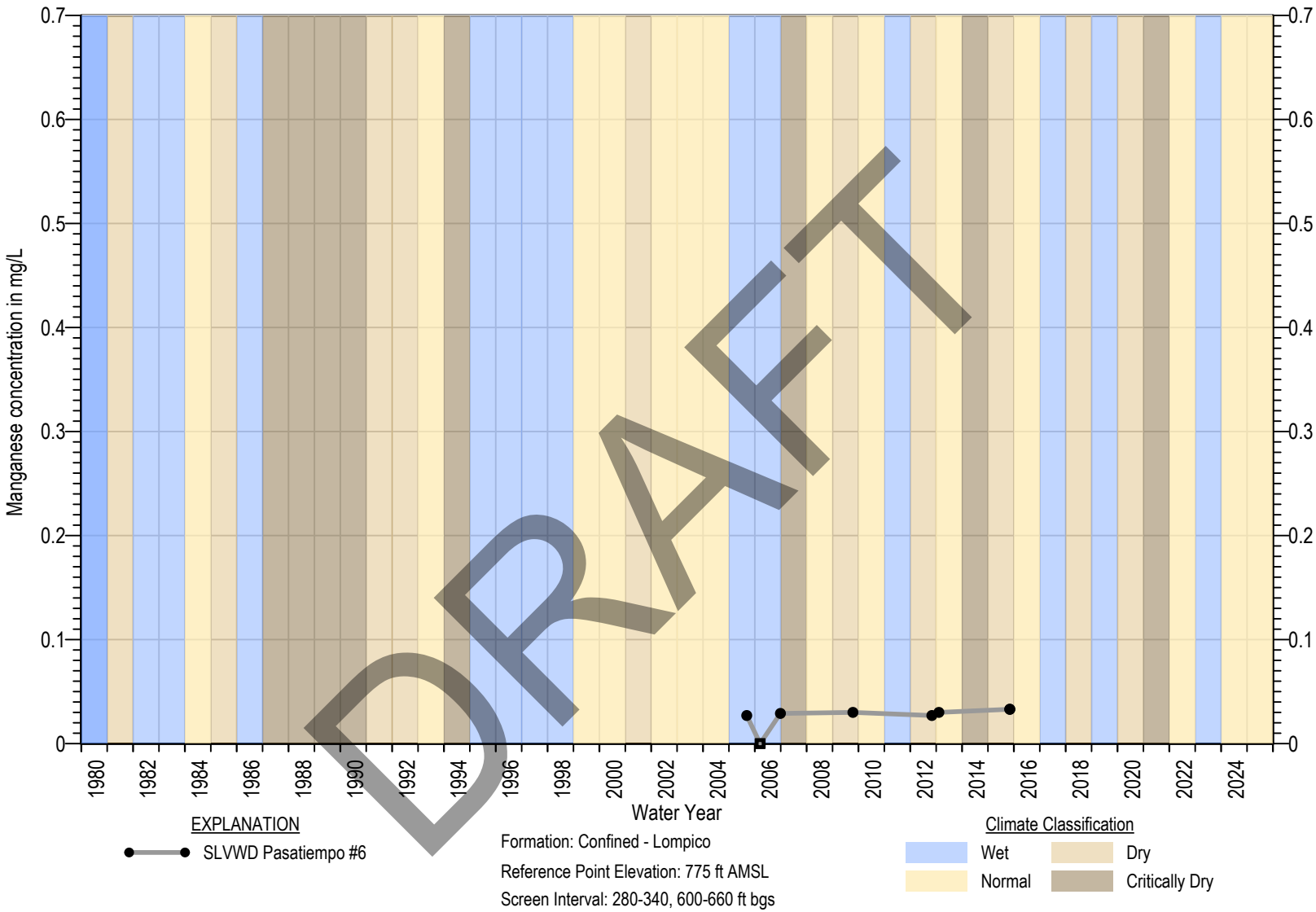
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-130. Manganese Hydrograph of SLVWD Pasatiempo #5A

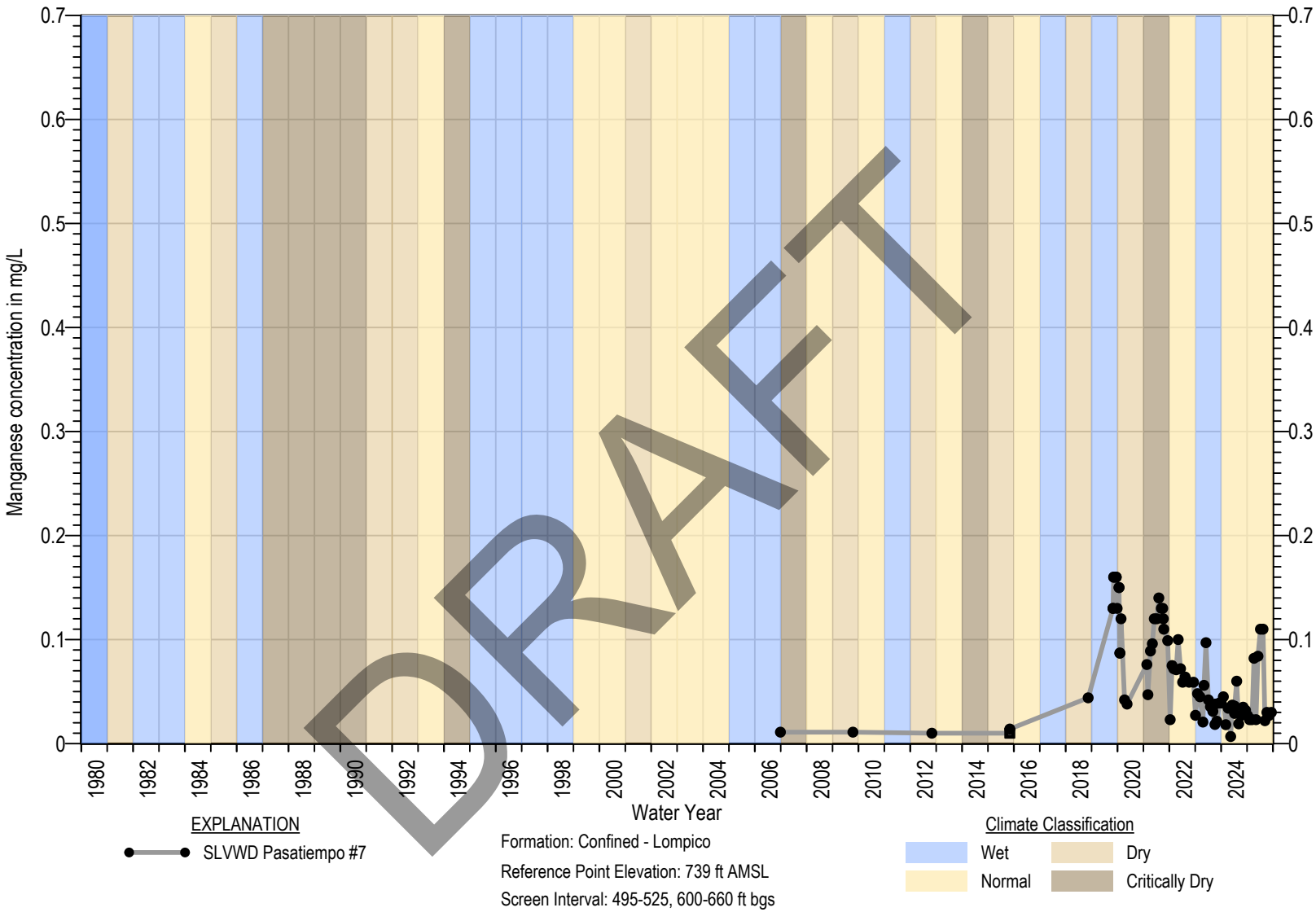
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-131. Manganese Hydrograph of SLVWD Pasatiempo #6

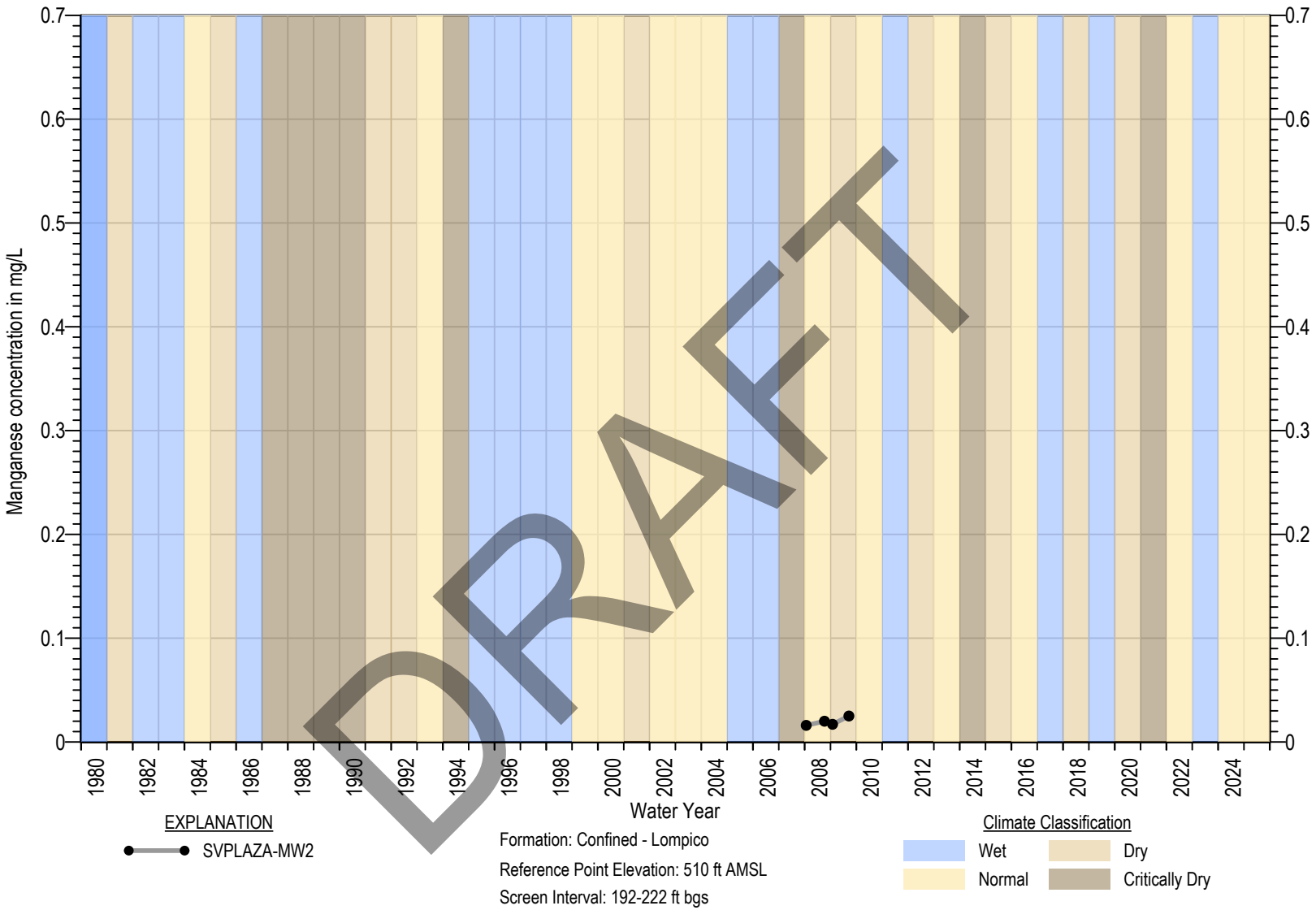
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-132. Manganese Hydrograph of SLVWD Pasatiempo #7

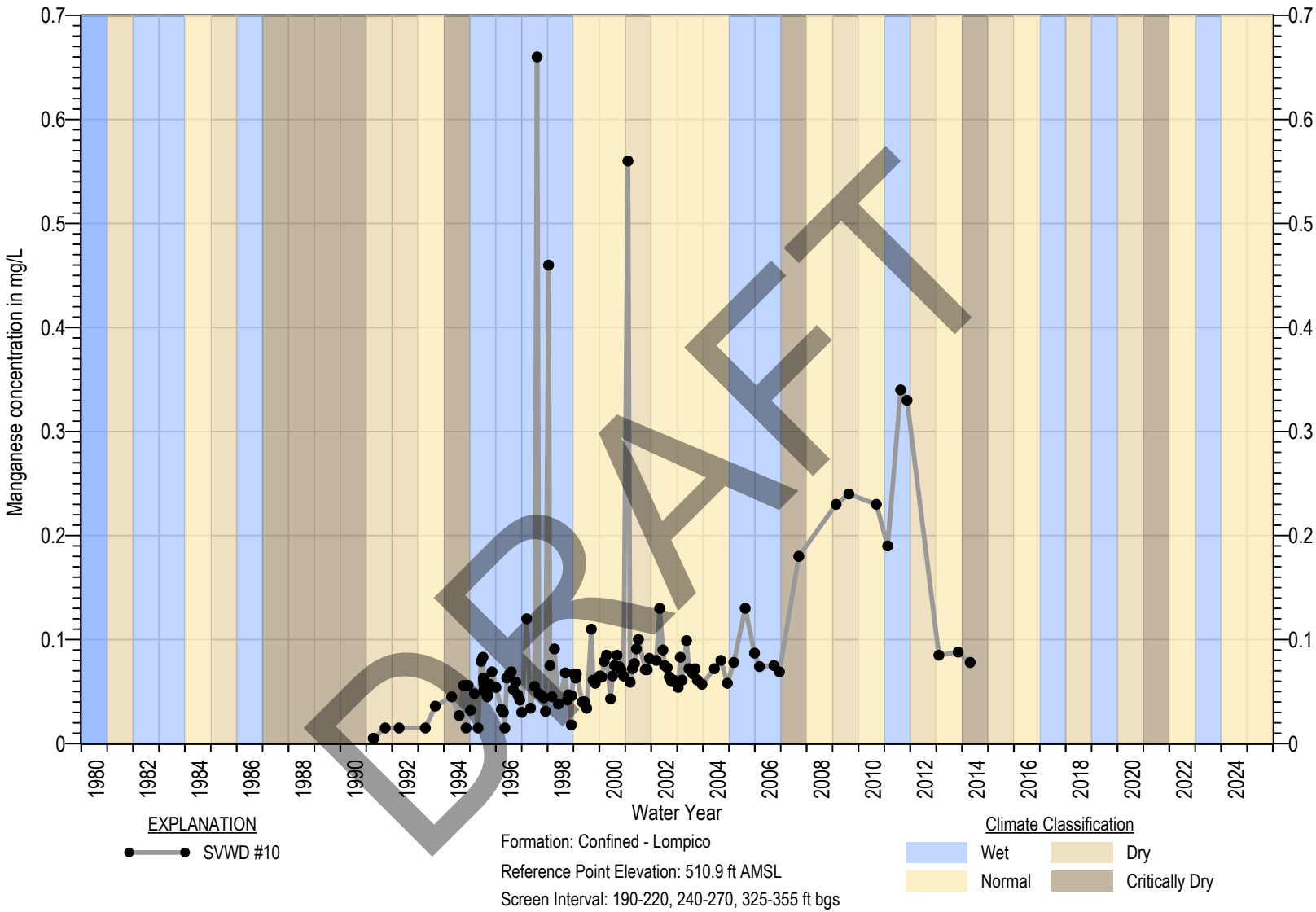
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-133. Manganese Hydrograph of SVPLAZA-MW2

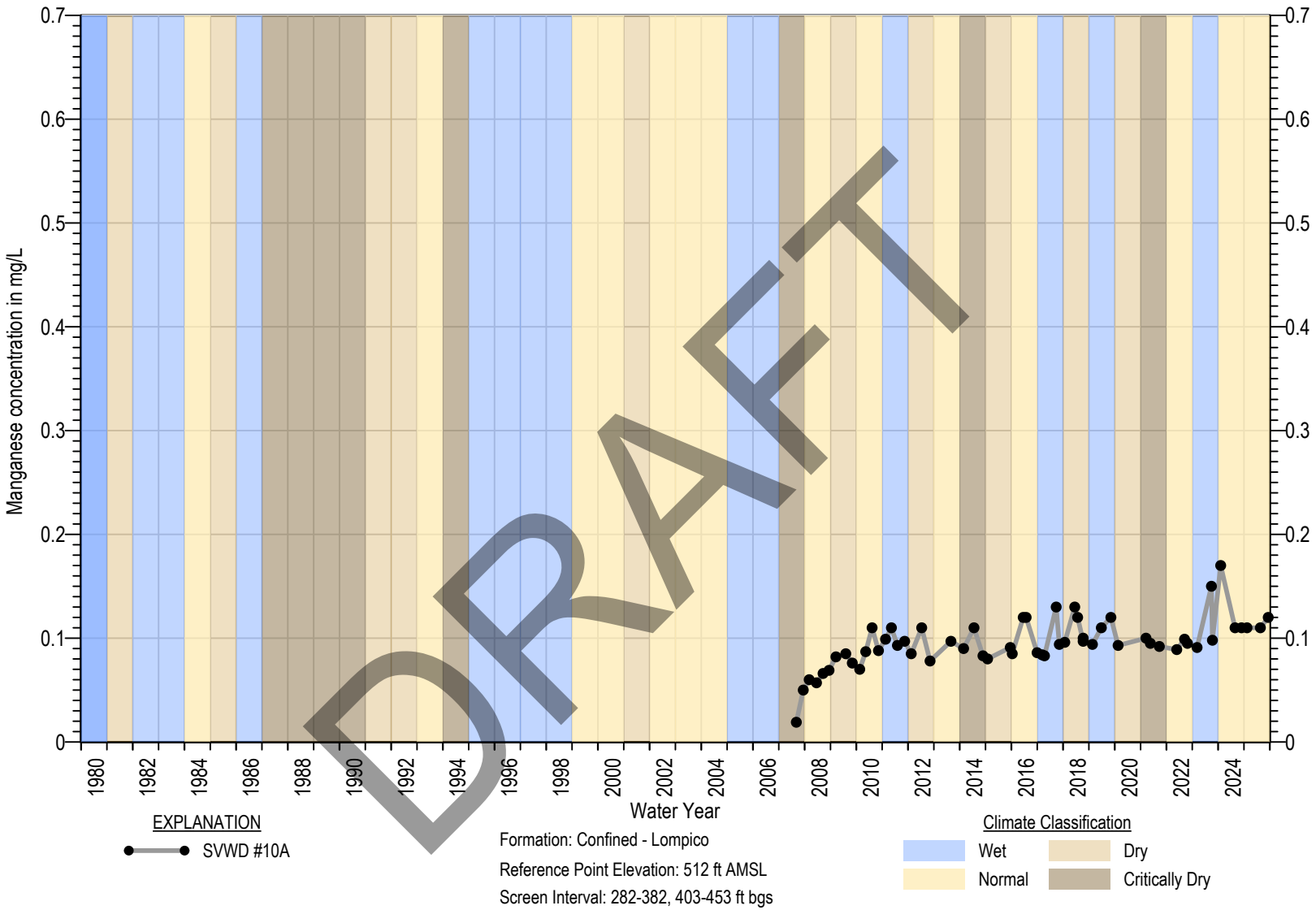
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-134. Manganese Hydrograph of SVWD #10

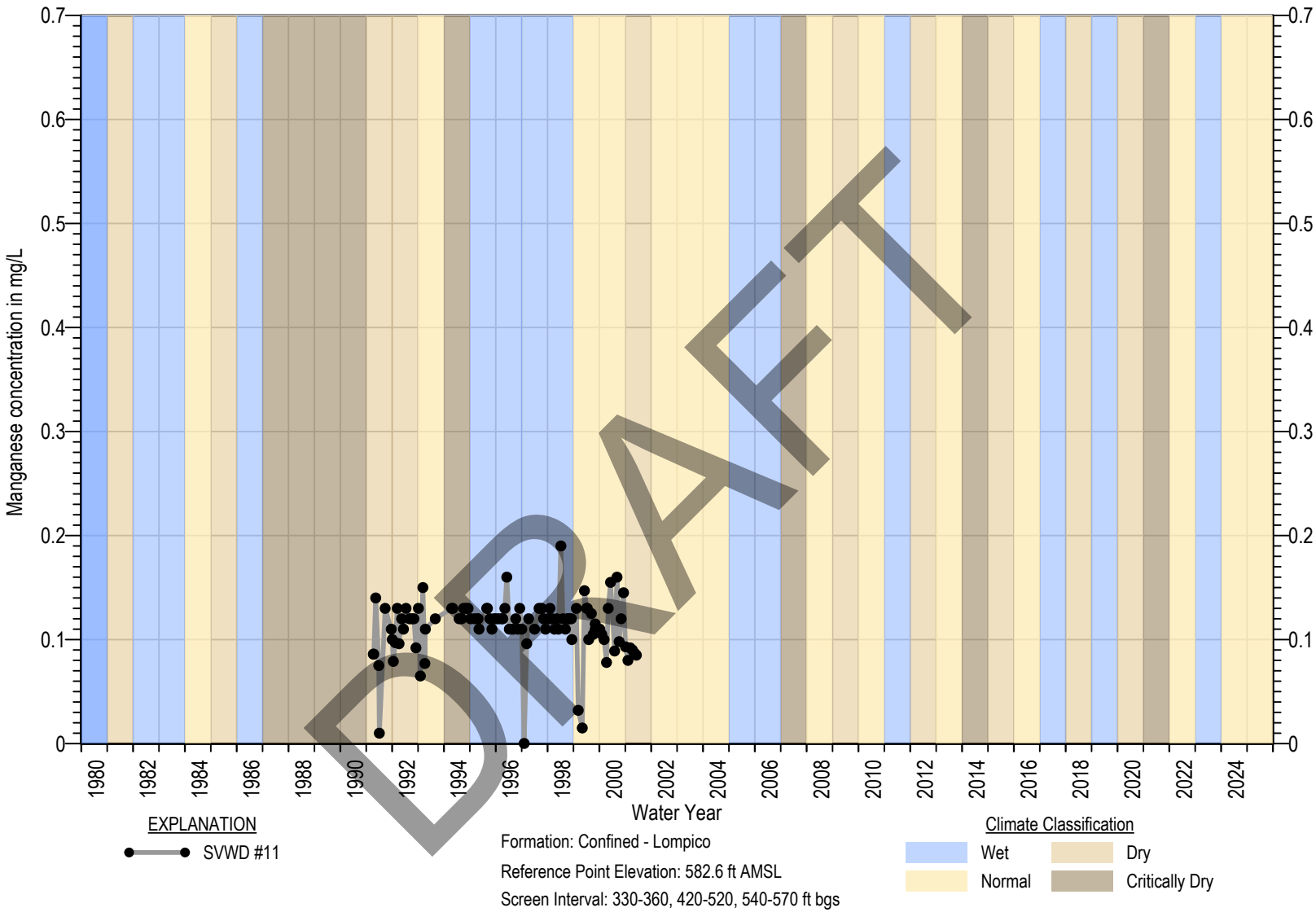
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-135. Manganese Hydrograph of SVWD #10A

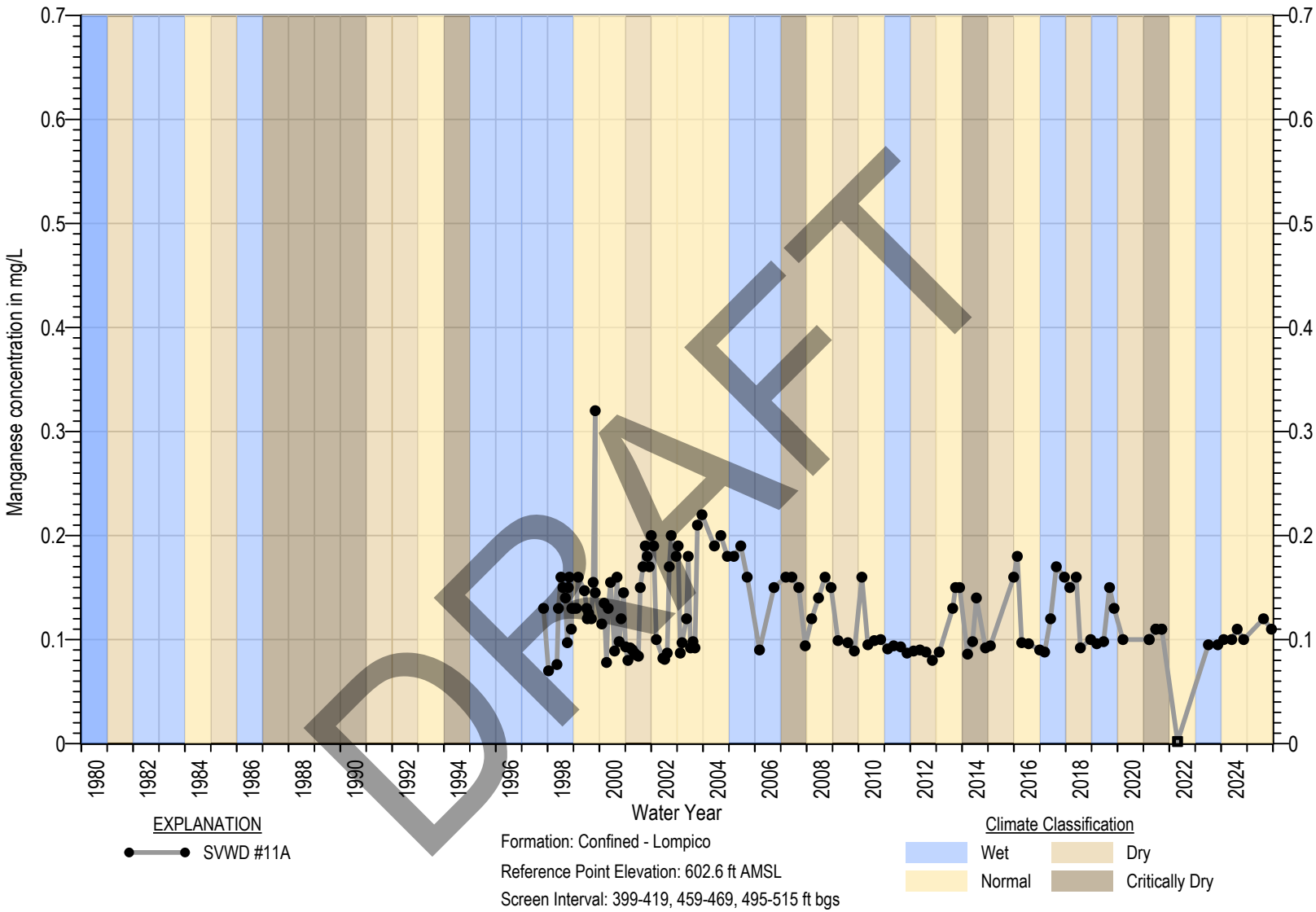
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-136. Manganese Hydrograph of SVWD #11

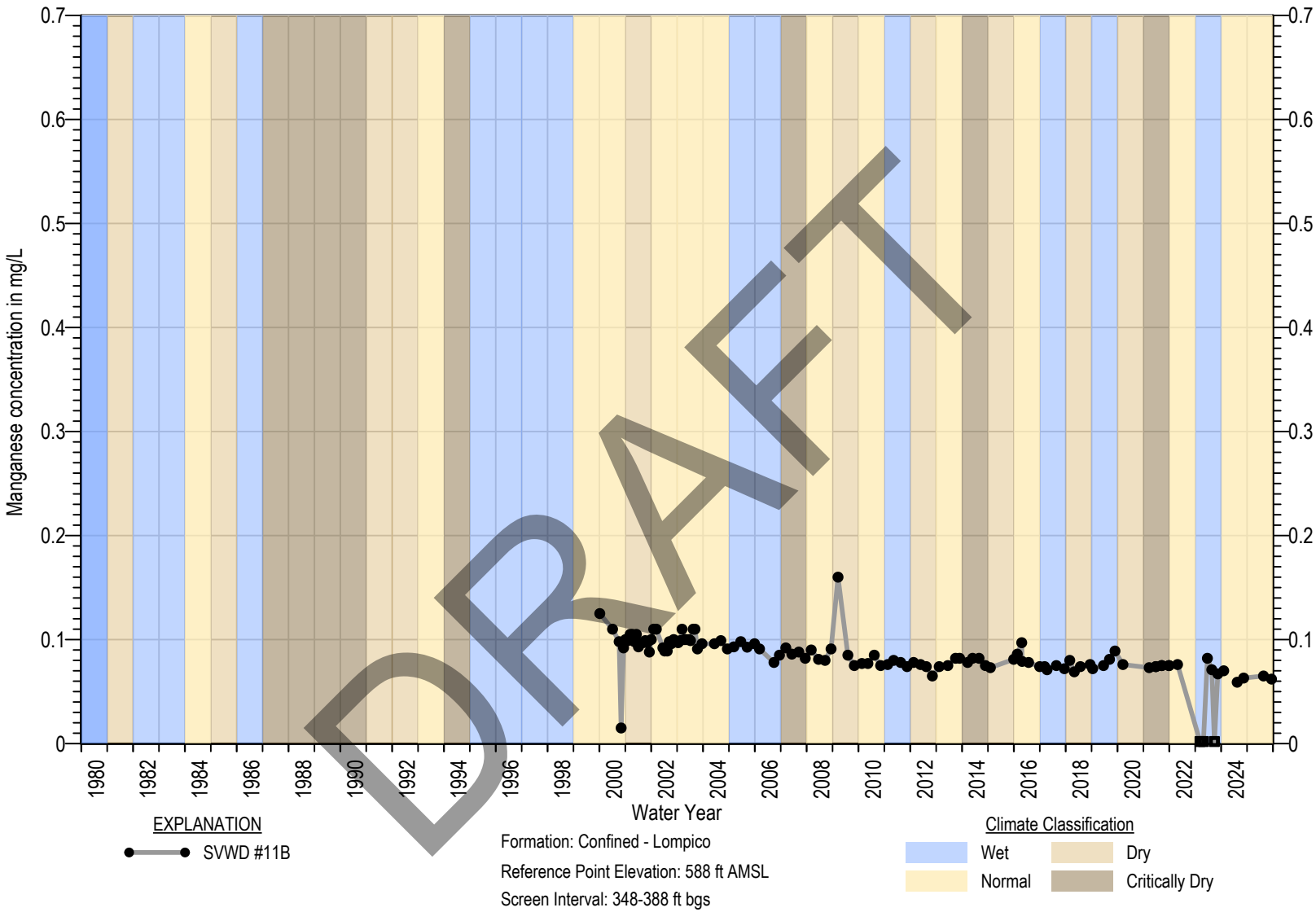
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-137. Manganese Hydrograph of SVWD #11A

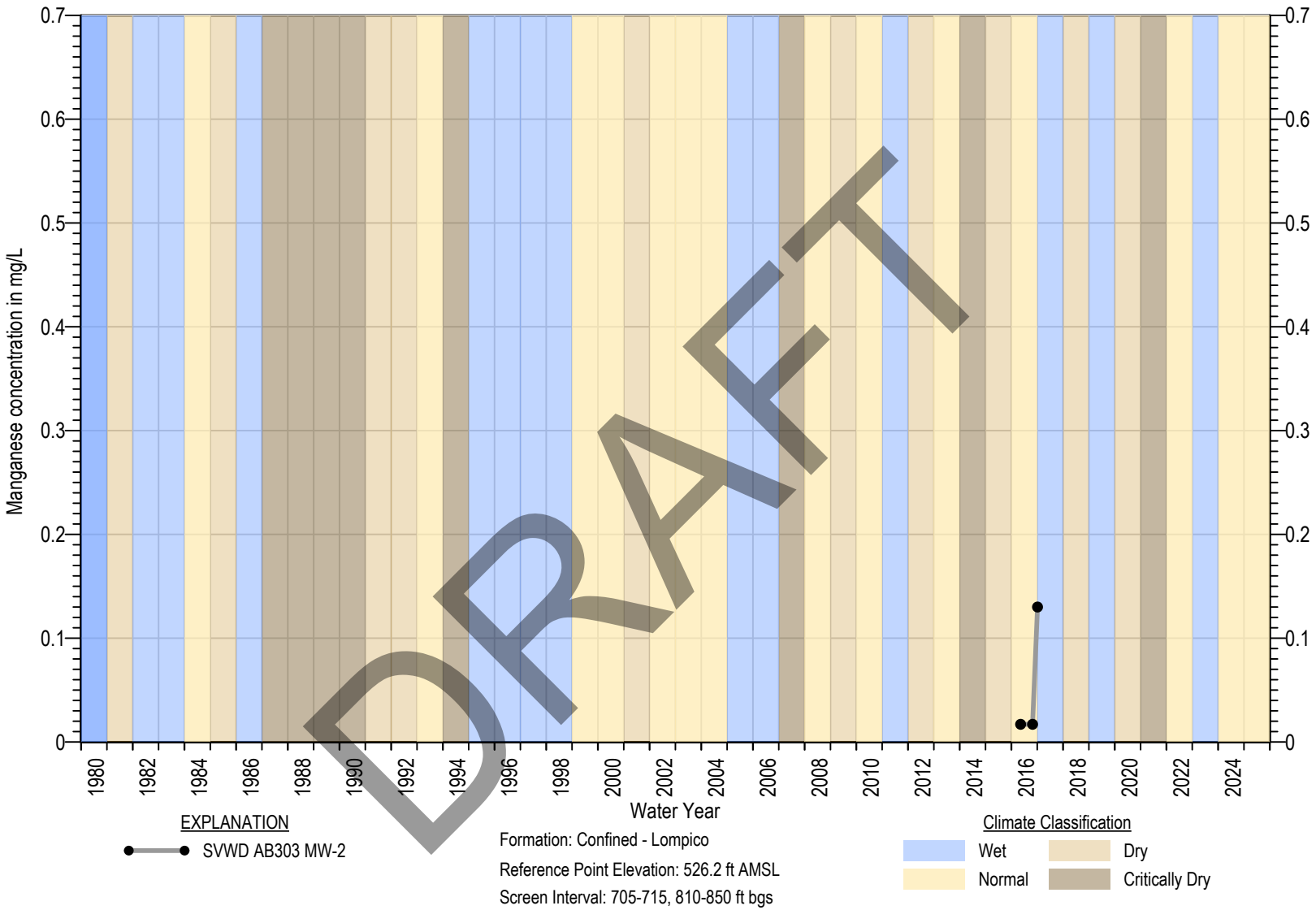
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-138. Manganese Hydrograph of SVWD #11B

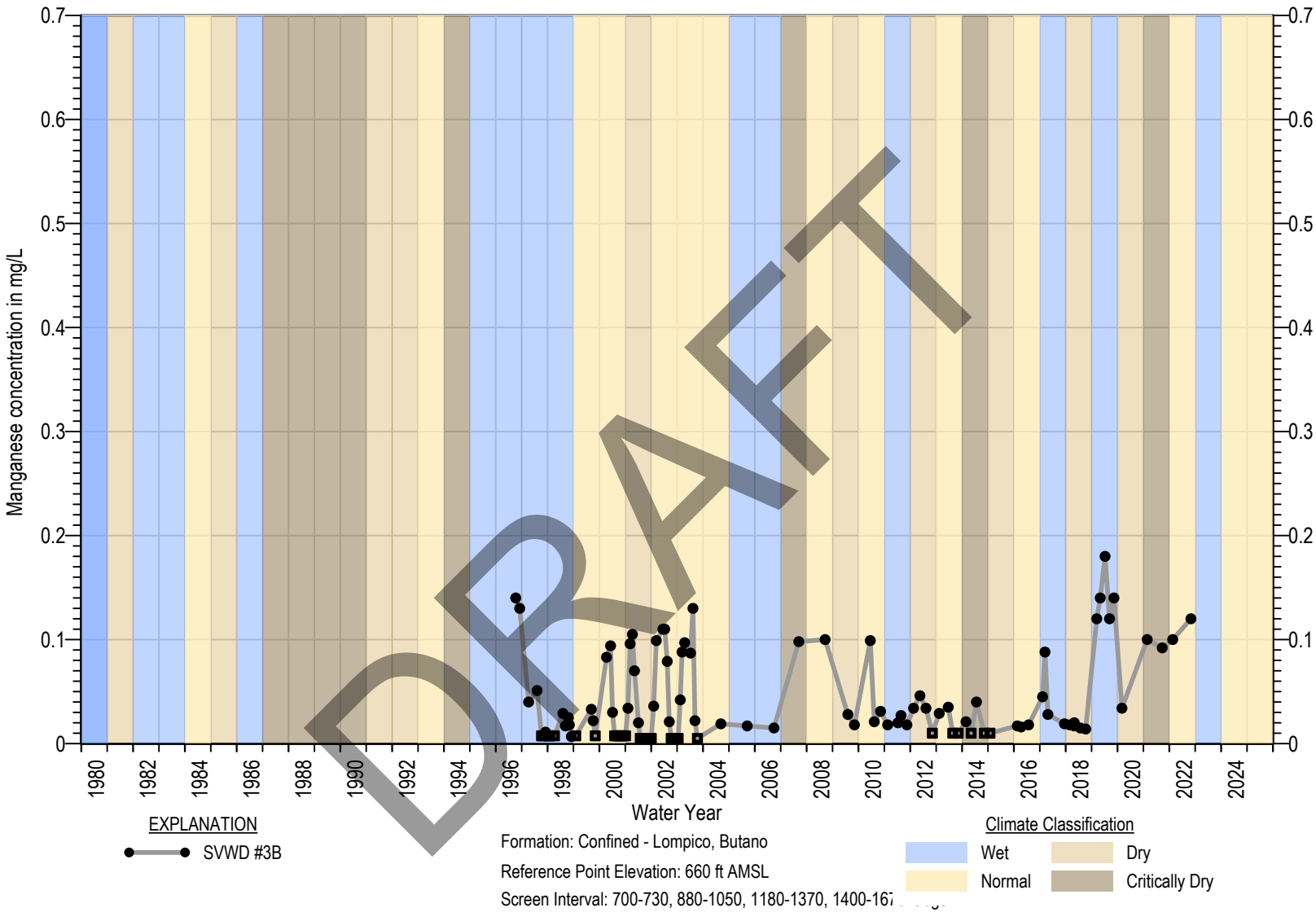
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-139. Manganese Hydrograph of SVWD AB303 MW-2

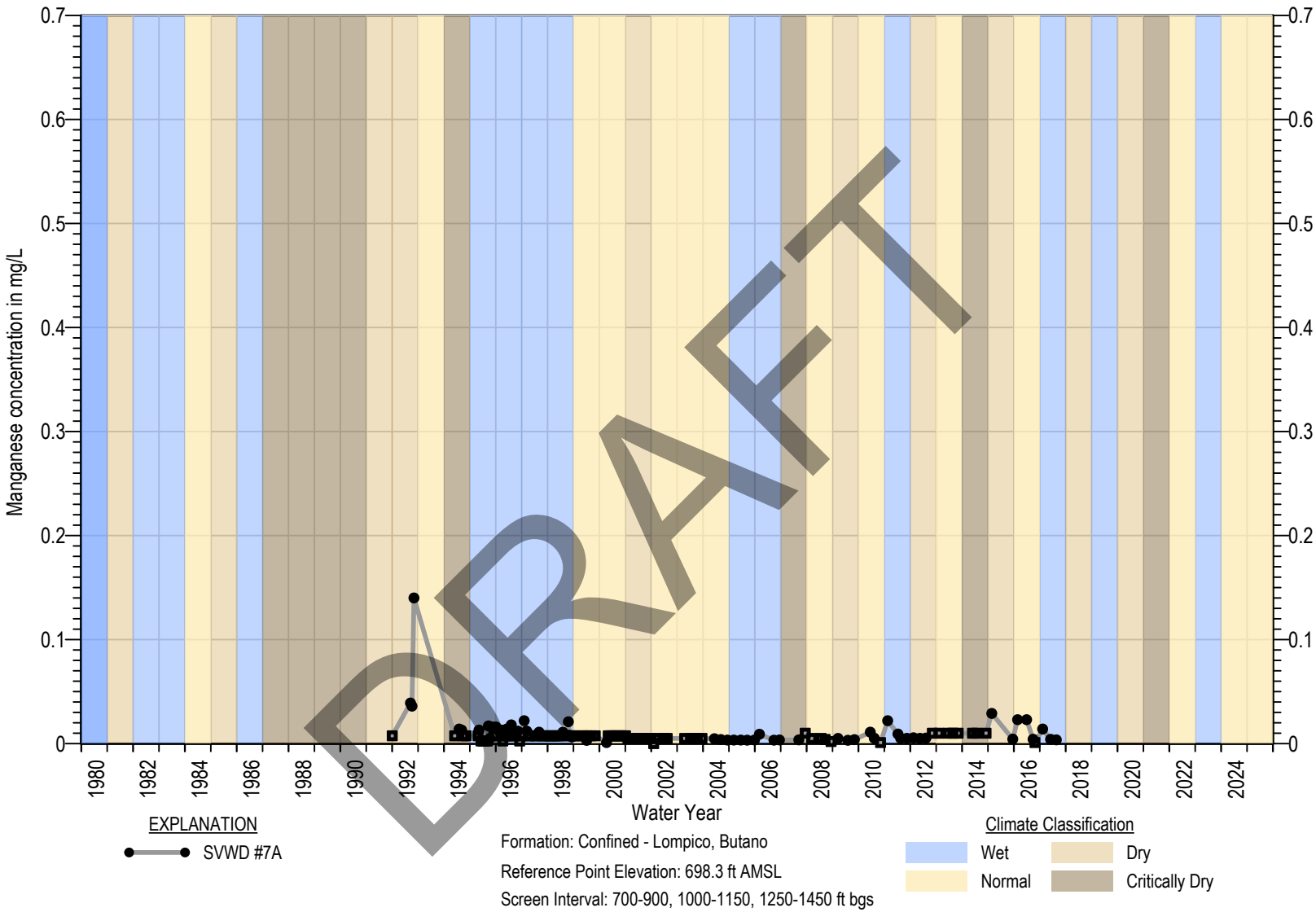
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-140. Manganese Hydrograph of SVWD #3B

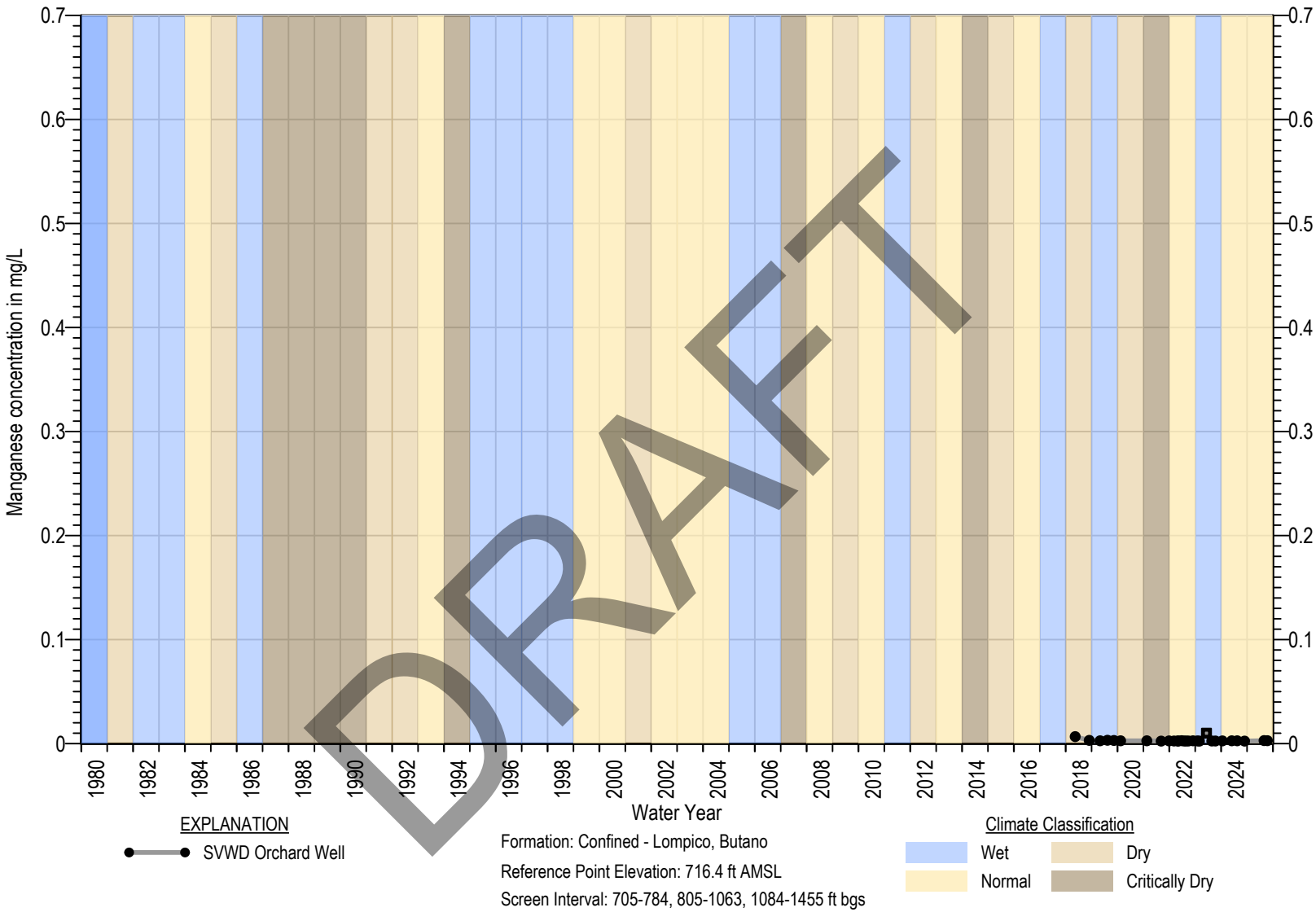
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-141. Manganese Hydrograph of SVWD #7A

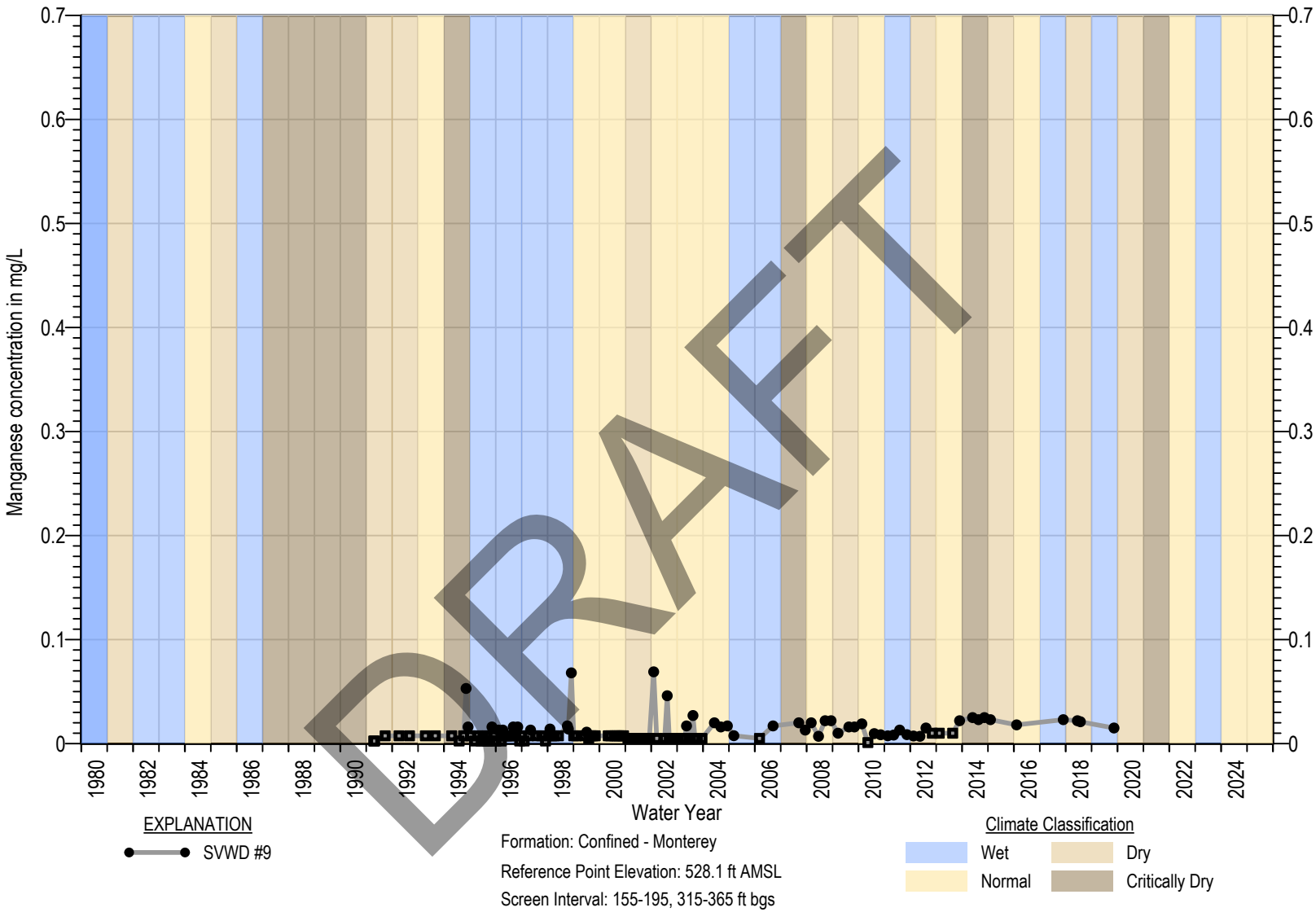
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-142. Manganese Hydrograph of SVWD Orchard Well

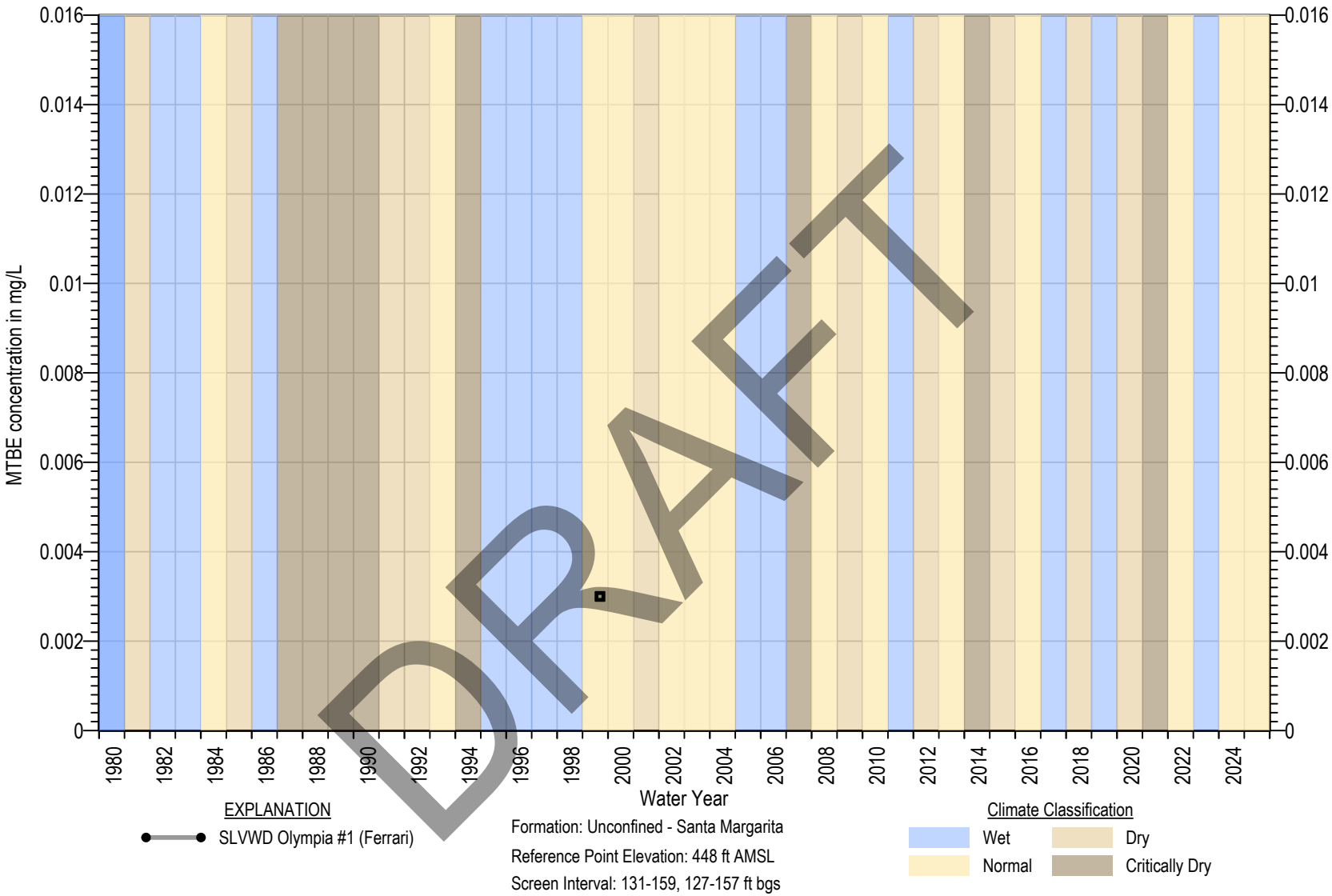
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-143. Manganese Hydrograph of SVWD #9

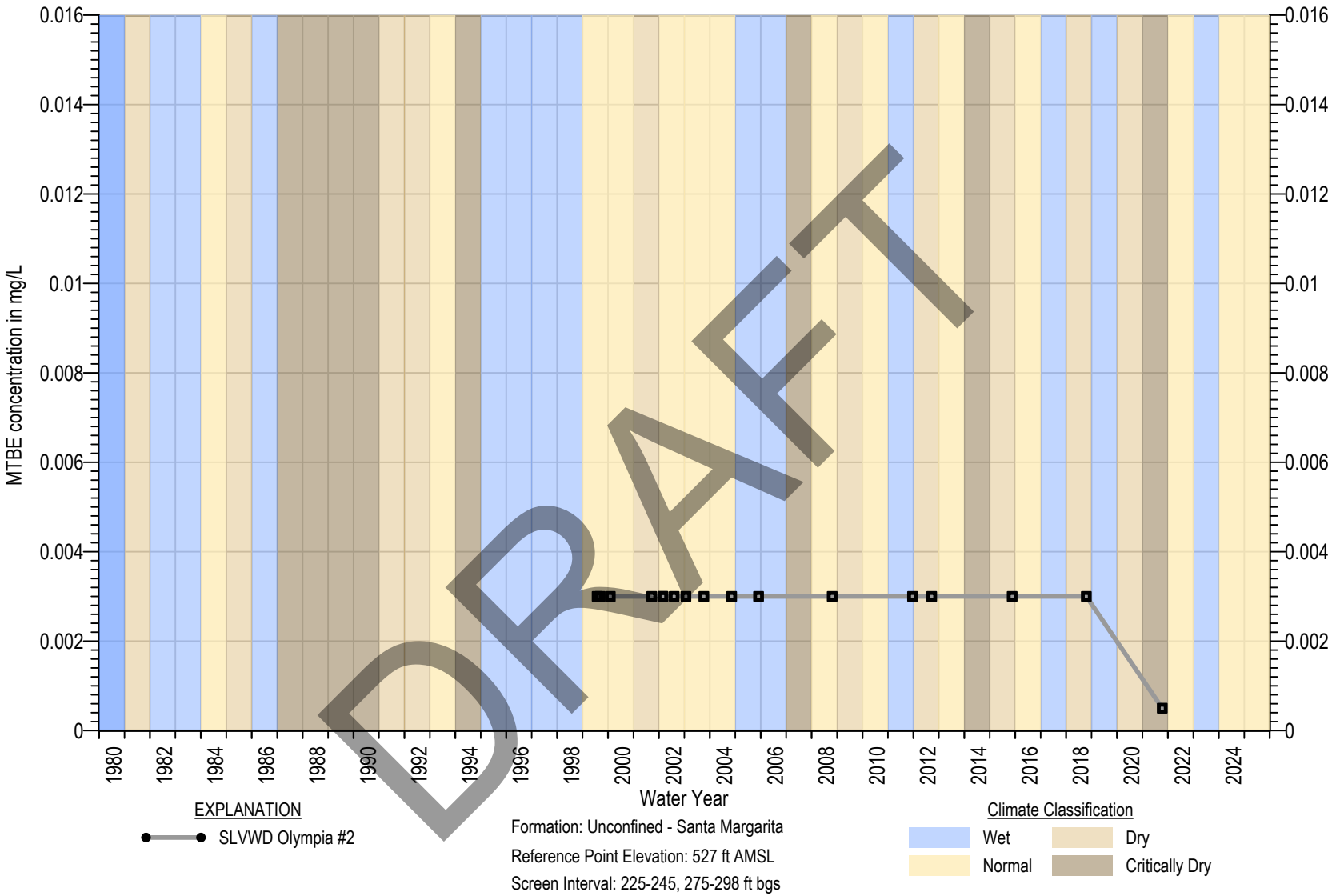
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-144. MTBE Hydrograph of SLVWD Olympia #1 (Ferrari)

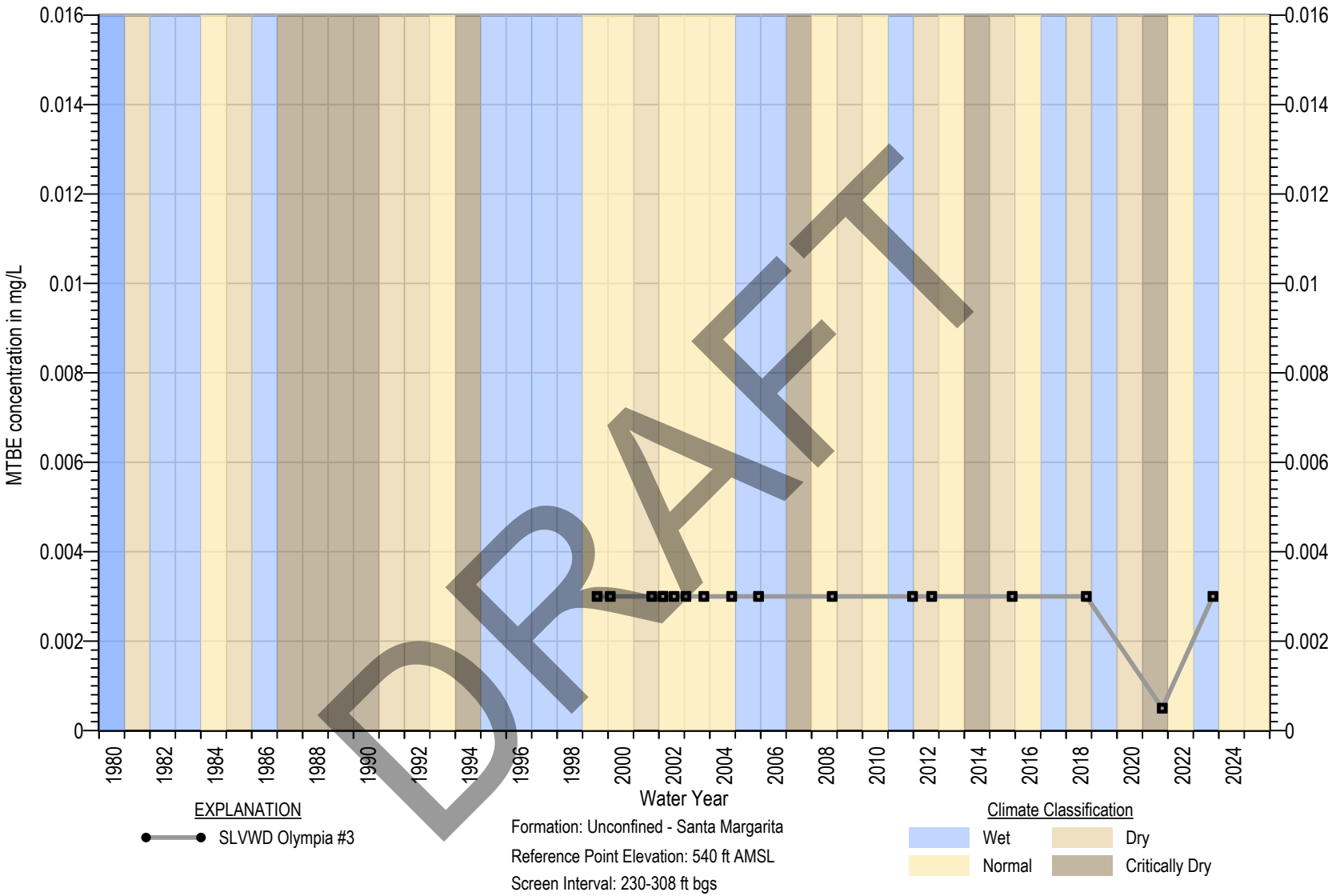
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-145. MTBE Hydrograph of SLVWD Olympia #2

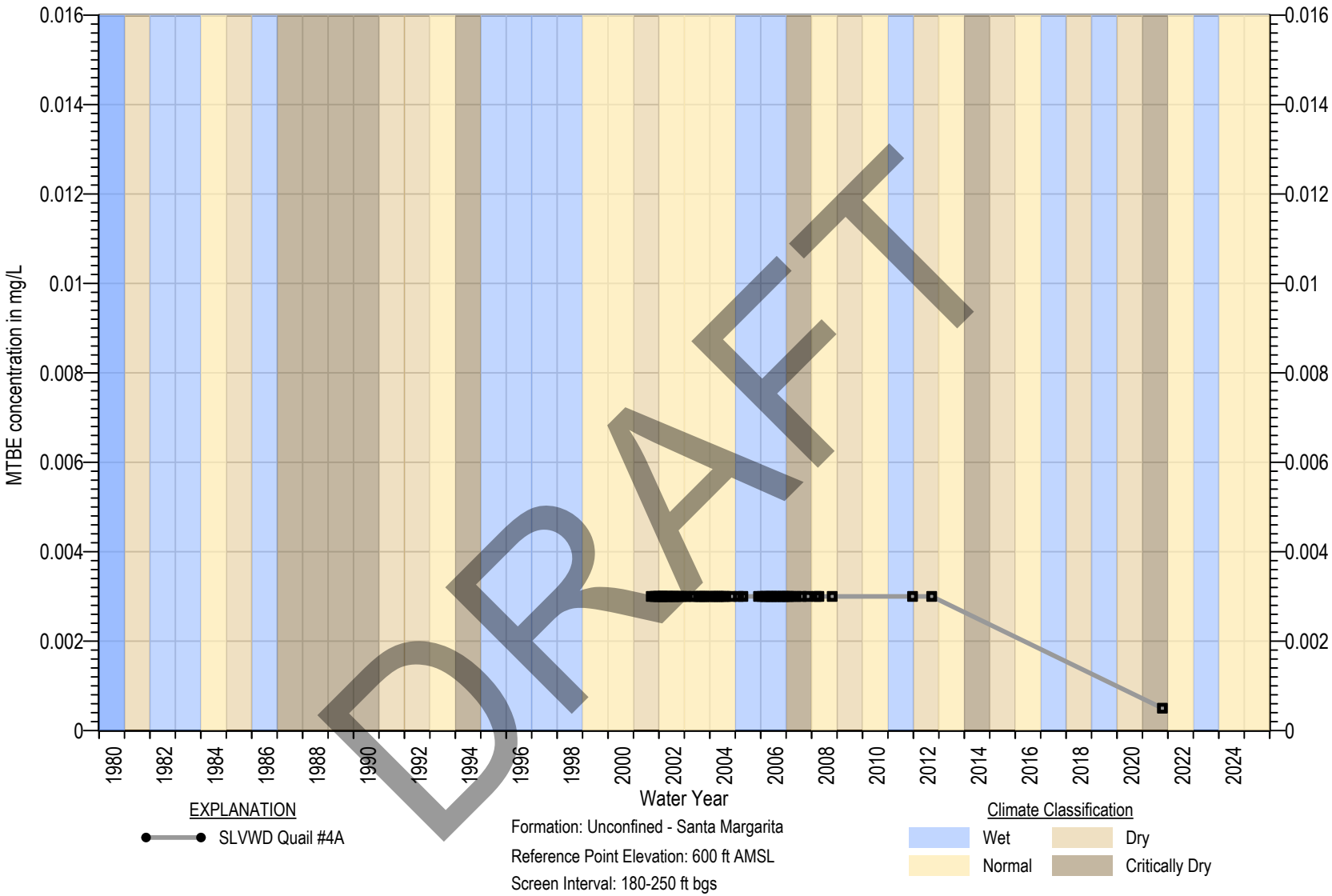
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-146. MTBE Hydrograph of SLVWD Olympia #3

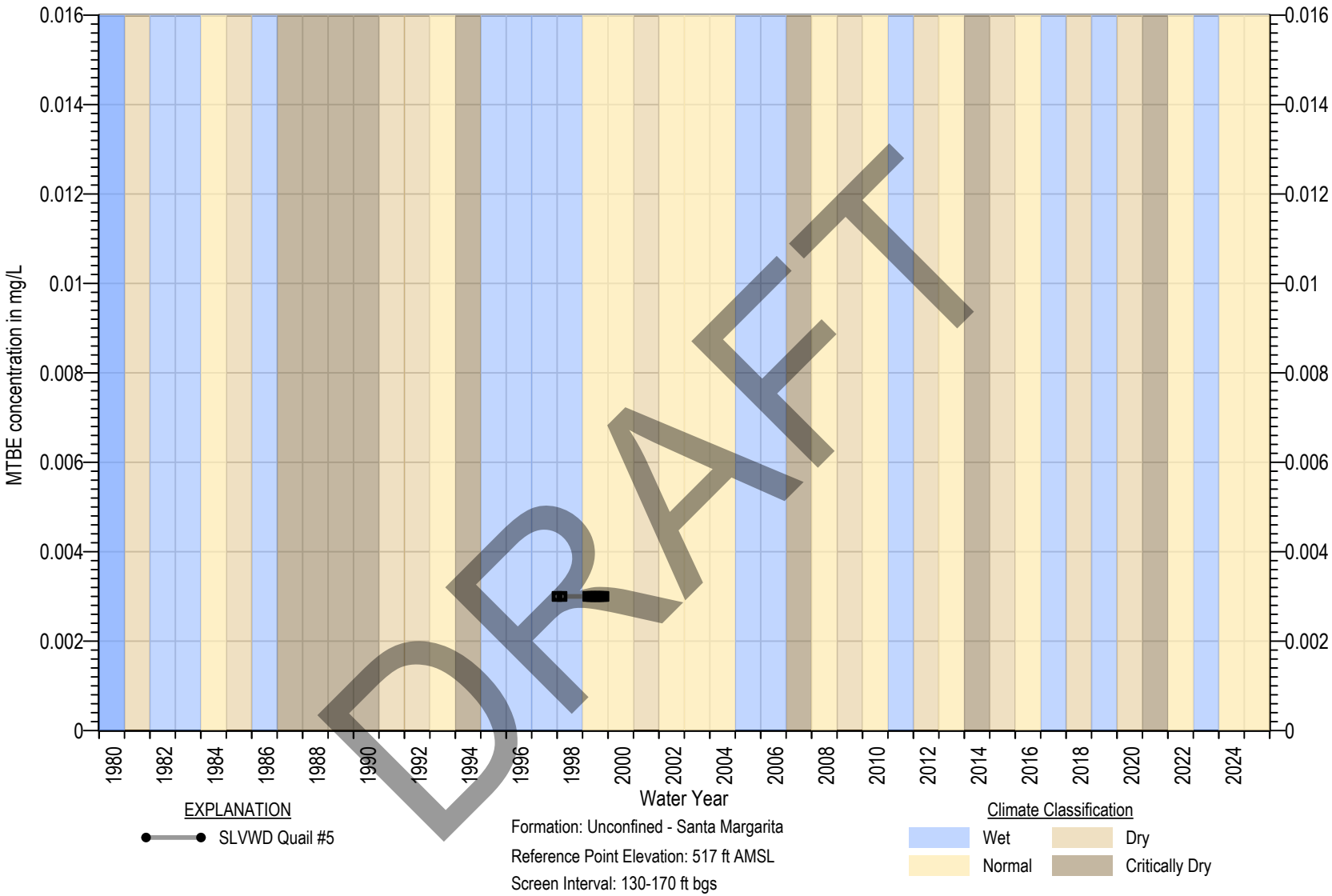
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-147. MTBE Hydrograph of SLVWD Quail #4A

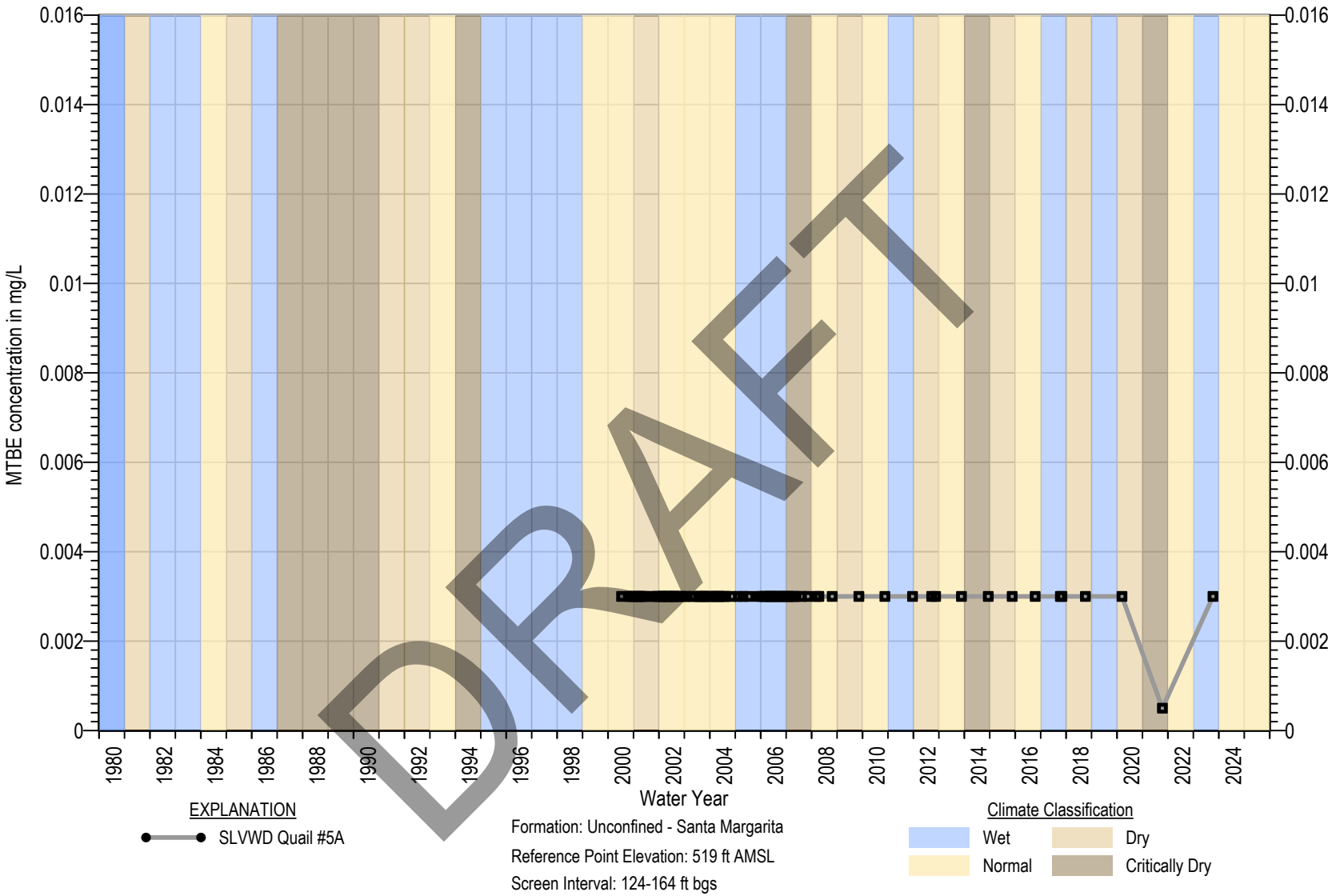
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-148. MTBE Hydrograph of SLVWD Quail #5

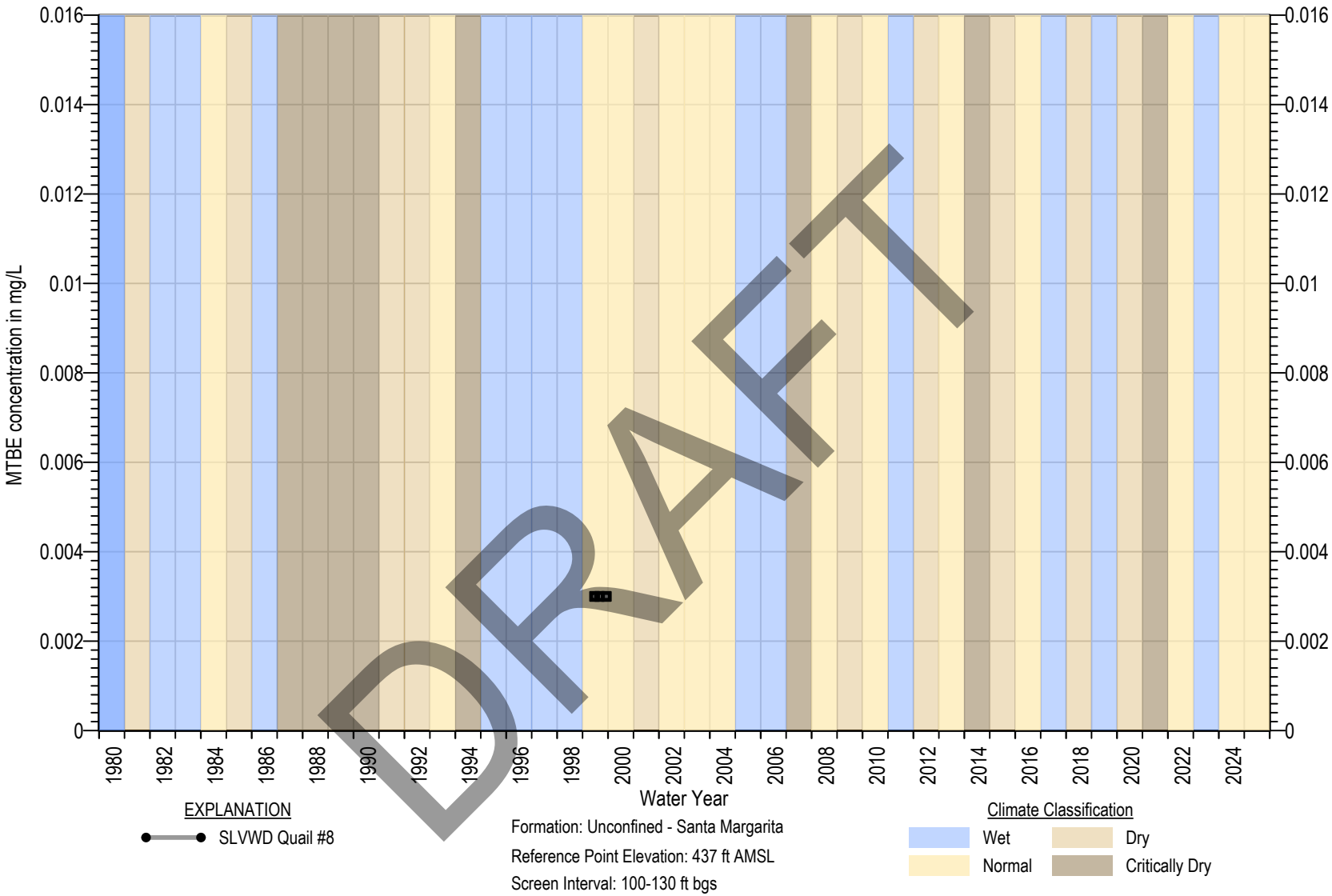
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-149. MTBE Hydrograph of SLVWD Quail #5A

MONTGOMERY & ASSOCIATES



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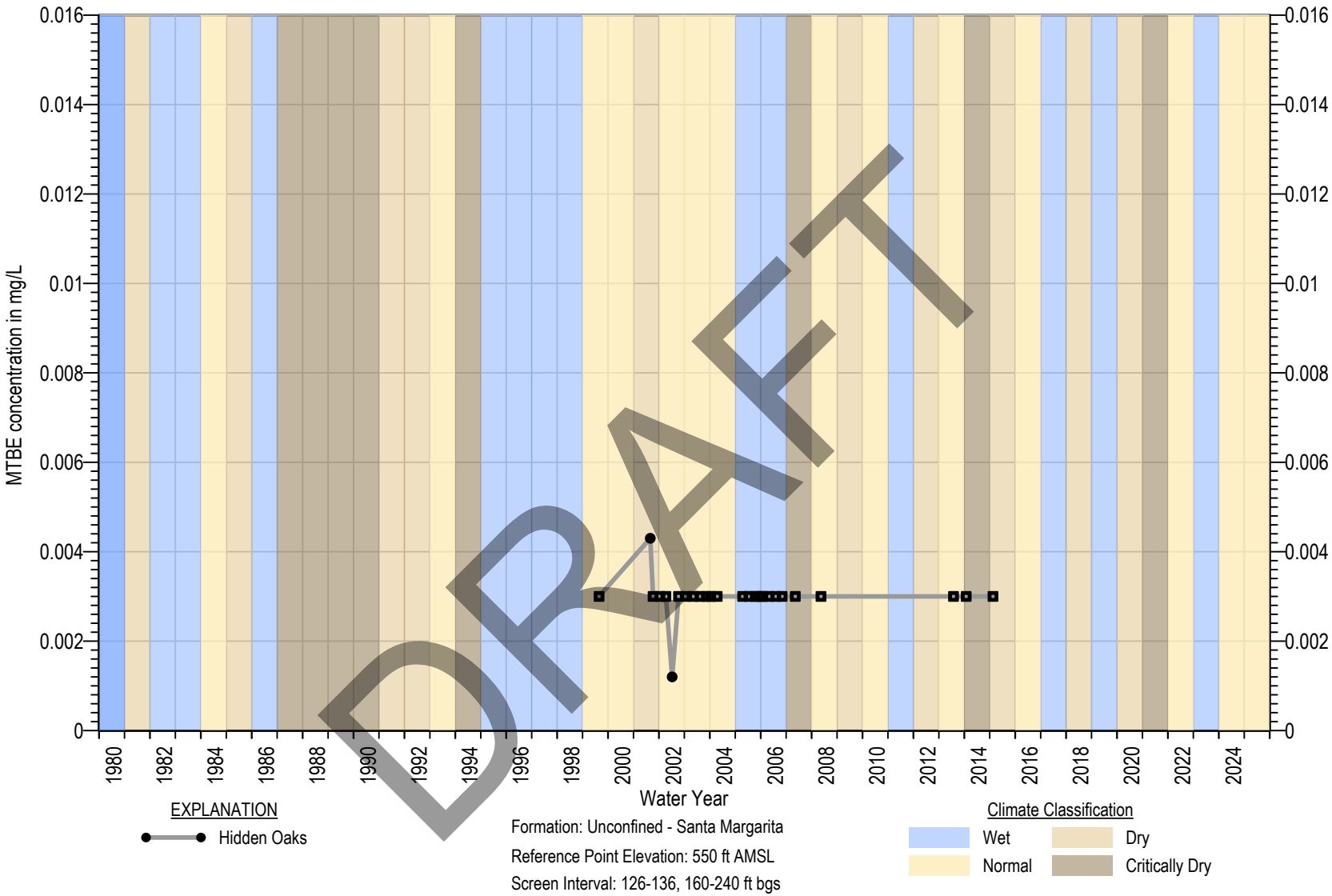
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-150. MTBE Hydrograph of SLVWD Quail #8

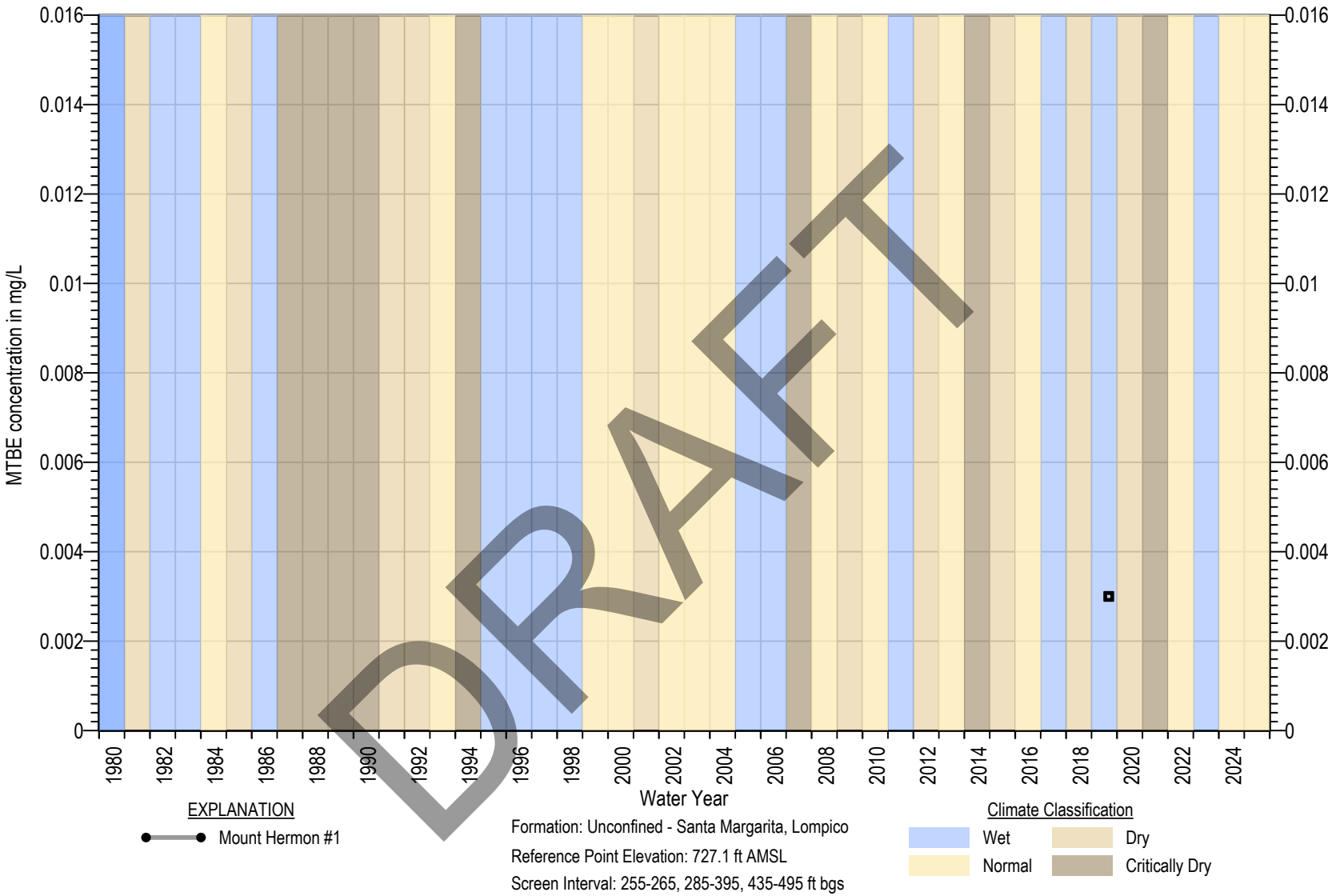
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-151. MTBE Hydrograph of Hidden Oaks

MONTGOMERY & ASSOCIATES



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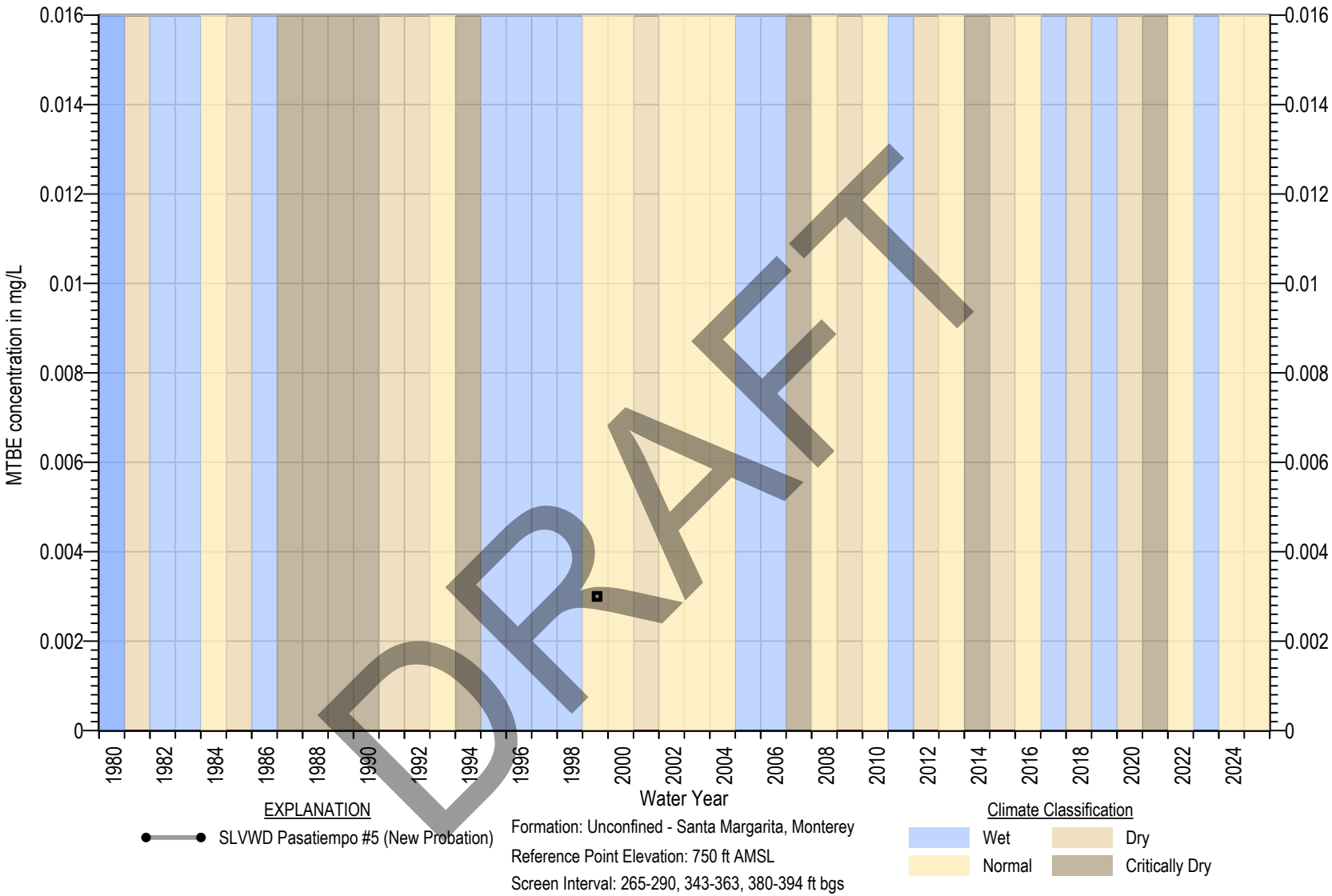
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-152. MTBE Hydrograph of Mount Hermon #1

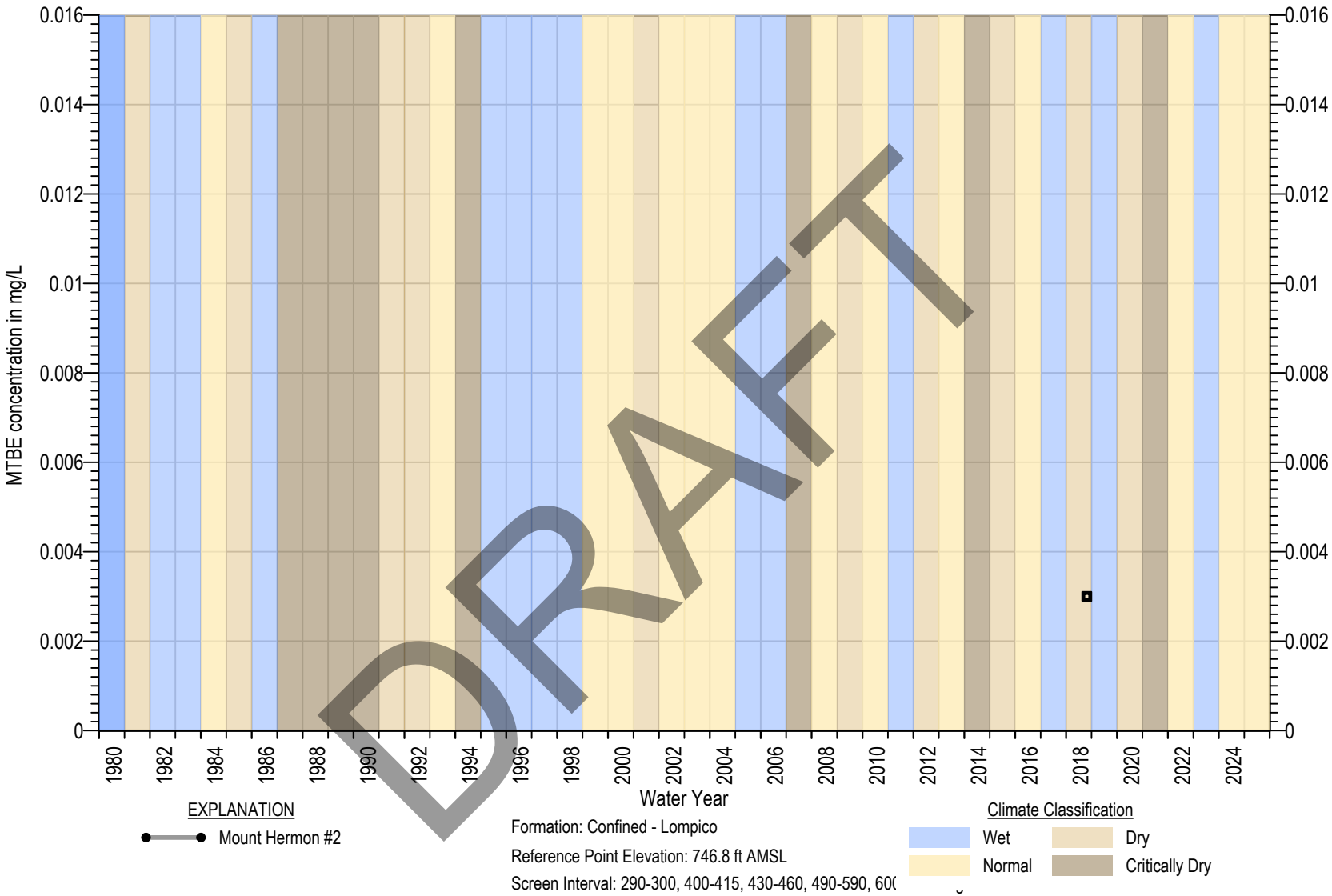
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-153. MTBE Hydrograph of SLVWD Pasatiempo #5 (New Probation)

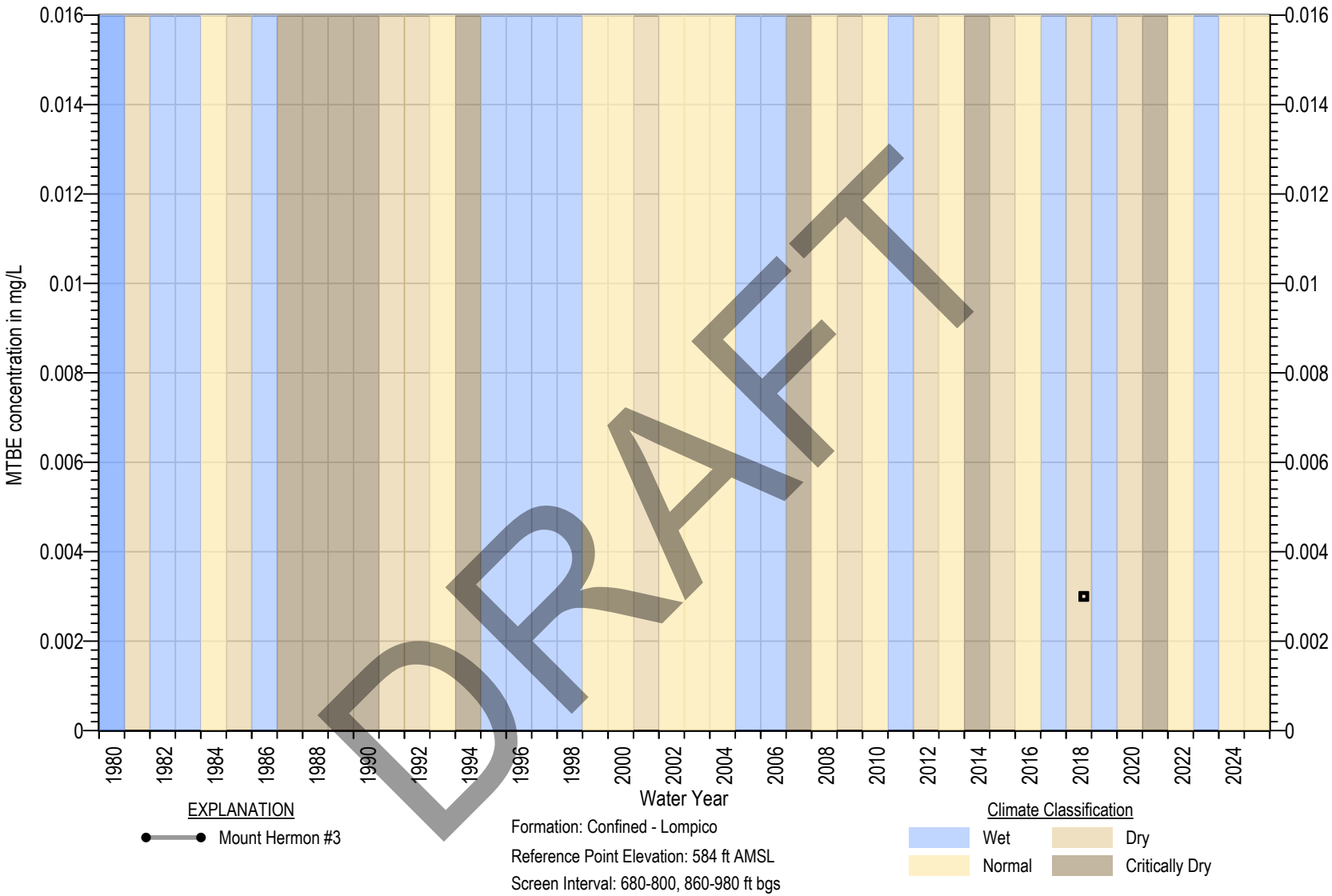
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-154. MTBE Hydrograph of Mount Hermon #2

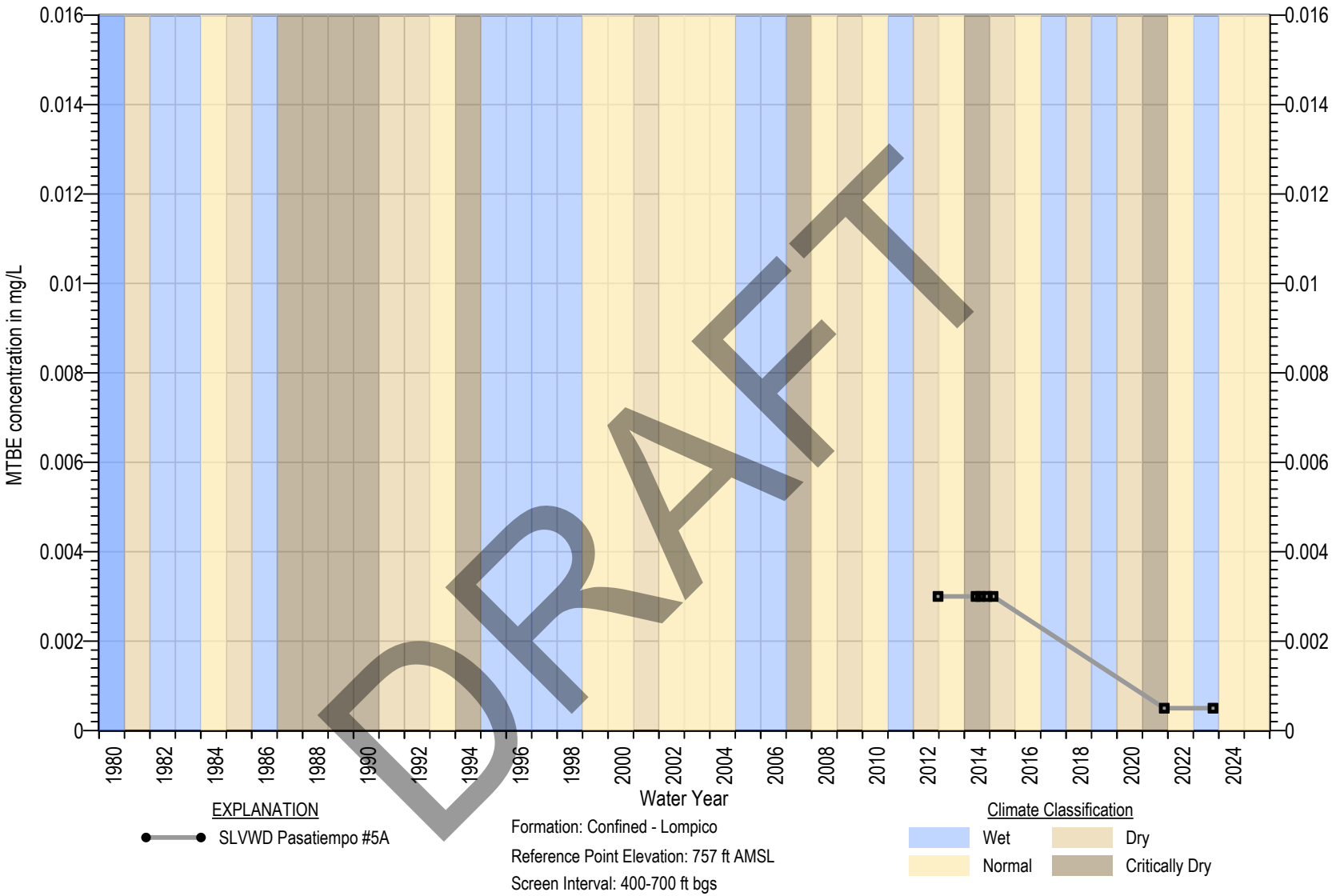
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-155. MTBE Hydrograph of Mount Hermon #3

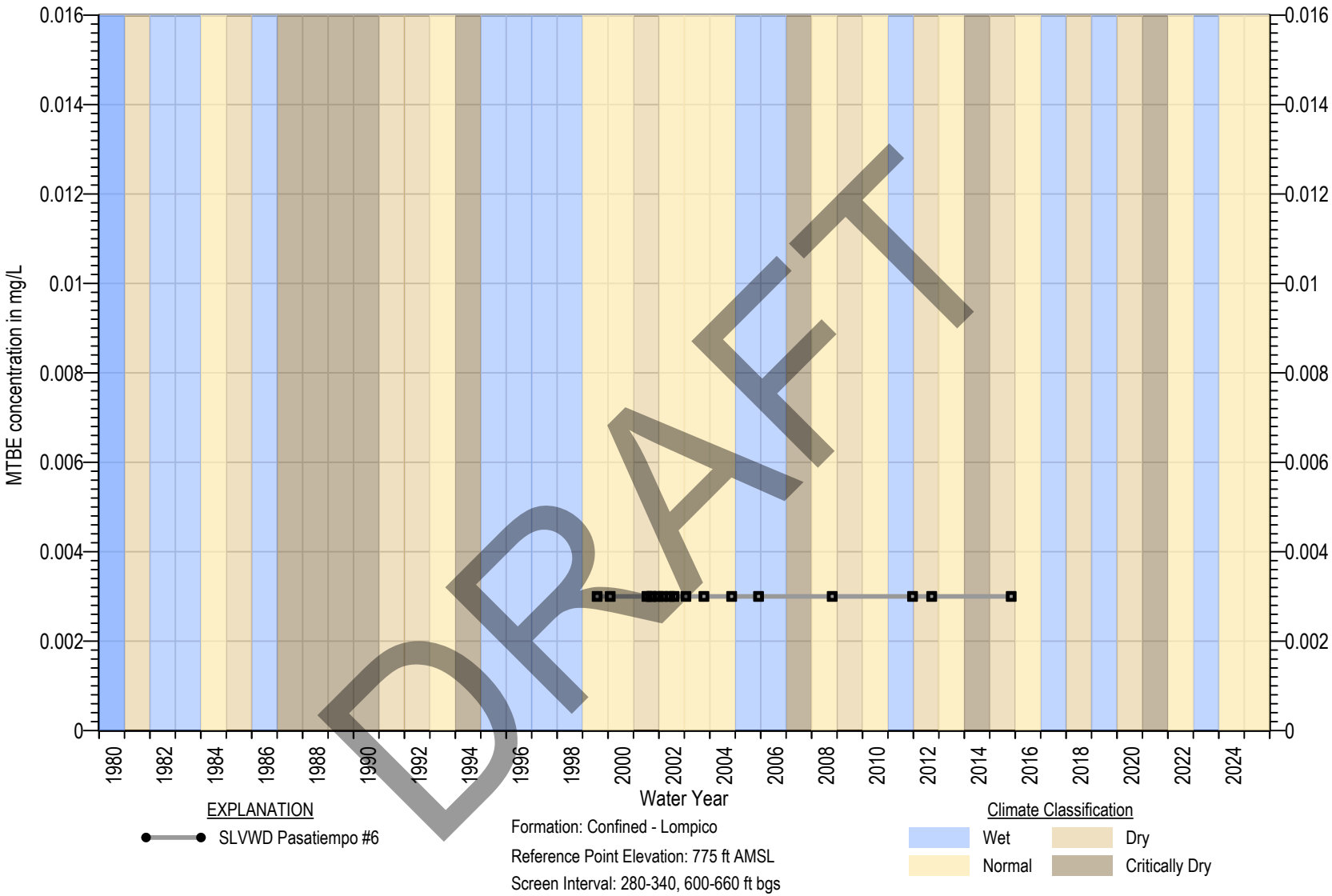
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-156. MTBE Hydrograph of SLVWD Pasatiempo #5A

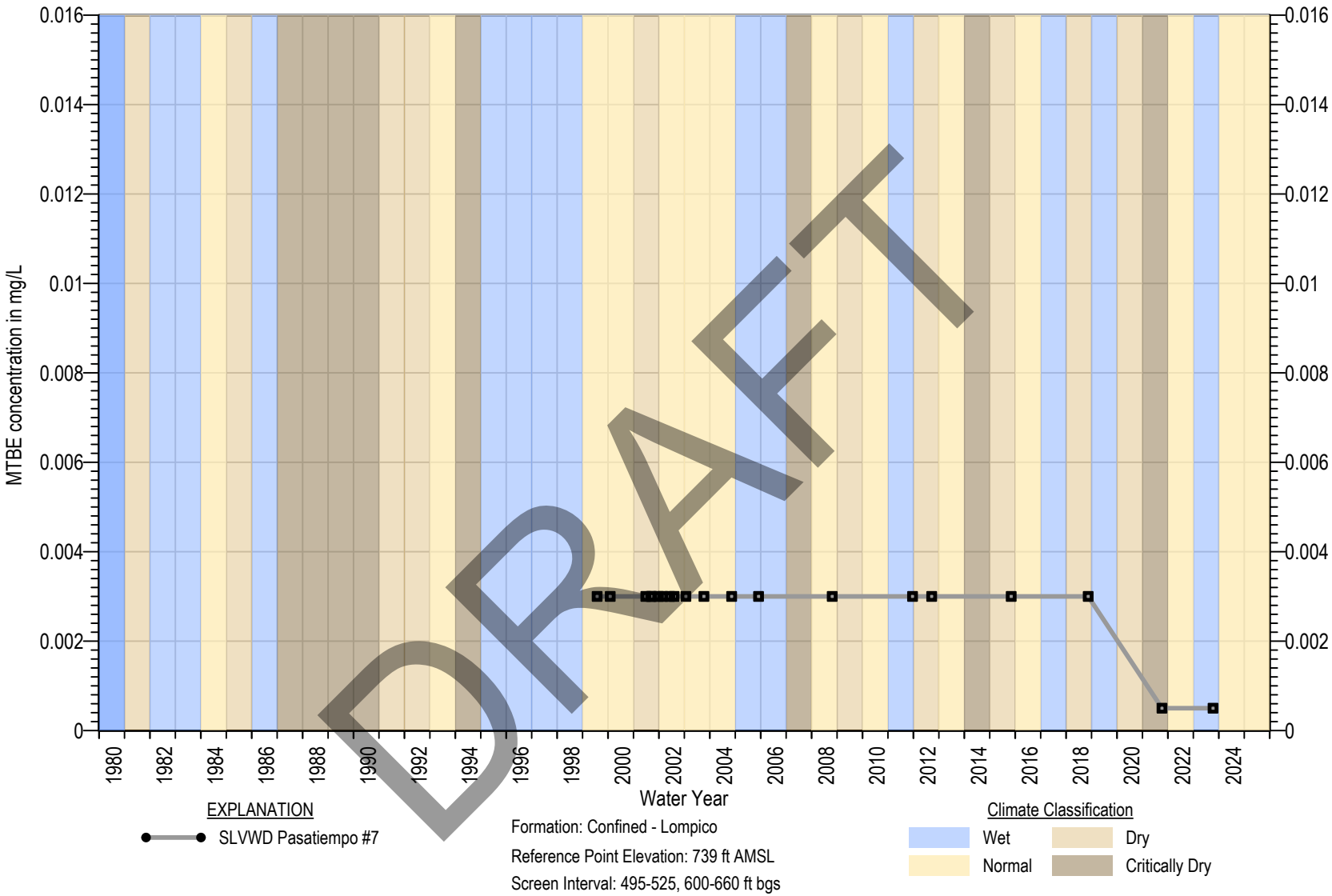
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-157. MTBE Hydrograph of SLVWD Pasatiempo #6

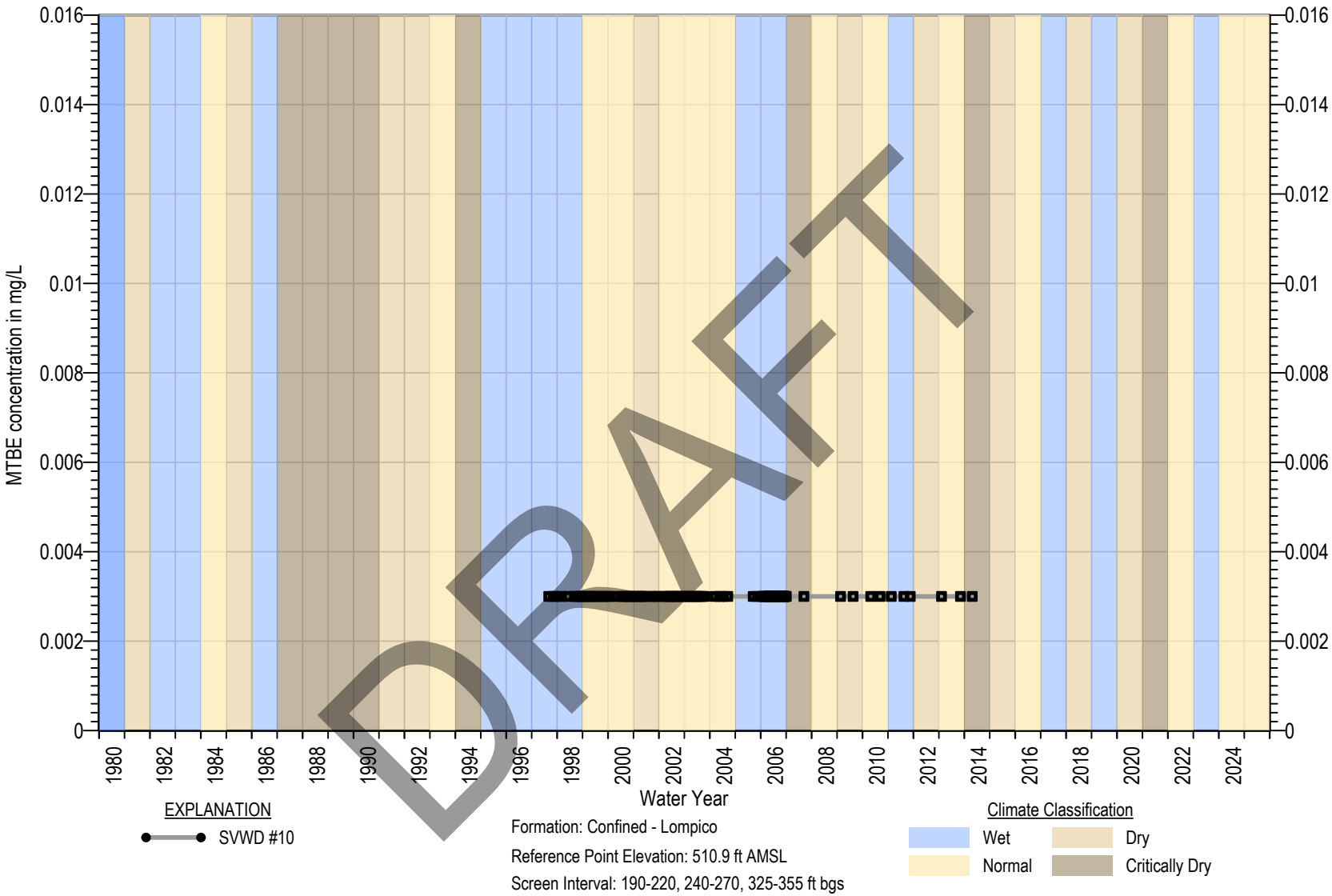
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-158. MTBE Hydrograph of SLVWD Pasatiempo #7

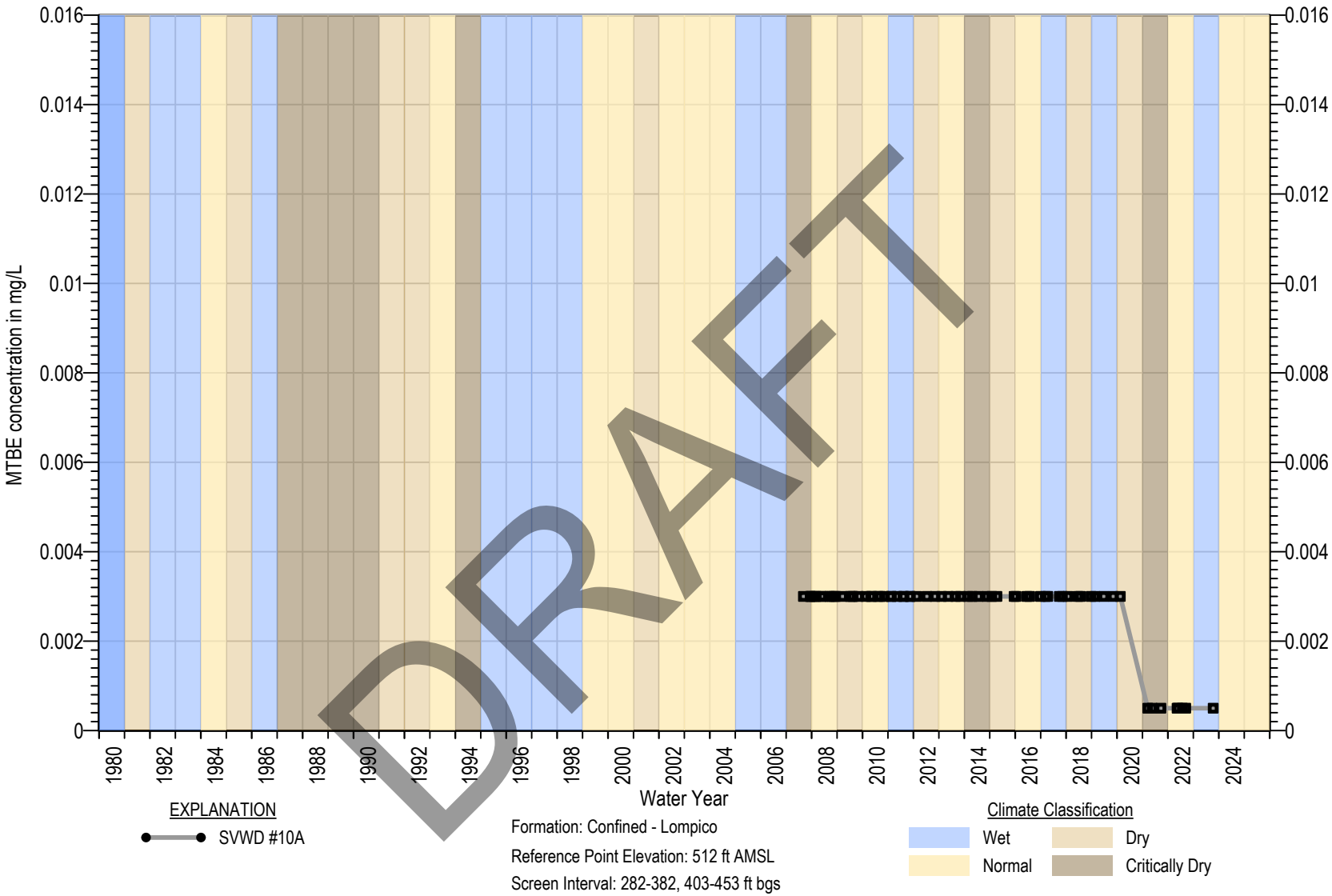
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-159. MTBE Hydrograph of SVWD #10

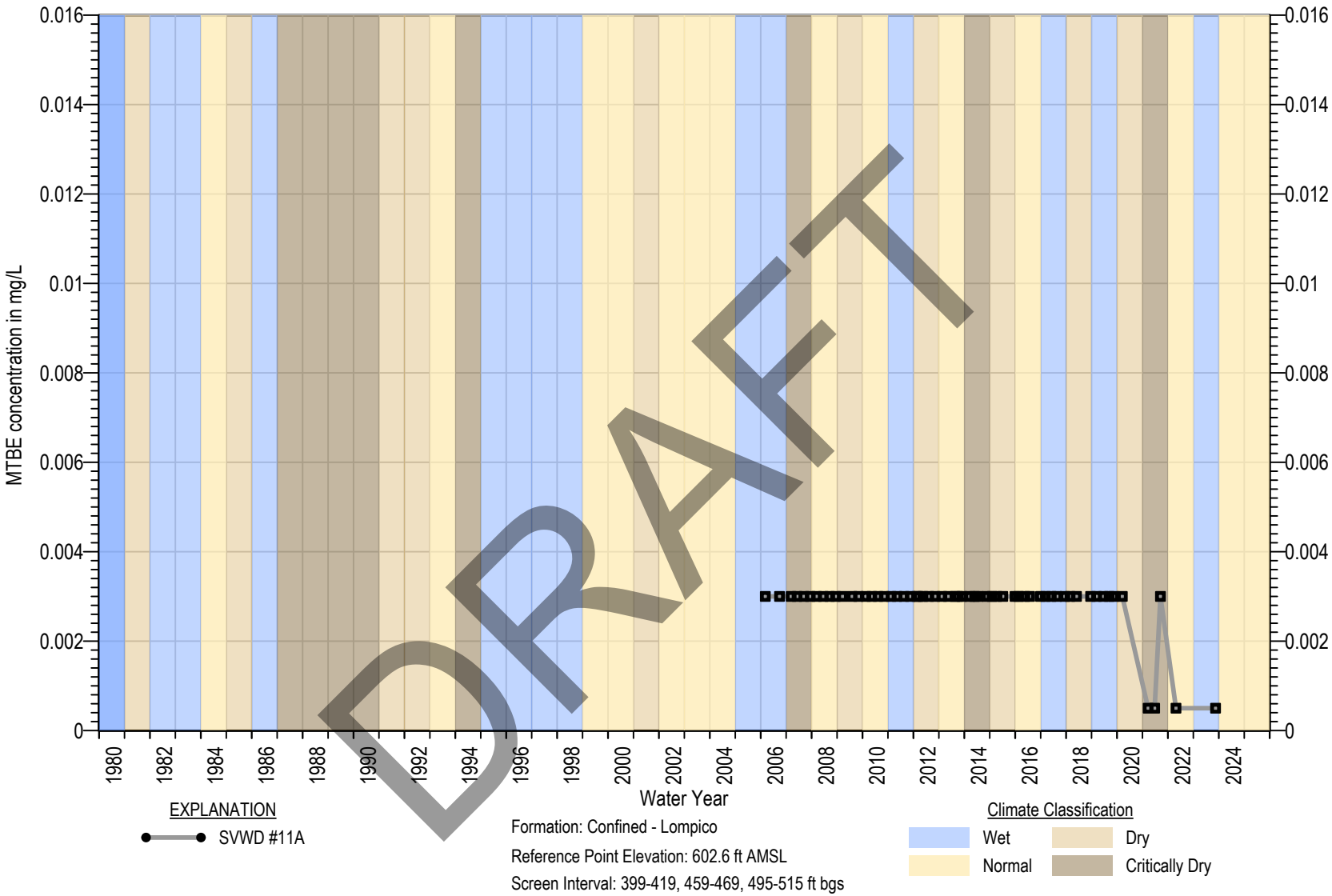
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-160. MTBE Hydrograph of SVWD #10A

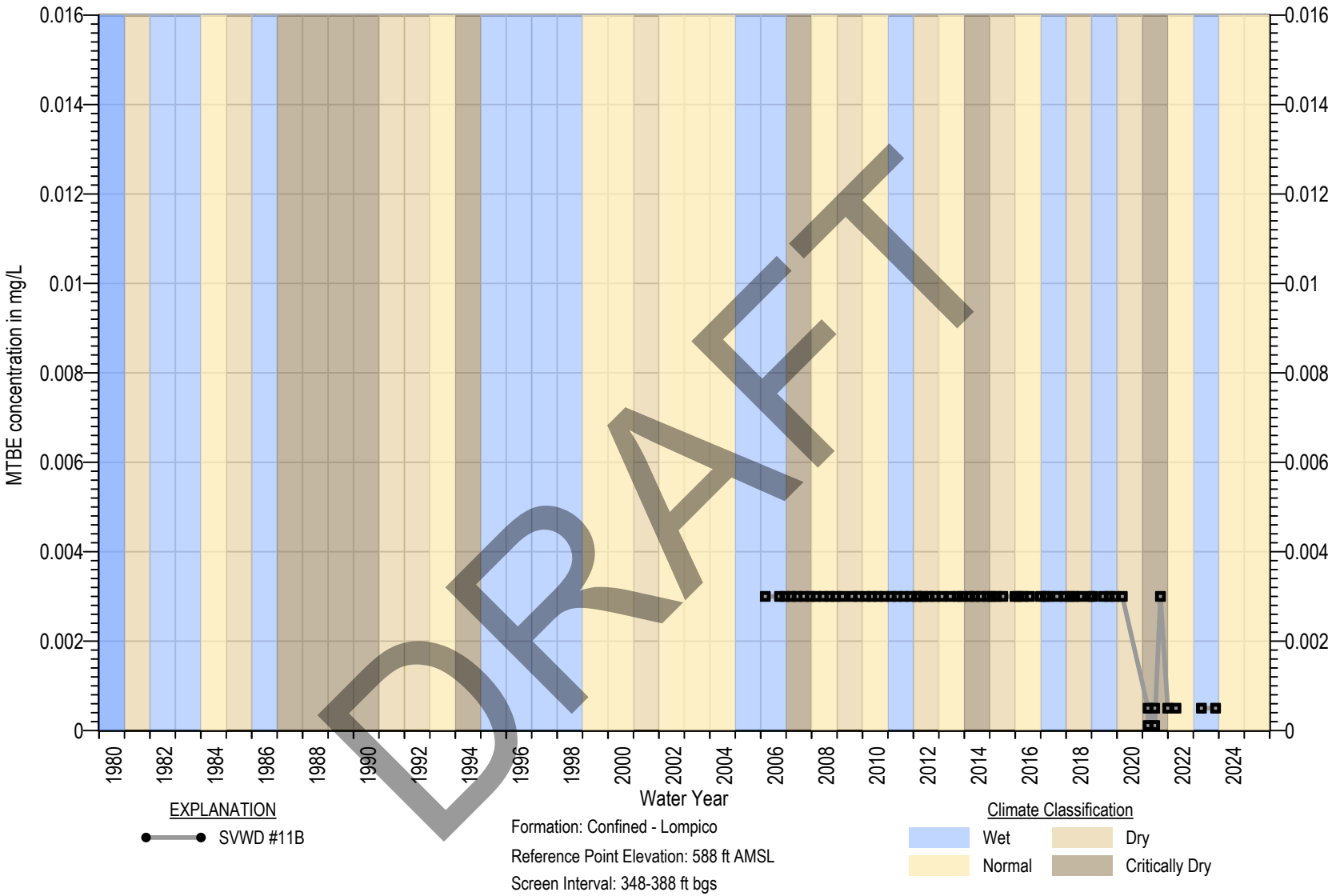
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-161. MTBE Hydrograph of SVWD #11A

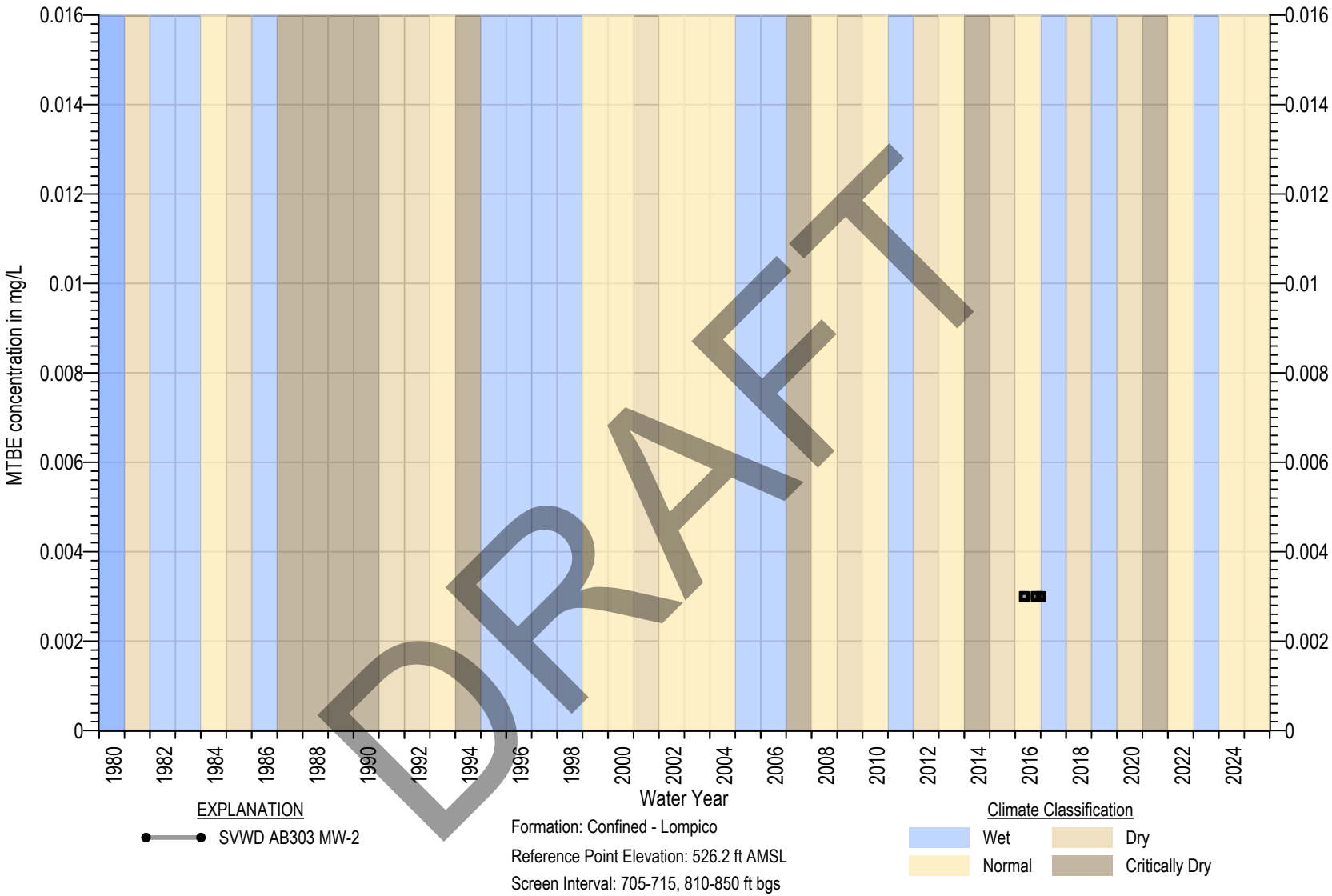
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-162. MTBE Hydrograph of SVWD #11B

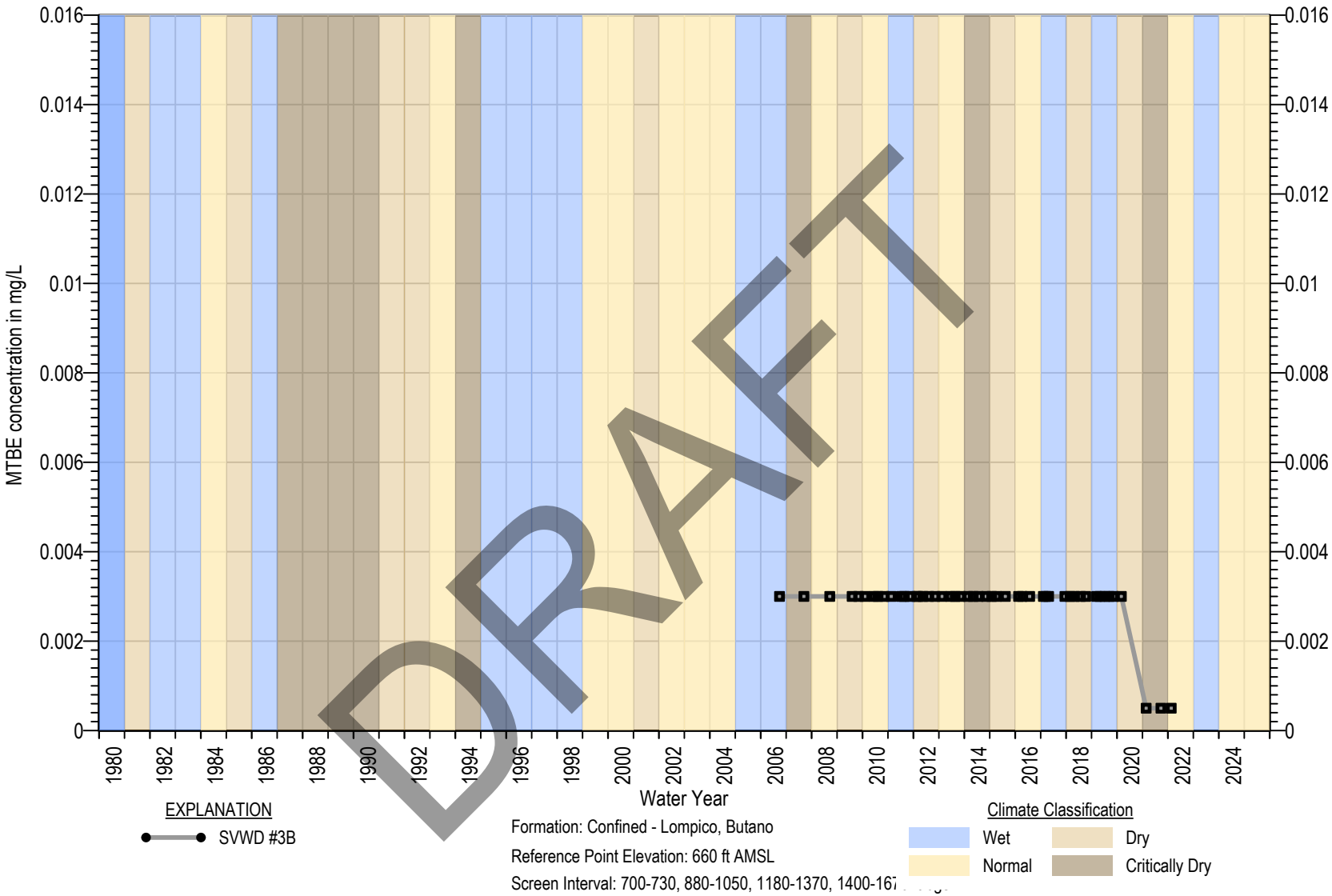
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-163. MTBE Hydrograph of SVWD AB303 MW-2

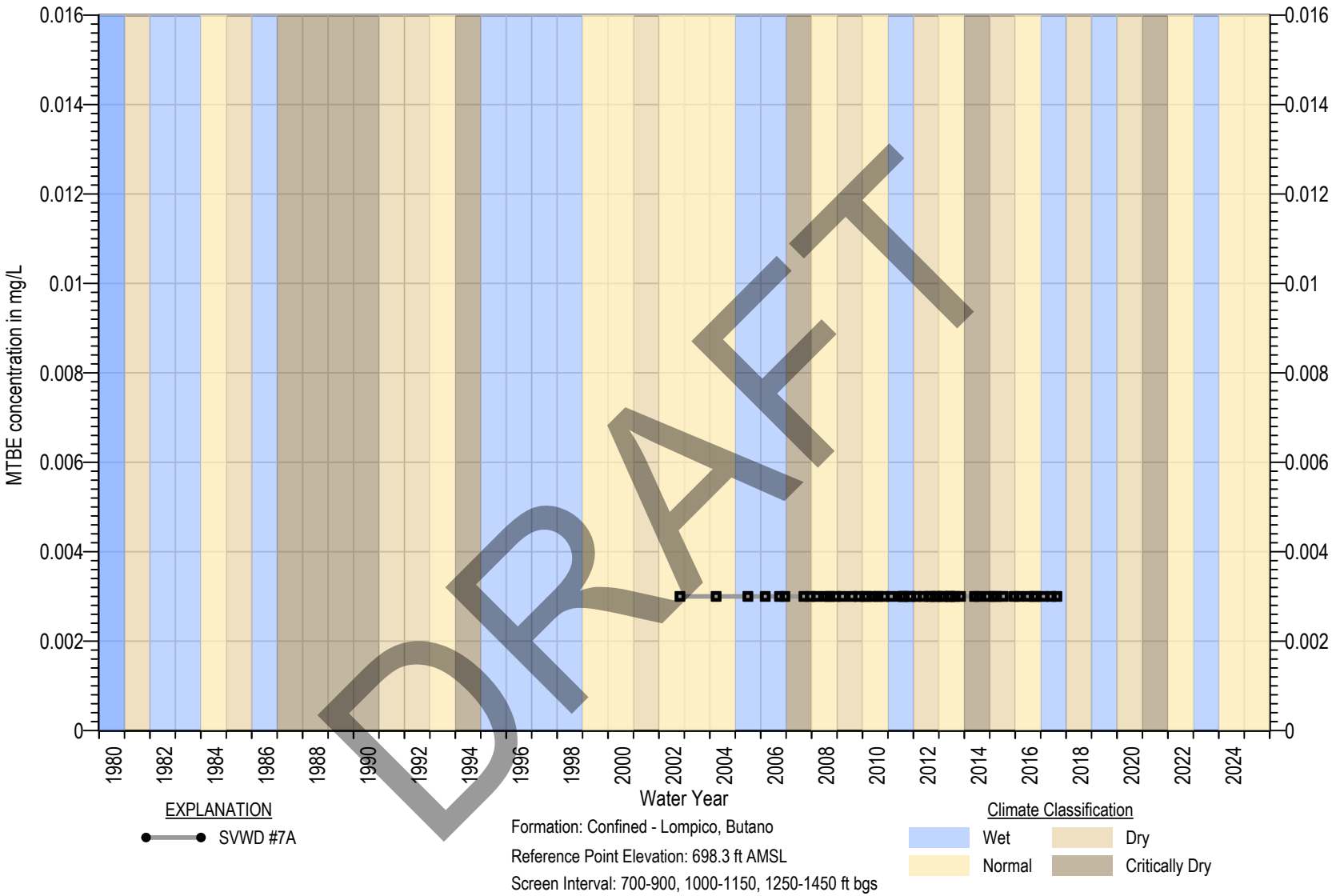
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-164. MTBE Hydrograph of SVWD #3B

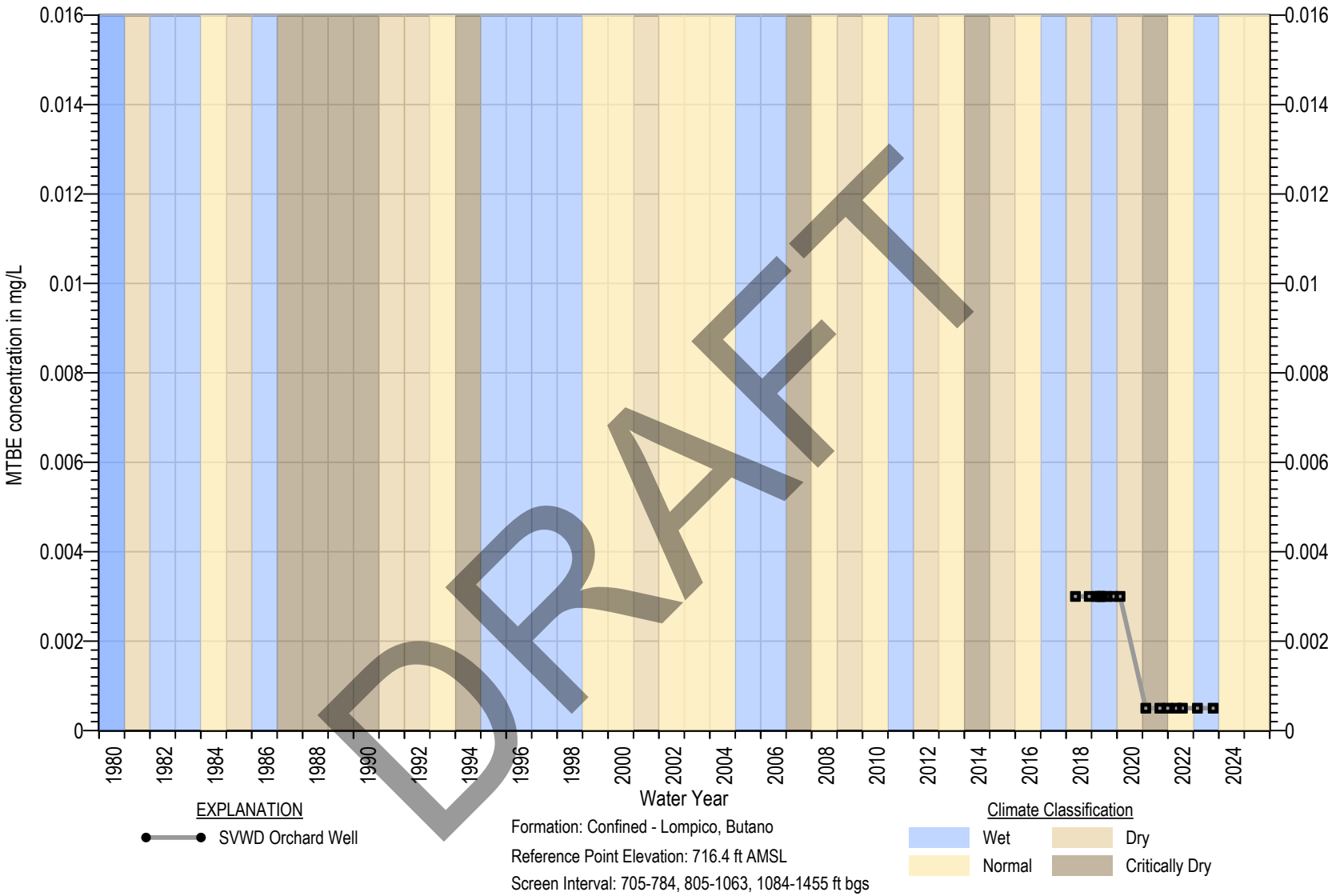
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-165. MTBE Hydrograph of SVWD #7A

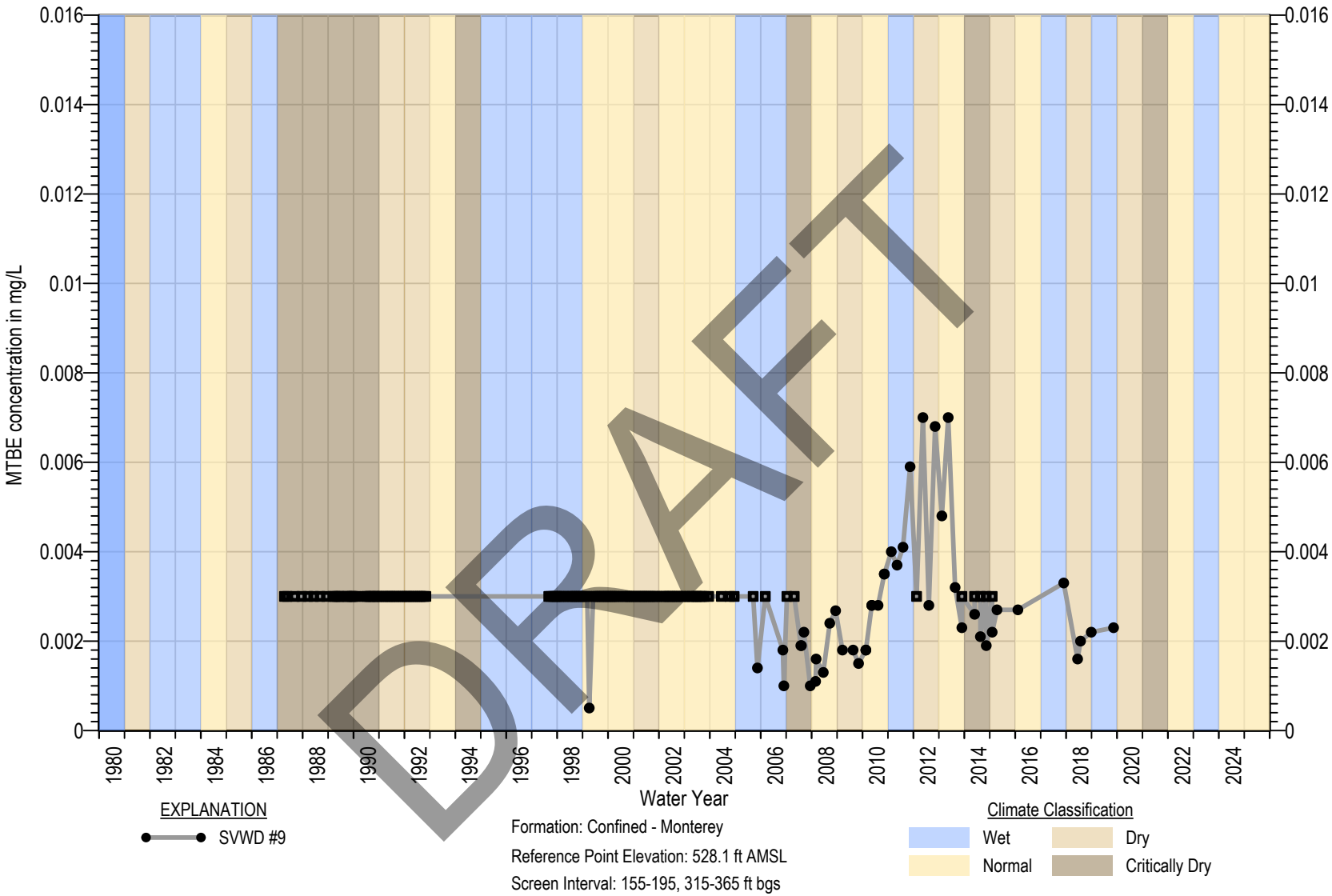
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-166. MTBE Hydrograph of SVWD Orchard Well

MONTGOMERY & ASSOCIATES



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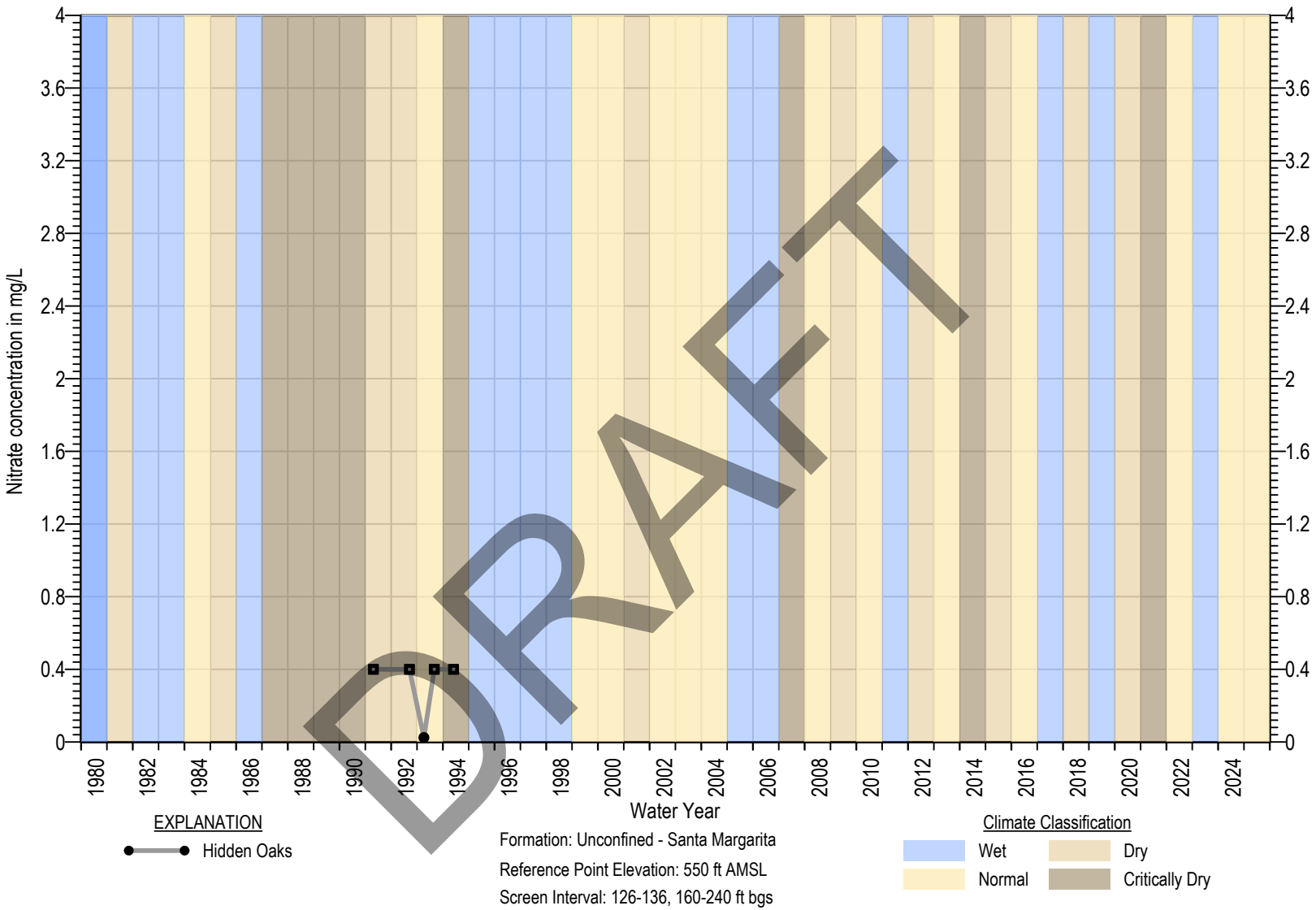
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-167. MTBE Hydrograph of SVWD #9

MONTGOMERY & ASSOCIATES

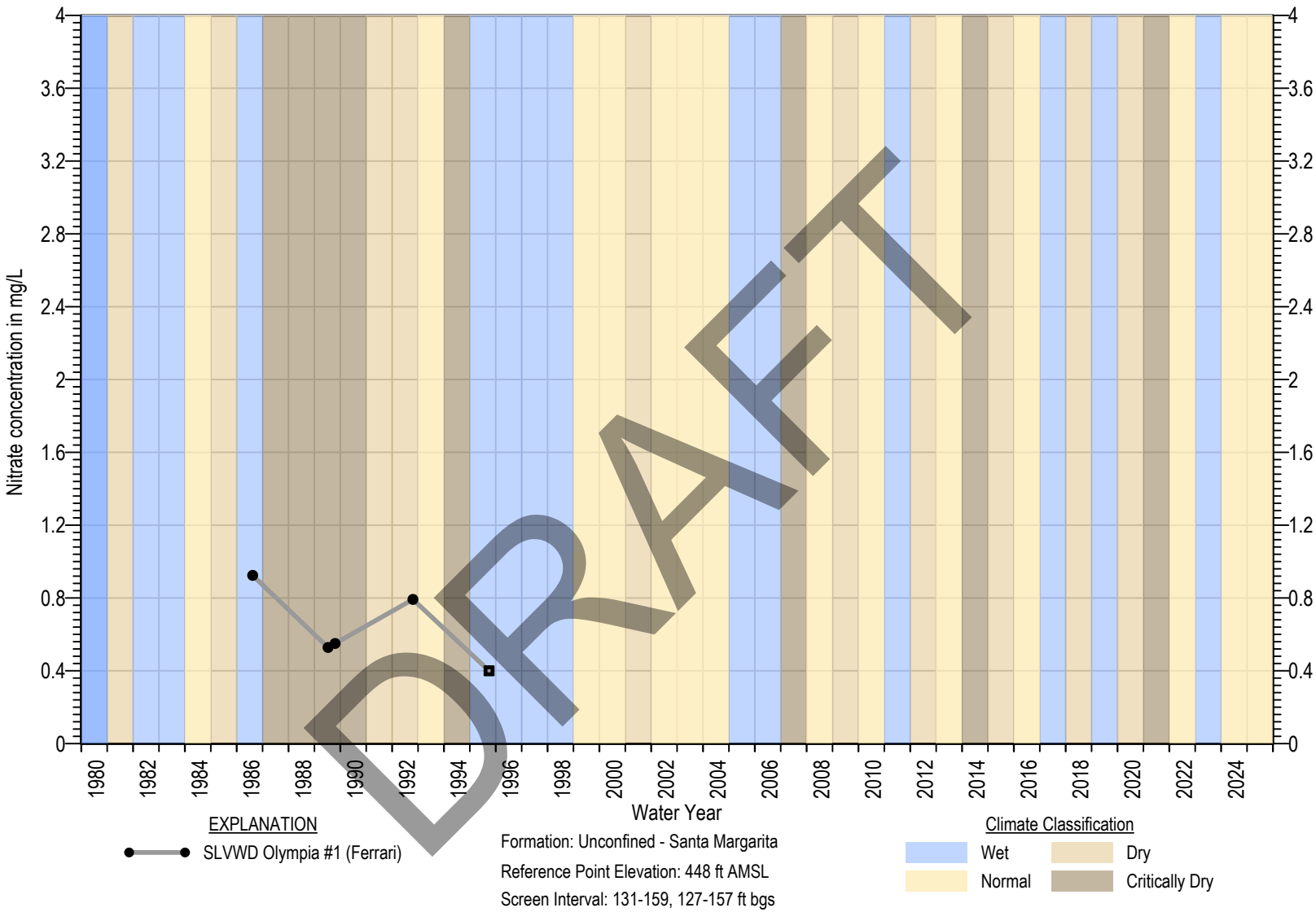


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-168. Nitrate Chemograph of Mountain Brook

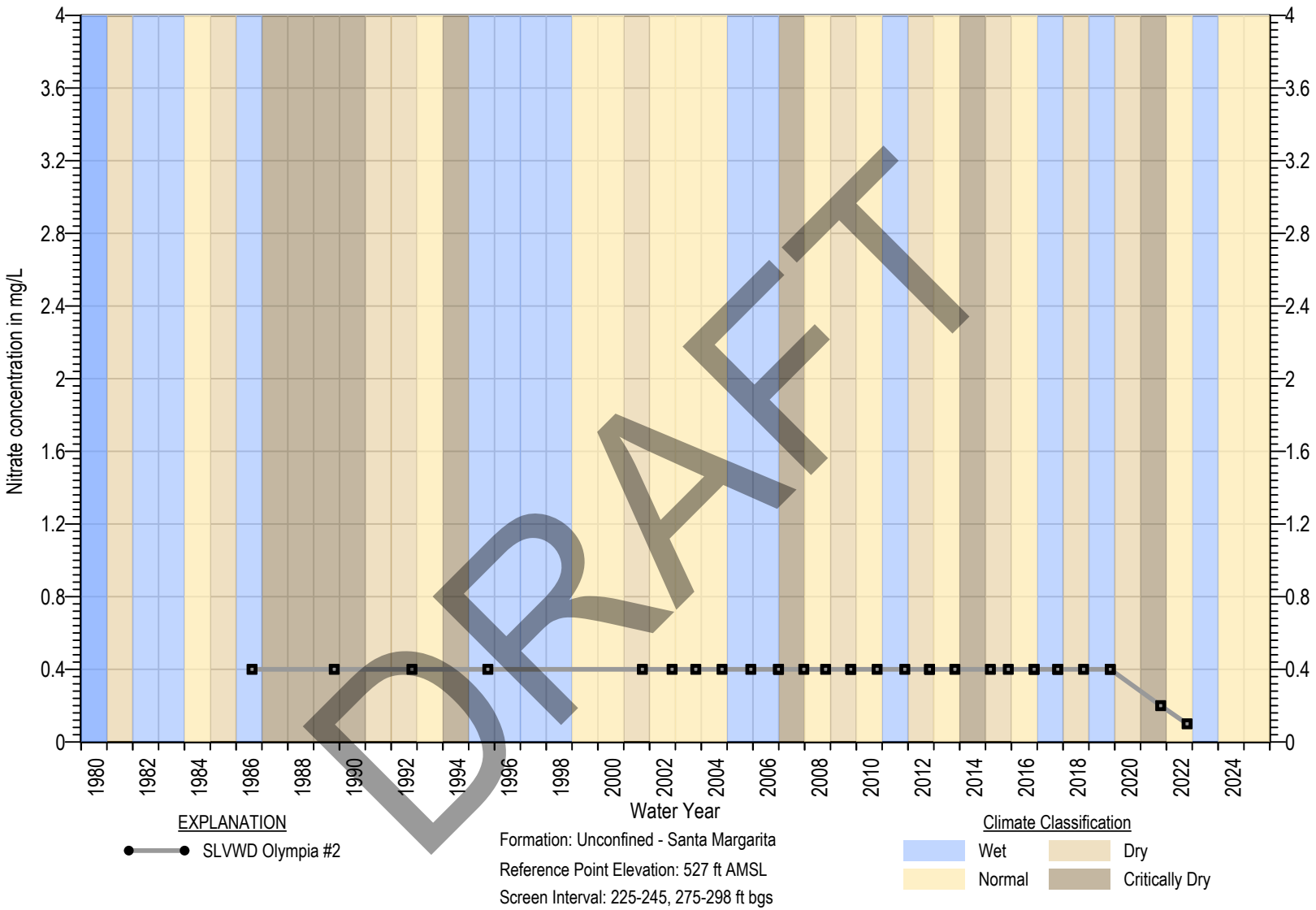
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-169. Nitrate Chemograph of Hidden Oaks

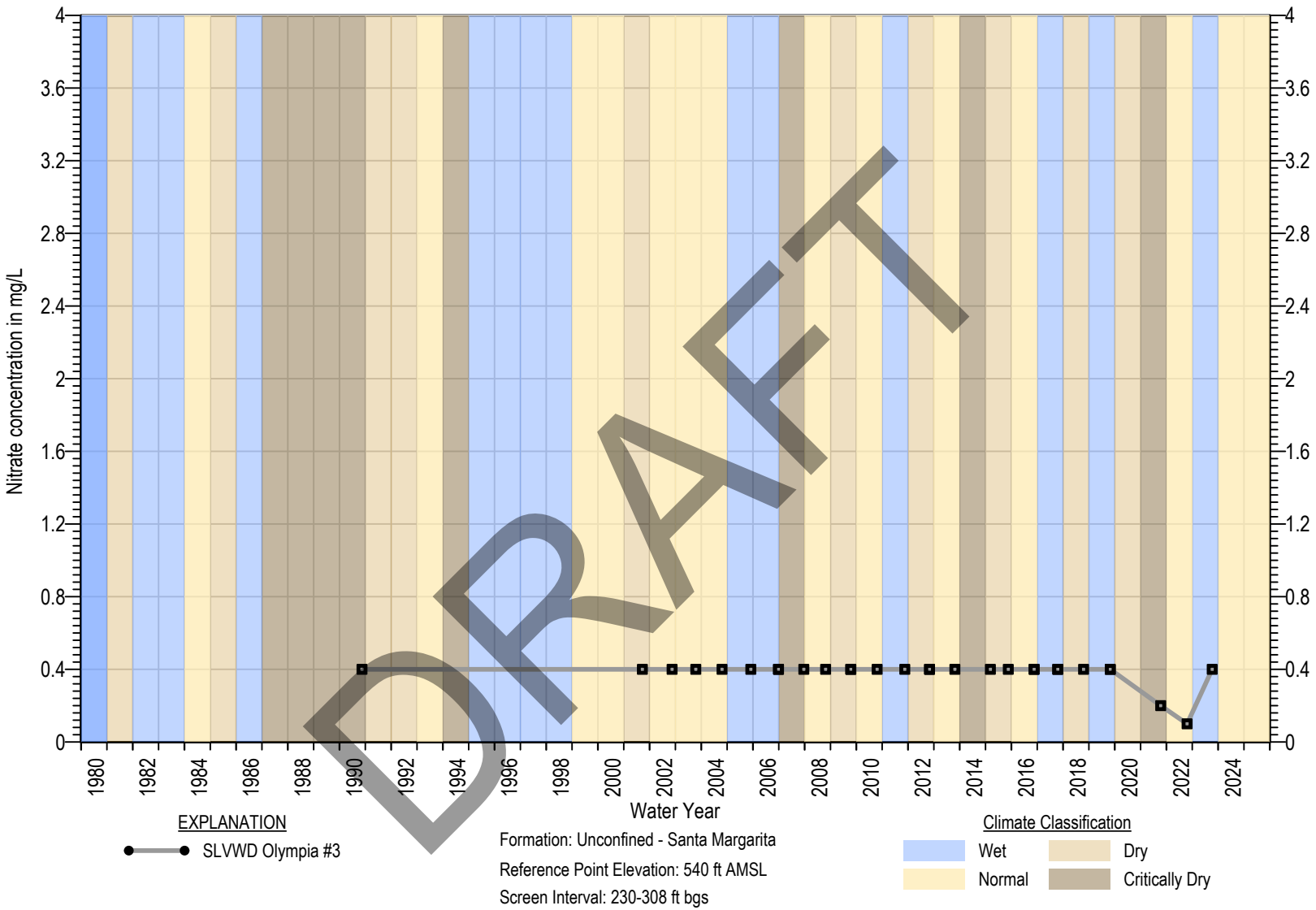
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-170. Nitrate Chemograph of SLVWD Olympia #1 (Ferrari)

MONTGOMERY & ASSOCIATES

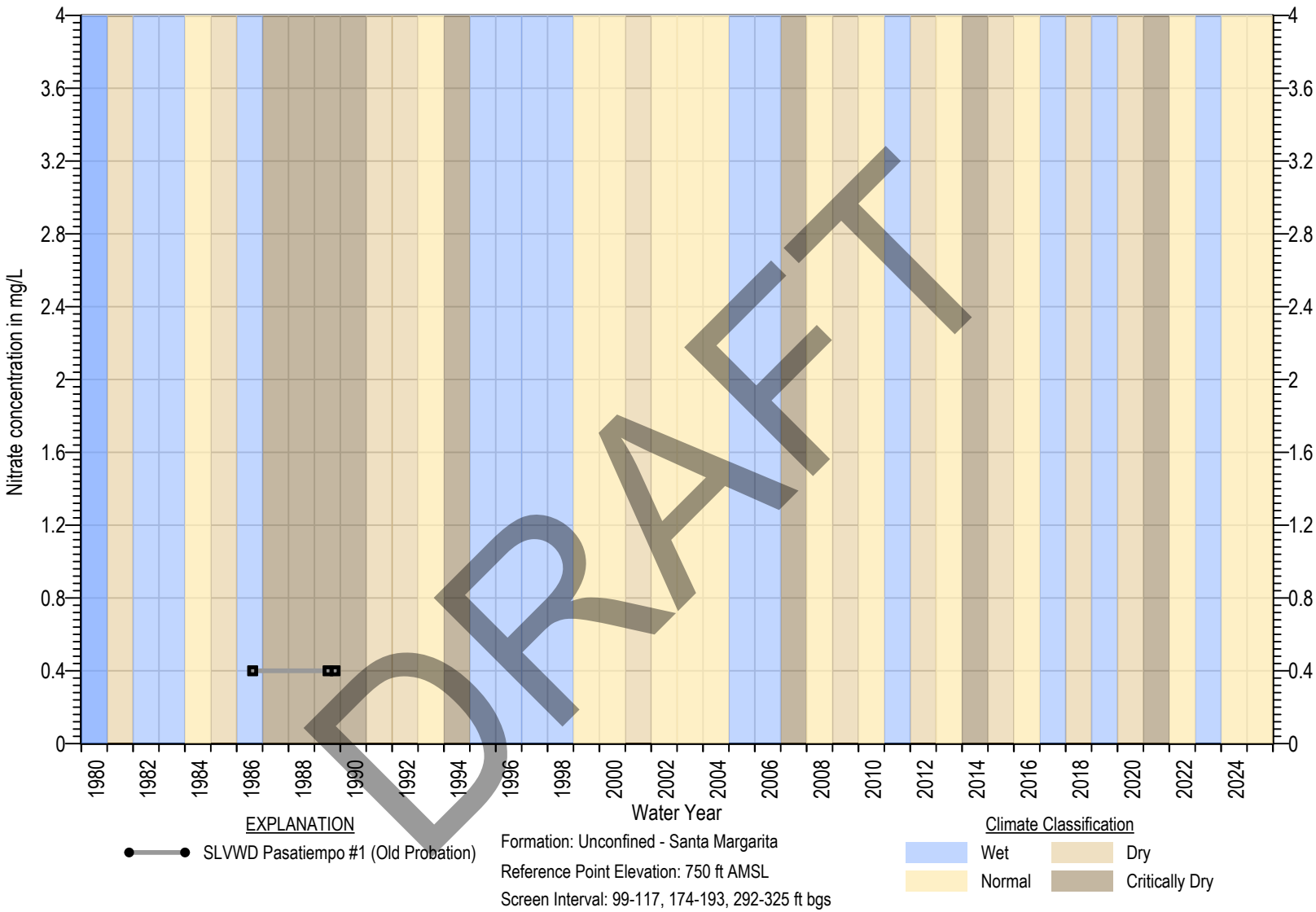


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-171. Nitrate Chemograph of SLVWD Olympia #2

MONTGOMERY & ASSOCIATES

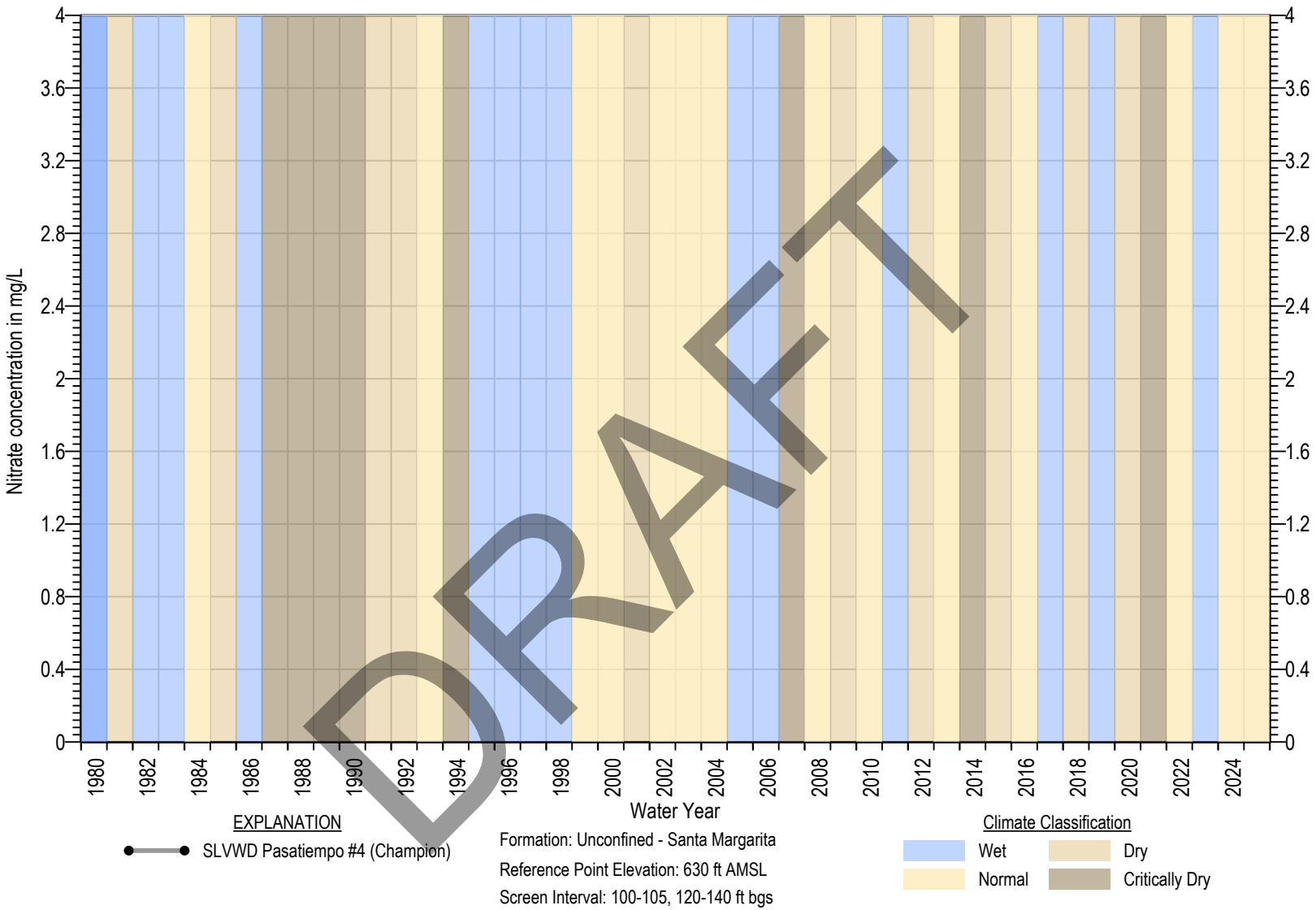


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-172. Nitrate Chemograph of SLVWD Olympia #3

MONTGOMERY & ASSOCIATES

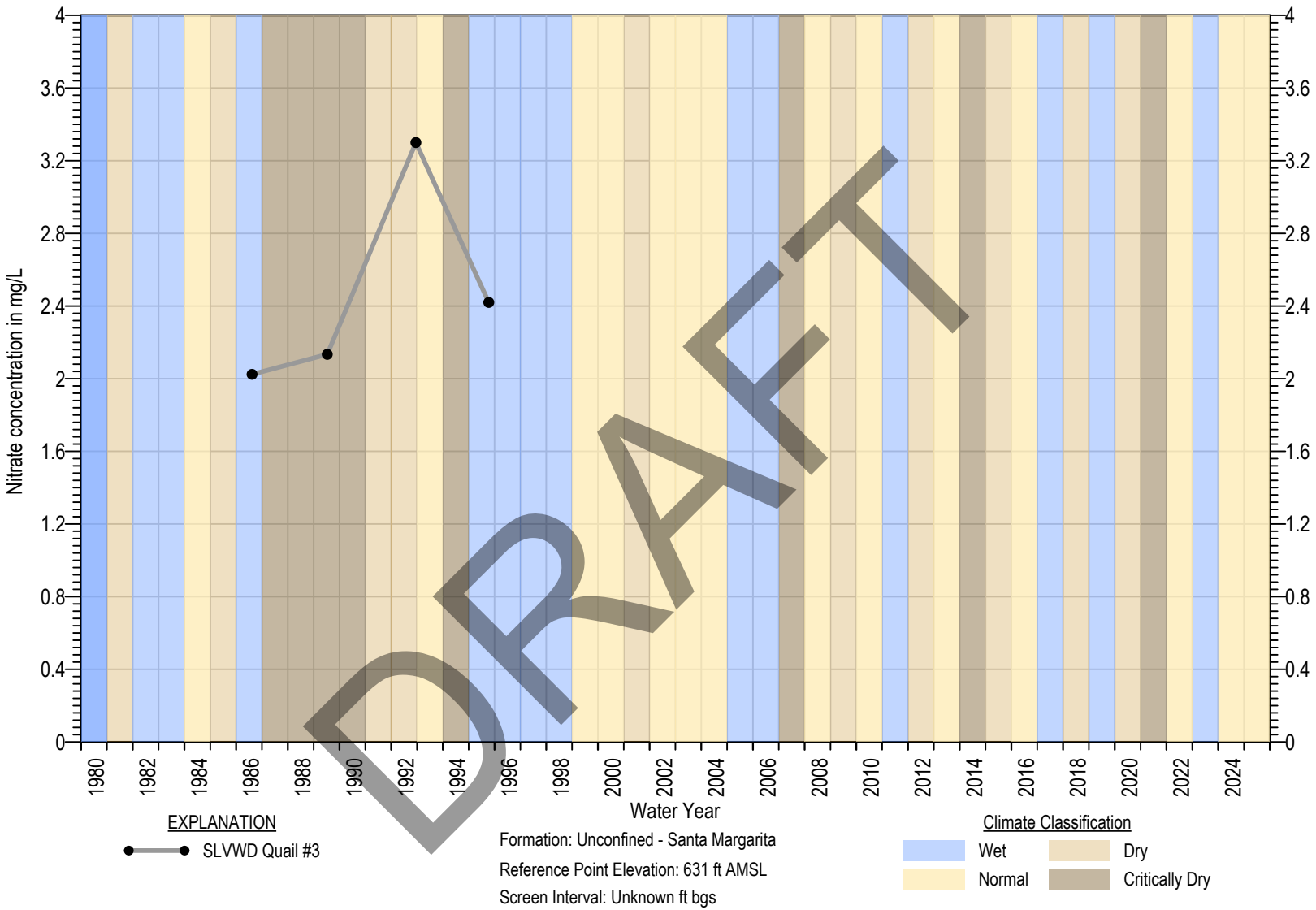


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-173. Nitrate Chemograph of SLVWD Pasatiempo #1 (Old Probation)

MONTGOMERY & ASSOCIATES



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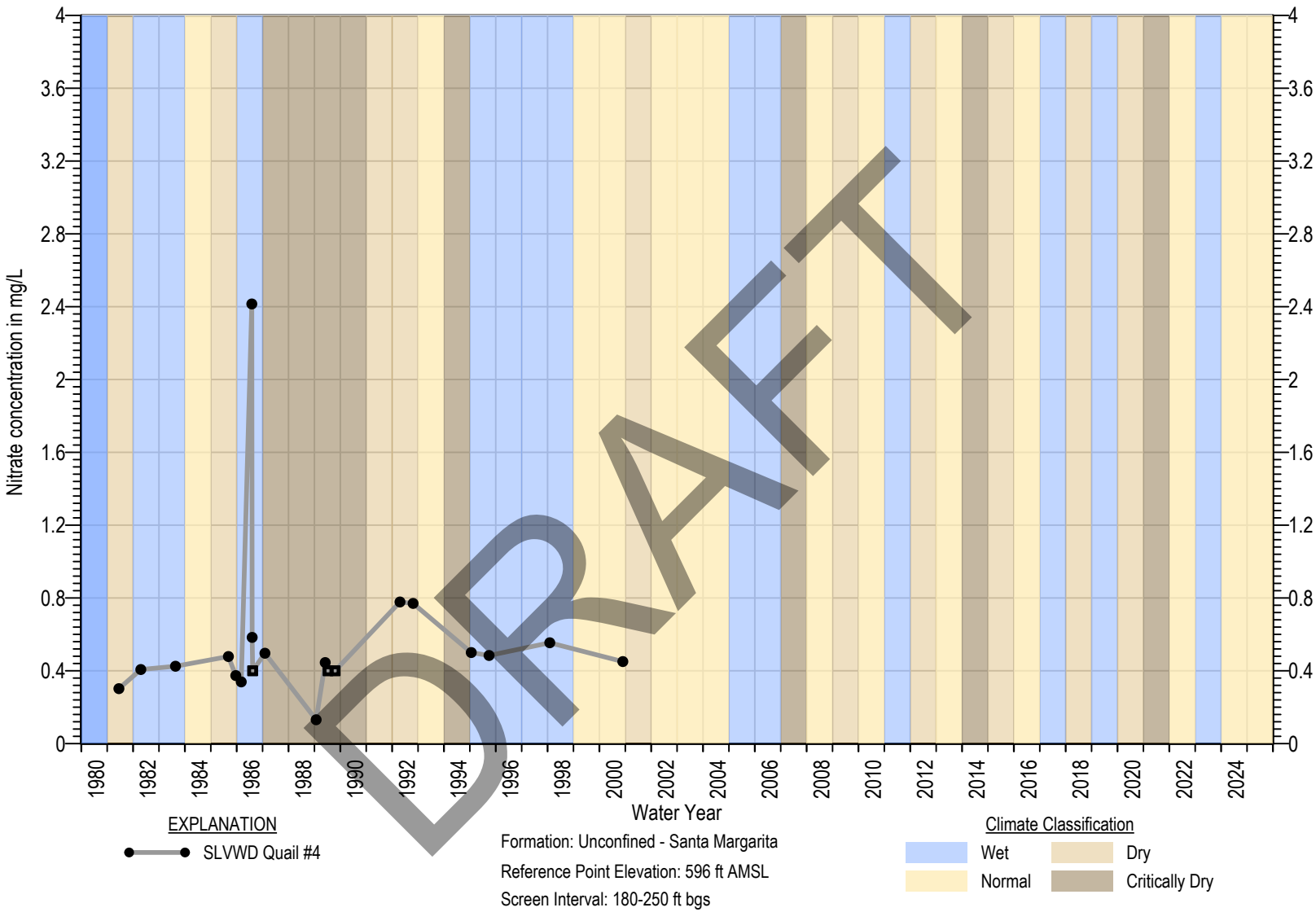
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-174. Nitrate Chemograph of SLVWD Pasatiempo #4 (Champion)

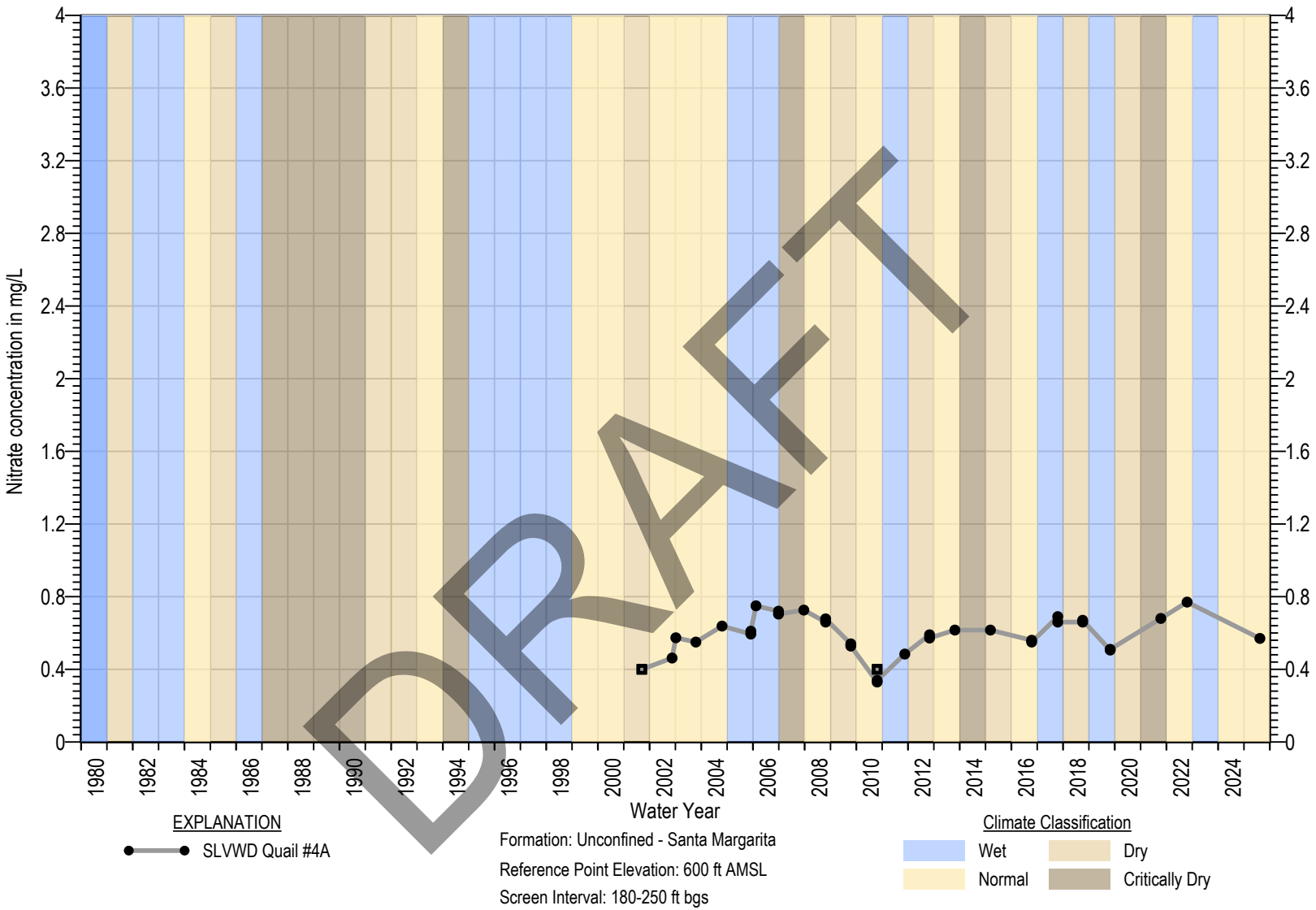
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-175. Nitrate Chemograph of SLVWD Quail #3

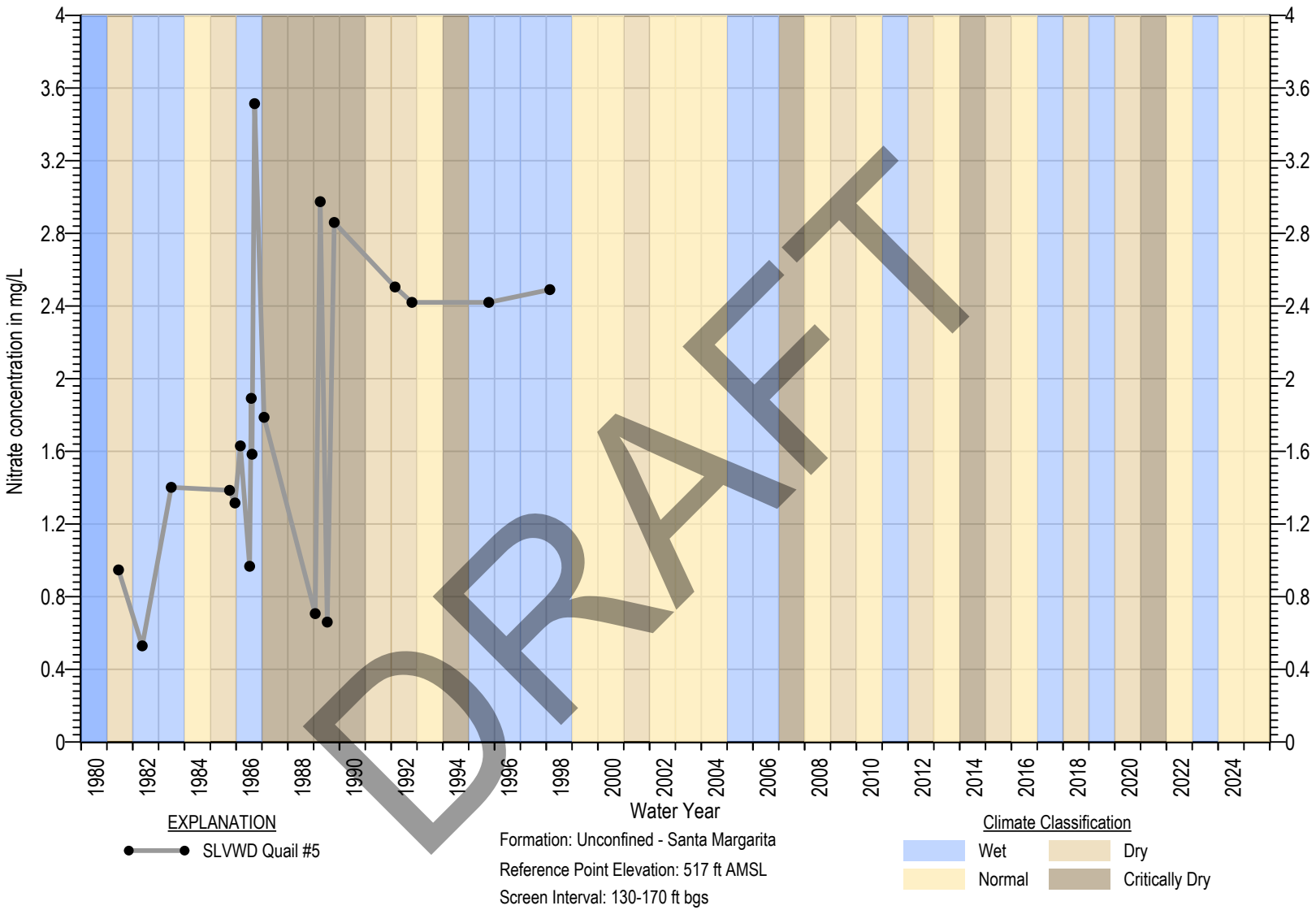
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-176. Nitrate Chemograph of SLVWD Quail #4

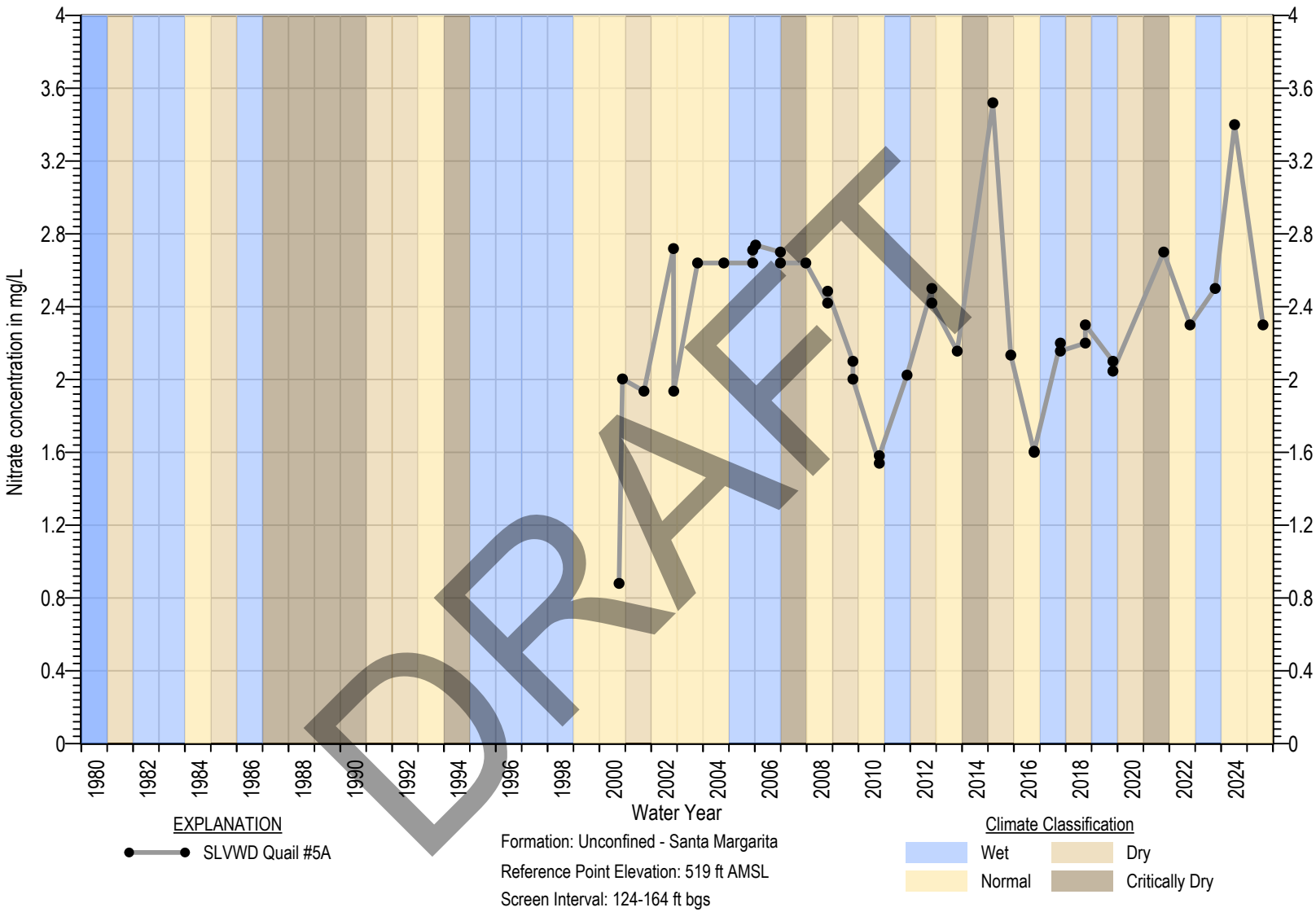
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-177. Nitrate Chemograph of SLVWD Quail #4A

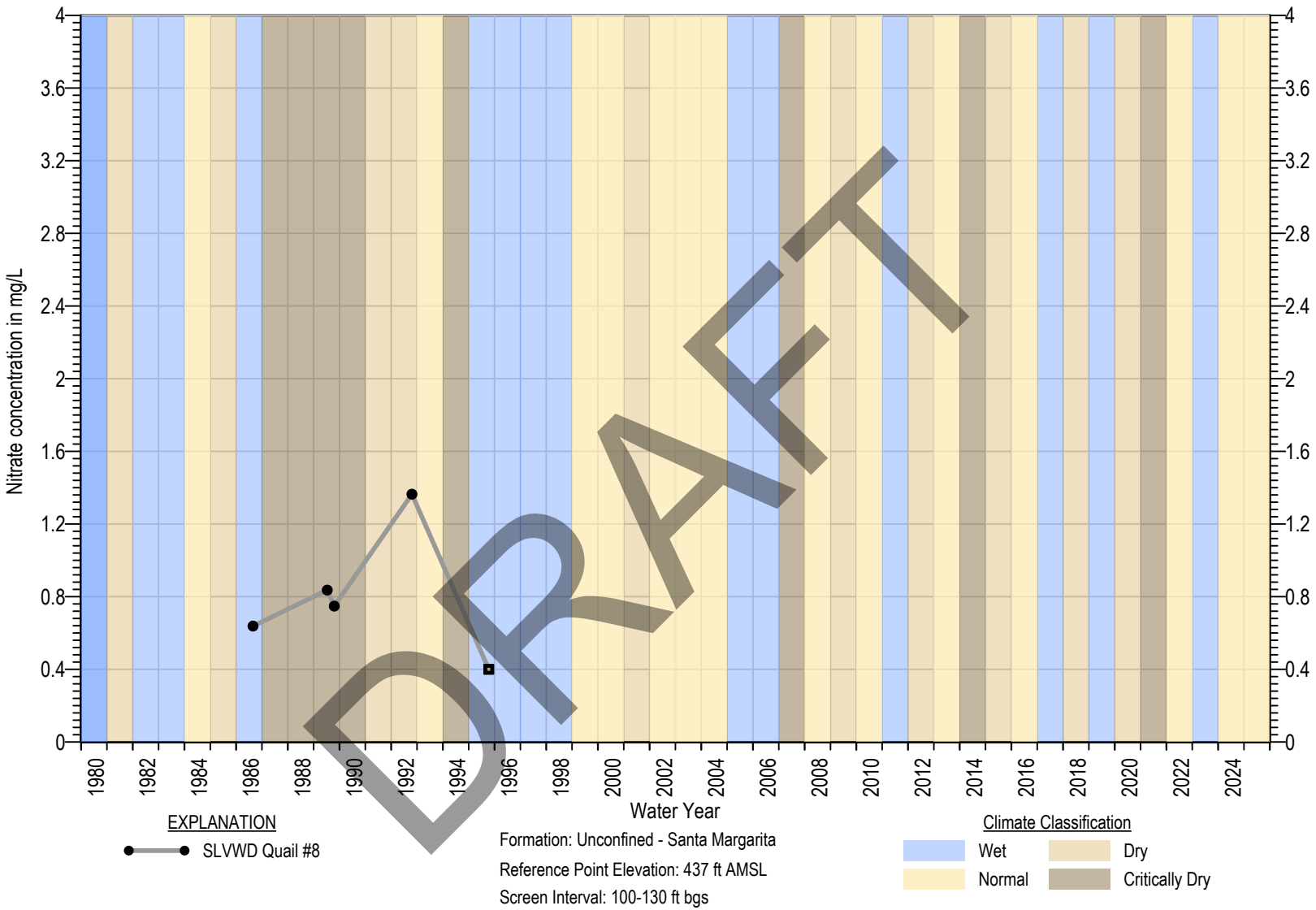
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-178. Nitrate Chemograph of SLVWD Quail #5

MONTGOMERY & ASSOCIATES

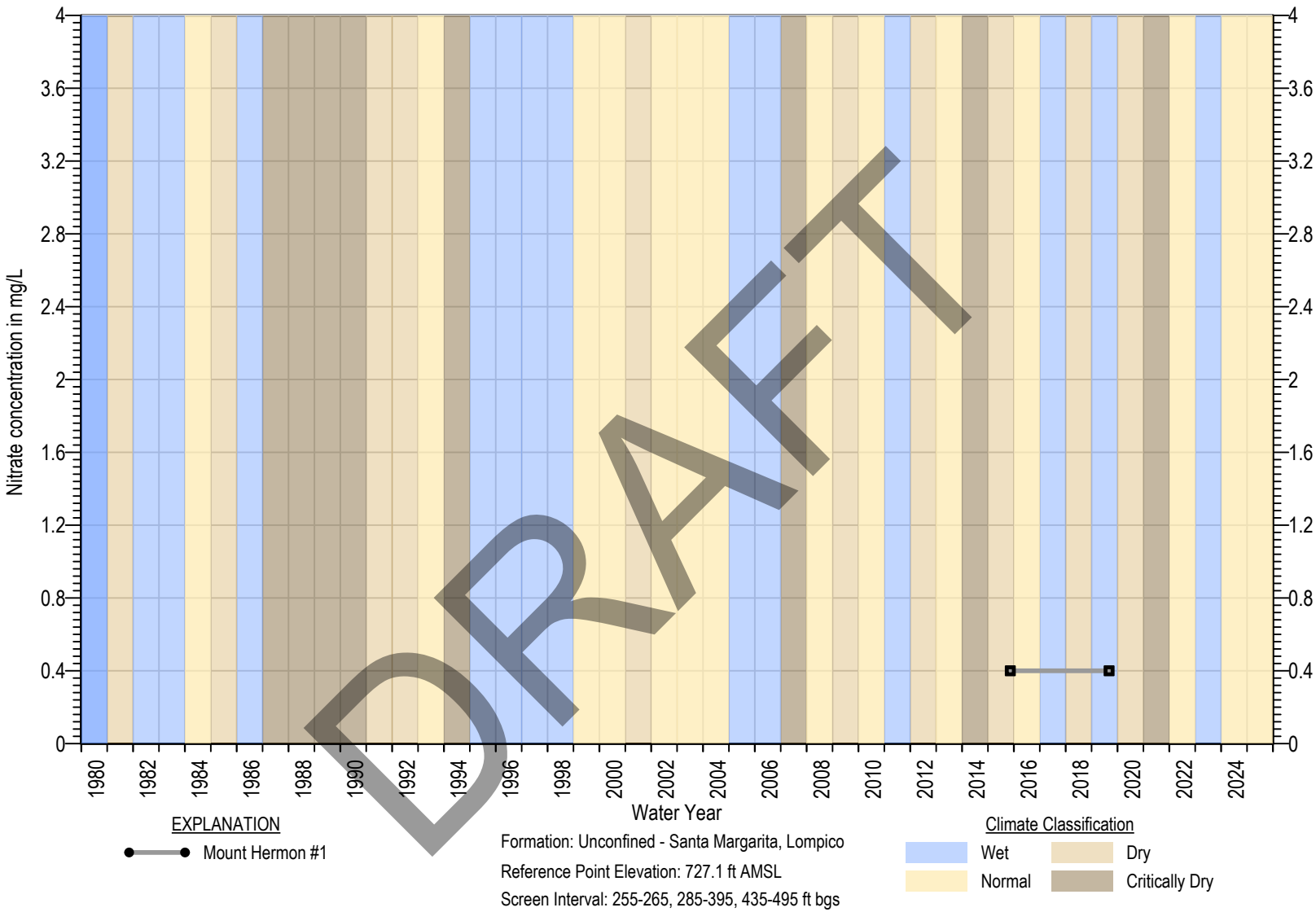


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-179. Nitrate Chemograph of SLVWD Quail #5A

MONTGOMERY & ASSOCIATES

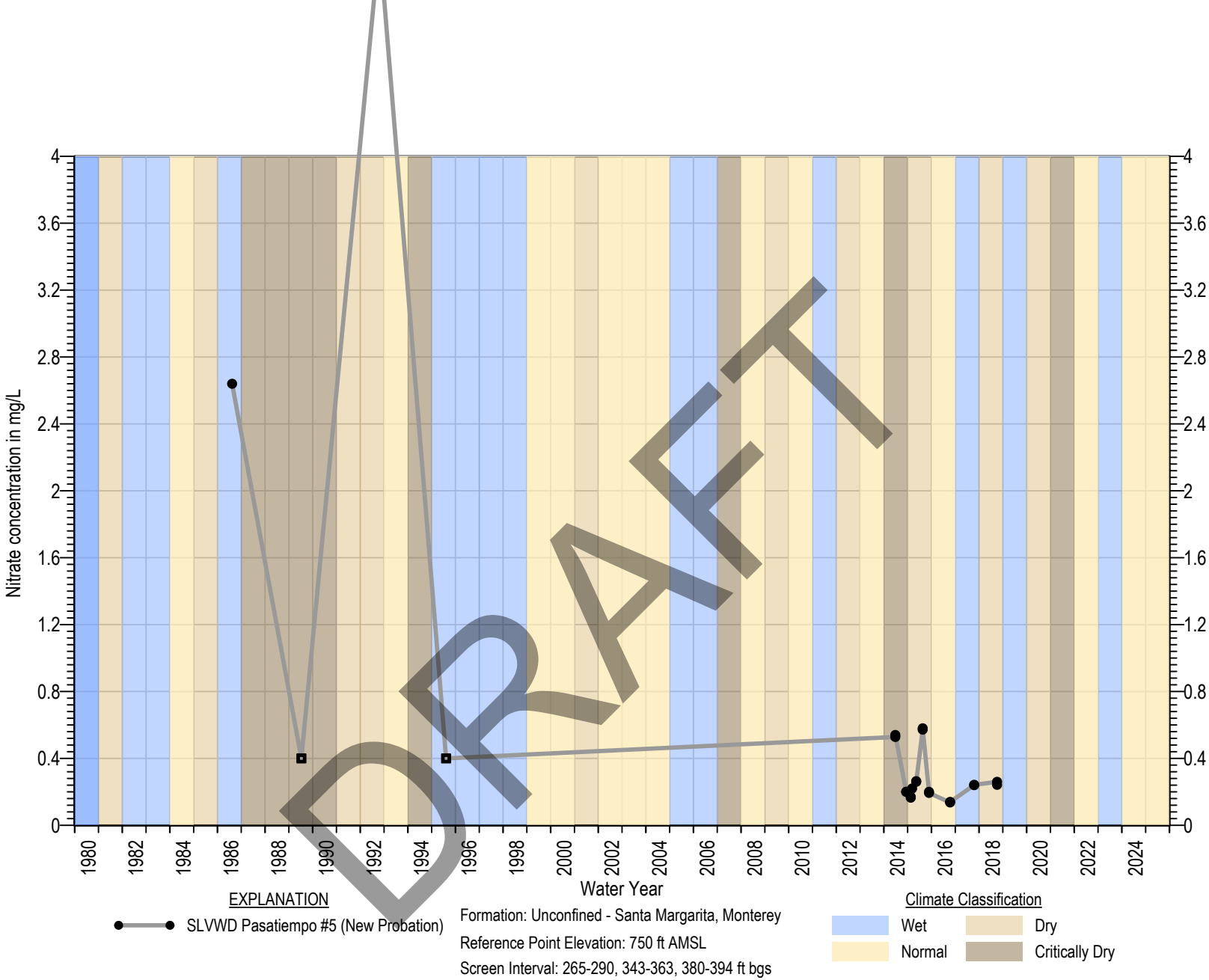


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-180. Nitrate Chemograph of SLVWD Quail #8

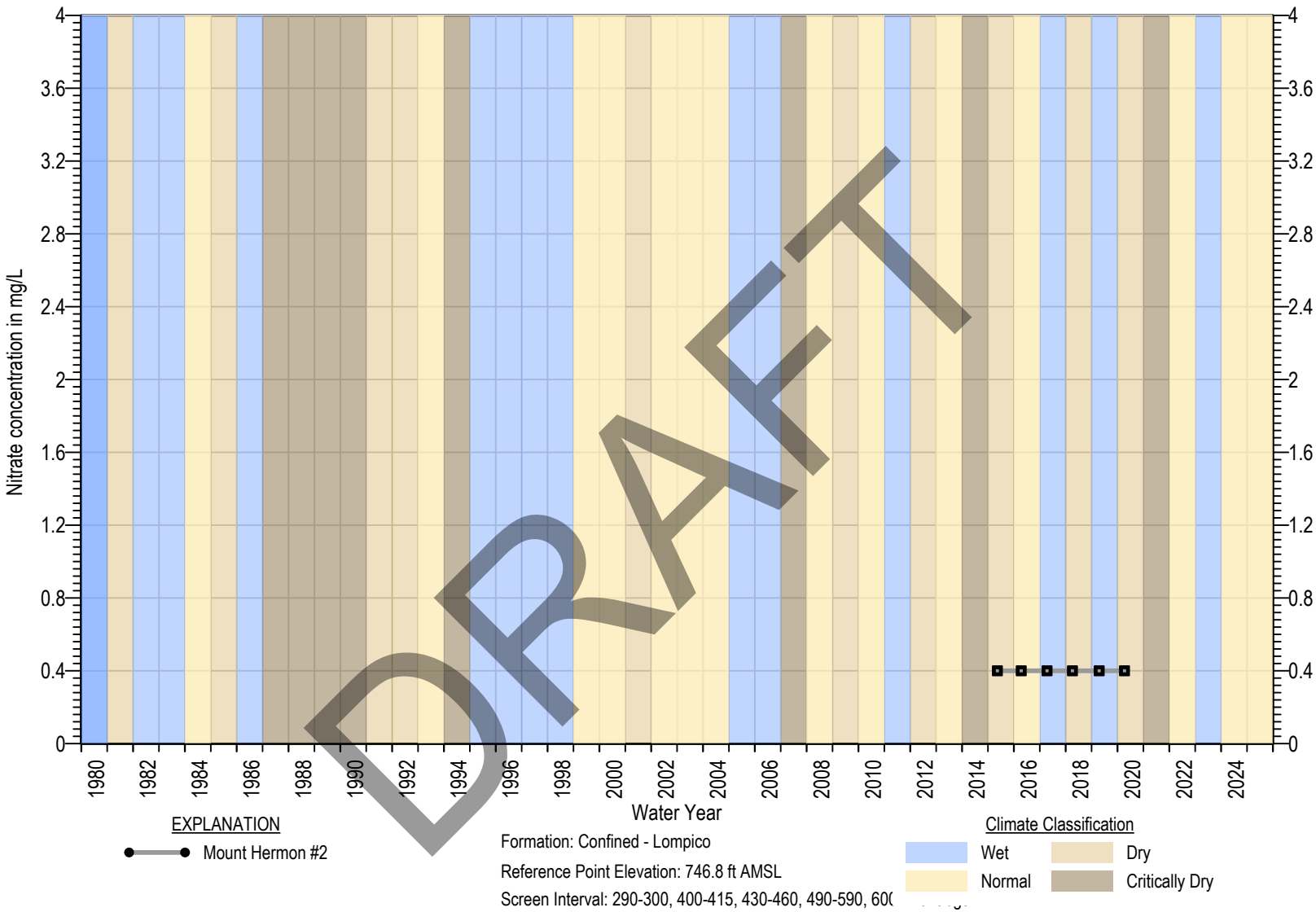
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-181. Nitrate Chemograph of Mount Hermon #1

MONTGOMERY & ASSOCIATES



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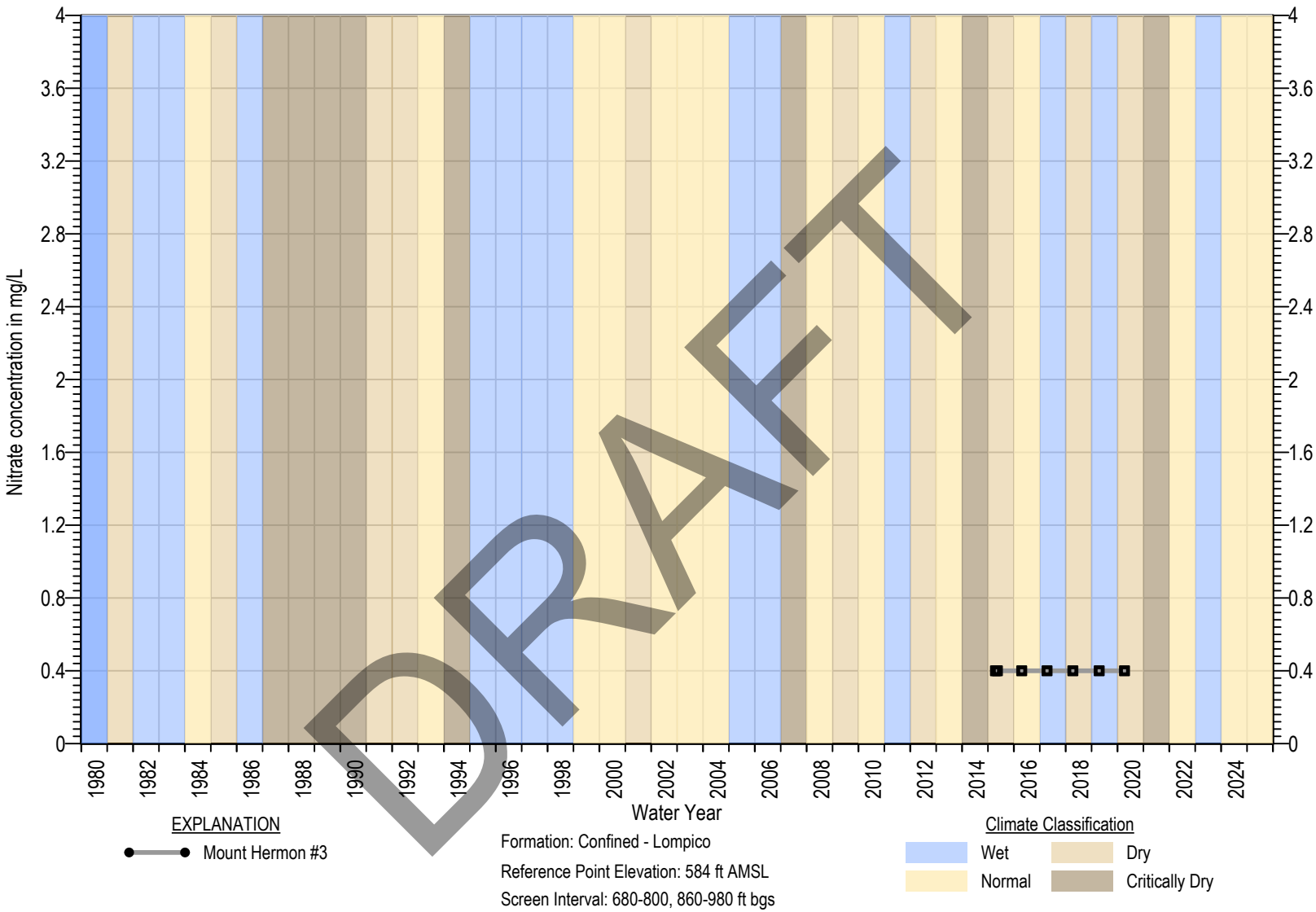
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-182. Nitrate Chemograph of SLVWD Pasatiempo #5 (New Probation)

MONTGOMERY & ASSOCIATES



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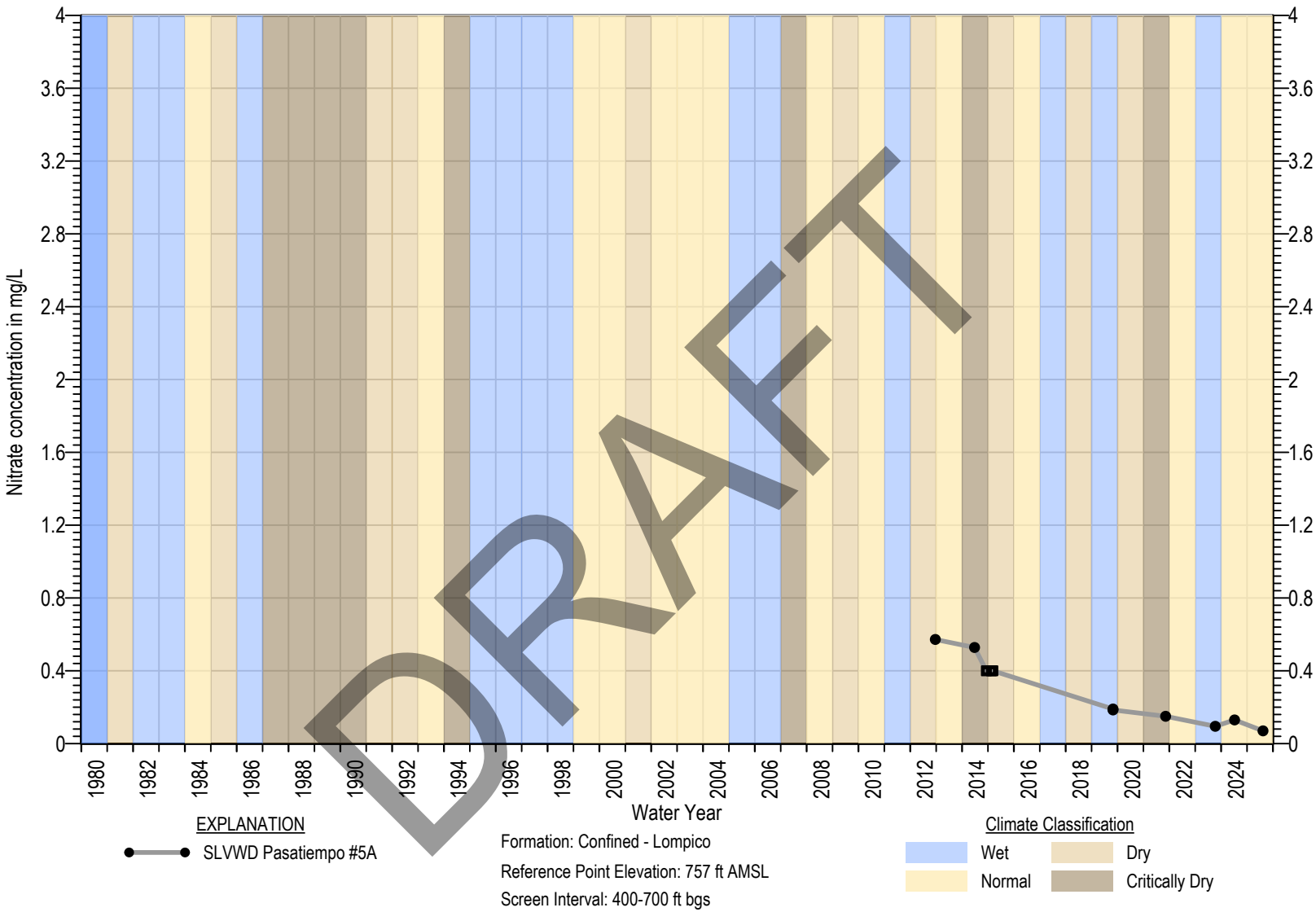
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-183. Nitrate Chemograph of Mount Hermon #2

MONTGOMERY & ASSOCIATES

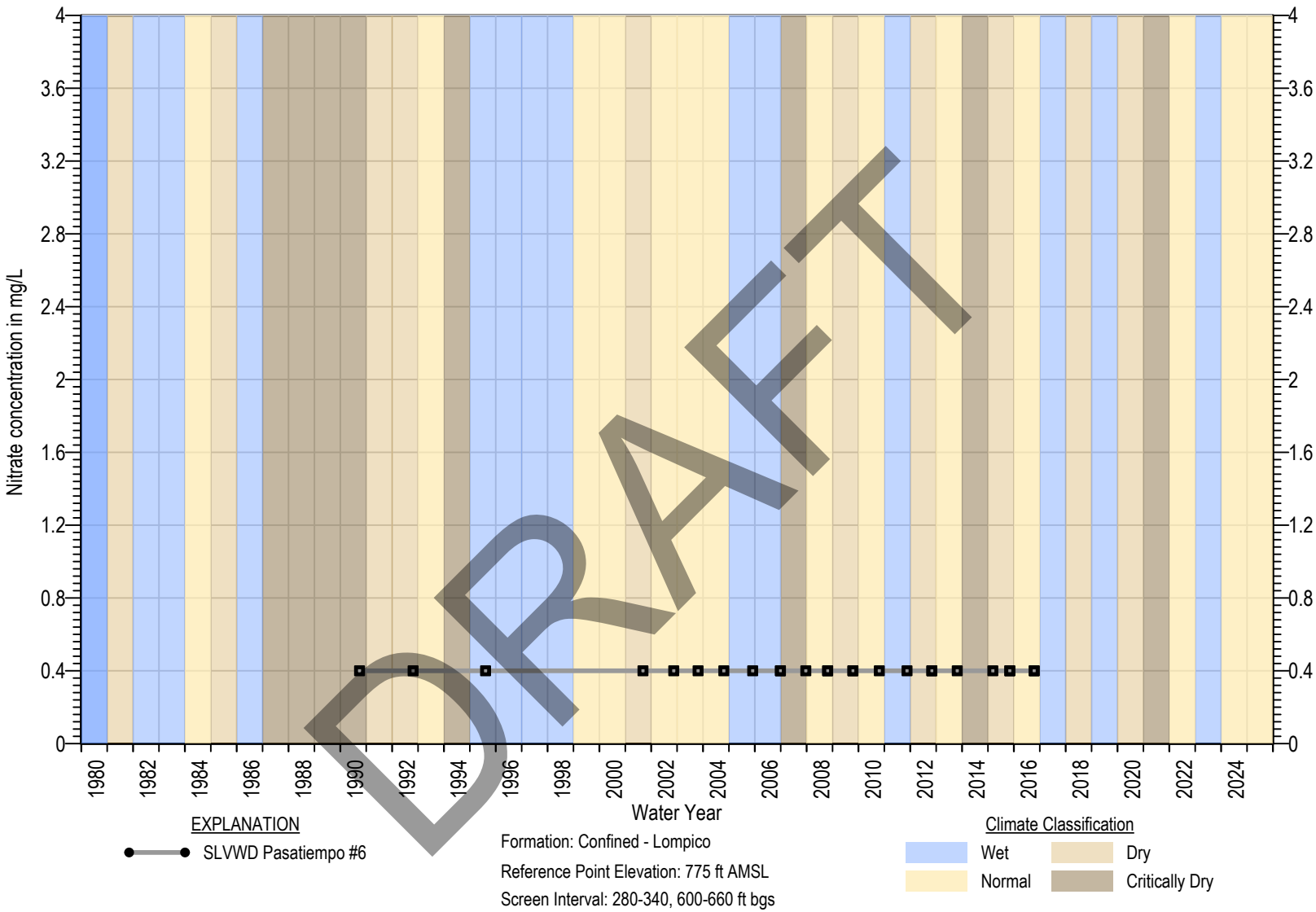


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-184. Nitrate Chemograph of Mount Hermon #3

MONTGOMERY & ASSOCIATES

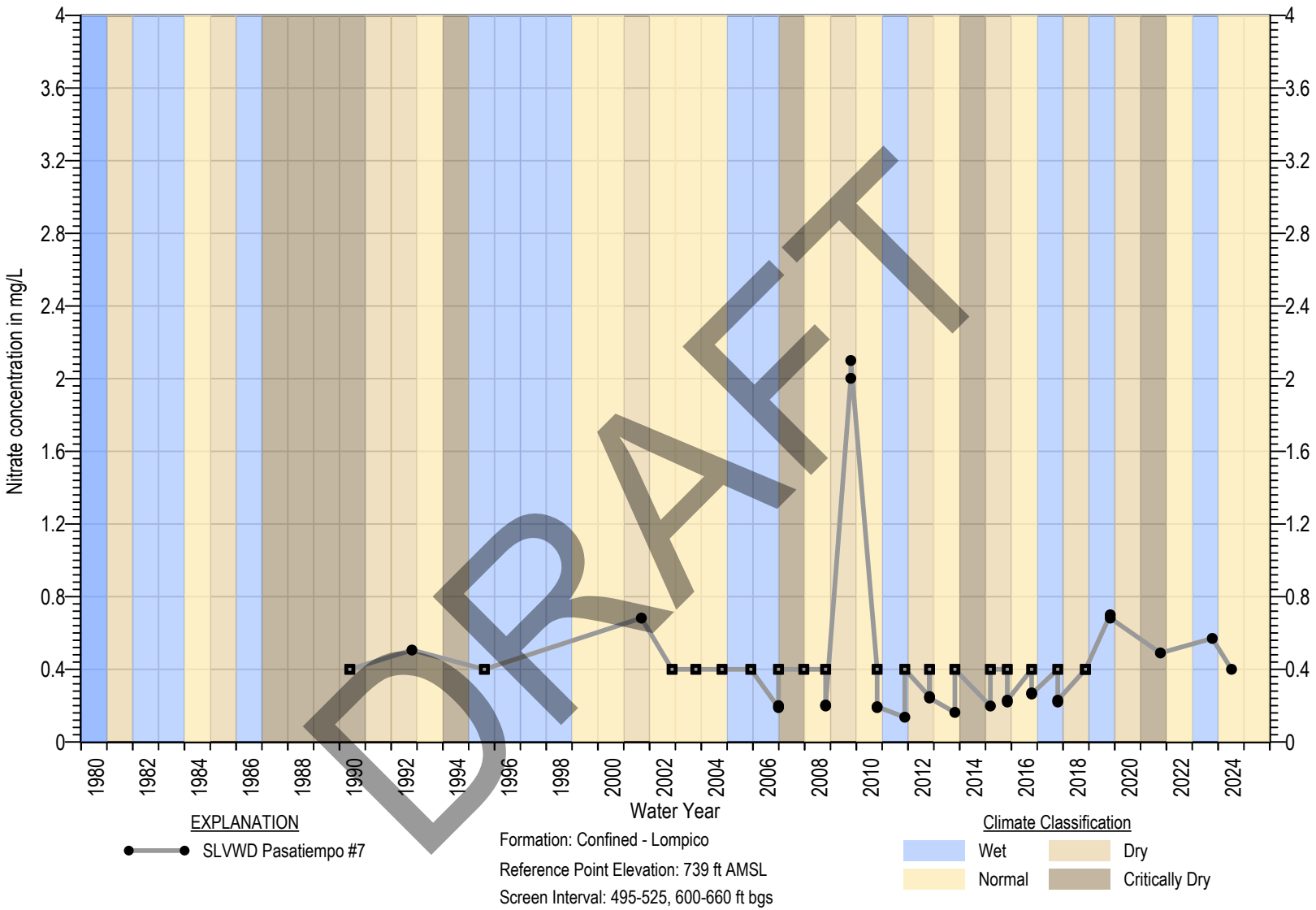


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-185. Nitrate Chemograph of SLVWD Pasatiempo #5A

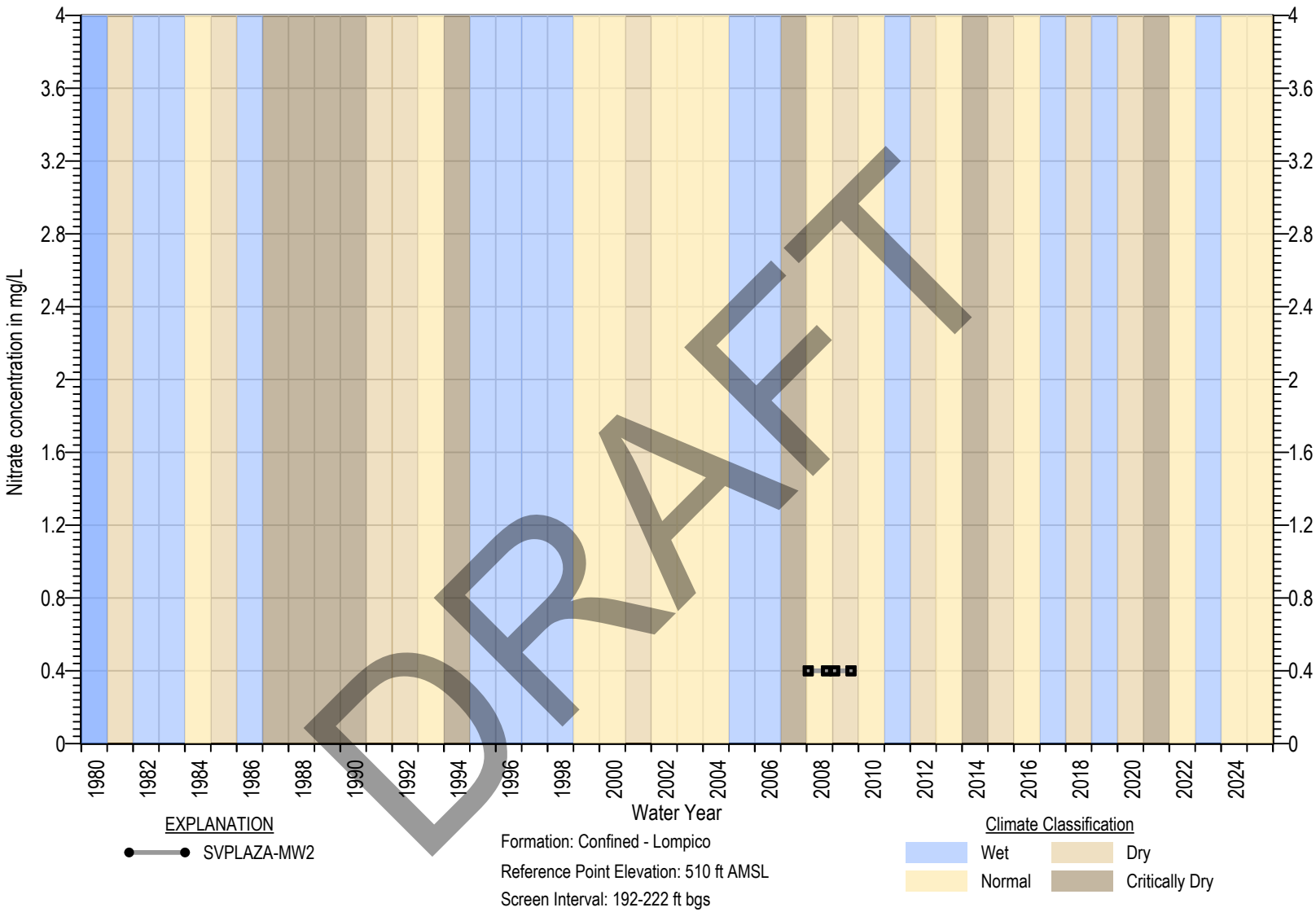
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-186. Nitrate Chemograph of SLVWD Pasatiempo #6

MONTGOMERY & ASSOCIATES

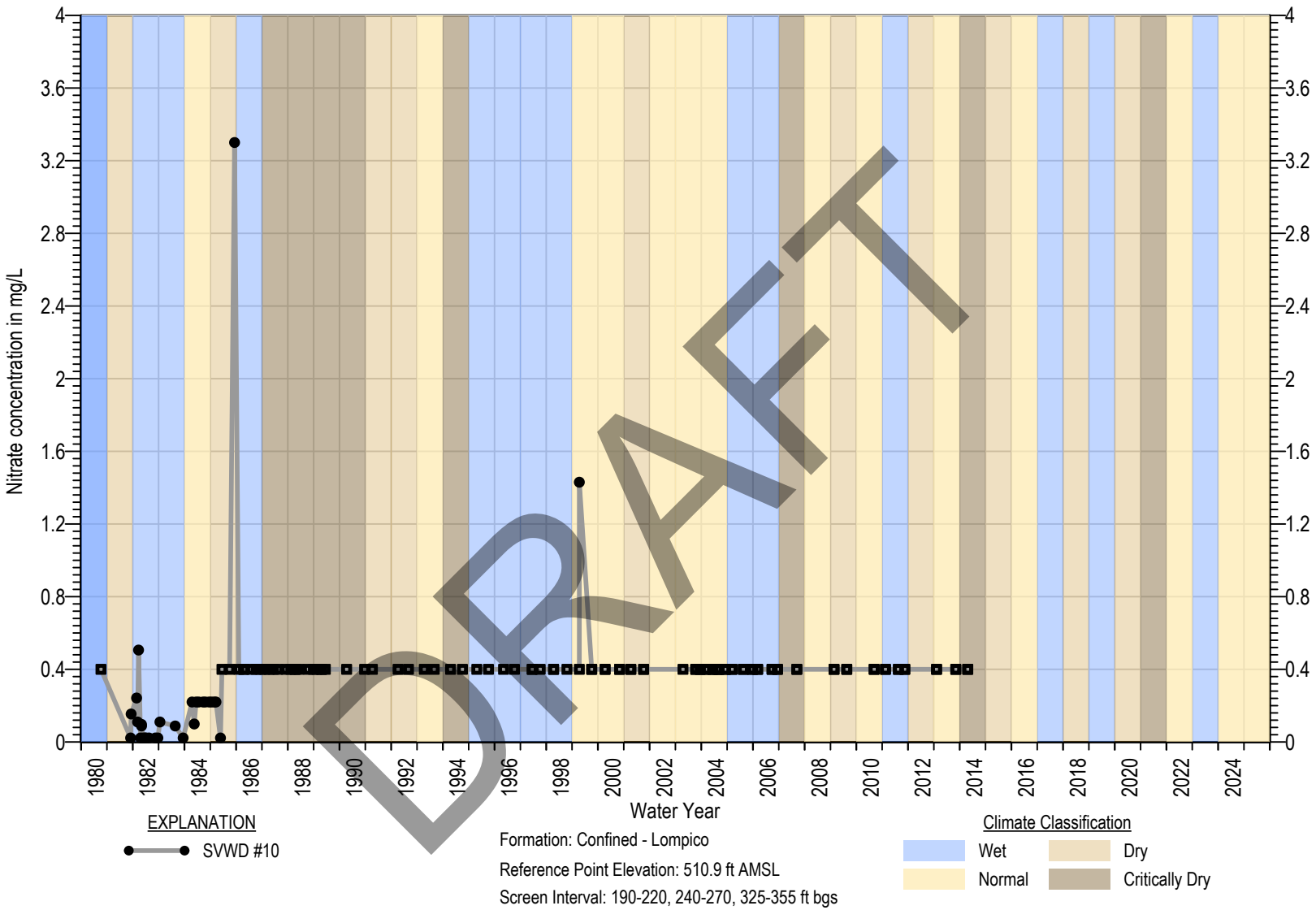


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-187. Nitrate Chemograph of SLVWD Pasatiempo #7

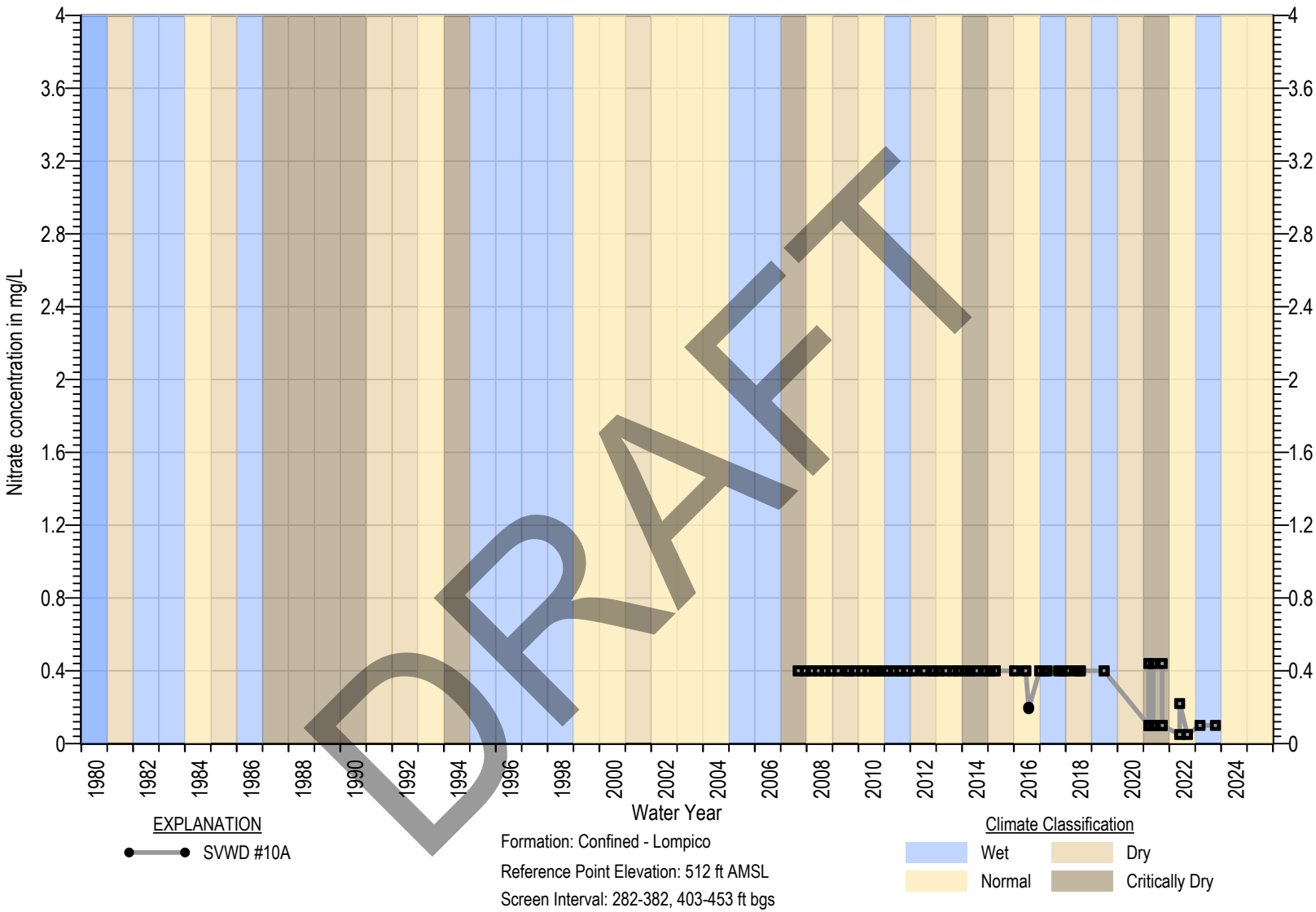
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-188. Nitrate Chemograph of SVPLAZA-MW2

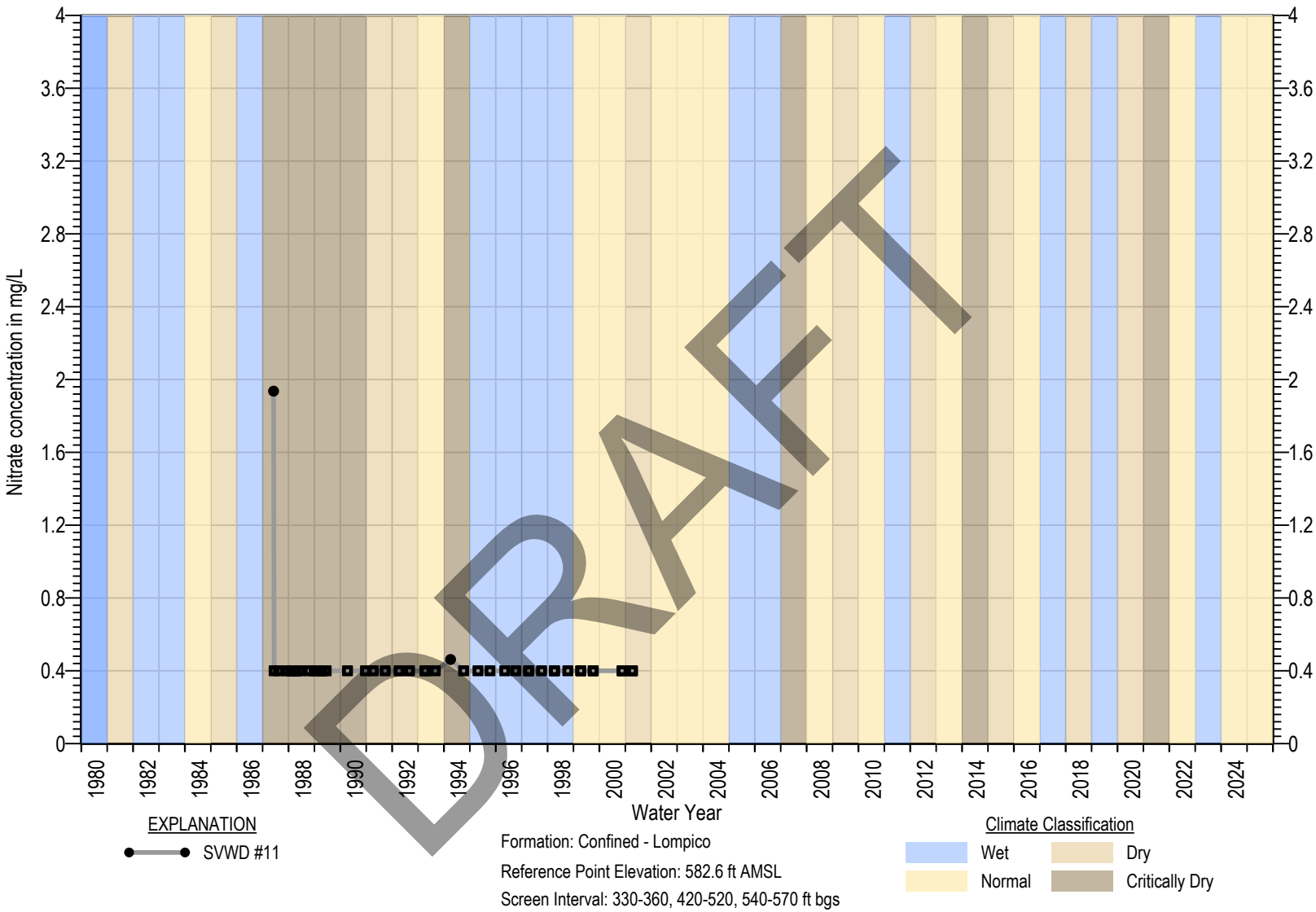
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-189. Nitrate Chemograph of SVWD #10

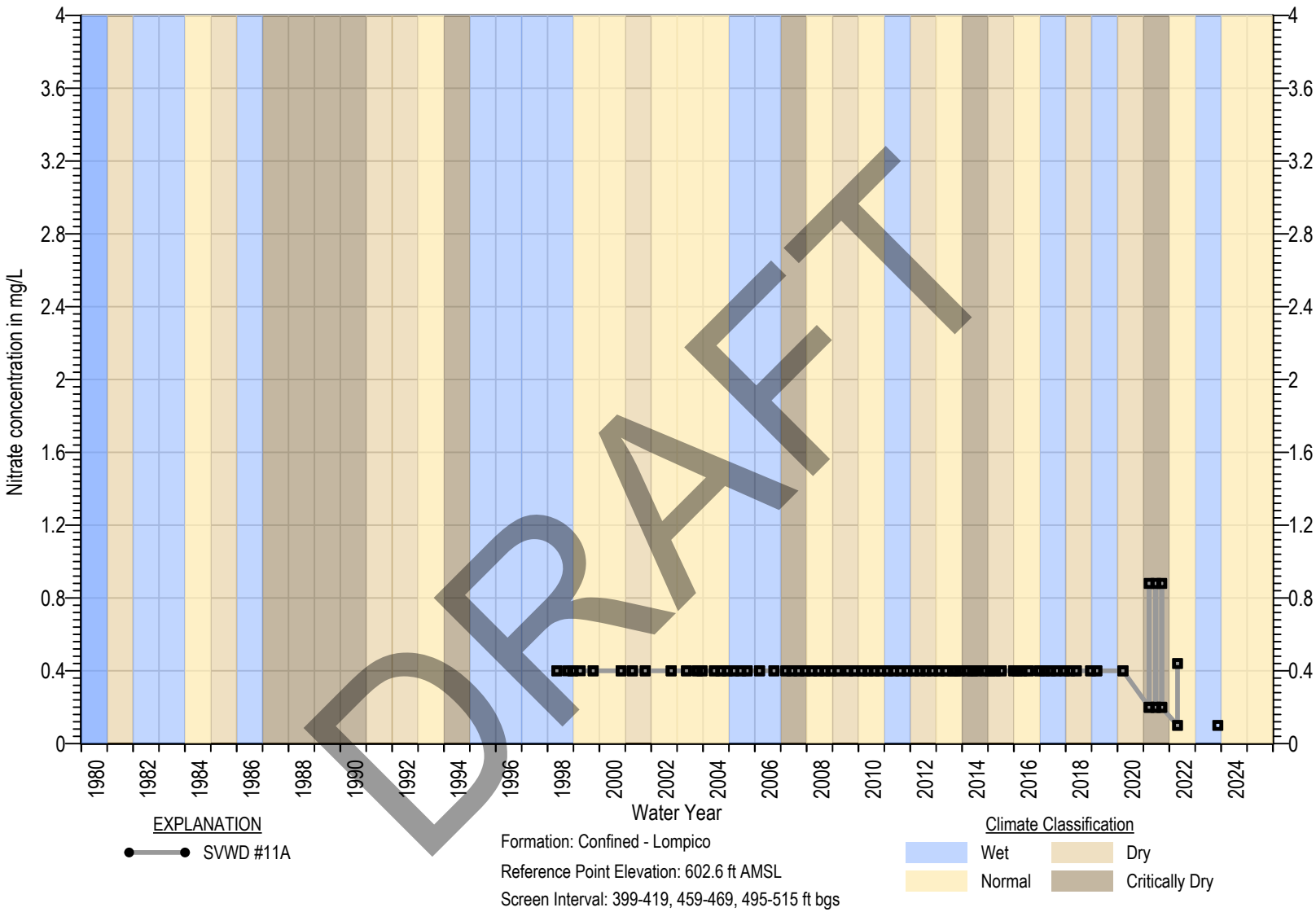
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-190. Nitrate Chemograph of SVWD #10A

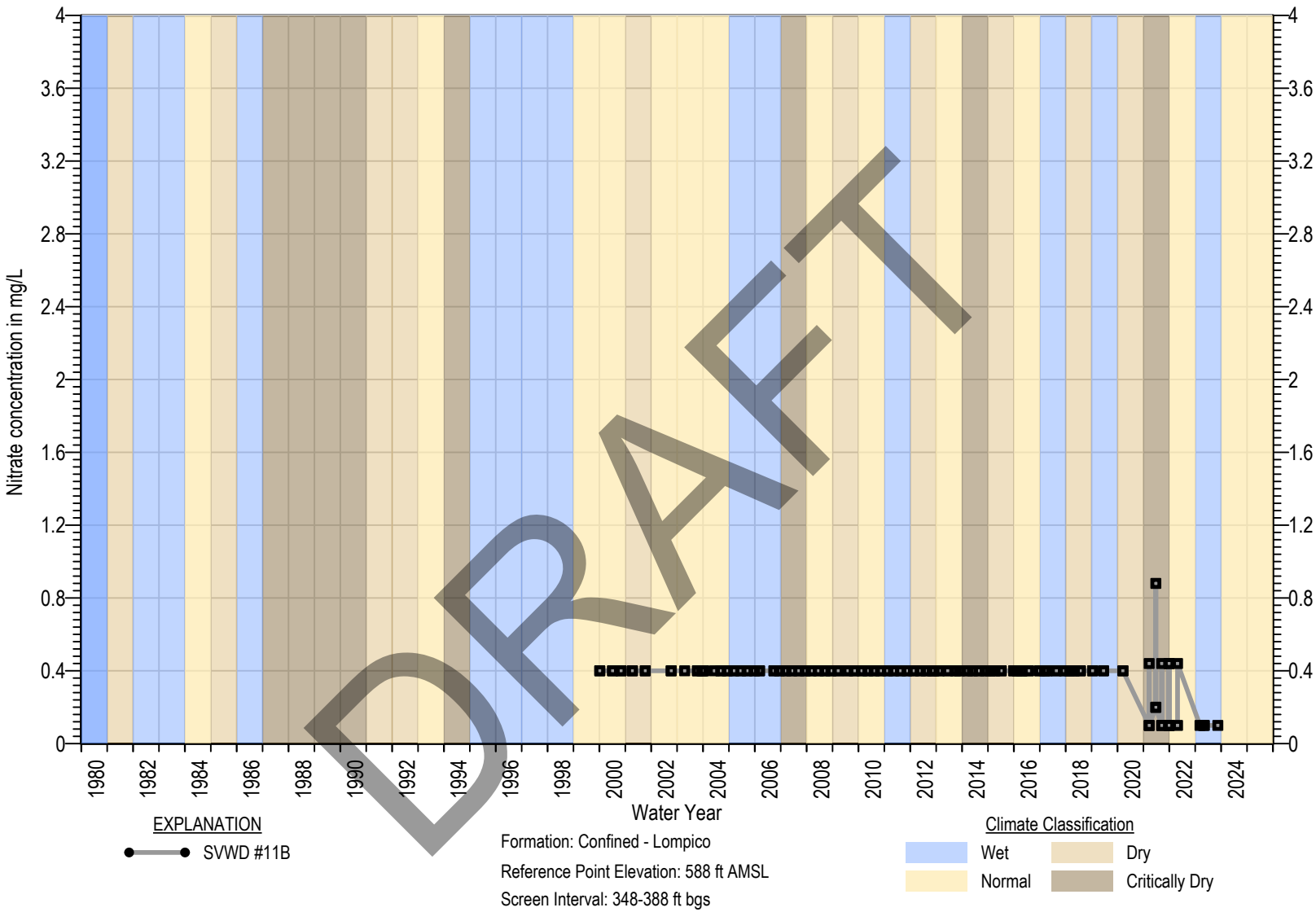
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-191. Nitrate Chemograph of SVWD #11

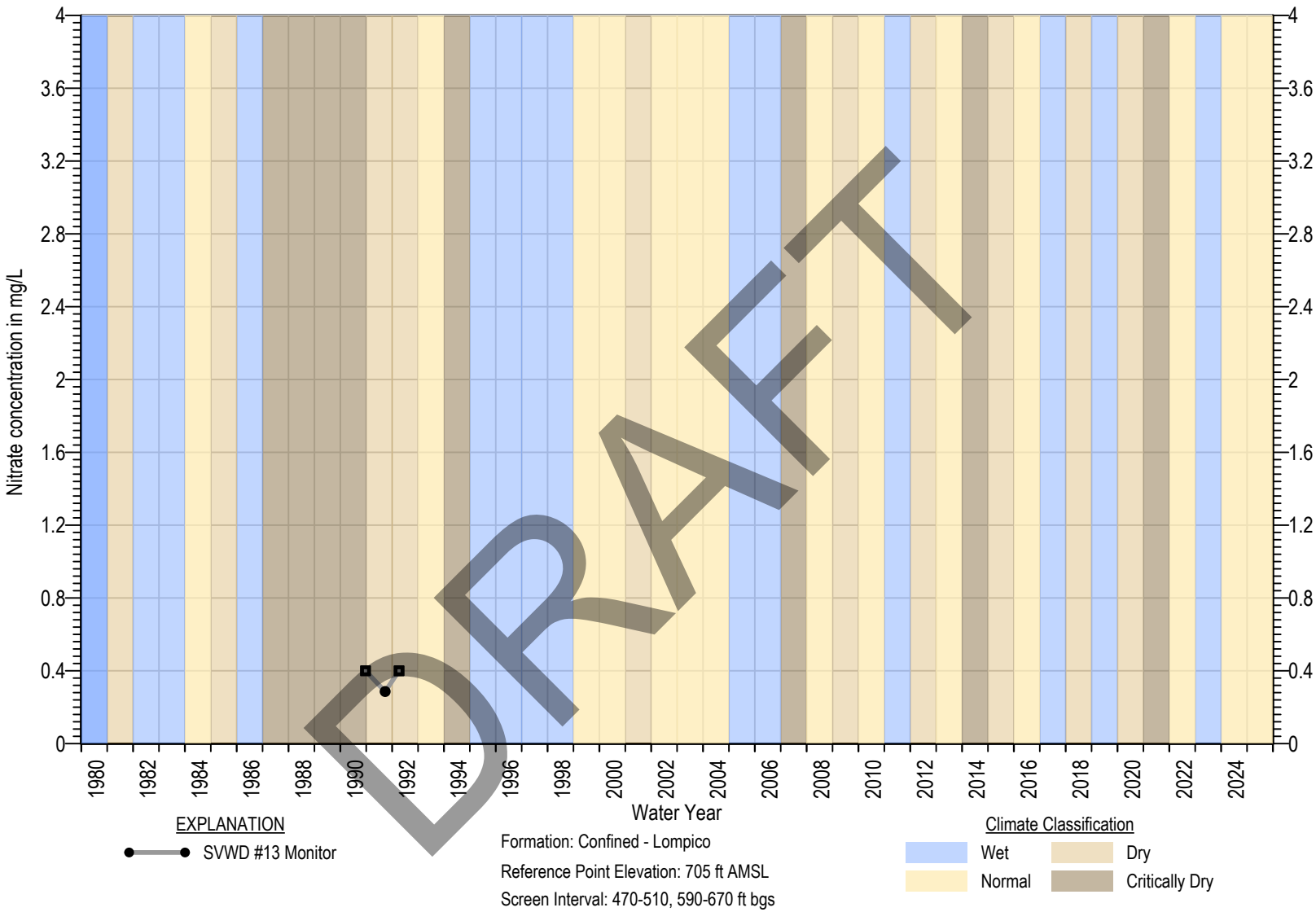
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-192. Nitrate Chemograph of SVWD #11A

MONTGOMERY & ASSOCIATES

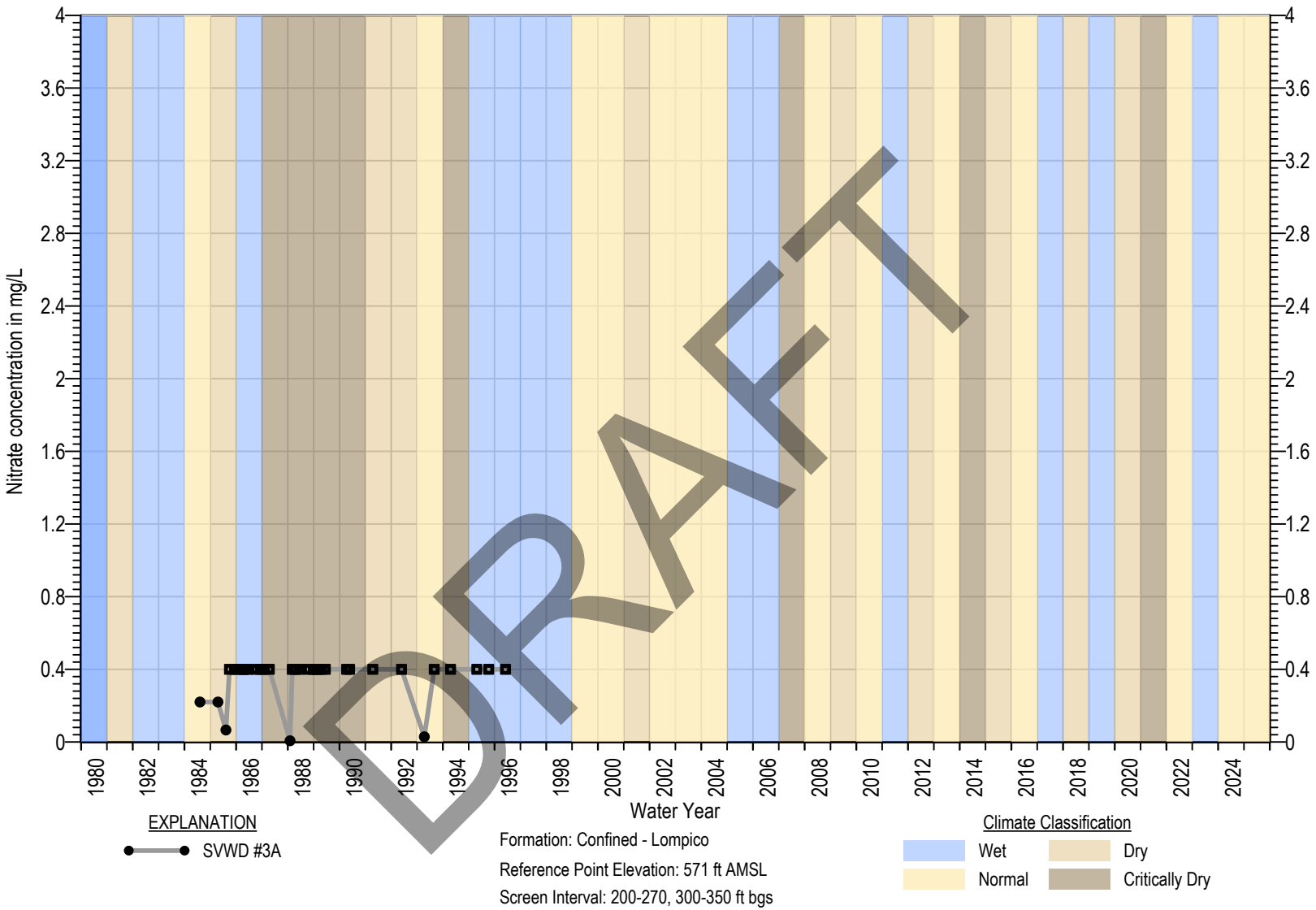


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-193. Nitrate Chemograph of SVWD #11B

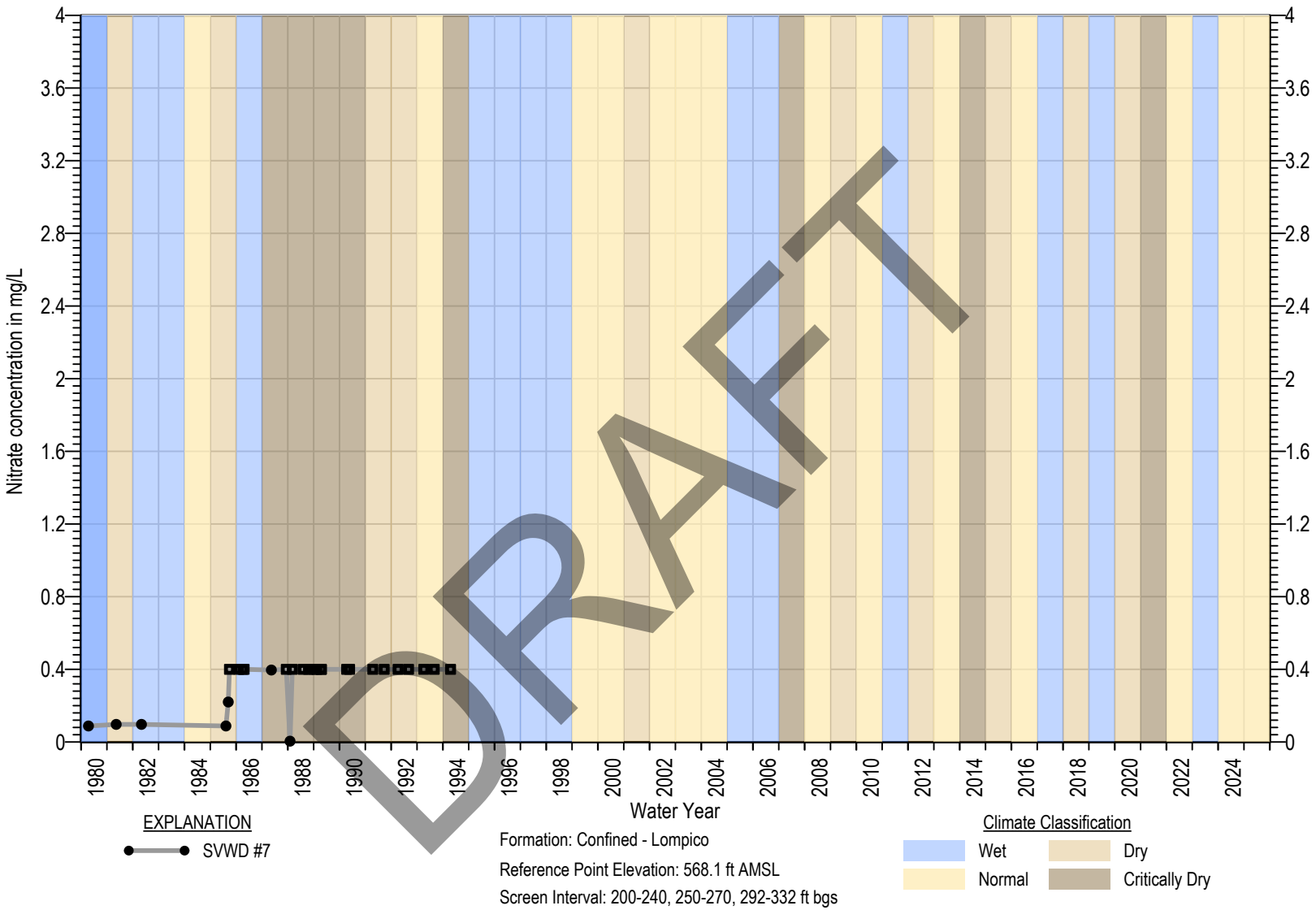
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-194. Nitrate Chemograph of SVWD #13 Monitor

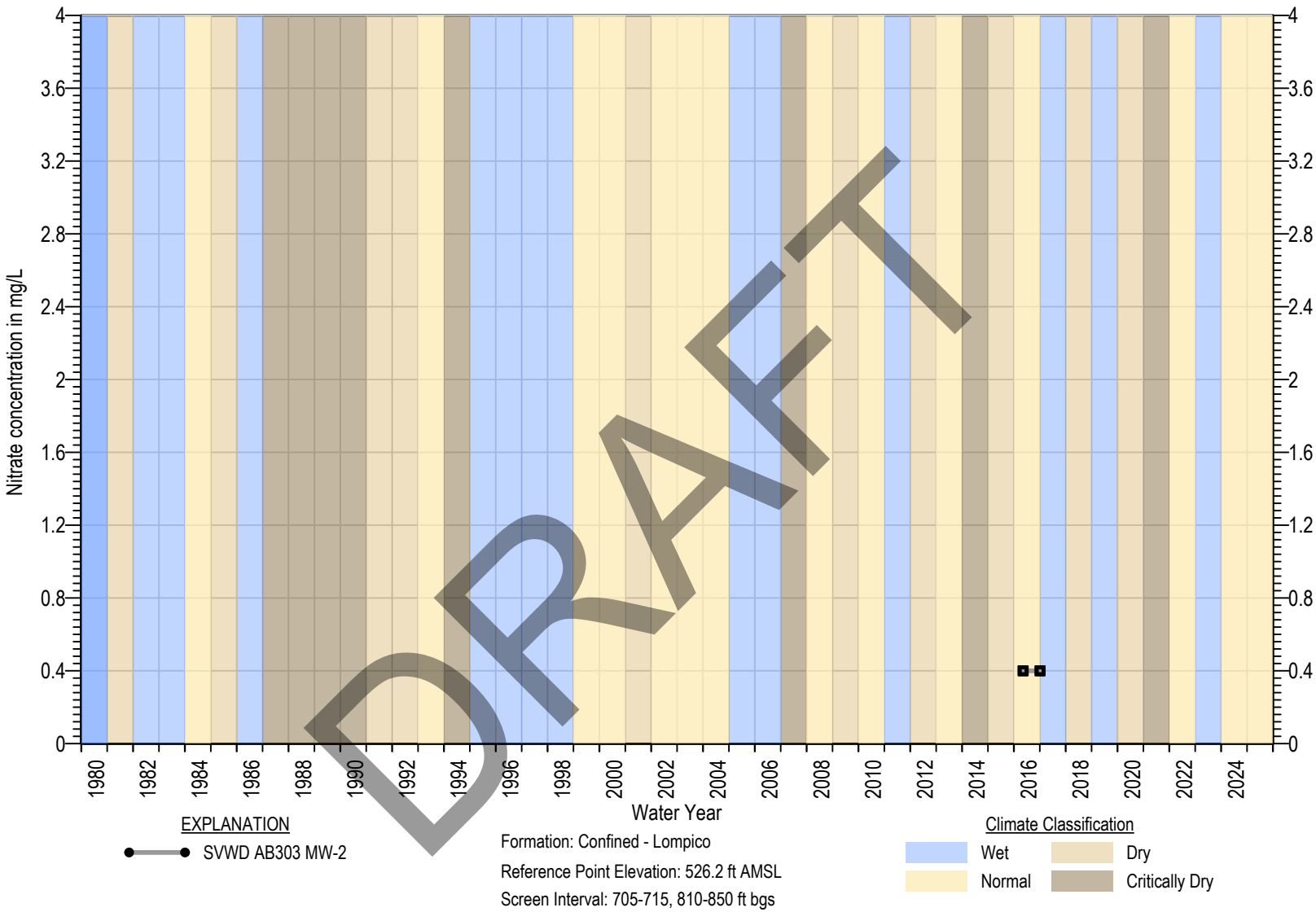
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-195. Nitrate Chemograph of SVWD #3A

MONTGOMERY & ASSOCIATES

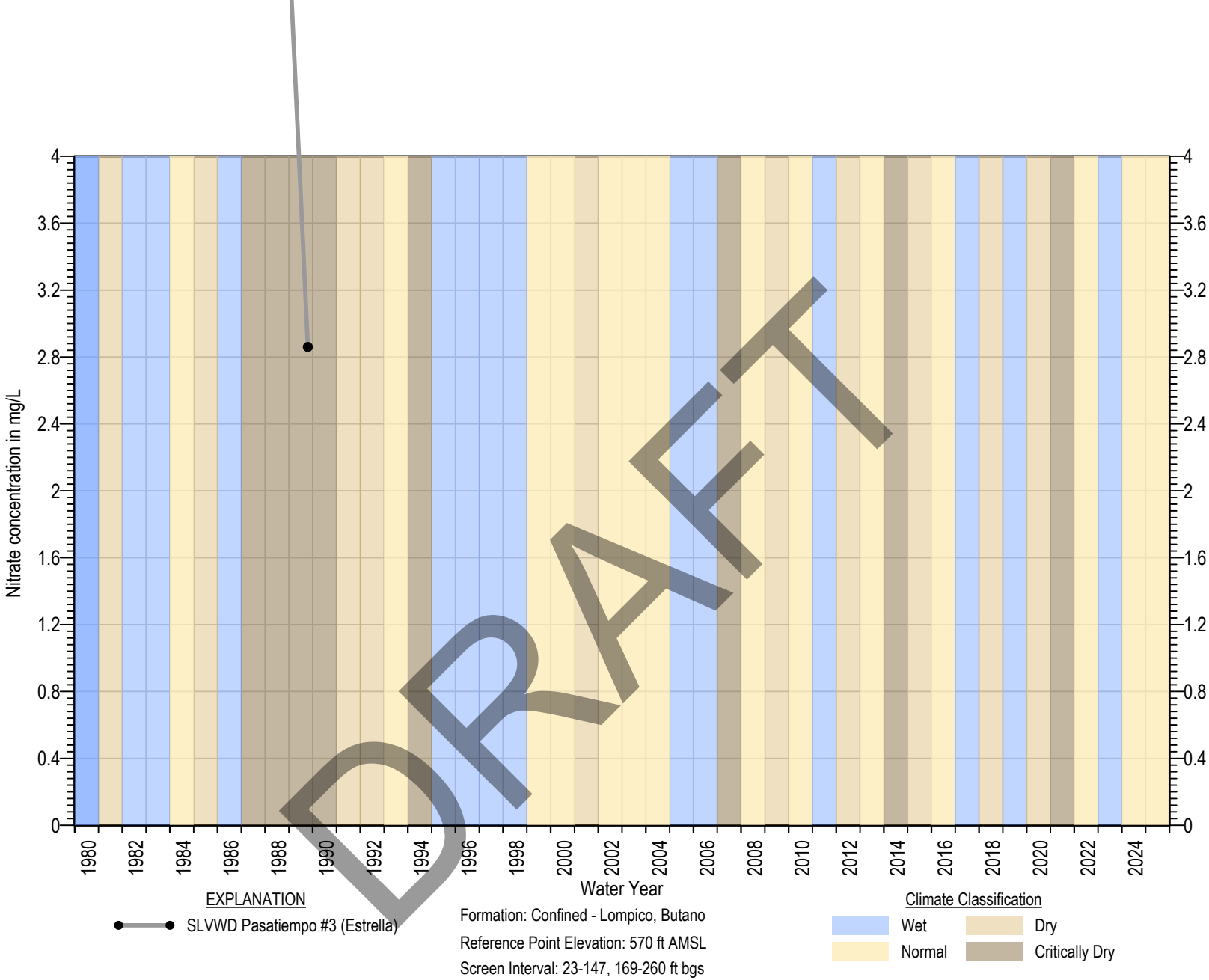


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-196. Nitrate Chemograph of SVWD #7

MONTGOMERY & ASSOCIATES

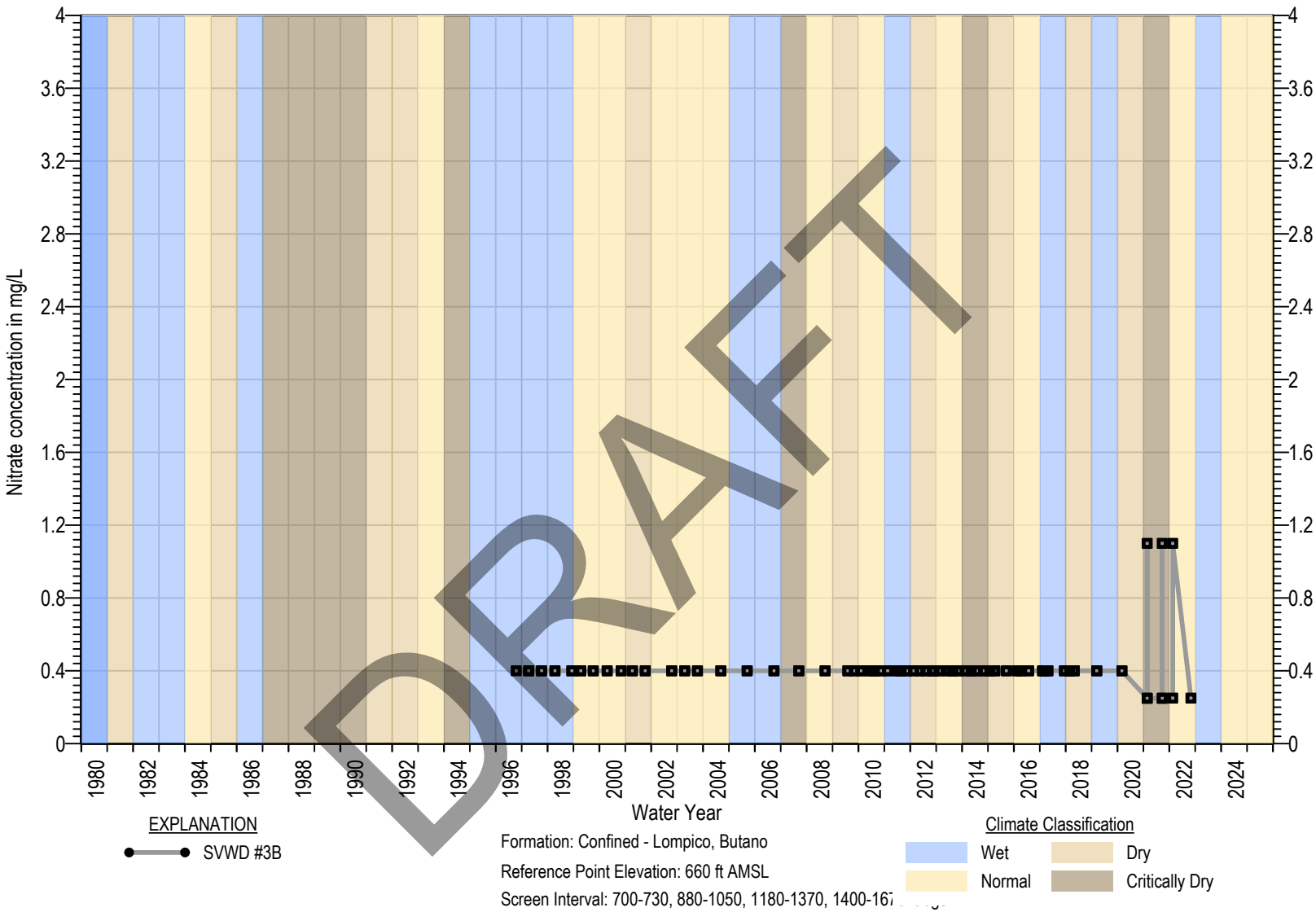


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-197. Nitrate Chemograph of SVWD AB303 MW-2

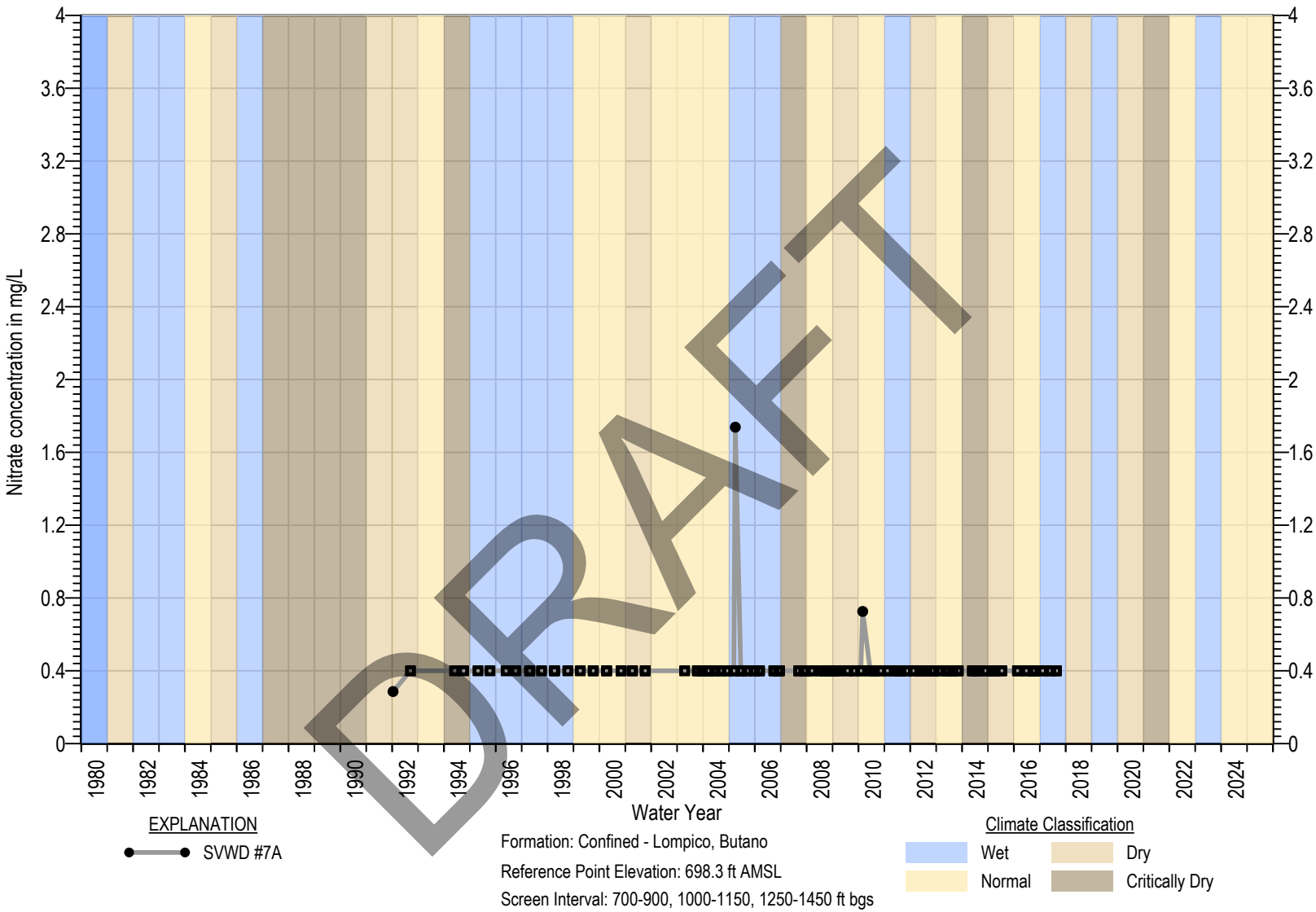
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-198. Nitrate Chemograph of SLVWD Pasatiempo #3 (Estrella)

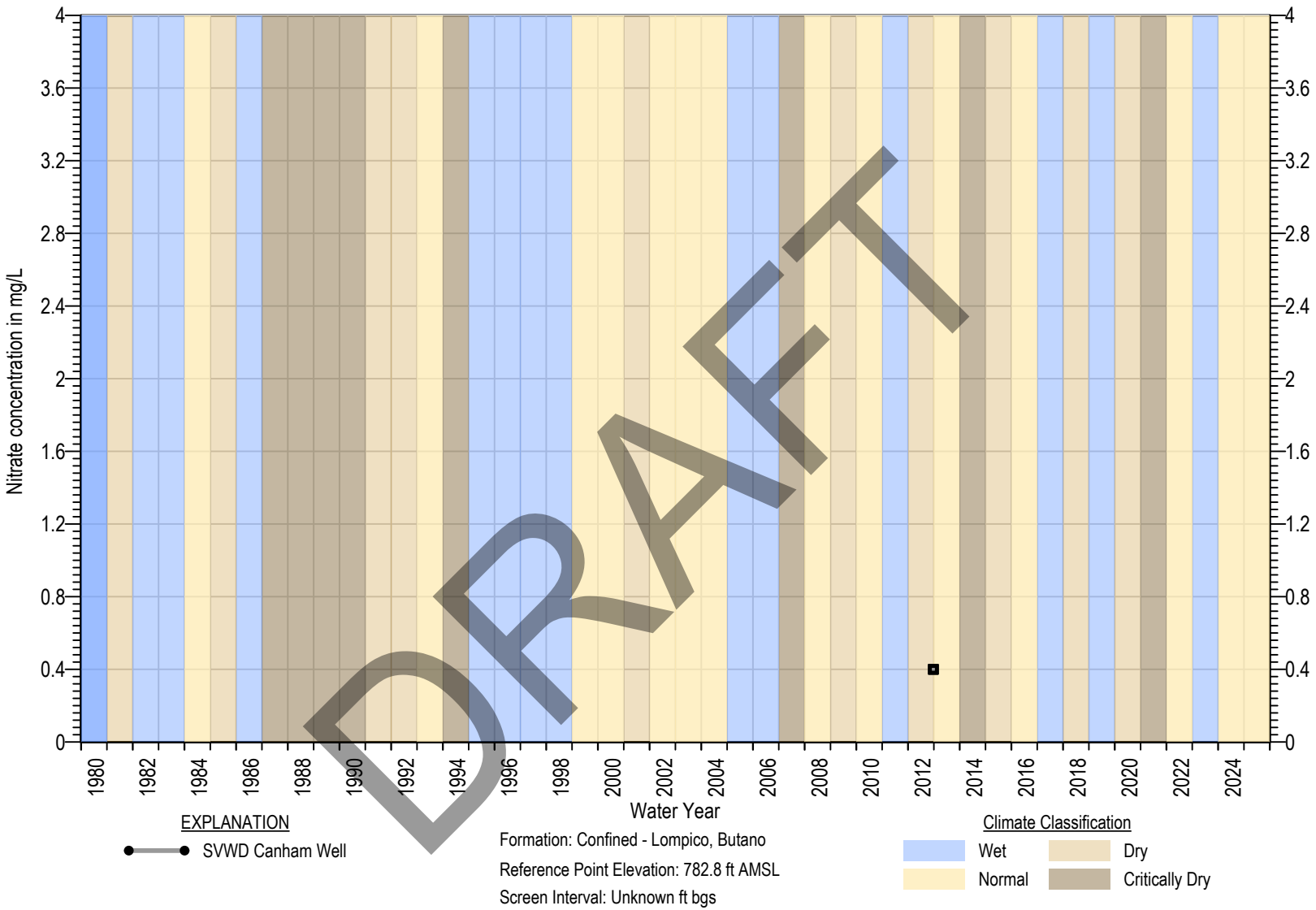
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-199. Nitrate Chemograph of SVWD #3B

MONTGOMERY & ASSOCIATES

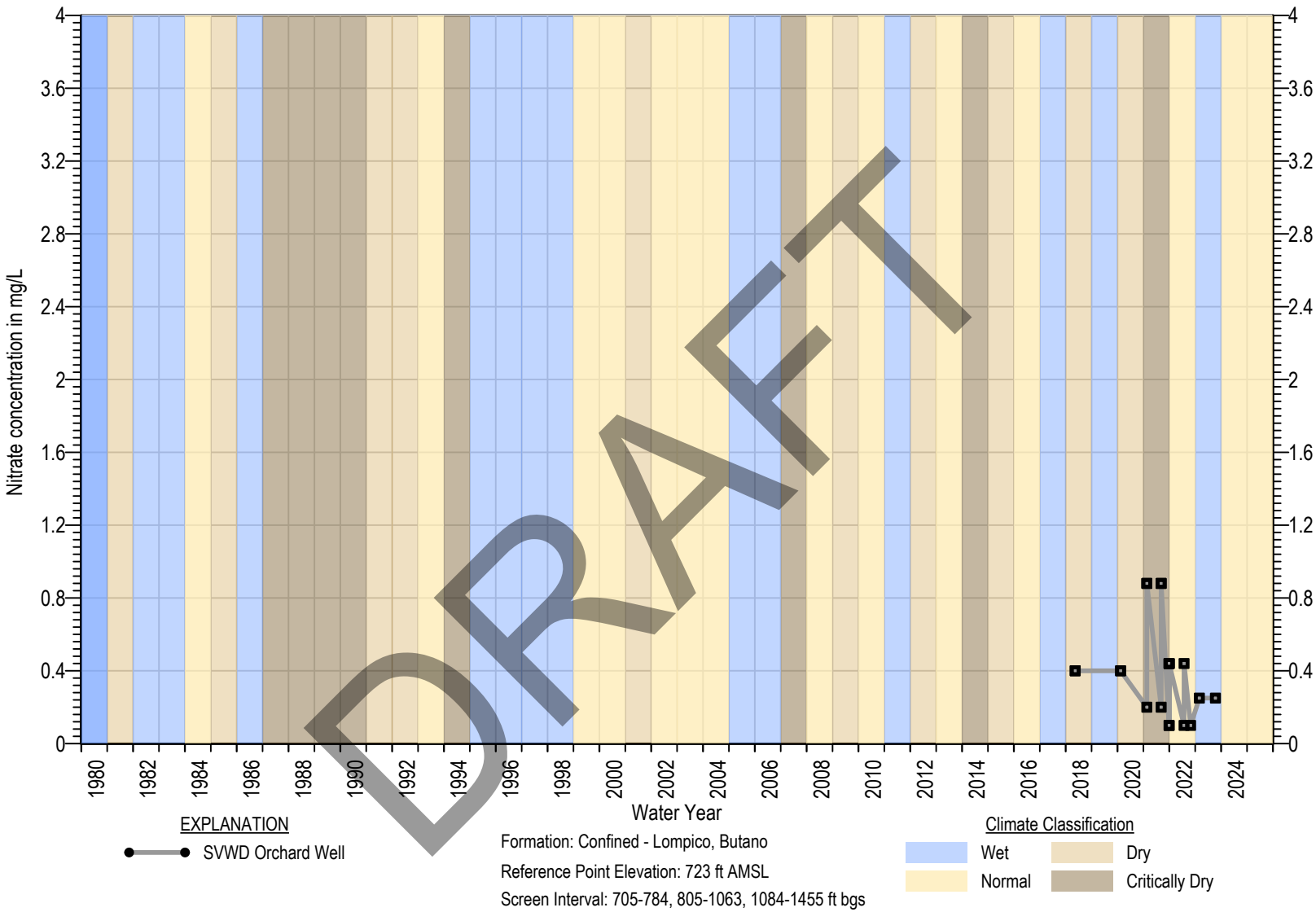


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-200. Nitrate Chemograph of SVWD #7A

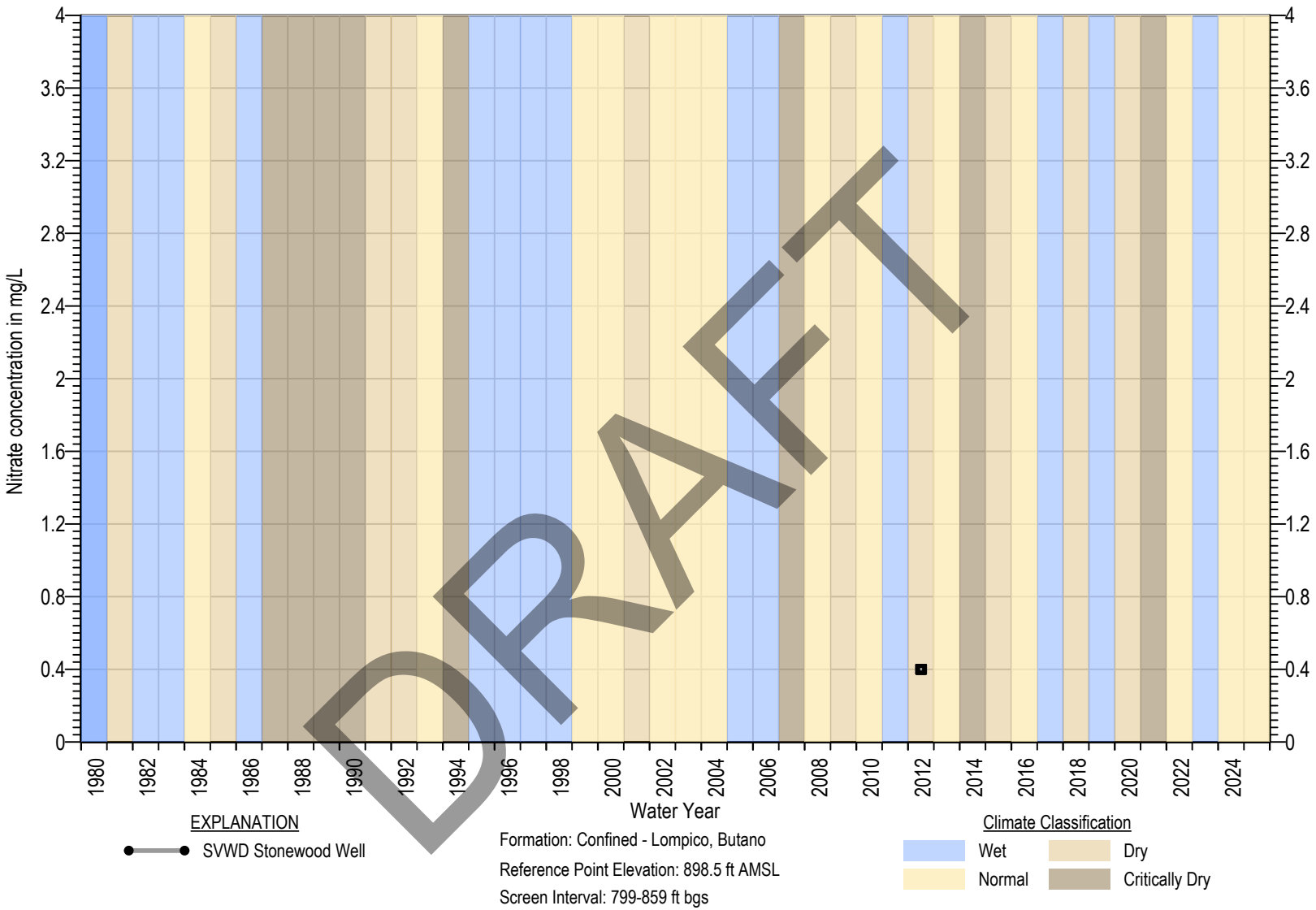
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-201. Nitrate Chemograph of SVWD Canham Well

MONTGOMERY & ASSOCIATES

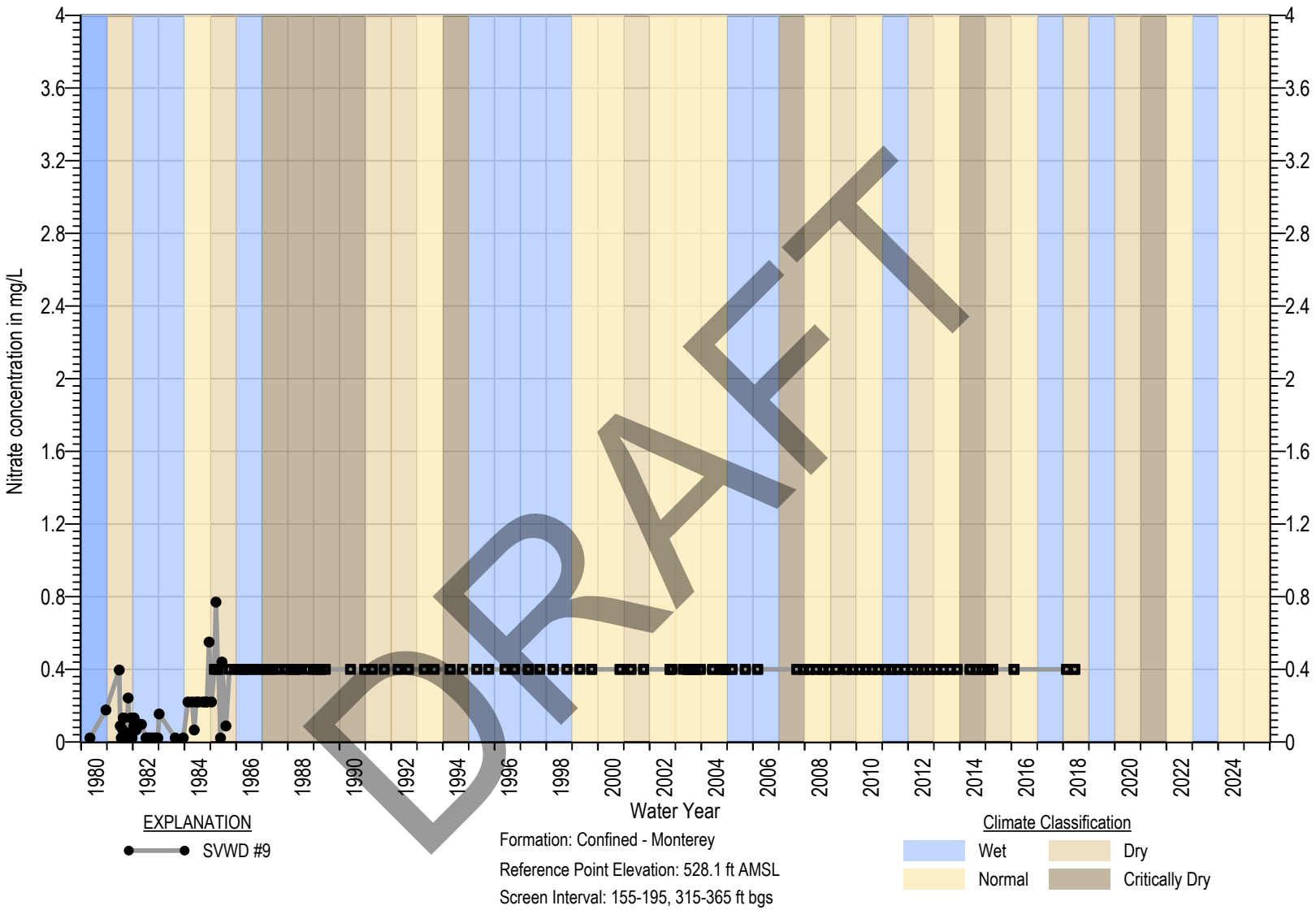


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-202. Nitrate Chemograph of SVWD Orchard Well

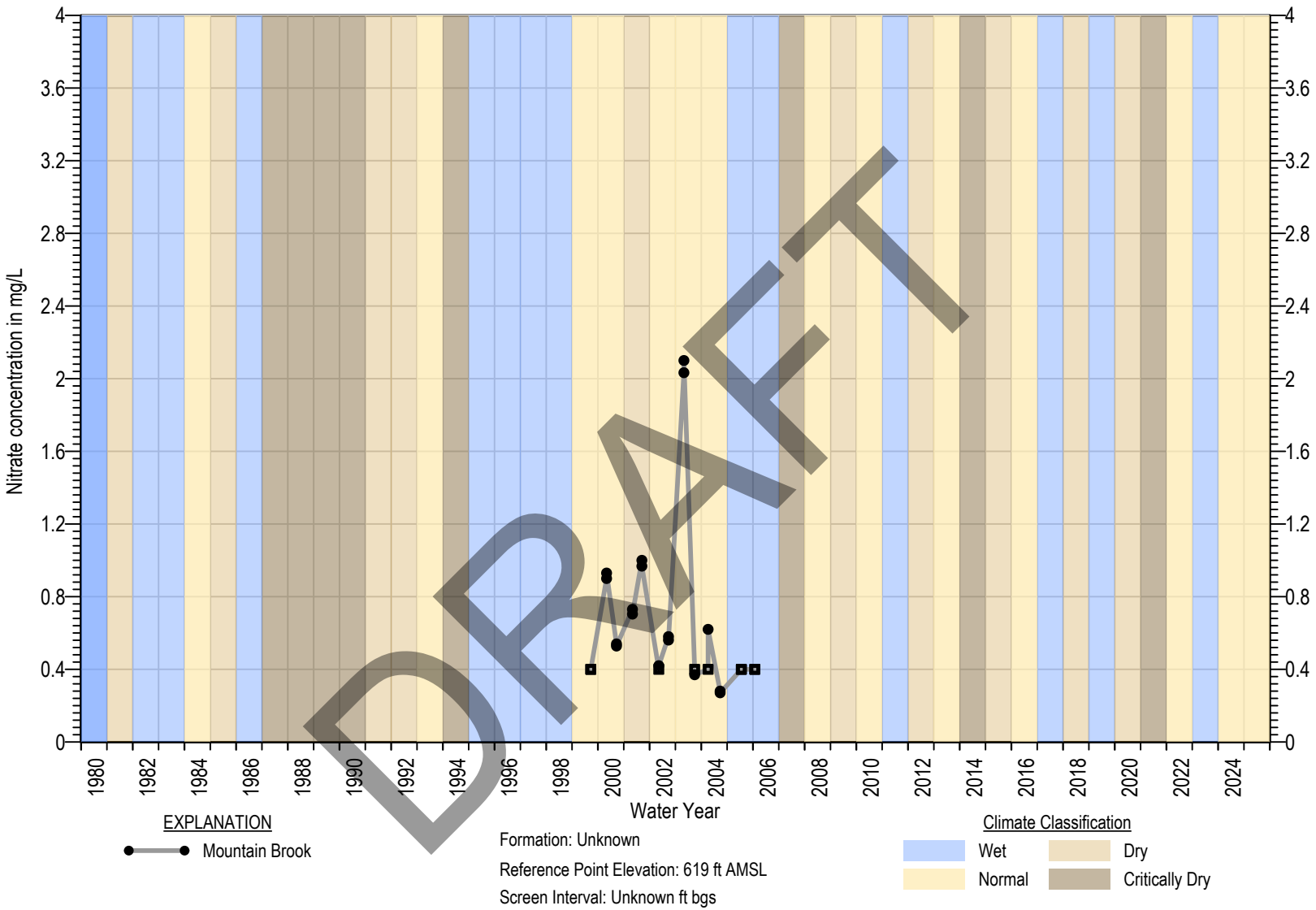
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-203. Nitrate Chemograph of SVWD Stonewood Well

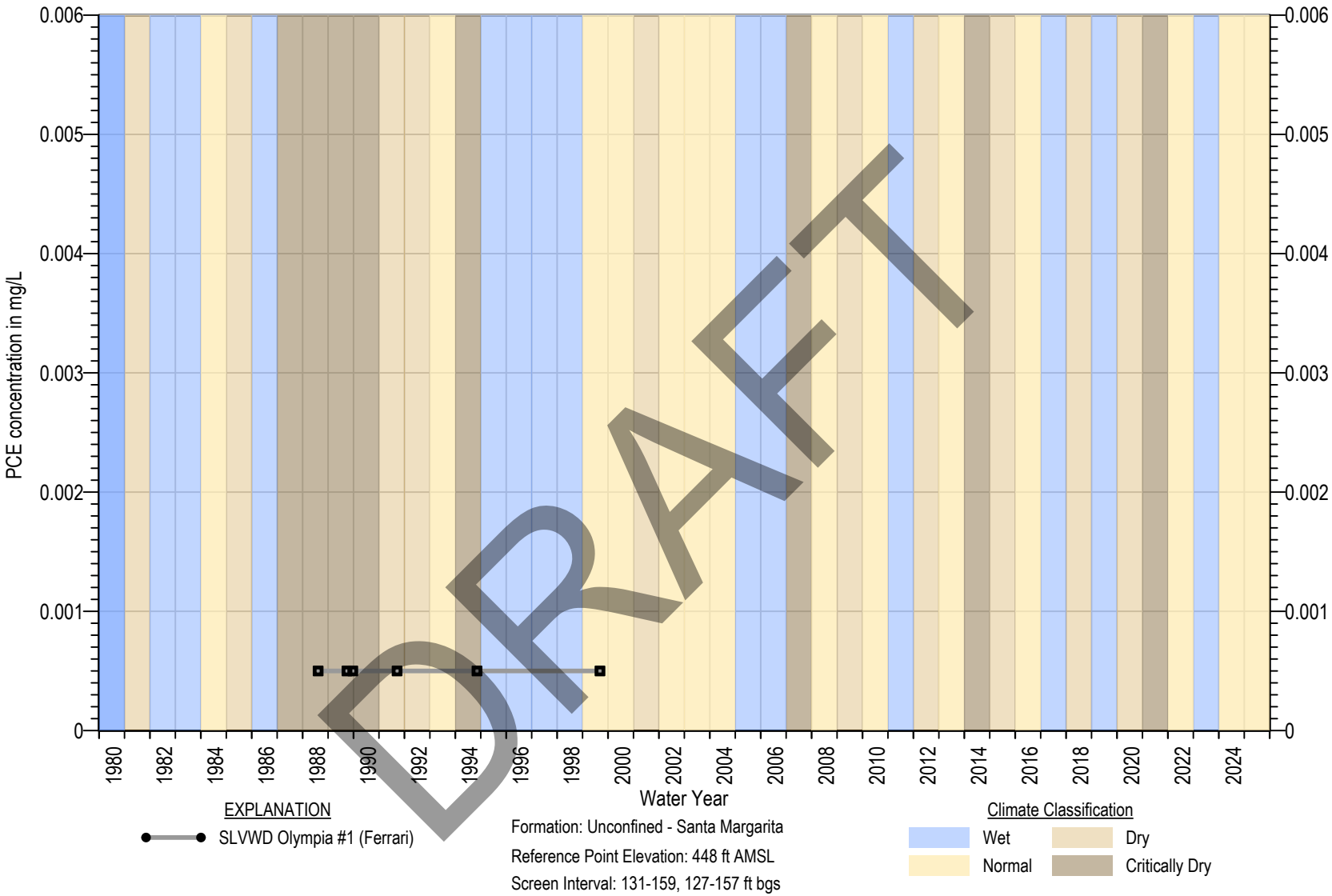
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-204. Nitrate Chemograph of SVWD #9

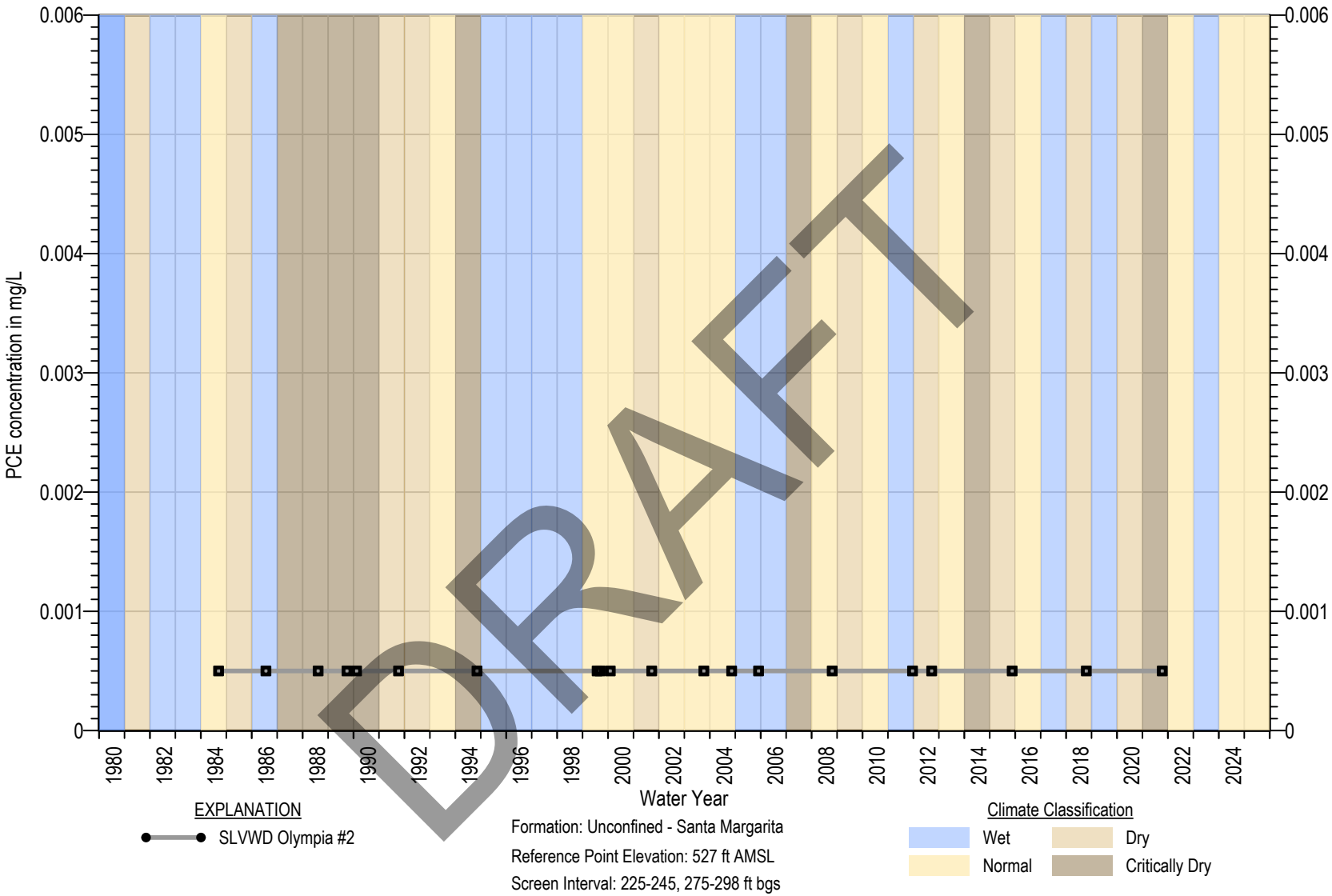
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-205. PCE Chemograph of SLVWD Olympia #1 (Ferrari)

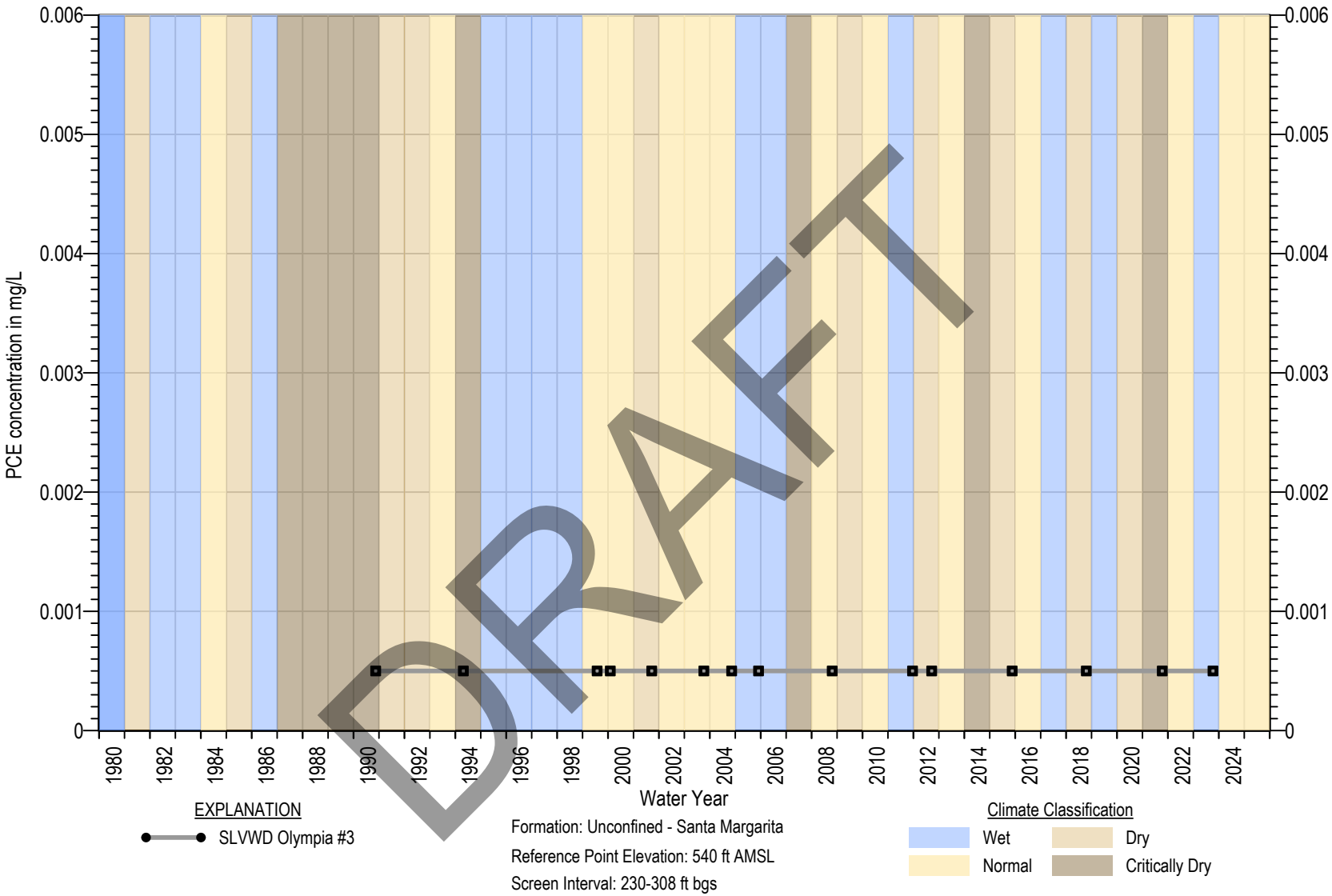
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-206. PCE Chemograph of SLVWD Olympia #2

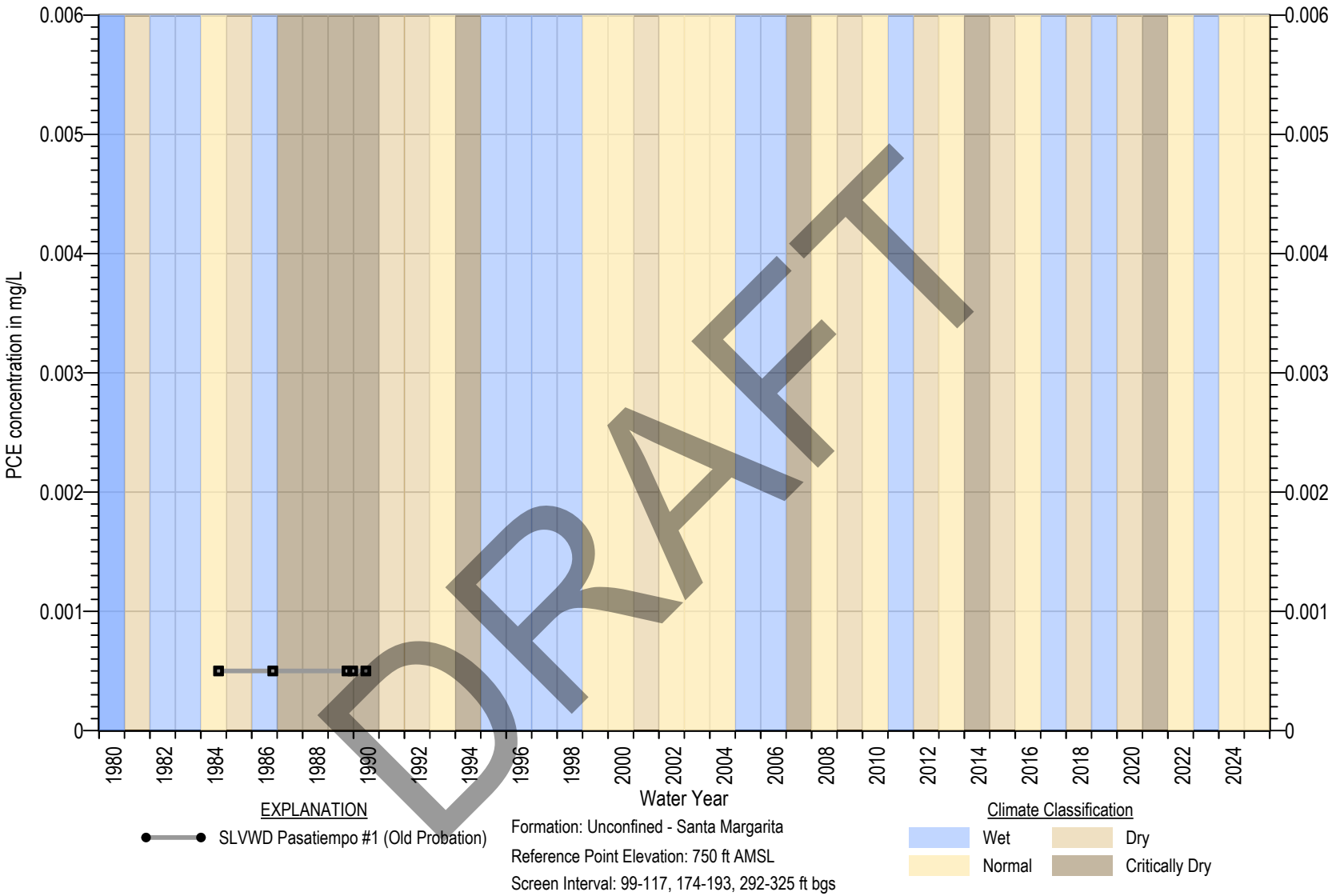
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-207. PCE Chemograph of SLVWD Olympia #3

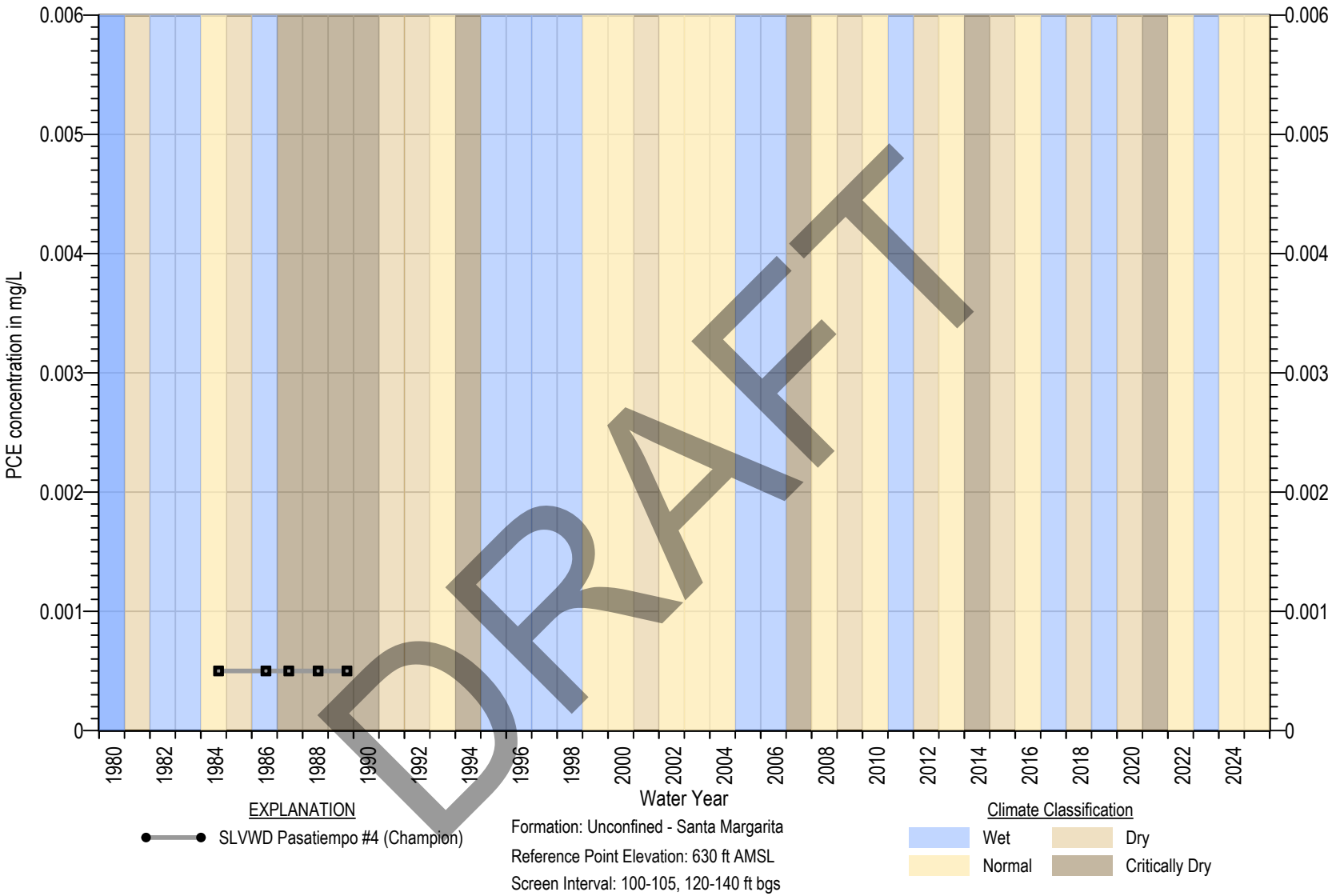
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-208. PCE Chemograph of SLVWD Pasatiempo #1 (Old Probation)

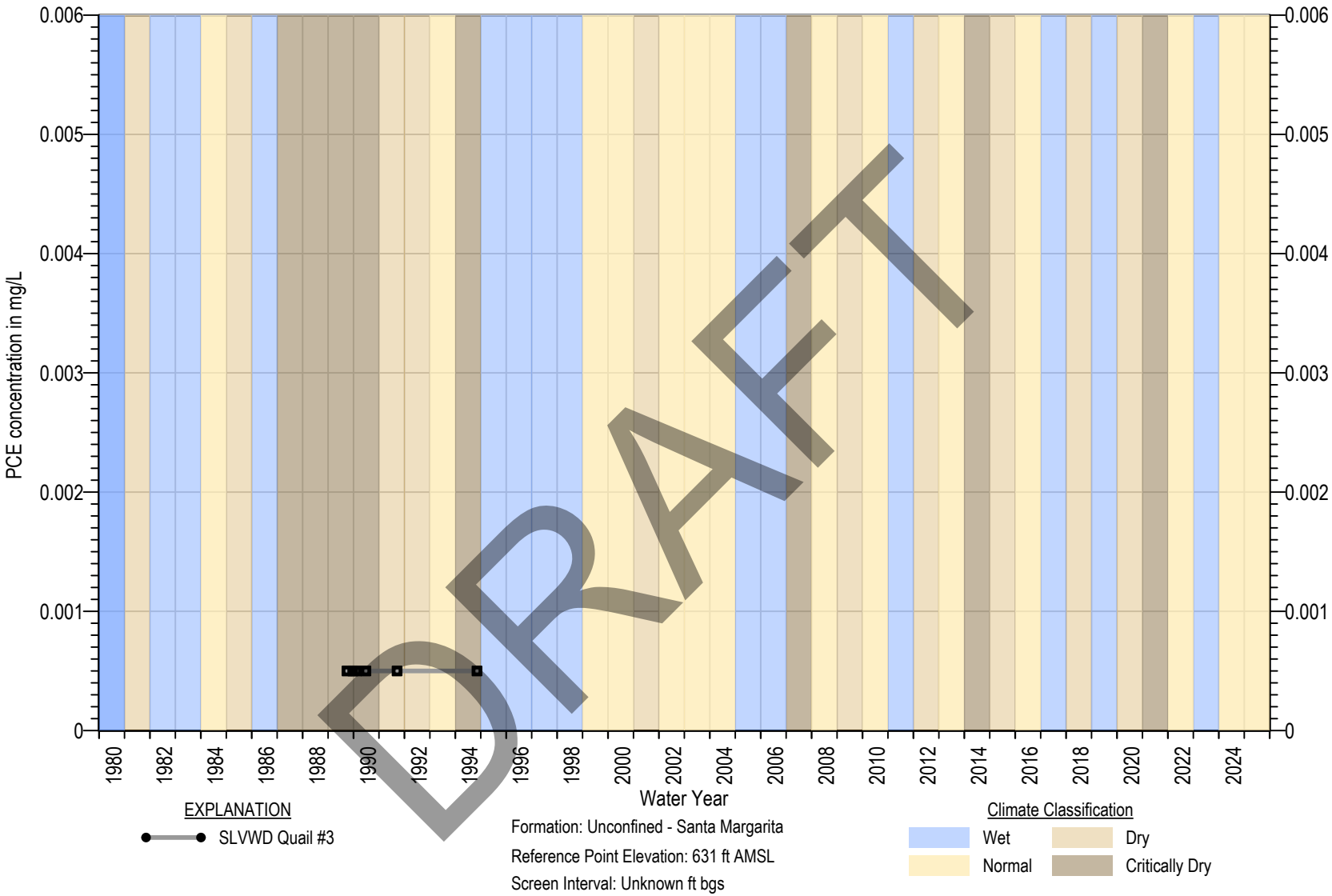
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-209. PCE Chemograph of SLVWD Pasatiempo #4 (Champion)

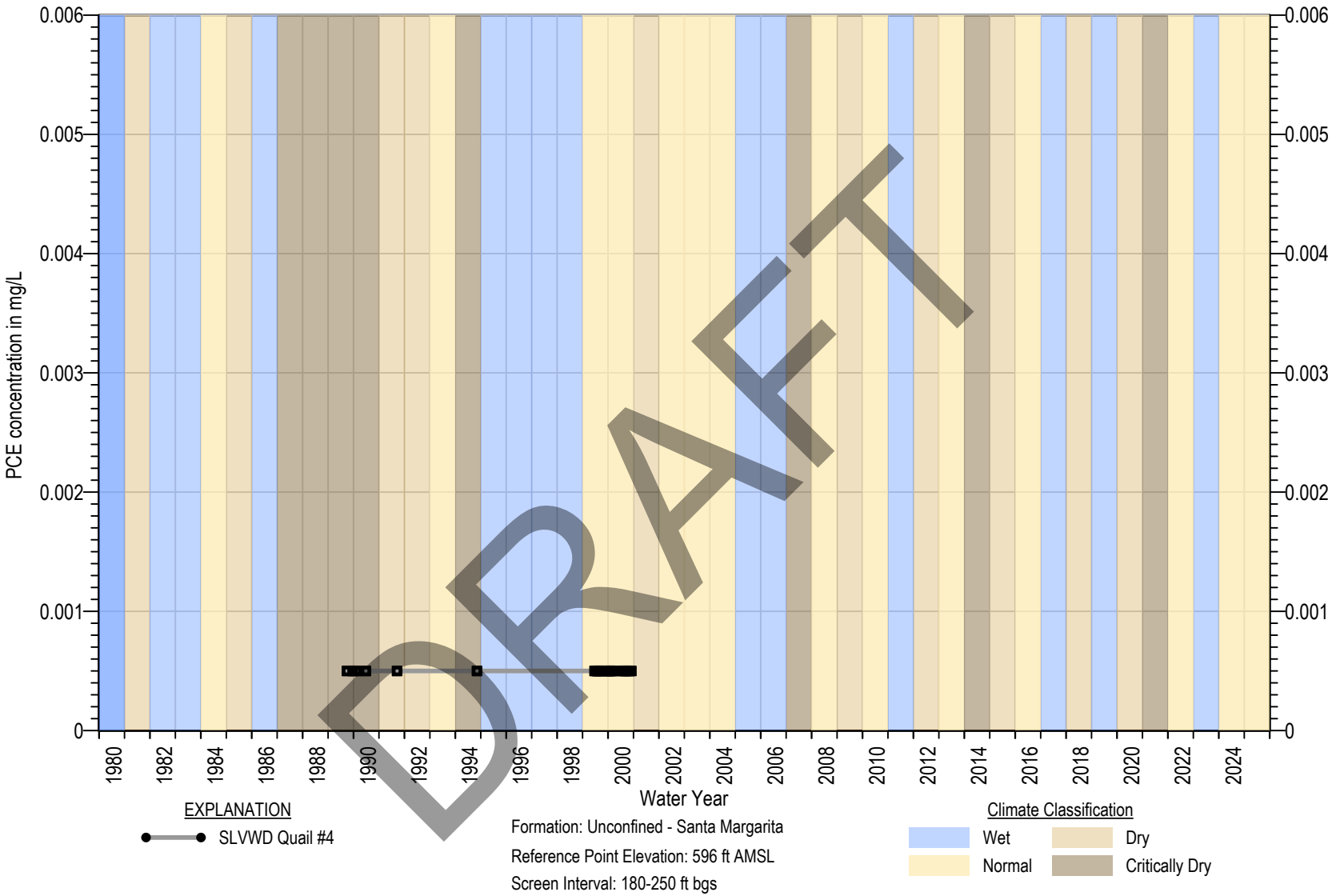
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-210. PCE Chemograph of SLVWD Quail #3

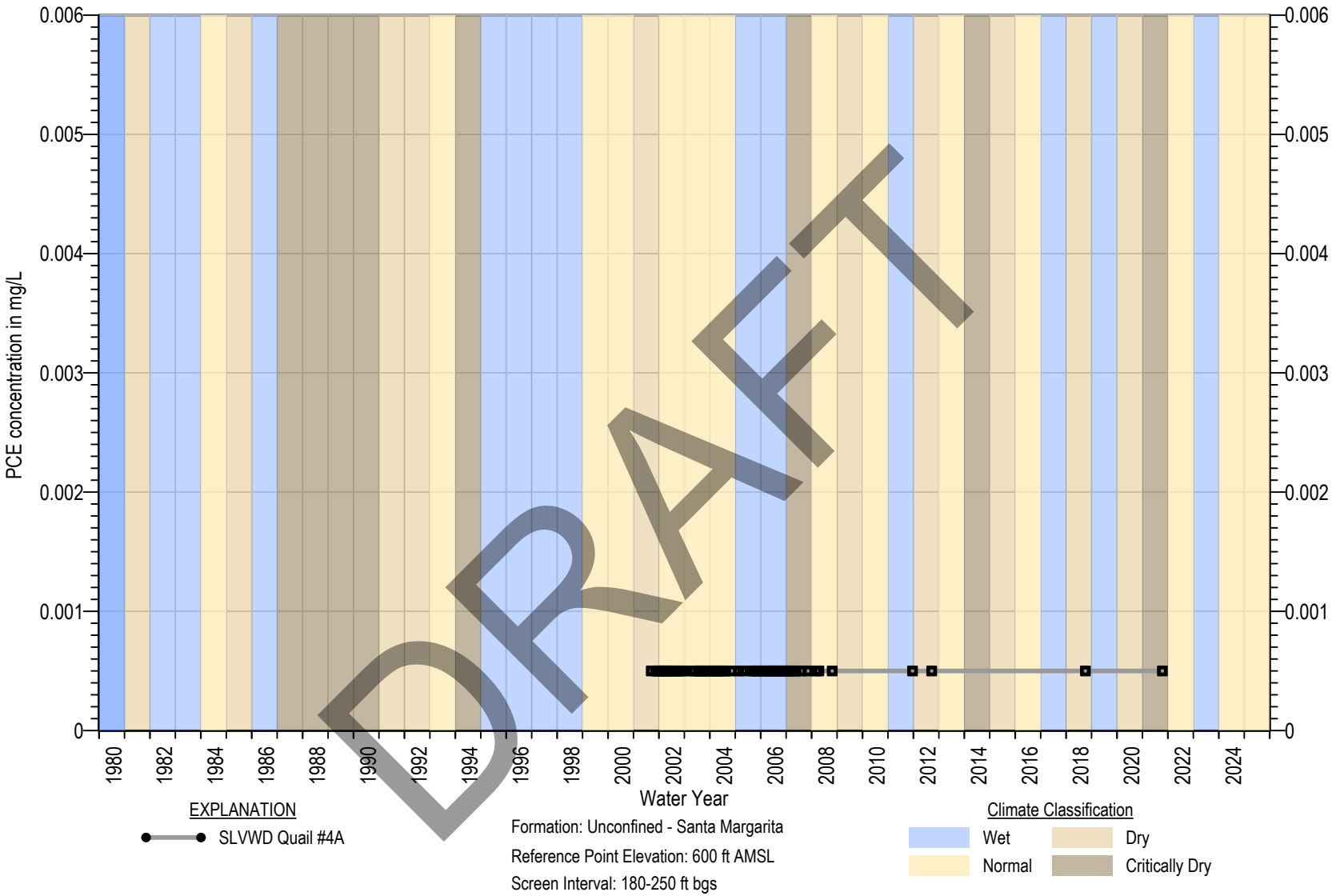
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-211. PCE Chemograph of SLVWD Quail #4

MONTGOMERY & ASSOCIATES



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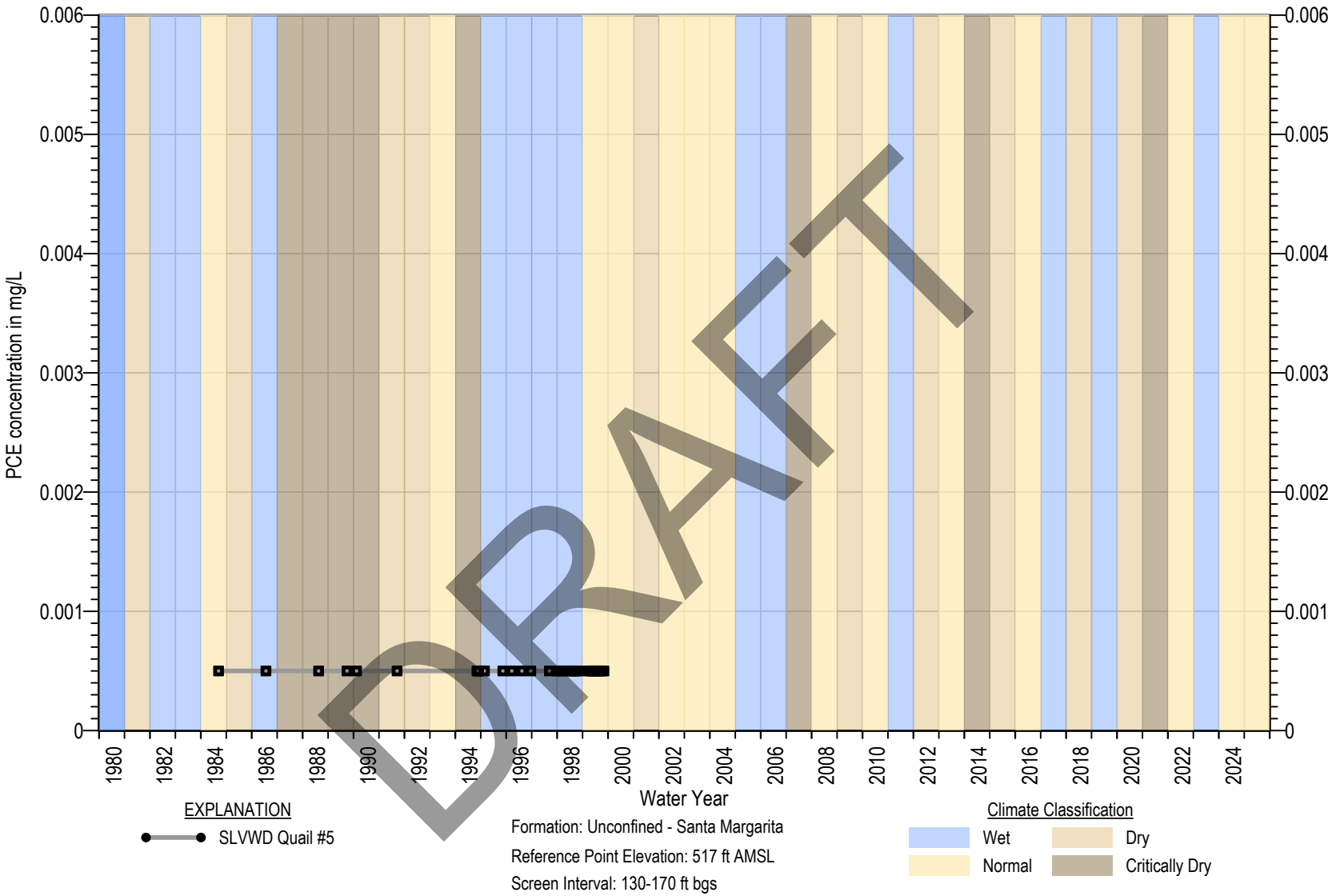
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-212. PCE Chemograph of SLVWD Quail #4A

MONTGOMERY & ASSOCIATES

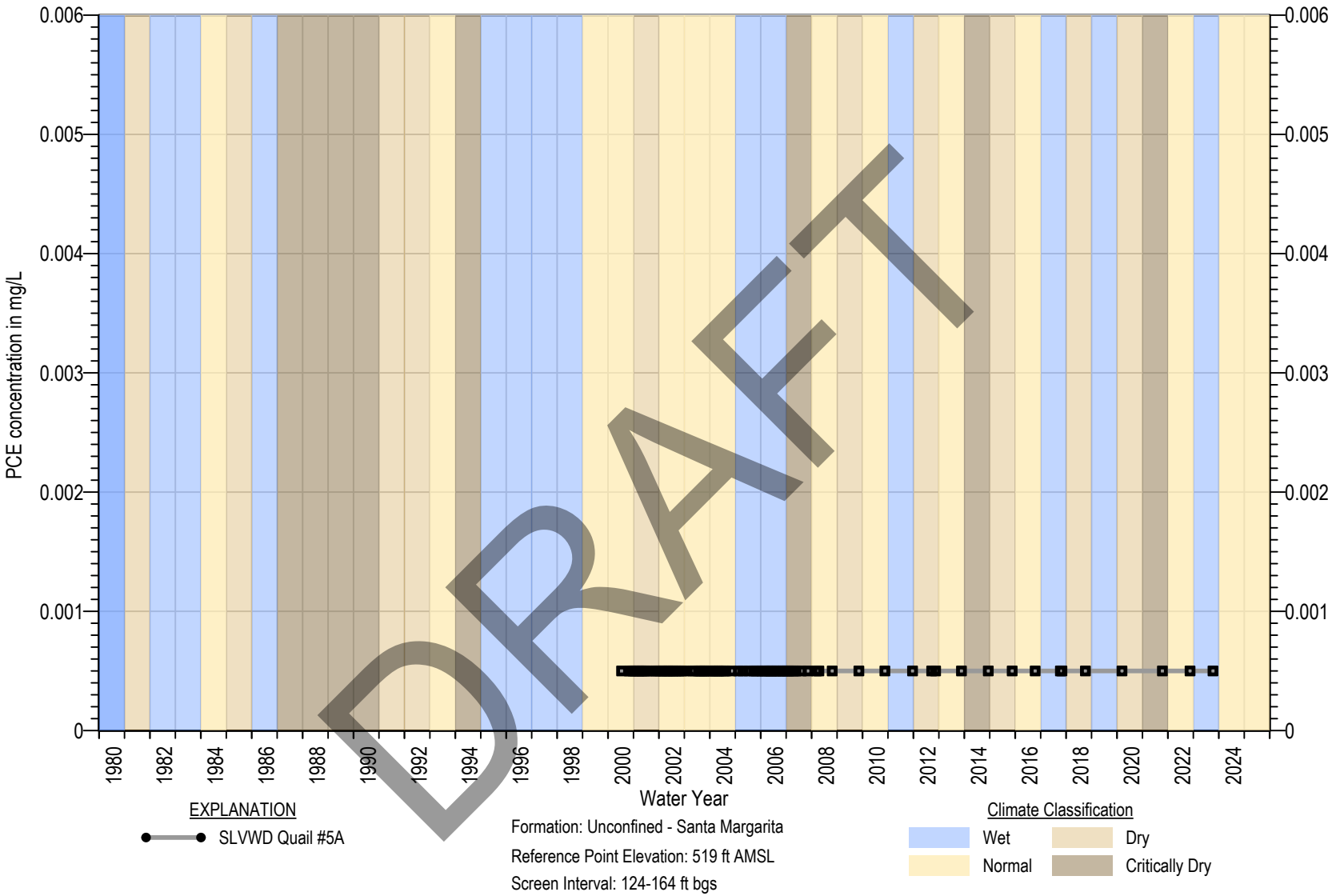


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-213. PCE Chemograph of SLVWD Quail #5

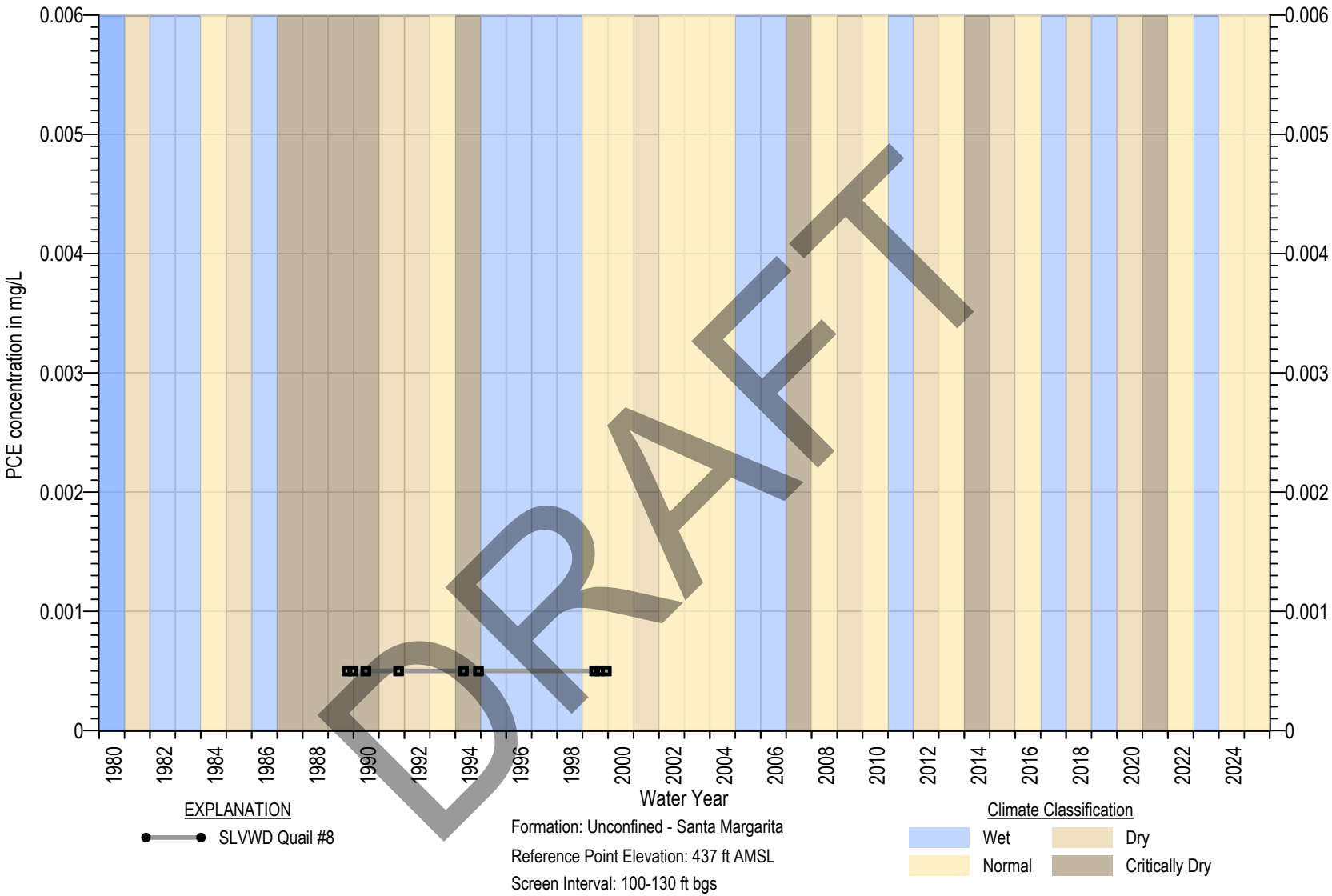
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-214. PCE Chemograph of SLVWD Quail #5A

MONTGOMERY & ASSOCIATES

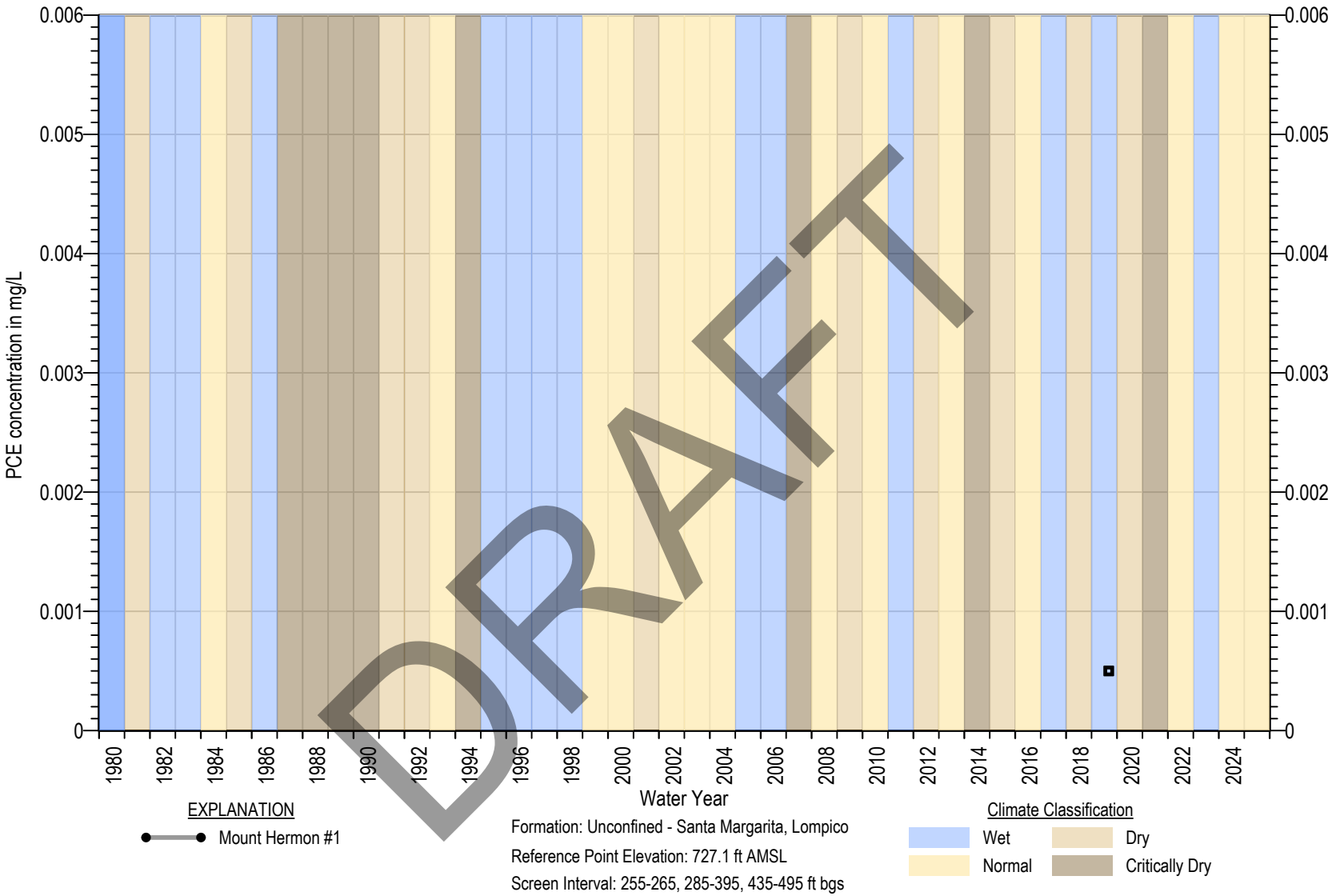


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-215. PCE Chemograph of SLVWD Quail #8

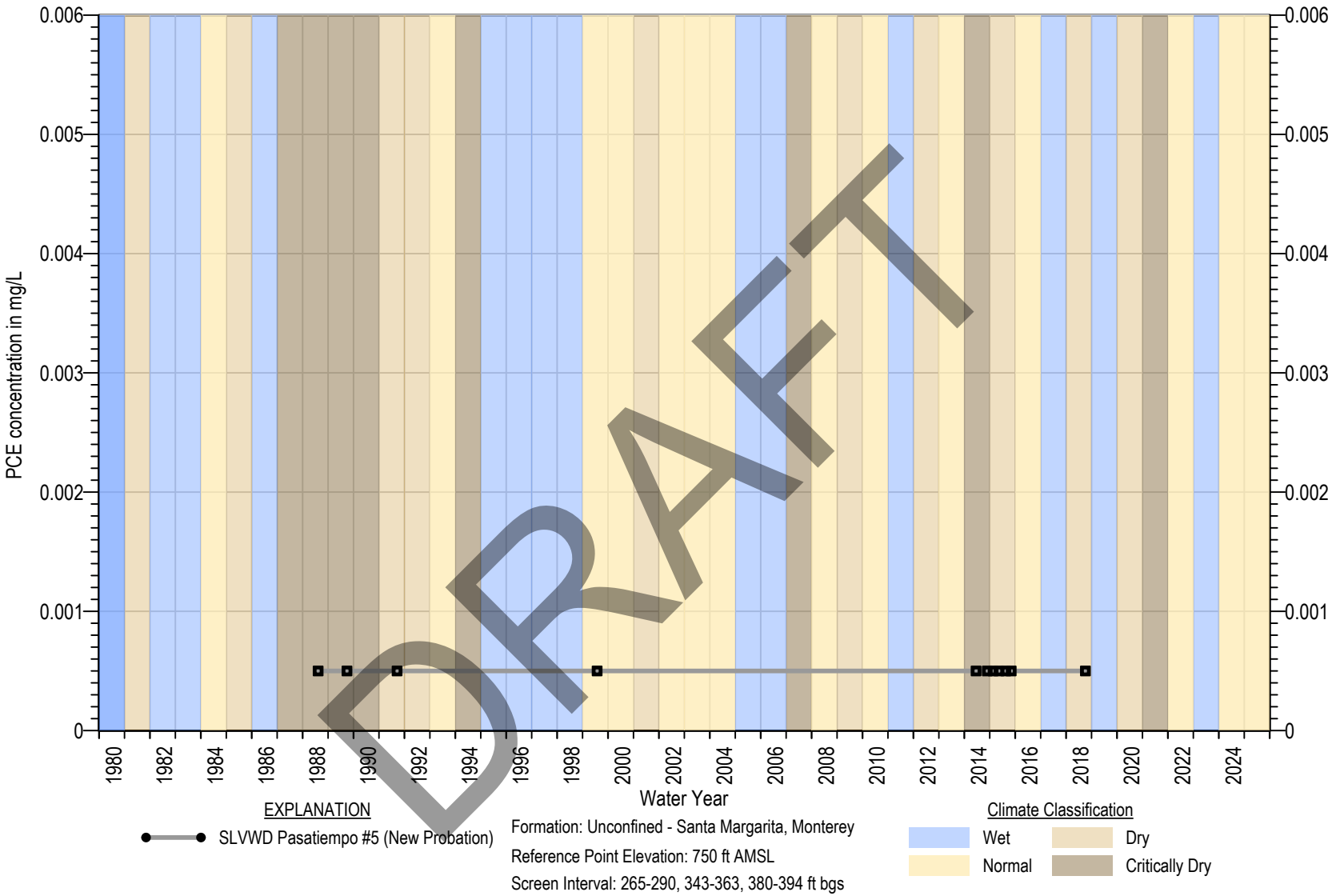
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-216. PCE Chemograph of Mount Hermon #1

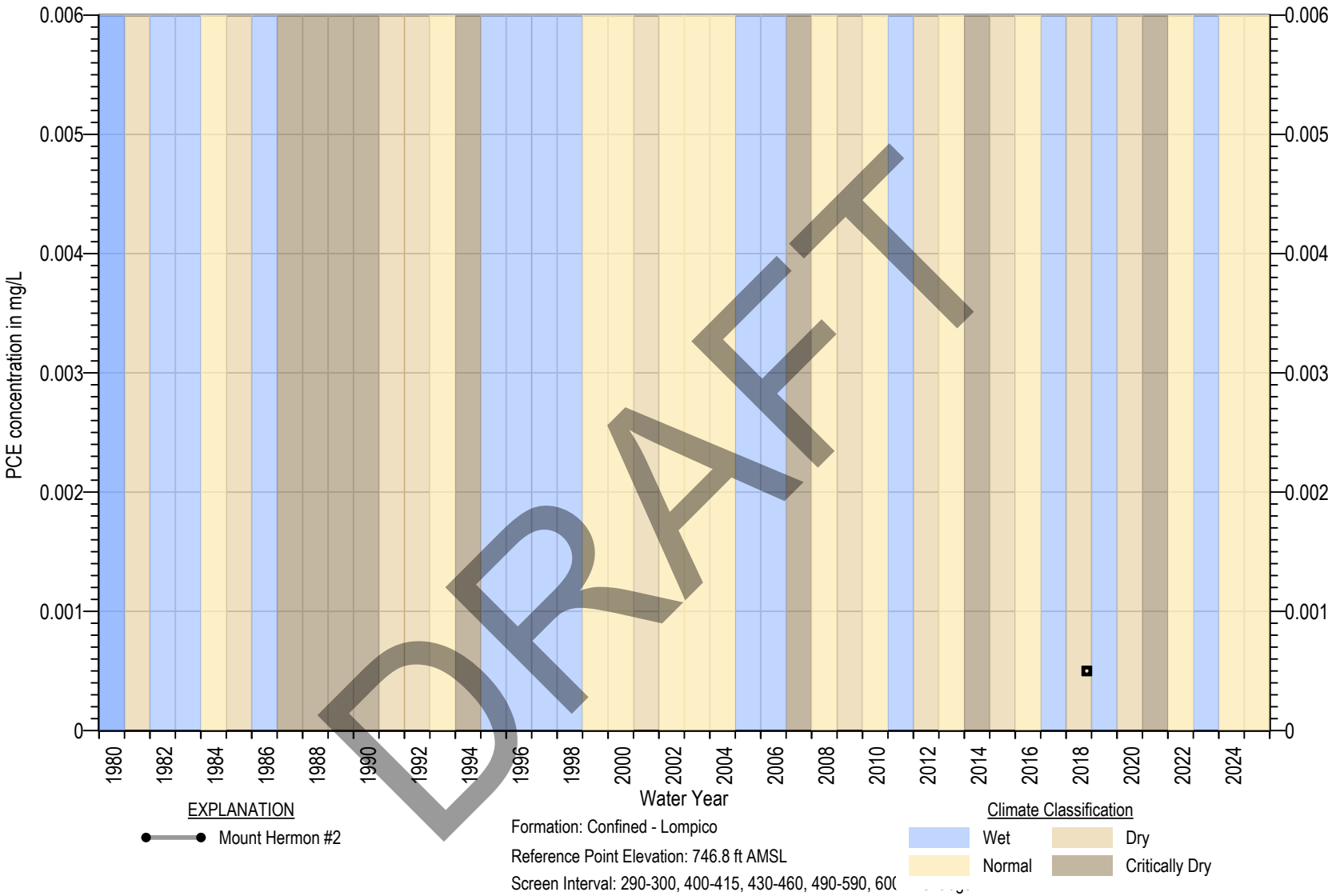
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-217. PCE Chemograph of SLVWD Pasatiempo #5 (New Probation)

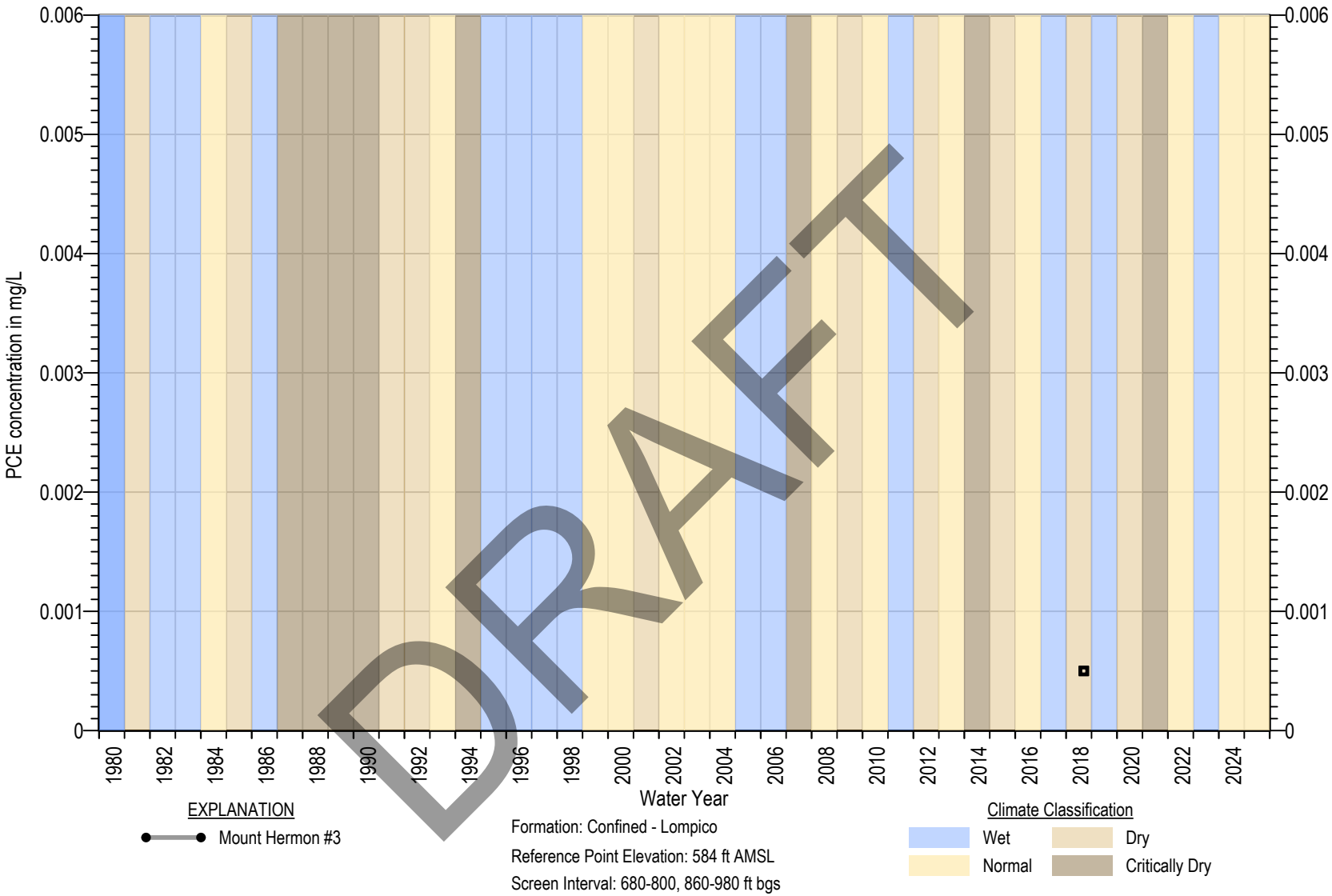
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-218. PCE Chemograph of Mount Hermon #2

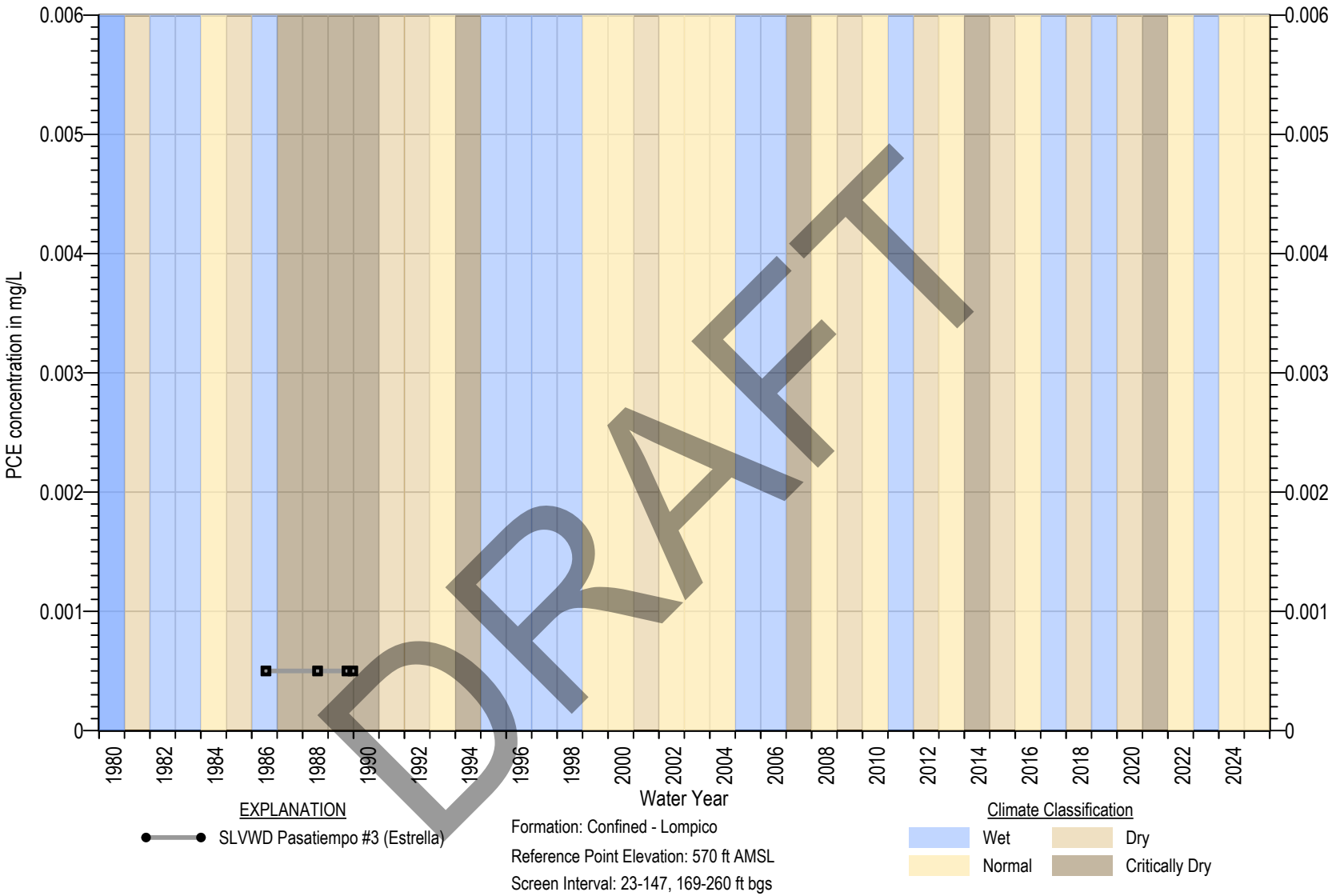
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-219. PCE Chemograph of Mount Hermon #3

MONTGOMERY & ASSOCIATES



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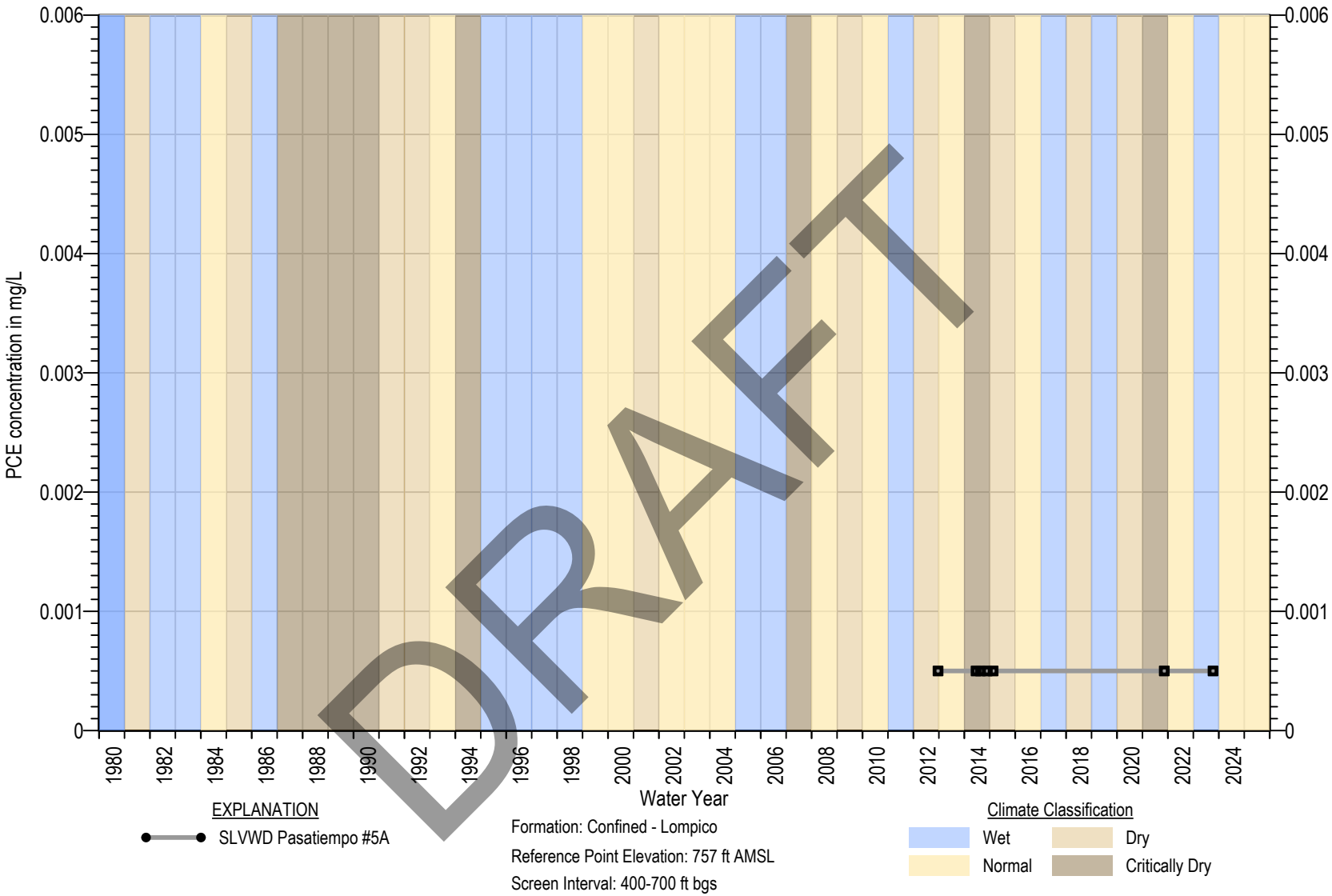
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-220. PCE Chemograph of SLVWD Pasatiempo #3 (Estrella)

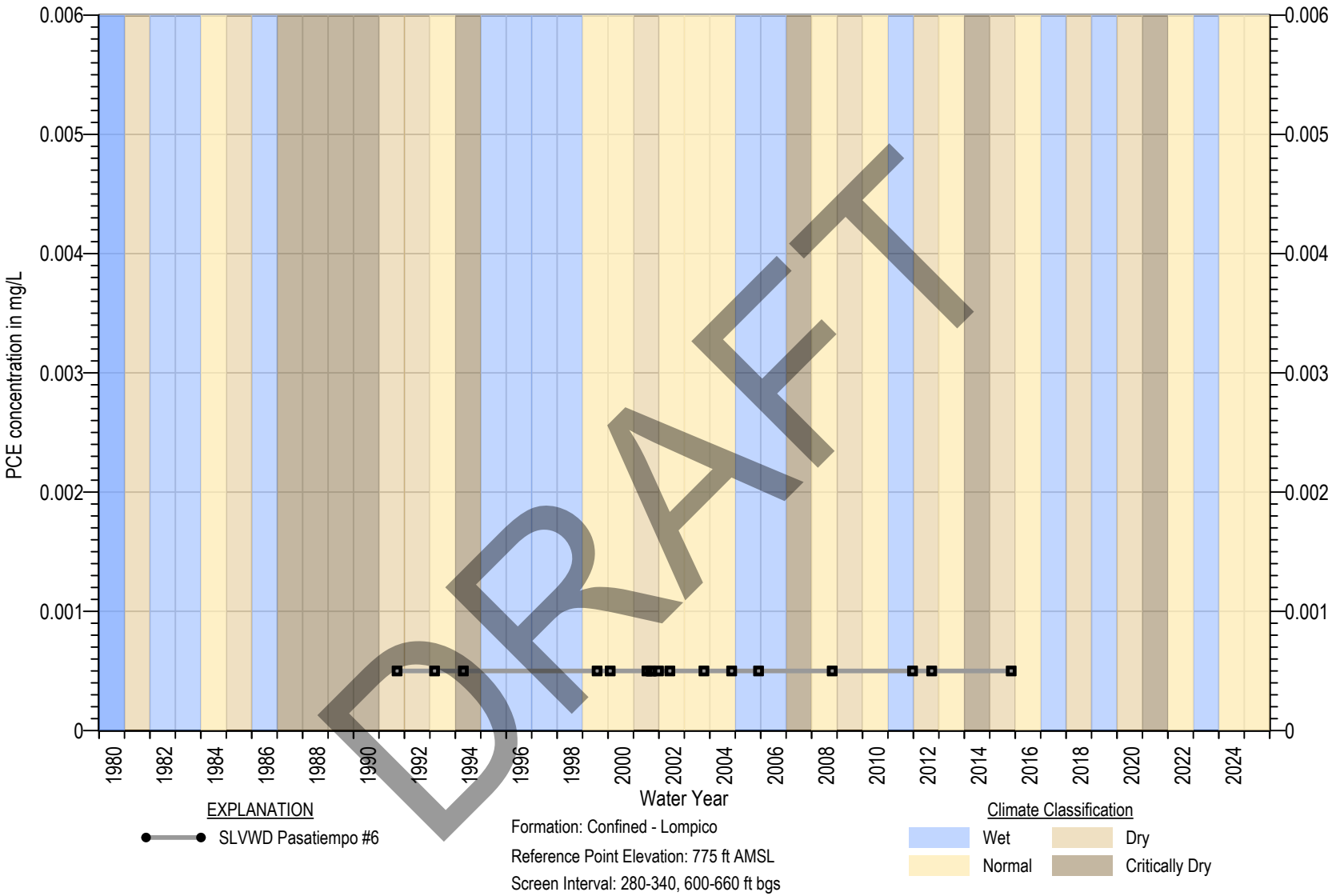
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-221. PCE Chemograph of SLVWD Pasatiempo #5A

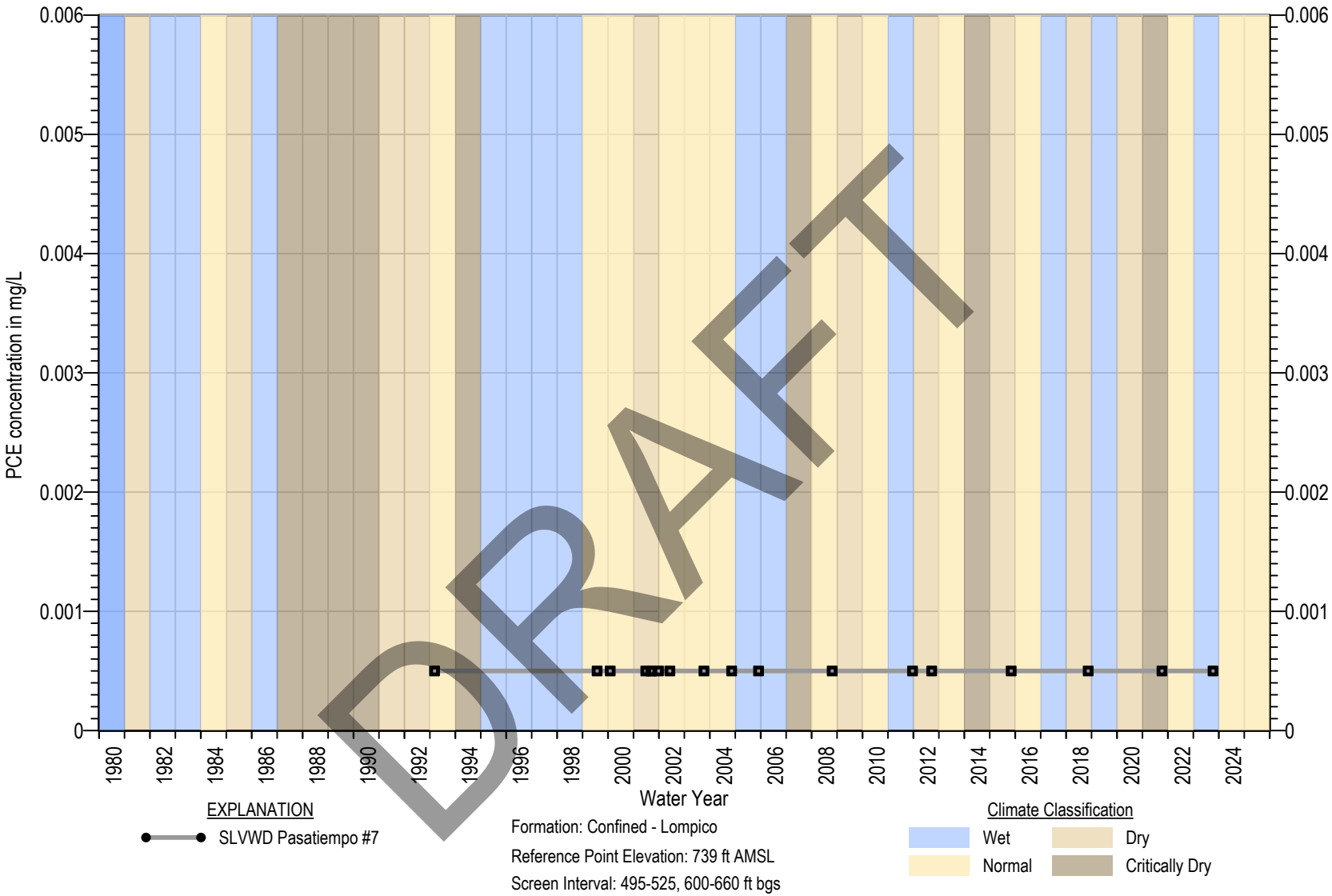
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-222. PCE Chemograph of SLVWD Pasatiempo #6

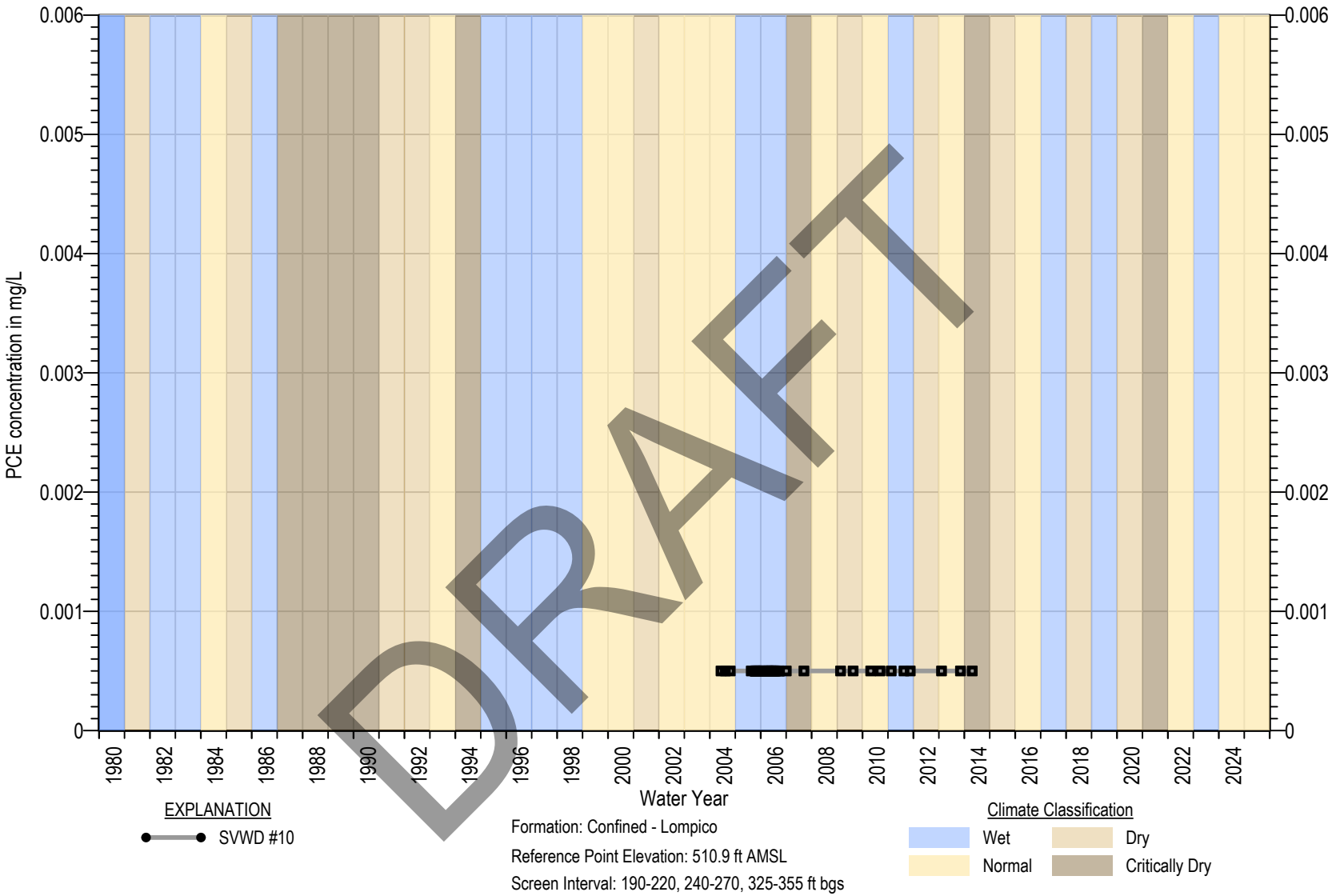
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-223. PCE Chemograph of SLVWD Pasatiempo #7

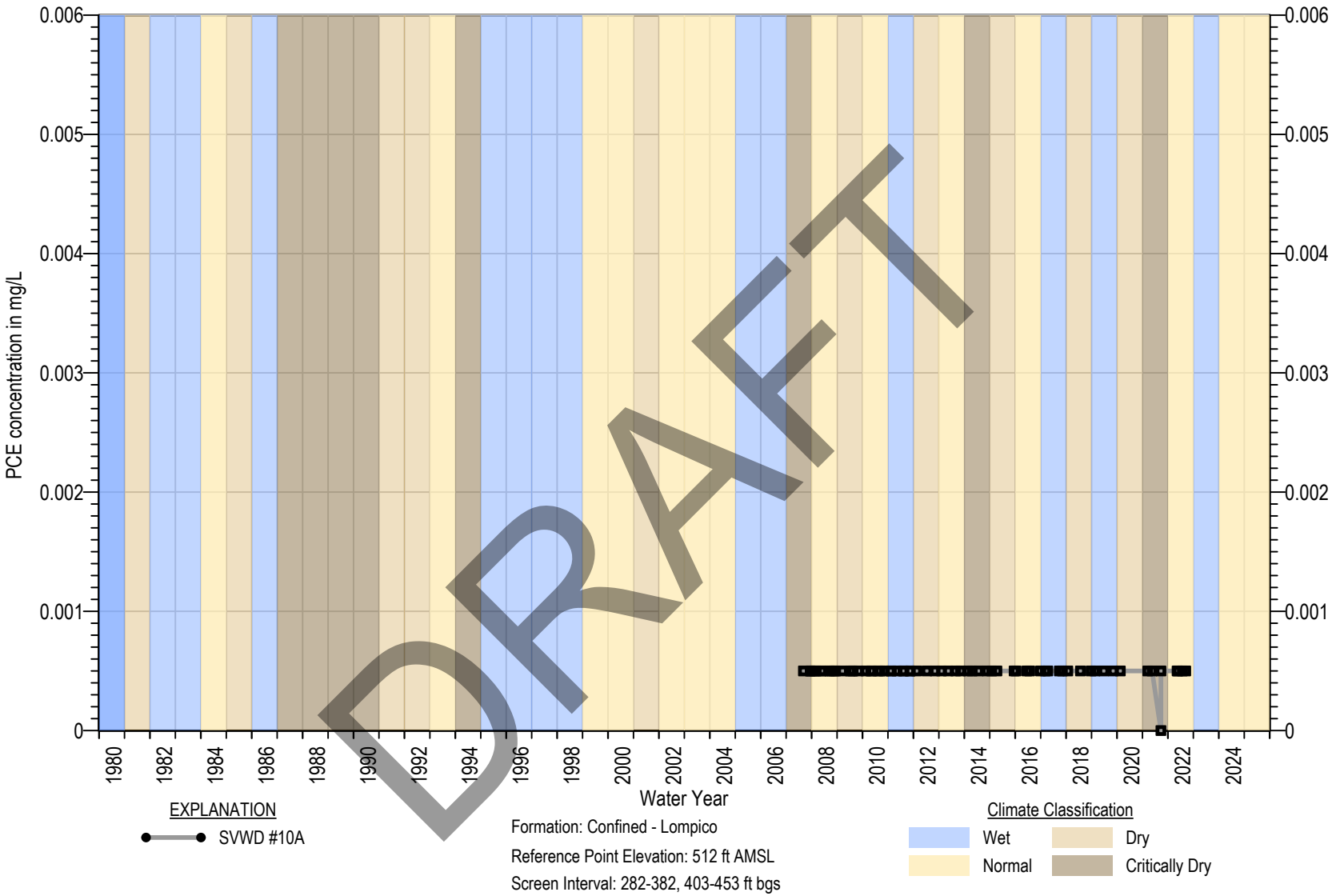
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-224. PCE Chemograph of SVWD #10

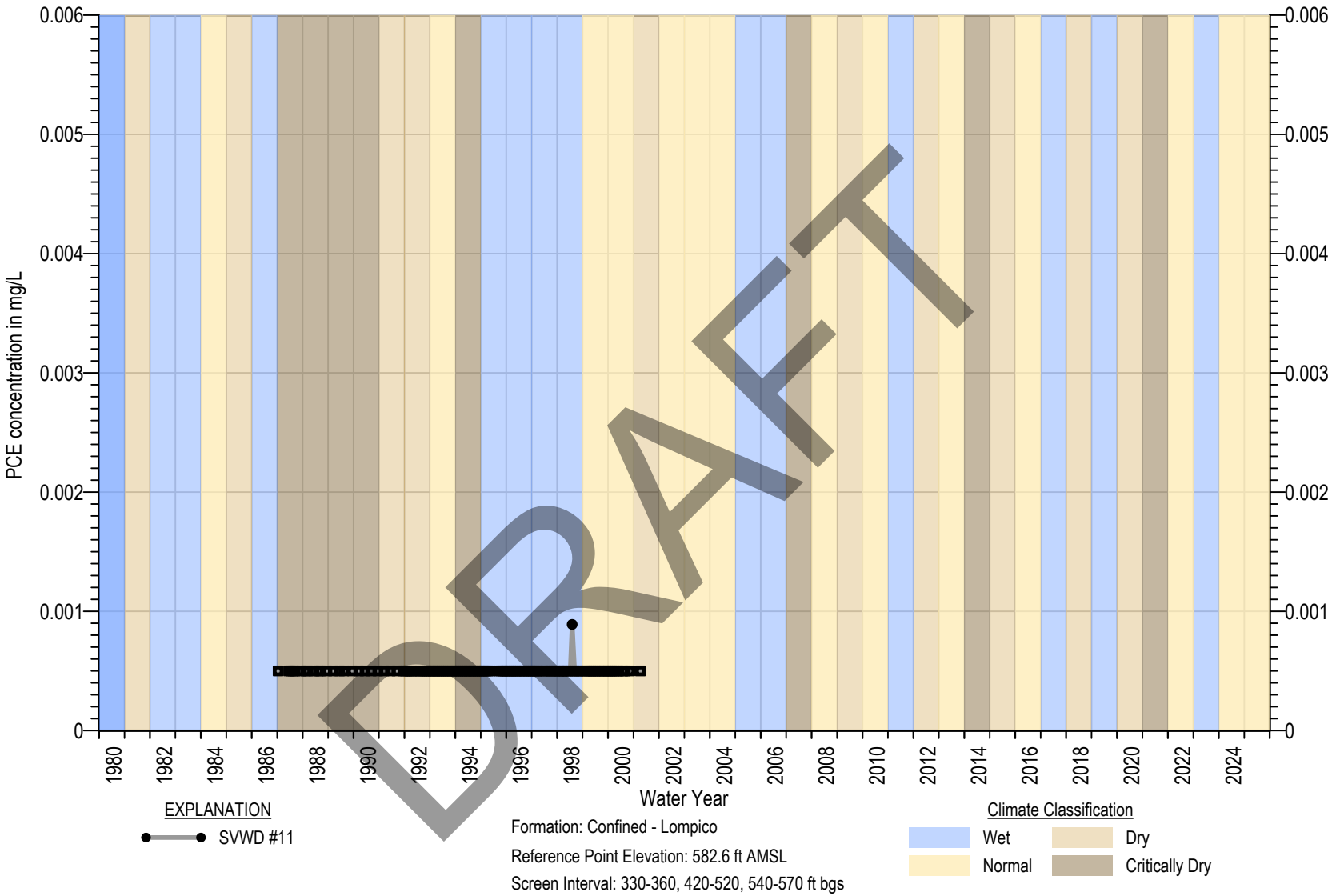
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-225. PCE Chemograph of SVWD #10A

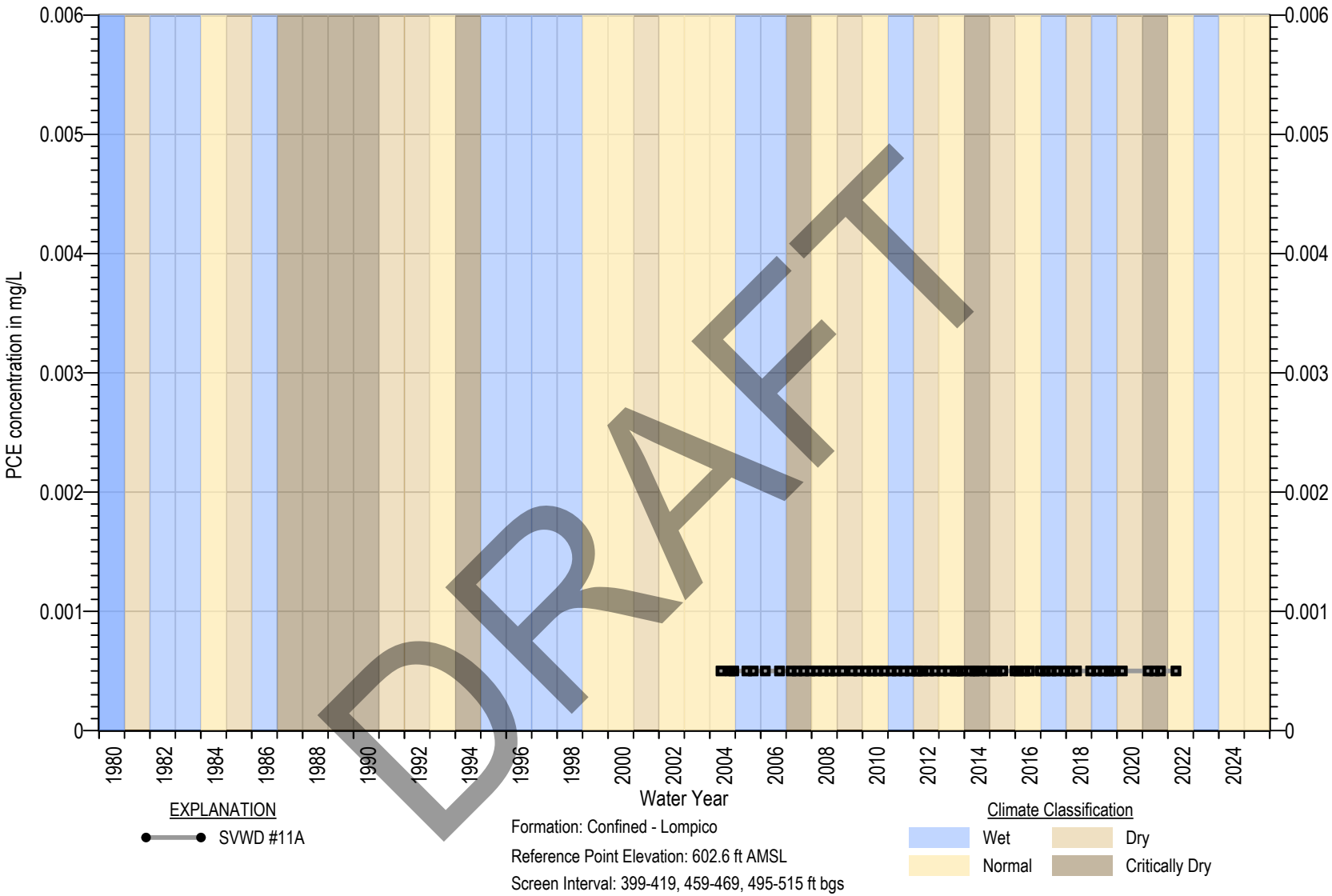
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-226. PCE Chemograph of SVWD #11

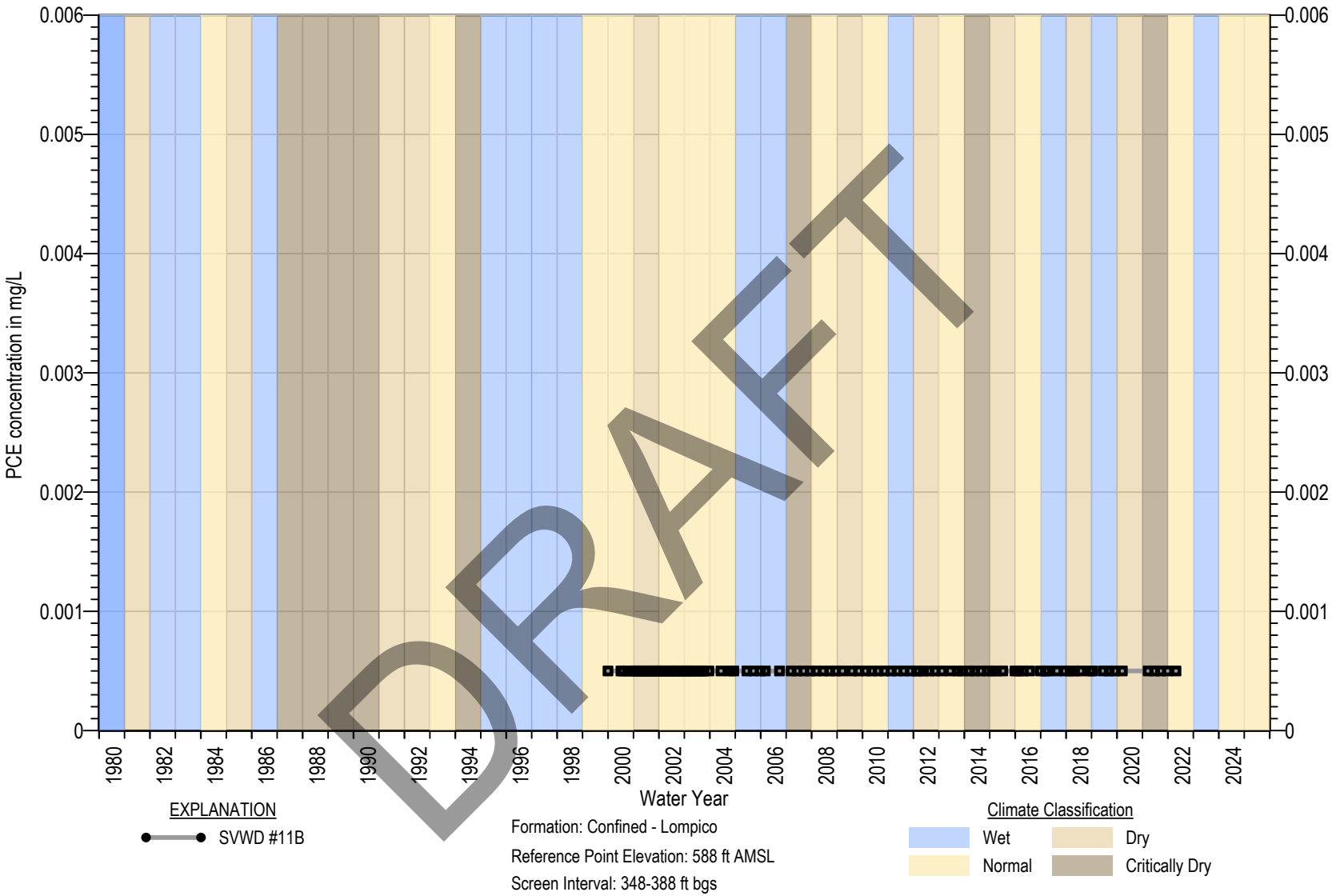
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-227. PCE Chemograph of SVWD #11A

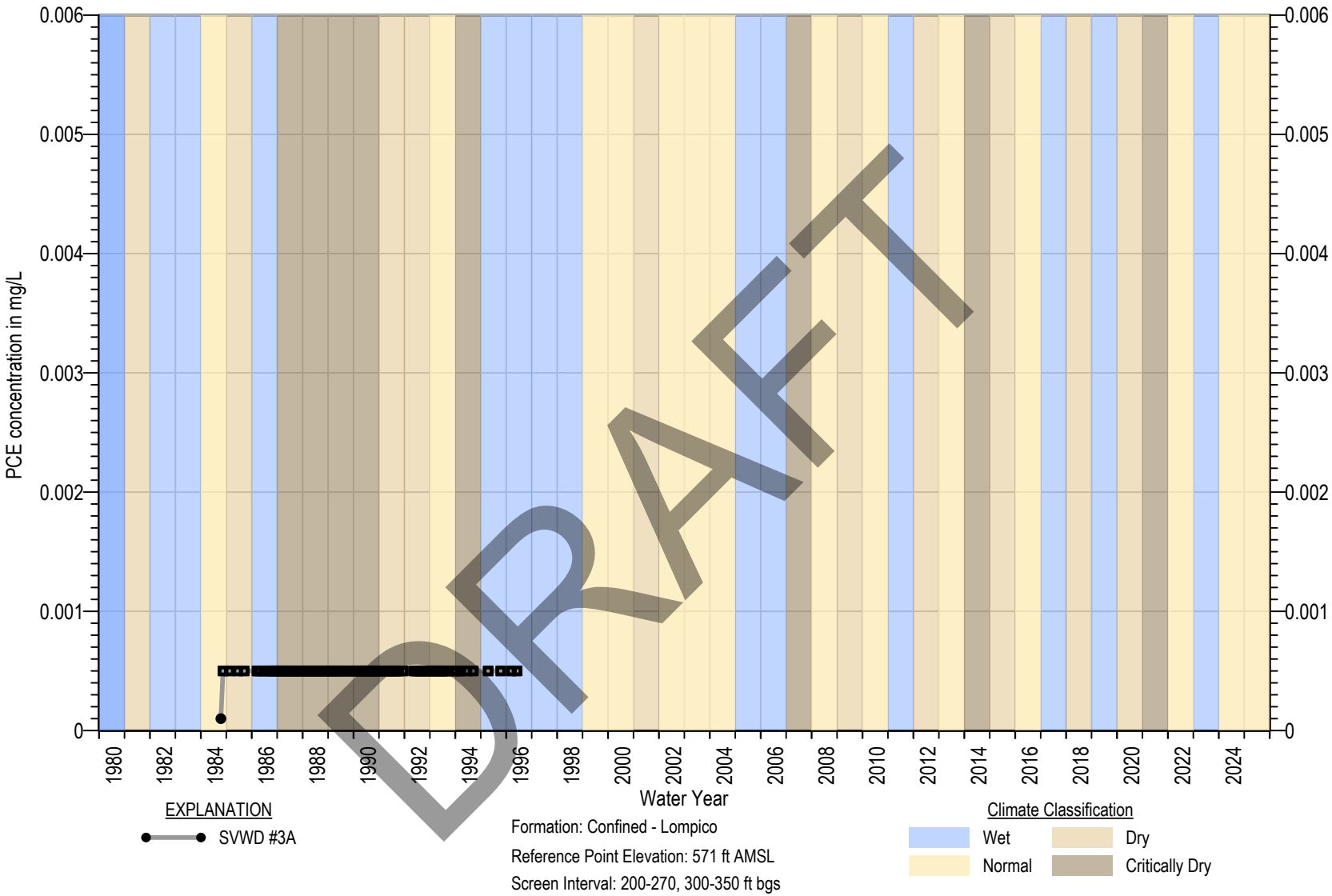
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-228. PCE Chemograph of SVWD #11B

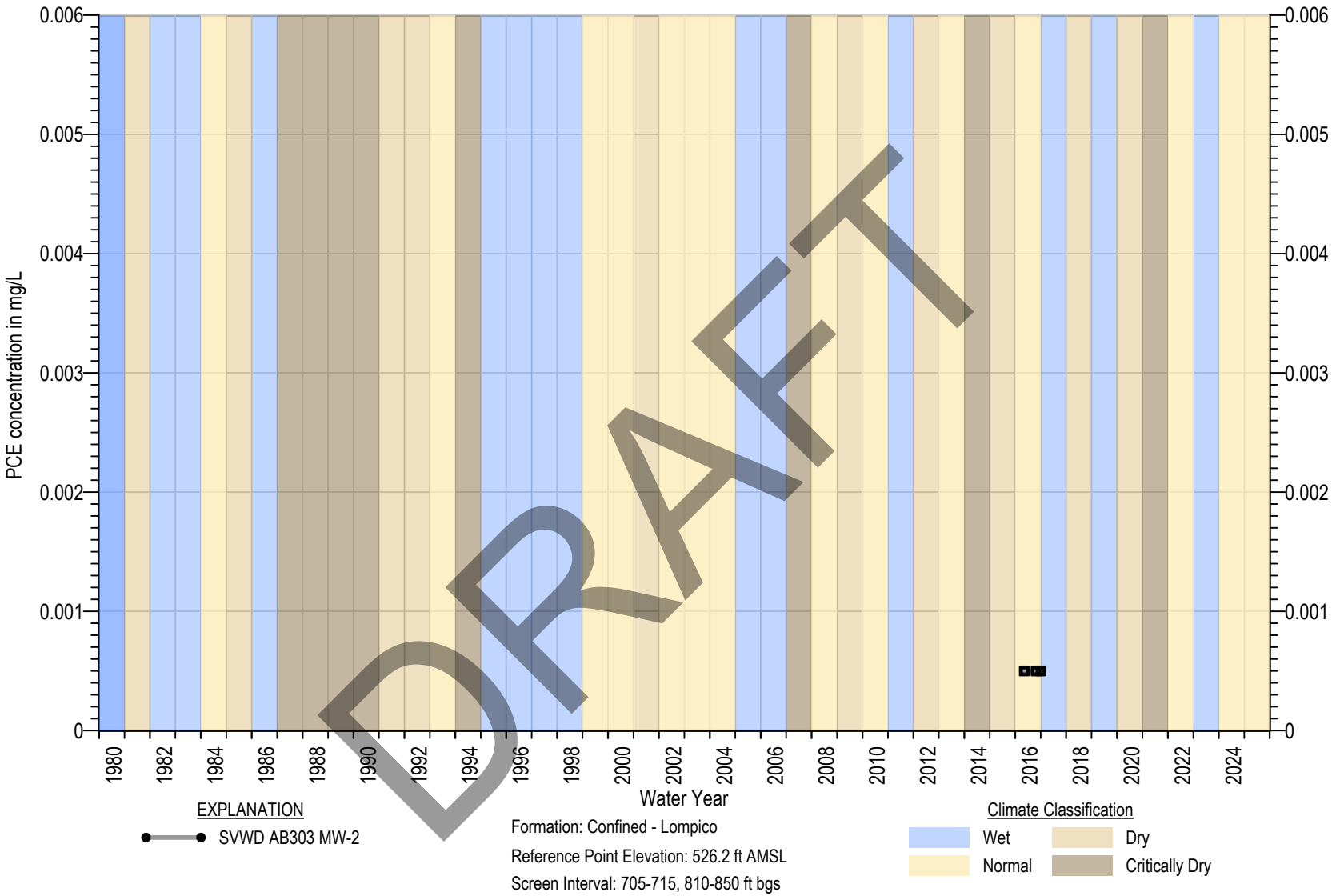
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-229. PCE Chemograph of SVWD #3A

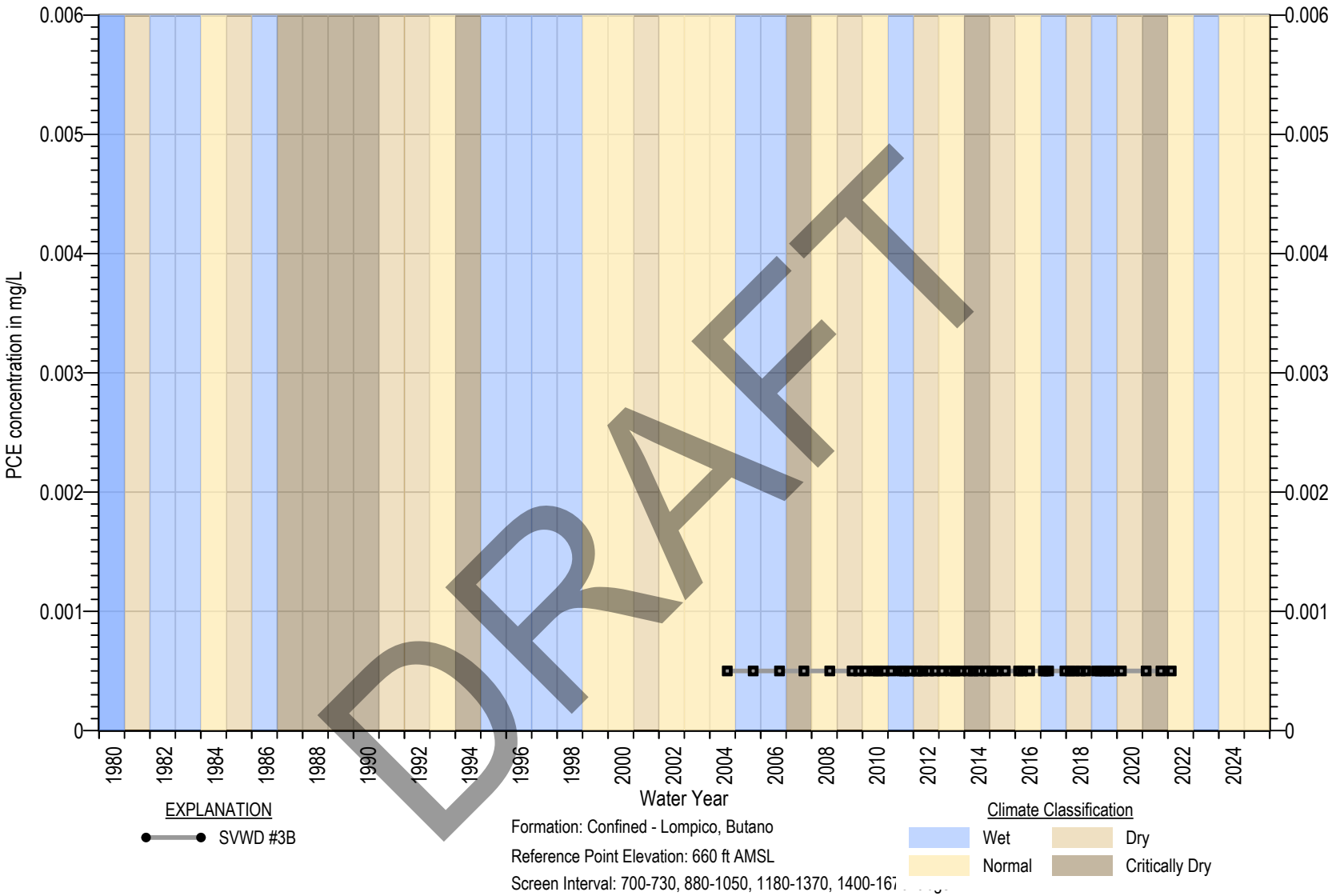
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-230. PCE Chemograph of SVWD AB303 MW-2

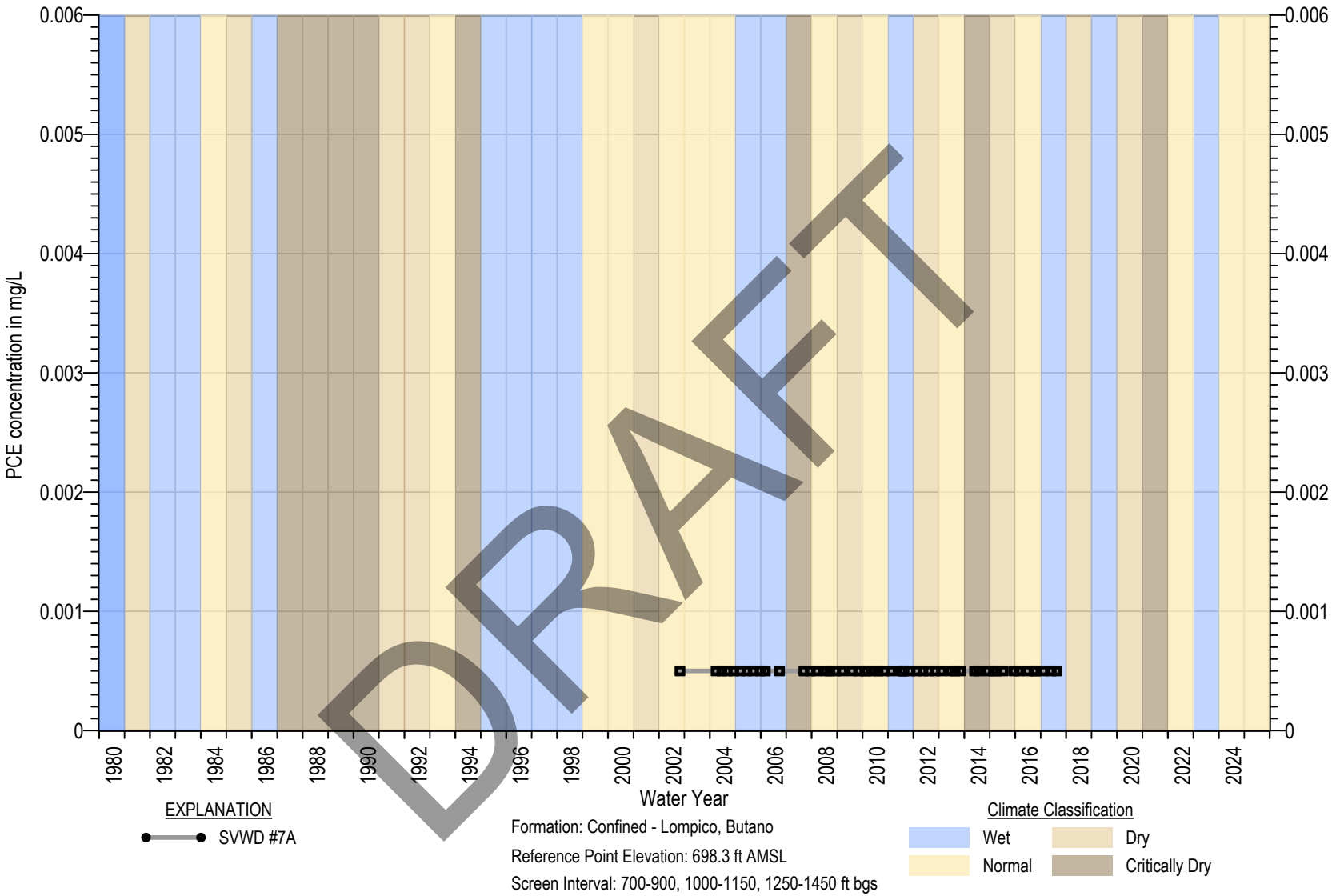
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-231. PCE Chemograph of SVWD #3B

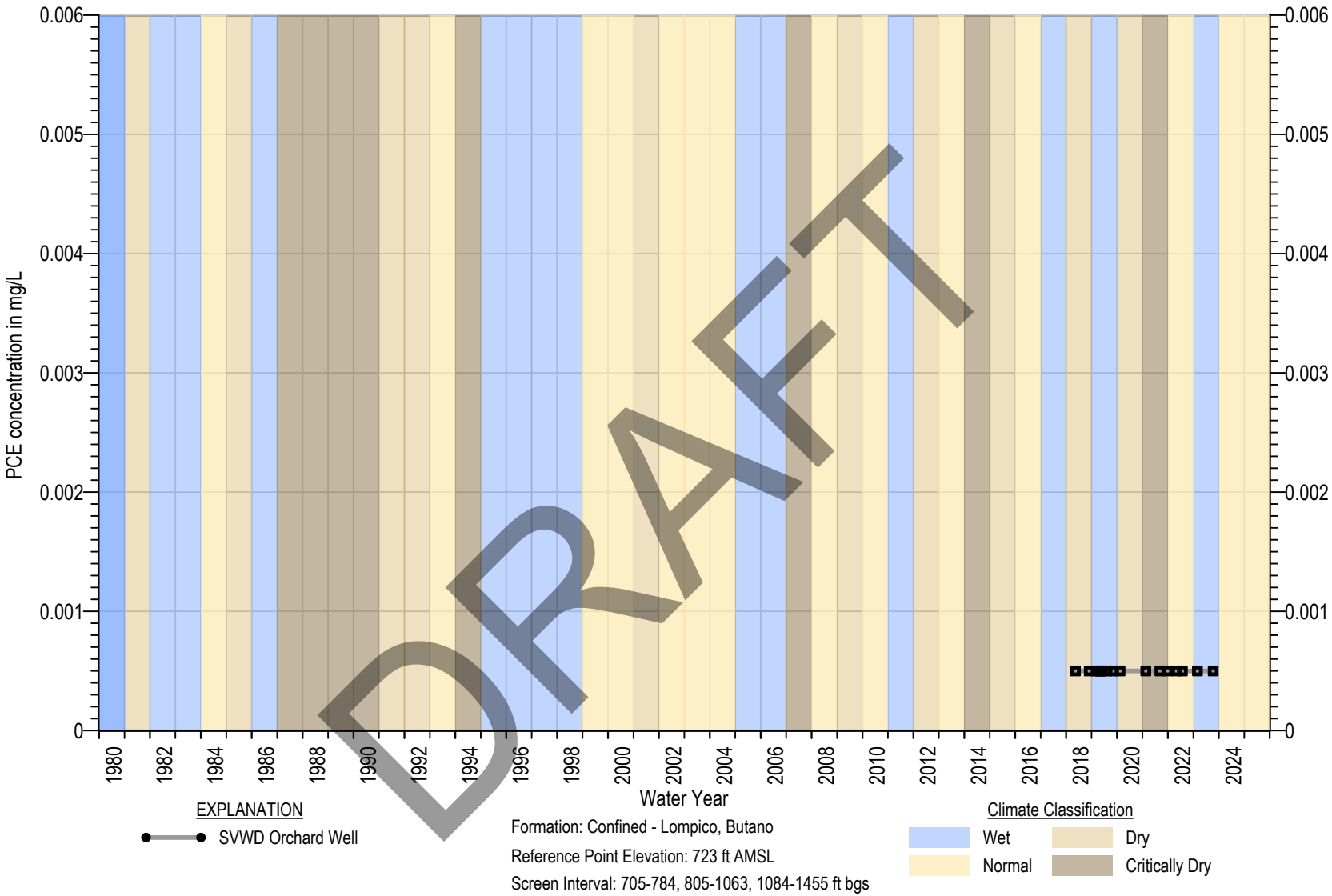
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-232. PCE Chemograph of SVWD #7A

MONTGOMERY & ASSOCIATES

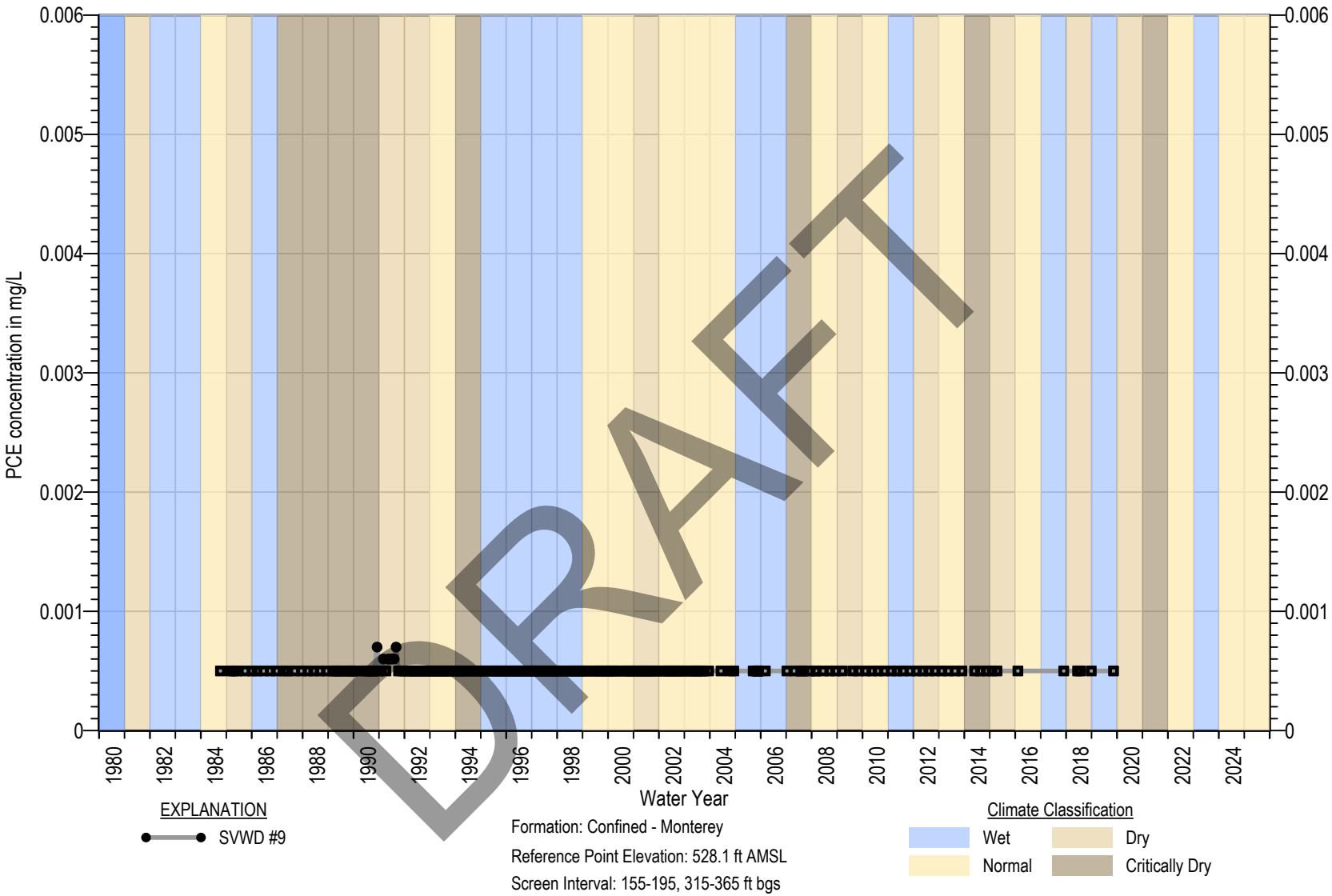


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-233. PCE Chemograph of SVWD Orchard Well

MONTGOMERY & ASSOCIATES

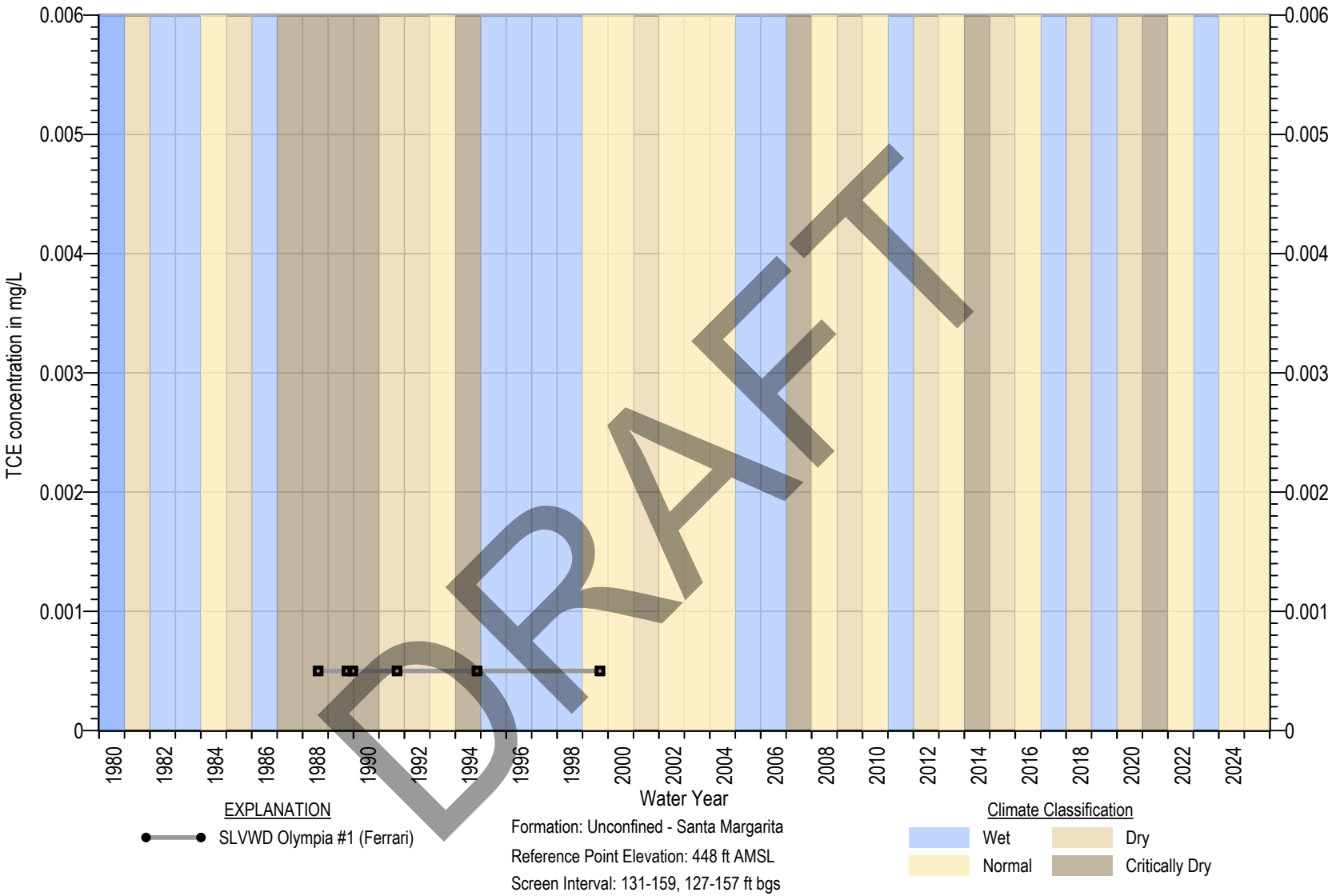


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-234. PCE Chemograph of SVWD #9

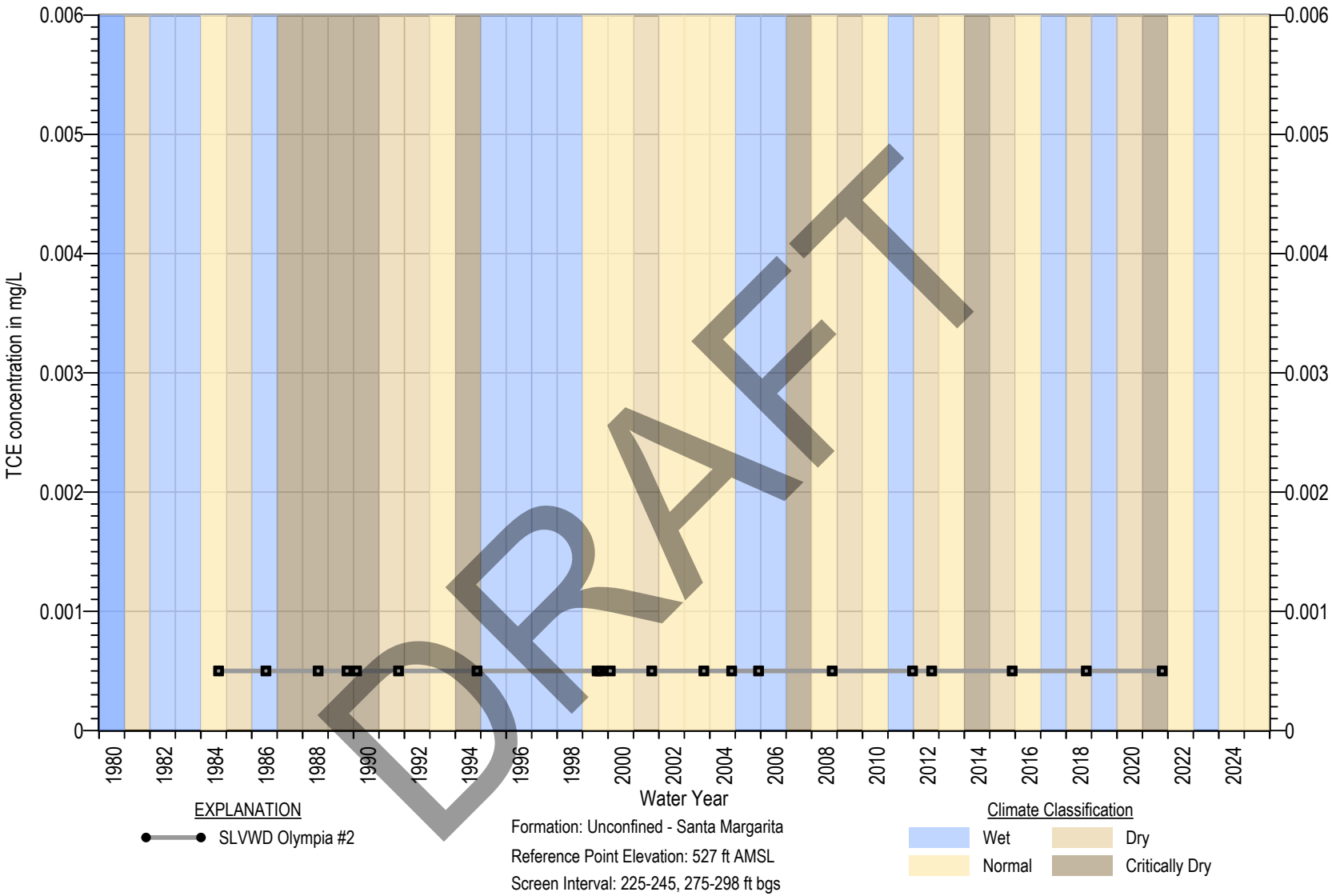
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-235. TCE Chemograph of SLVWD Olympia #1 (Ferrari)

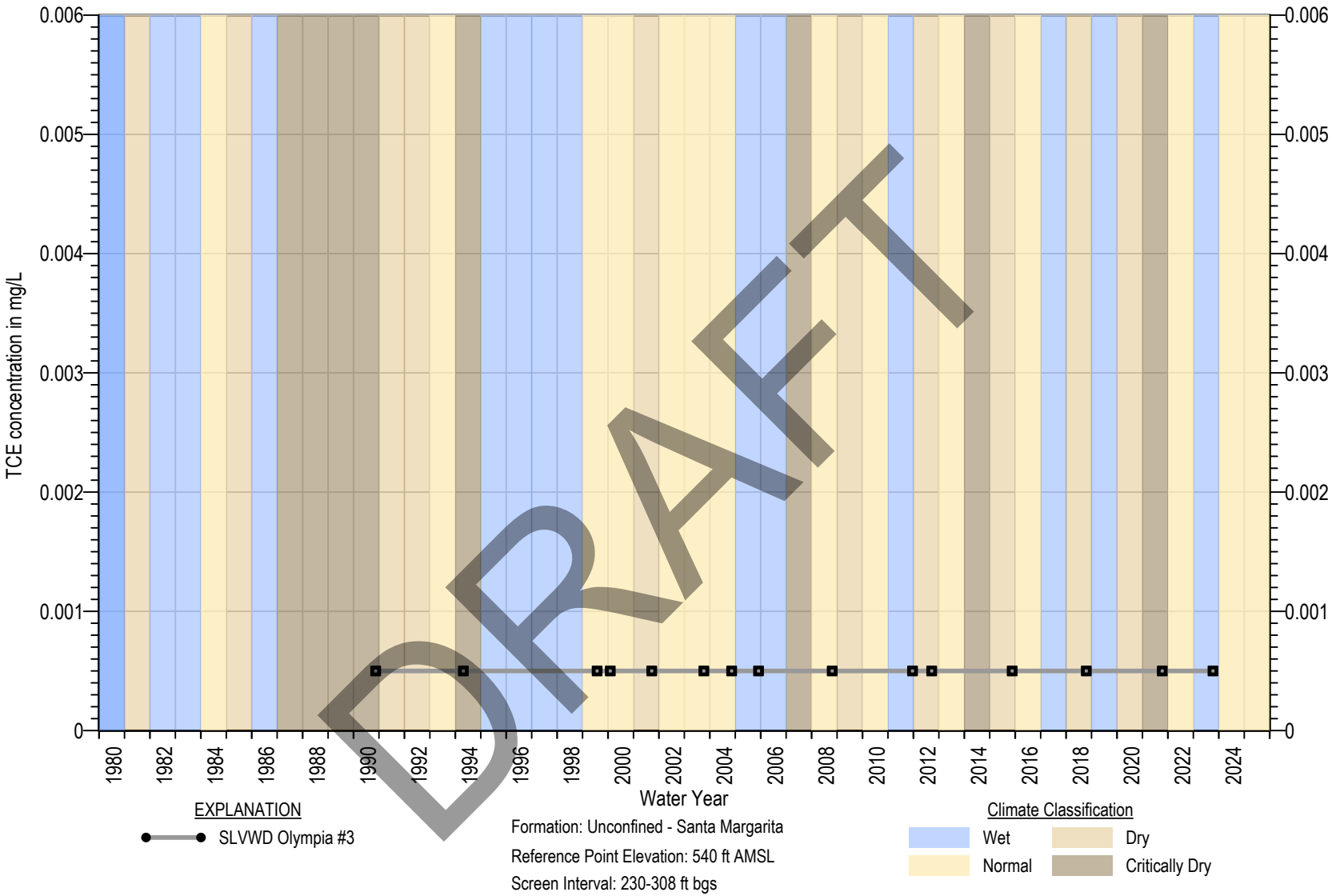
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-236. TCE Chemograph of SLVWD Olympia #2

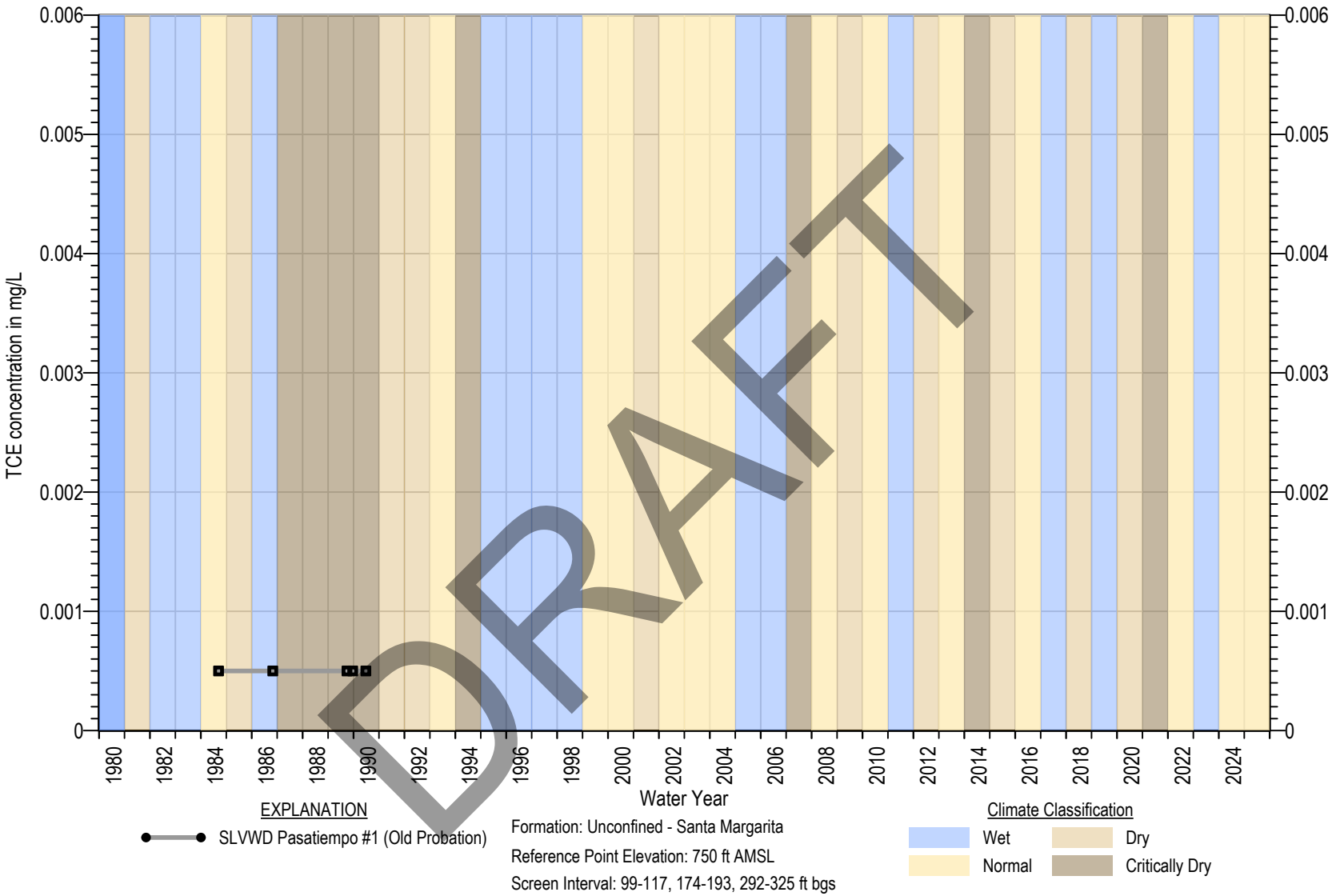
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-237. TCE Chemograph of SLVWD Olympia #3

MONTGOMERY & ASSOCIATES

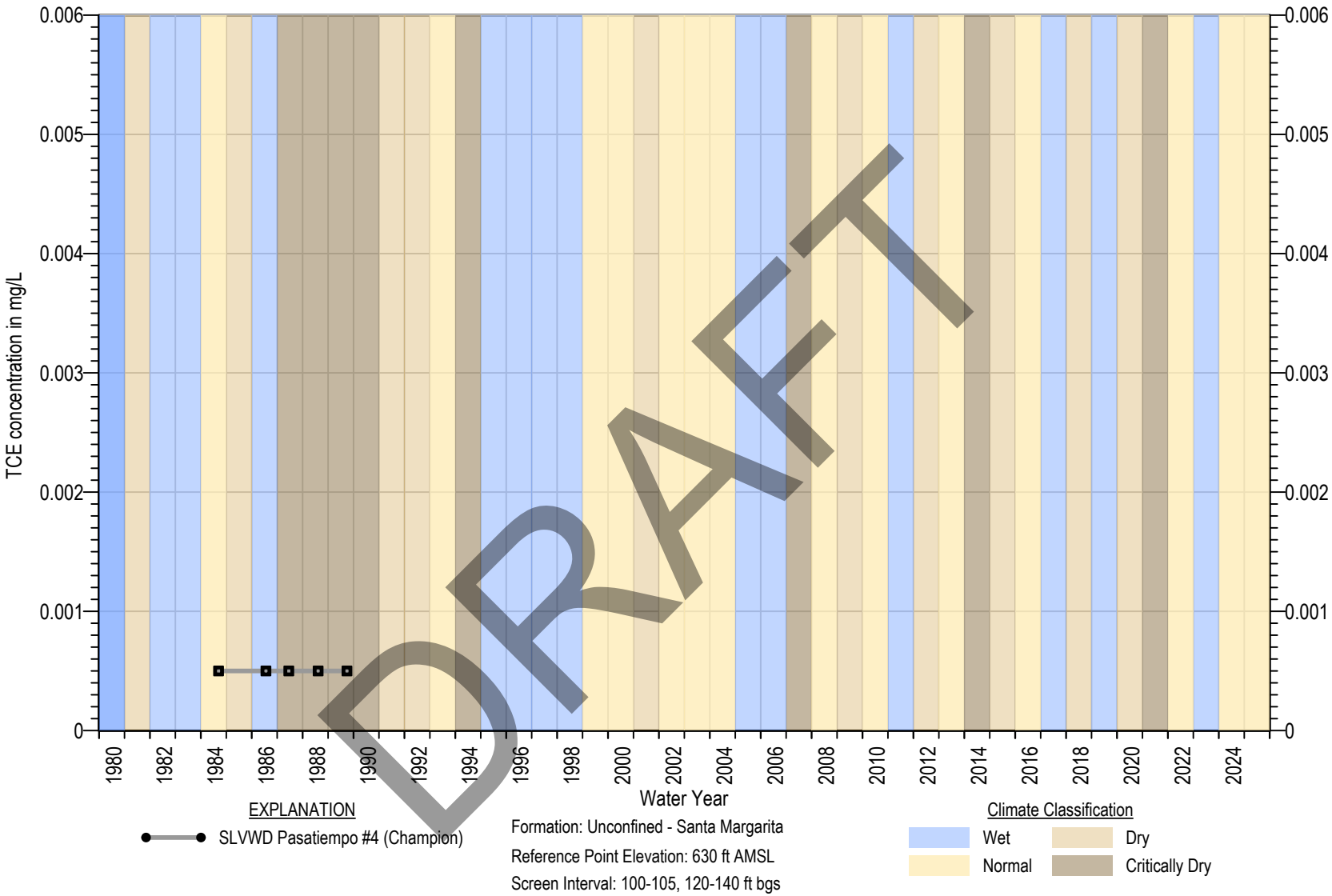


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-238. TCE Chemograph of SLVWD Pasatiempo #1 (Old Probation)

MONTGOMERY & ASSOCIATES

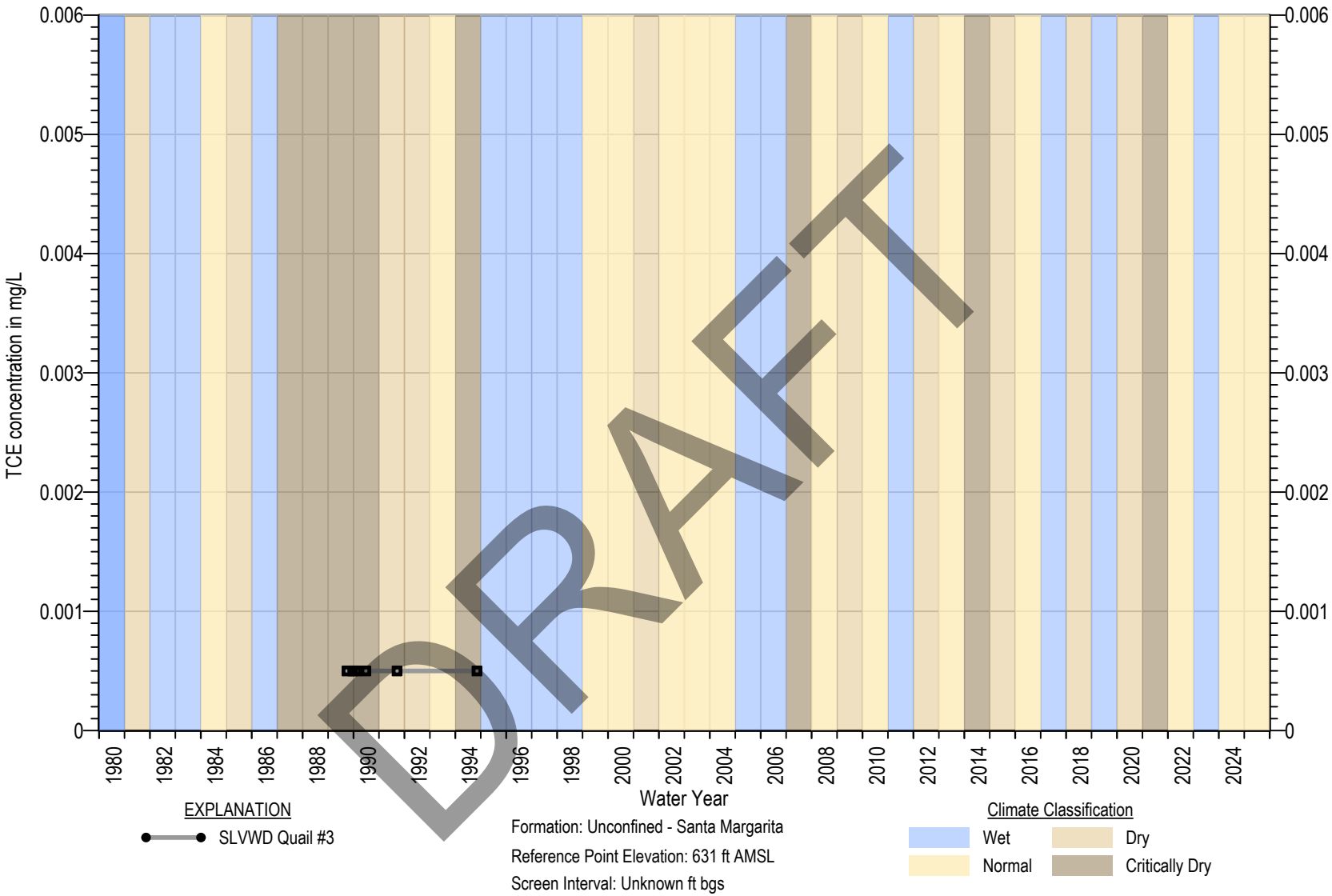


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-239. TCE Chemograph of SLVWD Pasatiempo #4 (Champion)

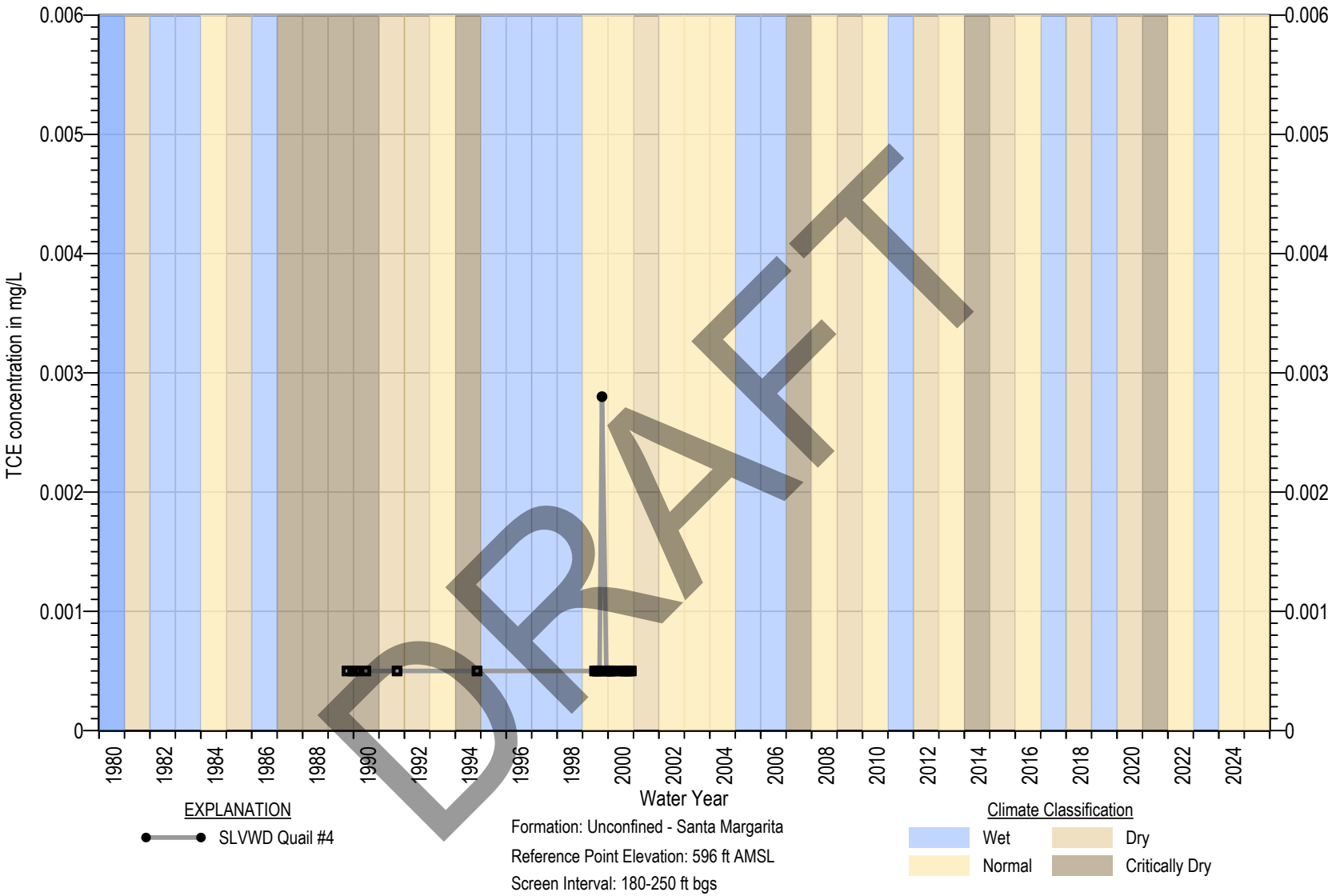
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-240. TCE Chemograph of SLVWD Quail #3

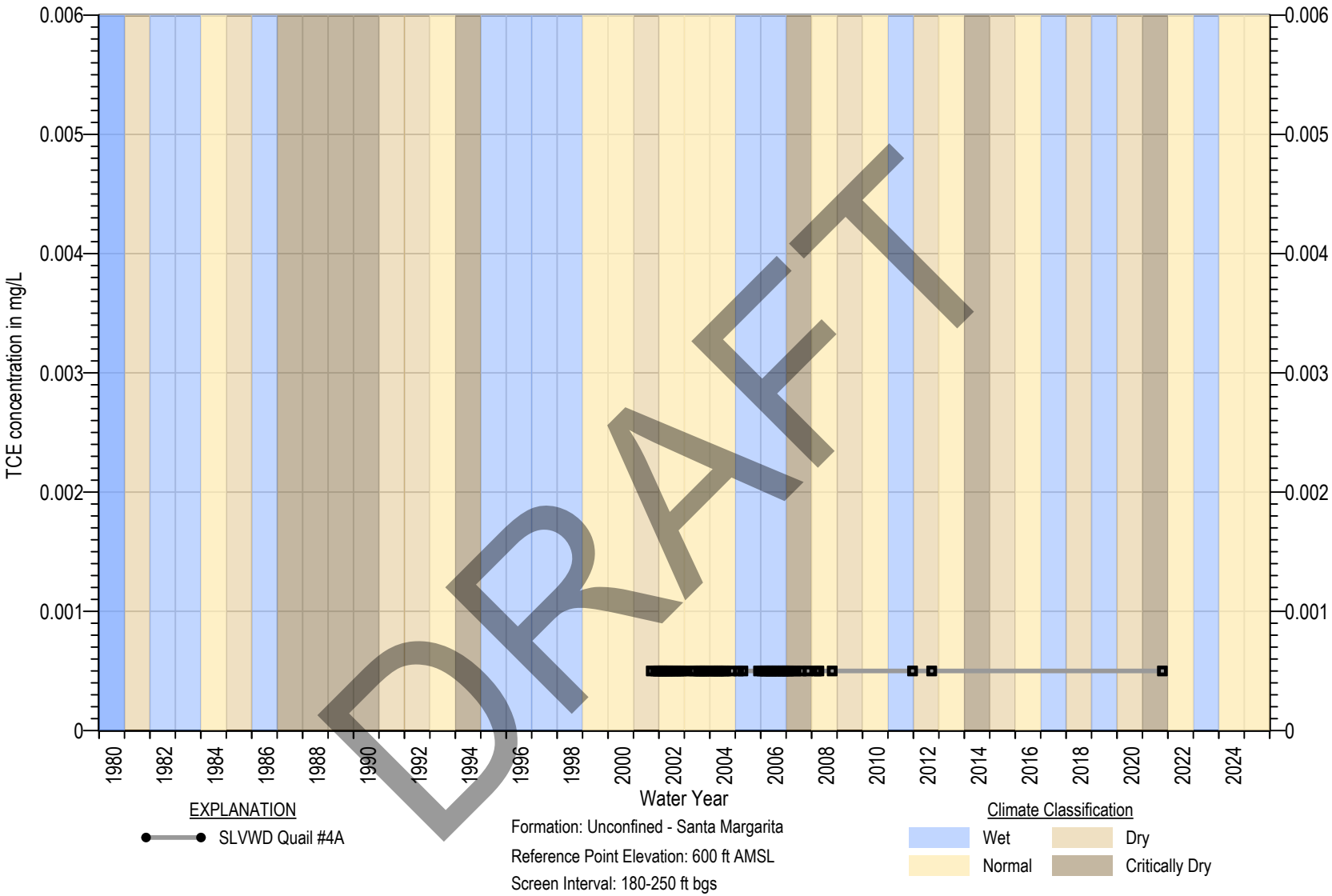
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-241. TCE Chemograph of SLVWD Quail #4

MONTGOMERY & ASSOCIATES

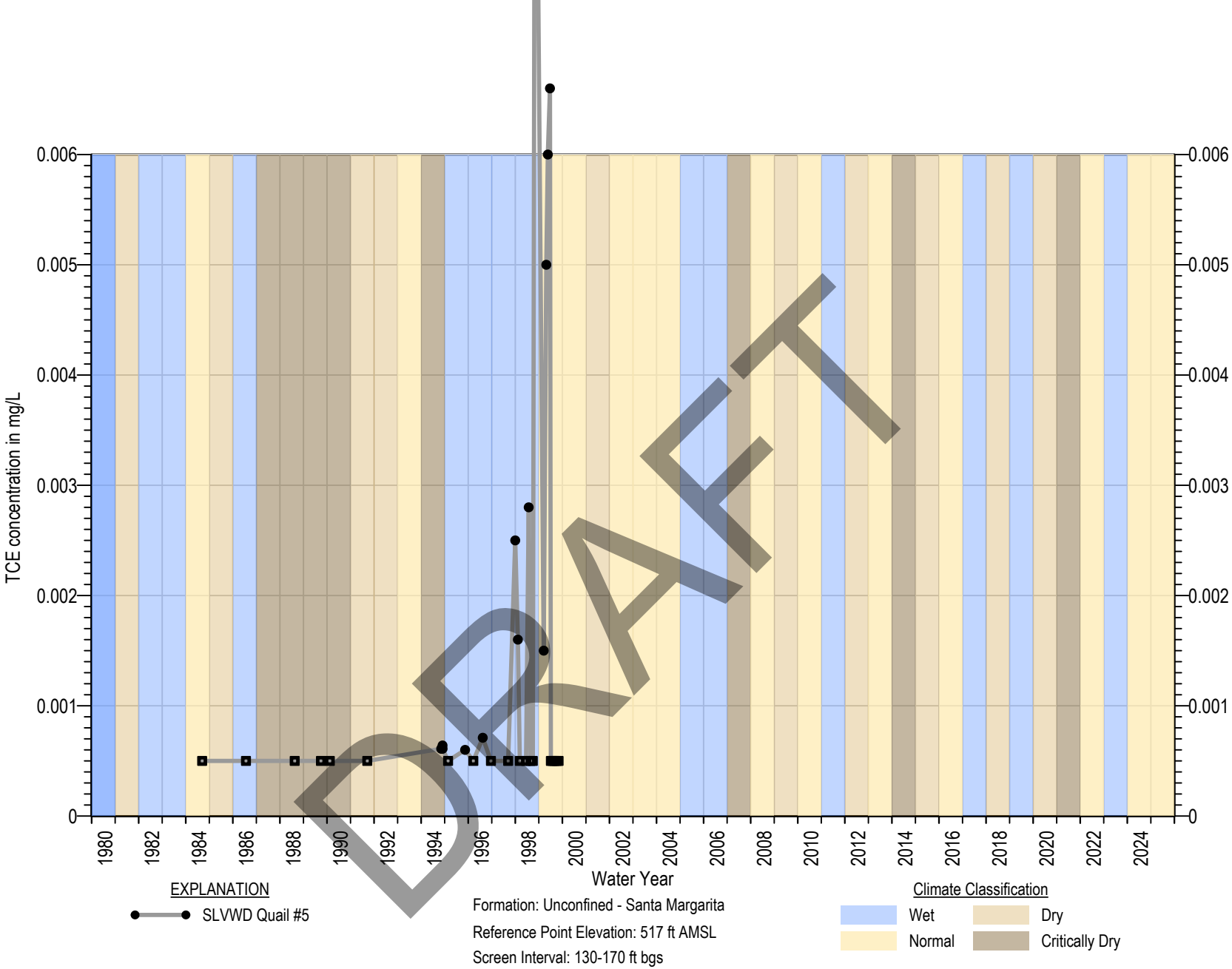


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-242. TCE Chemograph of SLVWD Quail #4A

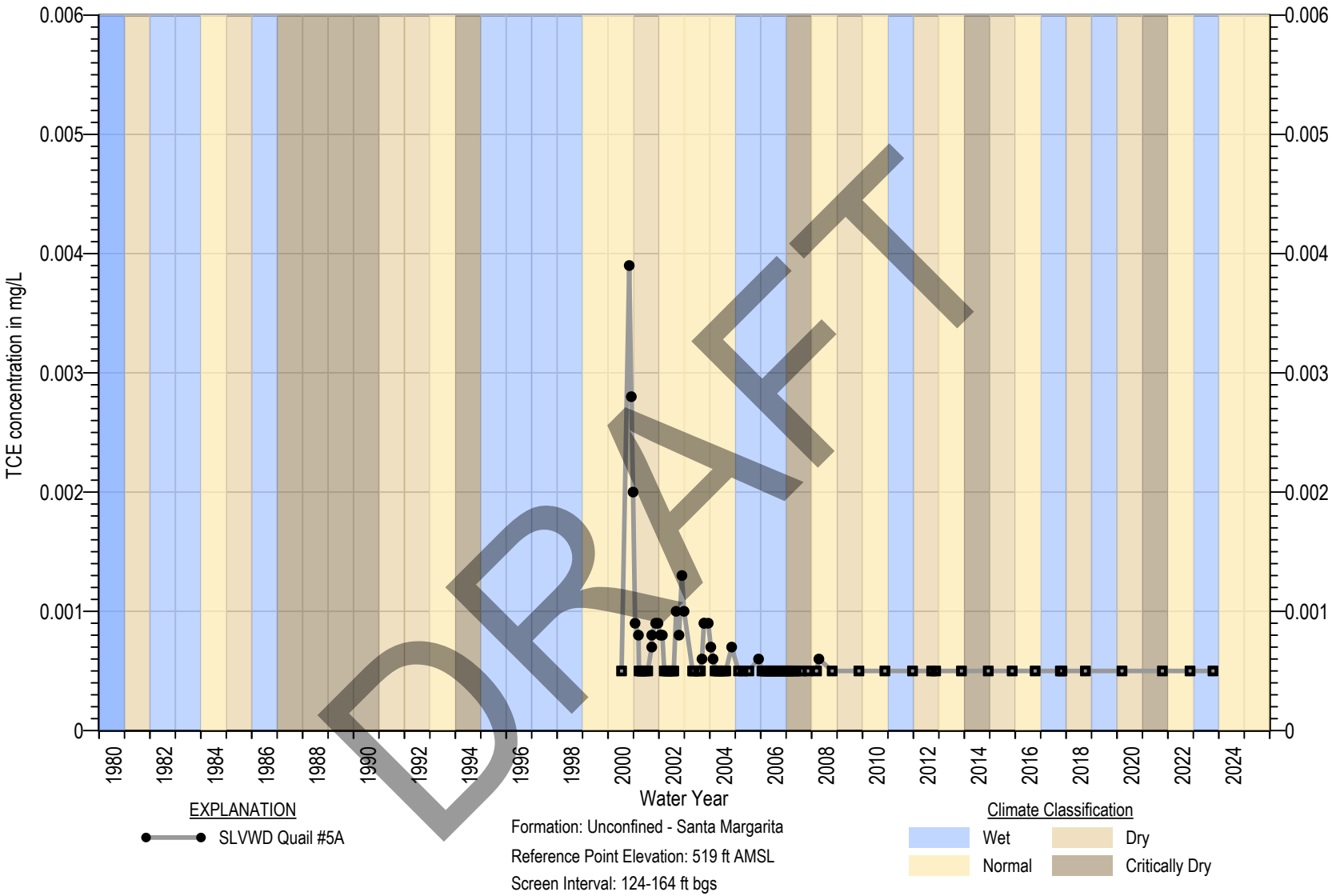
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-243. TCE Chemograph of SLVWD Quail #5

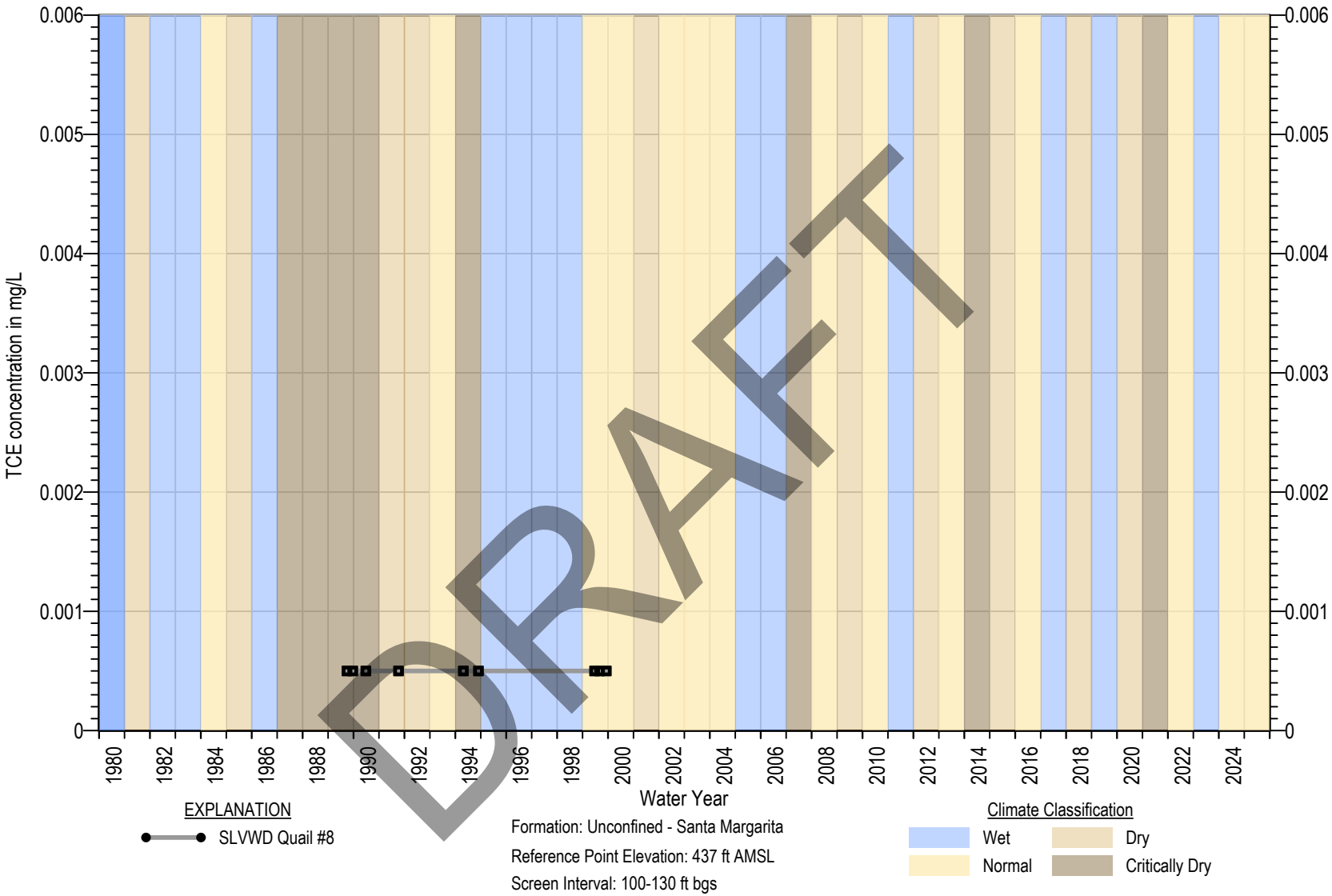
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-244. TCE Chemograph of SLVWD Quail #5A

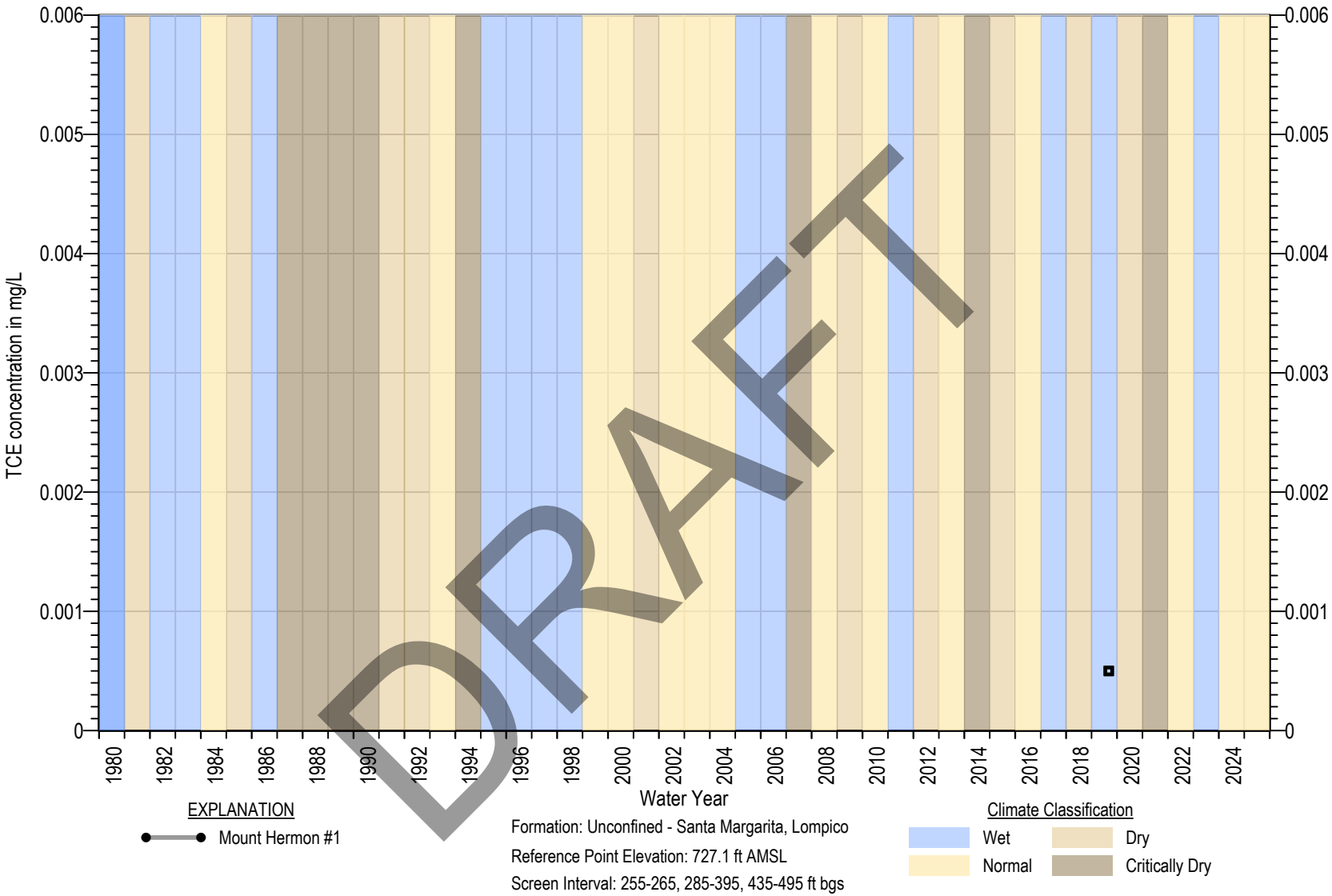
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-245. TCE Chemograph of SLVWD Quail #8

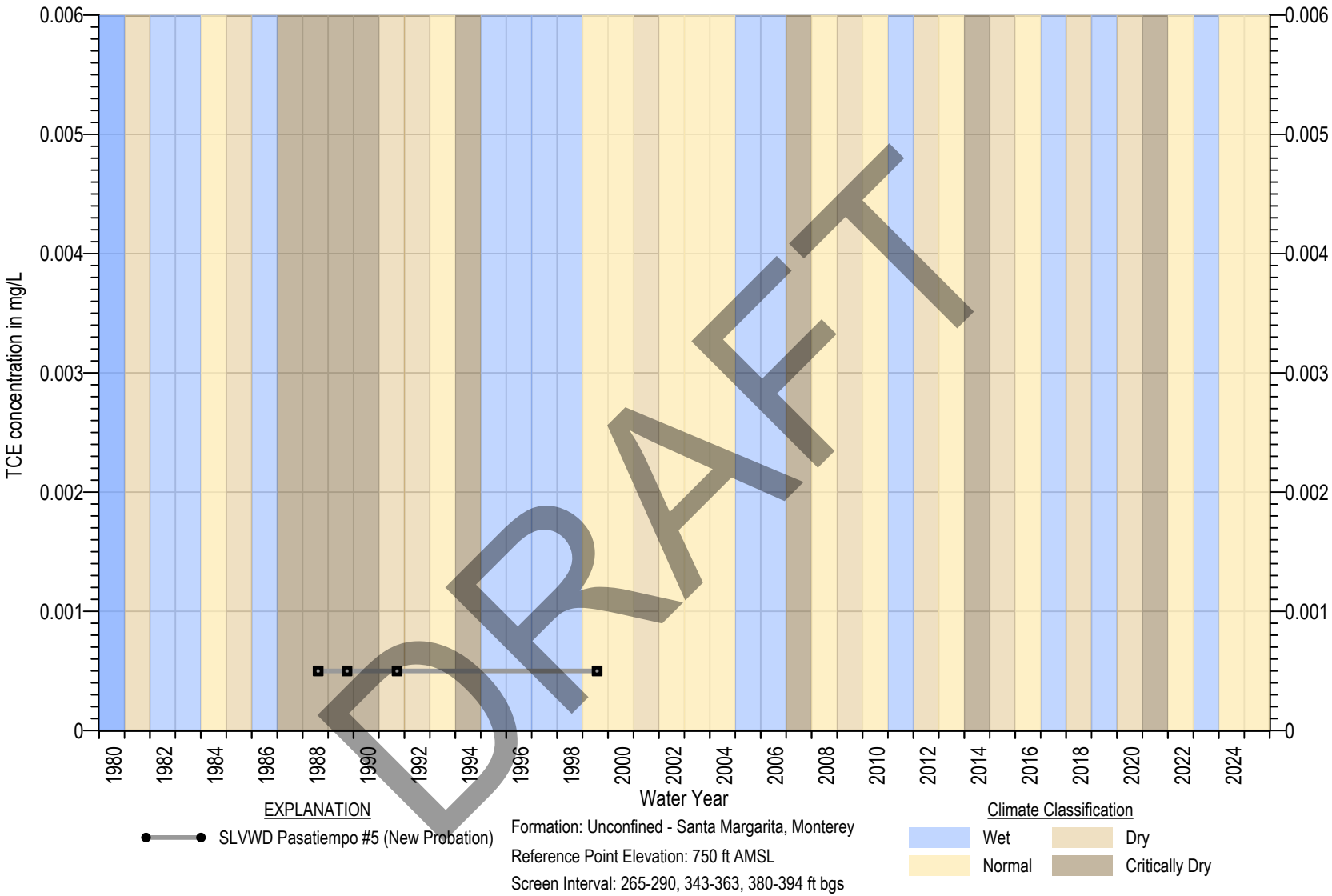
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-246. TCE Chemograph of Mount Hermon #1

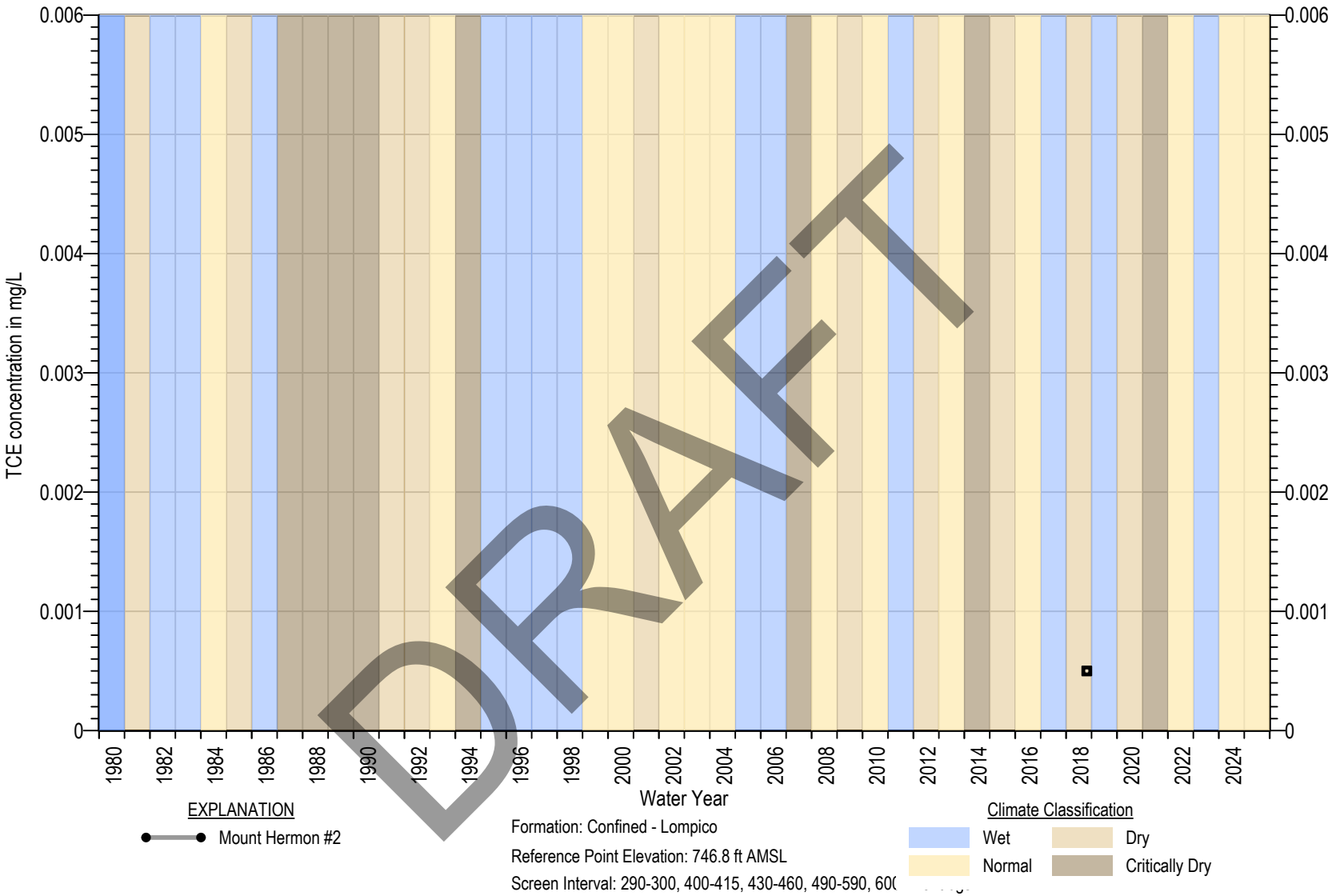
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-247. TCE Chemograph of SLVWD Pasatiempo #5 (New Probation)

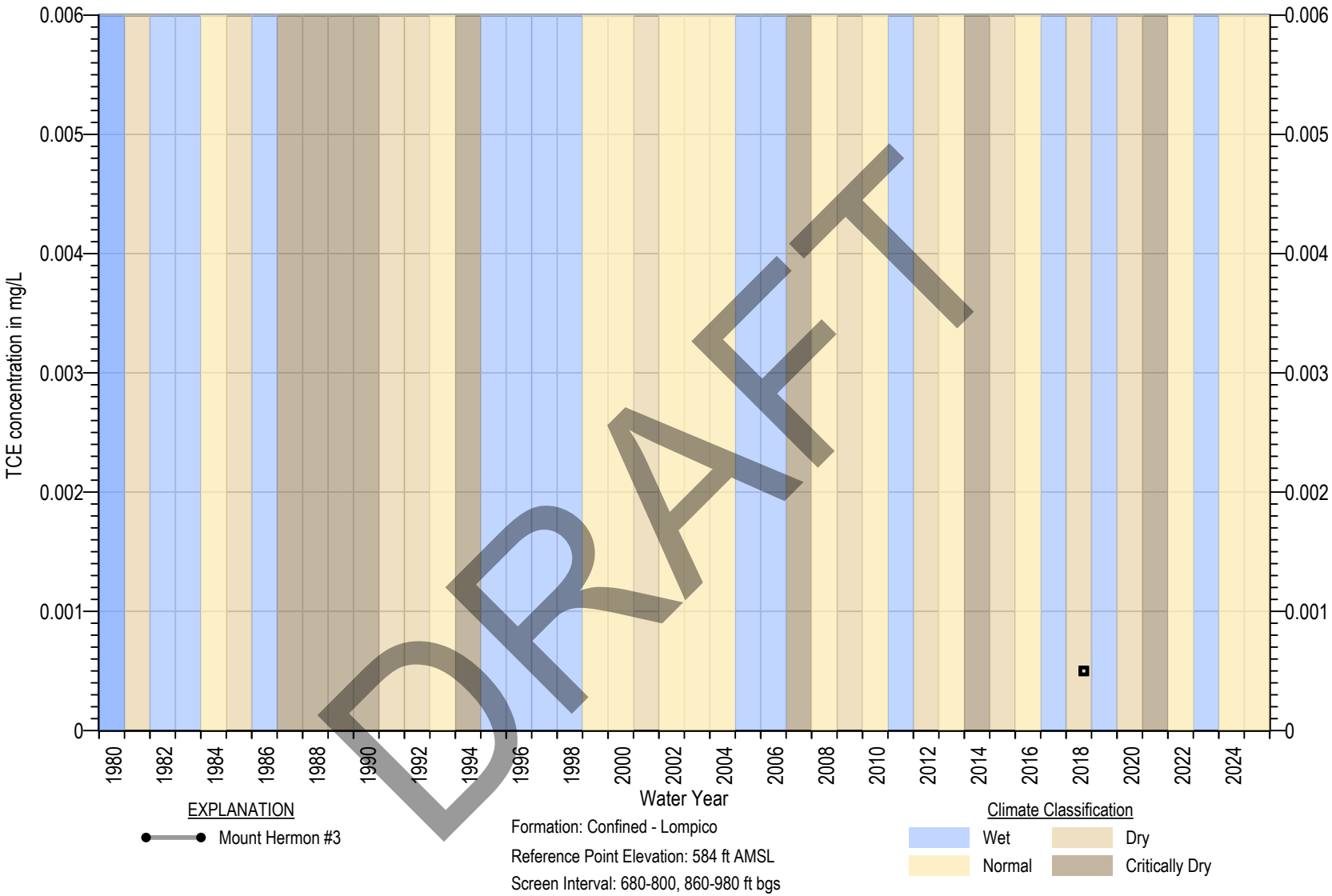
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-248. TCE Chemograph of Mount Hermon #2

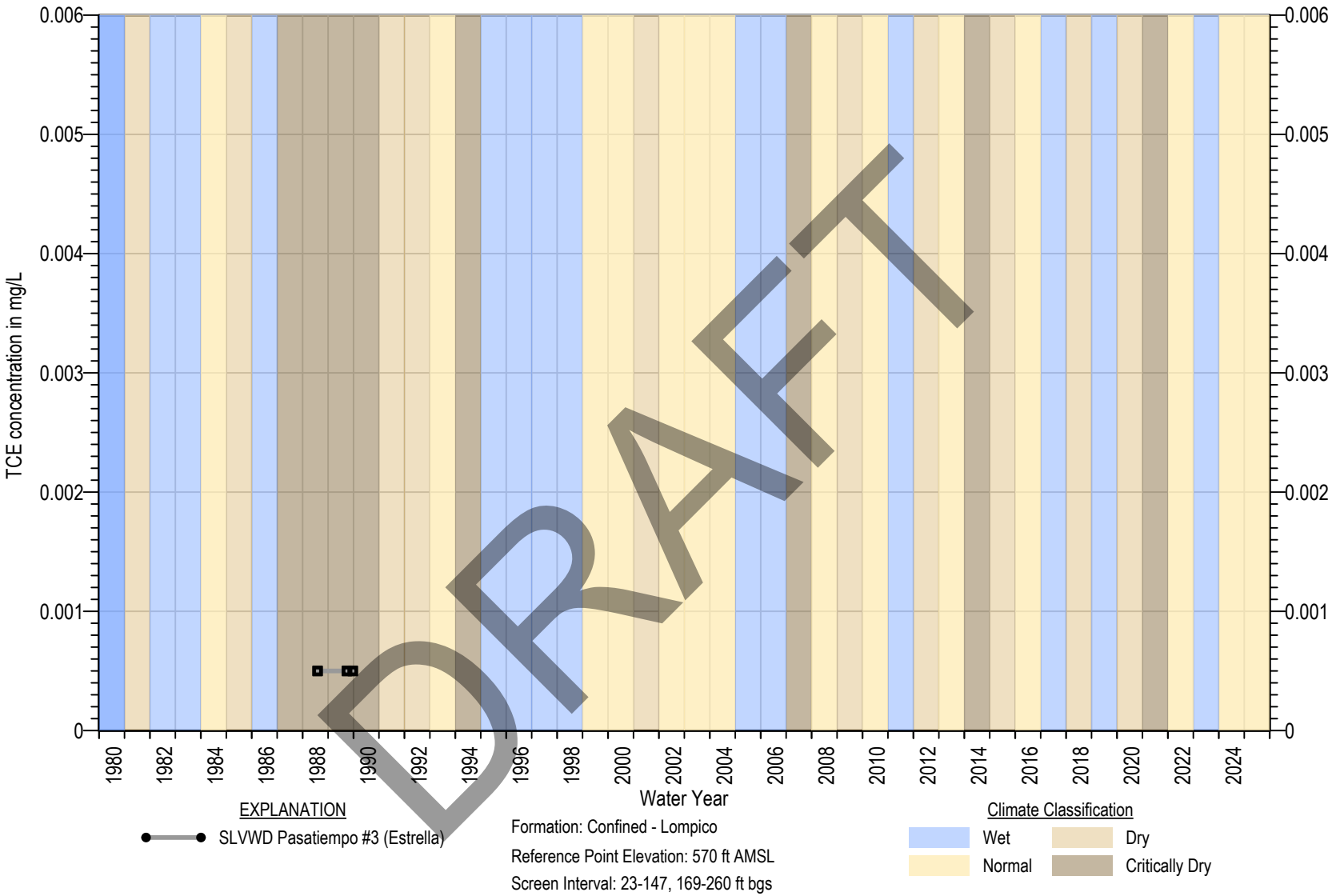
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-249. TCE Chemograph of Mount Hermon #3

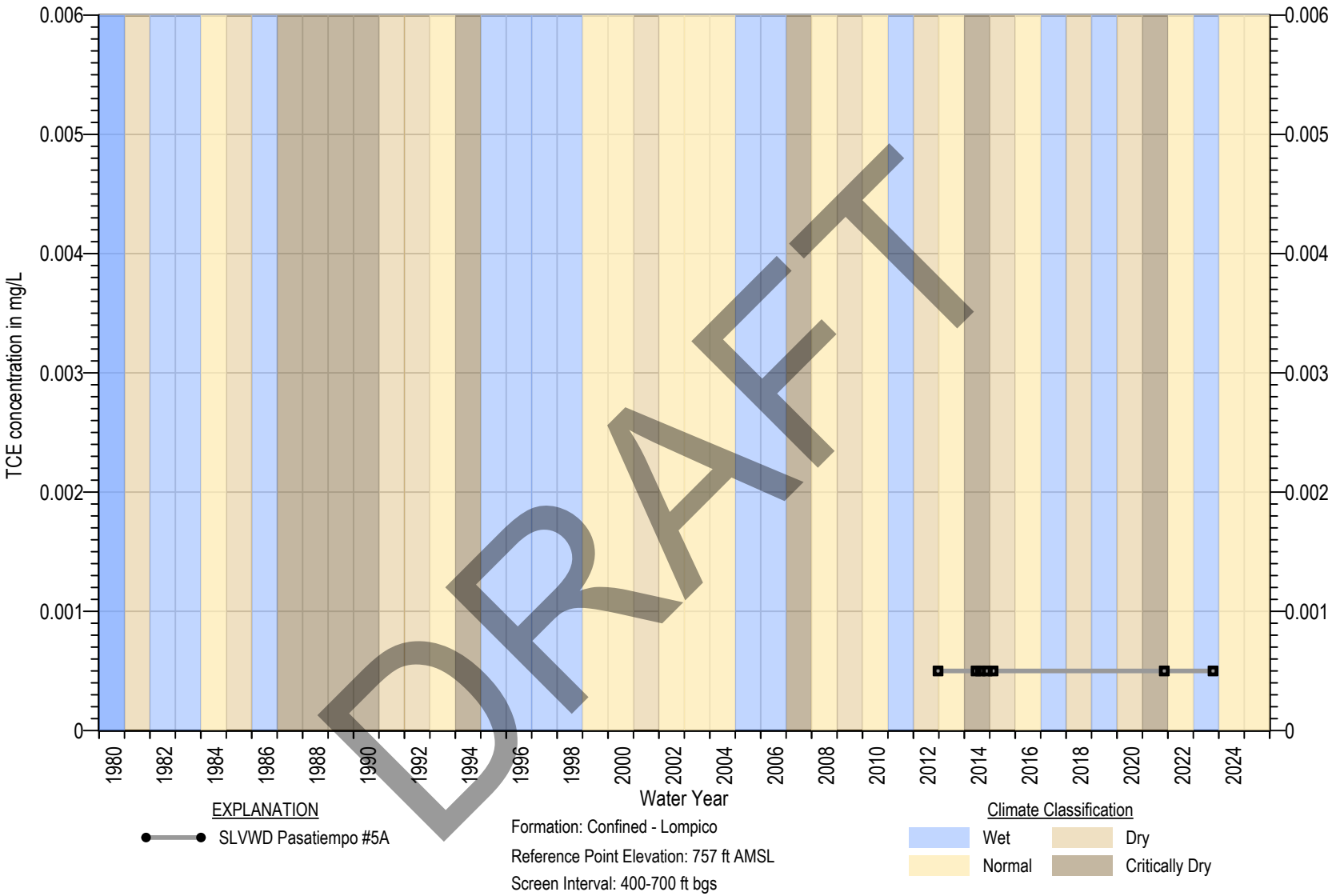
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-250. TCE Chemograph of SLVWD Pasatiempo #3 (Estrella)

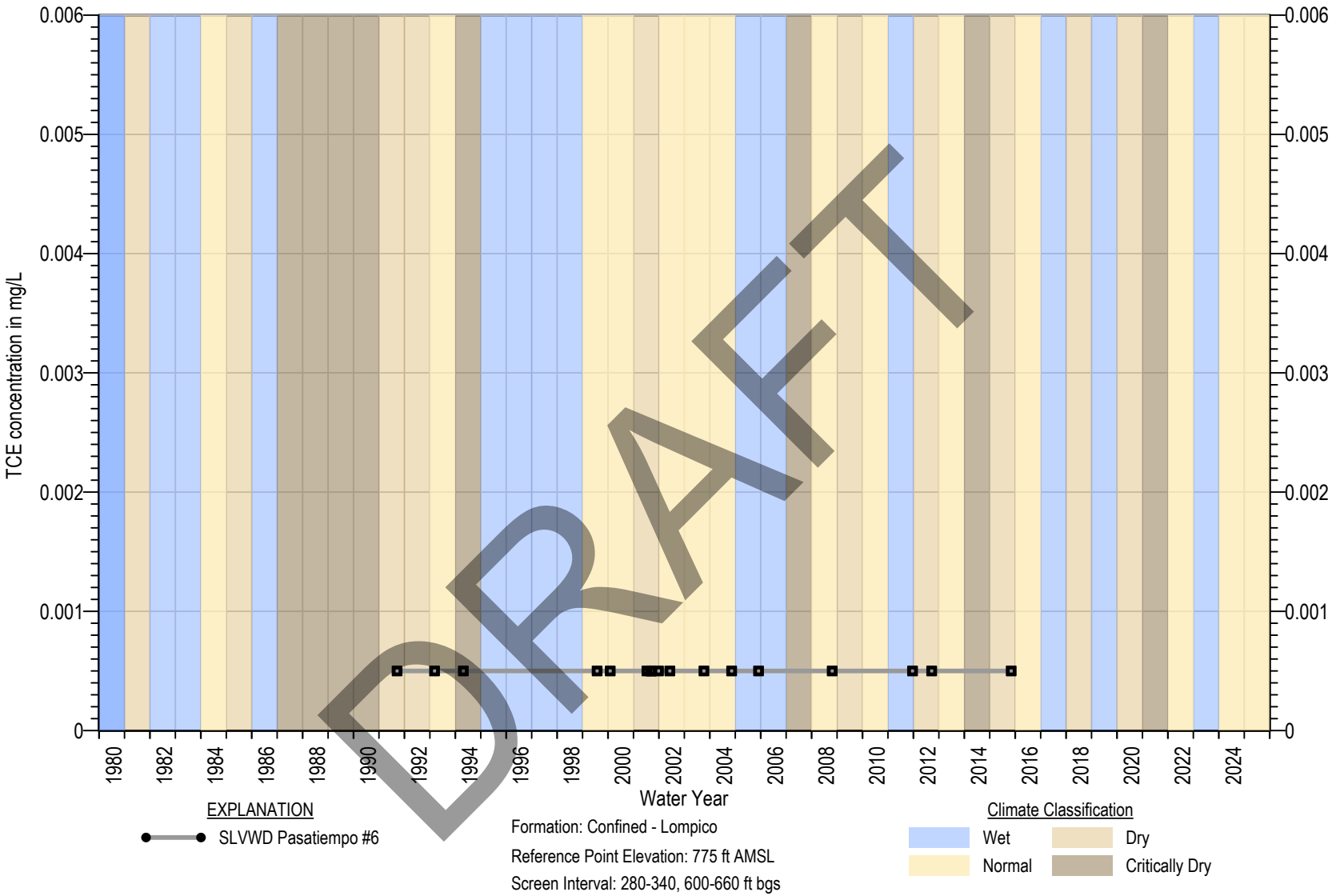
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-251. TCE Chemograph of SLVWD Pasatiempo #5A

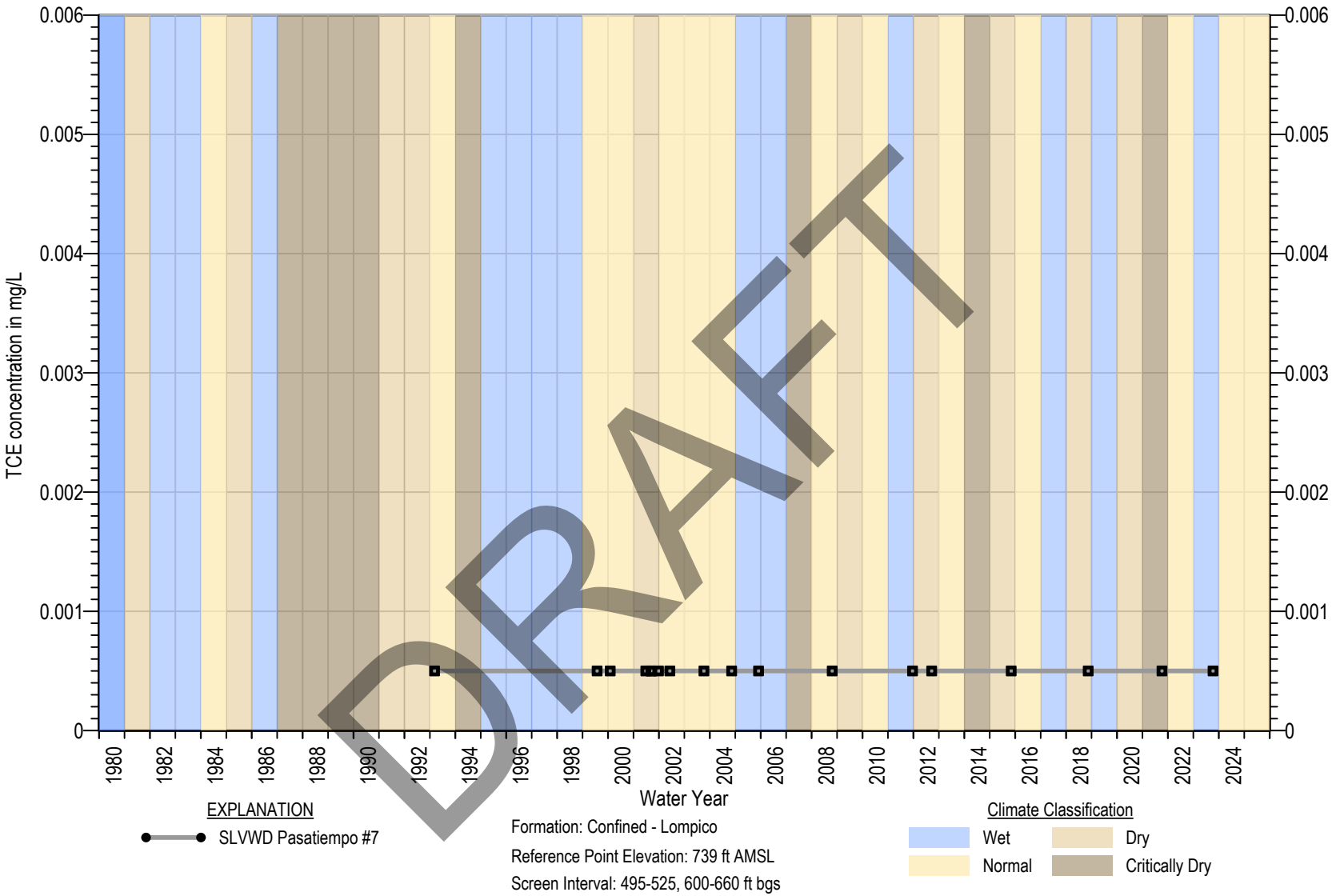
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-252. TCE Chemograph of SLVWD Pasatiempo #6

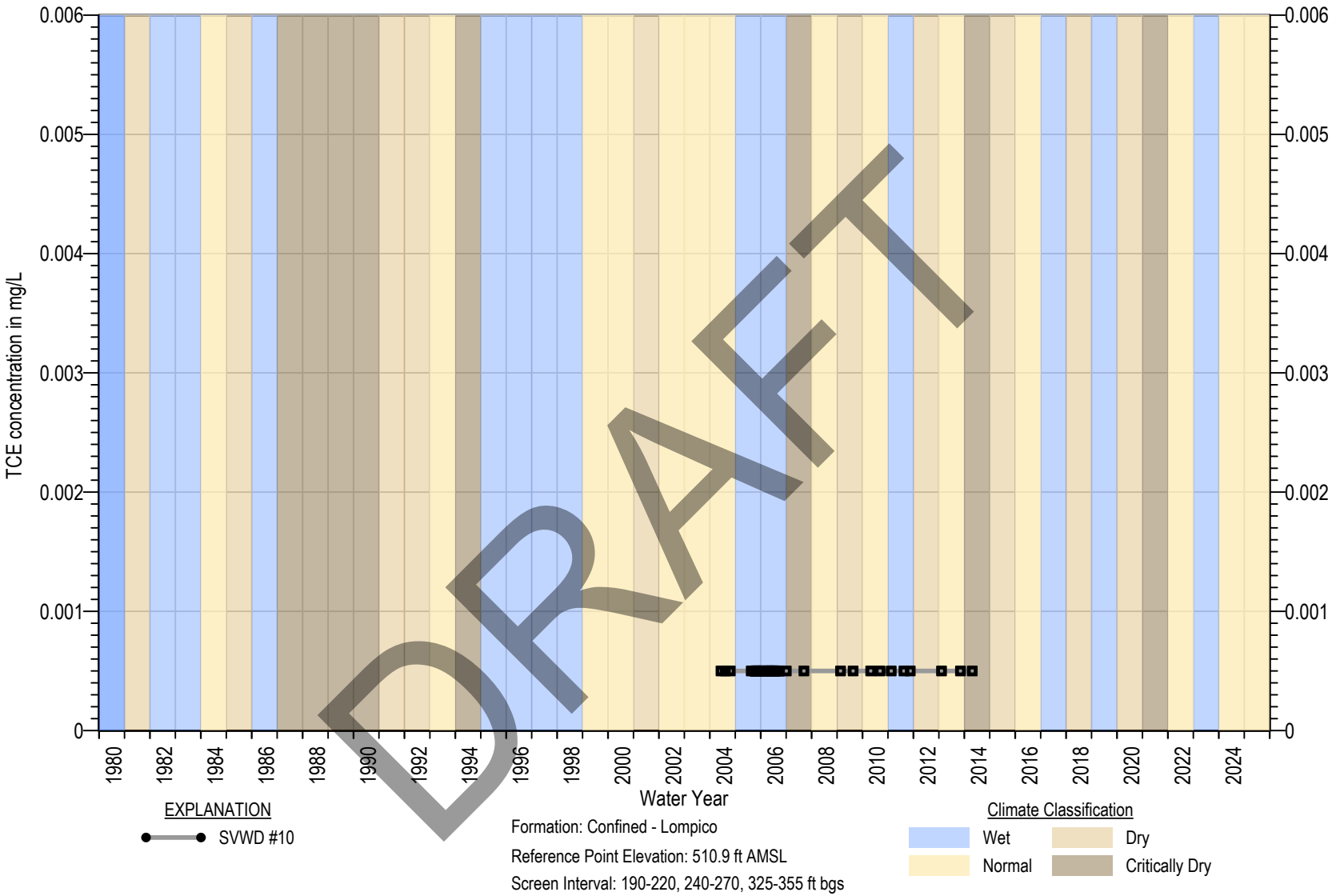
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-253. TCE Chemograph of SLVWD Pasatiempo #7

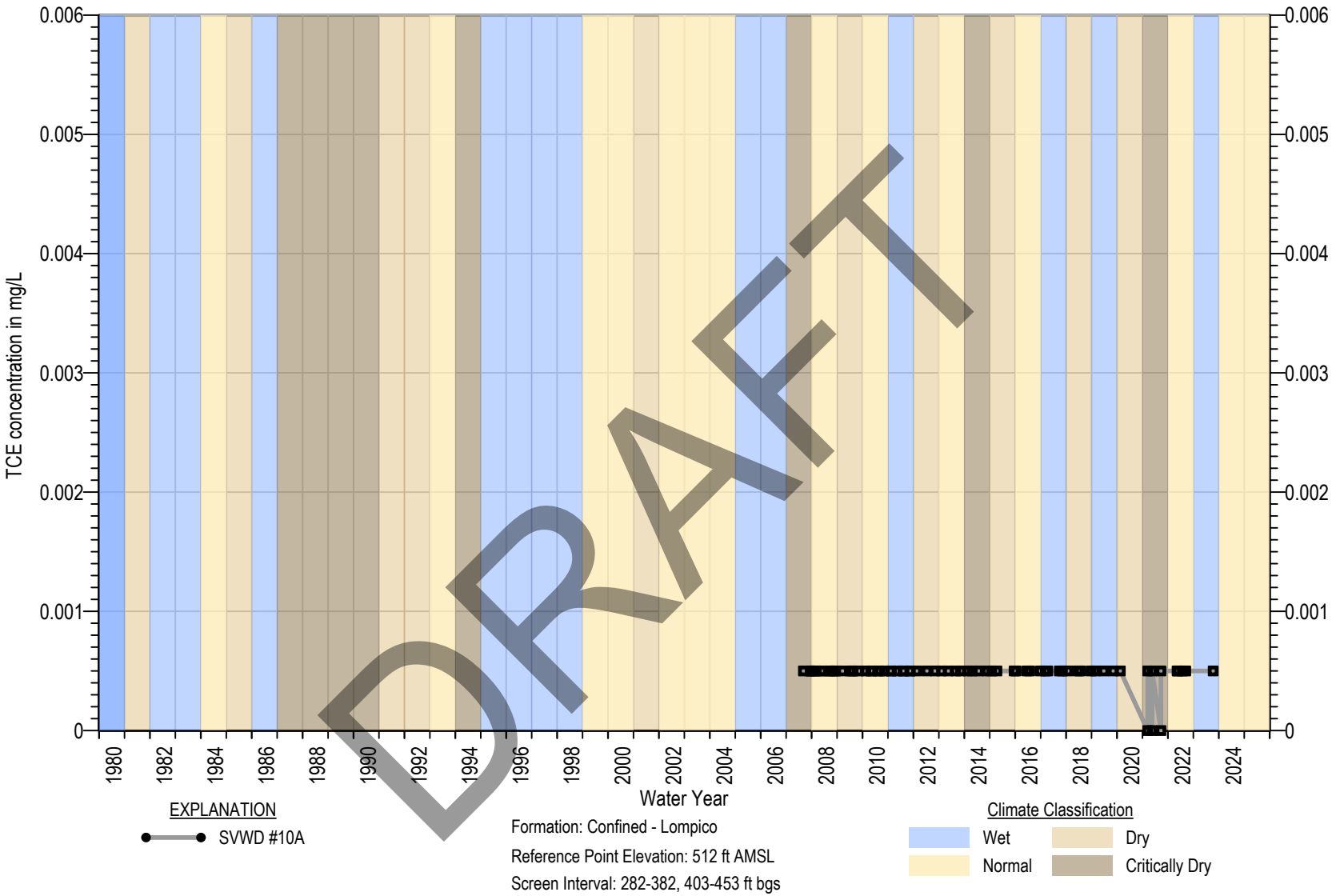
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-254. TCE Chemograph of SVWD #10

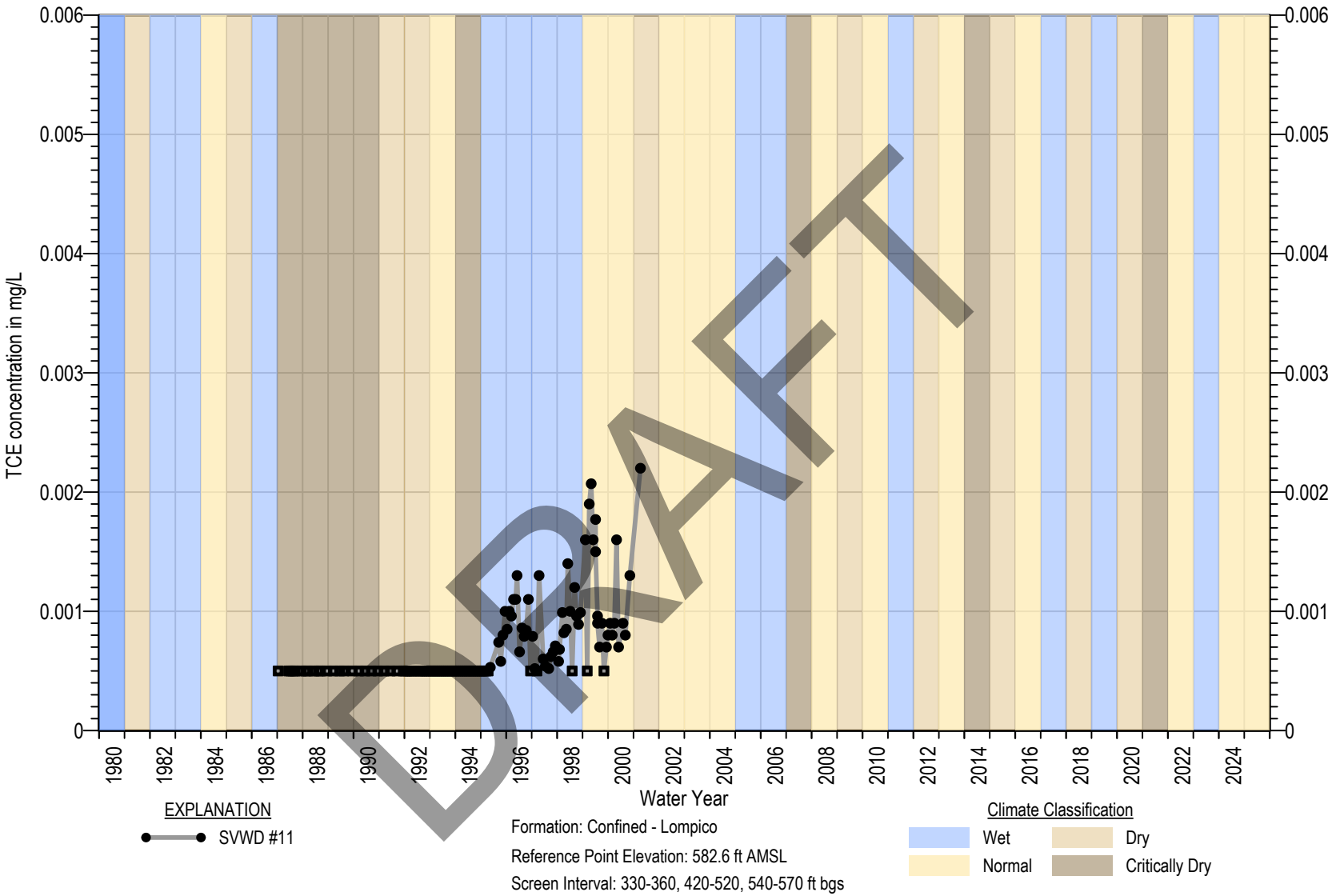
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-255. TCE Chemograph of SVWD #10A

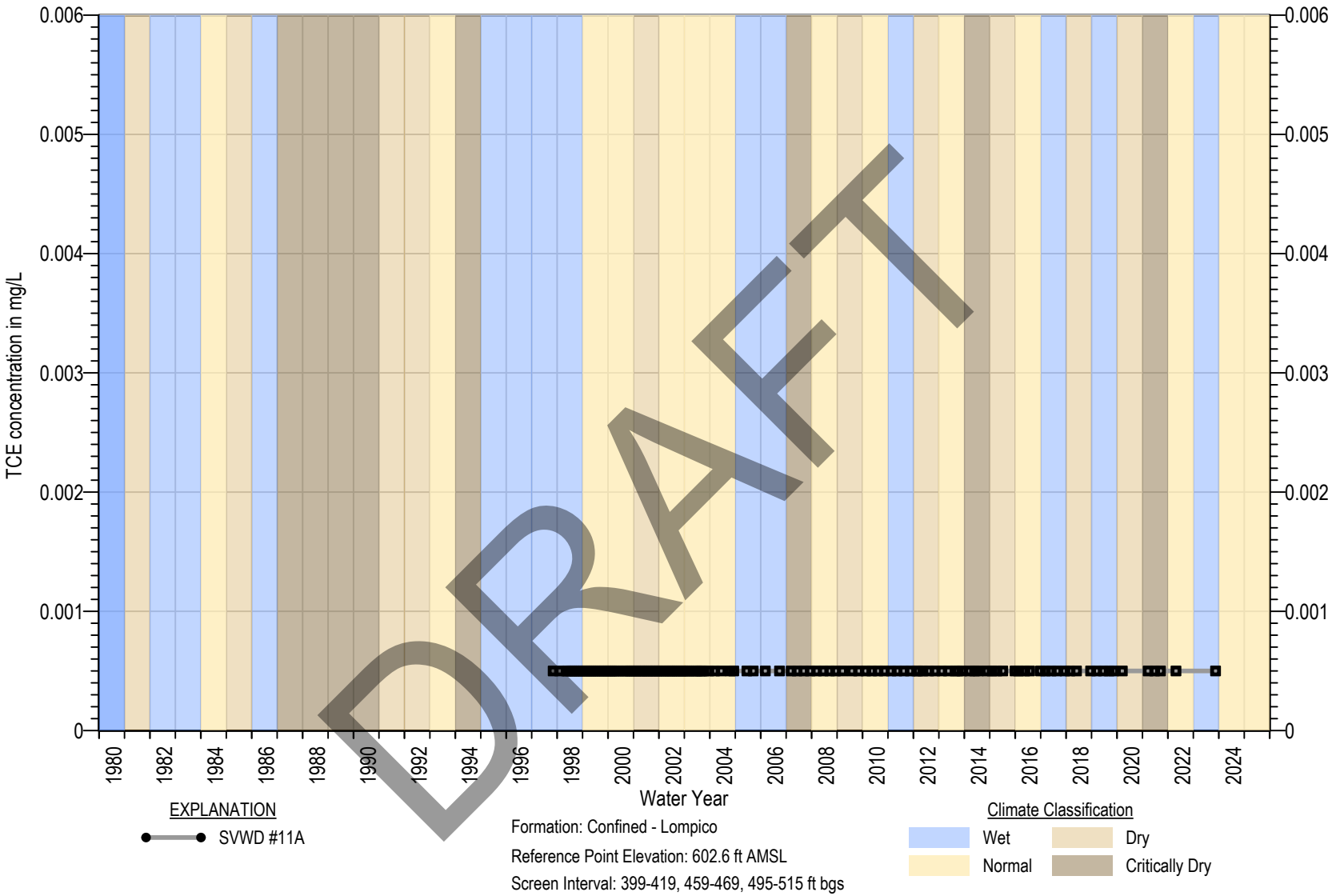
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-256. TCE Chemograph of SVWD #11

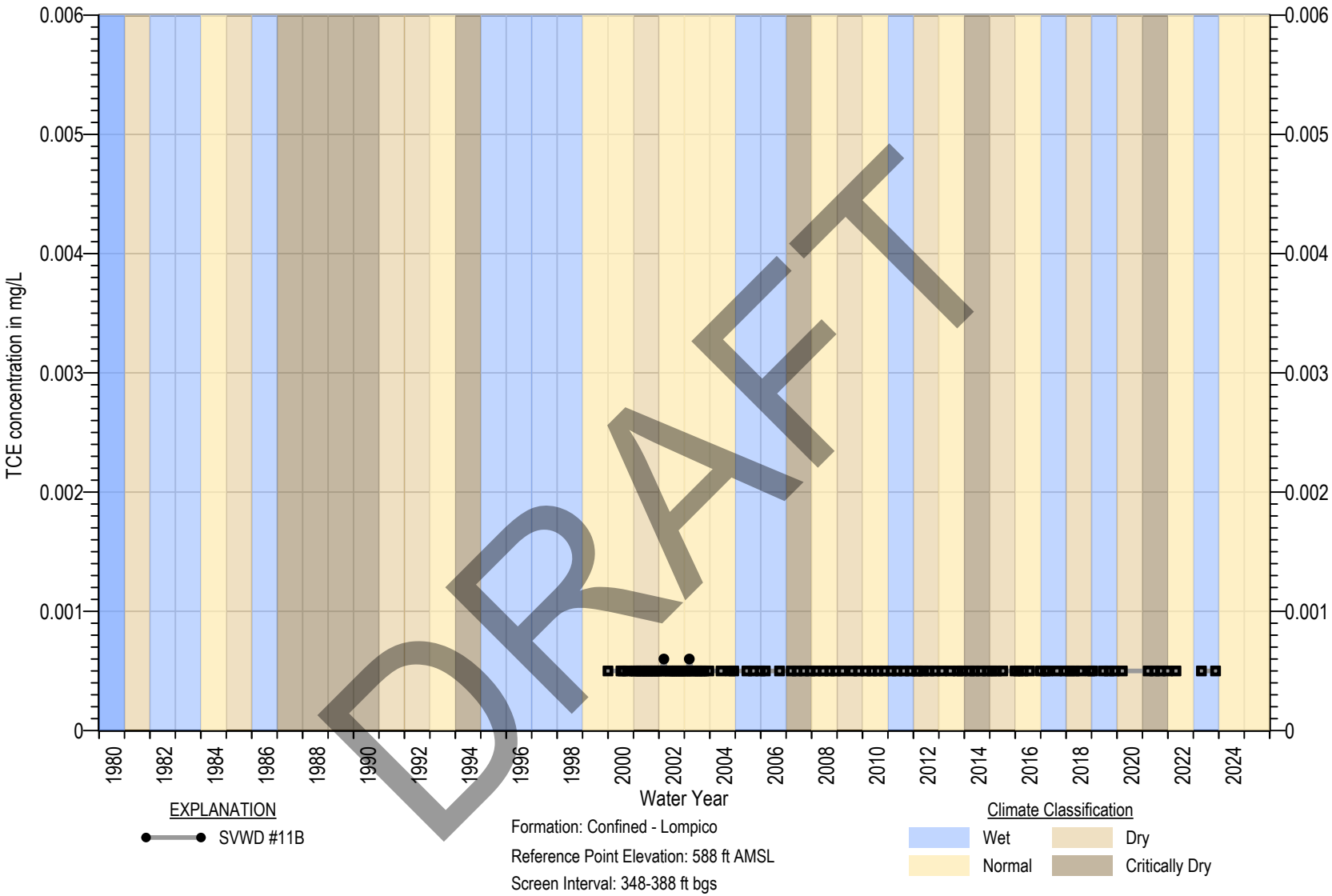
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-257. TCE Chemograph of SVWD #11A

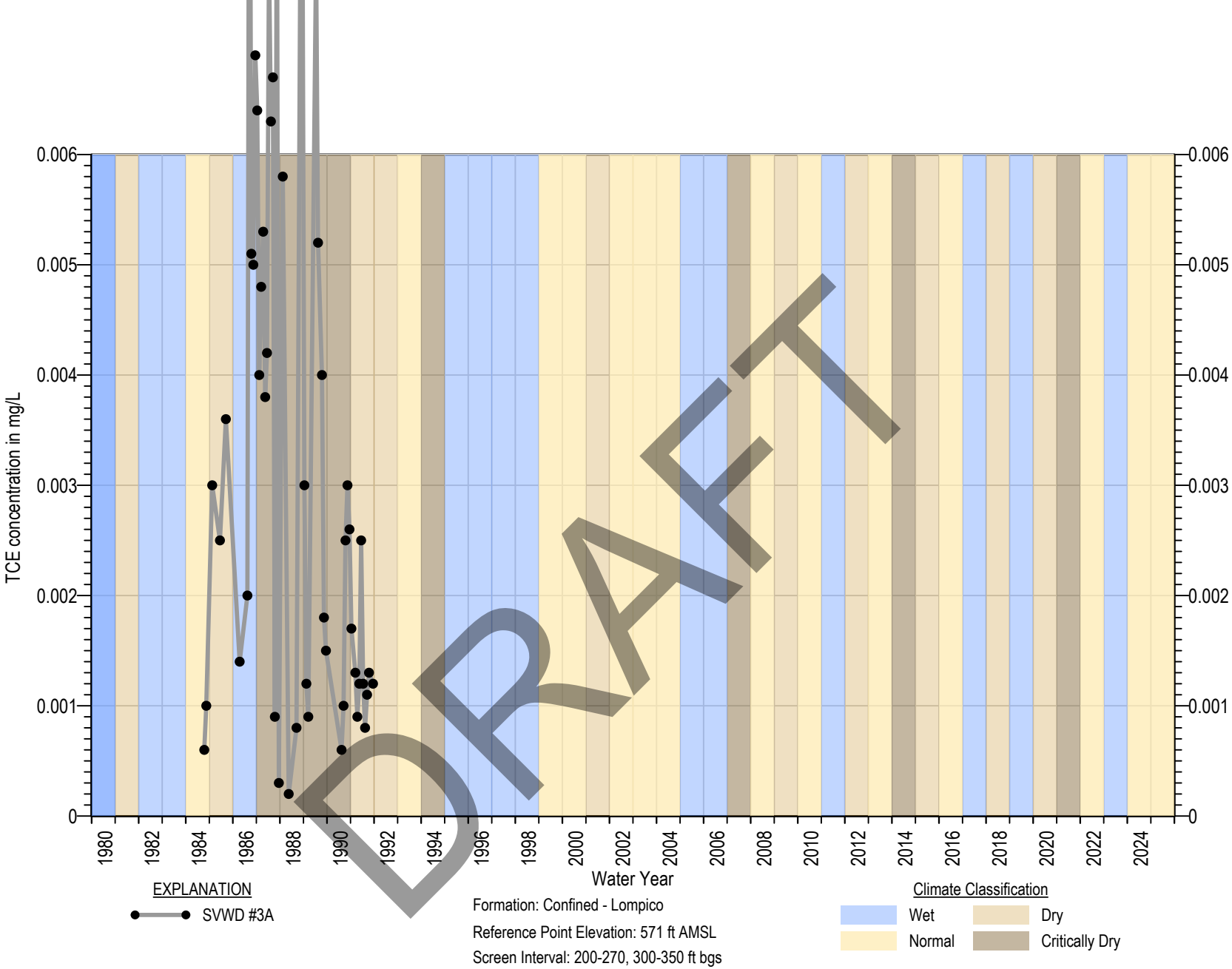
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-258. TCE Chemograph of SVWD #11B

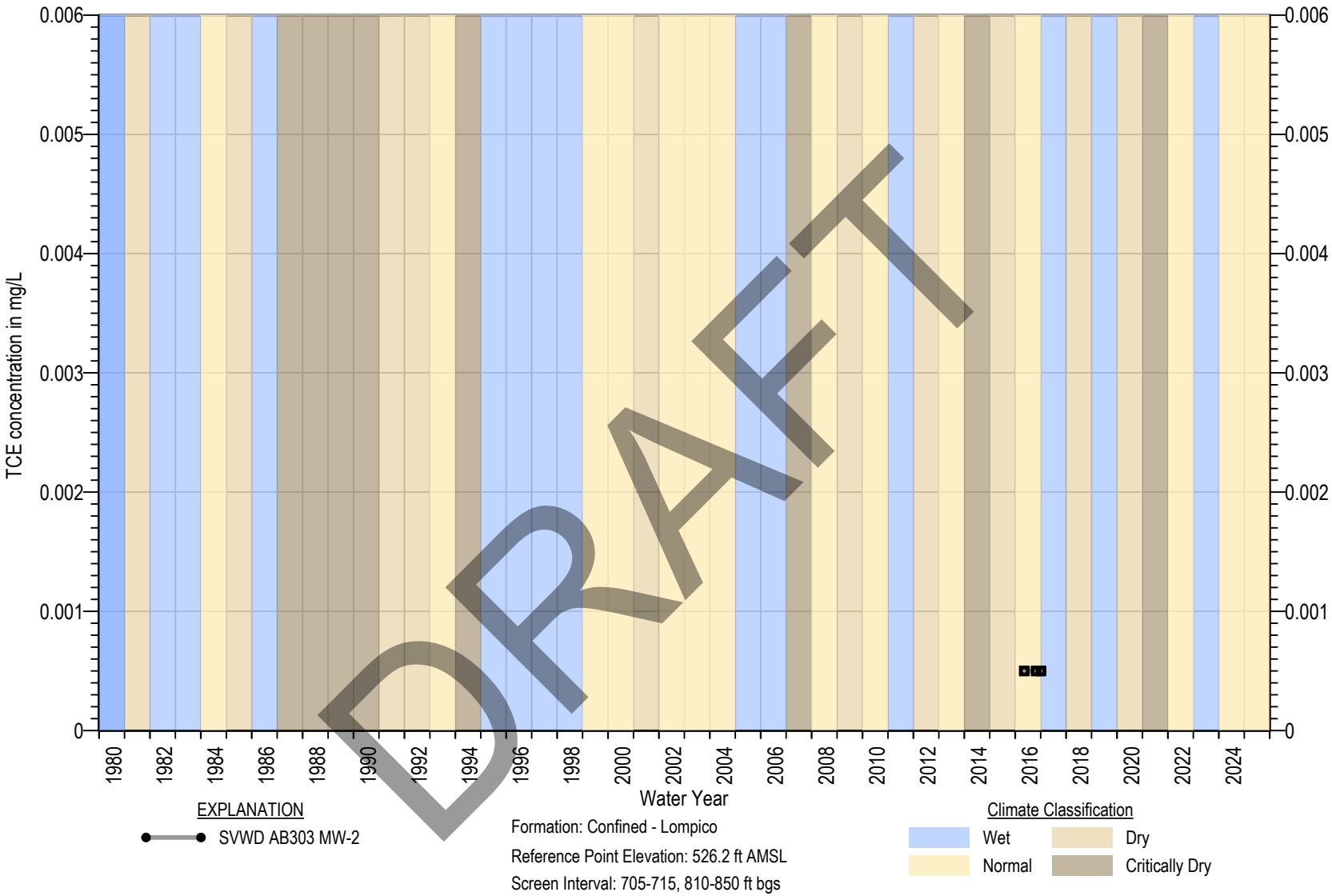
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-259. TCE Chemograph of SVWD #3A

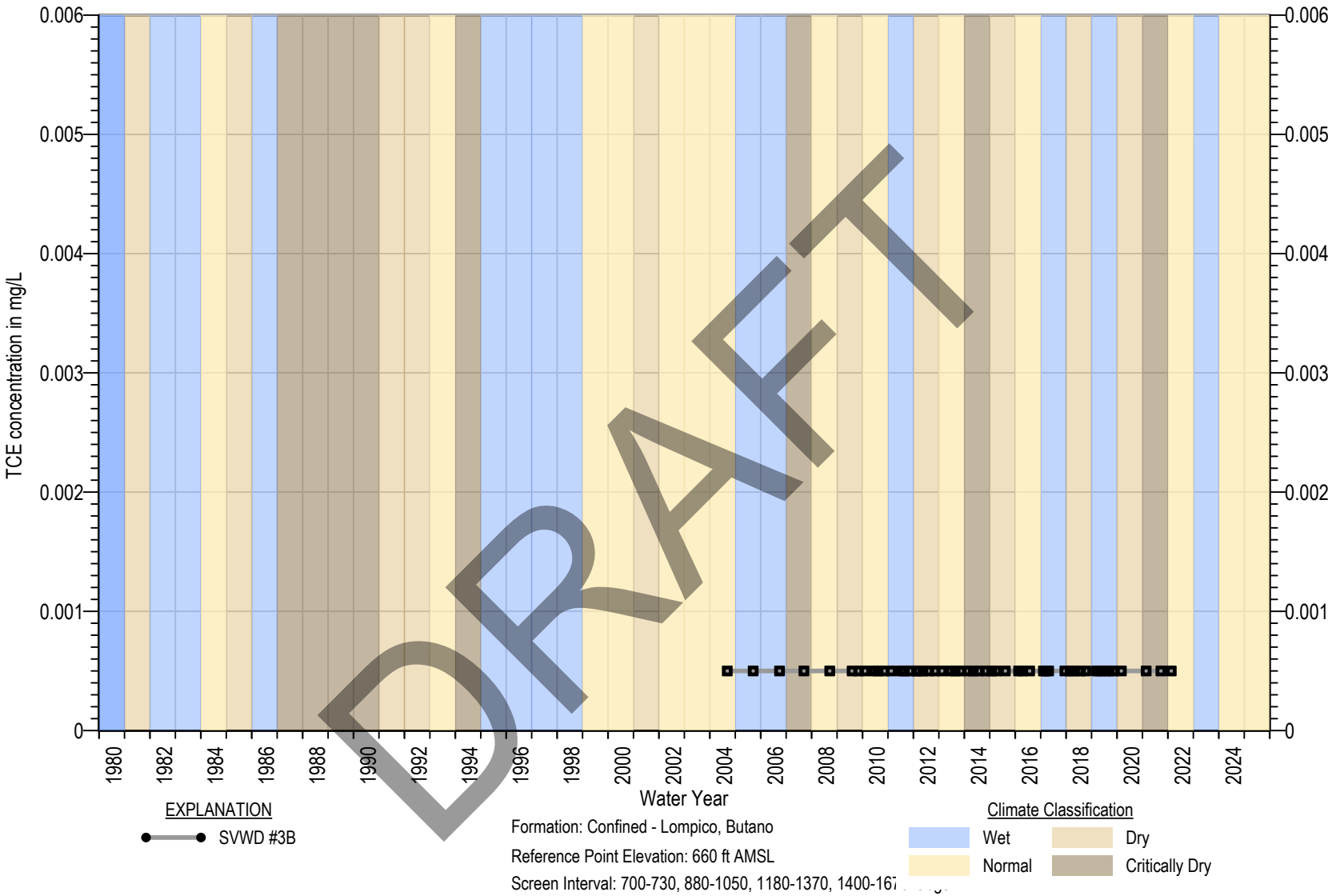
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-260. TCE Chemograph of SVWD AB303 MW-2

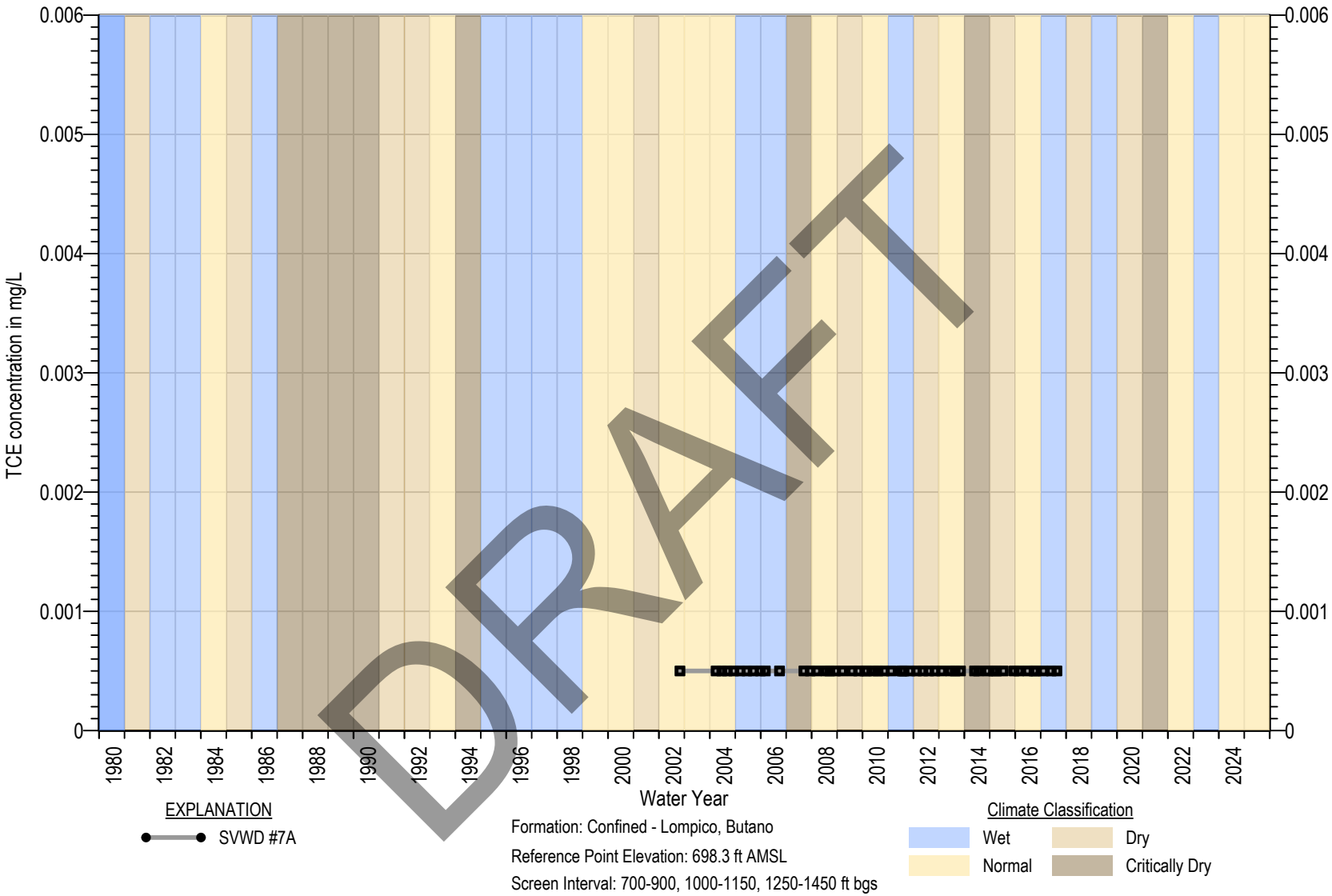
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-261. TCE Chemograph of SVWD #3B

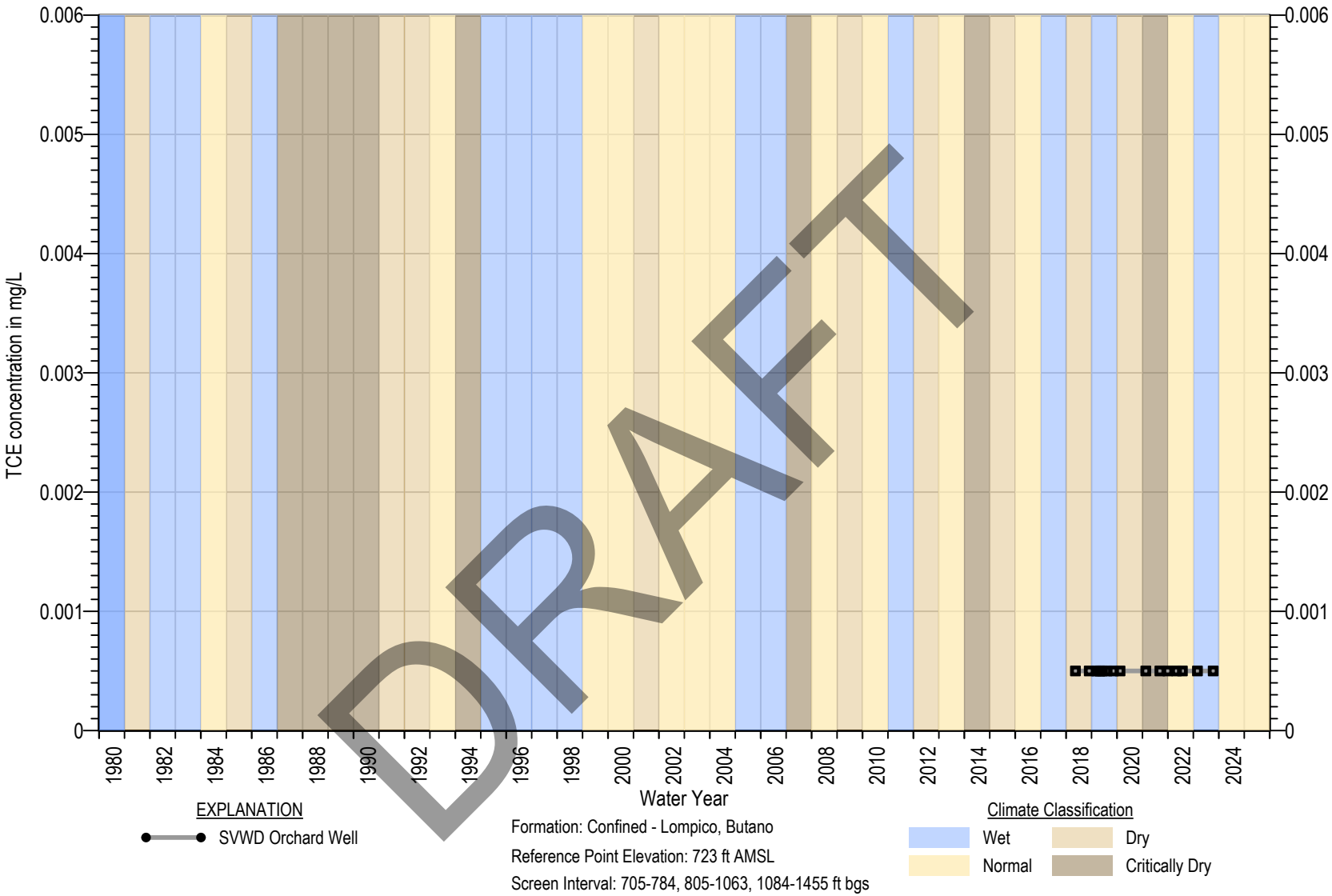
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-262. TCE Chemograph of SVWD #7A

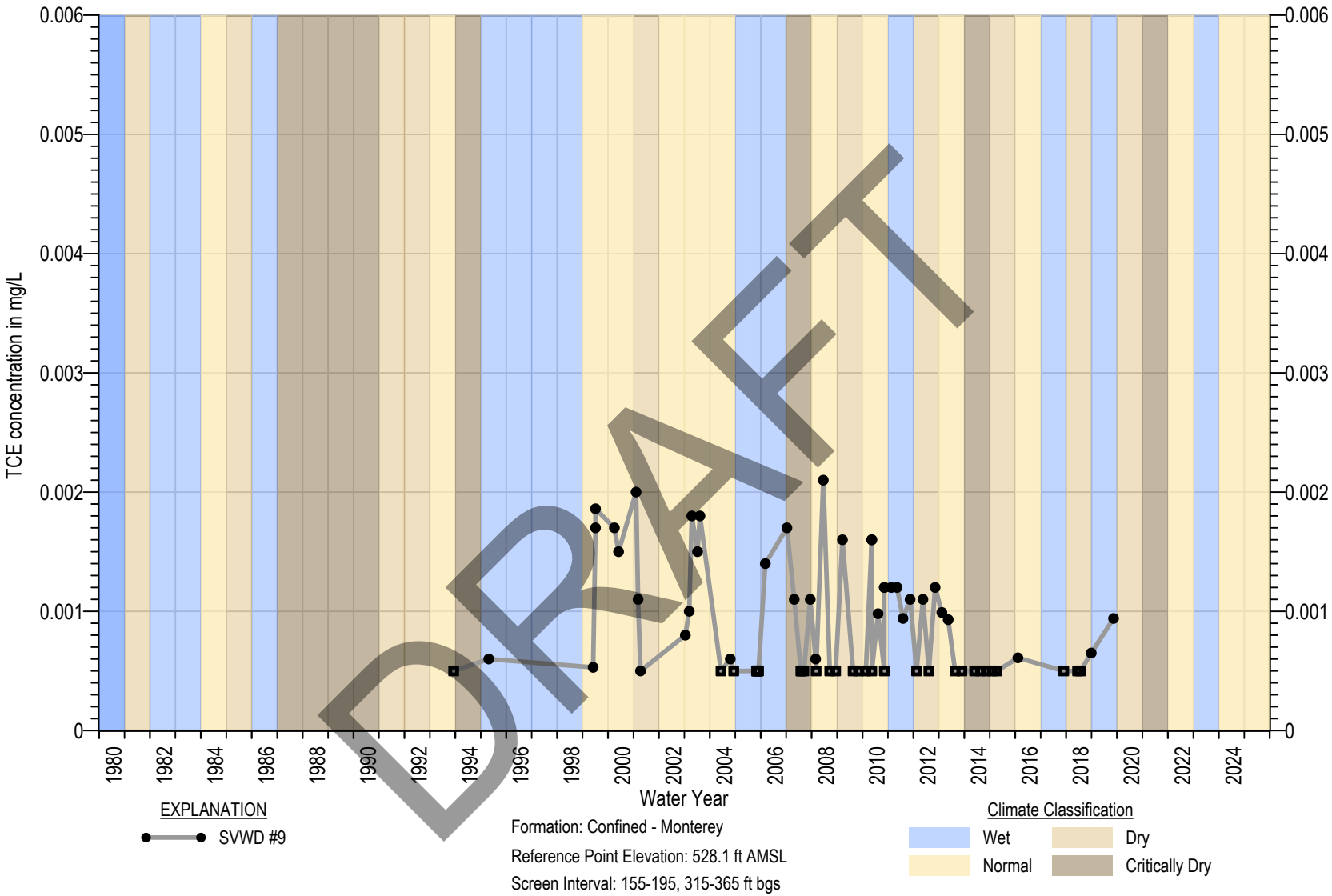
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-263. TCE Chemograph of SVWD Orchard Well

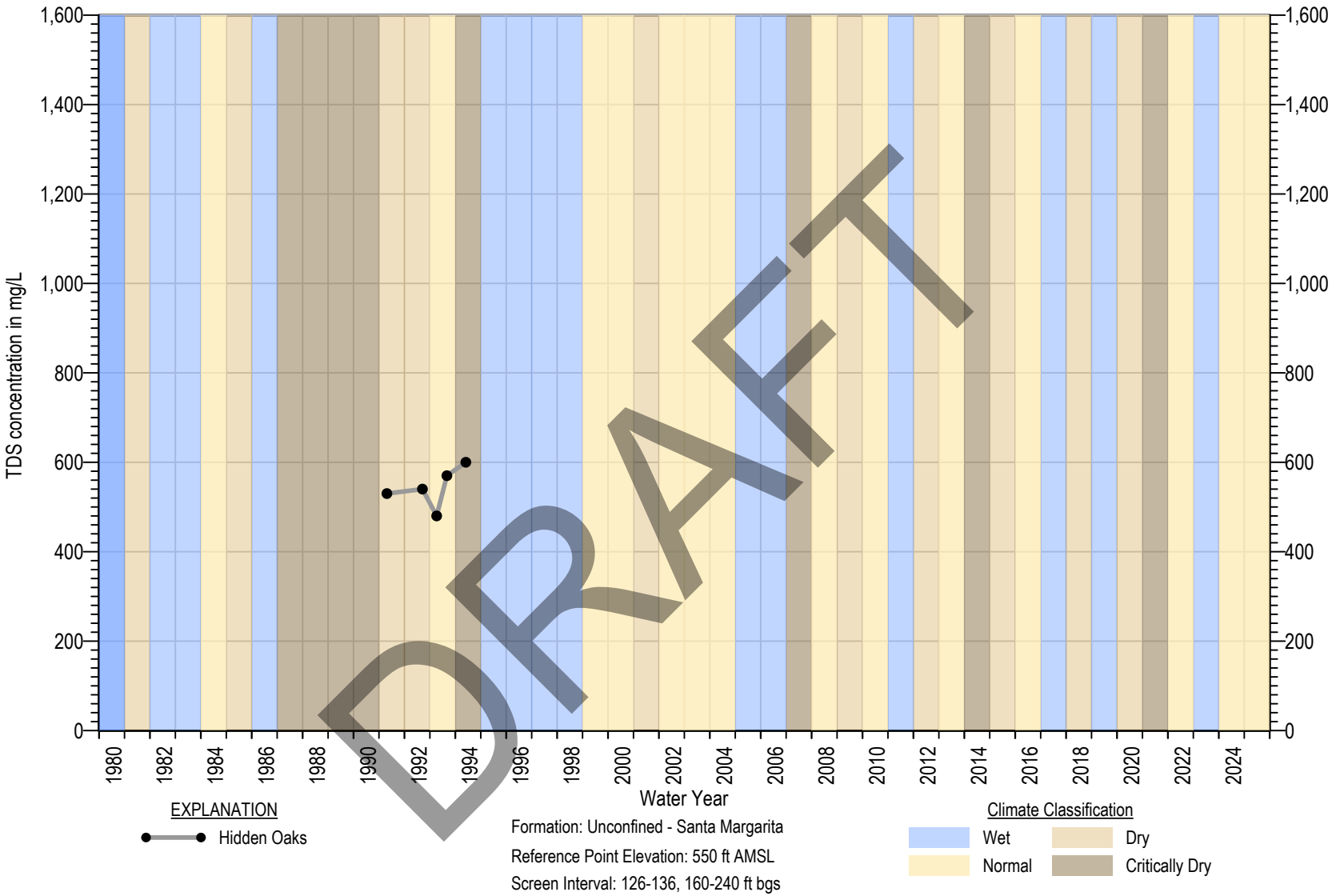
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-264. TCE Chemograph of SVWD #9

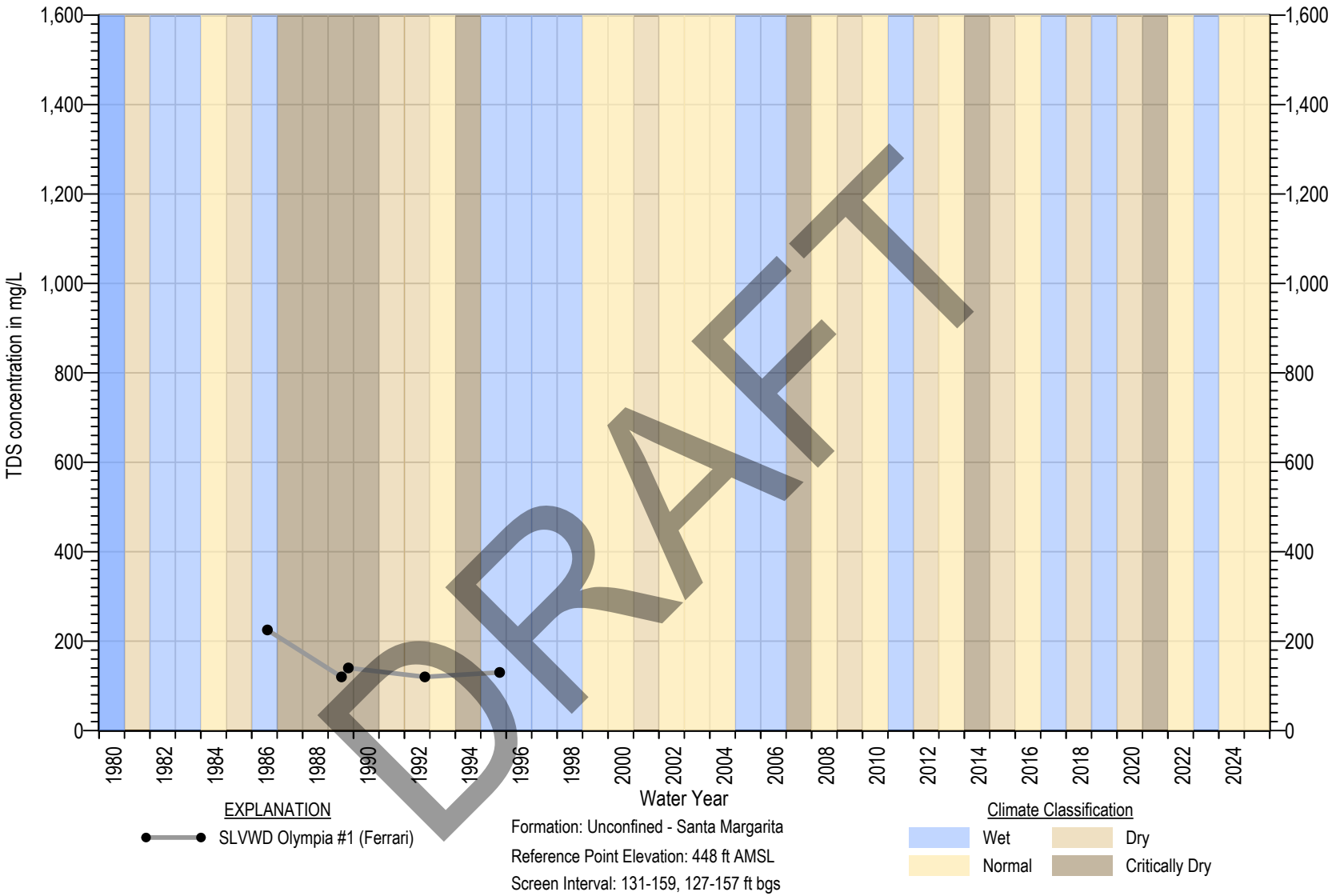
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-265. TDS Chemograph of Hidden Oaks

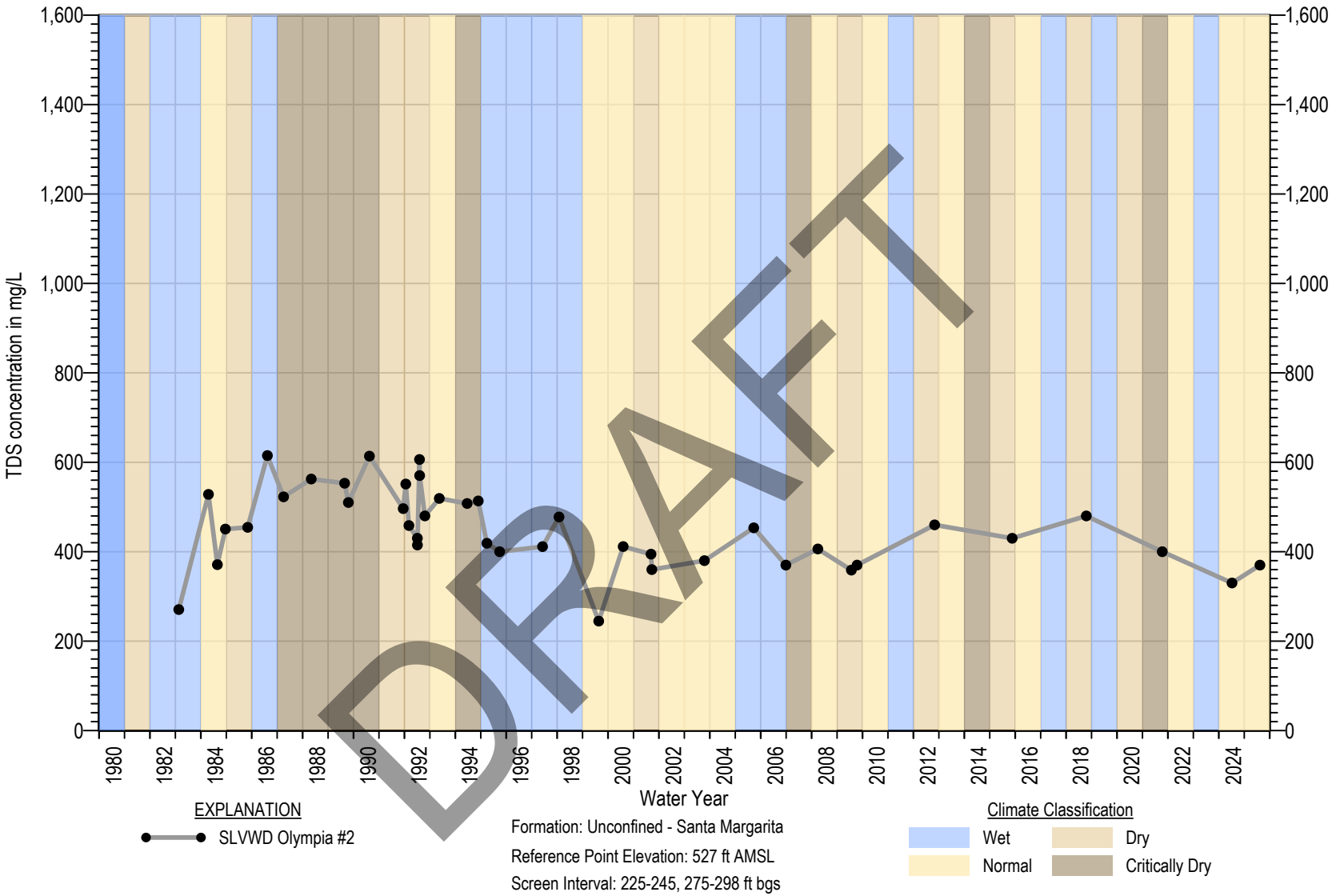
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-266. TDS Chemograph of SLVWD Olympia #1 (Ferrari)

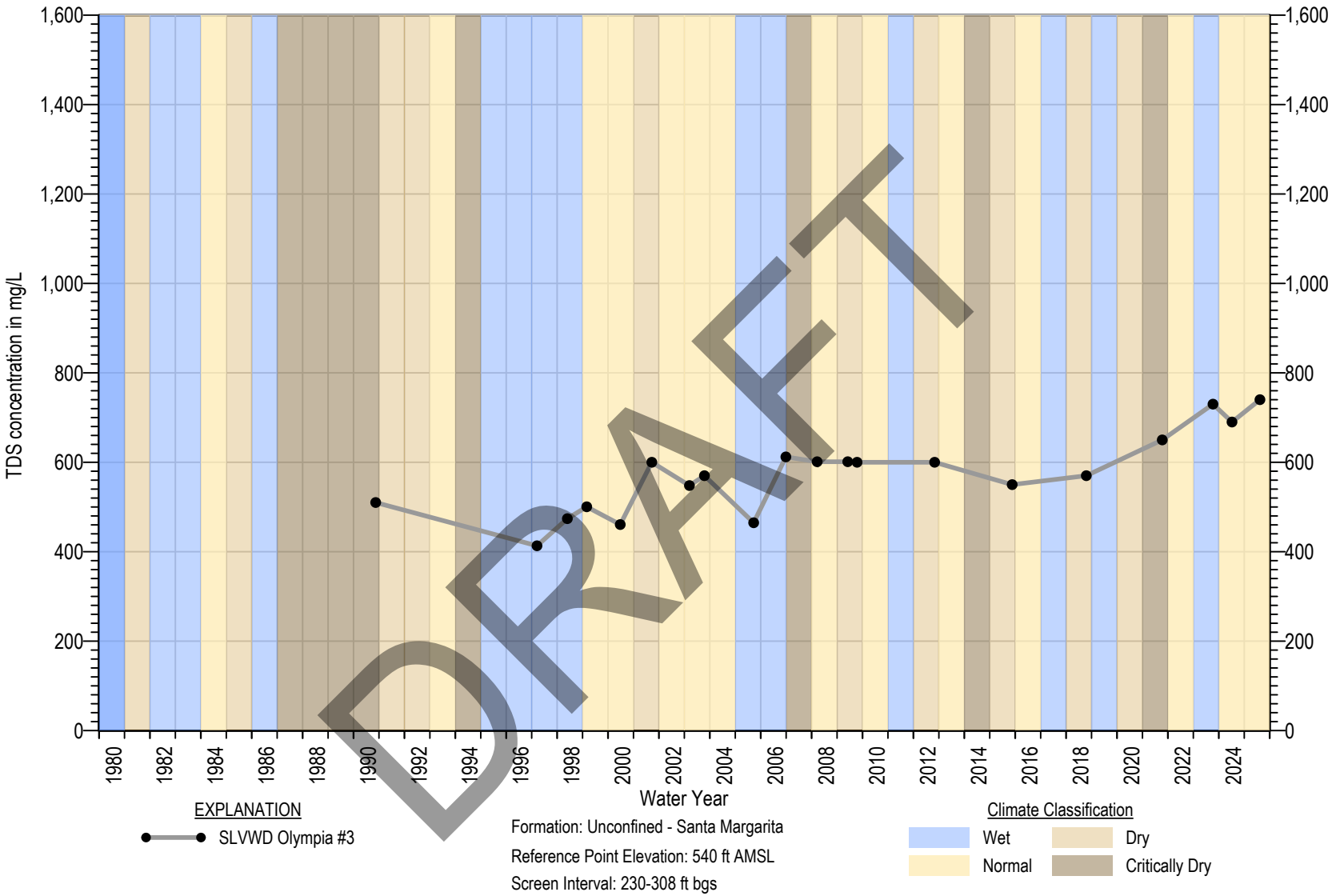
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-267. TDS Chemograph of SLVWD Olympia #2

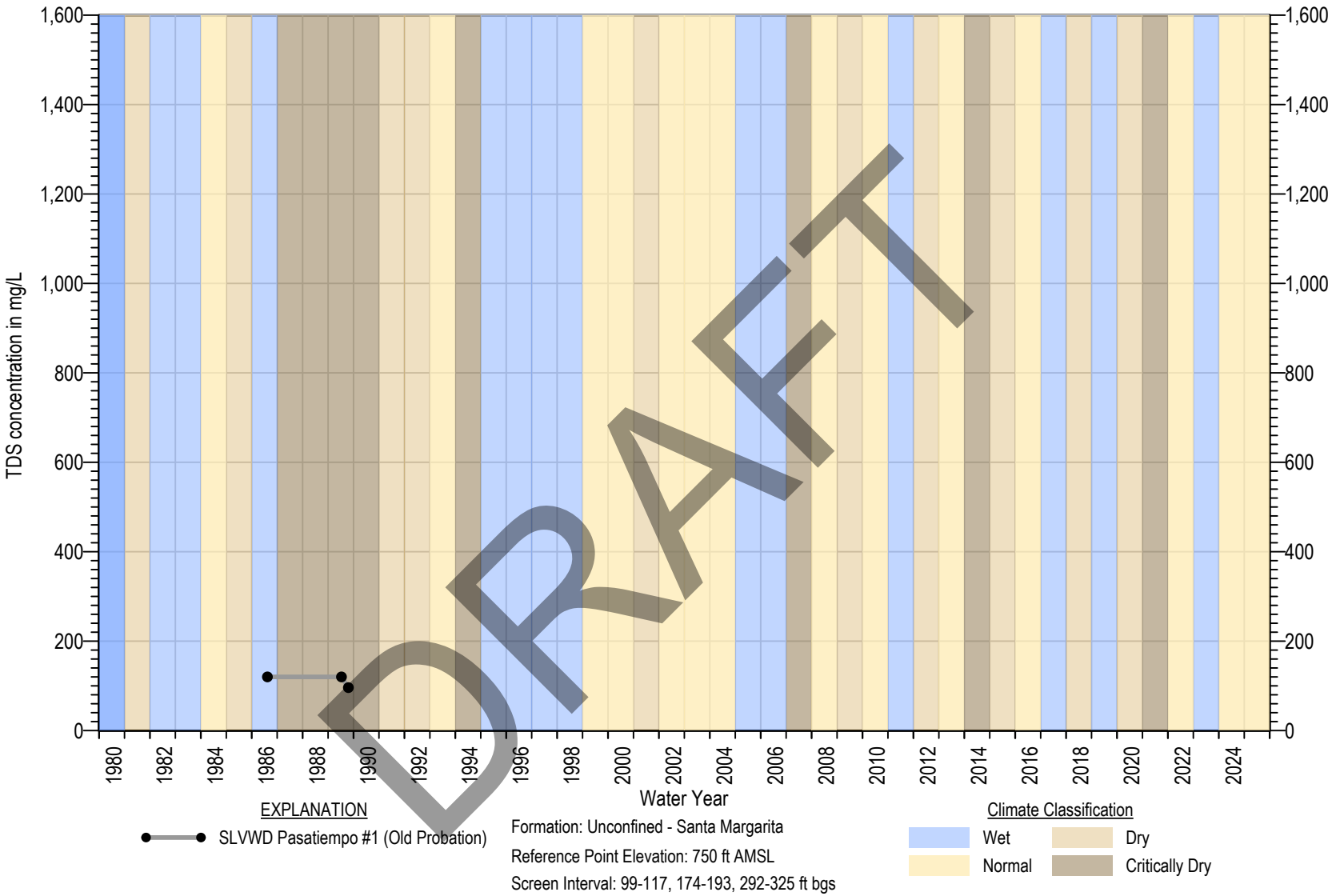
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-268. TDS Chemograph of SLVWD Olympia #3

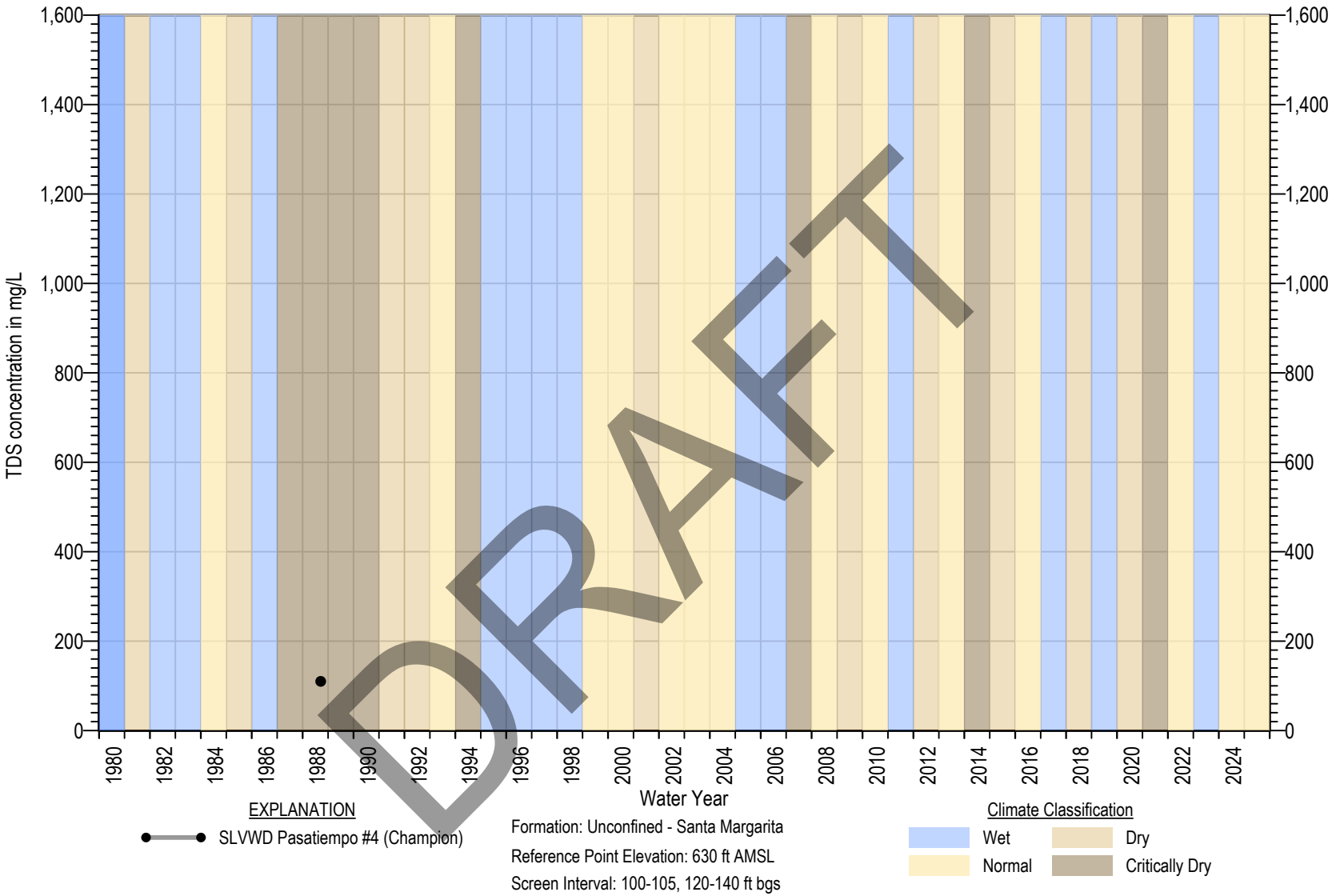
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-269. TDS Chemograph of SLVWD Pasatiempo #1 (Old Probation)

MONTGOMERY & ASSOCIATES



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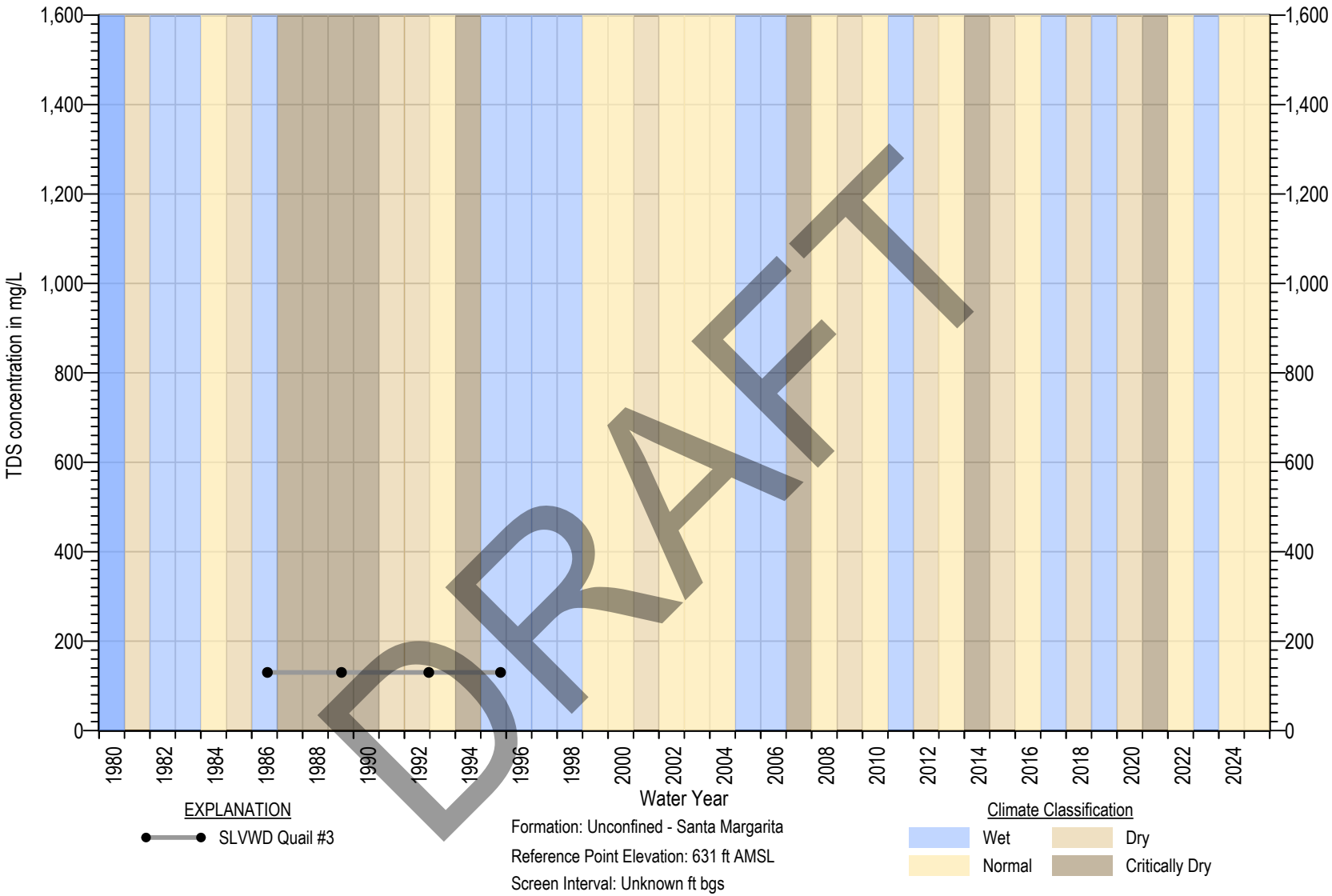
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-270. TDS Chemograph of SLVWD Pasatiempo #4 (Champion)

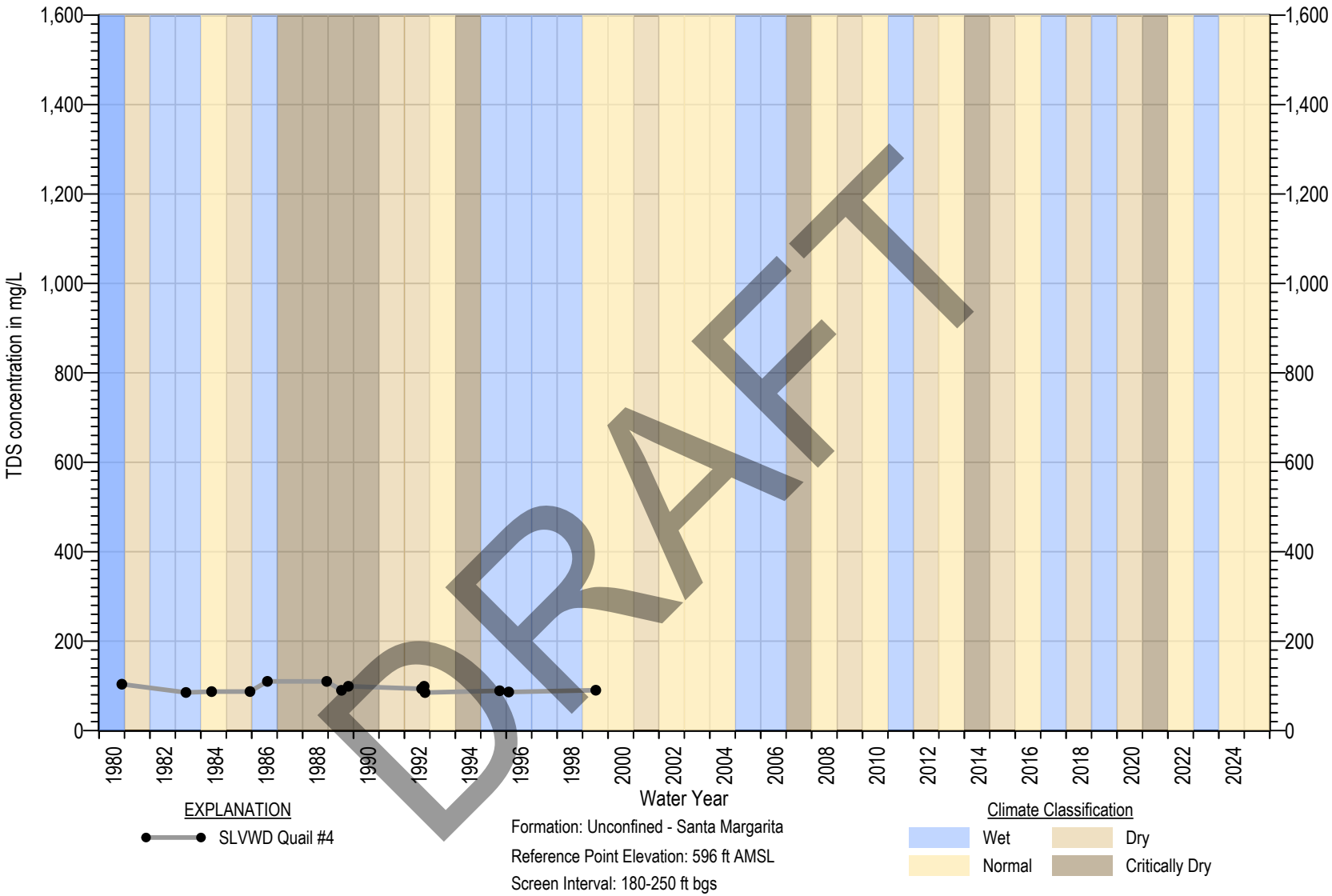
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-271. TDS Chemograph of SLVWD Quail #3

MONTGOMERY & ASSOCIATES

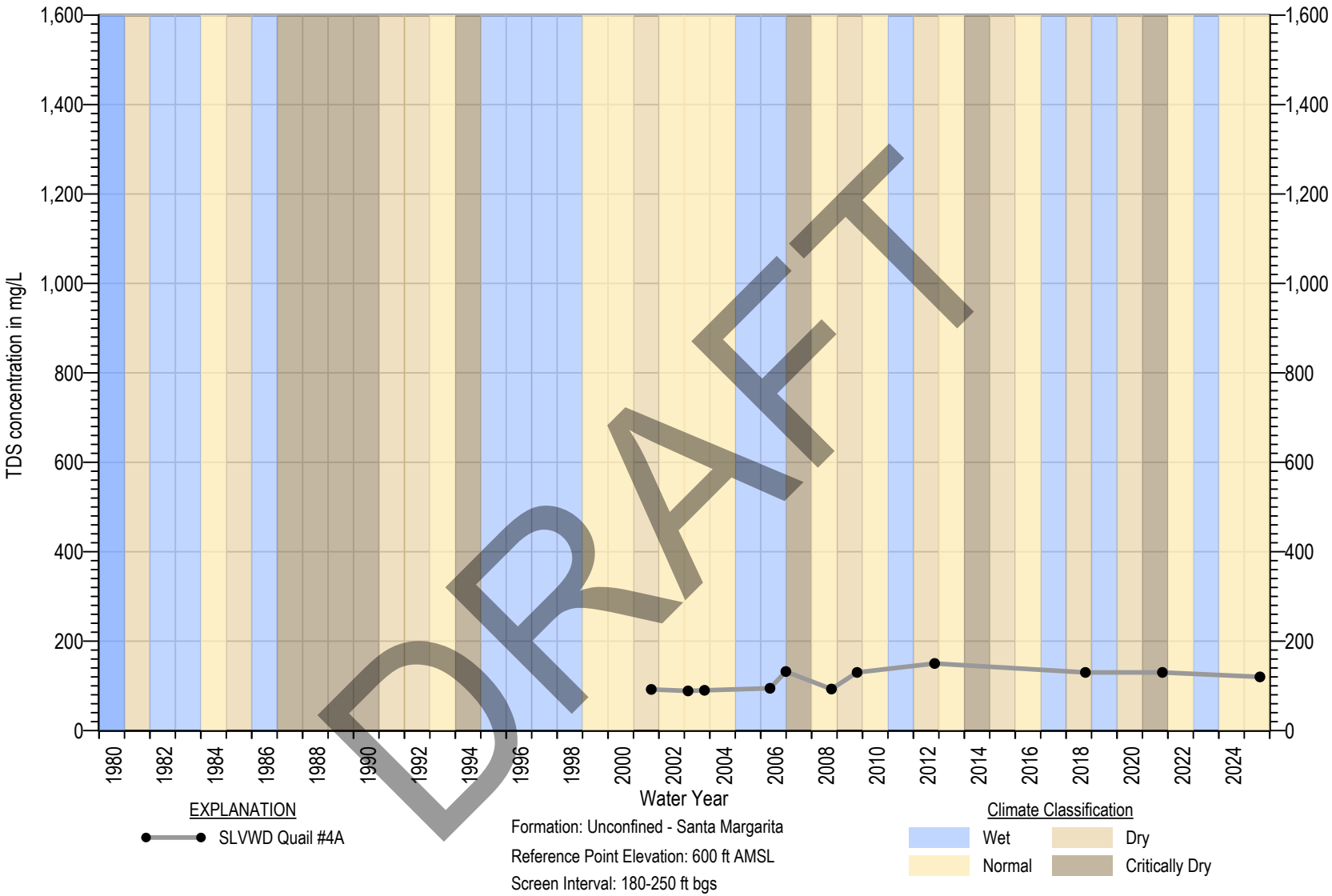


DRAFT

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-272. TDS Chemograph of SLVWD Quail #4

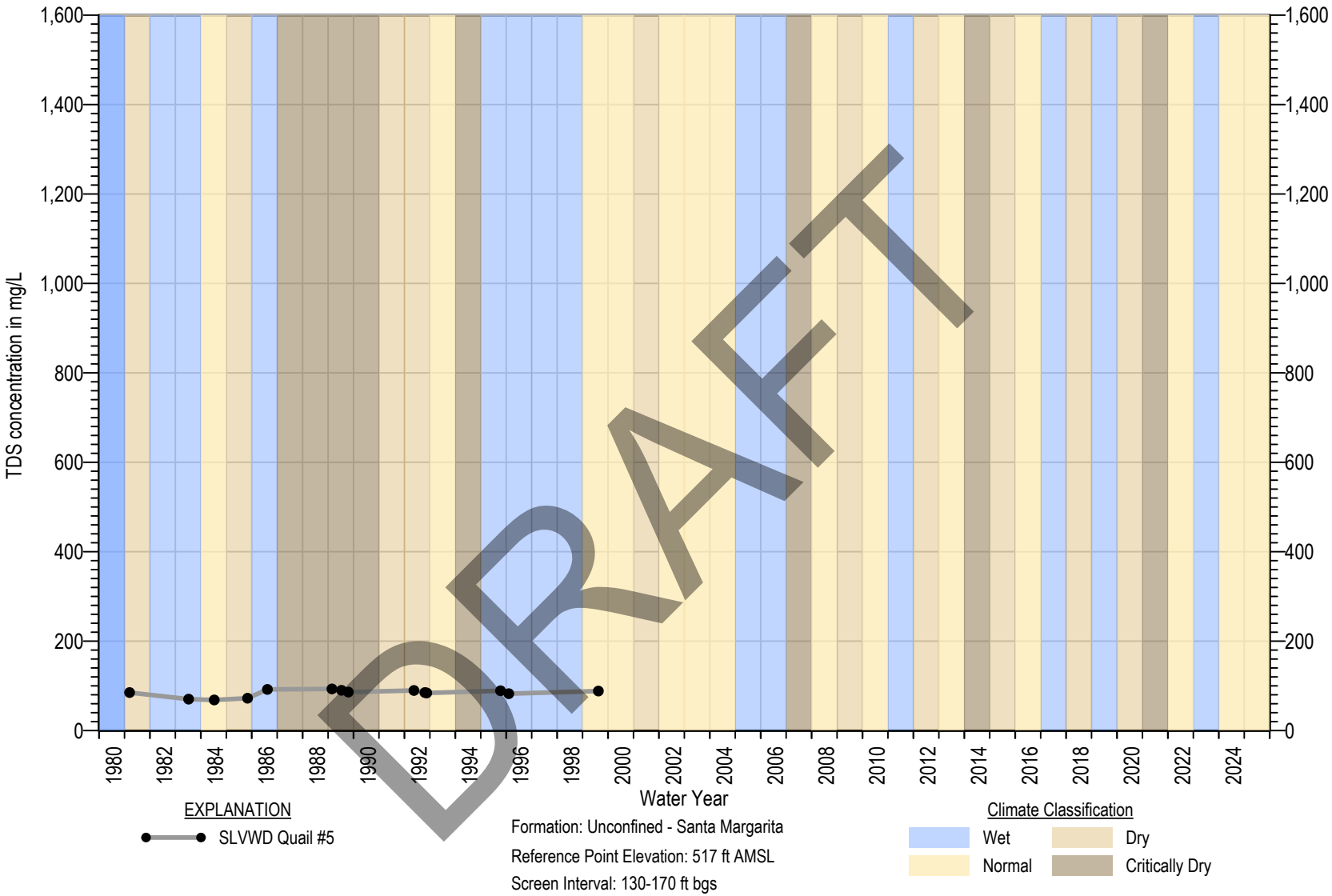
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-273. TDS Chemograph of SLVWD Quail #4A

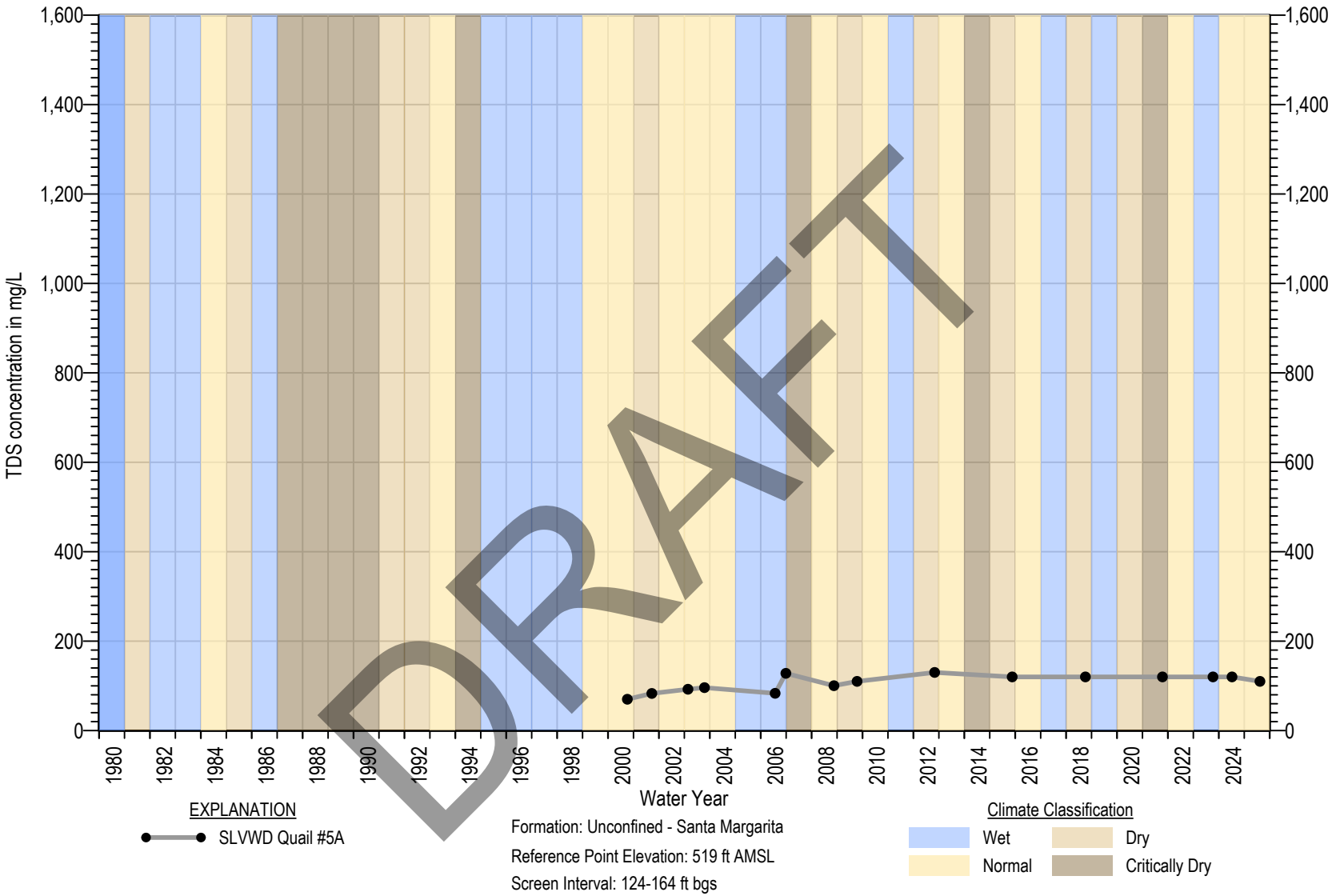
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-274. TDS Chemograph of SLVWD Quail #5

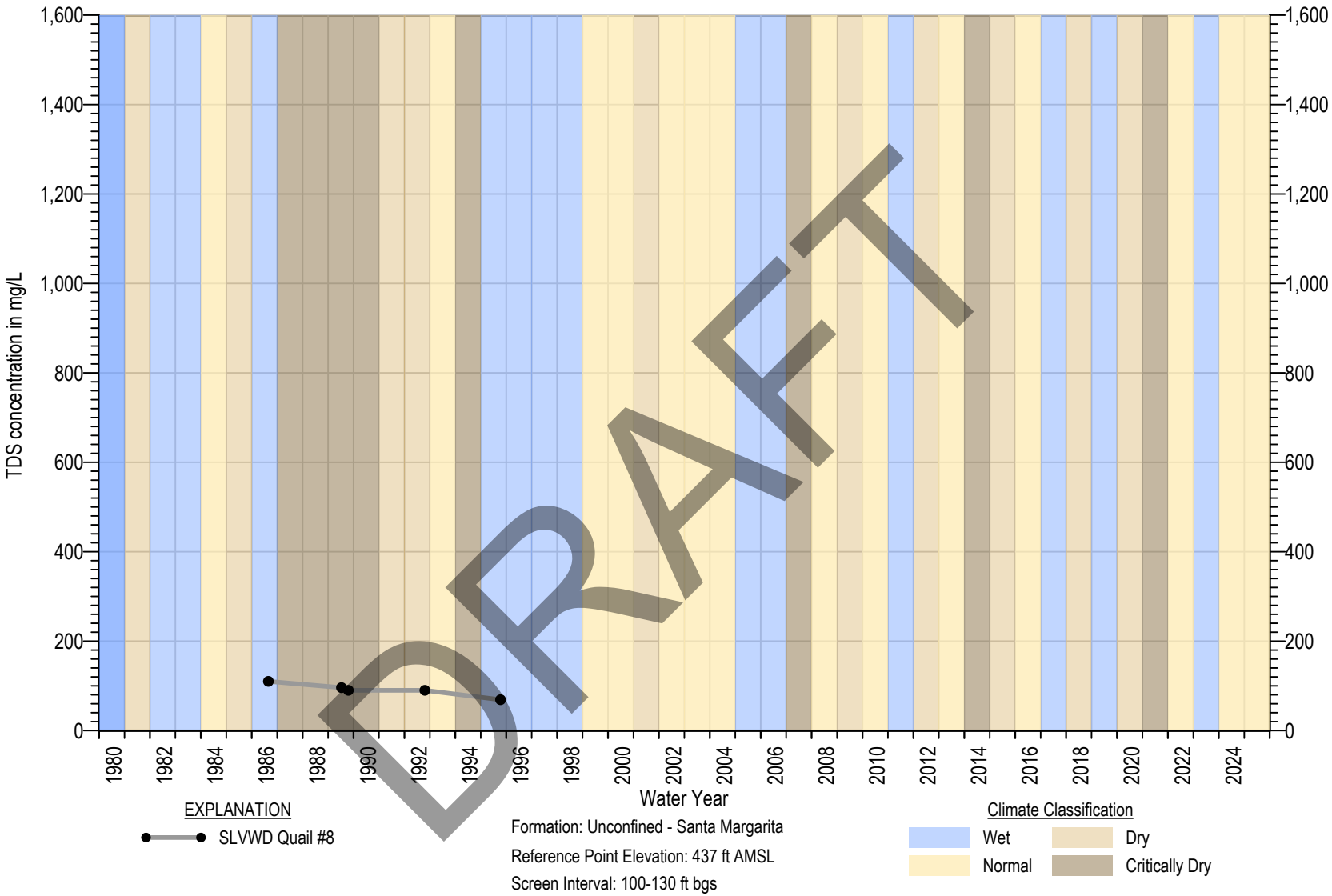
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-275. TDS Chemograph of SLVWD Quail #5A

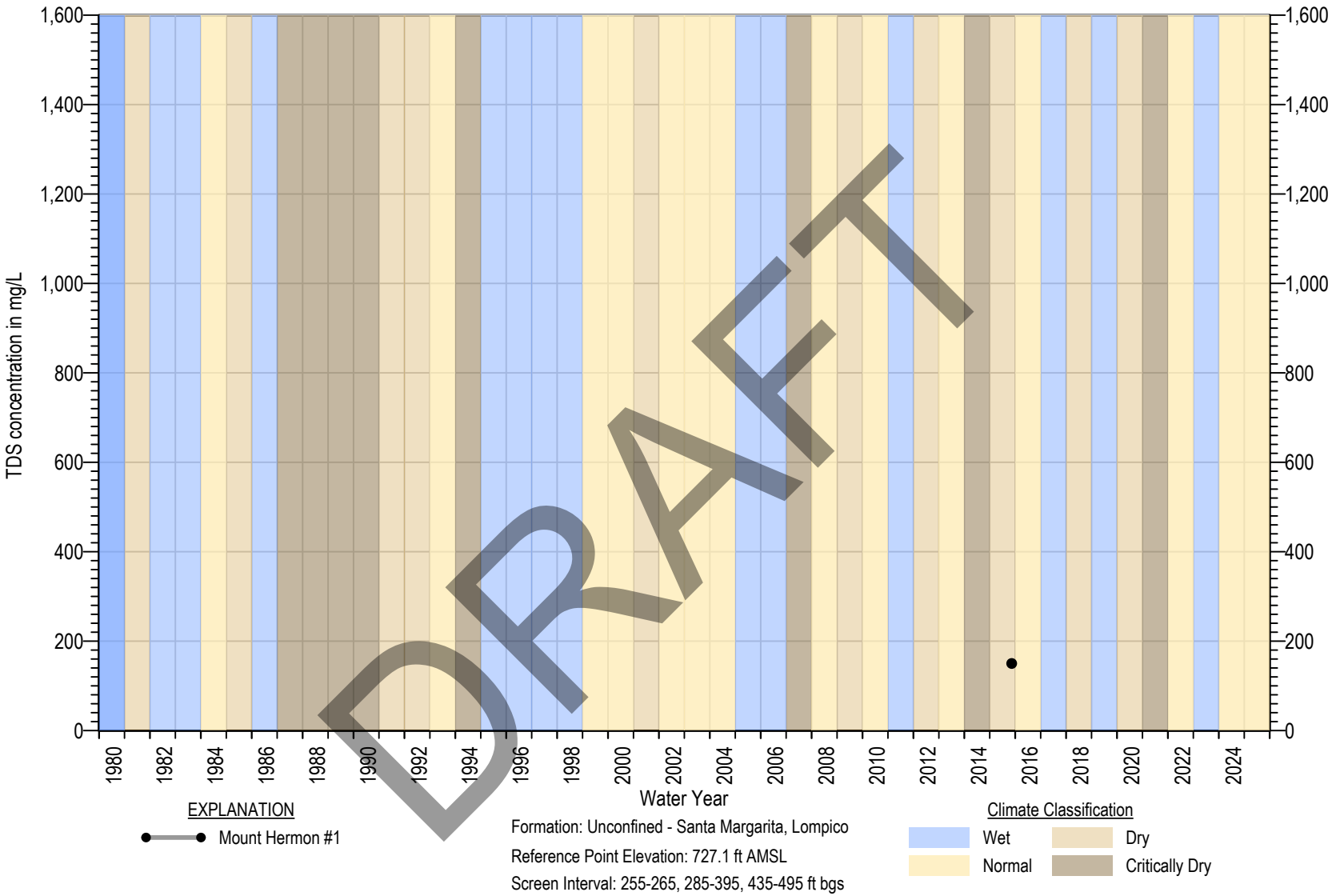
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-276. TDS Chemograph of SLVWD Quail #8

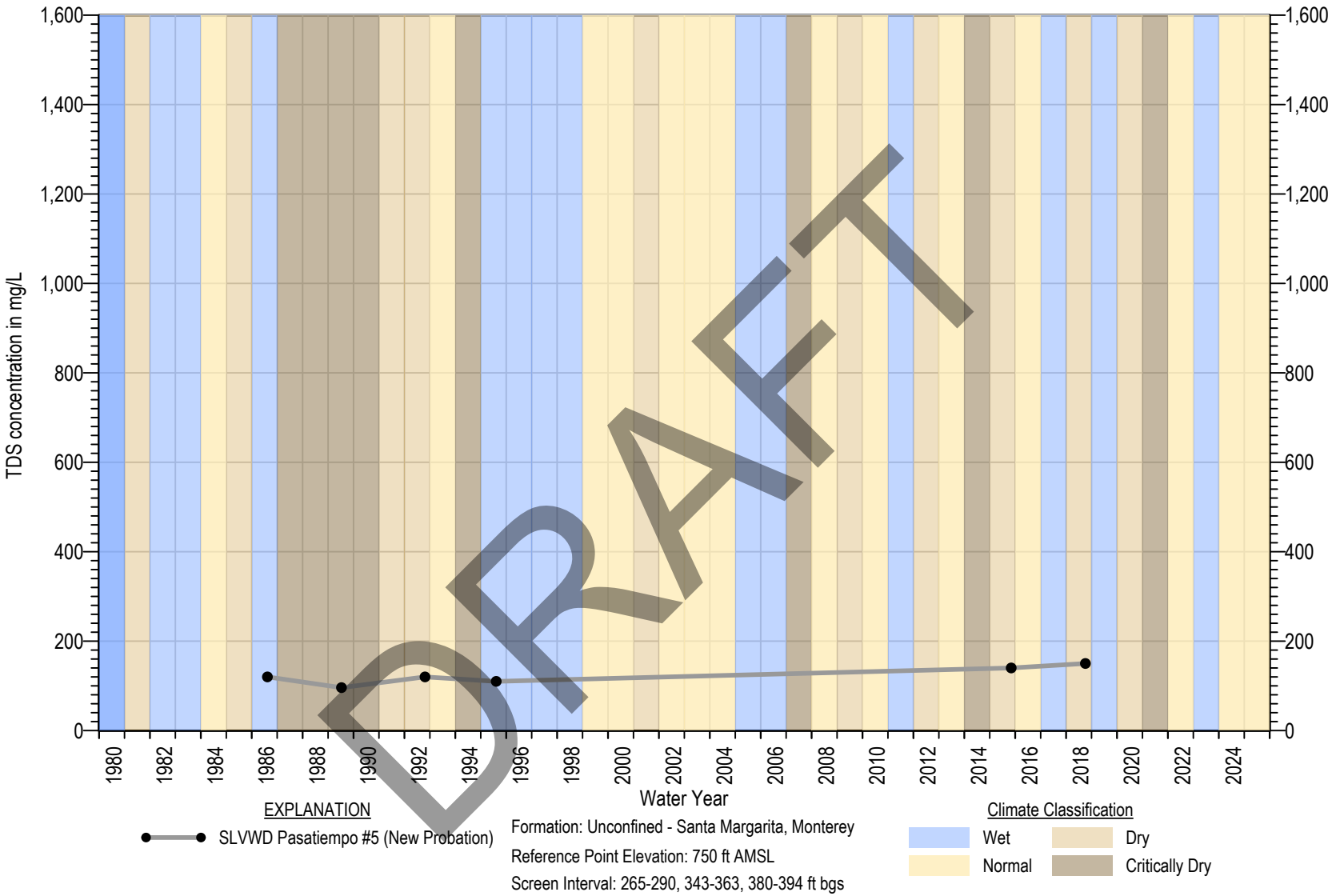
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-277. TDS Chemograph of Mount Hermon #1

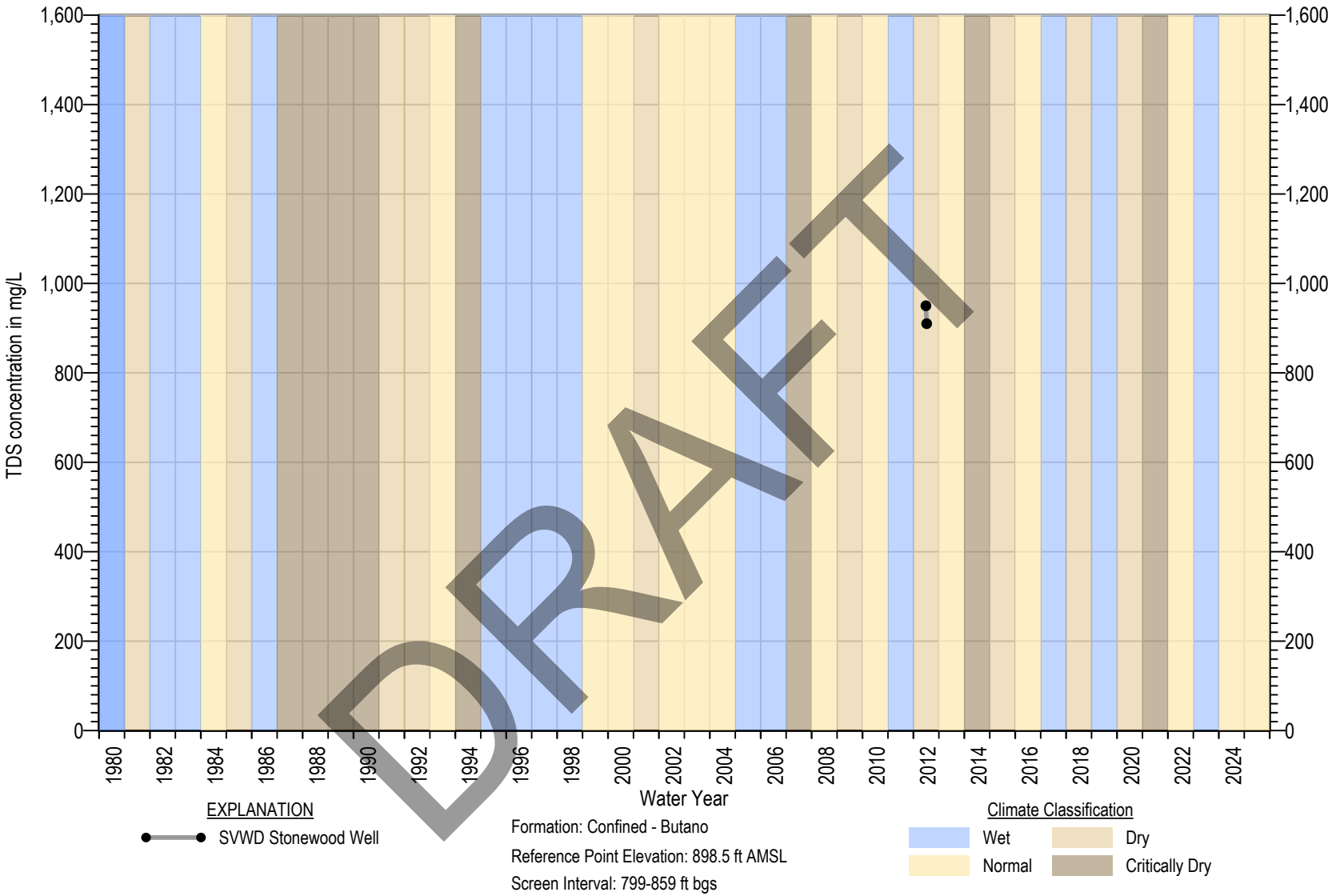
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-278. TDS Chemograph of SLVWD Pasatiempo #5 (New Probation)

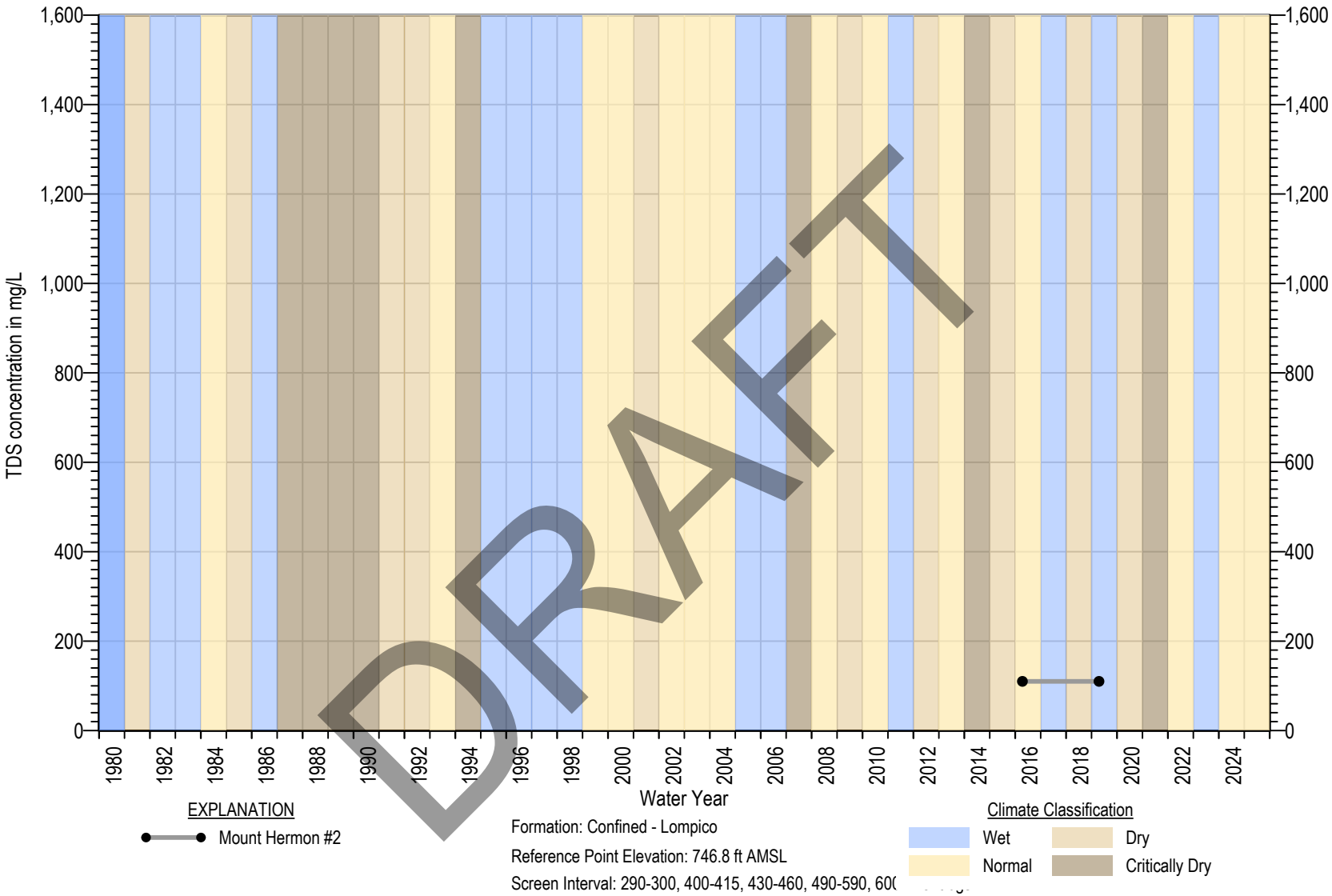
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-279. TDS Chemograph of SVWD Stonewood Well

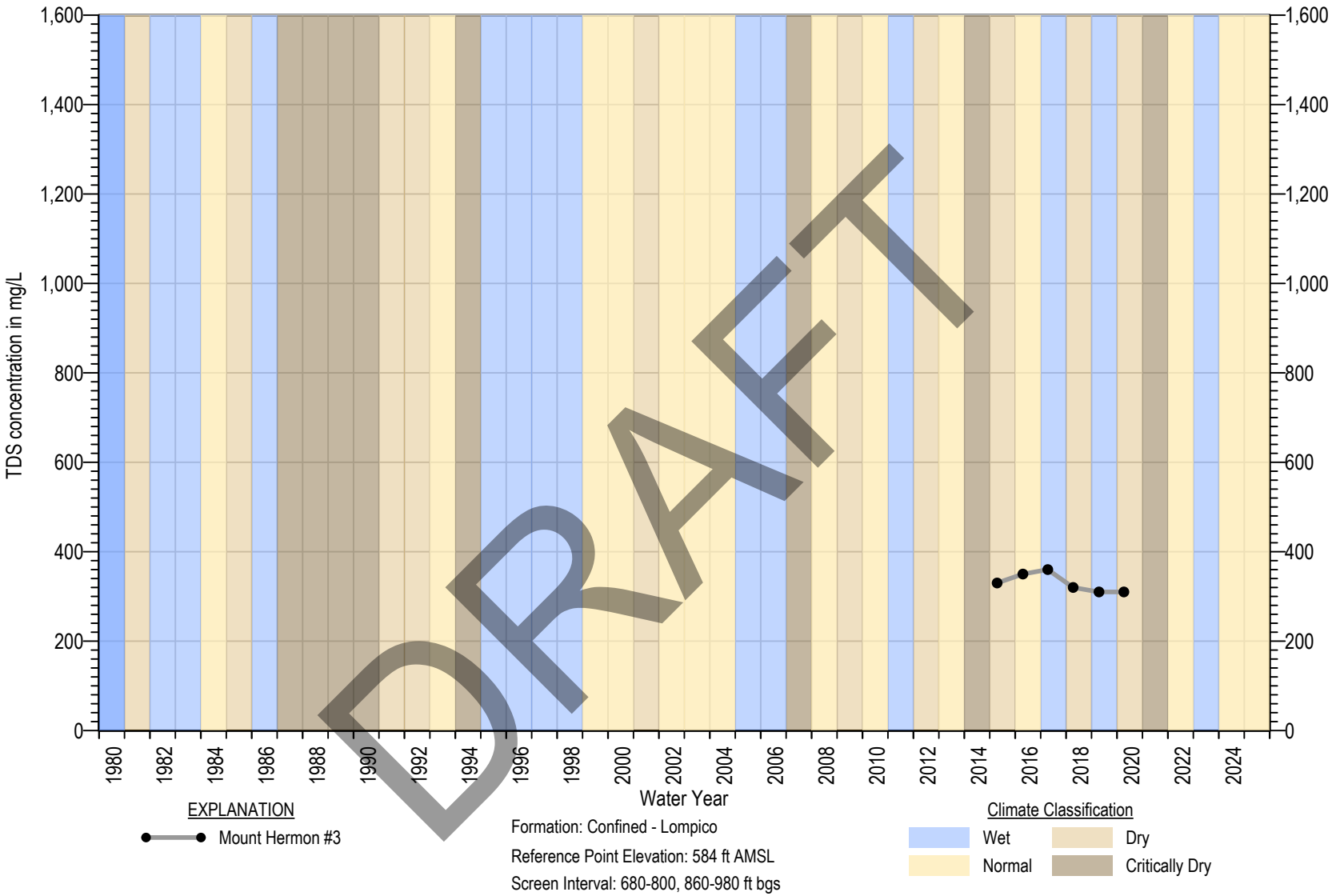
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-280. TDS Chemograph of Mount Hermon #2

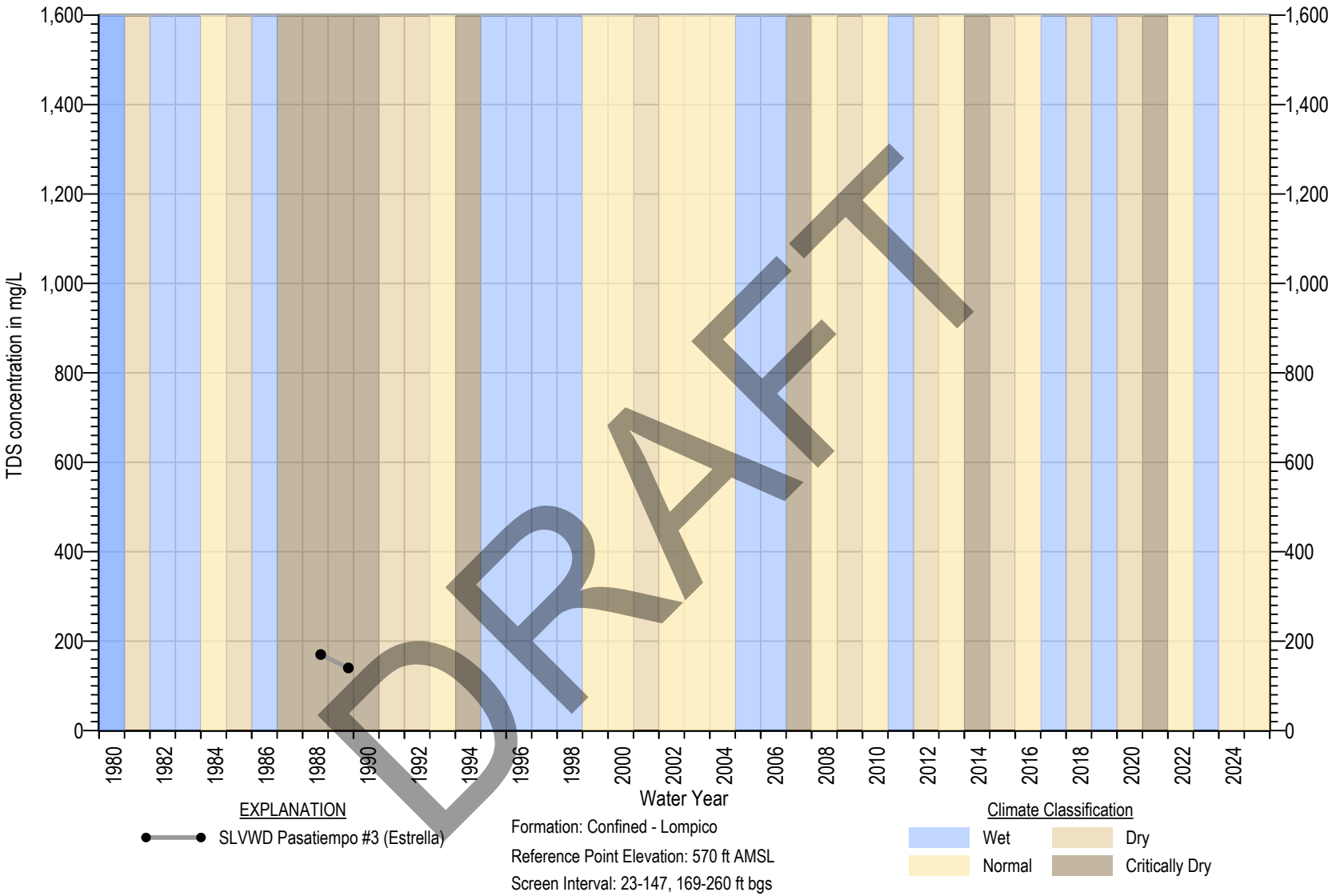
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-281. TDS Chemograph of Mount Hermon #3

MONTGOMERY & ASSOCIATES



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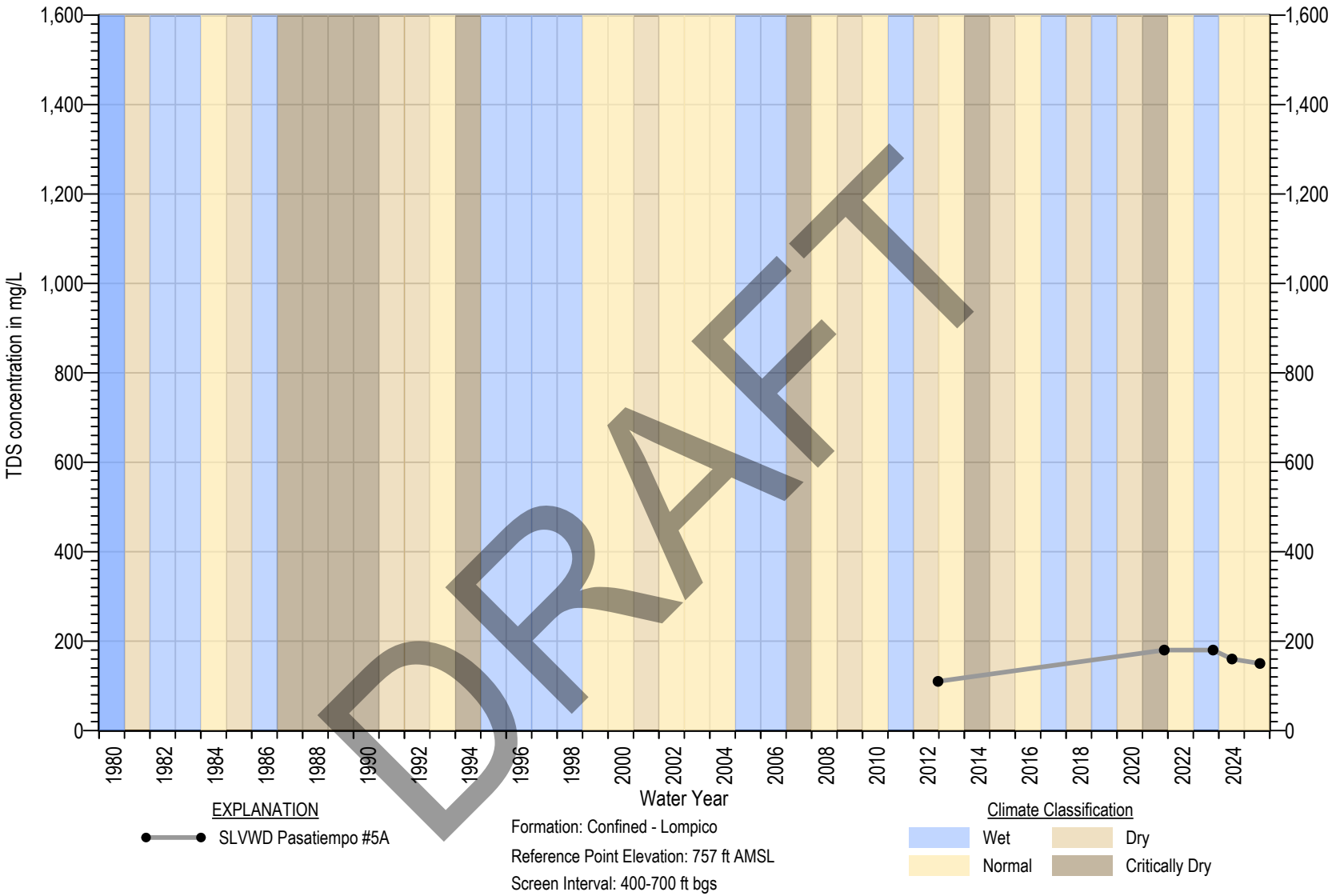
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-282. TDS Chemograph of SLVWD Pasatiempo #3 (Estrella)

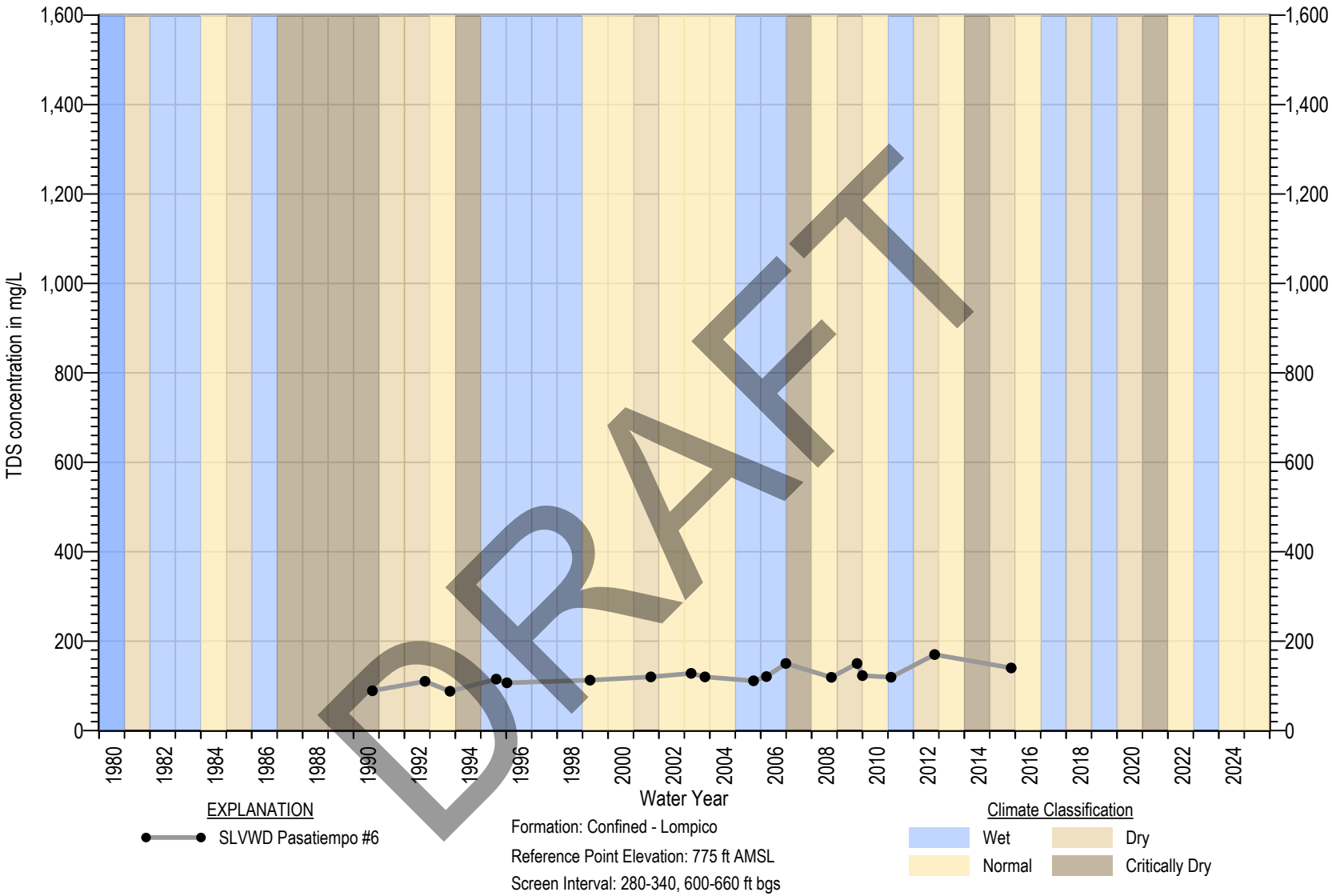
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-283. TDS Chemograph of SLVWD Pasatiempo #5A

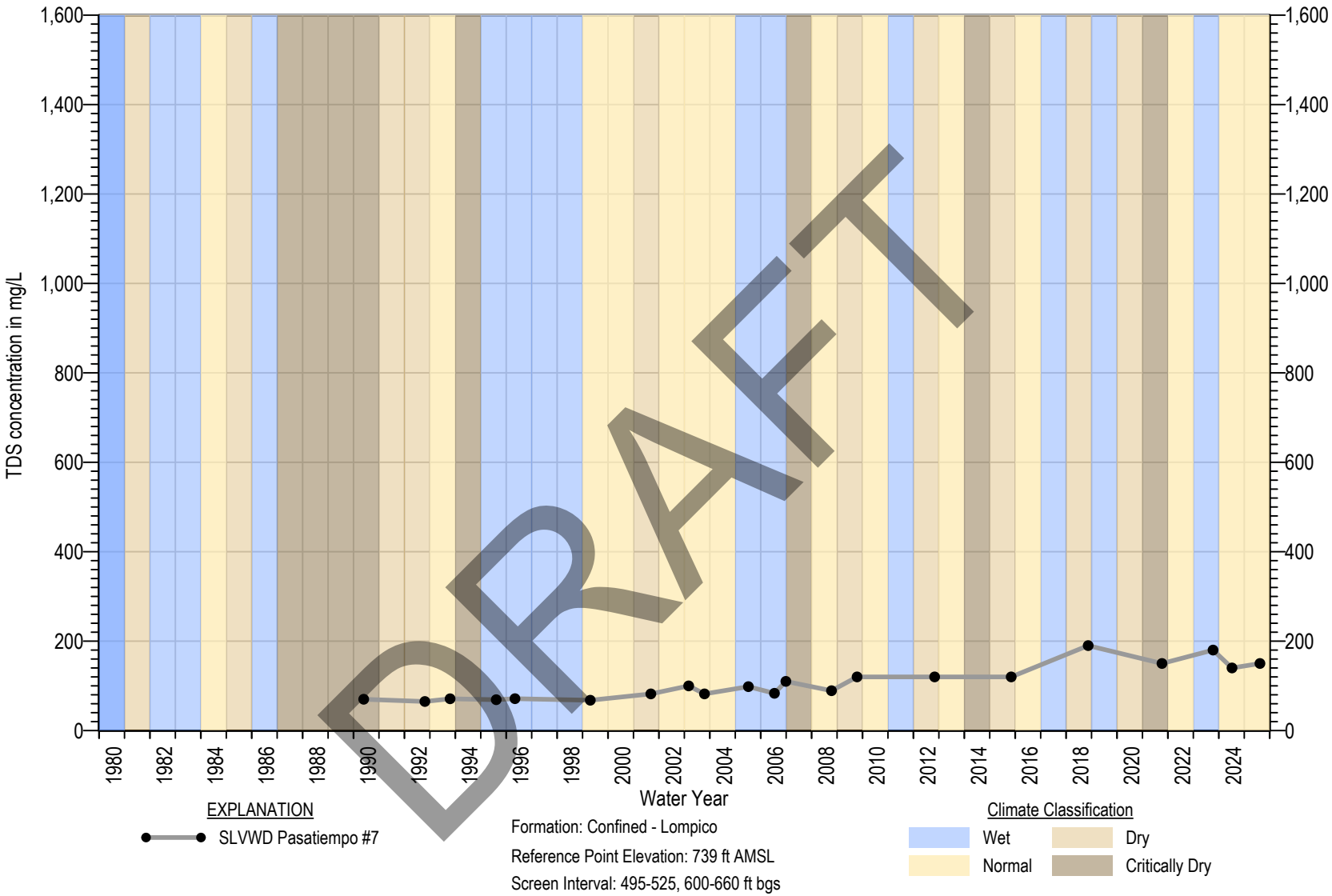
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-284. TDS Chemograph of SLVWD Pasatiempo #6

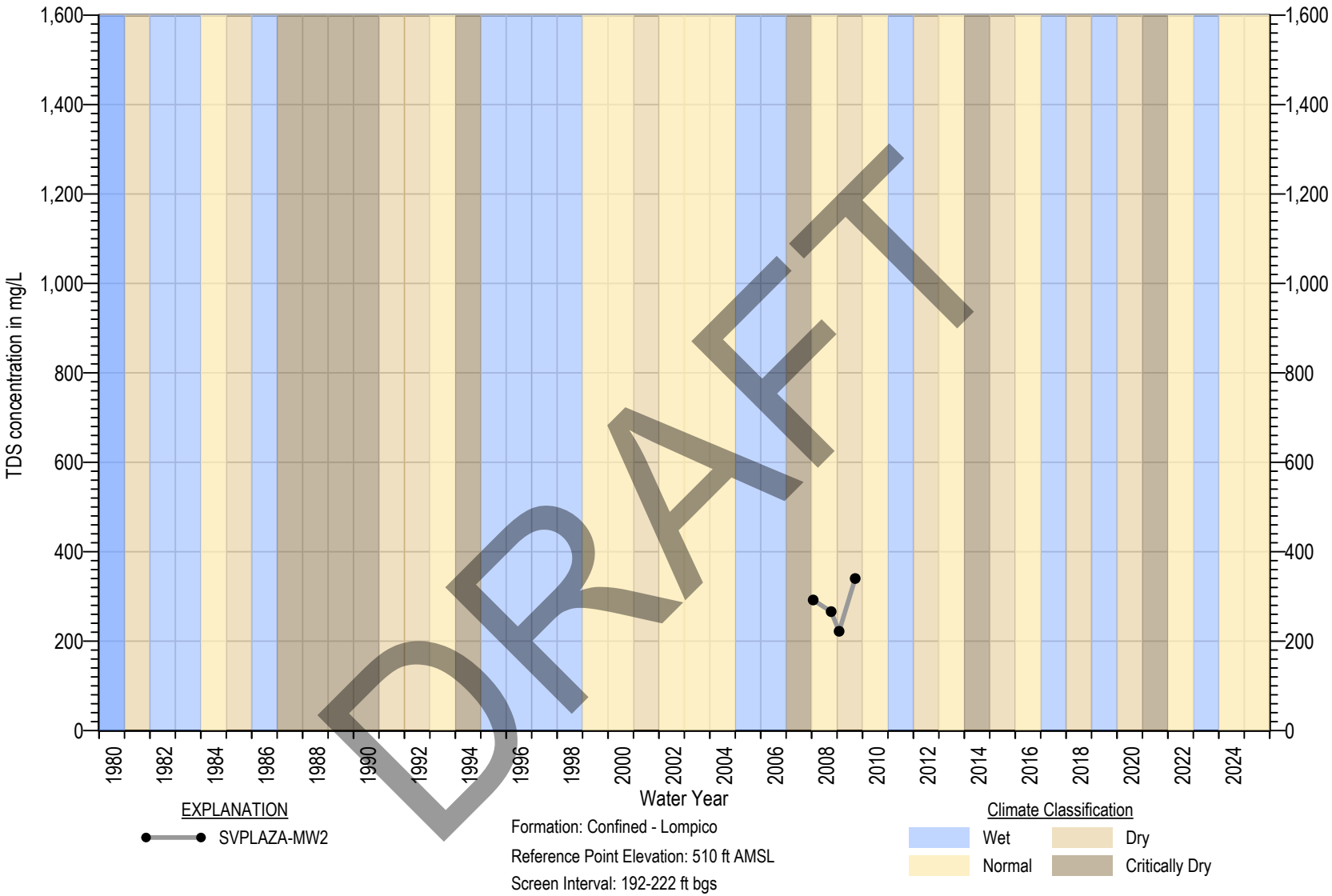
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-285. TDS Chemograph of SLVWD Pasatiempo #7

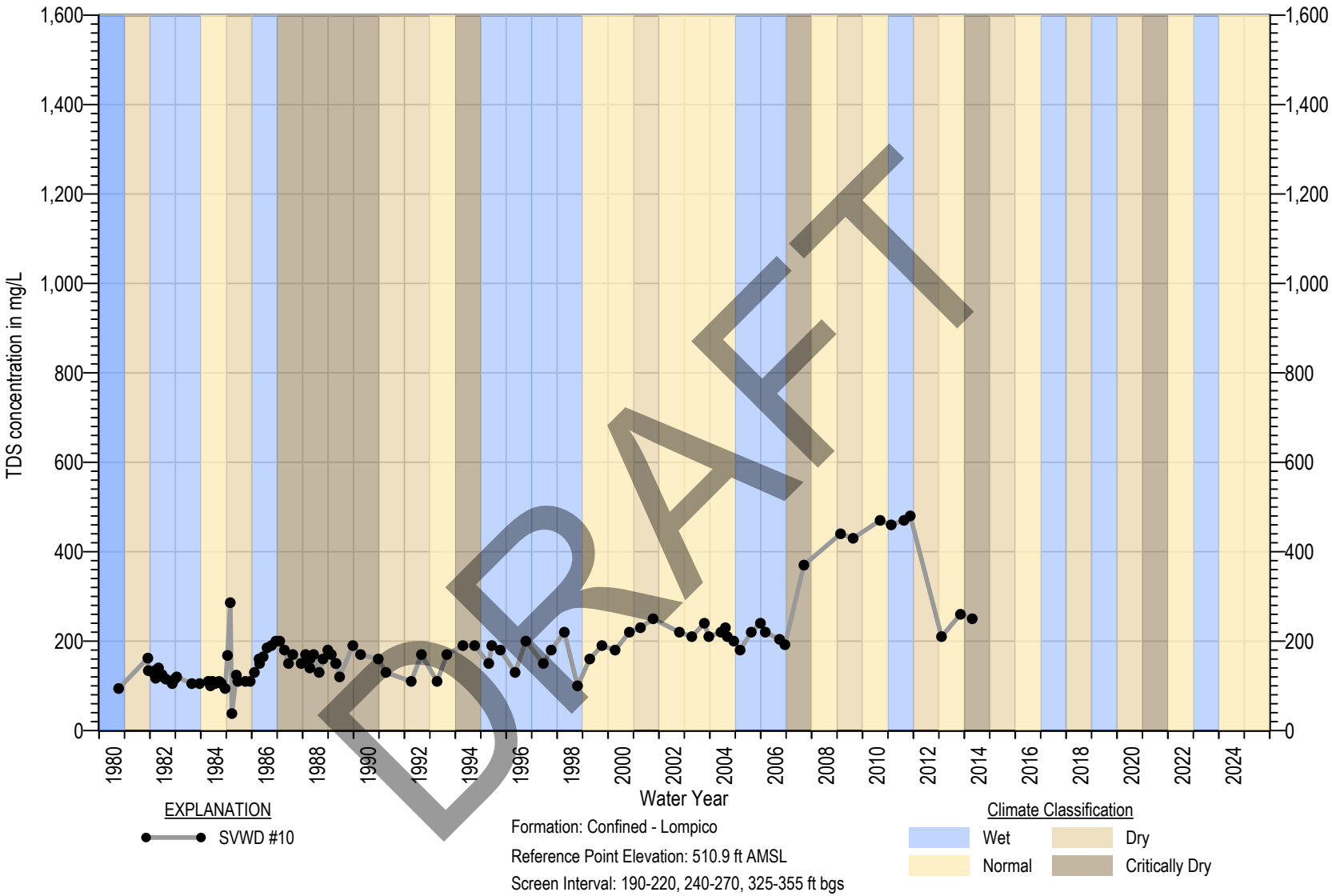
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-286. TDS Chemograph of SVPLAZA-MW2

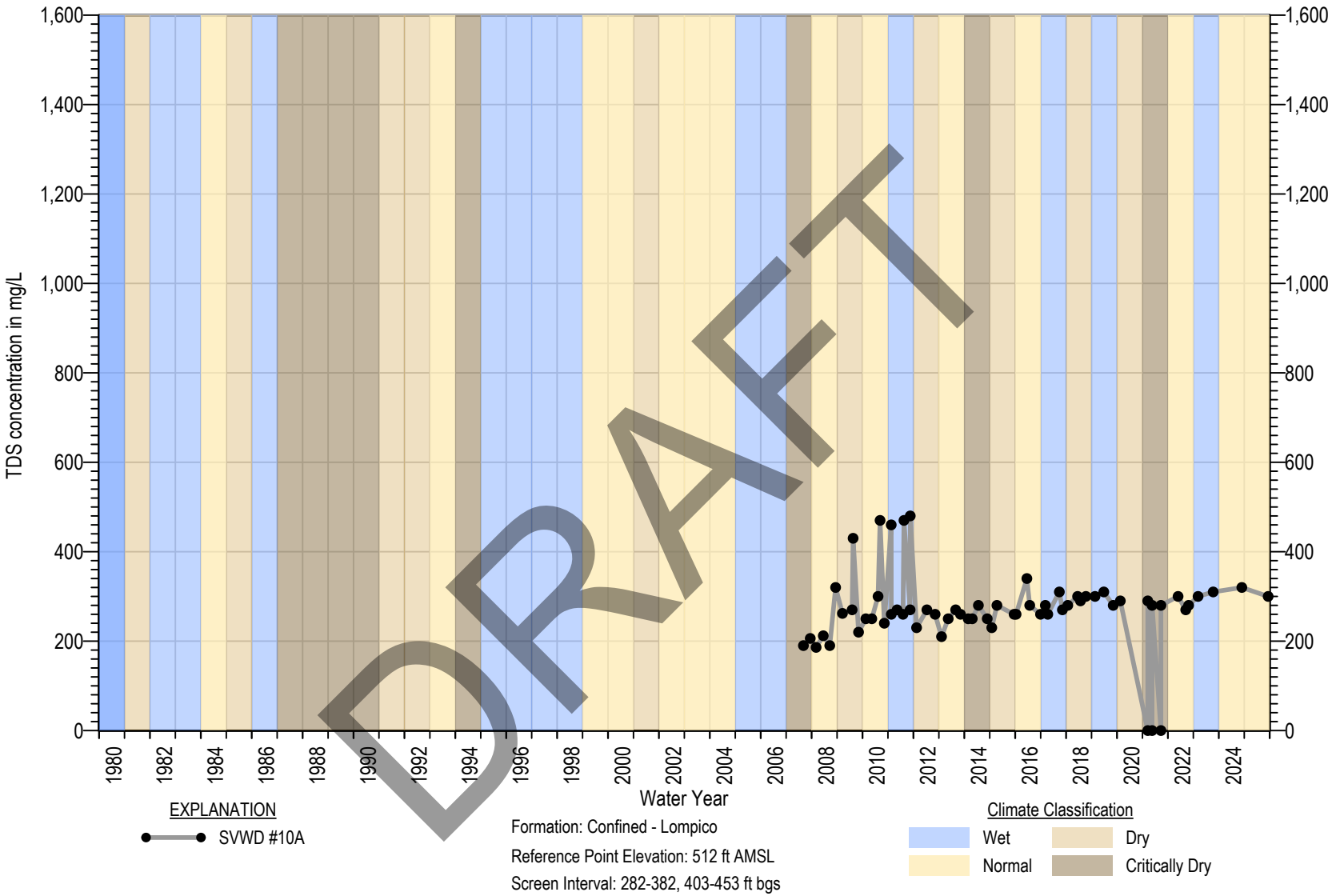
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-287. TDS Chemograph of SVWD #10

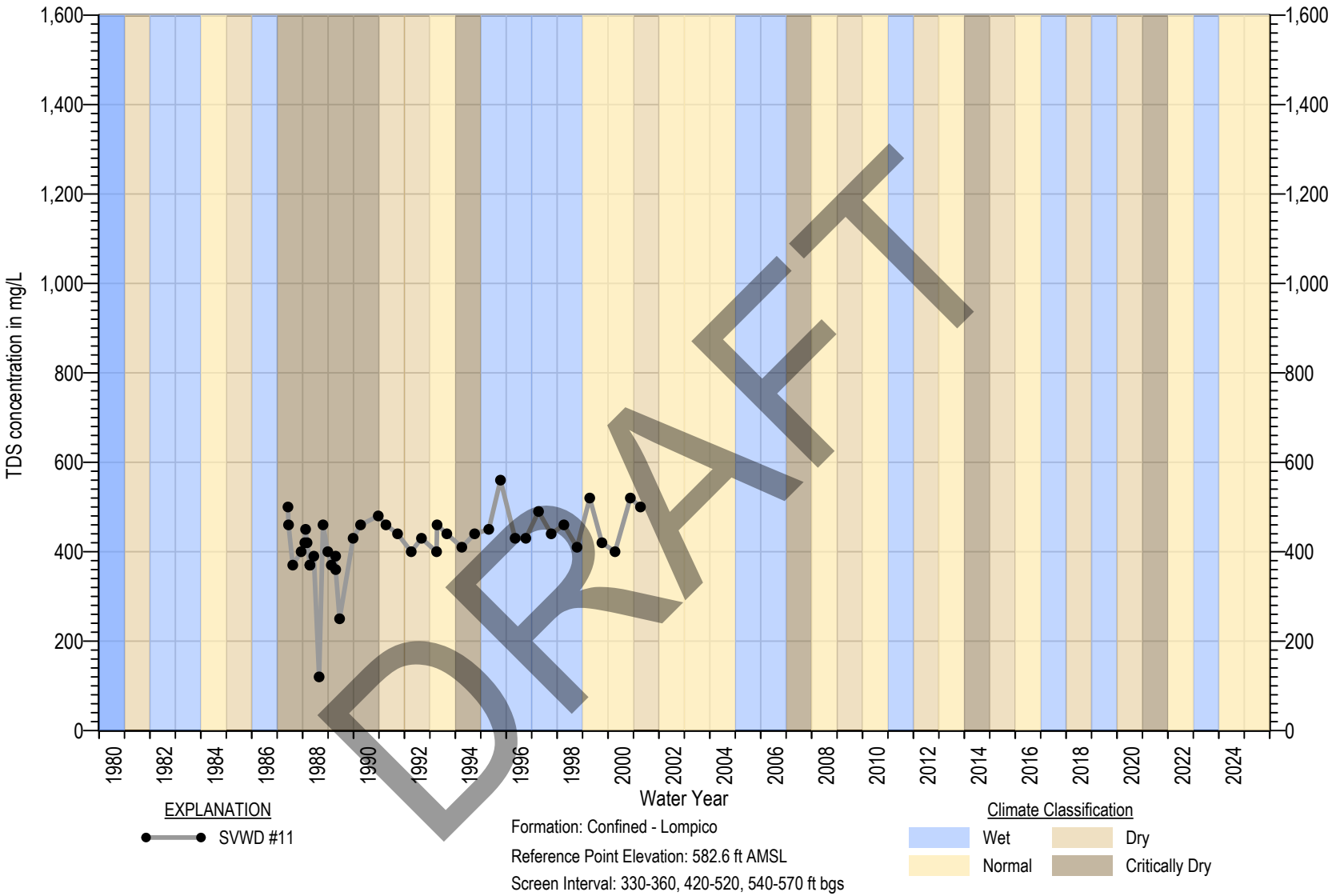
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-288. TDS Chemograph of SVWD #10A

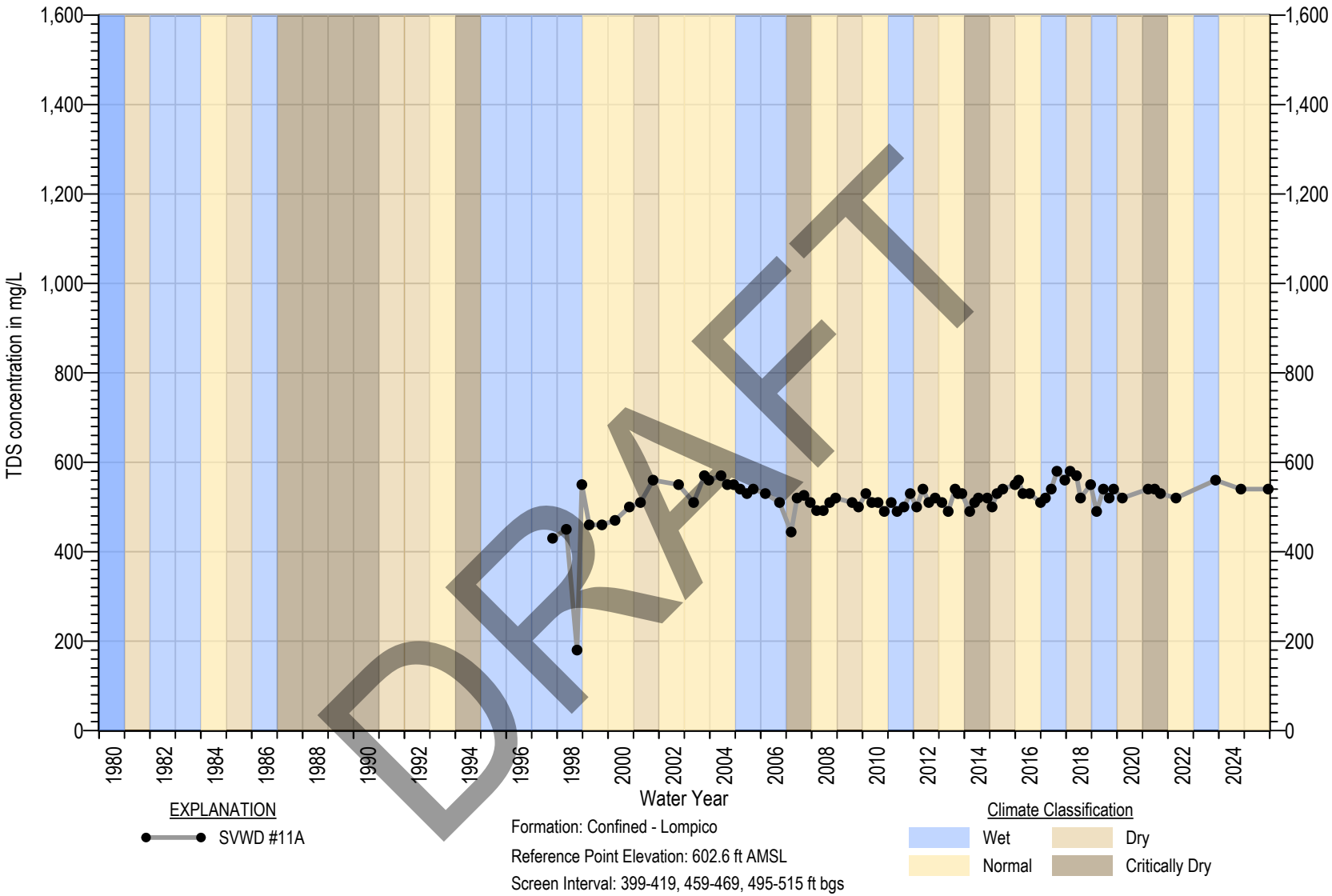
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-289. TDS Chemograph of SVWD #11

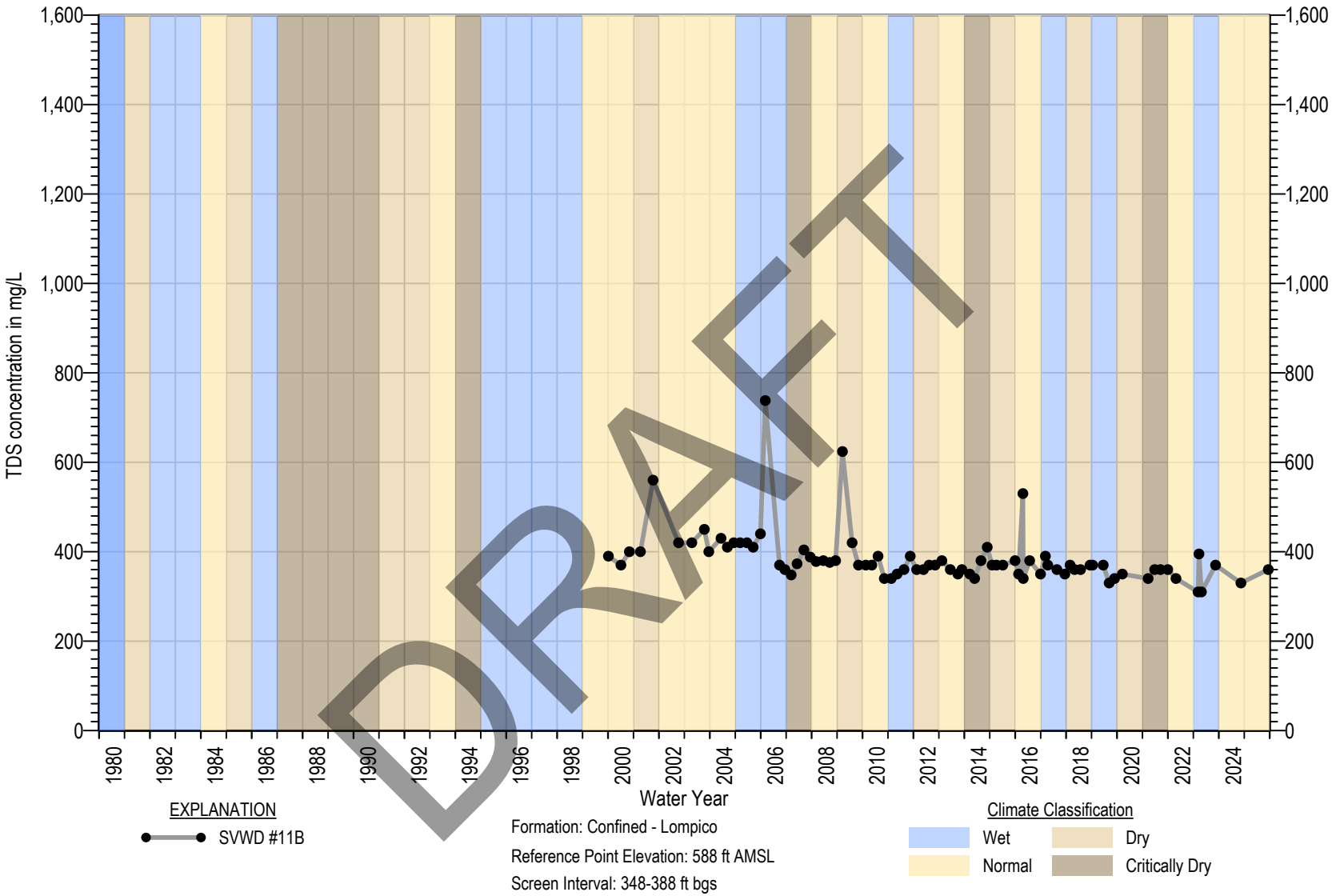
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-290. TDS Chemograph of SVWD #11A

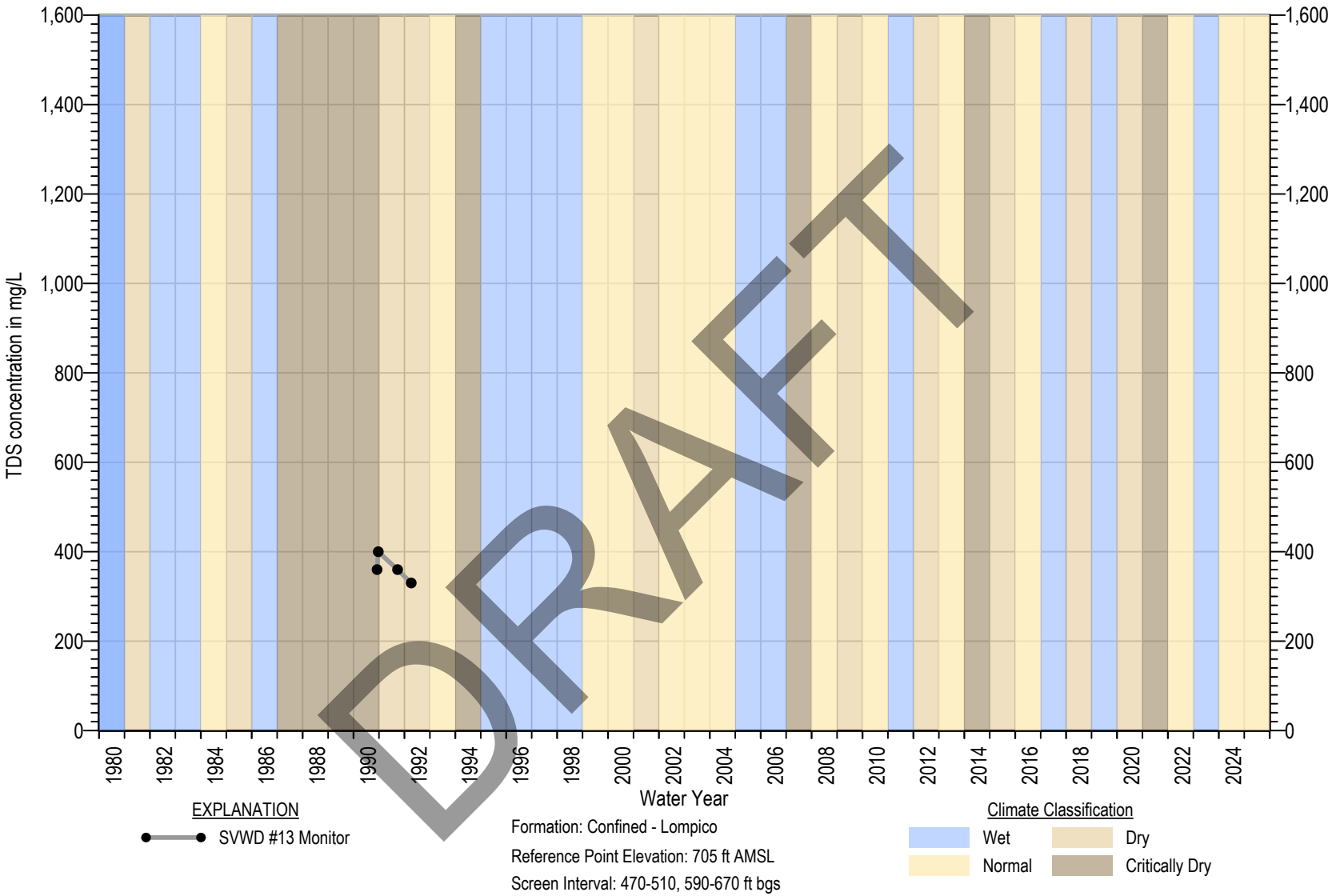
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-291. TDS Chemograph of SVWD #11B

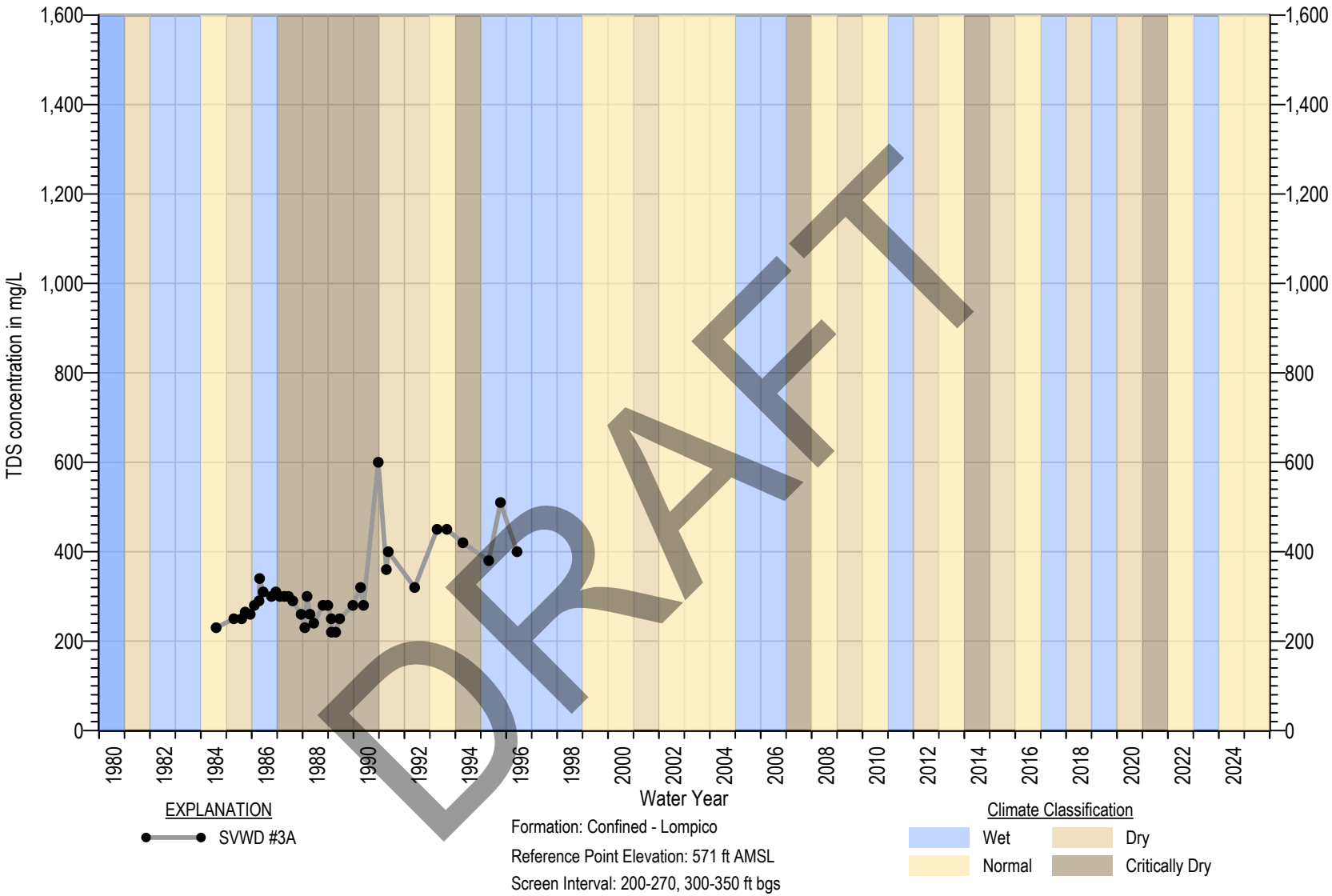
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-292. TDS Chemograph of SVWD #13 Monitor

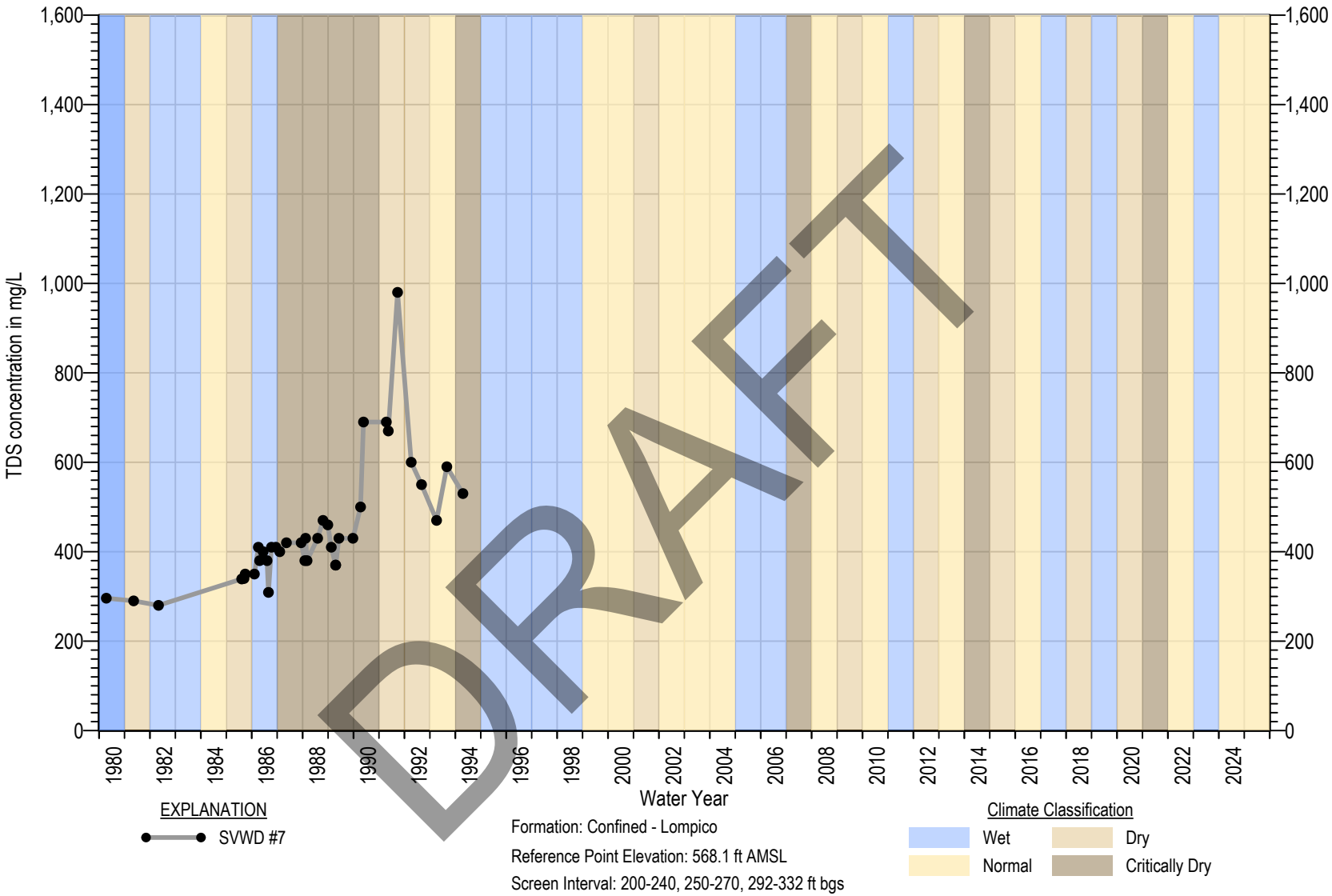
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-293. TDS Chemograph of SVWD #3A

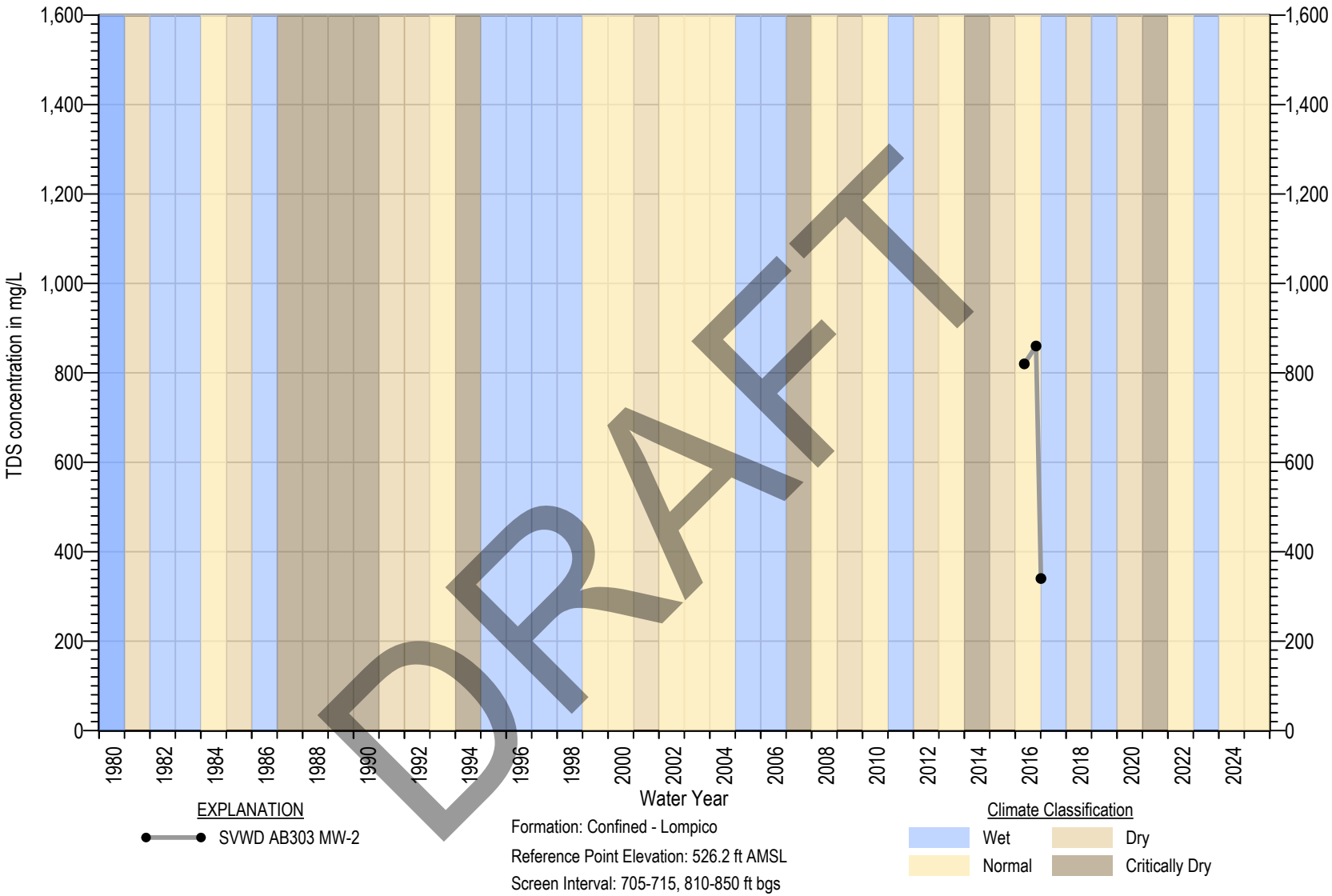
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-294. TDS Chemograph of SVWD #7

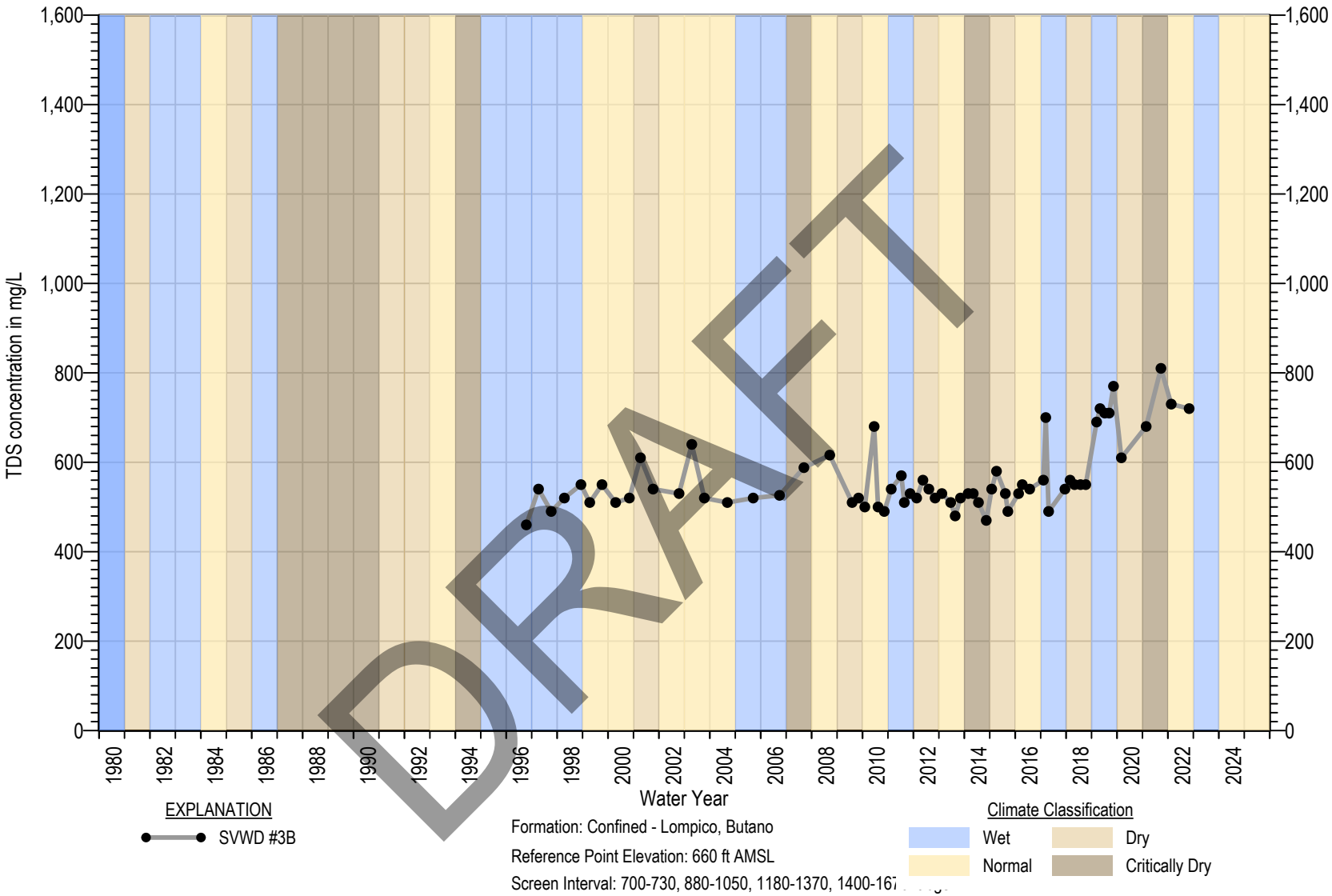
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-295. TDS Chemograph of SVWD AB303 MW-2

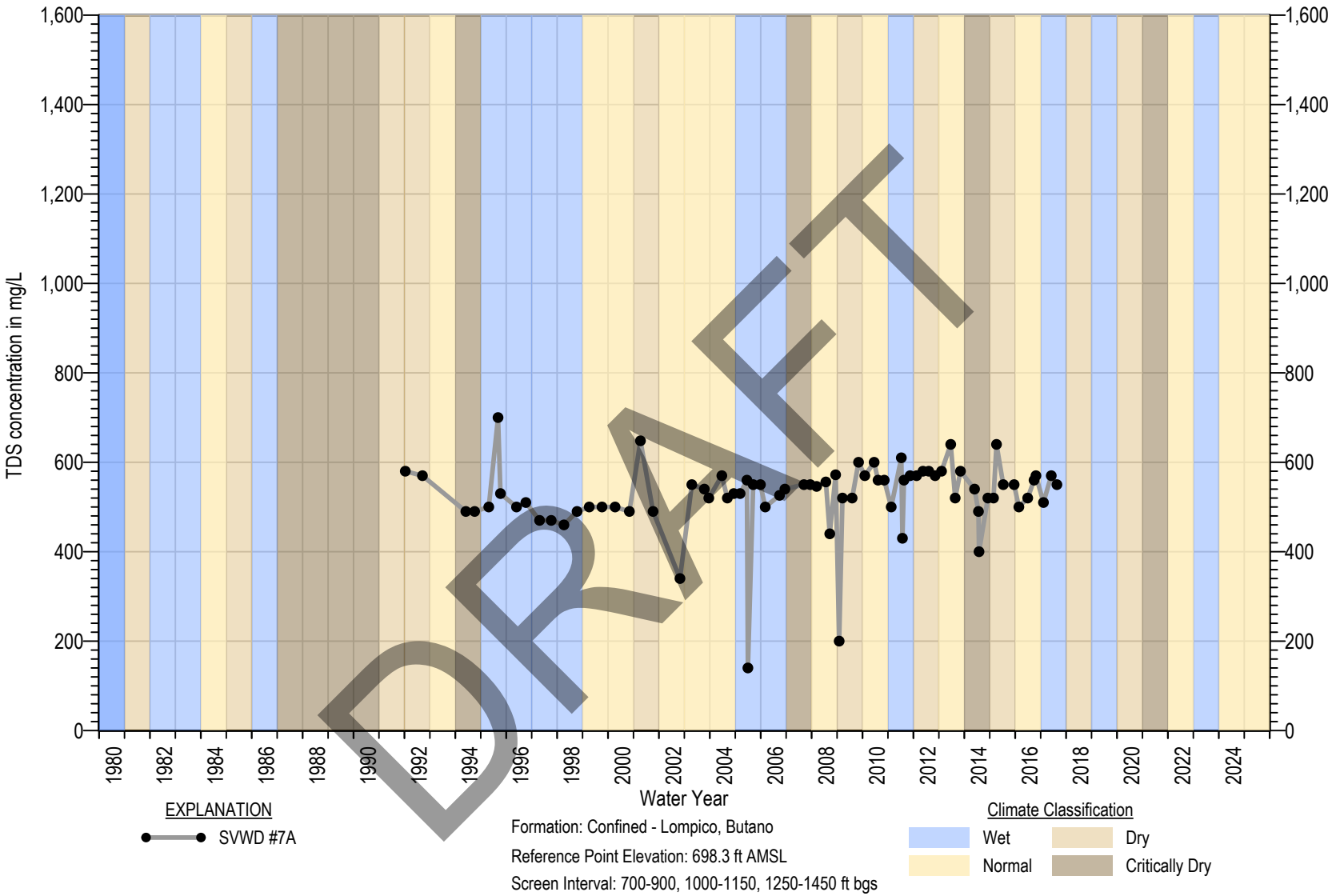
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-296. TDS Chemograph of SVWD #3B

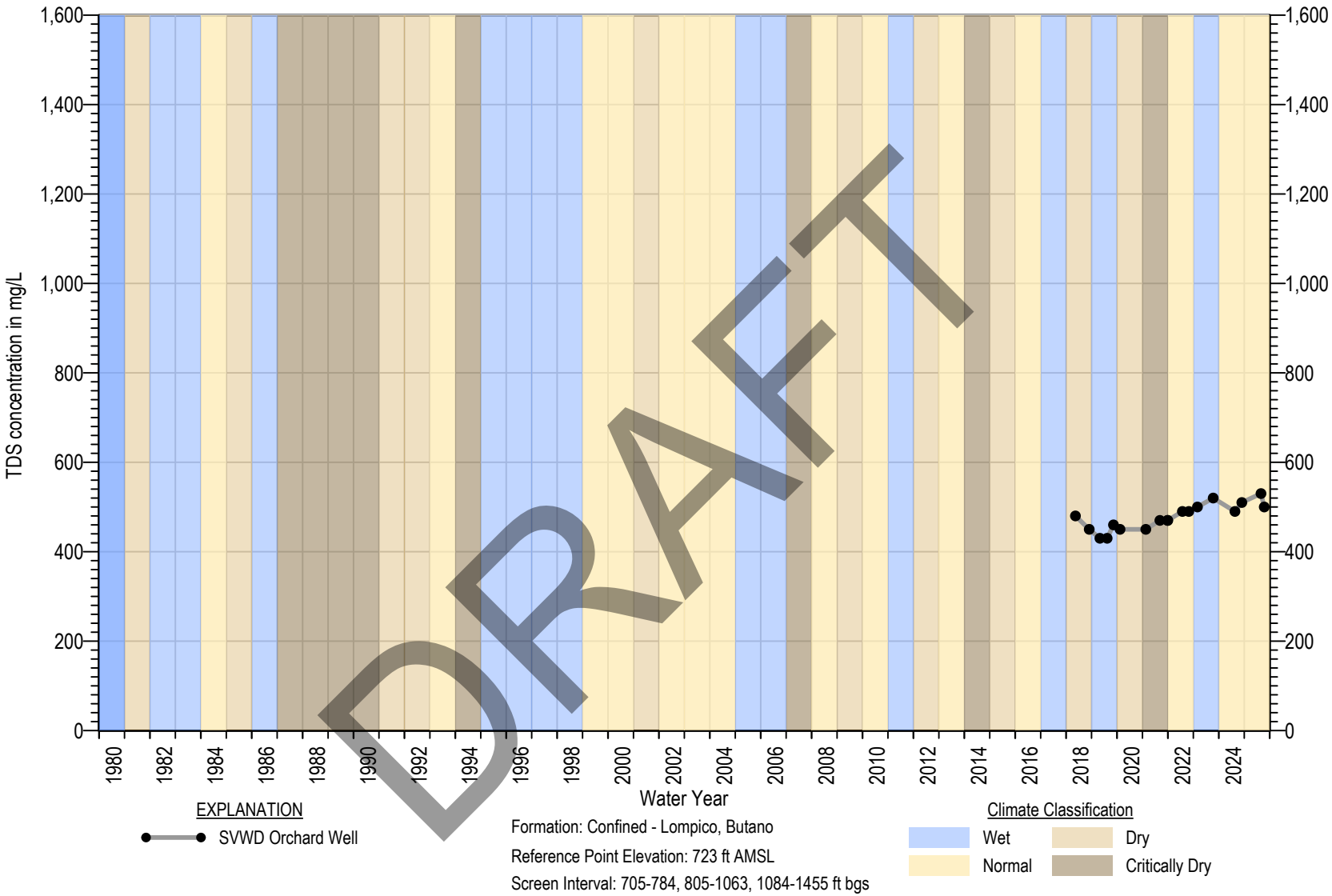
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-297. TDS Chemograph of SVWD #7A

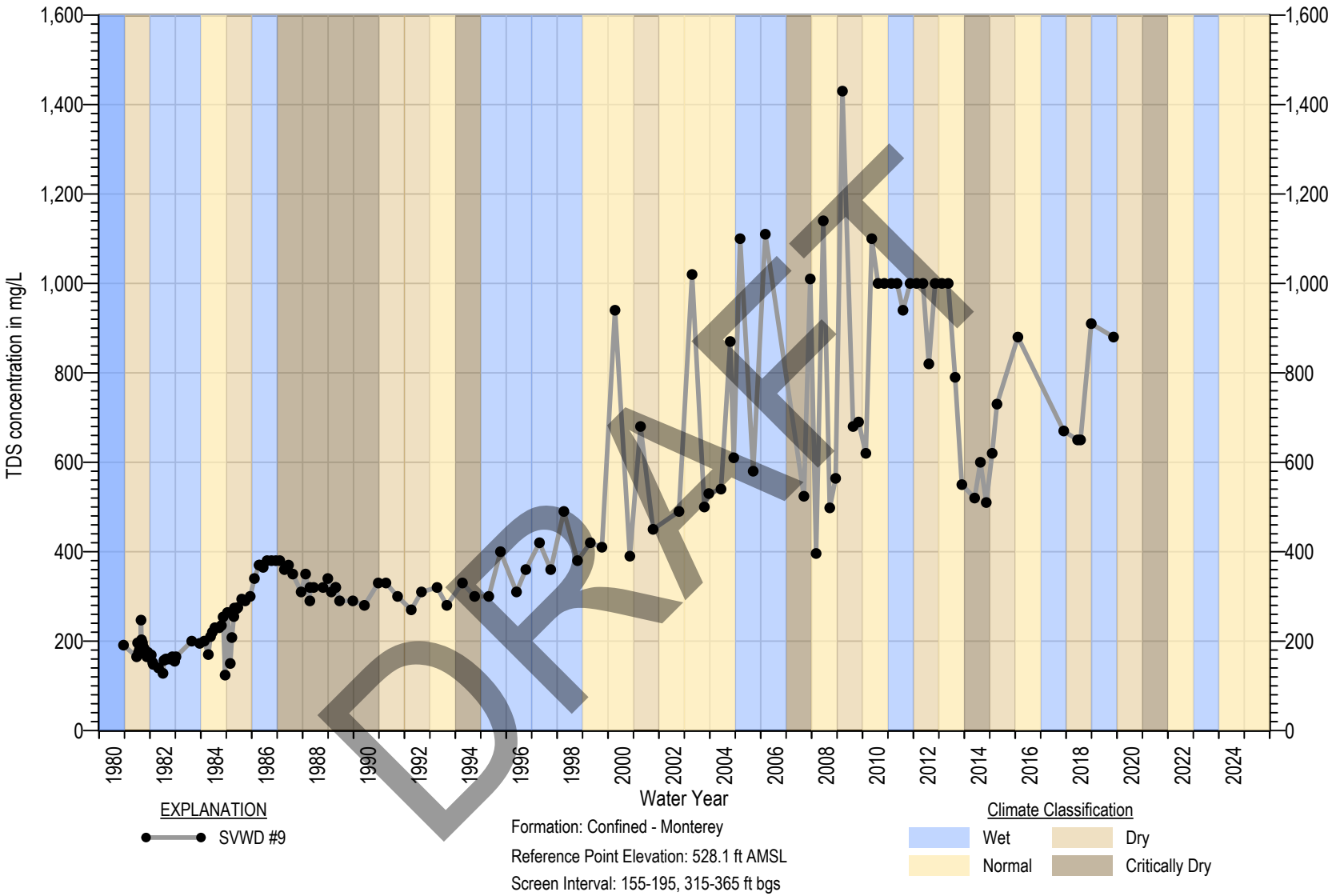
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-298. TDS Chemograph of SVWD Orchard Well

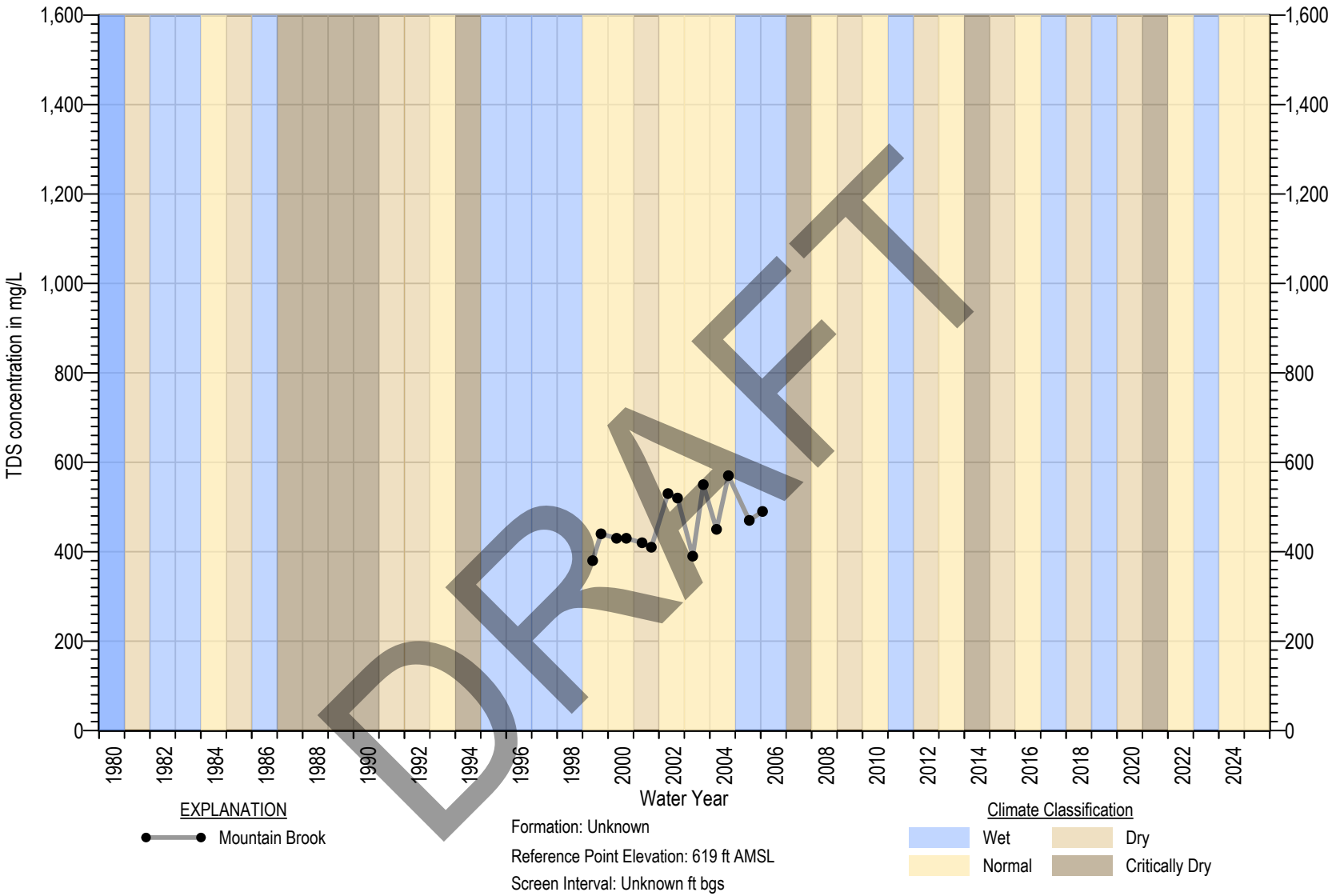
MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

Figure 4B-299. TDS Chemograph of SVWD #9

MONTGOMERY & ASSOCIATES



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

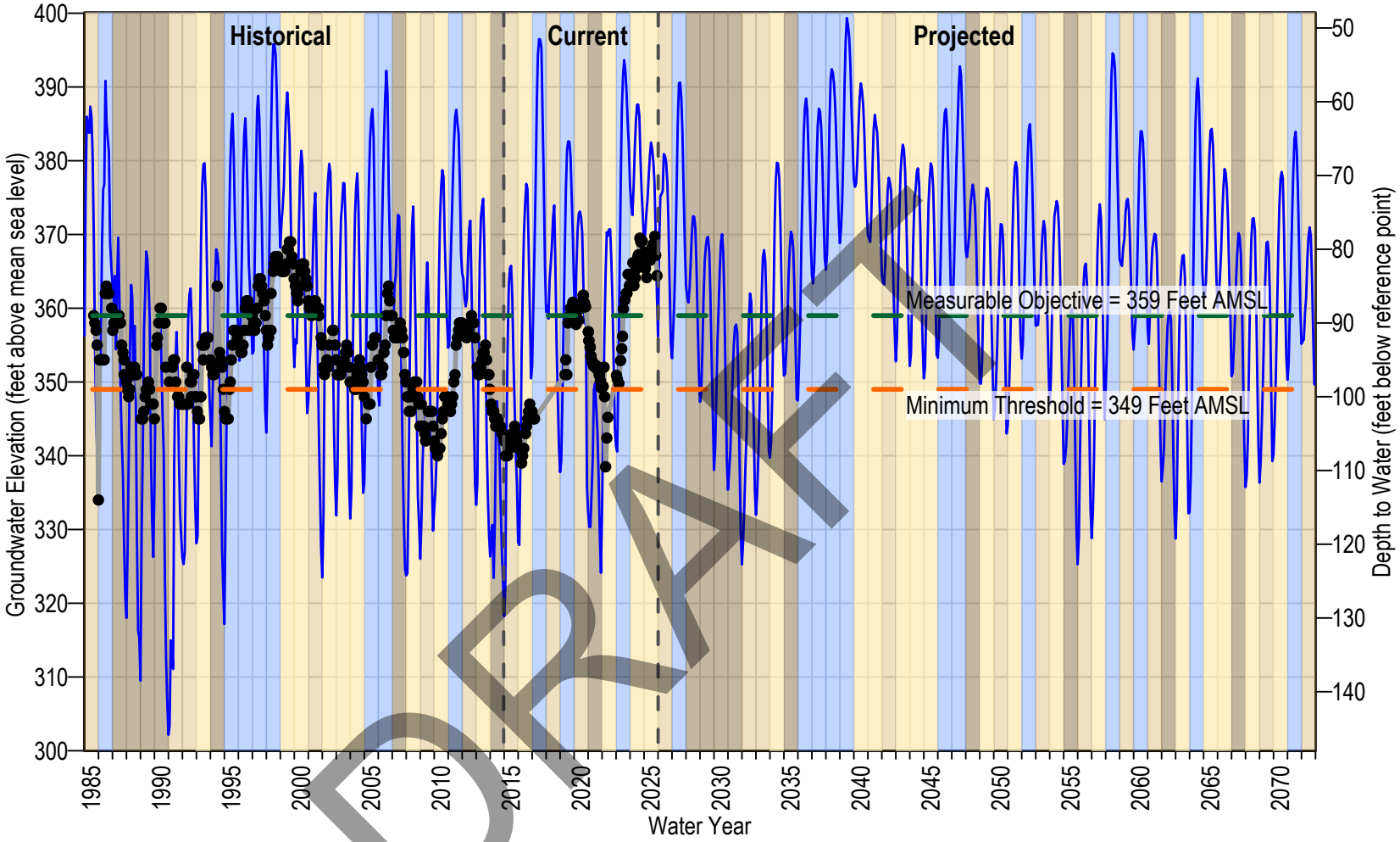
Figure 4B-300. TDS Chemograph of Mountain Brook

MONTGOMERY & ASSOCIATES

Appendix 5A

Historical, Current, and Projected Baseline Model Hydrographs

DRAFT



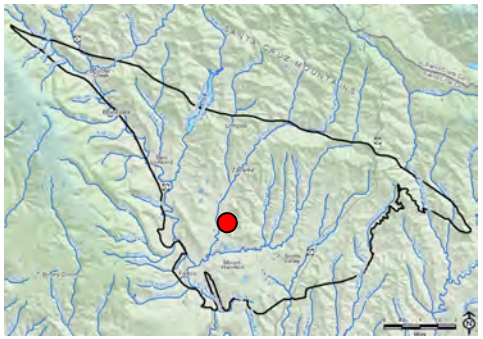
DRAFT

SLVWD Olympia #1 (Ferrari)
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 448 ft AMSL
Screen Interval: 127-157 ft bgs

Water Year Classification

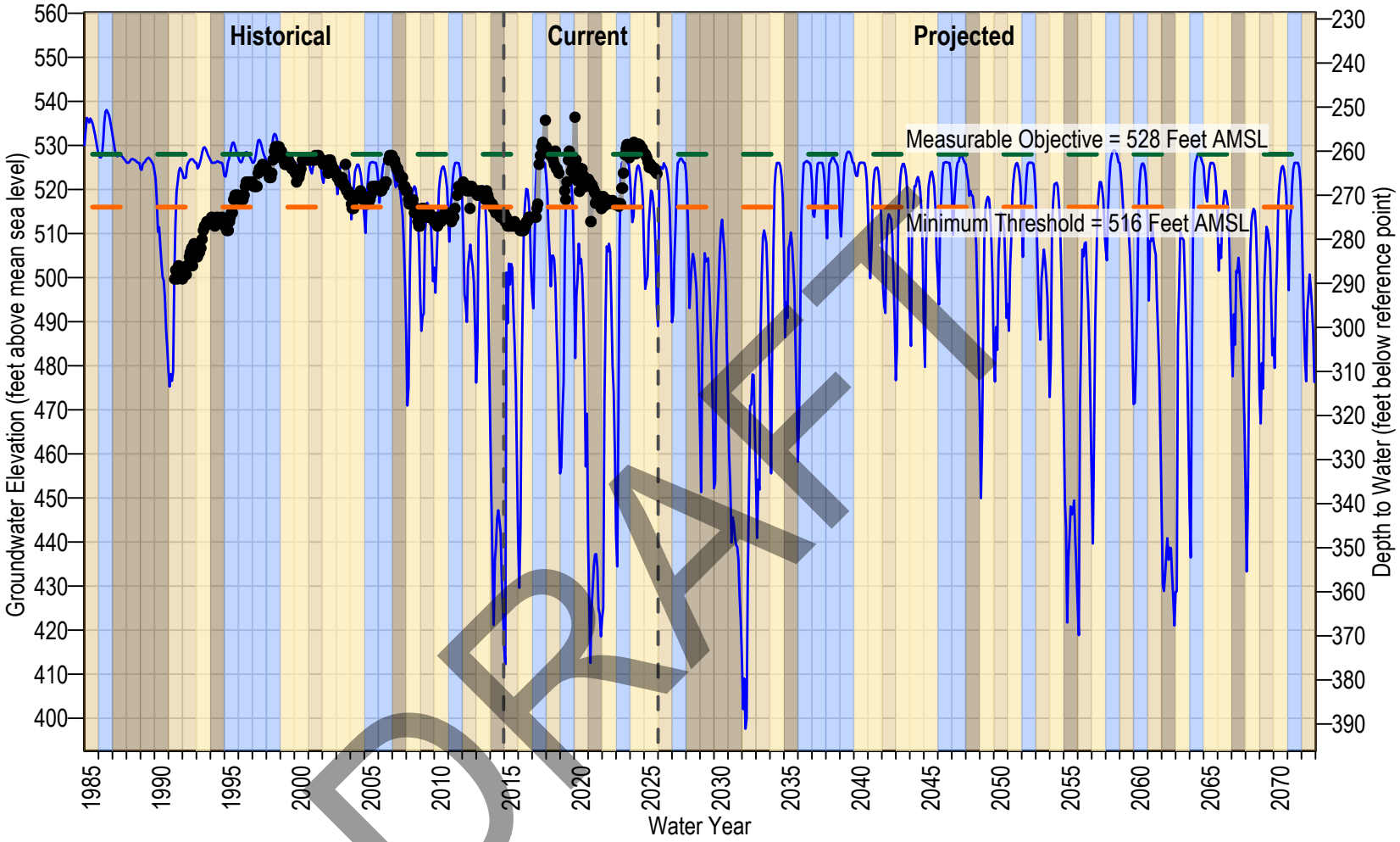
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-1. Simulated Hydrograph of SLVWD Olympia #1 (Ferrari)

MONTGOMERY & ASSOCIATES

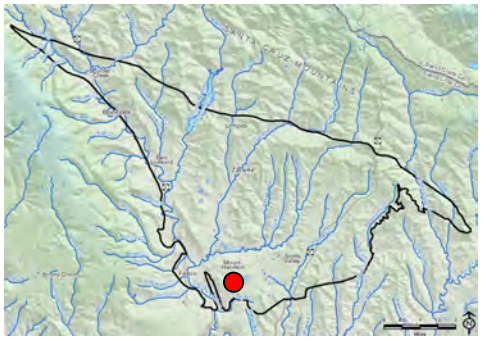


DRAFT

SLVWD Pasatiempo MW-2
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 788.7 ft AMSL
Screen Interval: 254-294 ft bgs

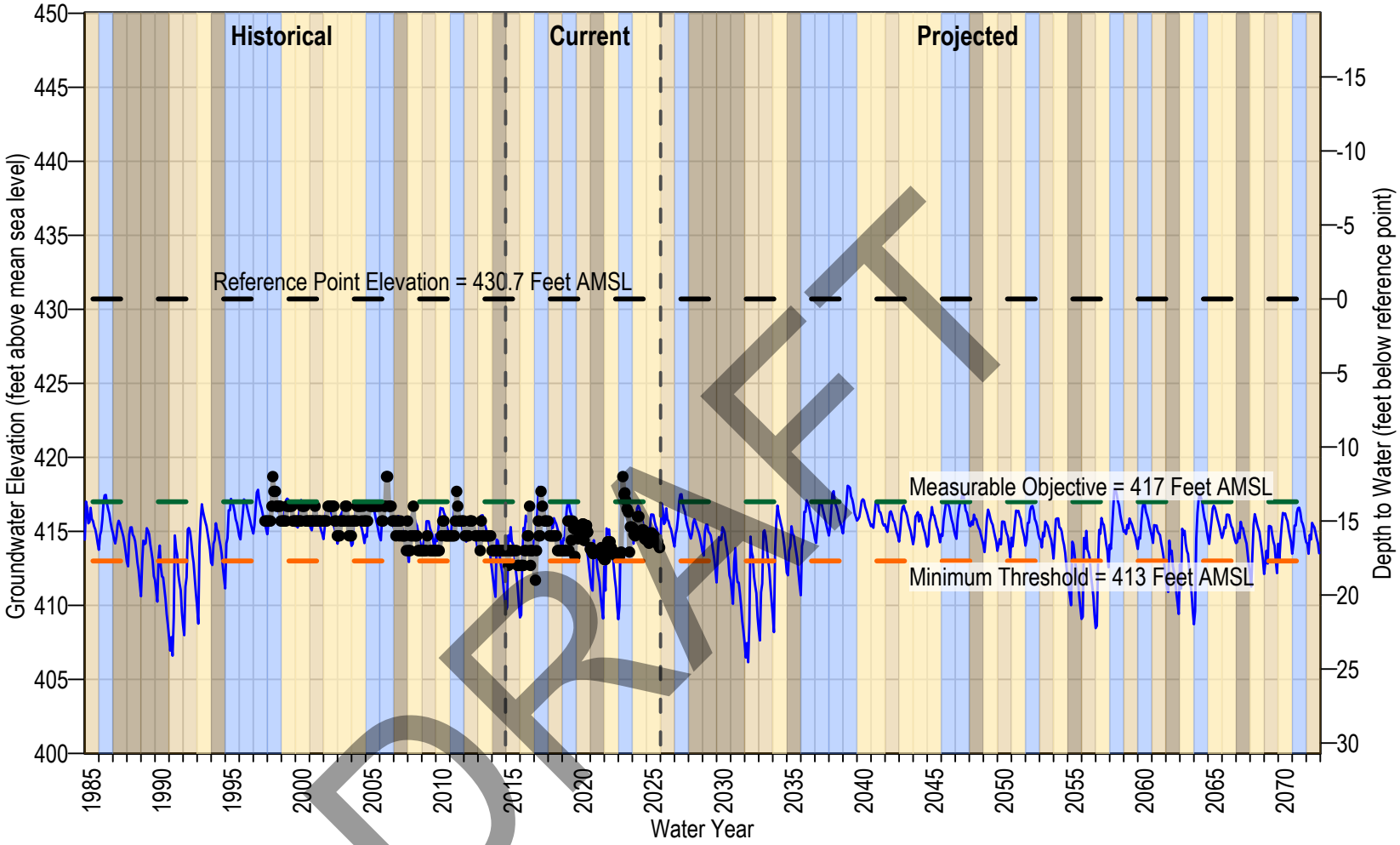
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-2. Simulated Hydrograph of SLVWD Pasatiempo MW-2

MONTGOMERY & ASSOCIATES

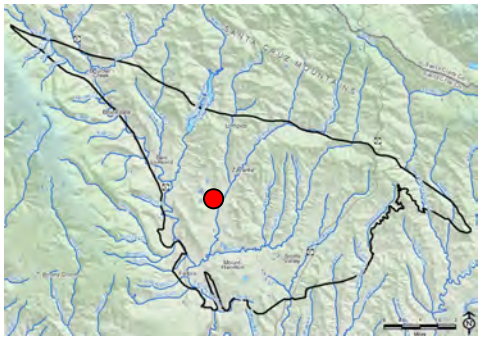


DRAFT

SLVWD Quail MW-A
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 430.7 ft AMSL
Screen Interval: 33-88 ft bgs

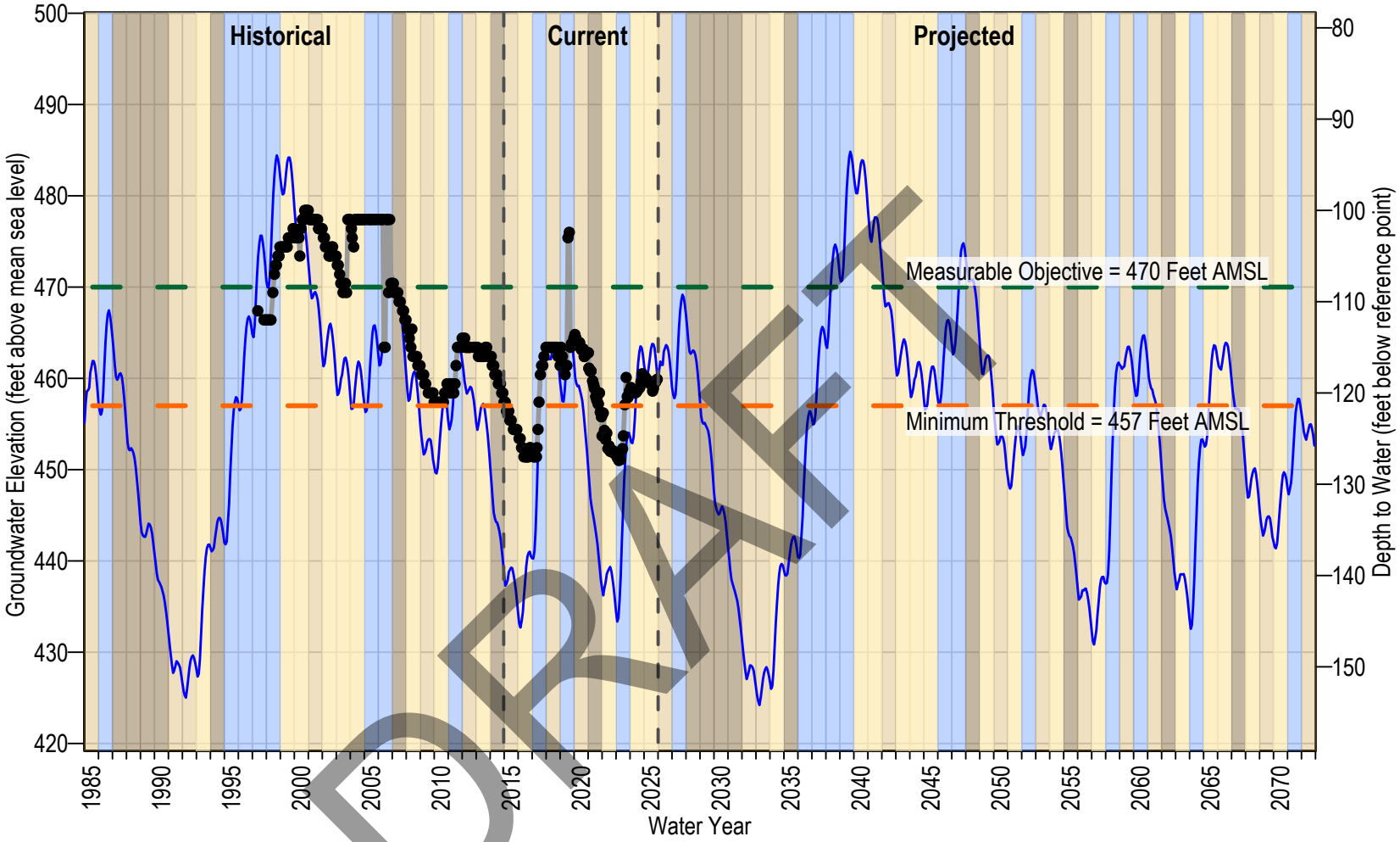
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-3. Simulated Hydrograph of SLVWD Quail MW-A

MONTGOMERY & ASSOCIATES

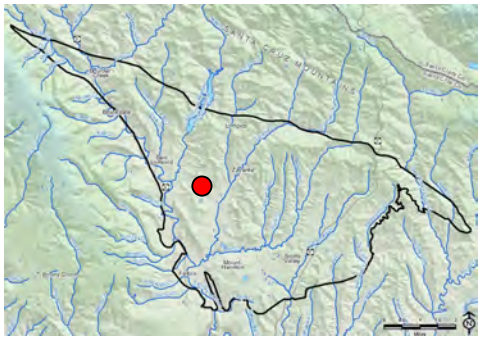


DRAFT

SLVWD Quail MW-B
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 578.4 ft AMSL
Screen Interval: 95-195 ft bgs

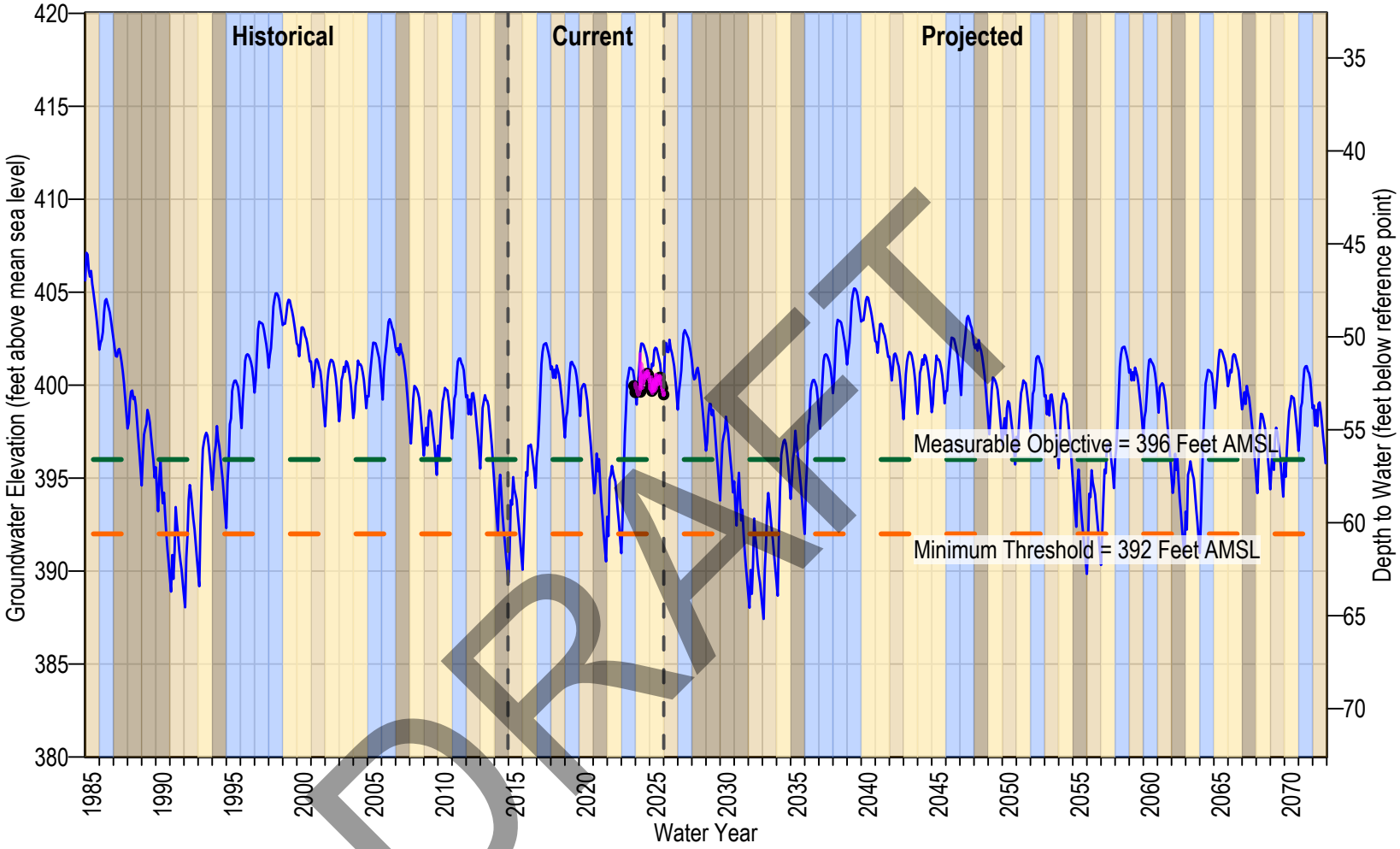
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-4. Simulated Hydrograph of SLVWD Quail MW-B

MONTGOMERY & ASSOCIATES



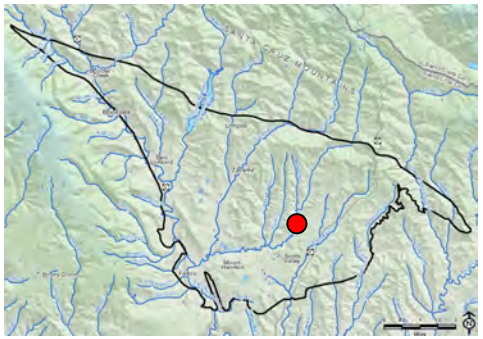
DRAFT

SMGWA-2 Bean Creek
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 452.6 ft AMSL
Screen Interval: 53-68 ft bgs

Water Year Classification

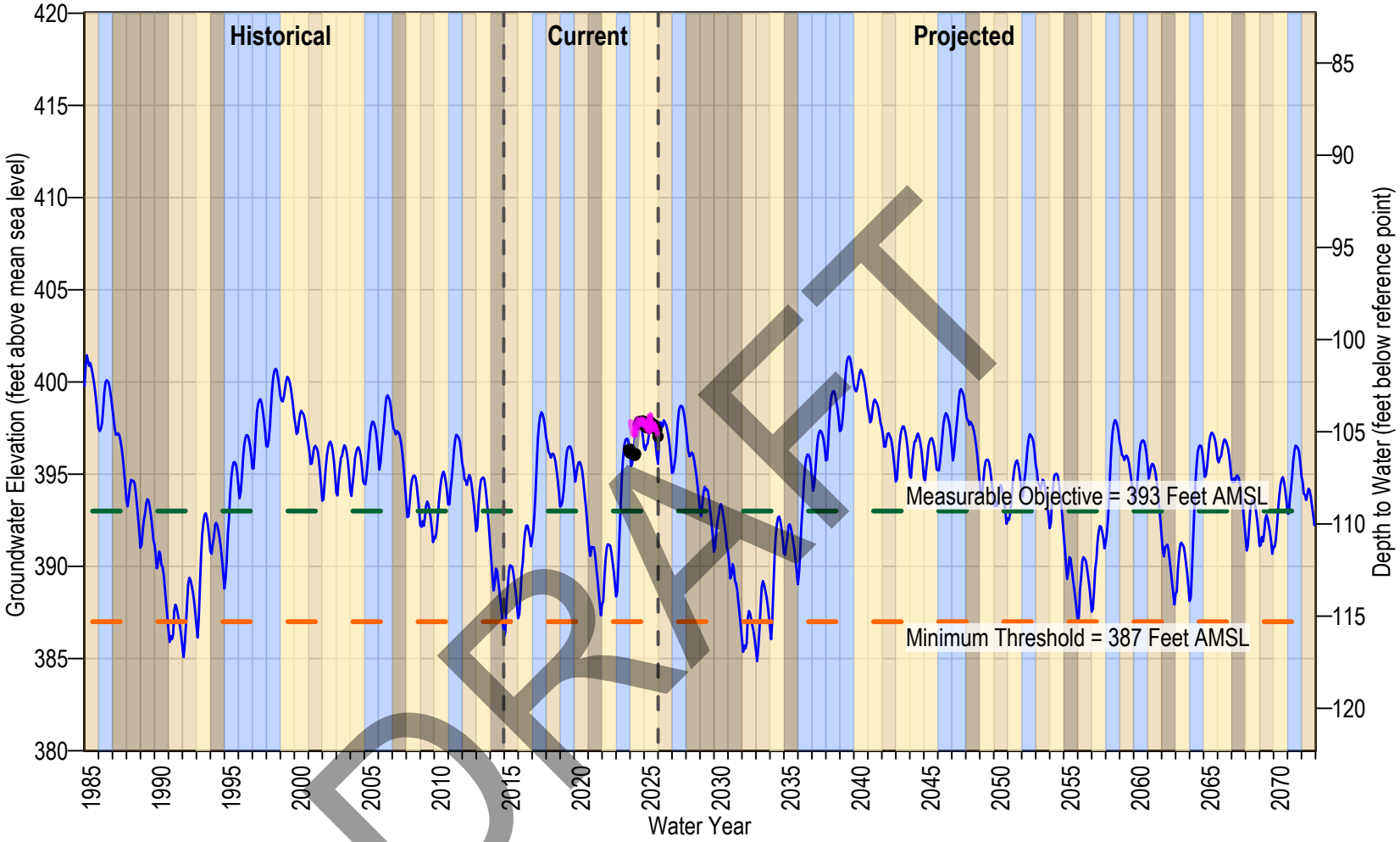
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-5. Simulated Hydrograph of SMGWA-2 Bean Creek

MONTGOMERY & ASSOCIATES



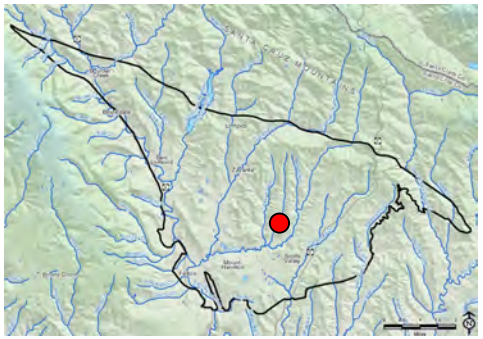
DRAFT

SMGWA-3 Ruins Creek
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 502.3 ft AMSL
Screen Interval: 145-160 ft bgs

Water Year Classification

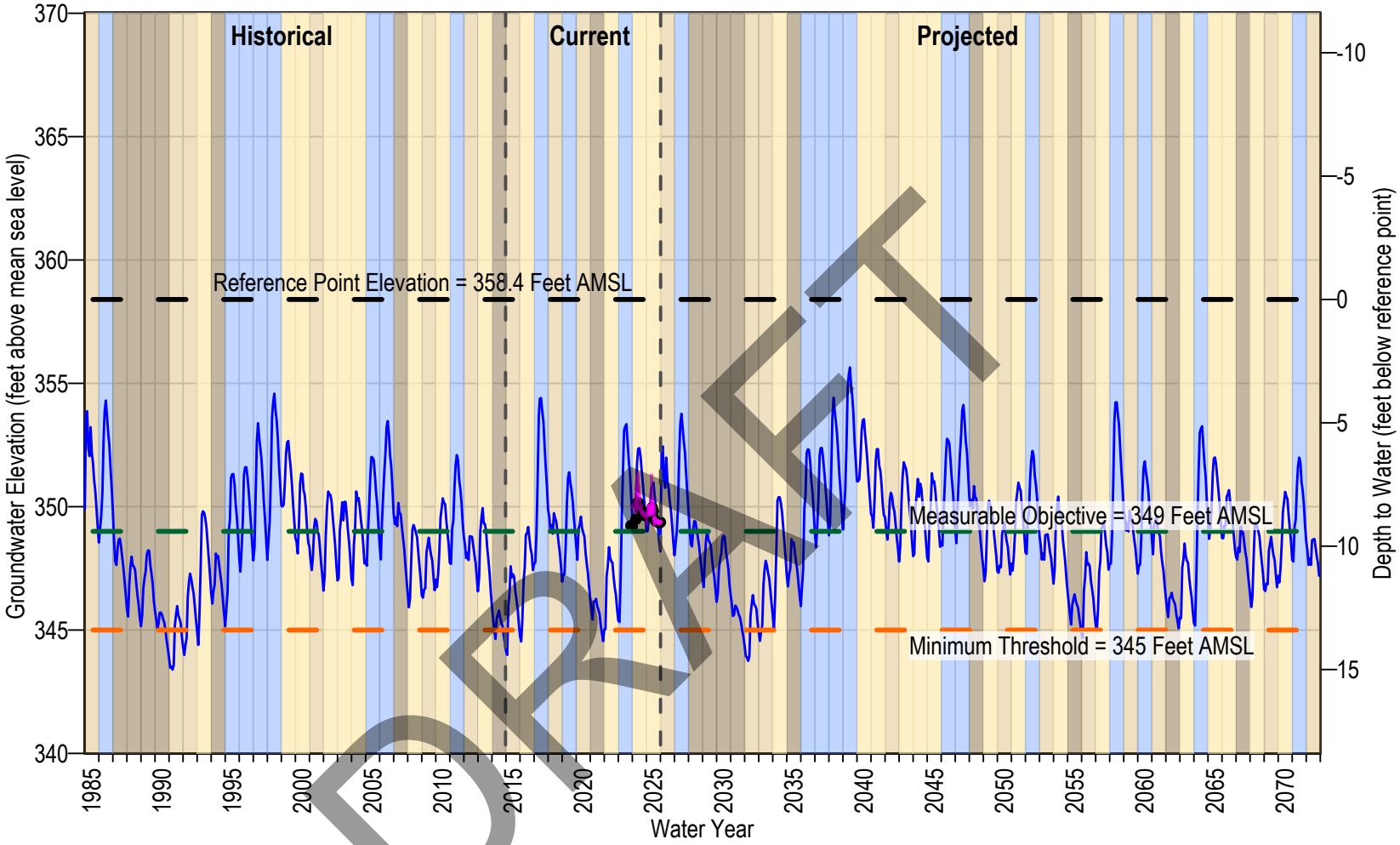
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-6. Simulated Hydrograph of SMGWA-3 Ruins Creek

MONTGOMERY & ASSOCIATES



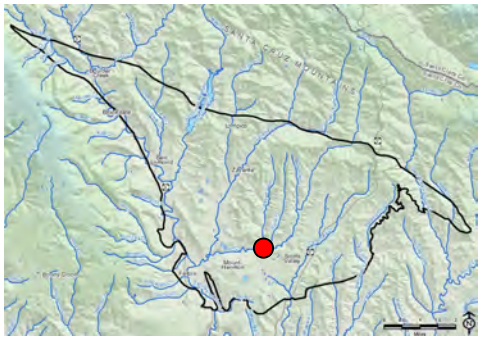
DRAFT

SMGWA-4 Nelson Road
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 358.4 ft AMSL
Screen Interval: 54-69 ft bgs

Water Year Classification

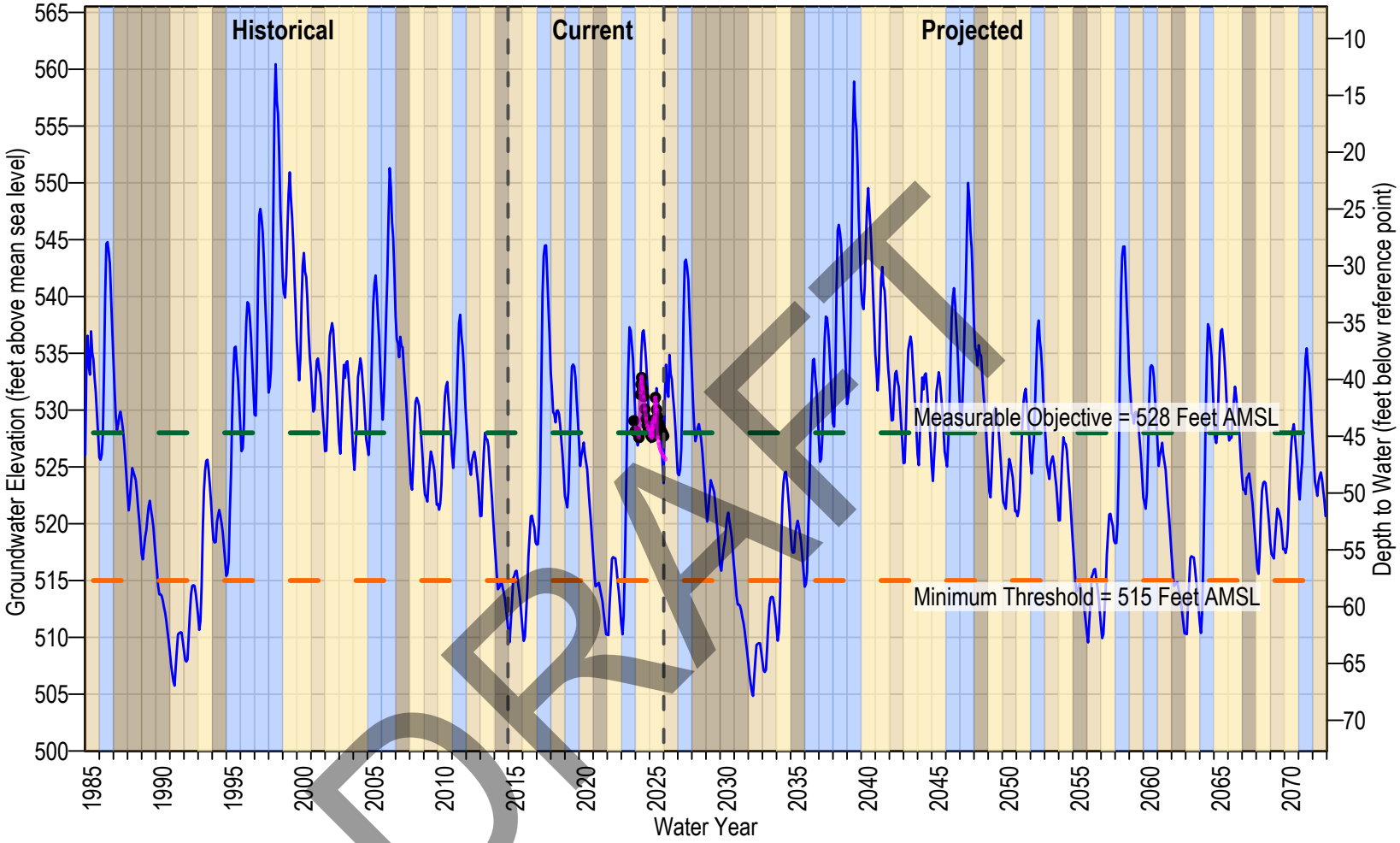
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-7. Simulated Hydrograph of SMGWA-4 Nelson Road

MONTGOMERY & ASSOCIATES



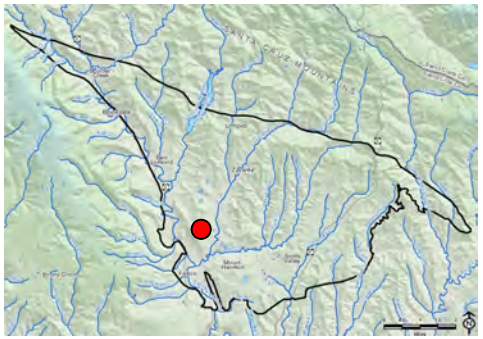
DRAFT

SMGWA-5 Bahr Drive
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 572.7 ft AMSL
Screen Interval: 40-55 ft bgs

Water Year Classification

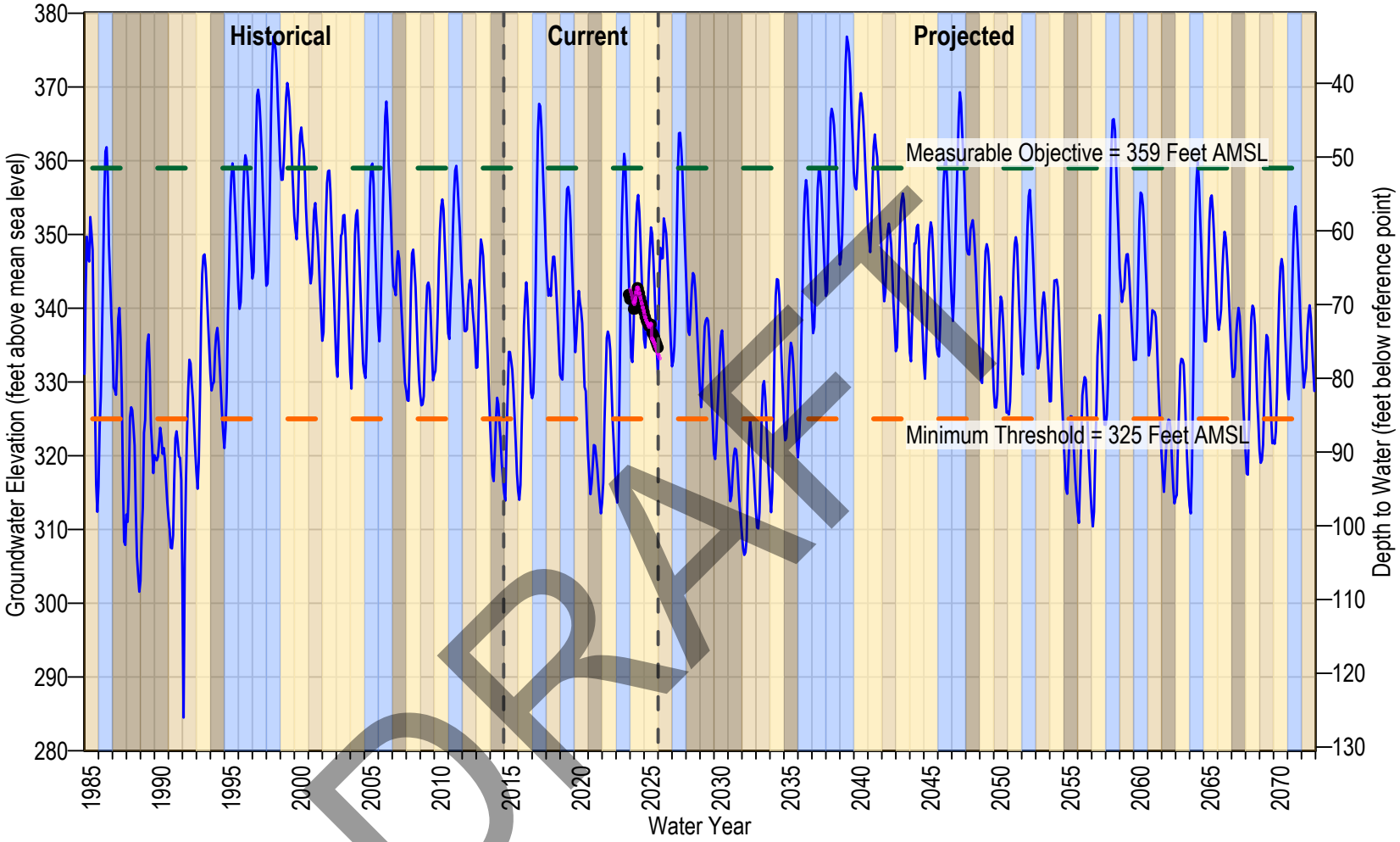
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-8. Simulated Hydrograph of SMGWA-5 Bahr Drive

MONTGOMERY & ASSOCIATES



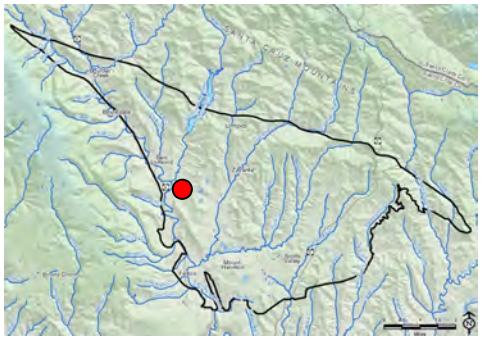
DRAFT

SMGWA-6 Quail Hollow
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 410.5 ft AMSL
Screen Interval: 115-130 ft bgs

Water Year Classification

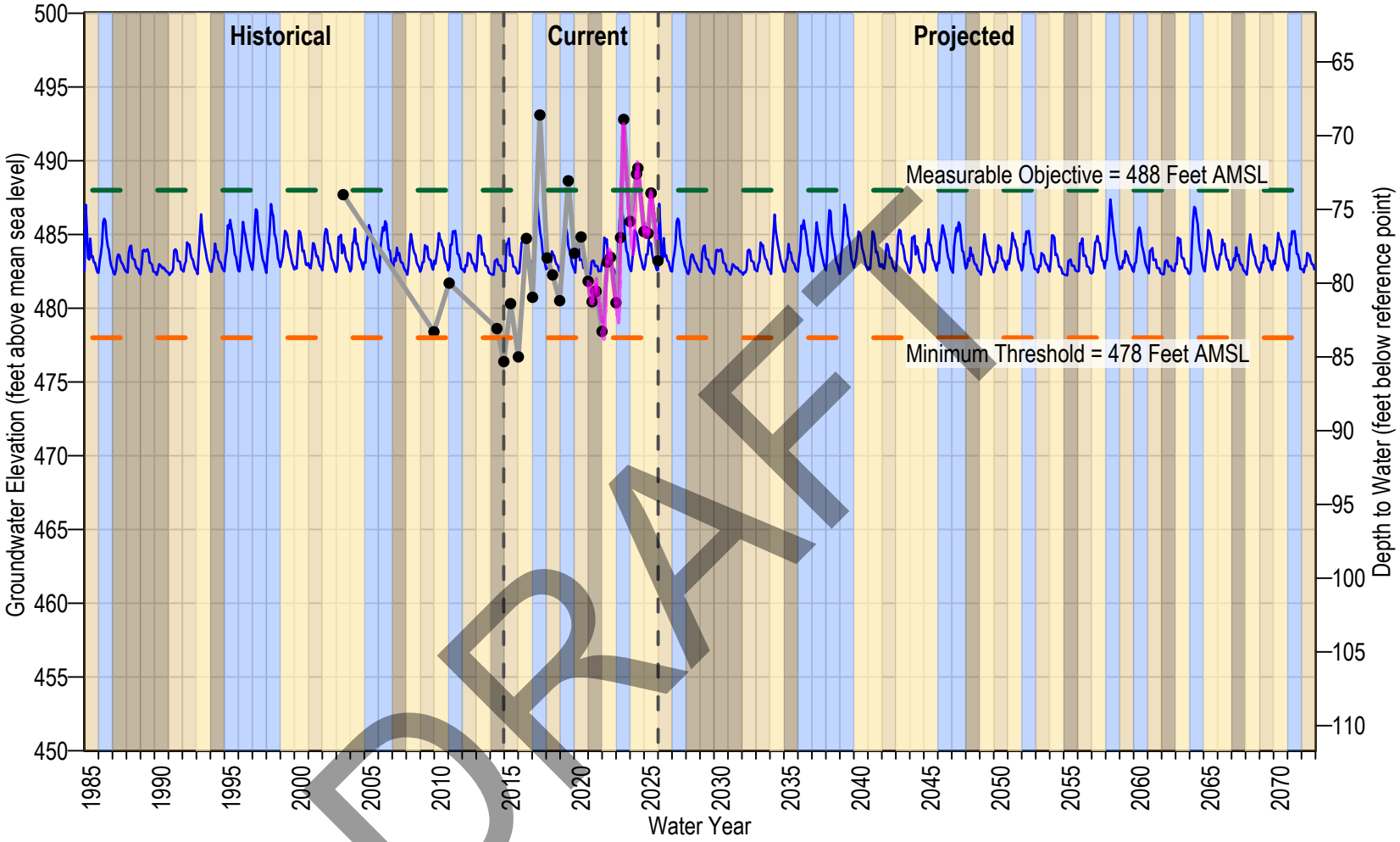
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-9. Simulated Hydrograph of SMGWA-6 Quail Hollow

MONTGOMERY & ASSOCIATES

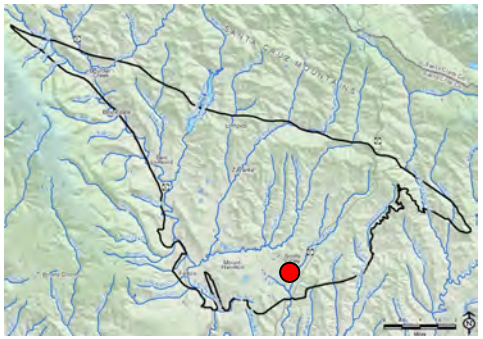


DRAFT

SVWD AB303 MW-1
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 561.7 ft AMSL
Screen Interval: 114-124 ft bgs

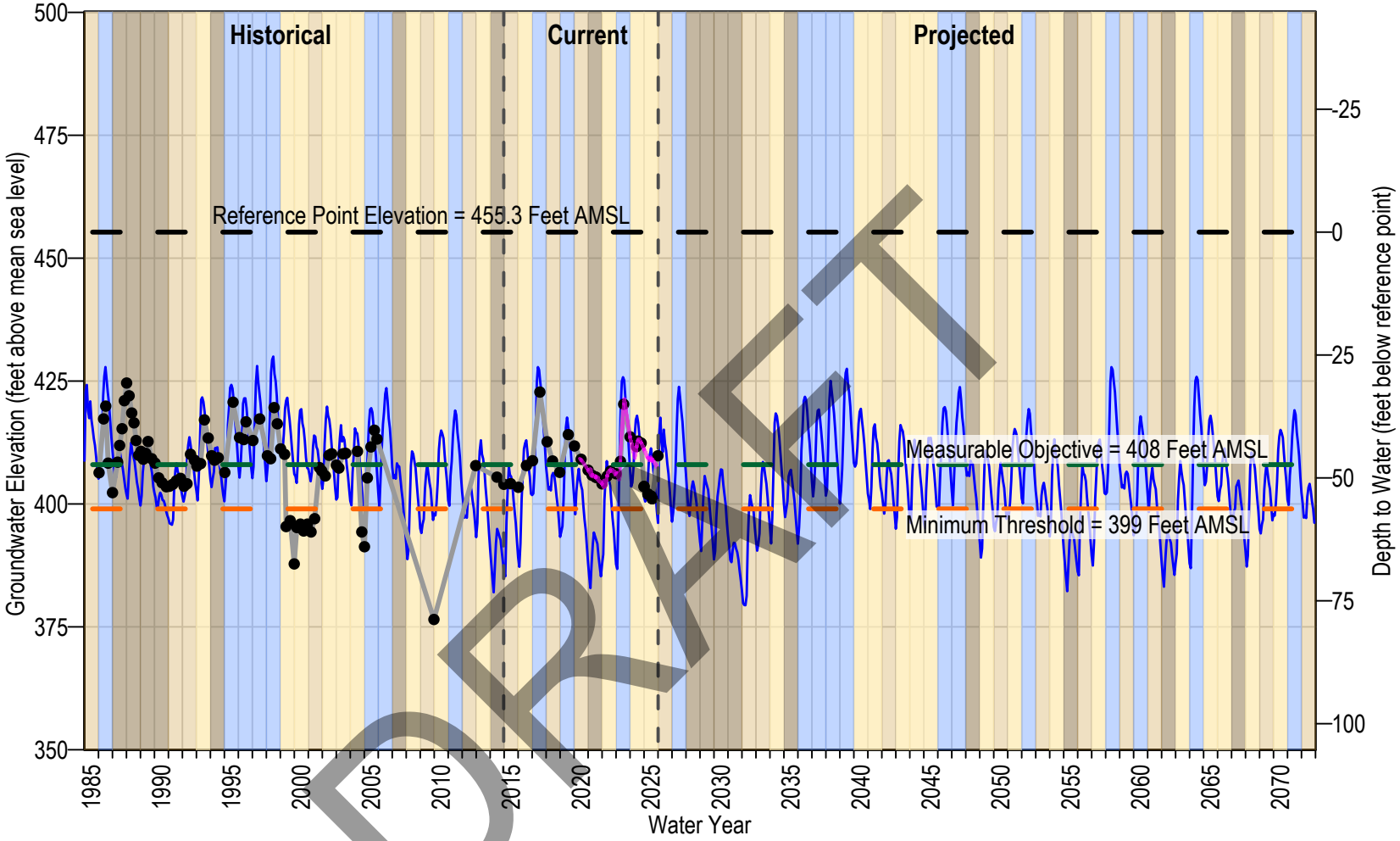
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-10. Simulated Hydrograph of SVWD AB303 MW-1

MONTGOMERY & ASSOCIATES

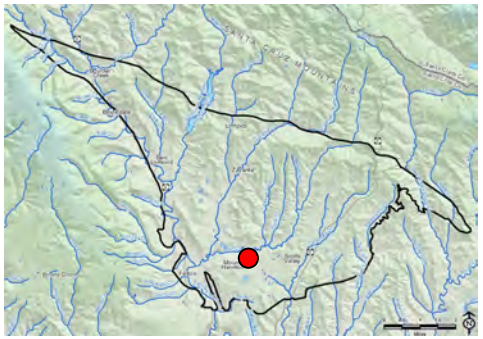


DRAFT

SVWD SV4-MW
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 455.3 ft AMSL
Screen Interval: 50-60 ft bgs

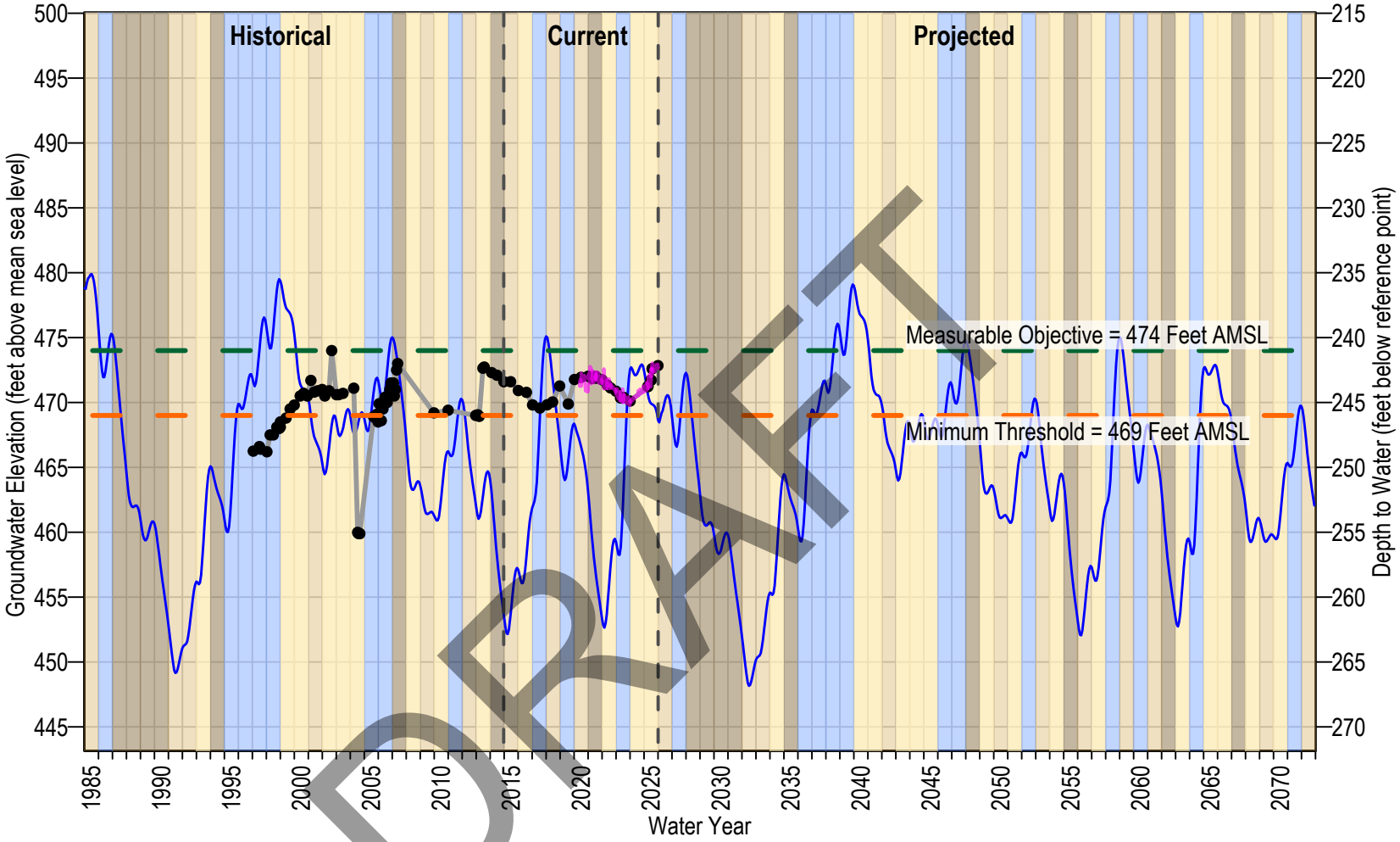
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-11. Simulated Hydrograph of SVWD SV4-MW

MONTGOMERY & ASSOCIATES

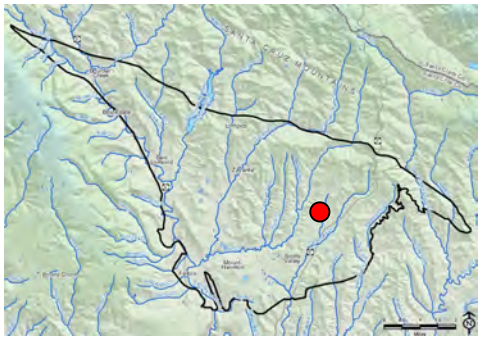


DRAFT

SVWD TW-18
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 715 ft AMSL
Screen Interval: 285-345 ft bgs

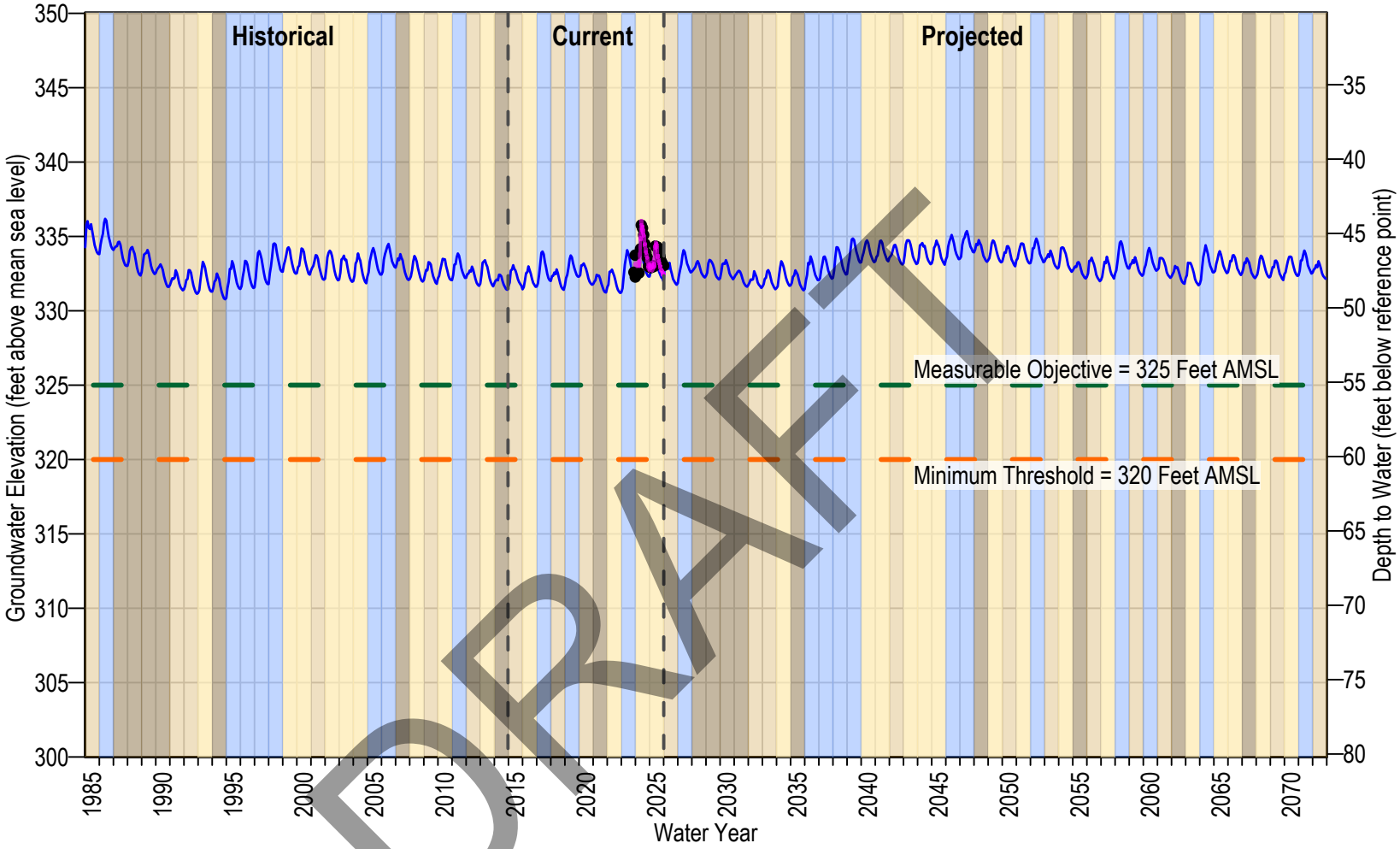
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-12. Simulated Hydrograph of SVWD TW-18

MONTGOMERY & ASSOCIATES



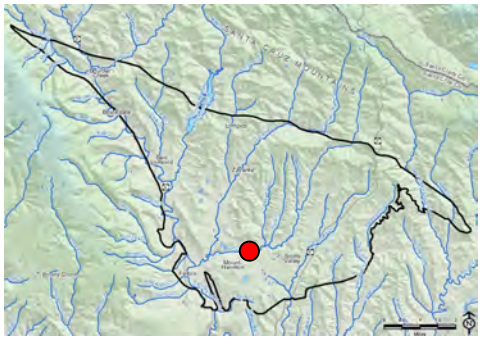
DRAFT

SMGWA-8 Randall Morgan Sandhills Preserve
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Monterey
Reference Point Elevation: 380.2 ft AMSL
Screen Interval: 155-170 ft bgs

Water Year Classification

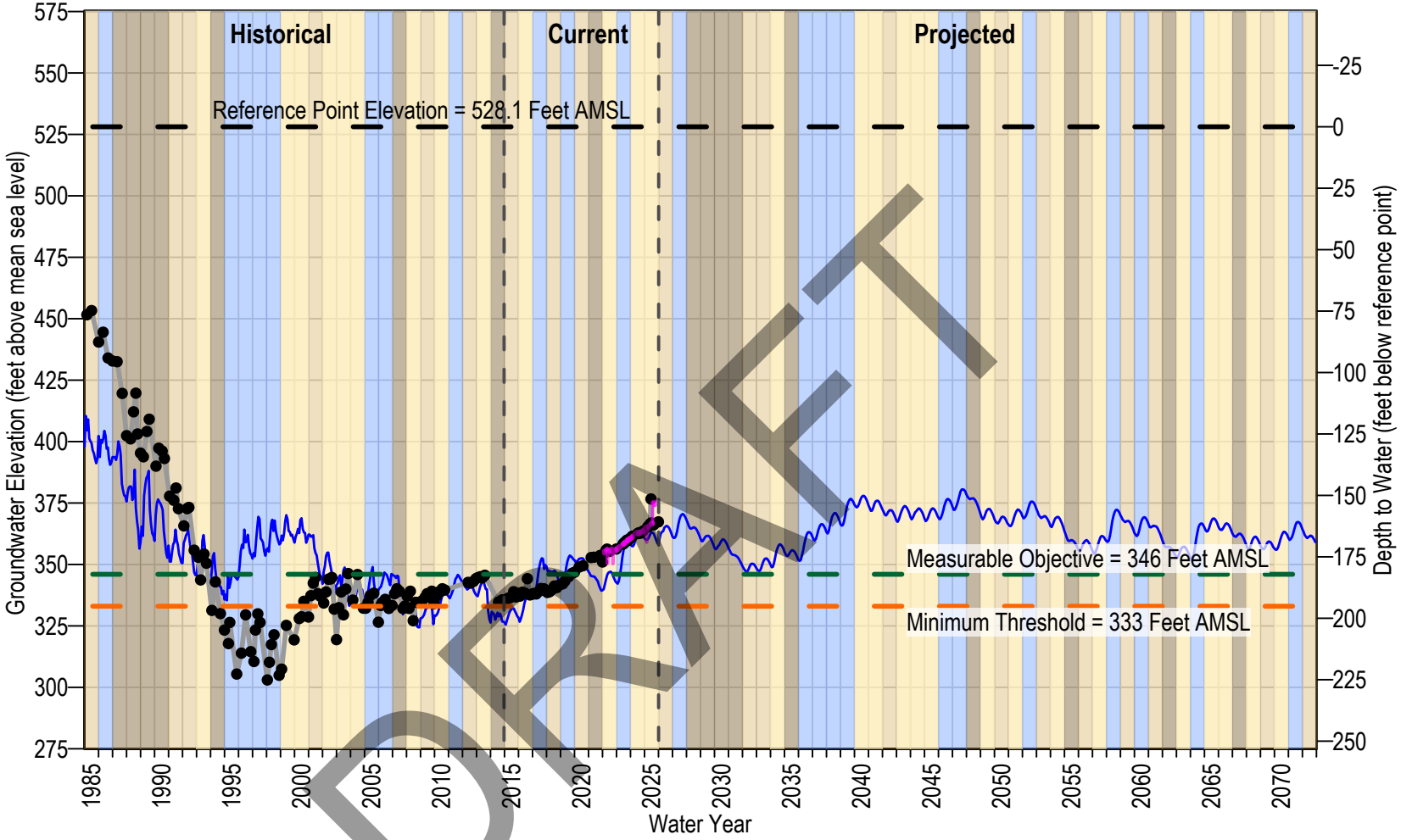
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-13. Simulated Hydrograph of SMGWA-8 Randall Morgan Sandhills Preserve

MONTGOMERY & ASSOCIATES



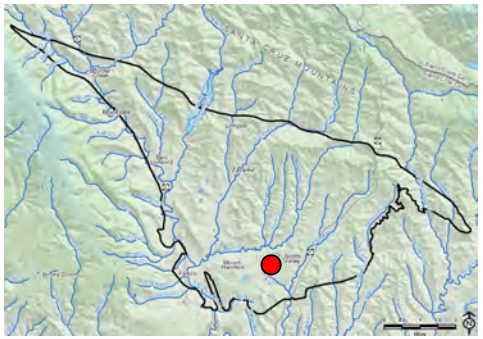
DRAFT

- SVWD #9
- Transducer
- Simulated
- Reference Point Elevation
- Minimum Threshold
- Measurable Objective

Formation: Confined - Monterey
Reference Point Elevation: 528.1 ft AMSL
Screen Interval: 155-195, 315-355 ft bgs

Water Year Classification

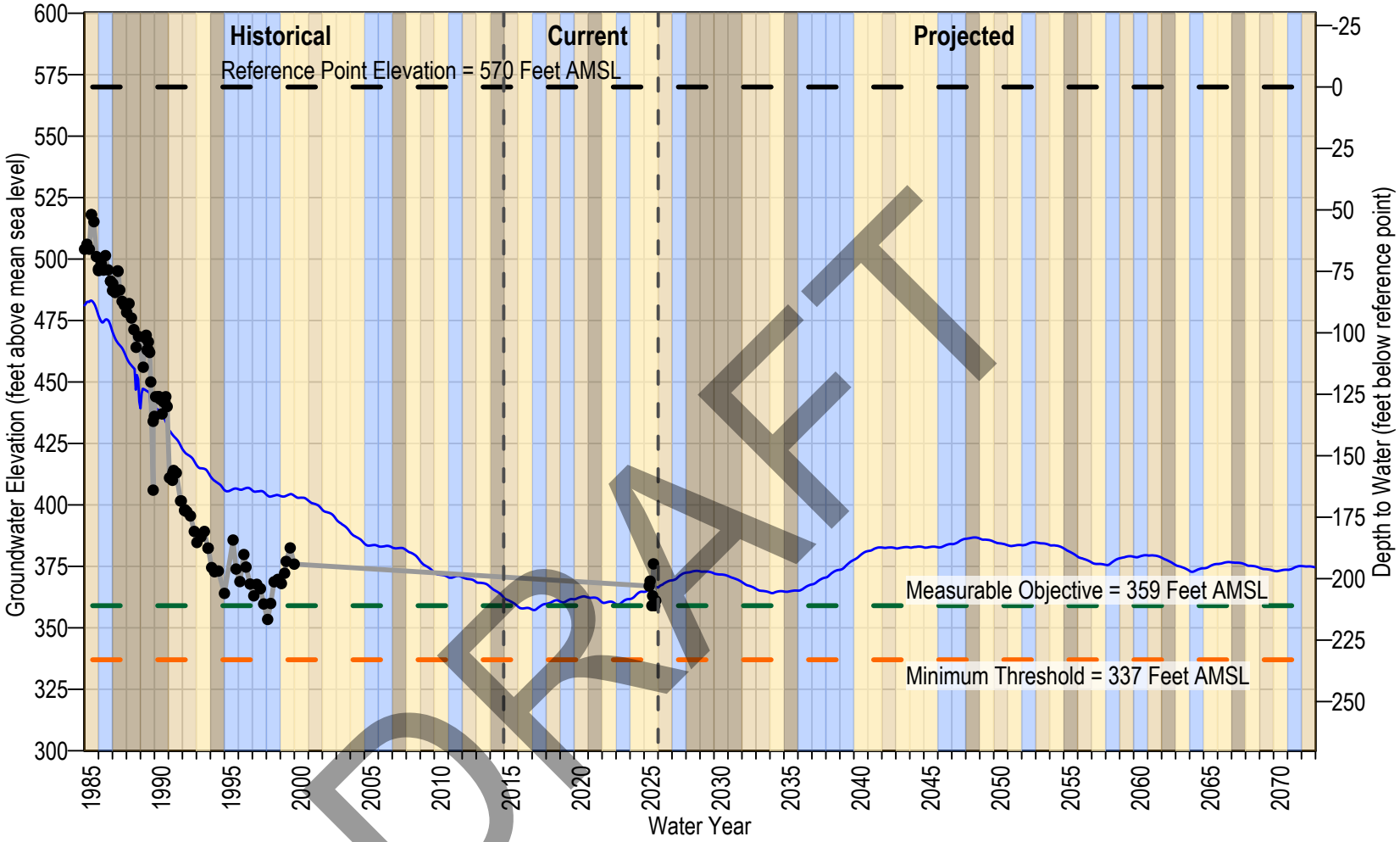
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-14. Simulated Hydrograph of SVWD #9

MONTGOMERY & ASSOCIATES

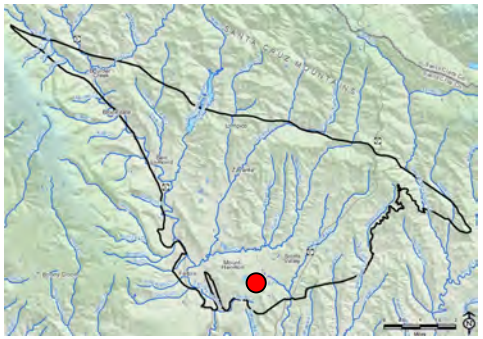


DRAFT

SLVWD Pasatiempo #3 (Estrella)
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 570 ft AMSL
Screen Interval: 23-147, 169-260 ft bgs

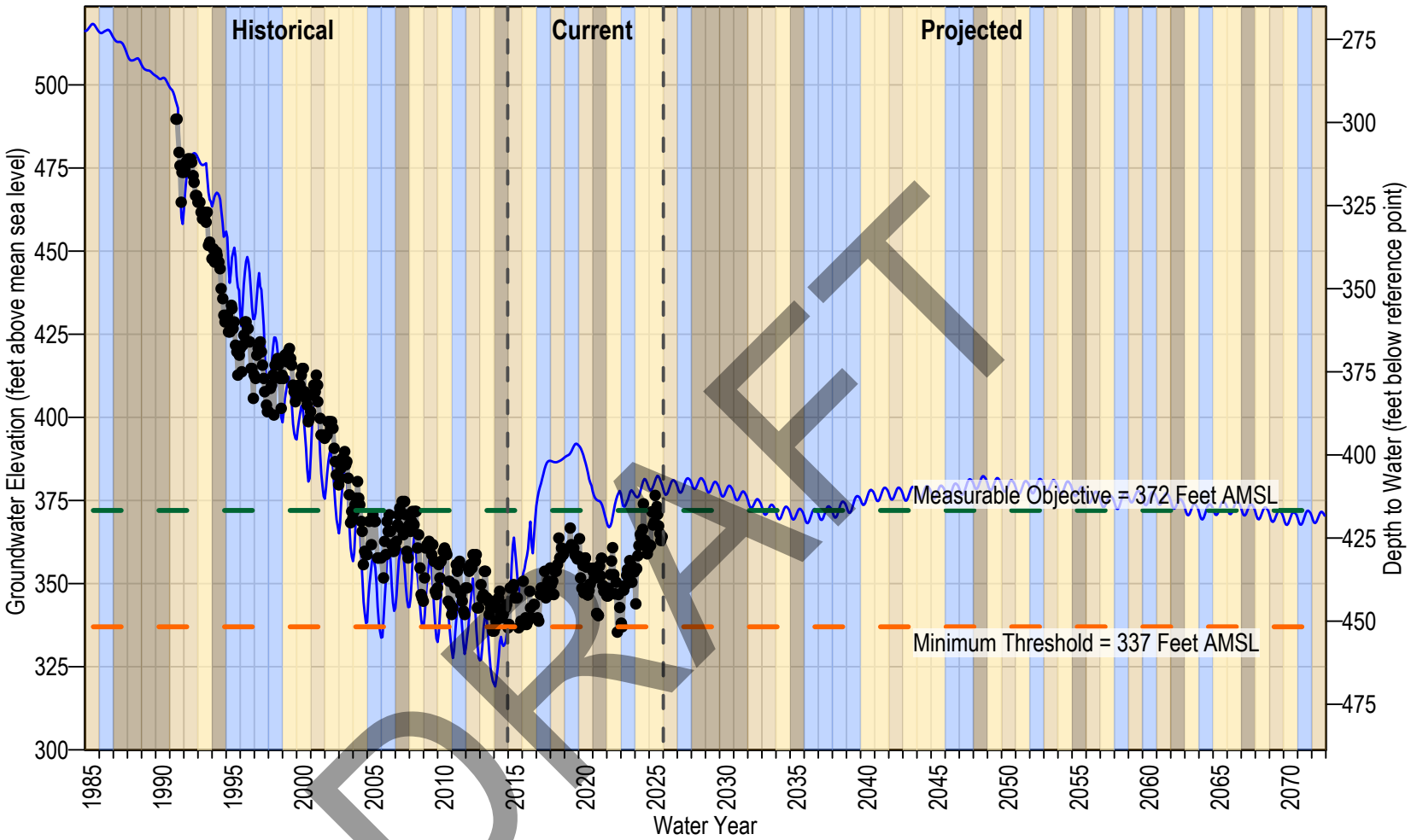
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-15. Simulated Hydrograph of SLVWD Pasatiempo #3 (Estrella)

MONTGOMERY & ASSOCIATES

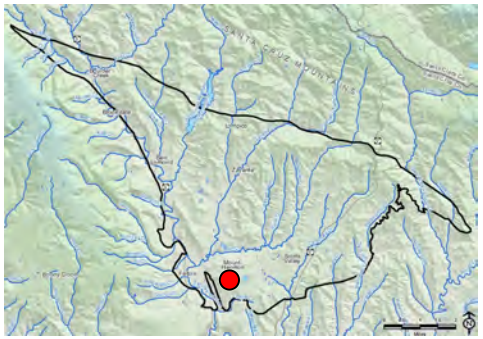


DRAFT

SLVWD Pasatiempo MW-1
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 788.7 ft AMSL
Screen Interval: 599-659 ft bgs

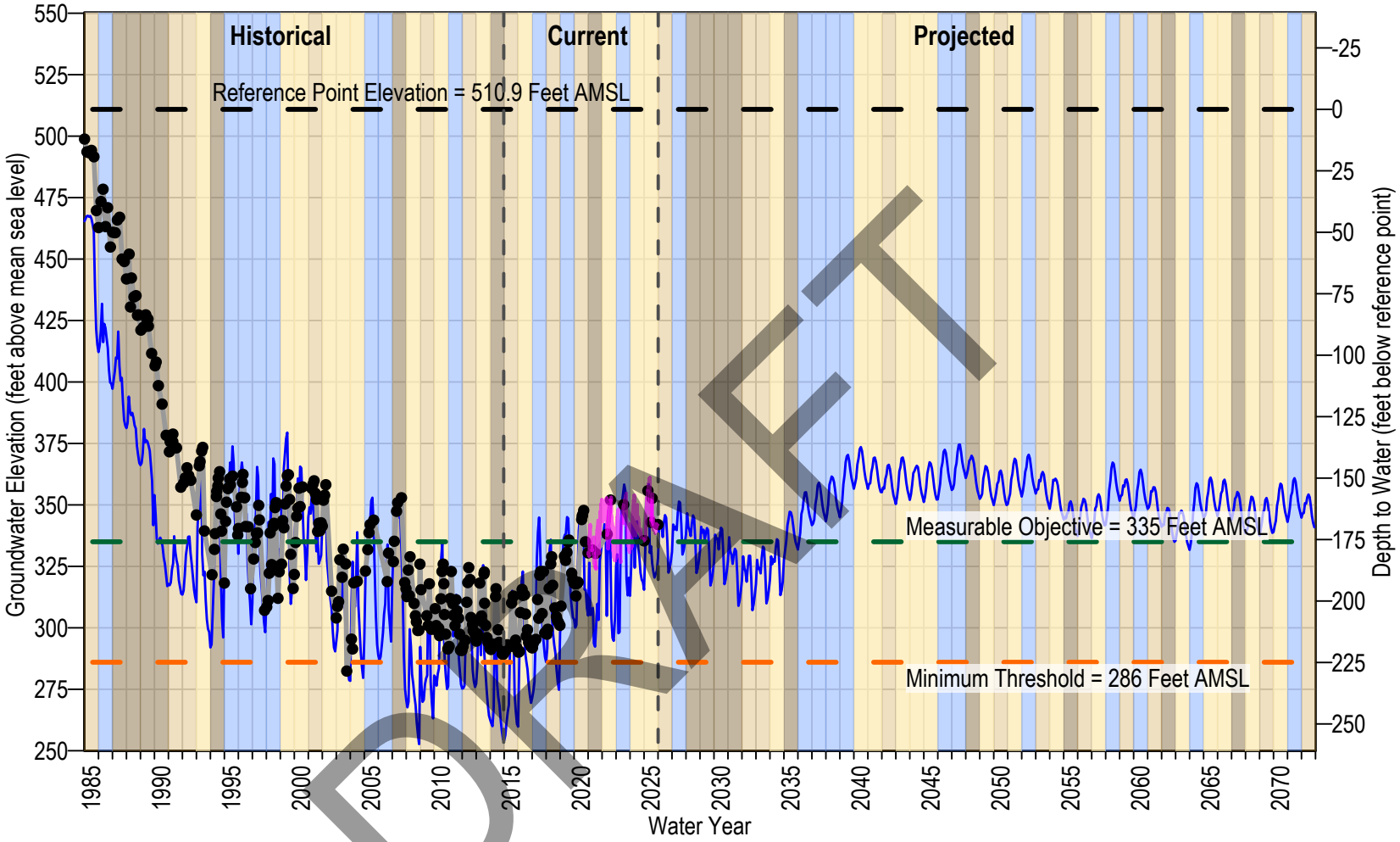
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-16. Simulated Hydrograph of SLVWD Pasatiempo MW-1

MONTGOMERY & ASSOCIATES



DRAFT

- SVWD #10
- Transducer
- Simulated
- Reference Point Elevation
- Minimum Threshold
- Measurable Objective

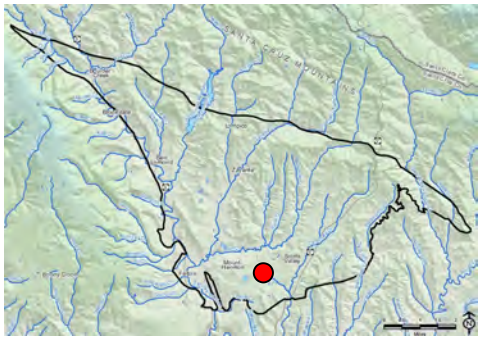
Formation: Confined - Lompico

Reference Point Elevation: 510.9 ft AMSL

Screen Interval: 190-220, 240-270, 325-355 ft bgs

Water Year Classification

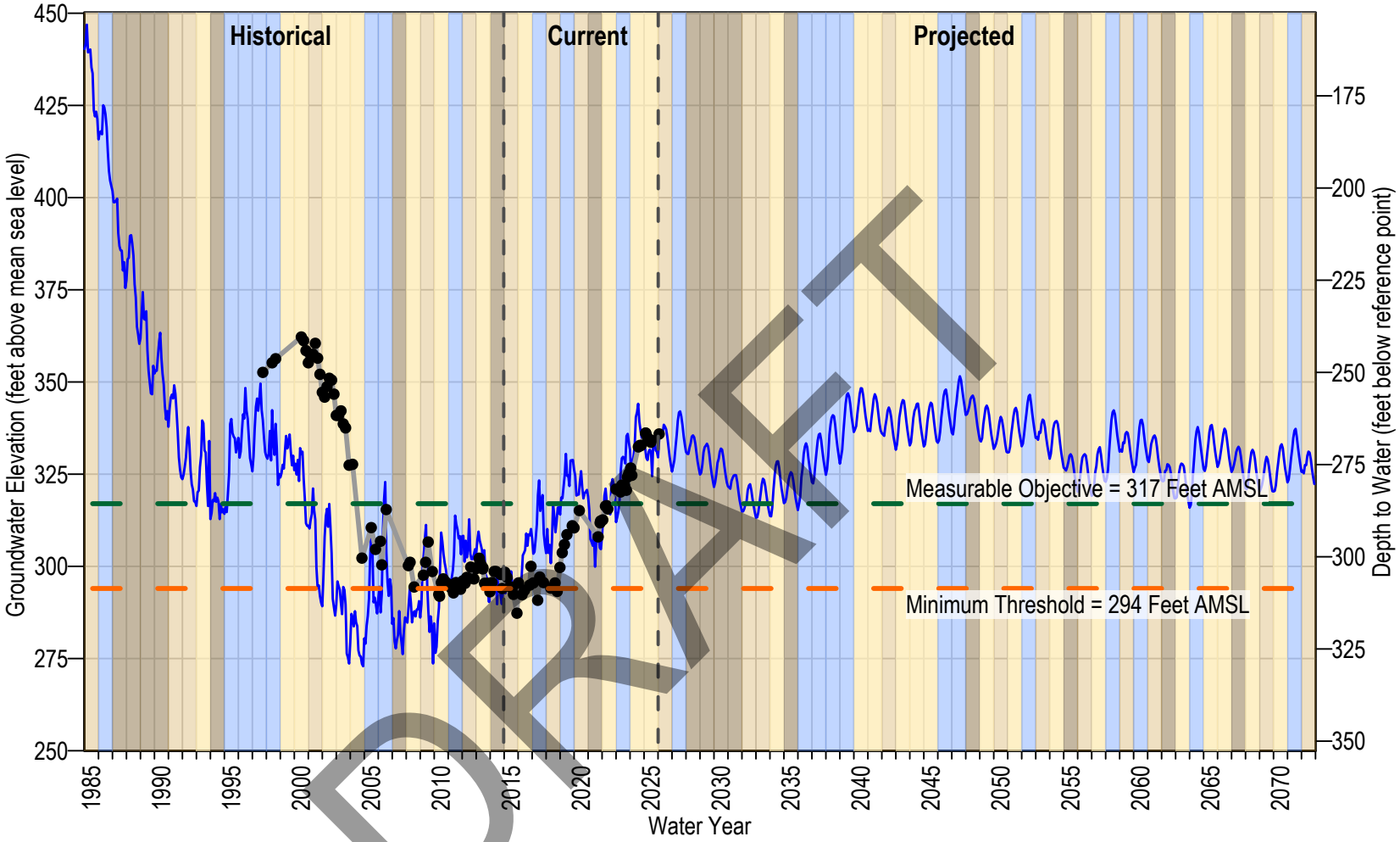
- Wet
- Dry
- Normal
- Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-17. Simulated Hydrograph of SVWD #10

MONTGOMERY & ASSOCIATES

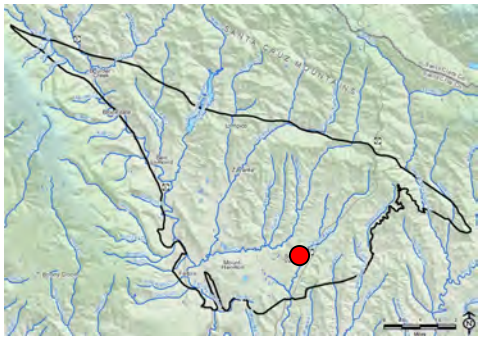


DRAFT

SVWD #11A
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 602.6 ft AMSL
Screen Interval: 399-419, 459-469, 495-515 ft bgs

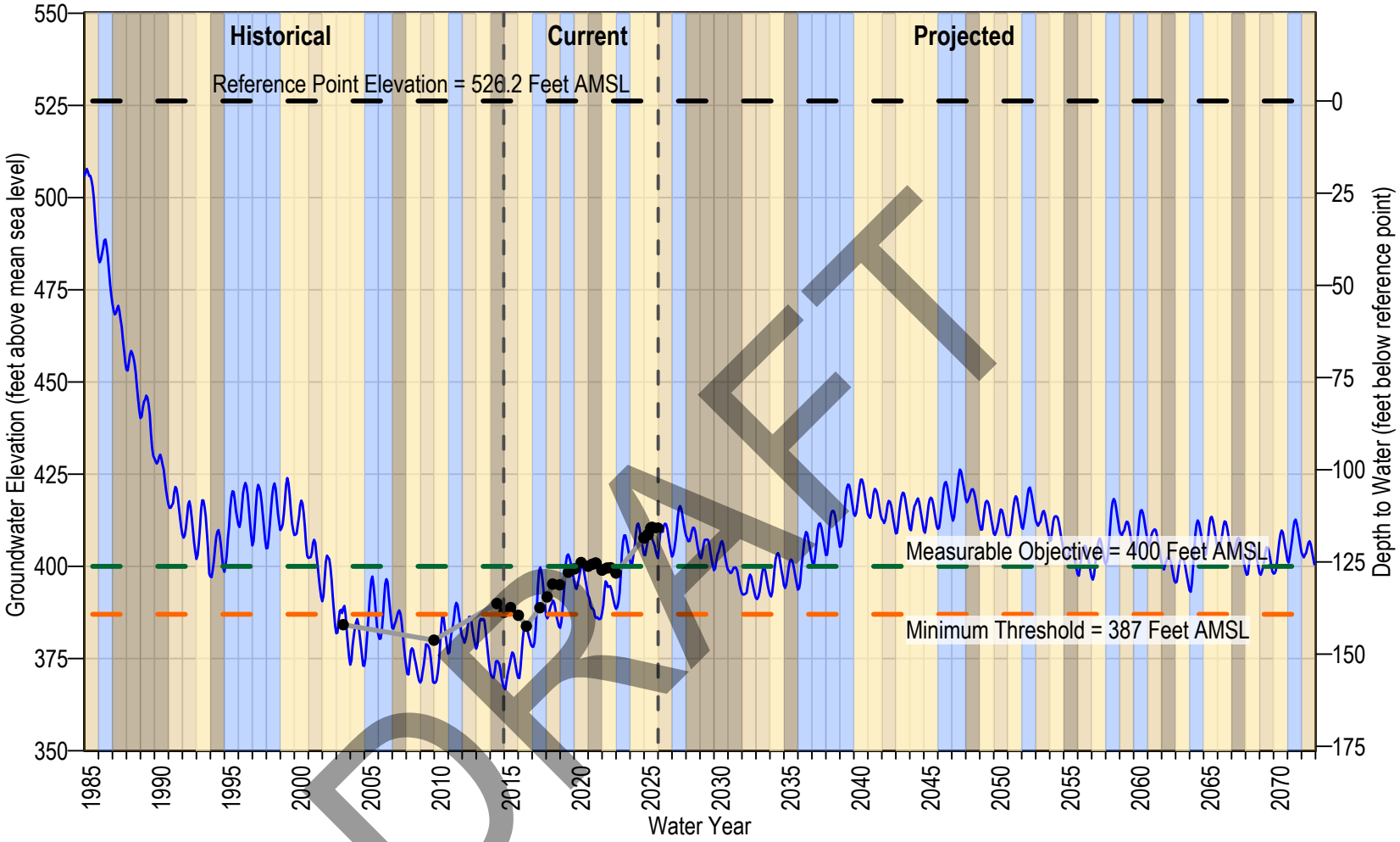
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-18. Simulated Hydrograph of SVWD #11A

MONTGOMERY & ASSOCIATES

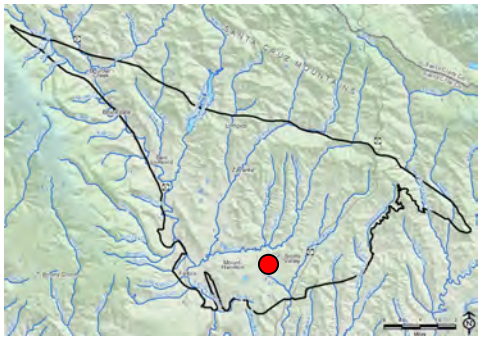


DRAFT

SVWD AB303 MW-2
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 526.2 ft AMSL
Screen Interval: 705-715, 810-850 ft bgs

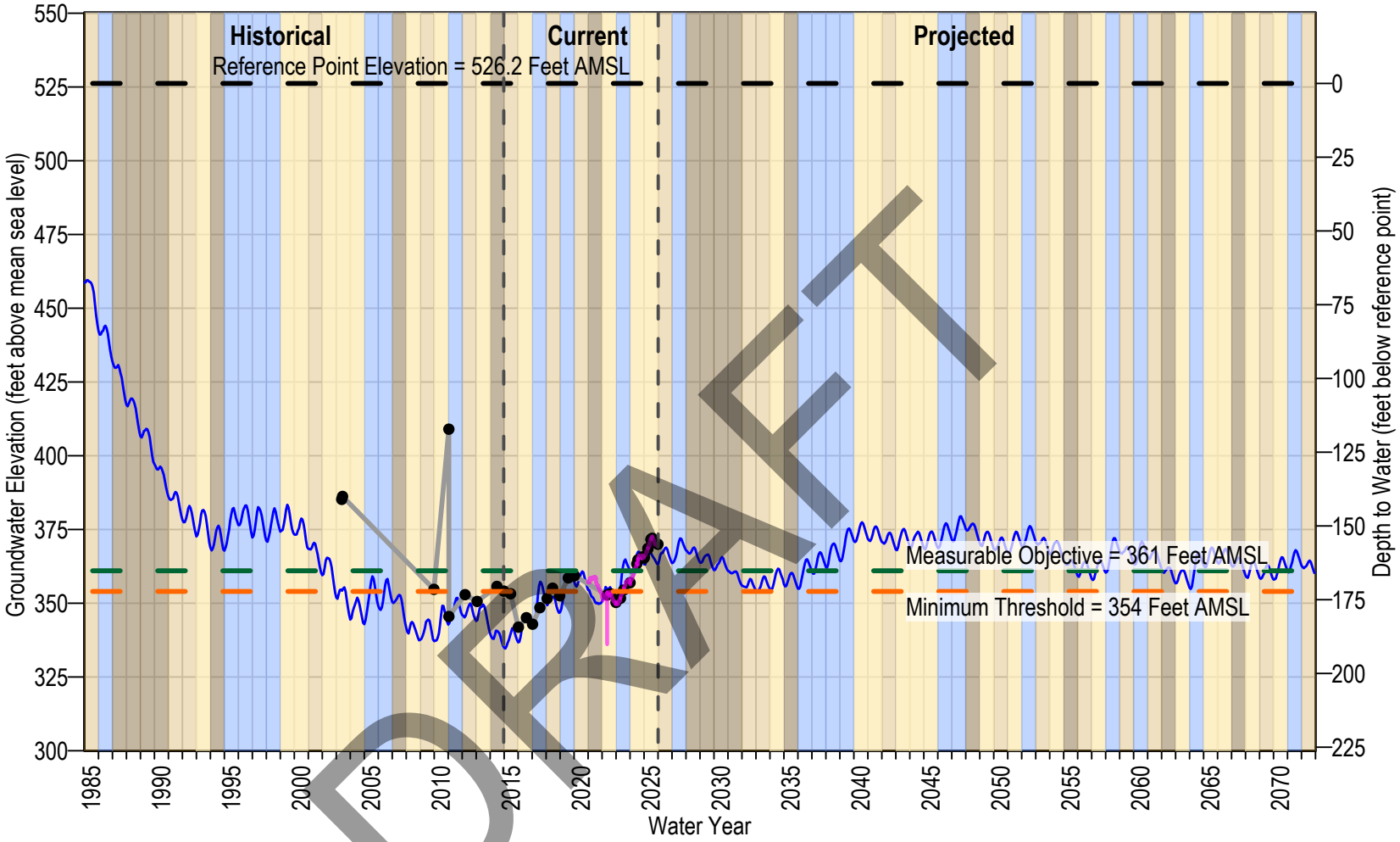
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-19. Simulated Hydrograph of SVWD AB303 MW-2

MONTGOMERY & ASSOCIATES

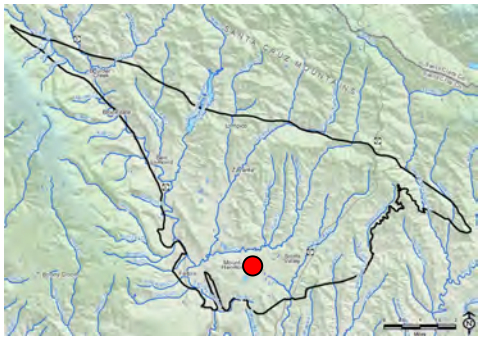


DRAFT

SVWD AB303 MW-3A
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 526.2 ft AMSL
Screen Interval: 630-680 ft bgs

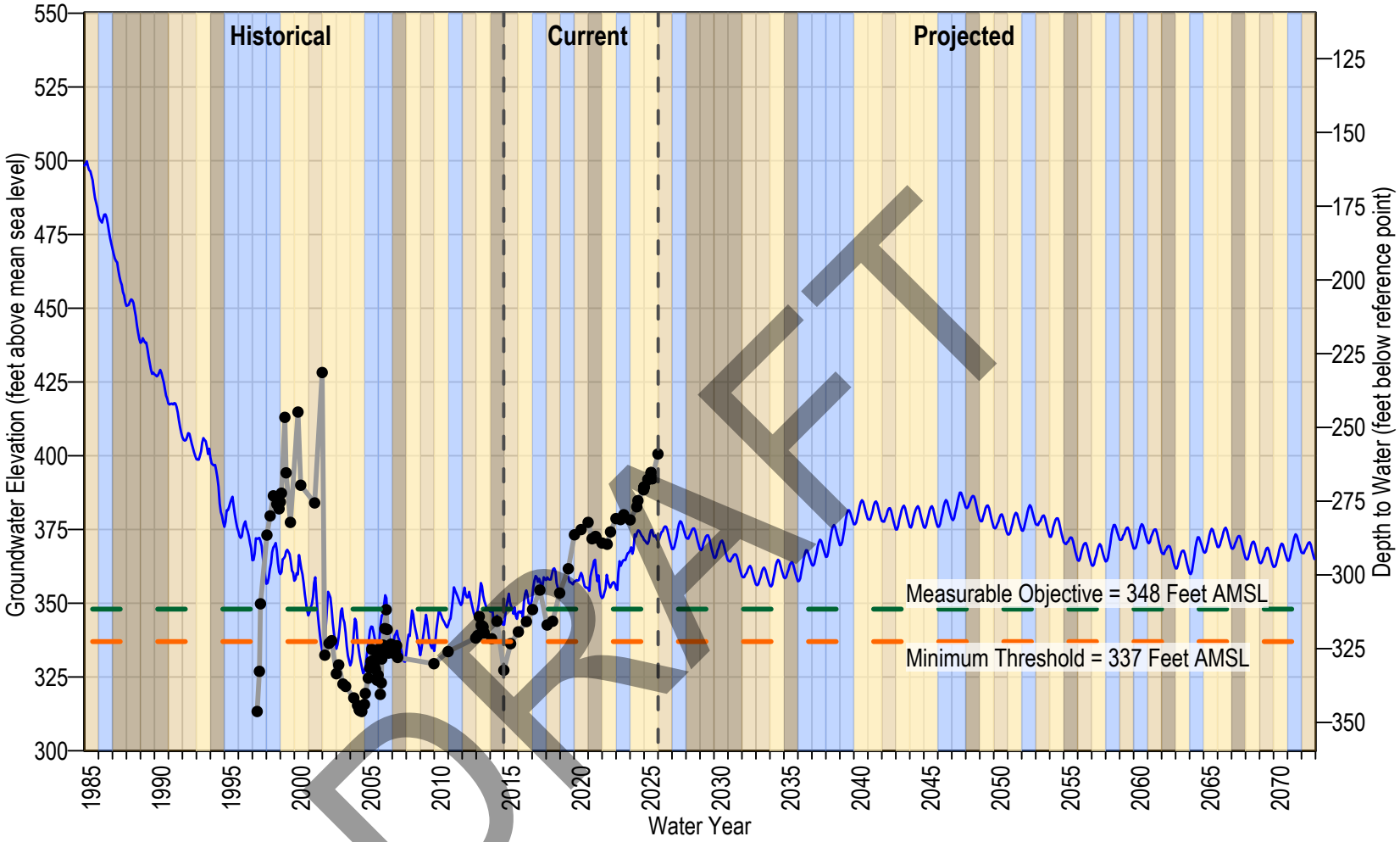
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-20. Simulated Hydrograph of SVWD AB303 MW-3A

MONTGOMERY & ASSOCIATES

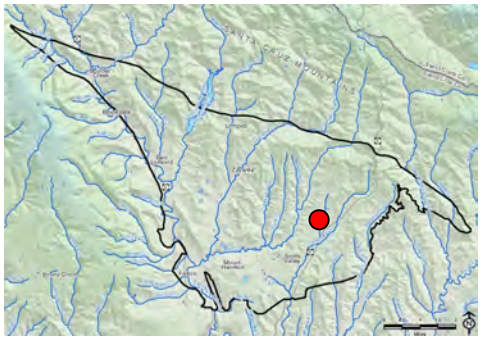


DRAFT

SVWD TW-19
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 659.6 ft AMSL
Screen Interval: 960-1060 ft bgs

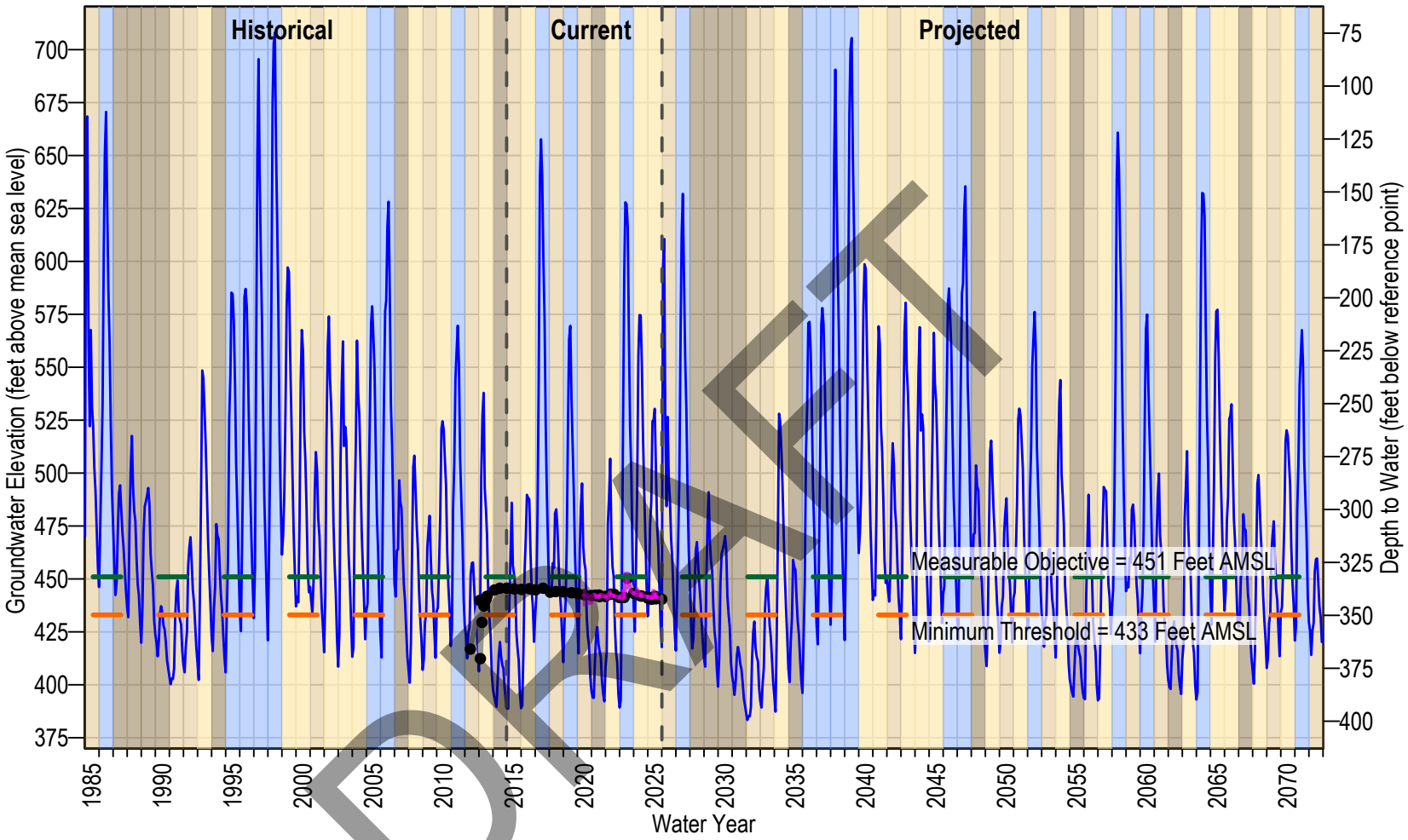
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-21. Simulated Hydrograph of SVWD TW-19

MONTGOMERY & ASSOCIATES

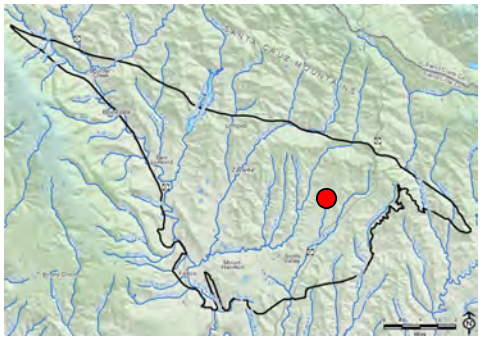


SVWD Canham Well
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Butano
Reference Point Elevation: 782.8 ft AMSL
Screen Interval: 1,281-1,381 ft bgs

Water Year Classification

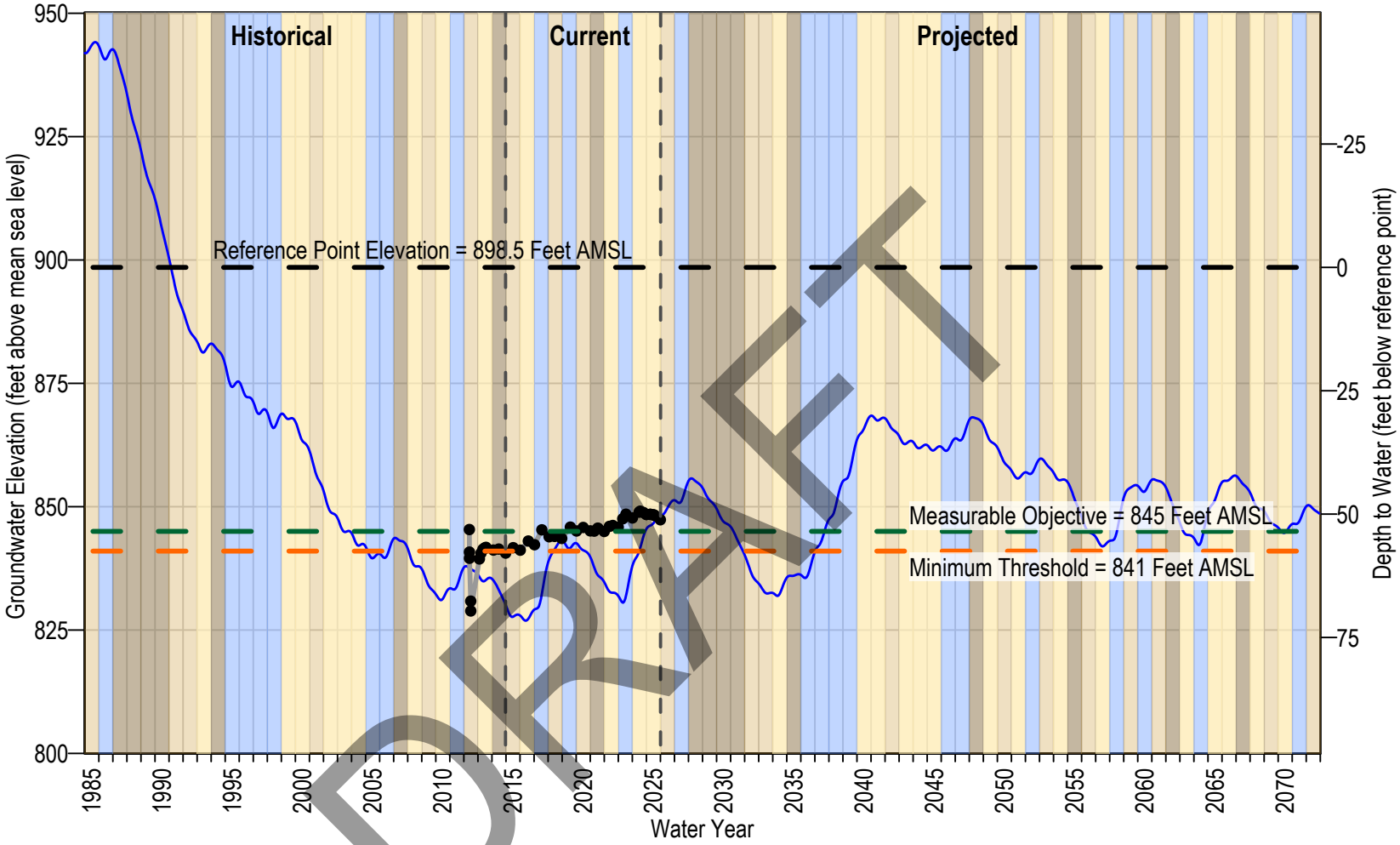
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-22. Simulated Hydrograph of SVWD Canham Well

MONTGOMERY & ASSOCIATES

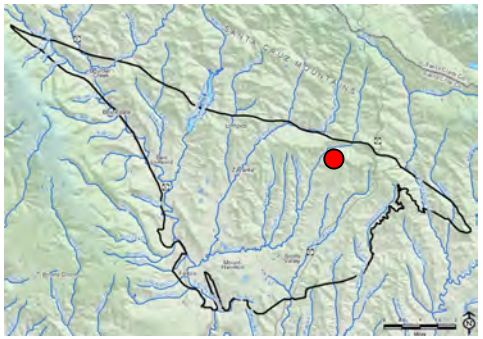


DRAFT

SVWD Stonewood Well
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Butano
Reference Point Elevation: 898.5 ft AMSL
Screen Interval: 799-859 ft bgs

Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5A-23. Simulated Hydrograph of SVWD Stonewood Well

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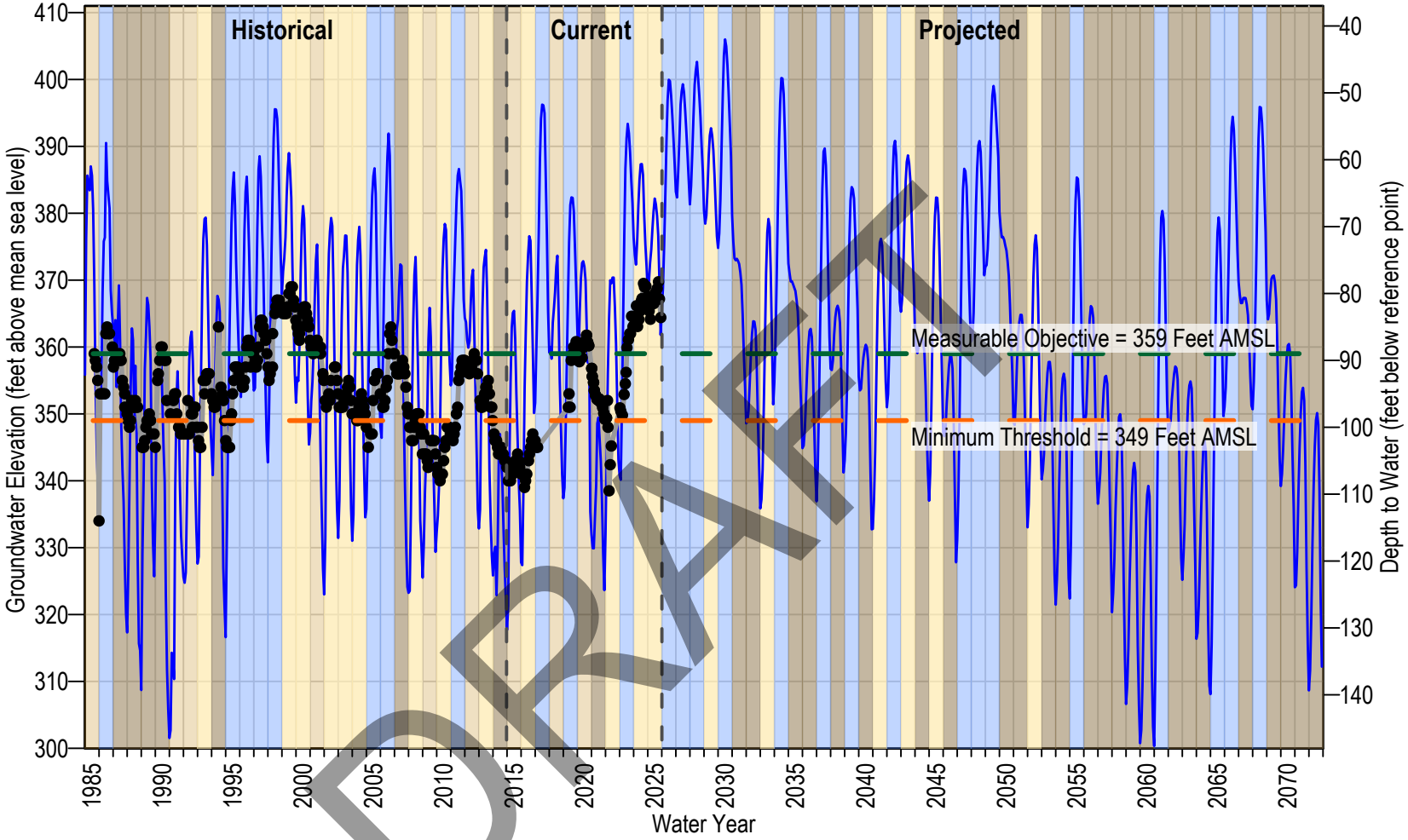
Appendix 5B

Historical, Current, and Projected Baseline with Climate Change Model Hydrographs

DRAFT

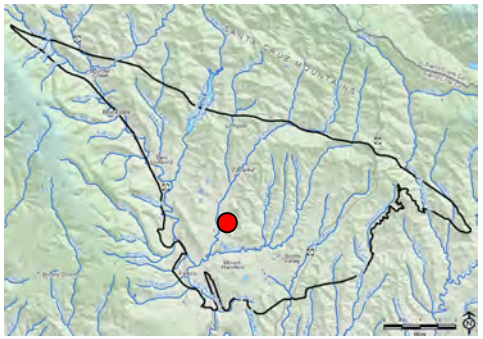


DRAFT

SLVWD Olympia #1 (Ferrari)
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 448 ft AMSL
Screen Interval: 127-157 ft bgs

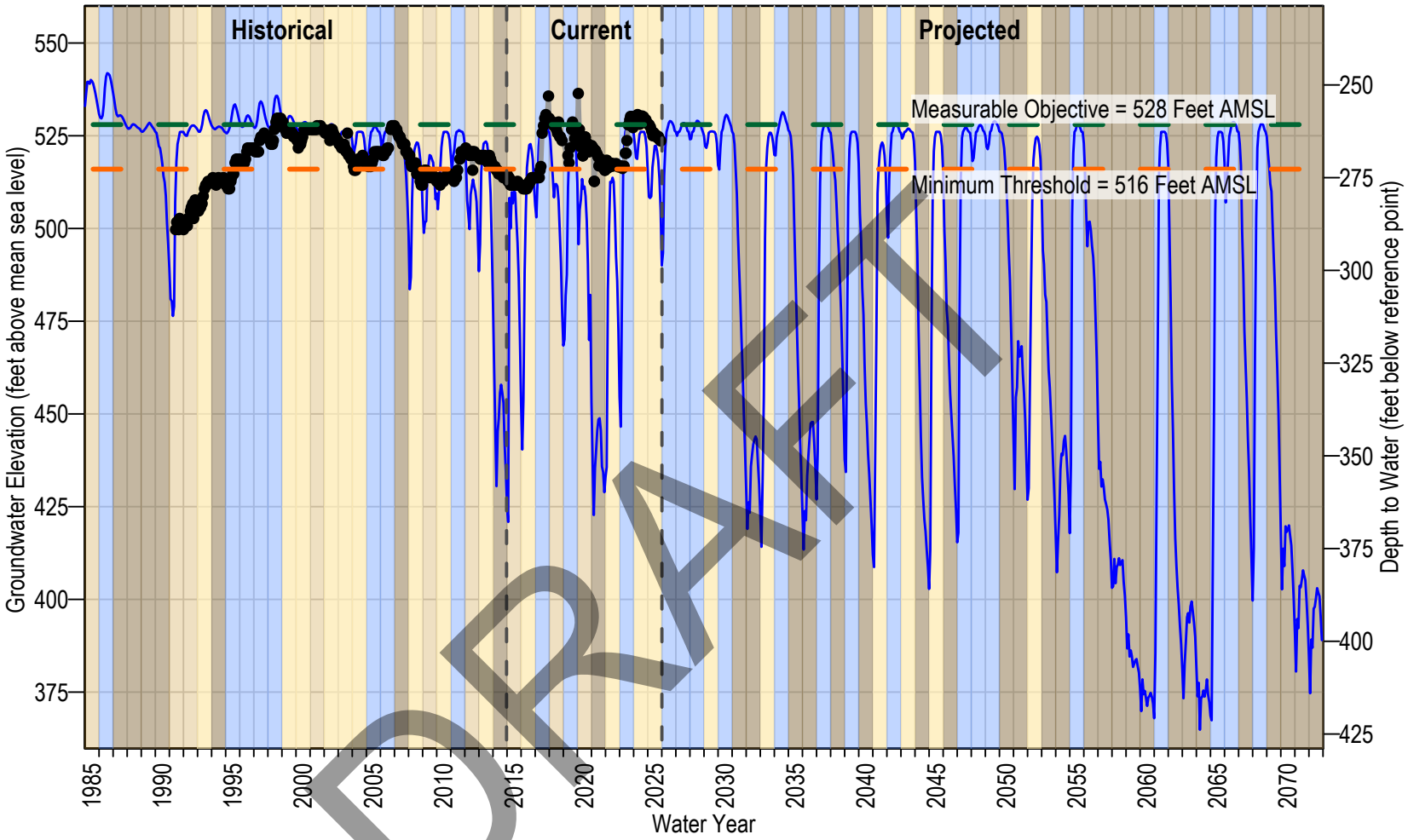
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-1. Simulated Hydrograph of SLVWD Olympia #1 (Ferrari)

MONTGOMERY & ASSOCIATES

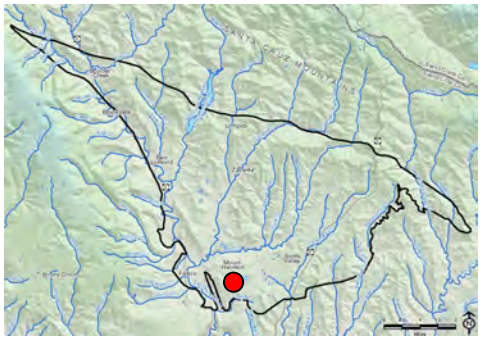


DRAFT

SLVWD Pasatiempo MW-2
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 788.7 ft AMSL
Screen Interval: 254-294 ft bgs

Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-2. Simulated Hydrograph of SLVWD Pasatiempo MW-2

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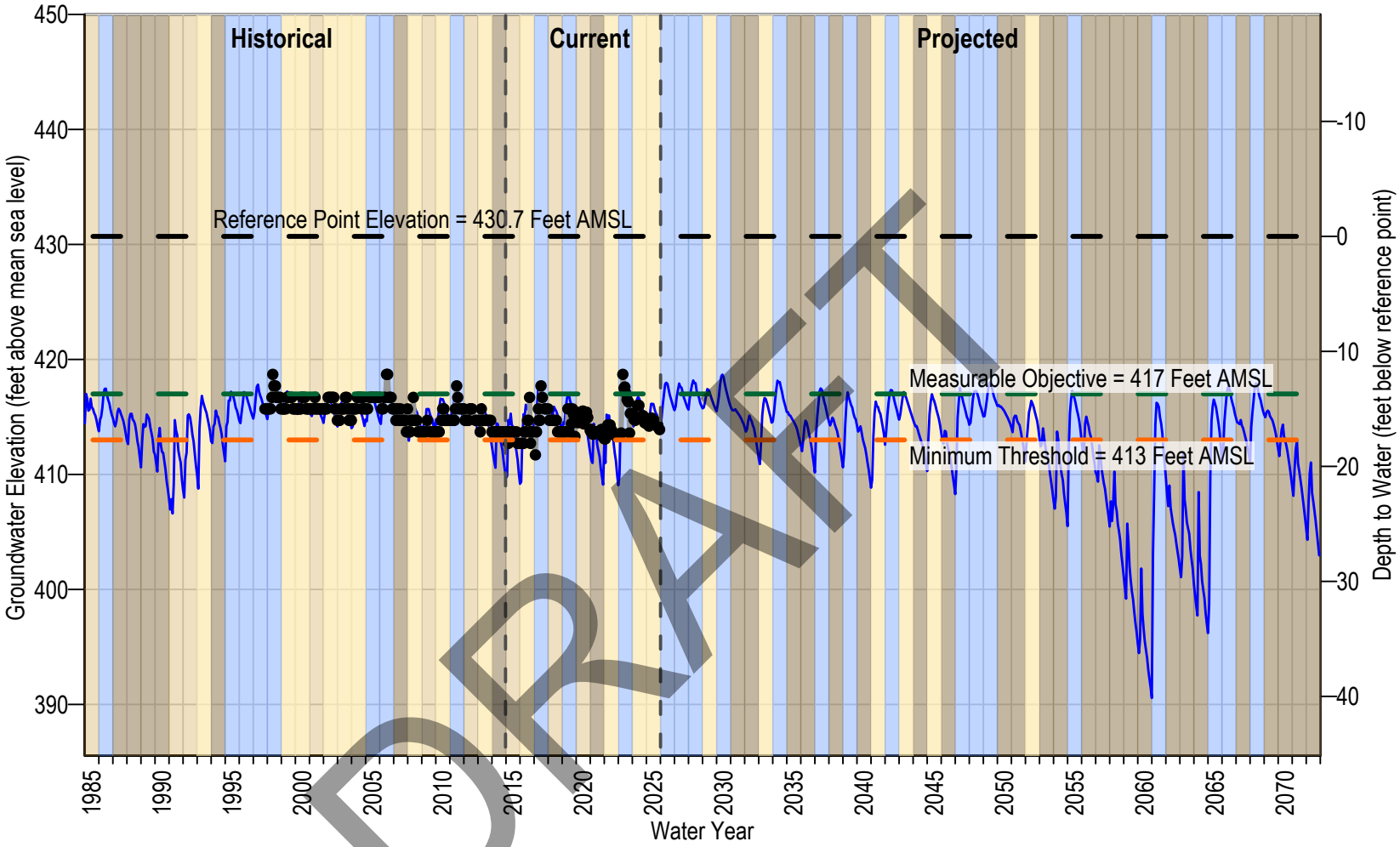
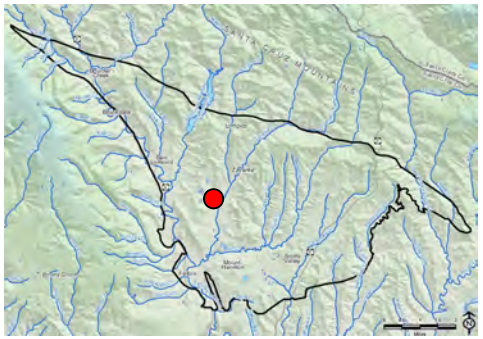


DRAFT

SLVWD Quail MW-A
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 430.7 ft AMSL
Screen Interval: 33-88 ft bgs

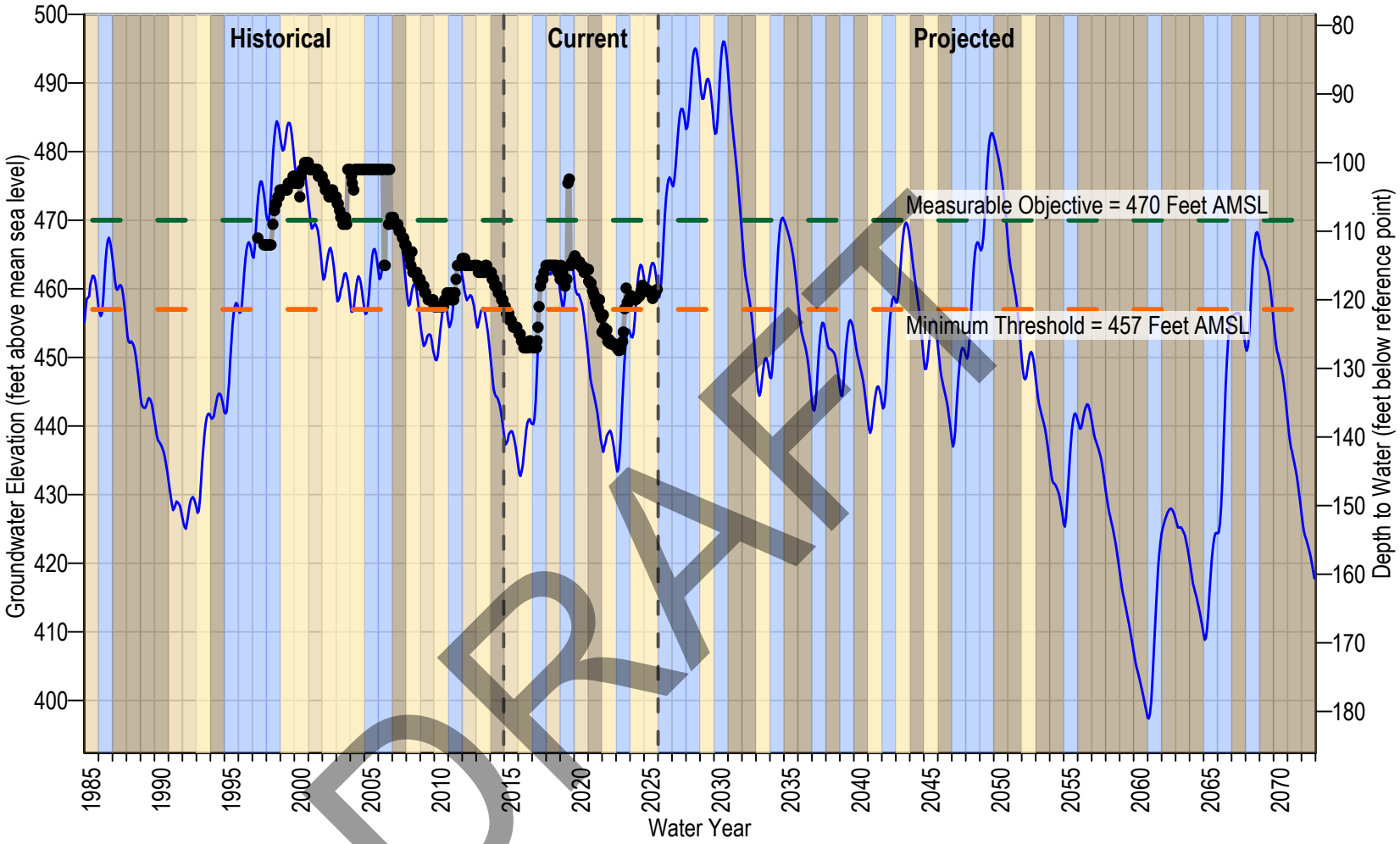
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-3. Simulated Hydrograph of SLVWD Quail MW-A

MONTGOMERY & ASSOCIATES



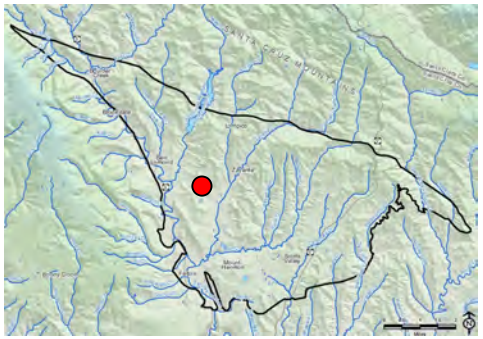
DRAFT

SLVWD Quail MW-B
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 578.4 ft AMSL
Screen Interval: 95-195 ft bgs

Water Year Classification

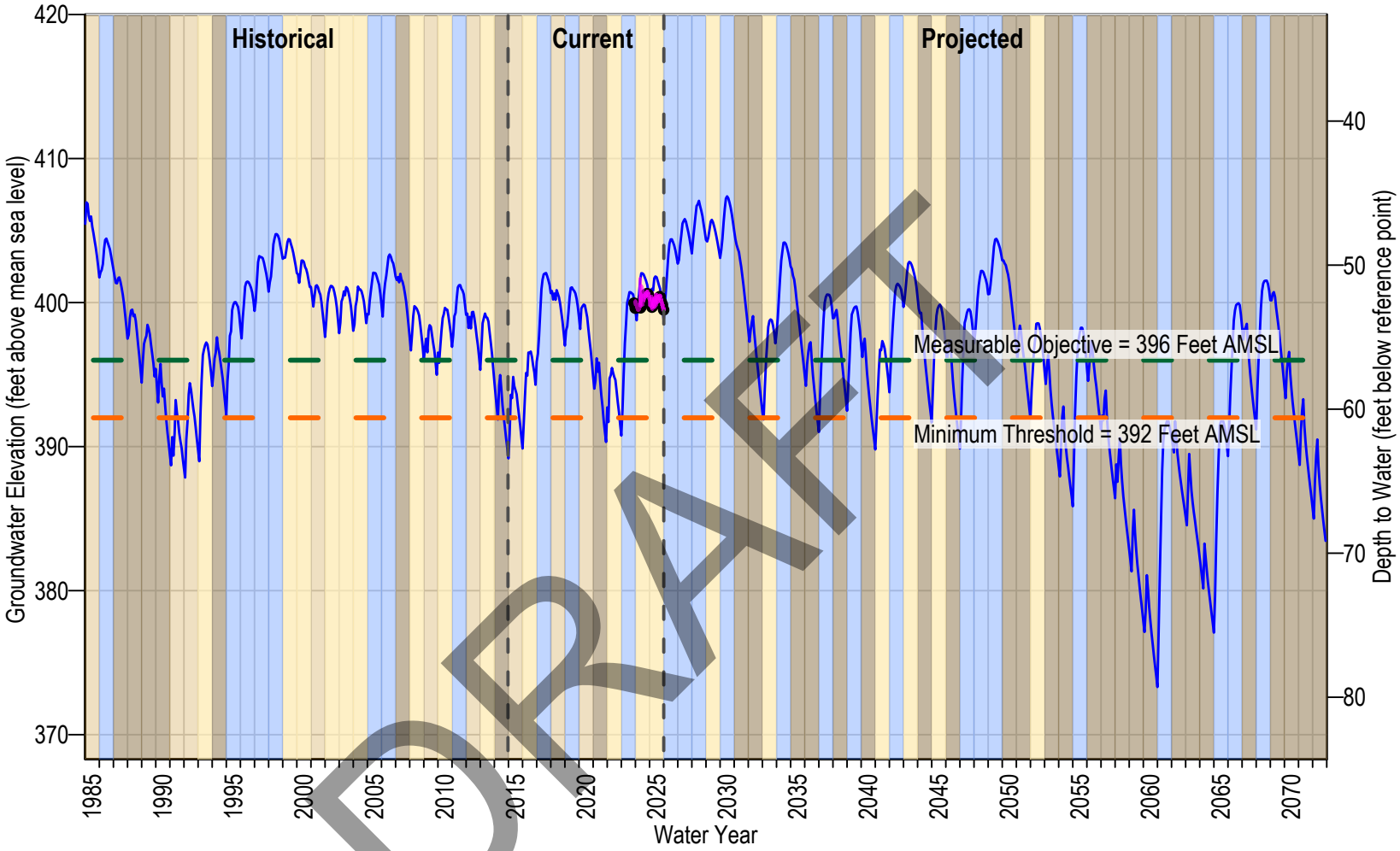
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-4. Simulated Hydrograph of SLVWD Quail MW-B

MONTGOMERY & ASSOCIATES

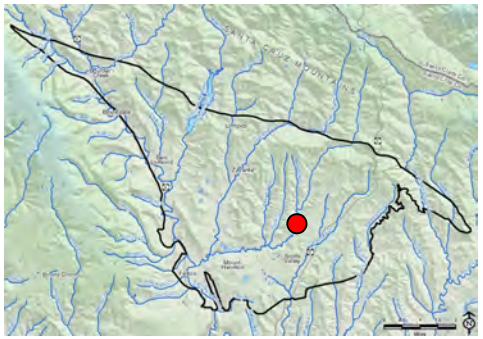


DRAFT

SMGWA-2 Bean Creek
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 452.6 ft AMSL
Screen Interval: 53-68 ft bgs

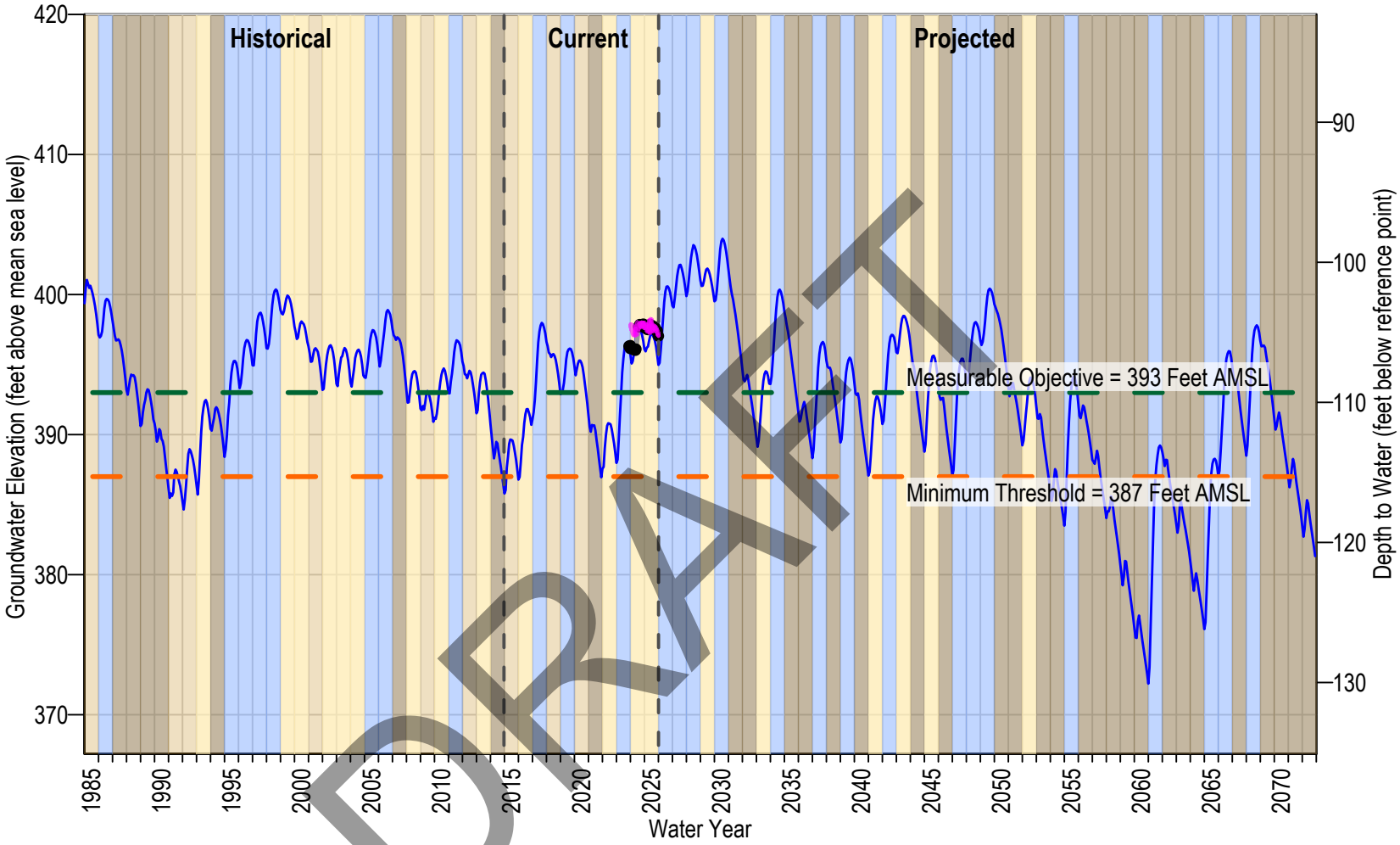
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-5. Simulated Hydrograph of SMGWA-2 Bean Creek

MONTGOMERY & ASSOCIATES



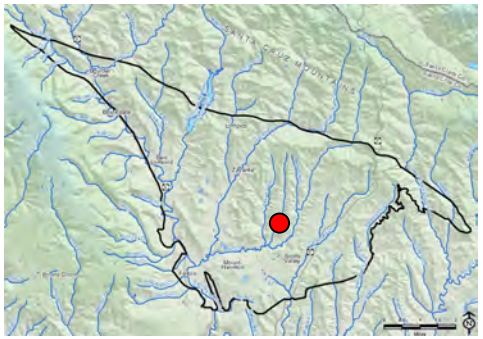
DRAFT

SMGWA-3 Ruins Creek
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 502.3 ft AMSL
Screen Interval: 145-160 ft bgs

Water Year Classification

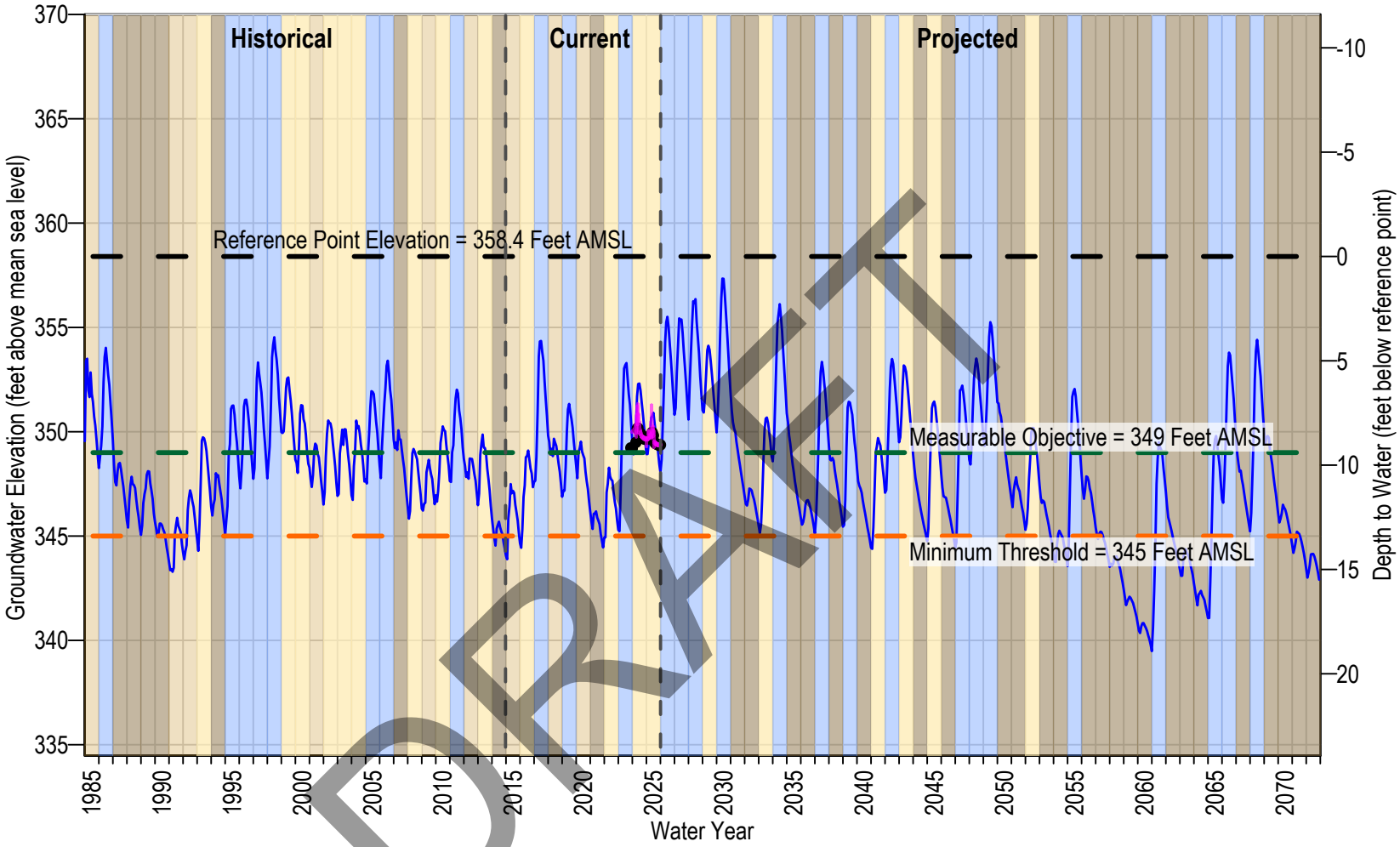
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-6. Simulated Hydrograph of SMGWA-3 Ruins Creek

MONTGOMERY & ASSOCIATES



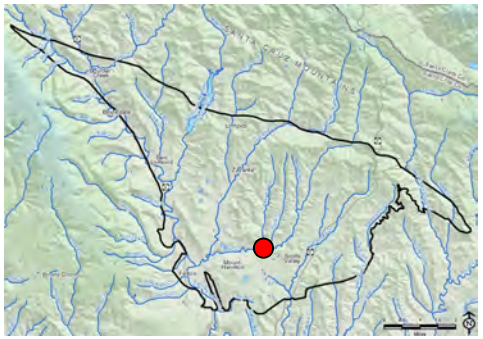
DRAFT

SMGWA-4 Nelson Road
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 358.4 ft AMSL
Screen Interval: 54-69 ft bgs

Water Year Classification

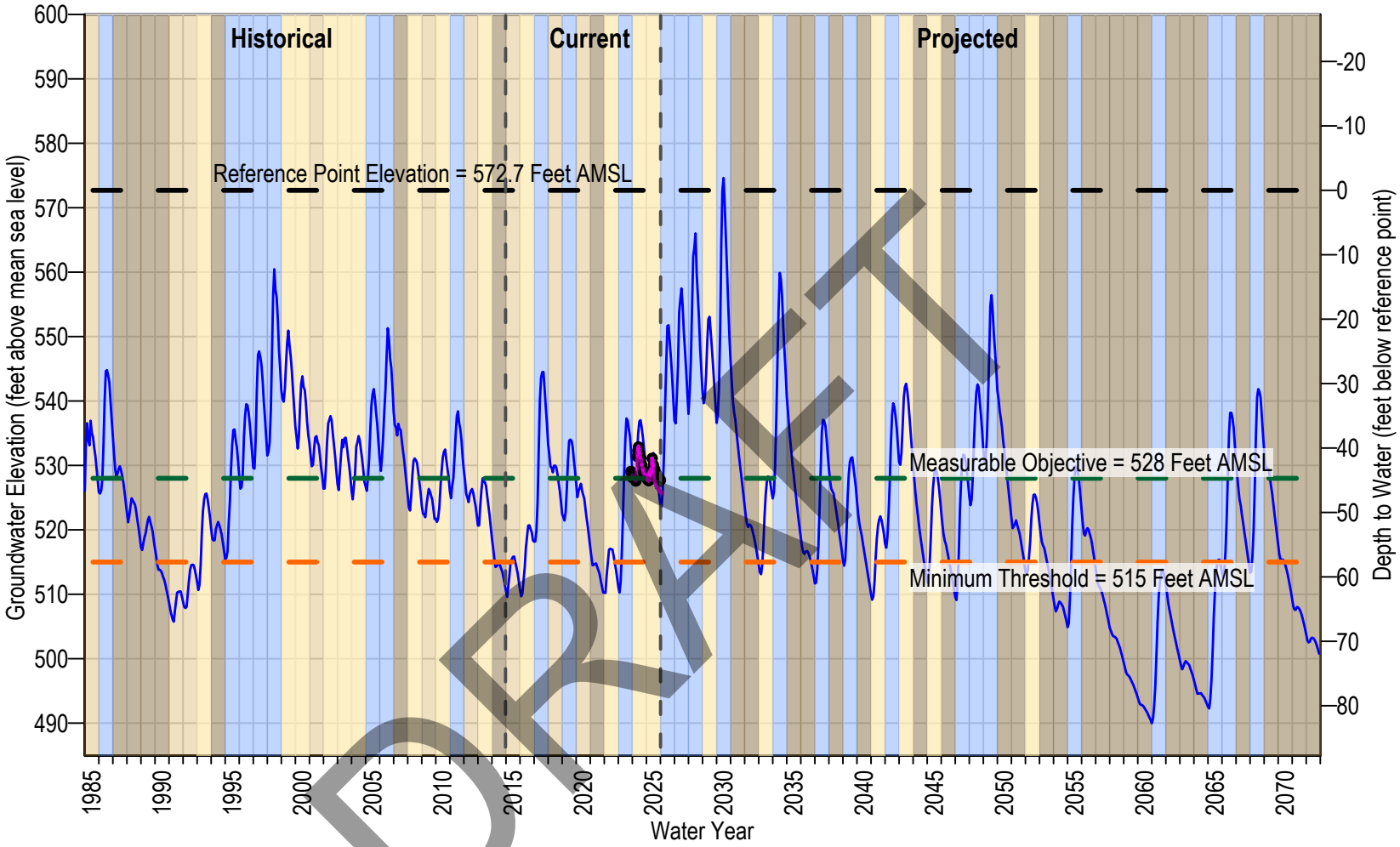
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-7. Simulated Hydrograph of SMGWA-4 Nelson Road

MONTGOMERY & ASSOCIATES



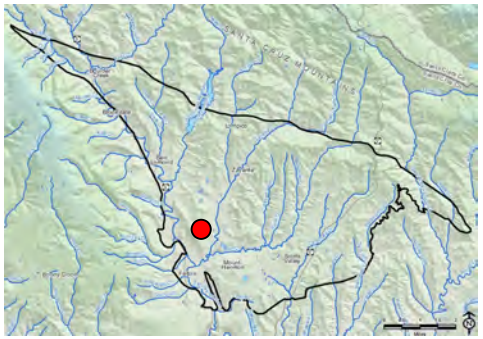
DRAFT

SMGWA-5 Bahr Drive
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 572.7 ft AMSL
Screen Interval: 40-55 ft bgs

Water Year Classification

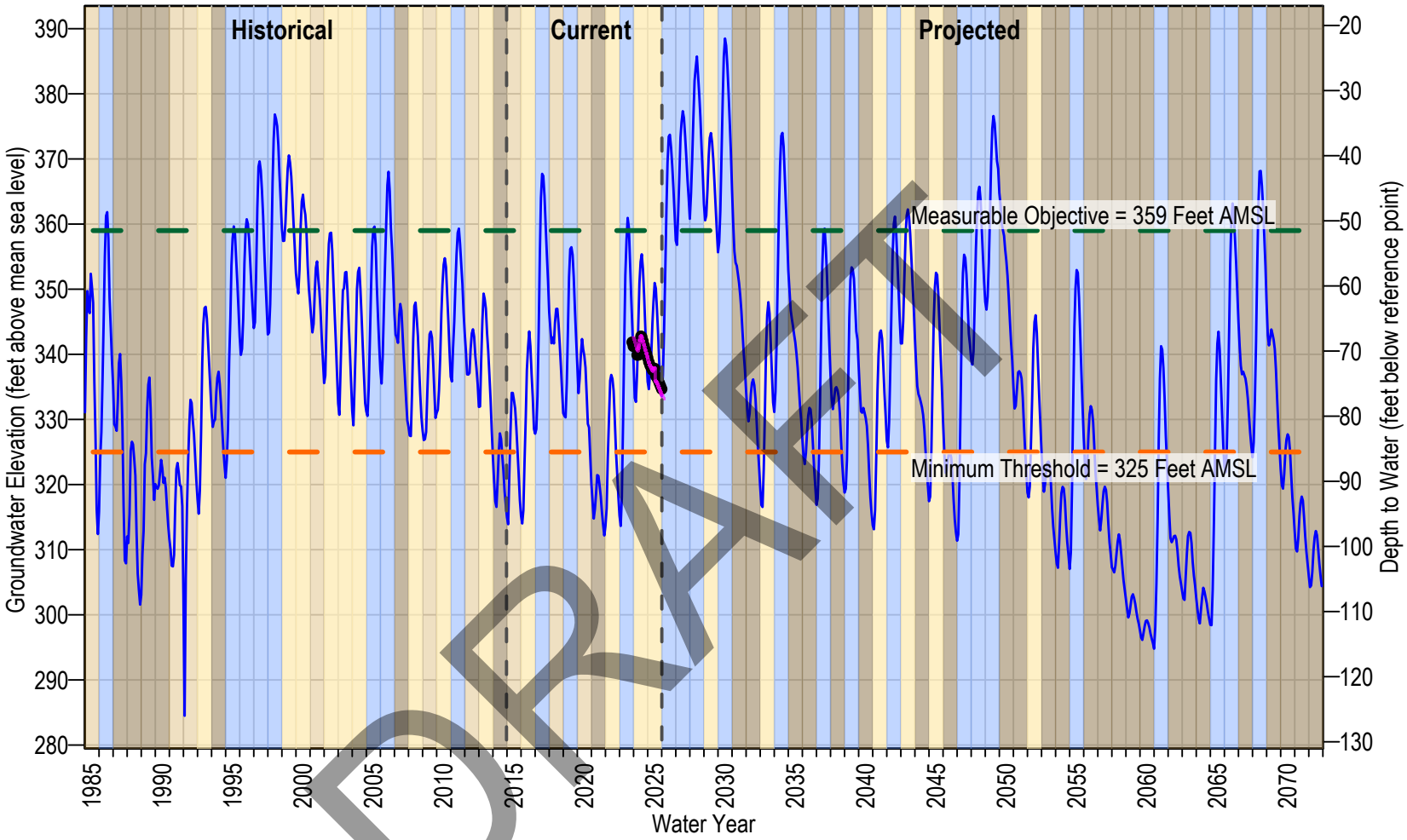
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-8. Simulated Hydrograph of SMGWA-5 Bahr Drive

MONTGOMERY & ASSOCIATES



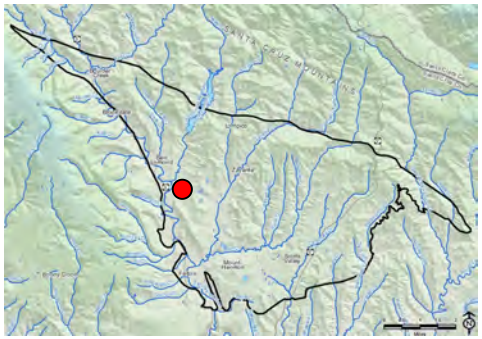
DRAFT

SMGWA-6 Quail Hollow
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 410.5 ft AMSL
Screen Interval: 115-130 ft bgs

Water Year Classification

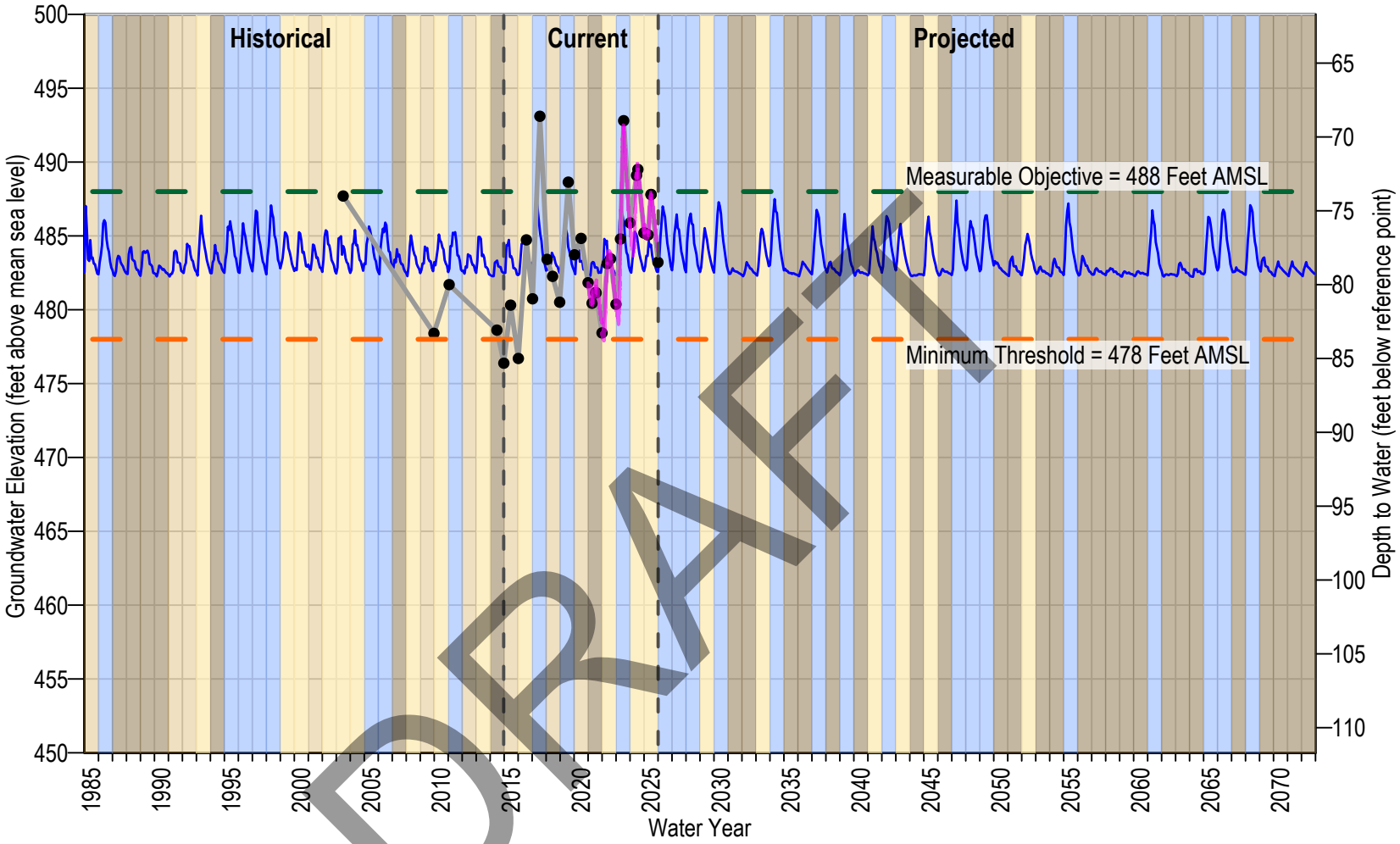
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-9. Simulated Hydrograph of SMGWA-6 Quail Hollow

MONTGOMERY & ASSOCIATES

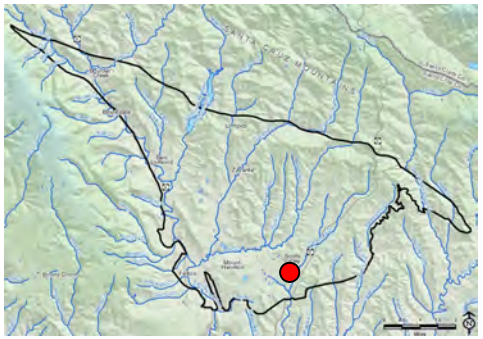


DRAFT

SVWD AB303 MW-1
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 561.7 ft AMSL
Screen Interval: 114-124 ft bgs

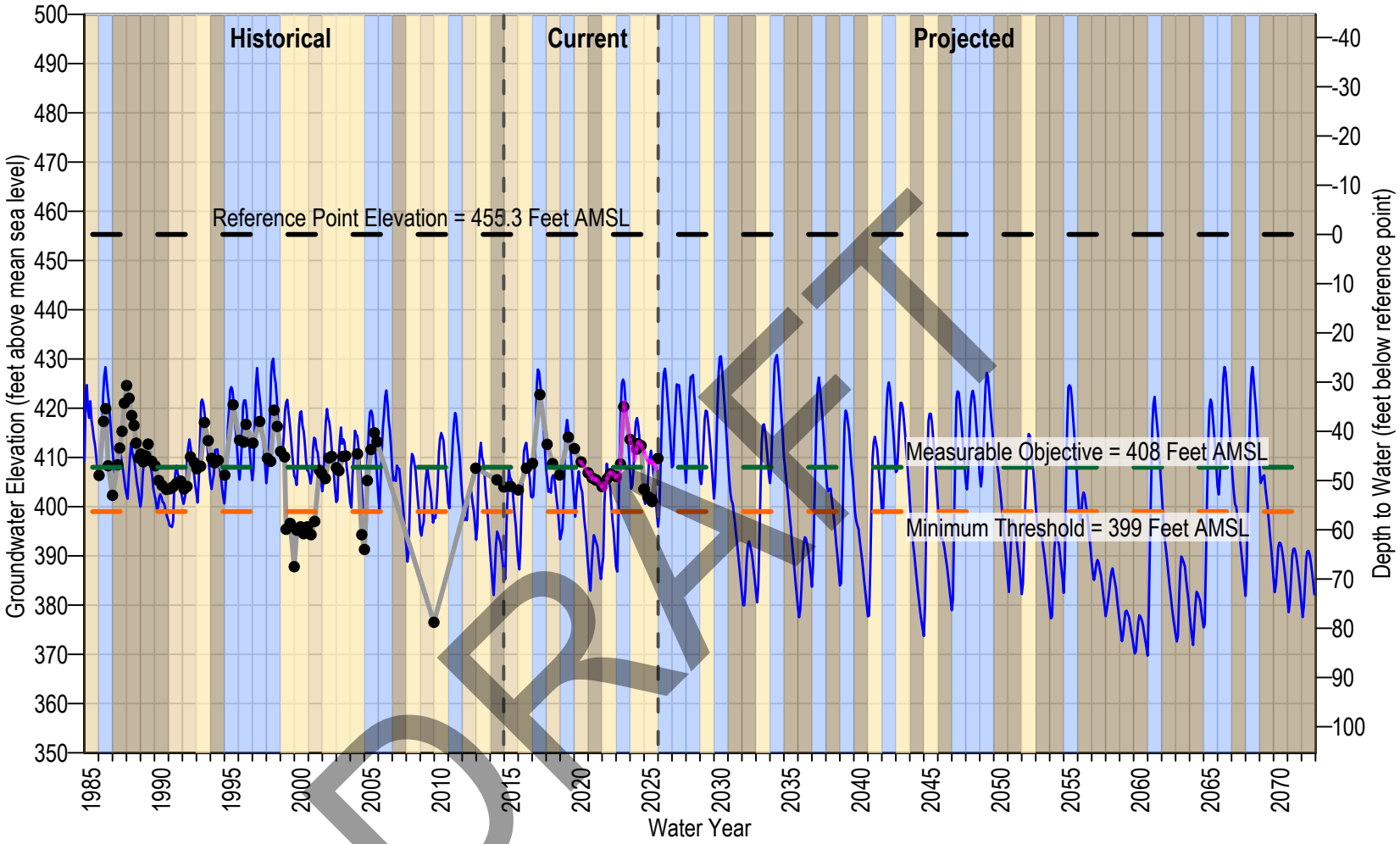
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-10. Simulated Hydrograph of SVWD AB303 MW-1

MONTGOMERY & ASSOCIATES

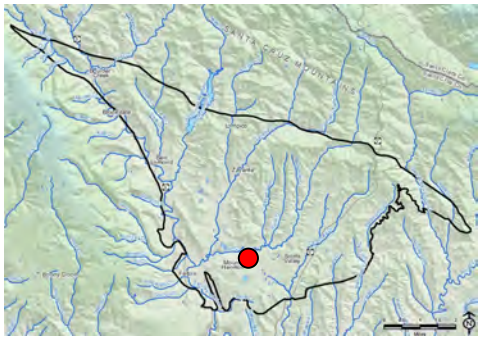


DRAFT

SVWD SV4-MW
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 455.3 ft AMSL
Screen Interval: 50-60 ft bgs

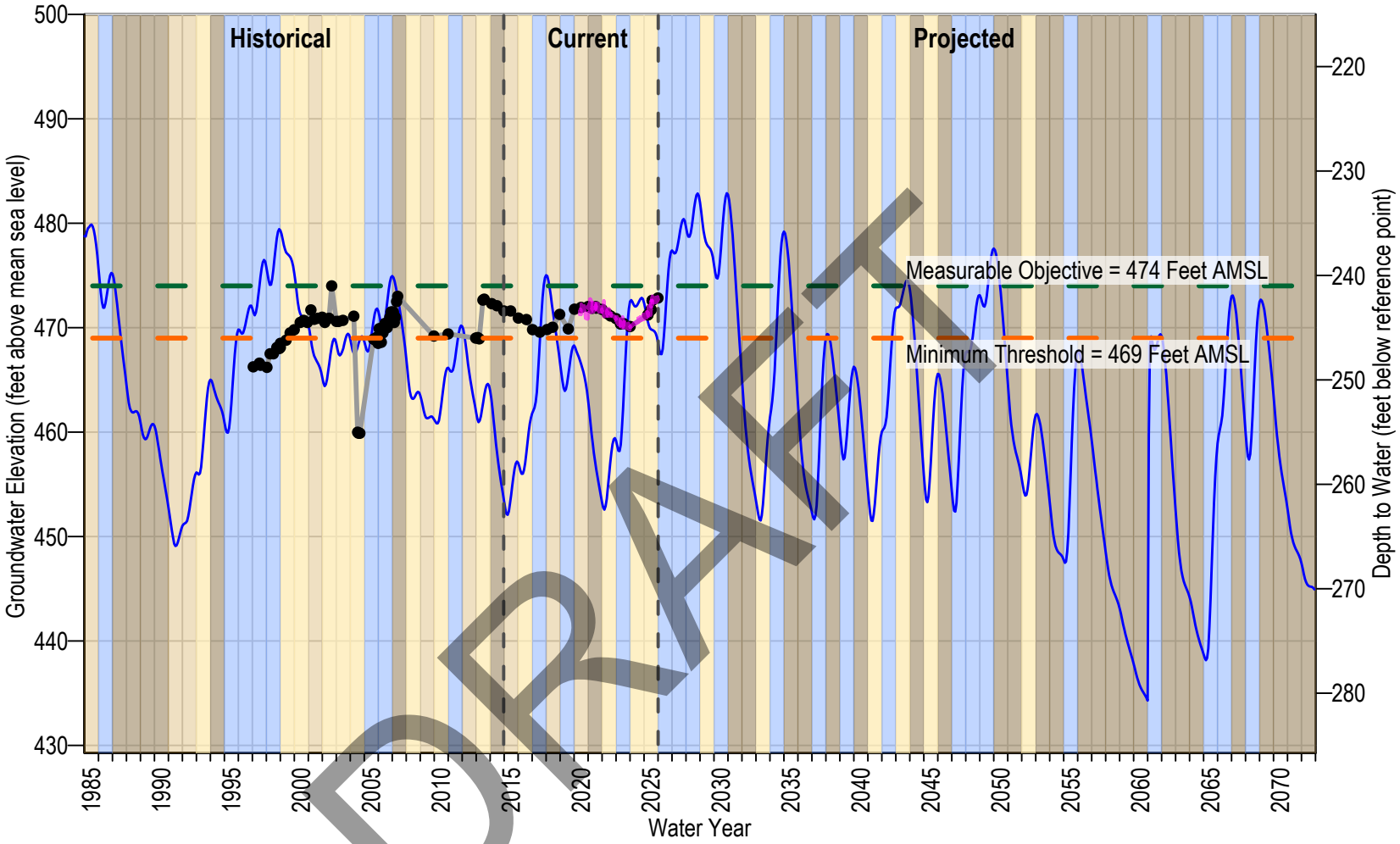
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-11. Simulated Hydrograph of SVWD SV4-MW

MONTGOMERY & ASSOCIATES

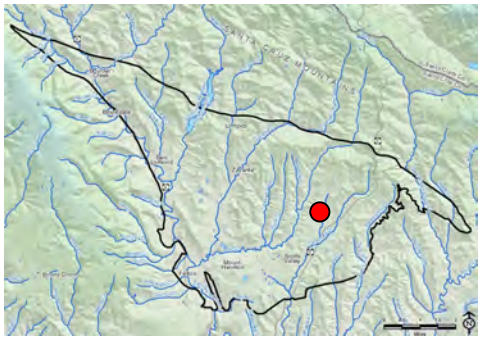


DRAFT

SVWD TW-18
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 715 ft AMSL
Screen Interval: 285-345 ft bgs

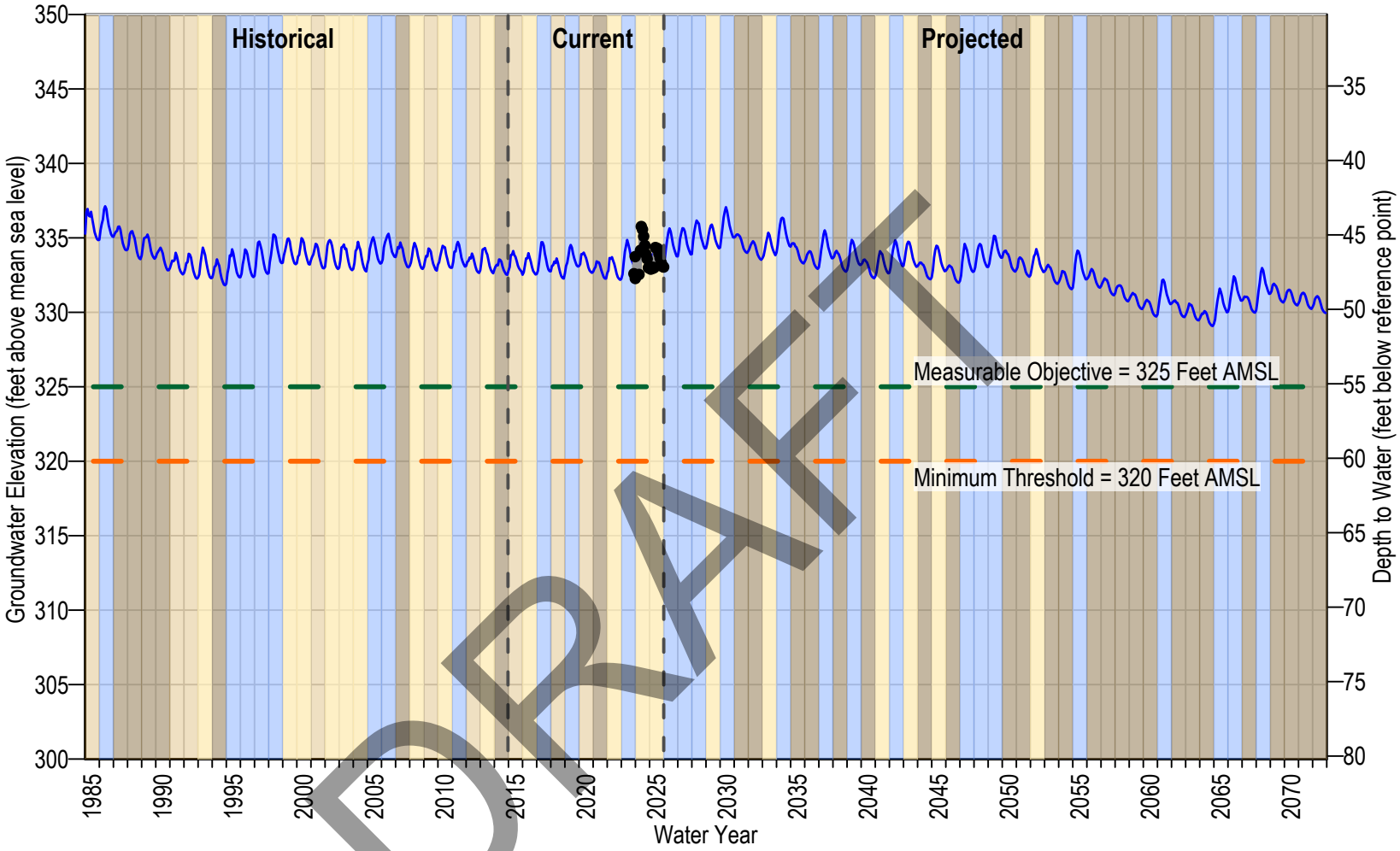
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-12. Simulated Hydrograph of SVWD TW-18

MONTGOMERY & ASSOCIATES

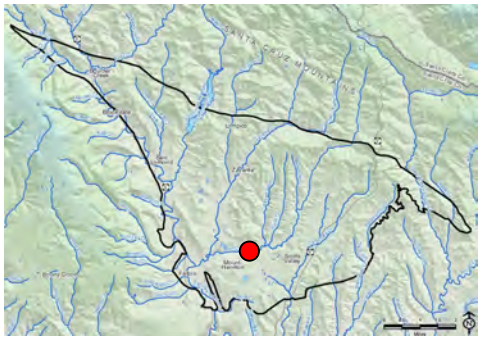


DRAFT

SMGWA-8 Randall Morgan Sandhills Preserve
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Monterey
Reference Point Elevation: 380.2 ft AMSL
Screen Interval: 155-170 ft bgs

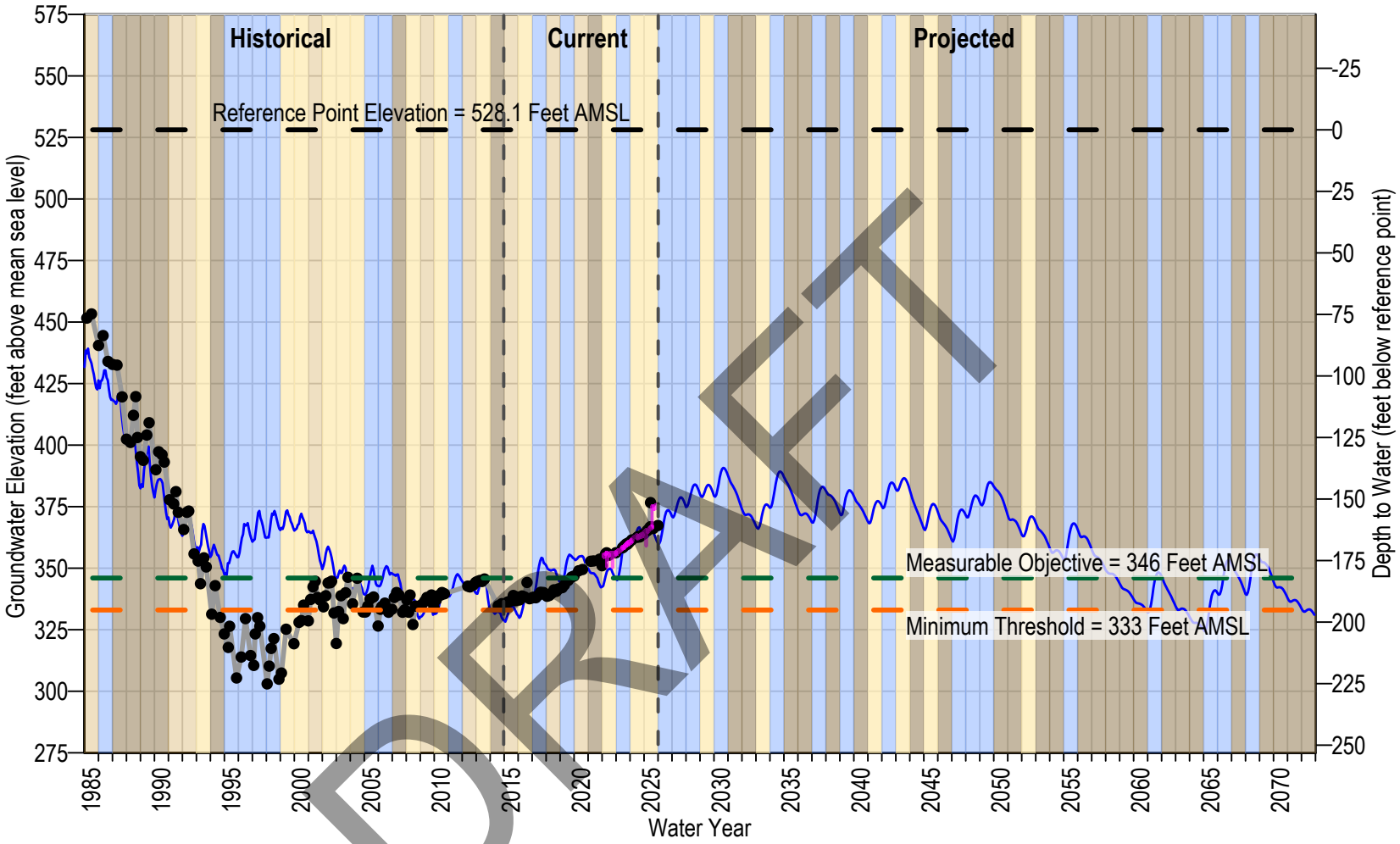
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-13. Simulated Hydrograph of SMGWA-8 Randall Morgan Sandhills Preserve

MONTGOMERY & ASSOCIATES



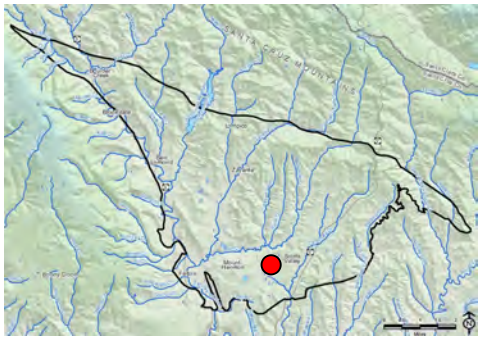
DRAFT

- SVWD #9
- Transducer
- Simulated
- Reference Point Elevation
- Minimum Threshold
- Measurable Objective

Formation: Confined - Monterey
Reference Point Elevation: 528.1 ft AMSL
Screen Interval: 155-195, 315-355 ft bgs

Water Year Classification

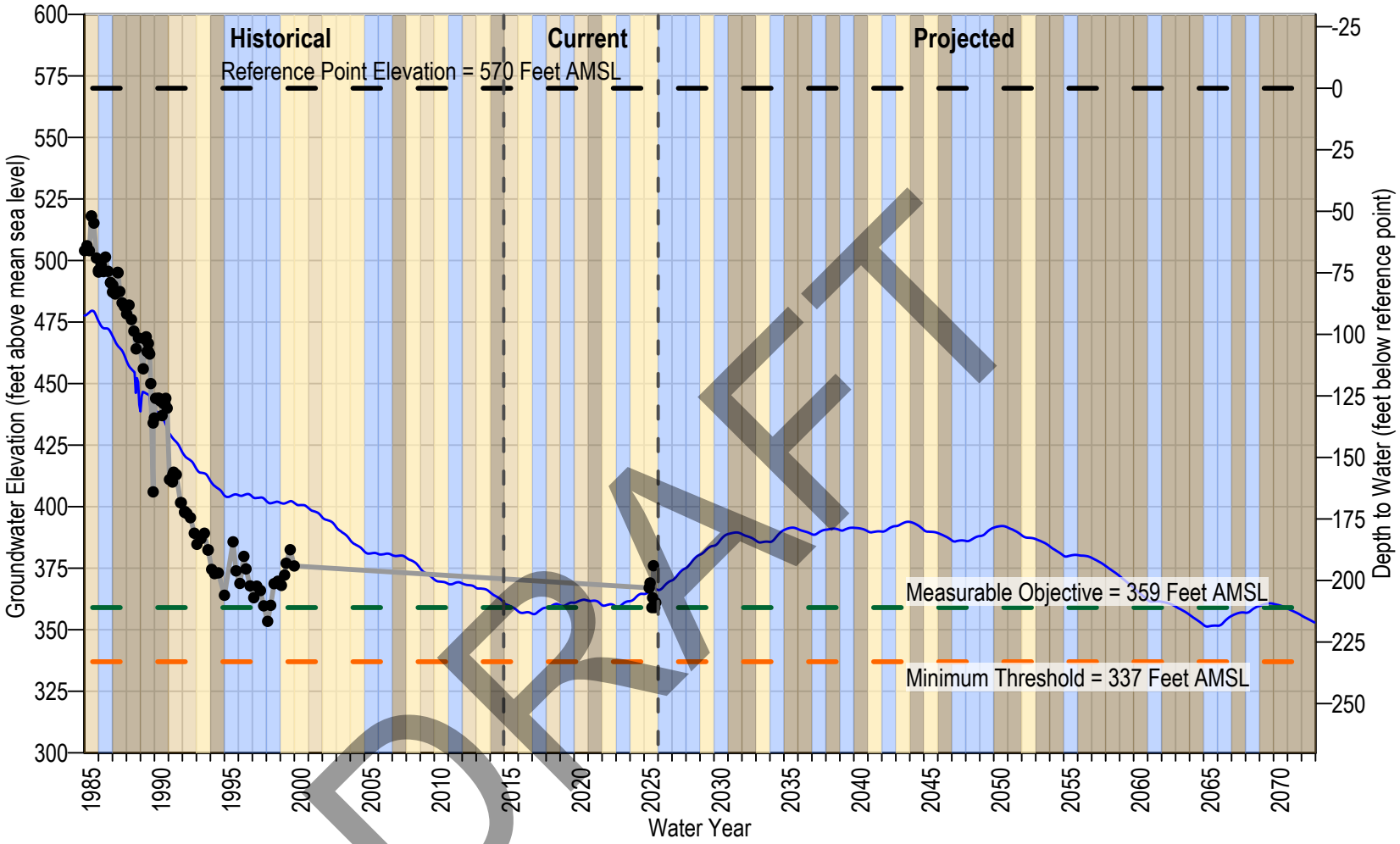
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-14. Simulated Hydrograph of SVWD #9

MONTGOMERY & ASSOCIATES

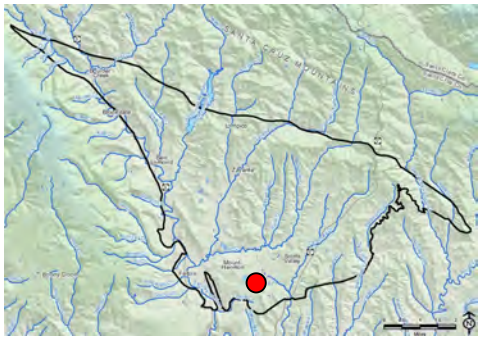


DRAFT

SLVWD Pasatiempo #3 (Estrella)
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 570 ft AMSL
Screen Interval: 23-147, 169-260 ft bgs

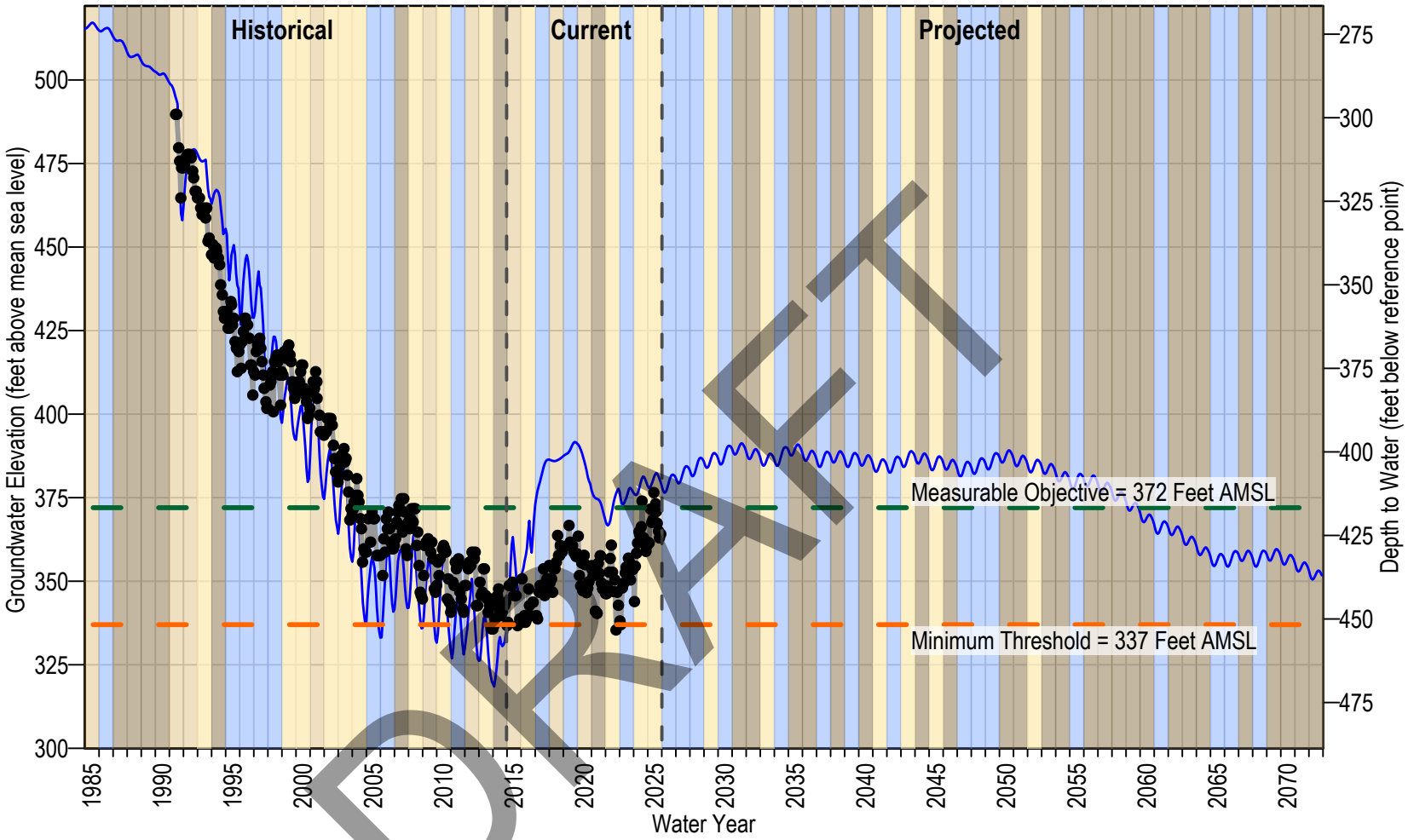
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-15. Simulated Hydrograph of SLVWD Pasatiempo #3 (Estrella)

MONTGOMERY & ASSOCIATES

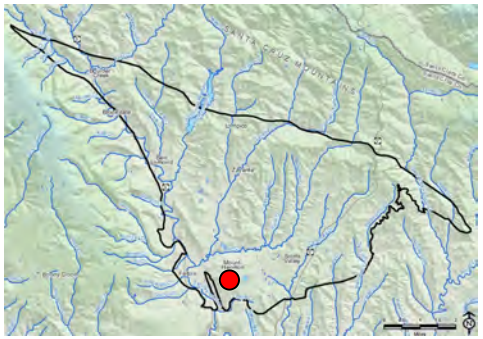


DRAFT

SLVWD Pasatiempo MW-1
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 788.7 ft AMSL
Screen Interval: 599-659 ft bgs

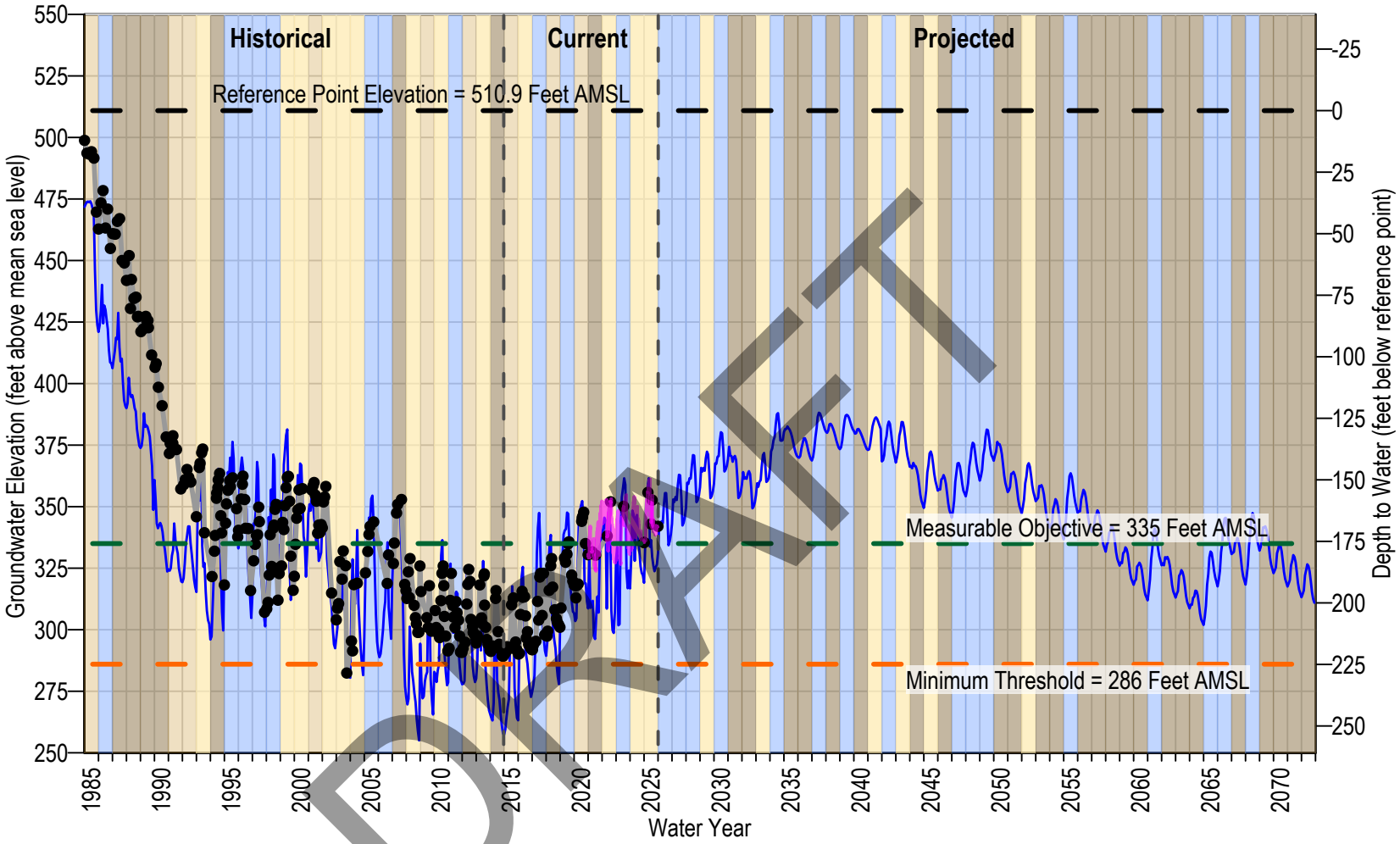
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-16. Simulated Hydrograph of SLVWD Pasatiempo MW-1

MONTGOMERY & ASSOCIATES



DRAFT

- SVWD #10
- Transducer
- Simulated
- Reference Point Elevation
- Minimum Threshold
- Measurable Objective

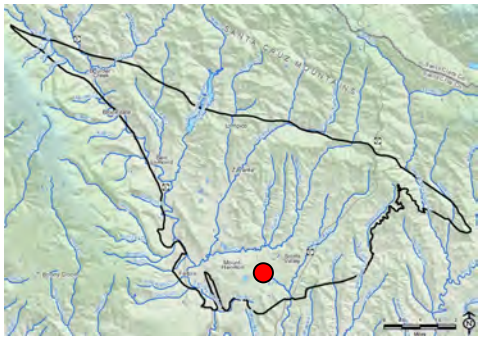
Formation: Confined - Lompico

Reference Point Elevation: 510.9 ft AMSL

Screen Interval: 190-220, 240-270, 325-355 ft bgs

Water Year Classification

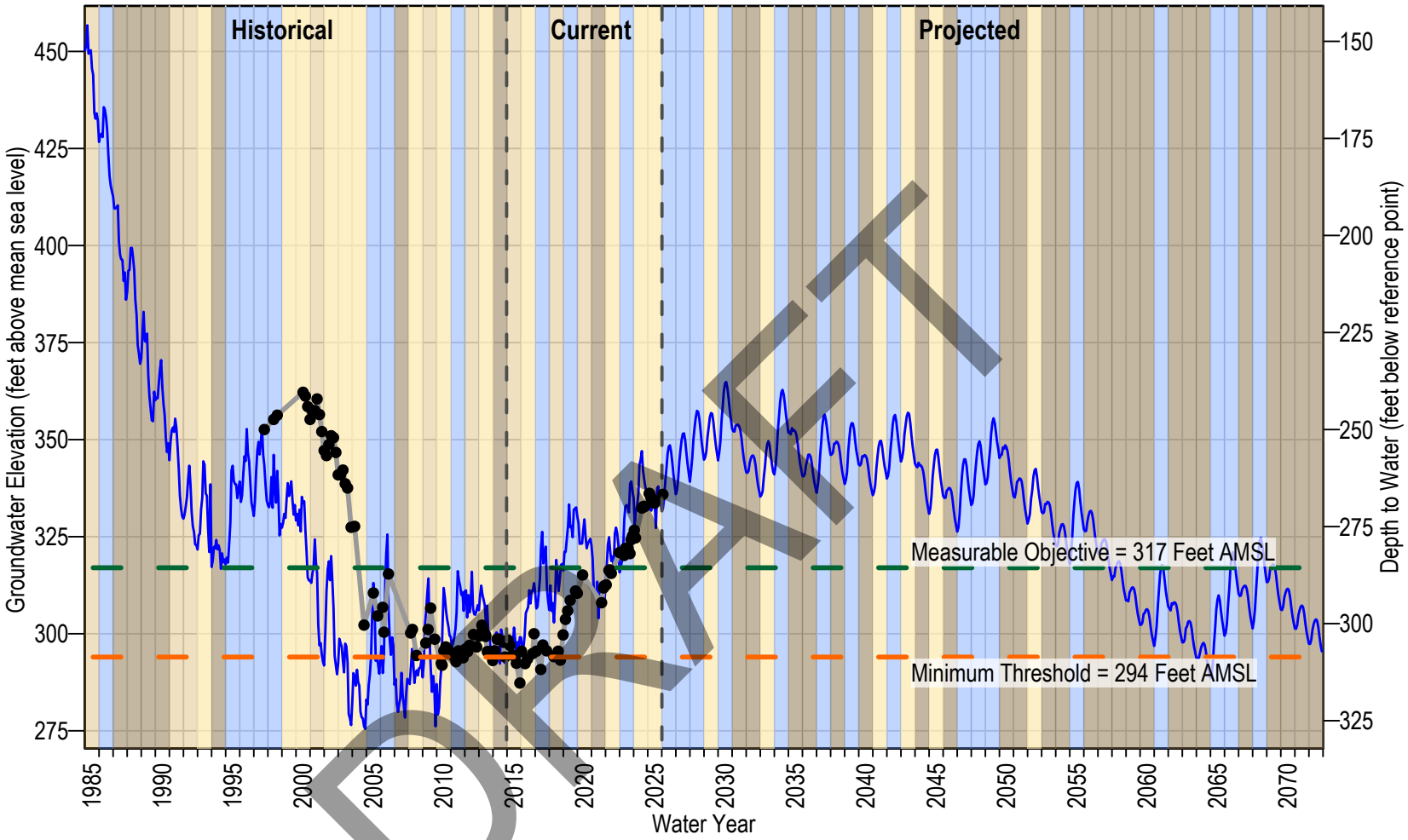
- Wet
- Dry
- Normal
- Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-17. Simulated Hydrograph of SVWD #10

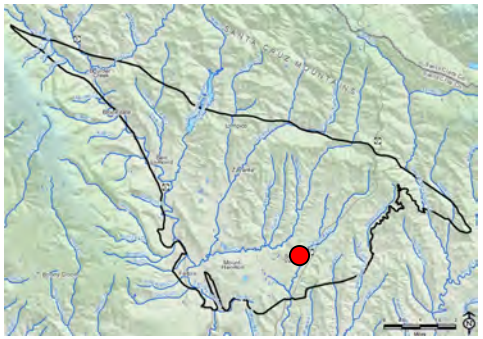
MONTGOMERY & ASSOCIATES



SVWD #11A
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 602.6 ft AMSL
Screen Interval: 399-419, 459-469, 495-515 ft bgs

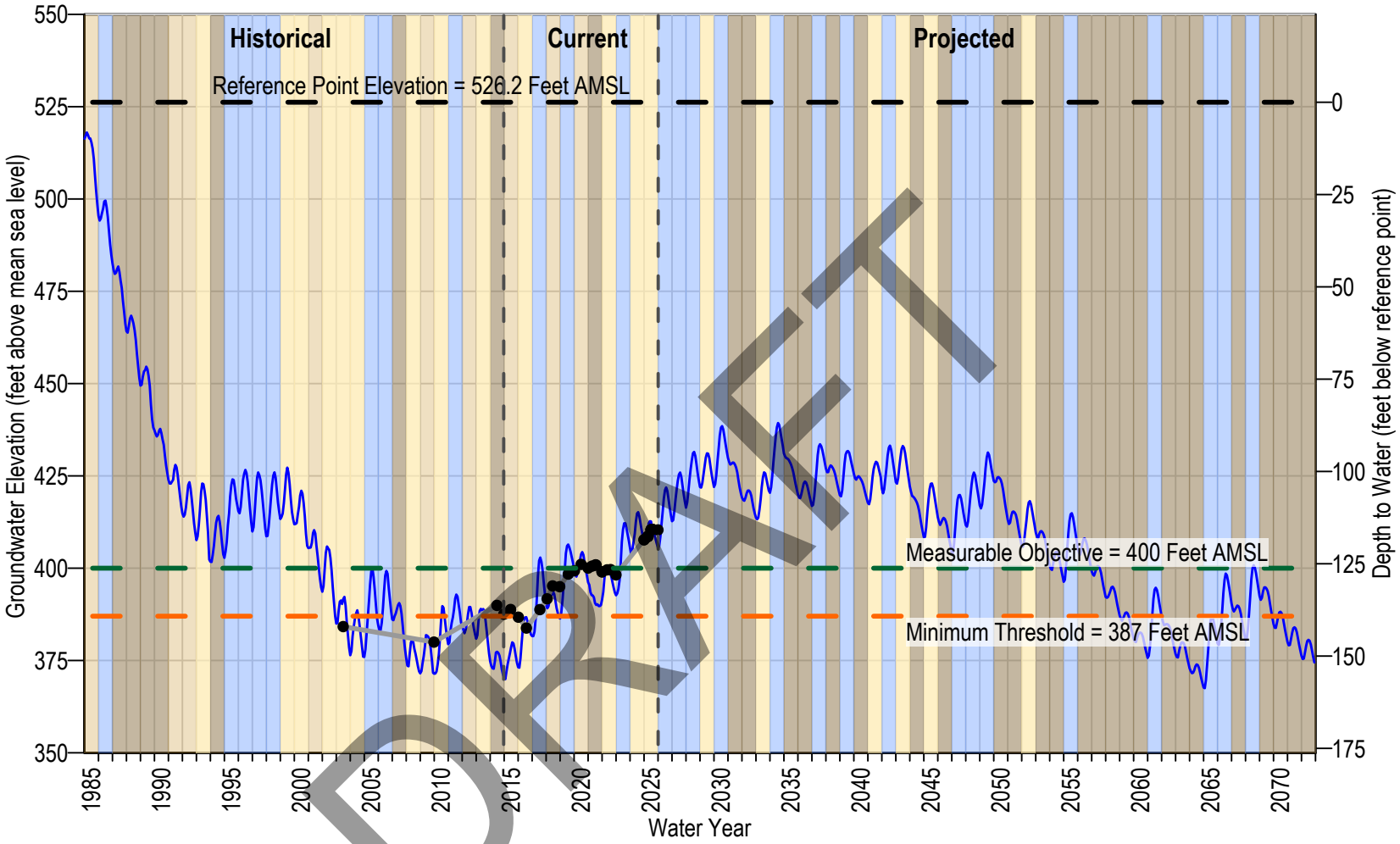
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-18. Simulated Hydrograph of SVWD #11A

MONTGOMERY & ASSOCIATES

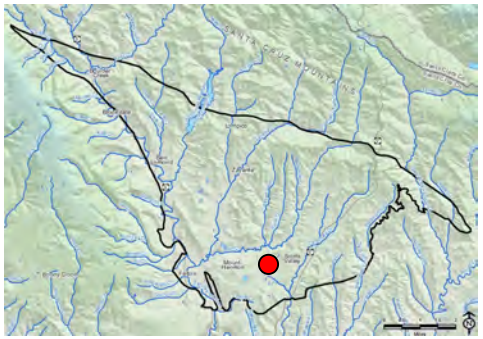


DRAFT

SVWD AB303 MW-2
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 526.2 ft AMSL
Screen Interval: 705-715, 810-850 ft bgs

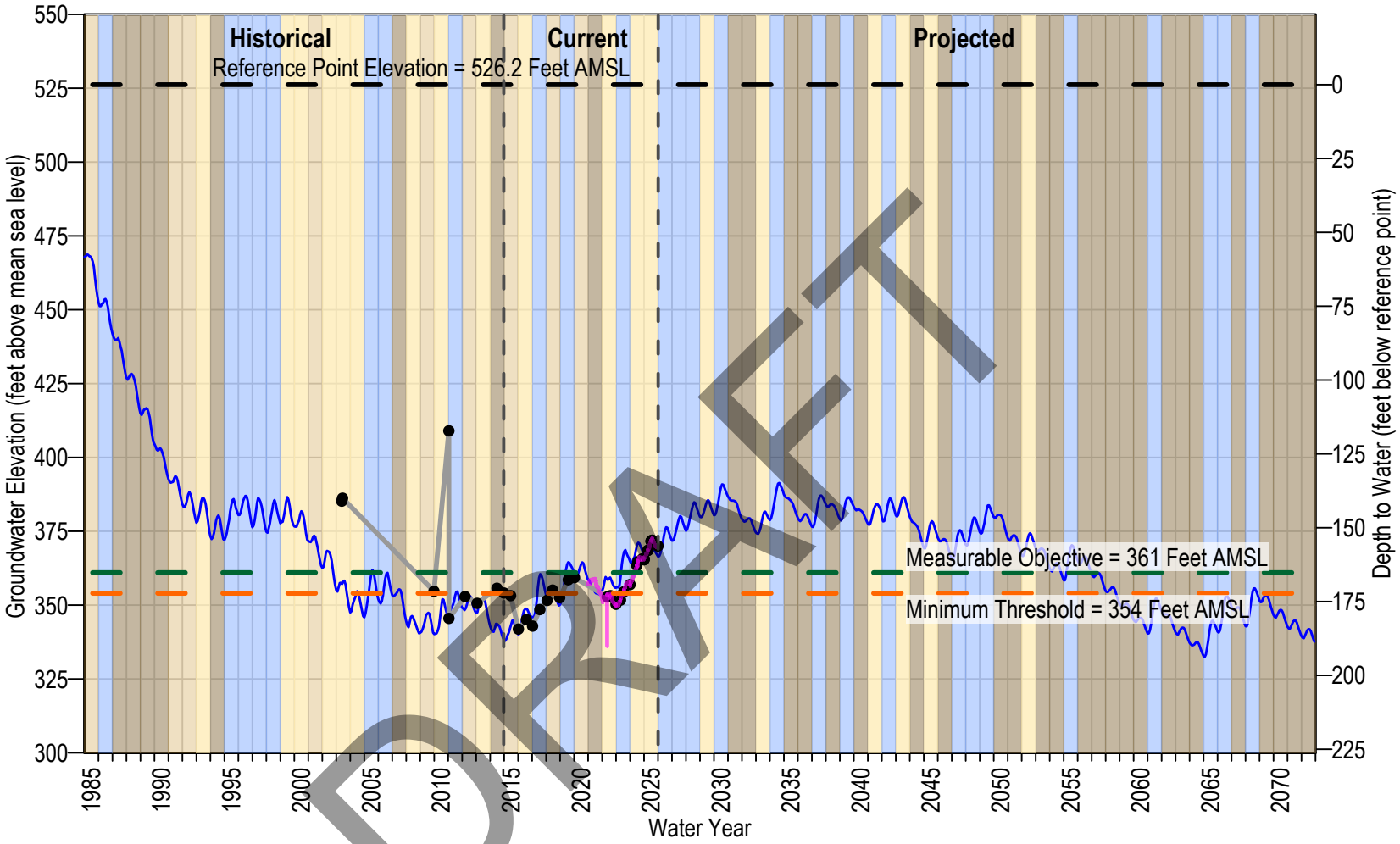
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-19. Simulated Hydrograph of SVWD AB303 MW-2

MONTGOMERY & ASSOCIATES

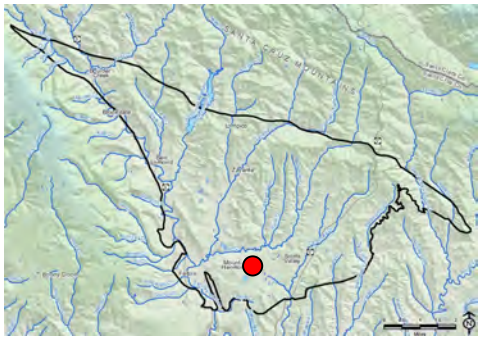


DRAFT

SVWD AB303 MW-3A
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 526.2 ft AMSL
Screen Interval: 630-680 ft bgs

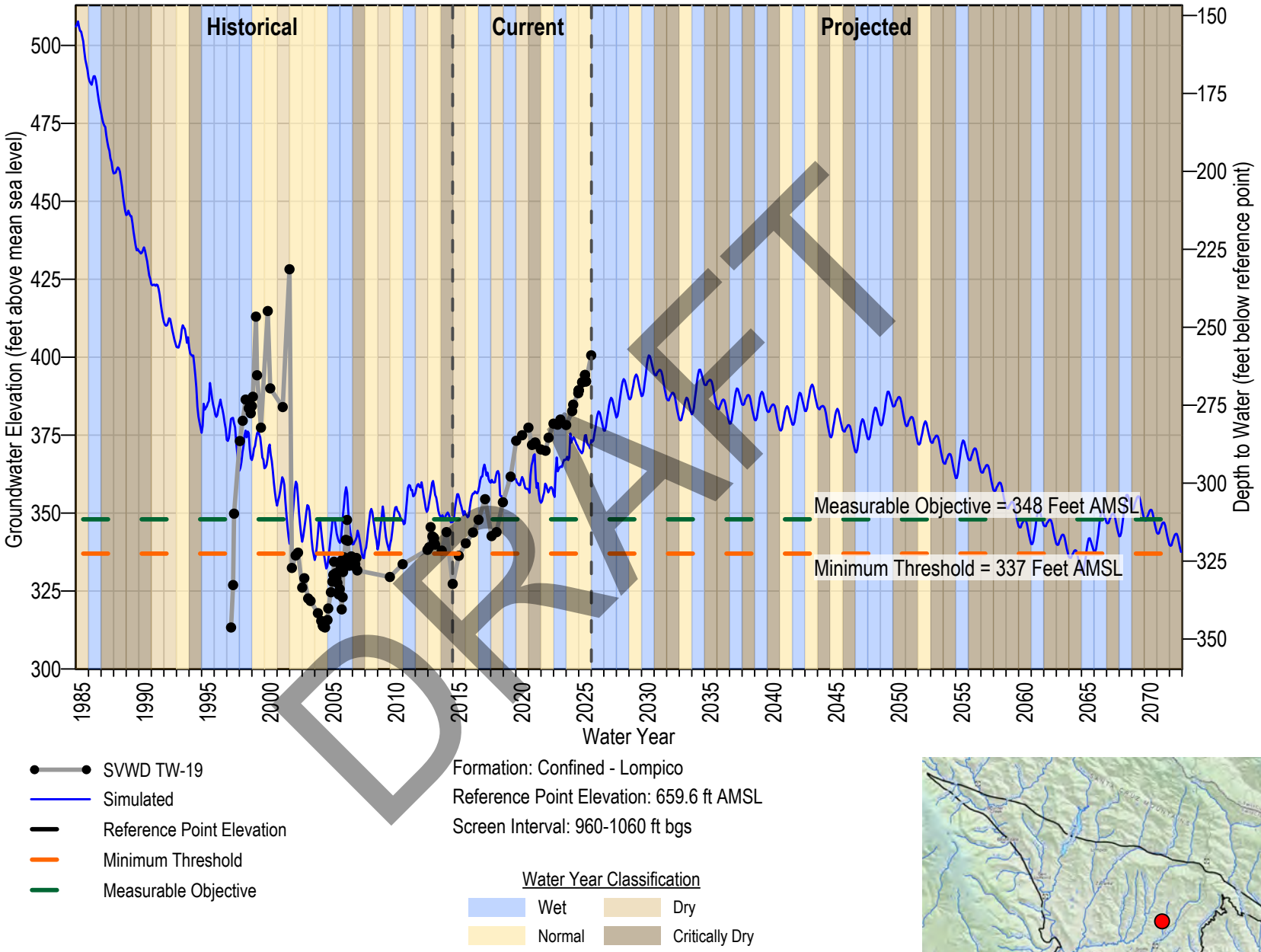
Water Year Classification
Wet
Dry
Normal
Critically Dry

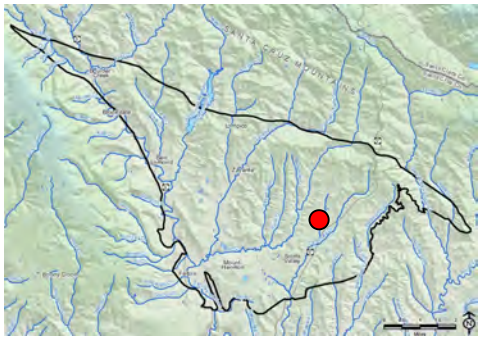


Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-20. Simulated Hydrograph of SVWD AB303 MW-3A

MONTGOMERY & ASSOCIATES

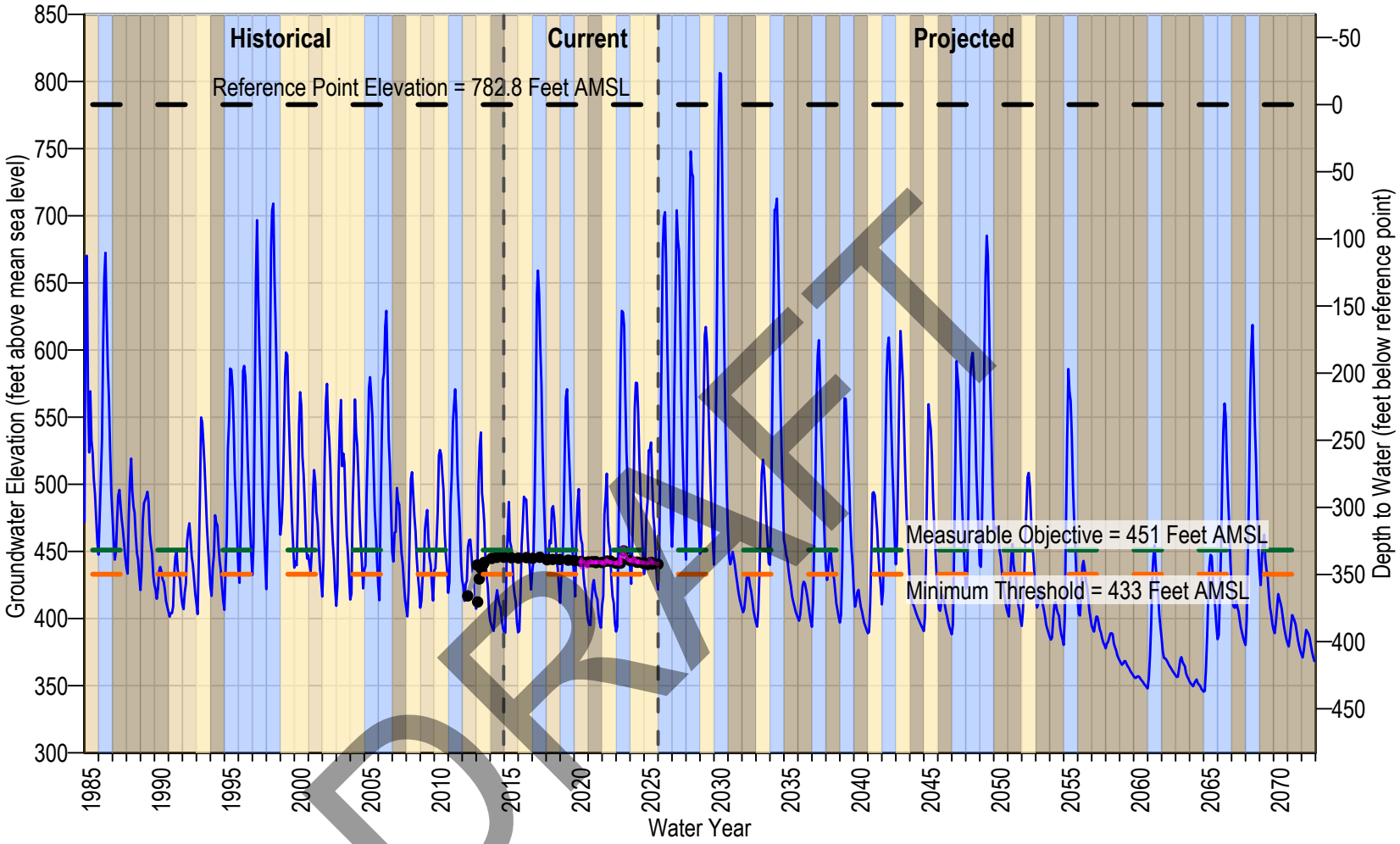




Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-21. Simulated Hydrograph of SVWD TW-19

MONTGOMERY & ASSOCIATES

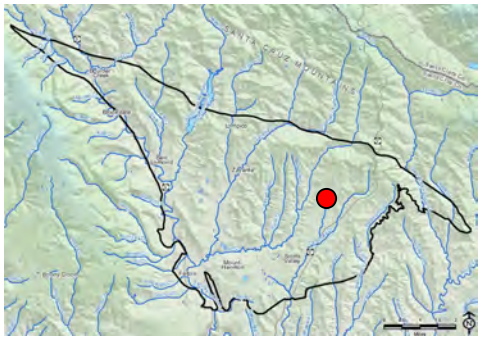


DRAFT

SVWD Canham Well
Transducer
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Butano
Reference Point Elevation: 782.8 ft AMSL
Screen Interval: 1,281-1,381 ft bgs

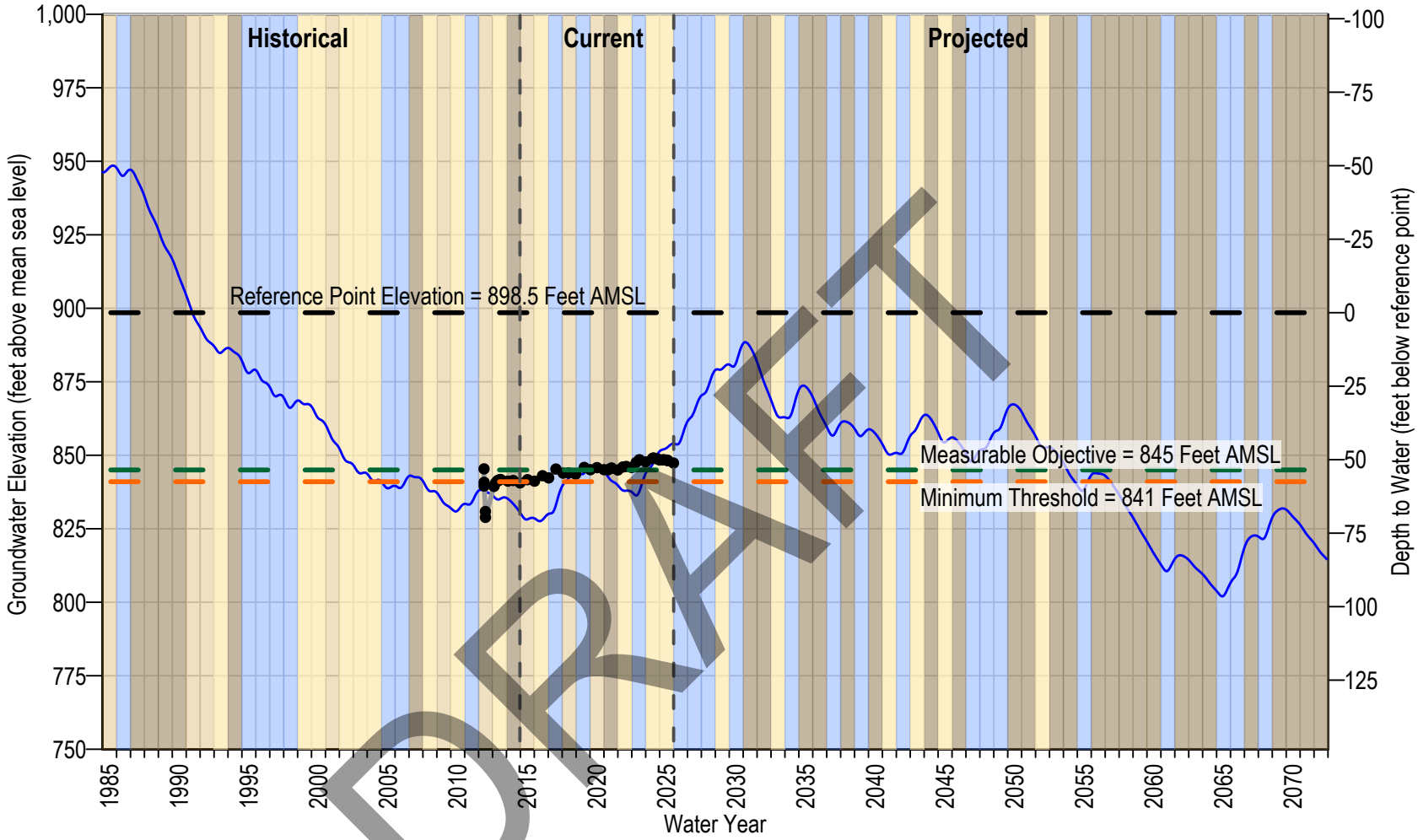
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-22. Simulated Hydrograph of SVWD Canham Well

MONTGOMERY & ASSOCIATES

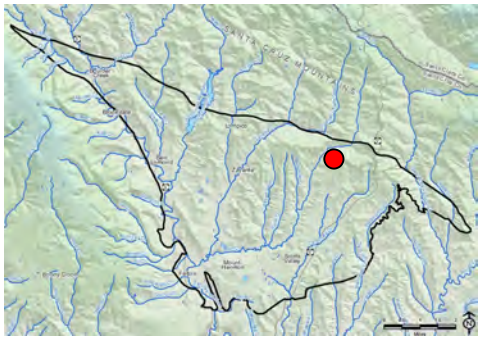


DRAFT

SVWD Stonewood Well
Simulated
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Butano
Reference Point Elevation: 898.5 ft AMSL
Screen Interval: 799-859 ft bgs

Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 5B-23. Simulated Hydrograph of SVWD Stonewood Well

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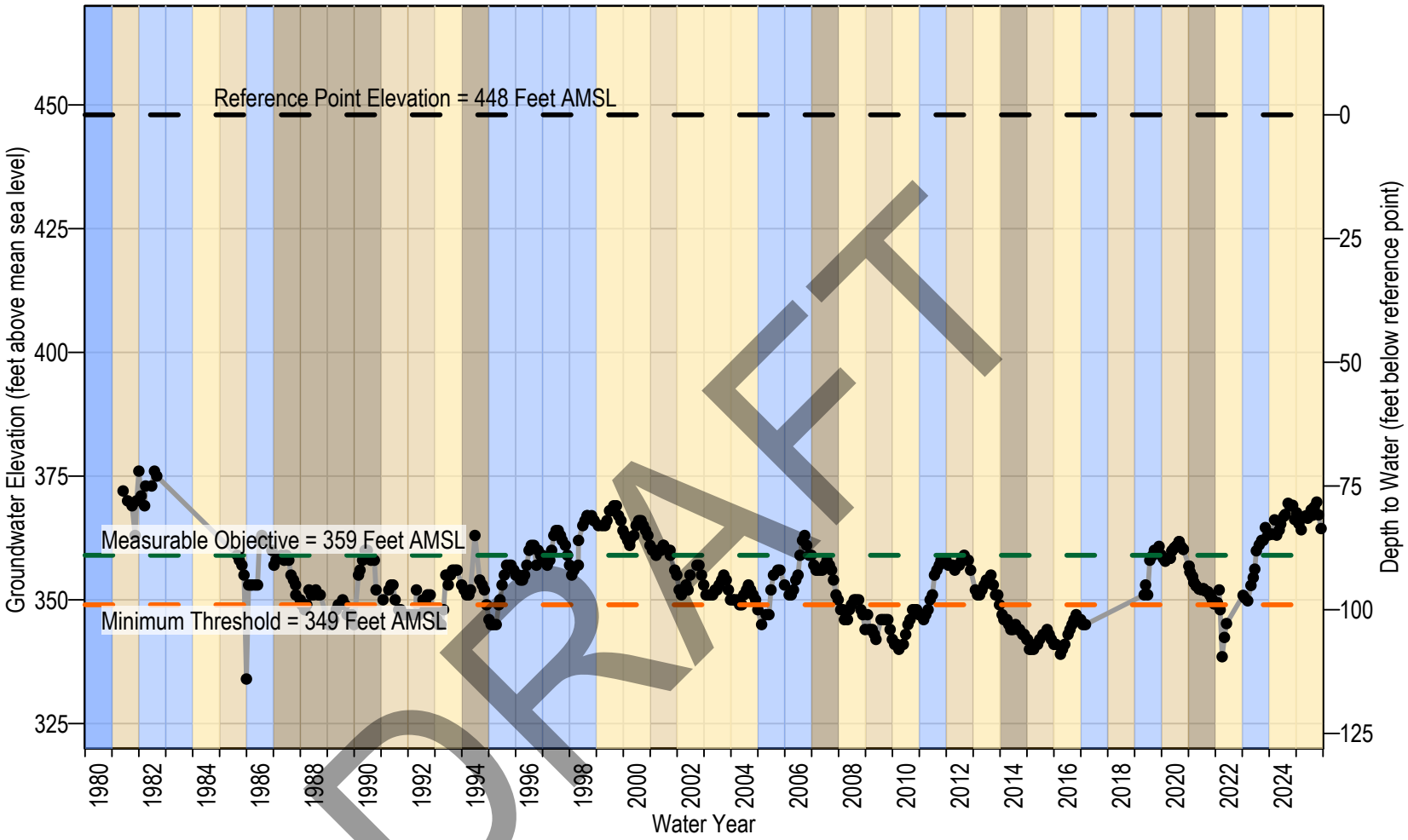
Appendix 7A

Representative Monitoring Point Hydrographs with Sustainable Management Criteria

DRAFT

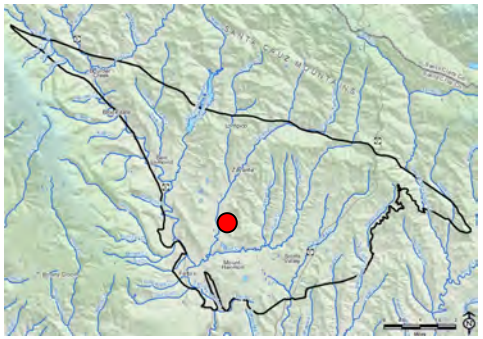


DRAFT

SLVWD Olympia #1 (Ferrari)
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 448 ft AMSL
Screen Interval: 127-157 ft bgs

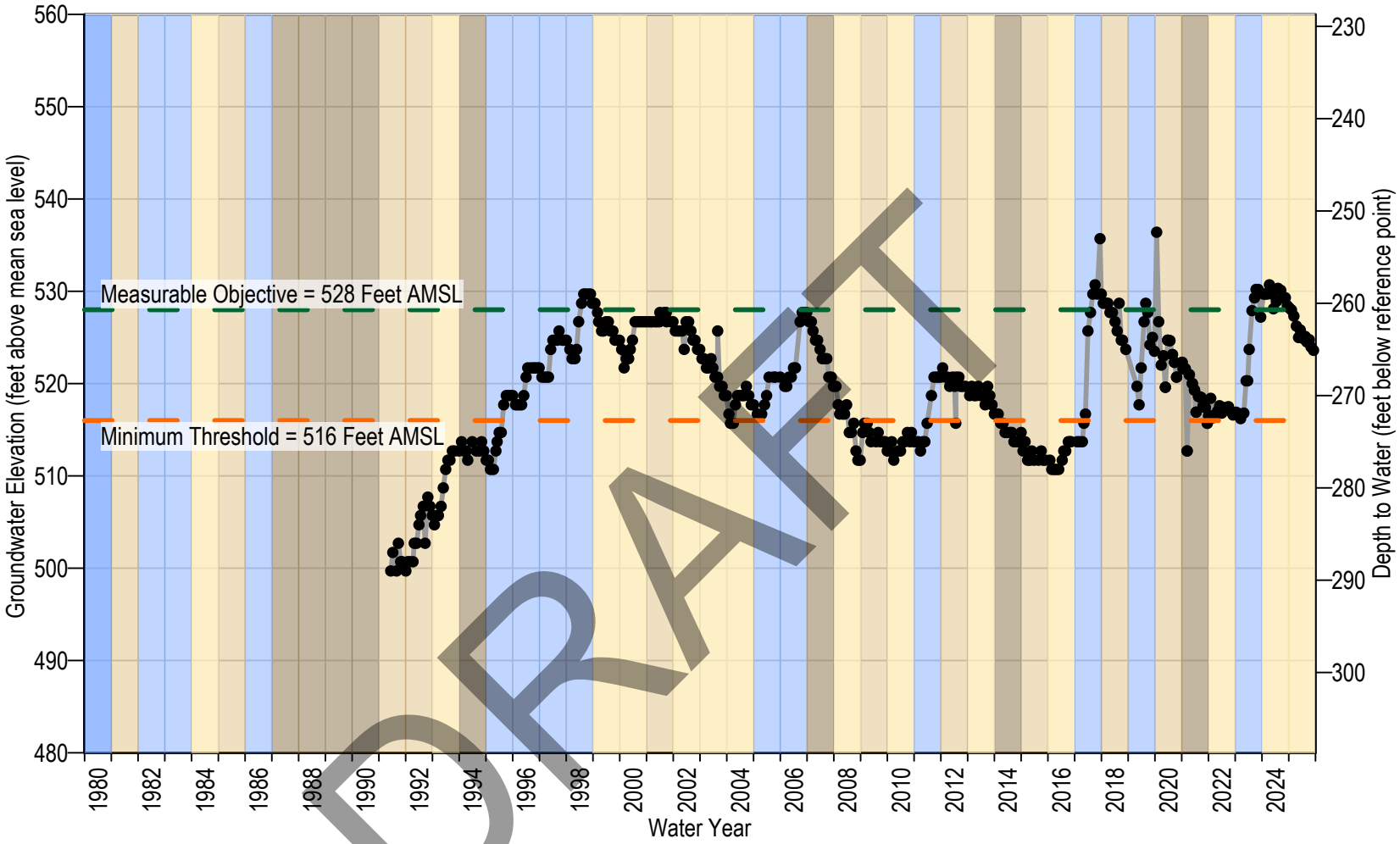
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-1. Hydrograph of SLVWD Olympia #1 (Ferrari)

MONTGOMERY & ASSOCIATES

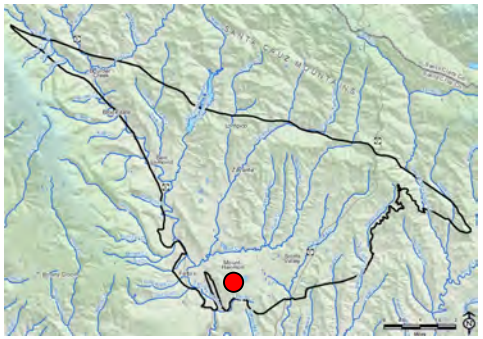


DRAFT

SLVWD Pasatiempo MW-2
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 788.7 ft AMSL
Screen Interval: 254-294 ft bgs

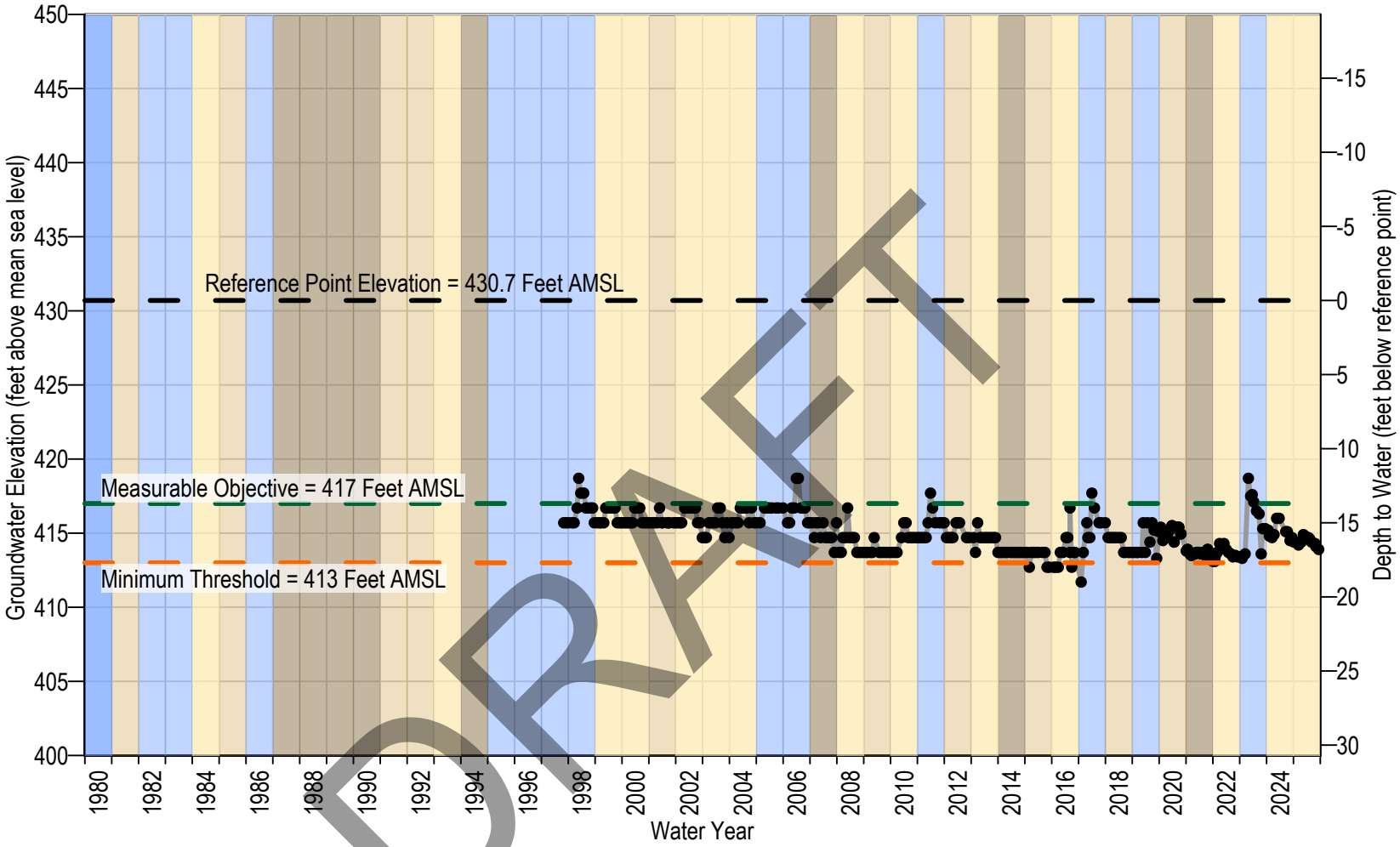
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-2. Hydrograph of SLVWD Pasatiempo MW-2

MONTGOMERY & ASSOCIATES

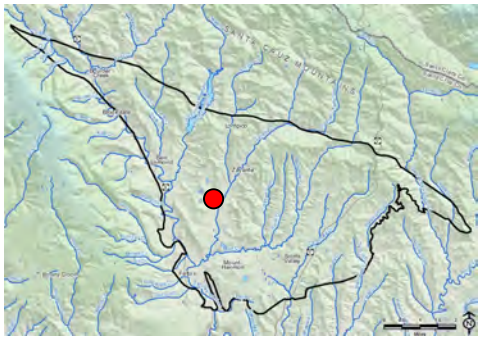


DRAFT

SLVWD Quail MW-A
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 430.7 ft AMSL
Screen Interval: 33-88 ft bgs

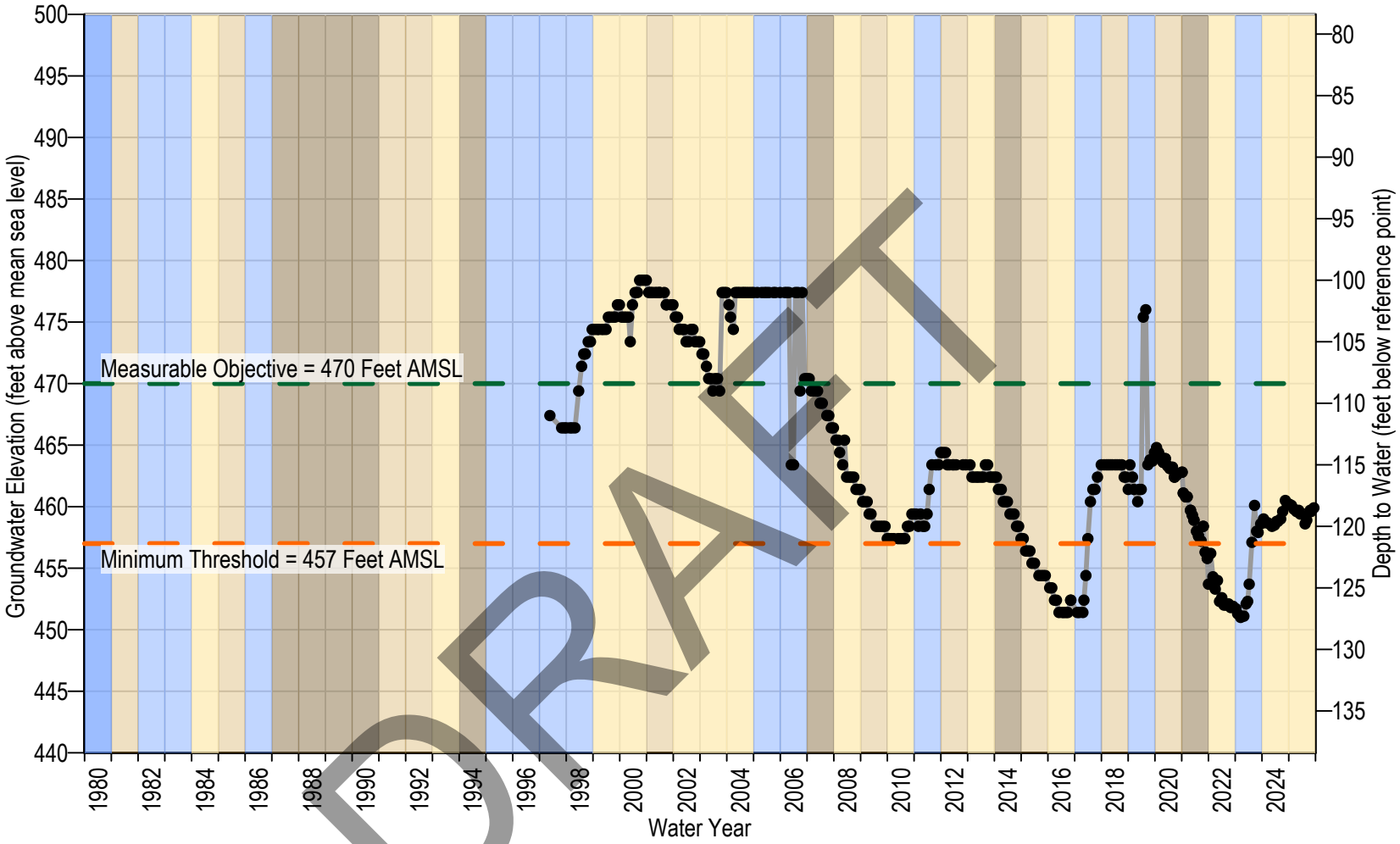
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-3. Hydrograph of SLVWD Quail MW-A

MONTGOMERY & ASSOCIATES

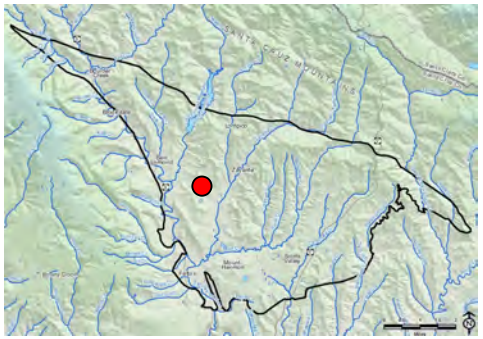


DRAFT

SLVWD Quail MW-B
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 578.4 ft AMSL
Screen Interval: 95-195 ft bgs

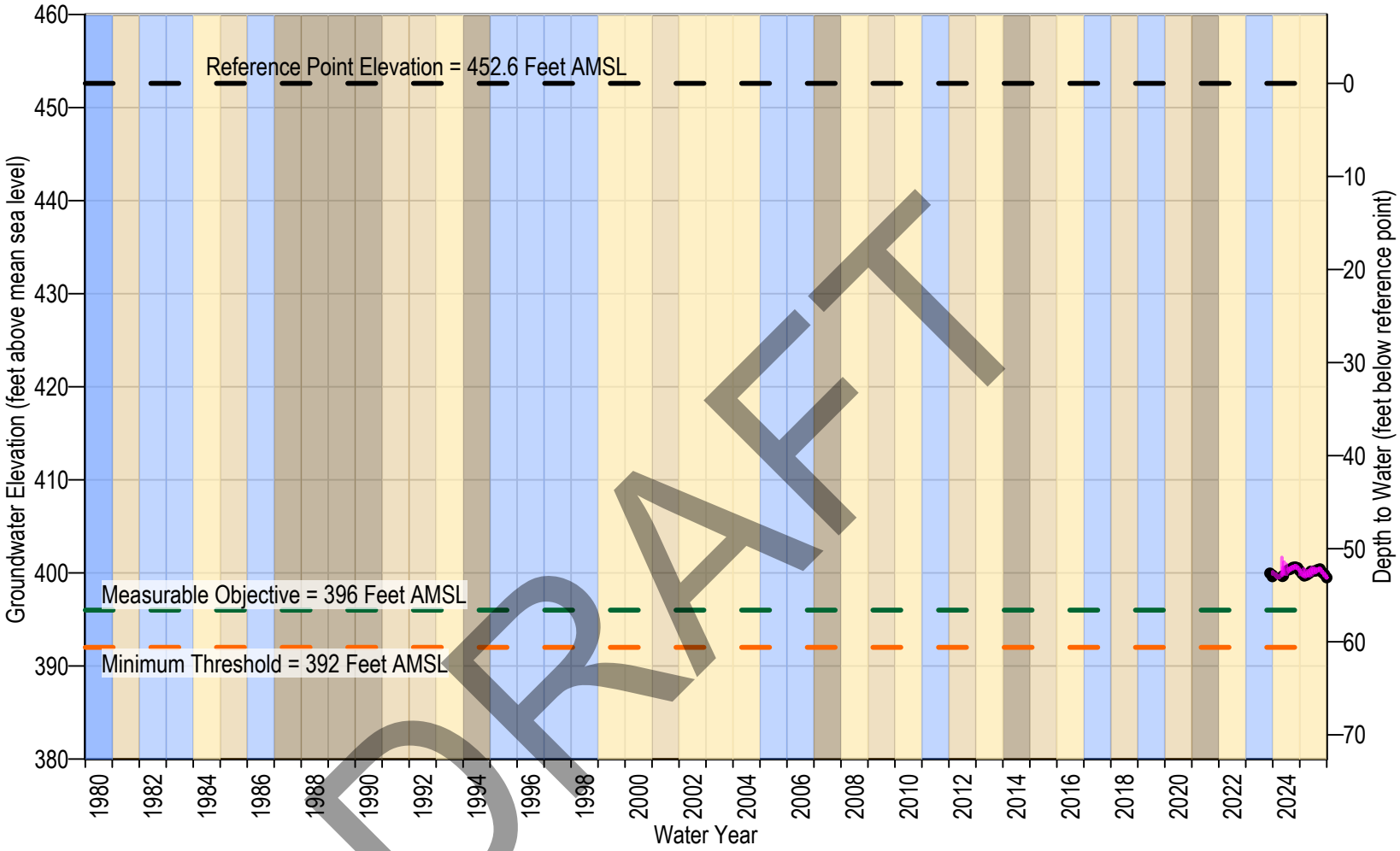
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-4. Hydrograph of SLVWD Quail MW-B

MONTGOMERY & ASSOCIATES

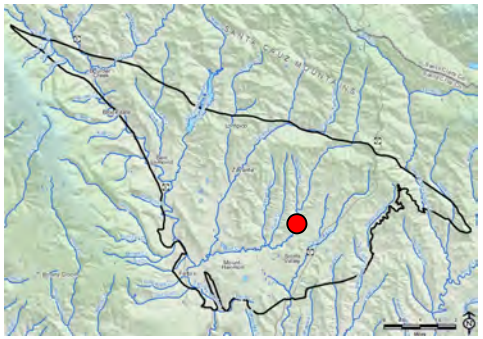


DRAFT

SMGWA-2 Bean Creek
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 452.6 ft AMSL
Screen Interval: 53-68 ft bgs

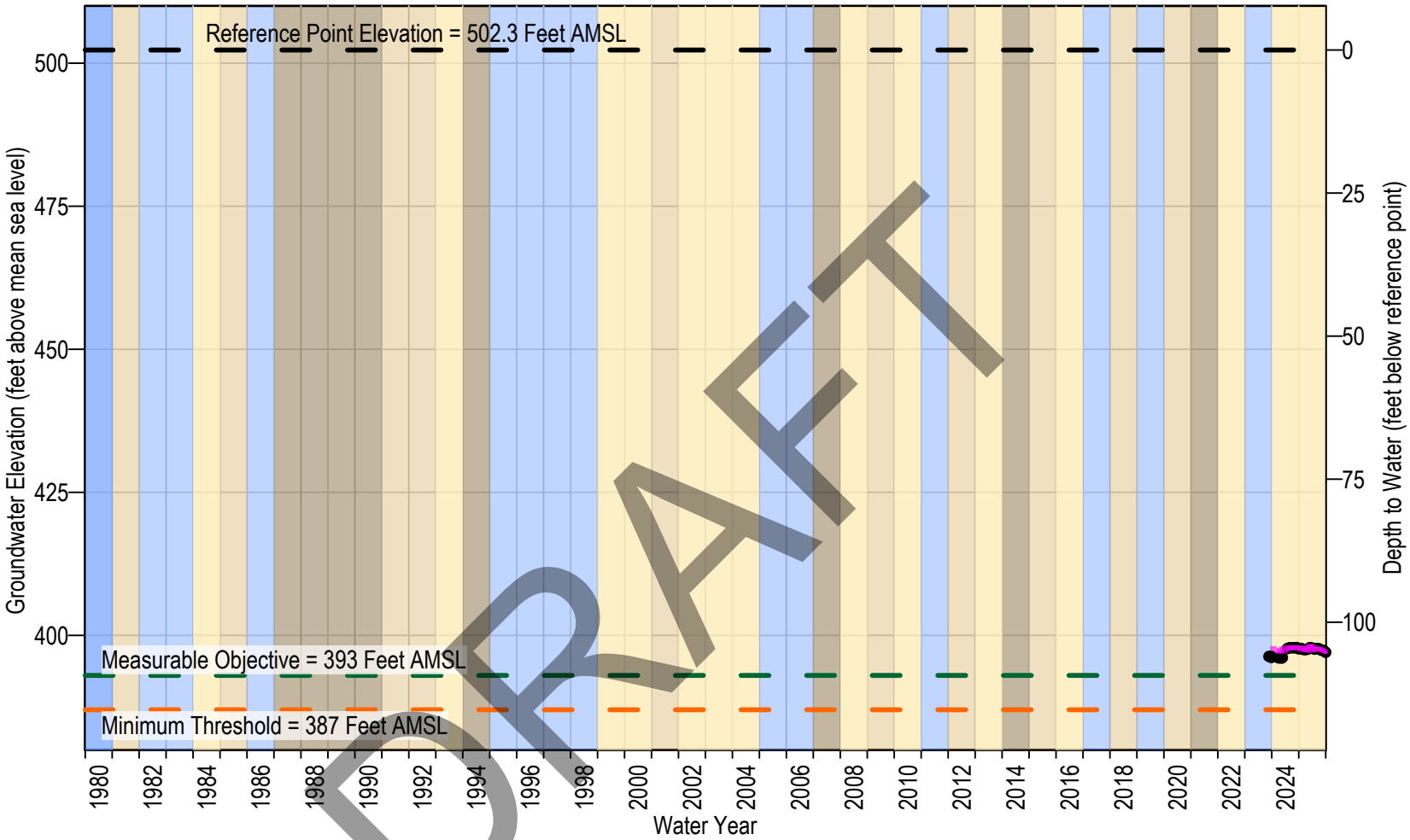
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-5. Hydrograph of SMGWA-2 Bean Creek

MONTGOMERY & ASSOCIATES

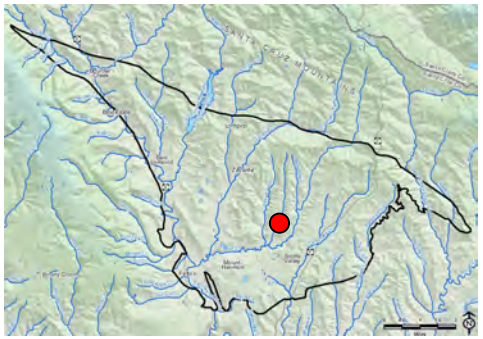


DRAFT

SMGWA-3 Ruins Creek
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 502.3 ft AMSL
Screen Interval: 145-160 ft bgs

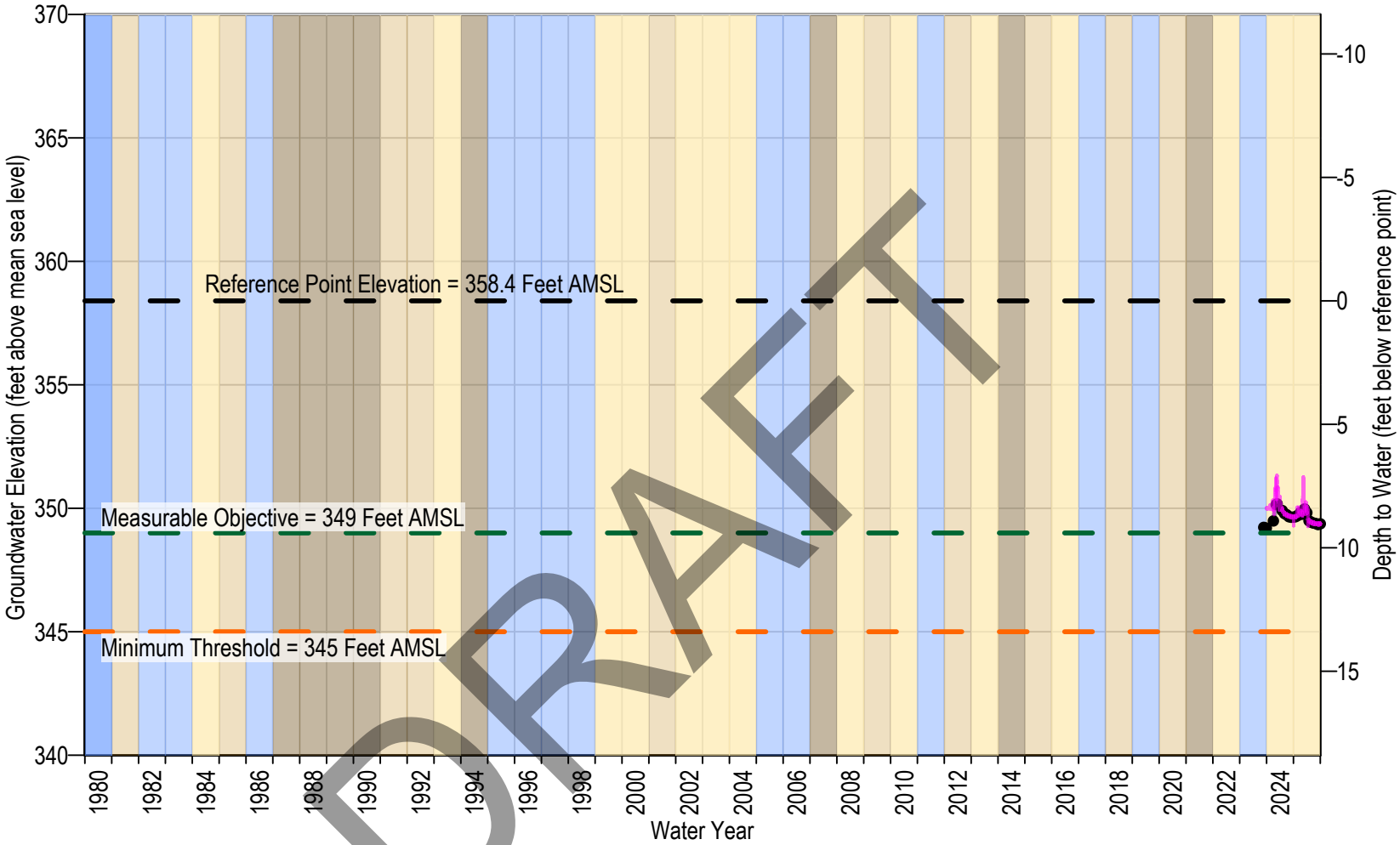
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-6. Hydrograph of SMGWA-3 Ruins Creek

MONTGOMERY & ASSOCIATES

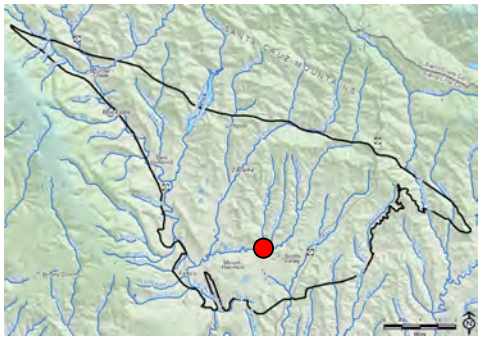


DRAFT

SMGWA-4 Nelson Road
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 358.4 ft AMSL
Screen Interval: 54-69 ft bgs

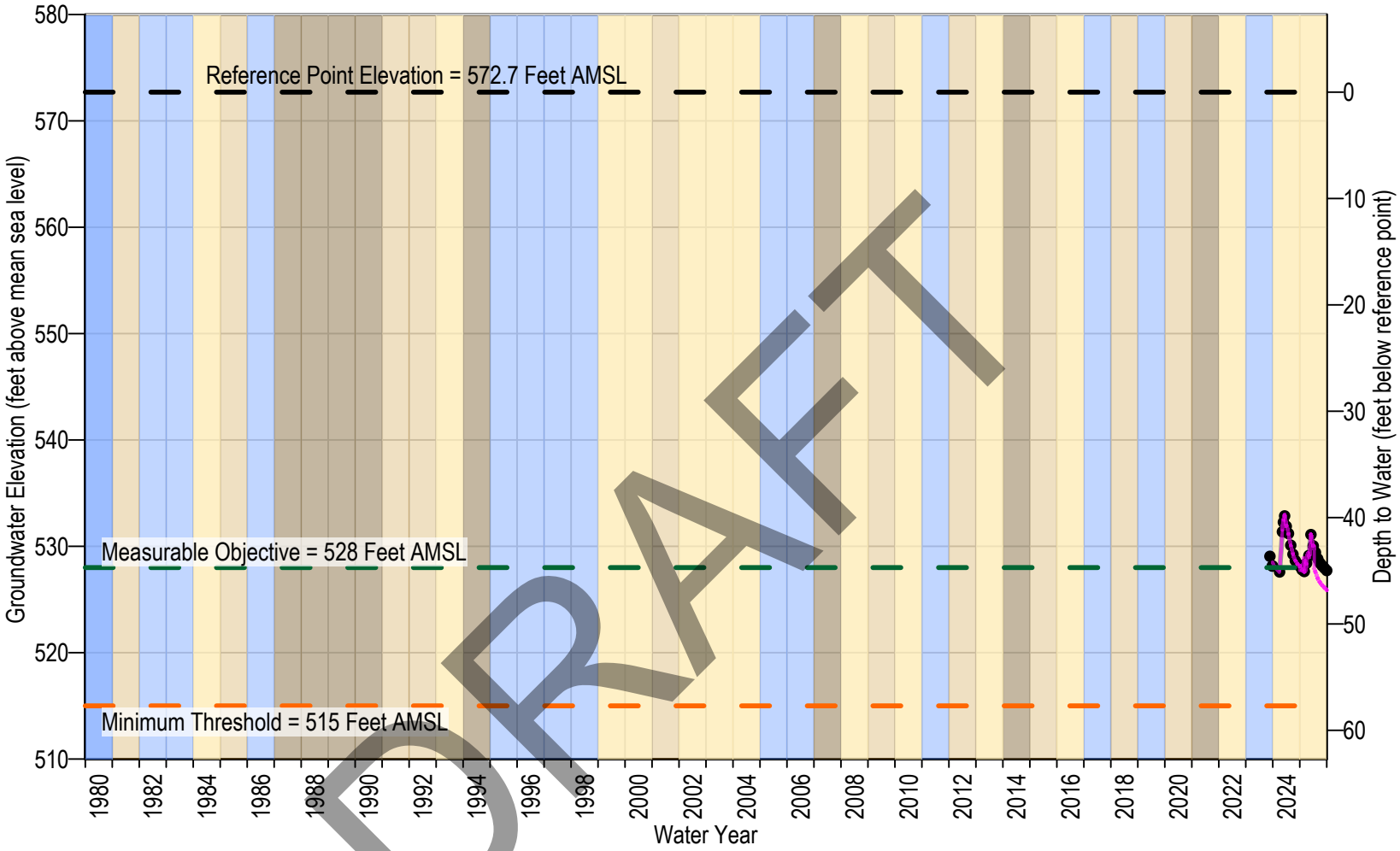
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-7. Hydrograph of SMGWA-4 Nelson Road

MONTGOMERY & ASSOCIATES

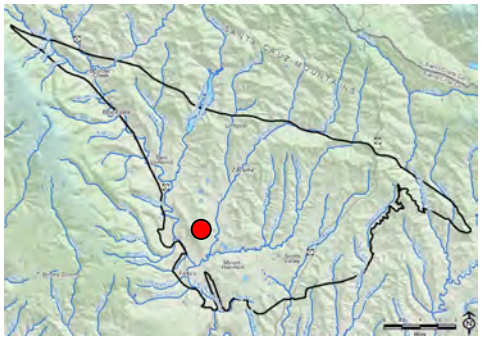


DRAFT

SMGWA-5 Bahr Drive
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 572.7 ft AMSL
Screen Interval: 40-55 ft bgs

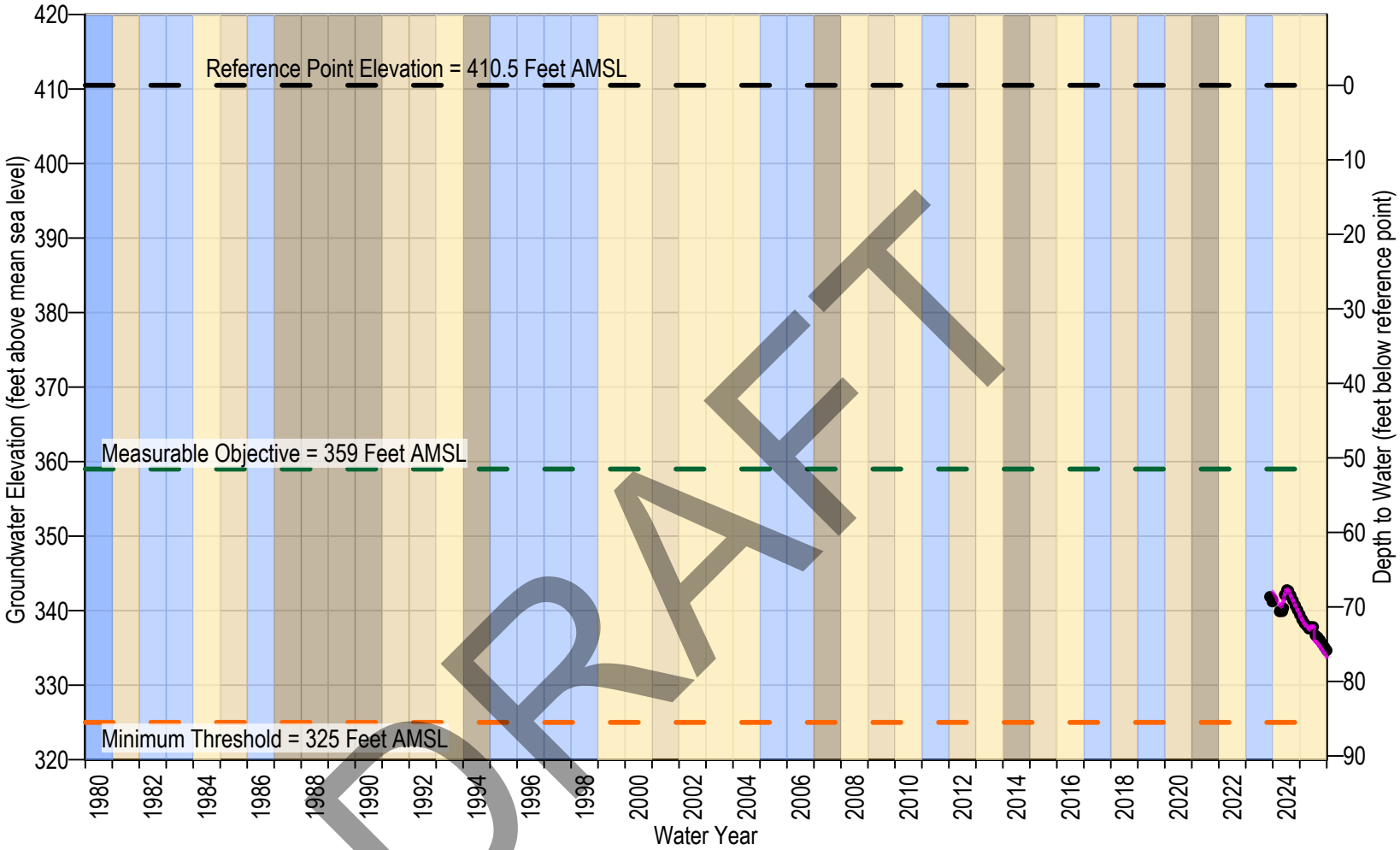
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-8. Hydrograph of SMGWA-5 Bahr Drive

MONTGOMERY & ASSOCIATES



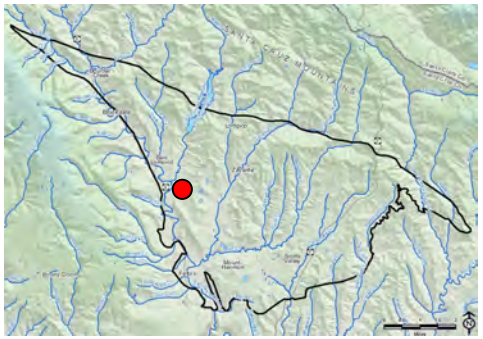
DRAFT

SMGWA-6 Quail Hollow
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 410.5 ft AMSL
Screen Interval: 115-130 ft bgs

Water Year Classification

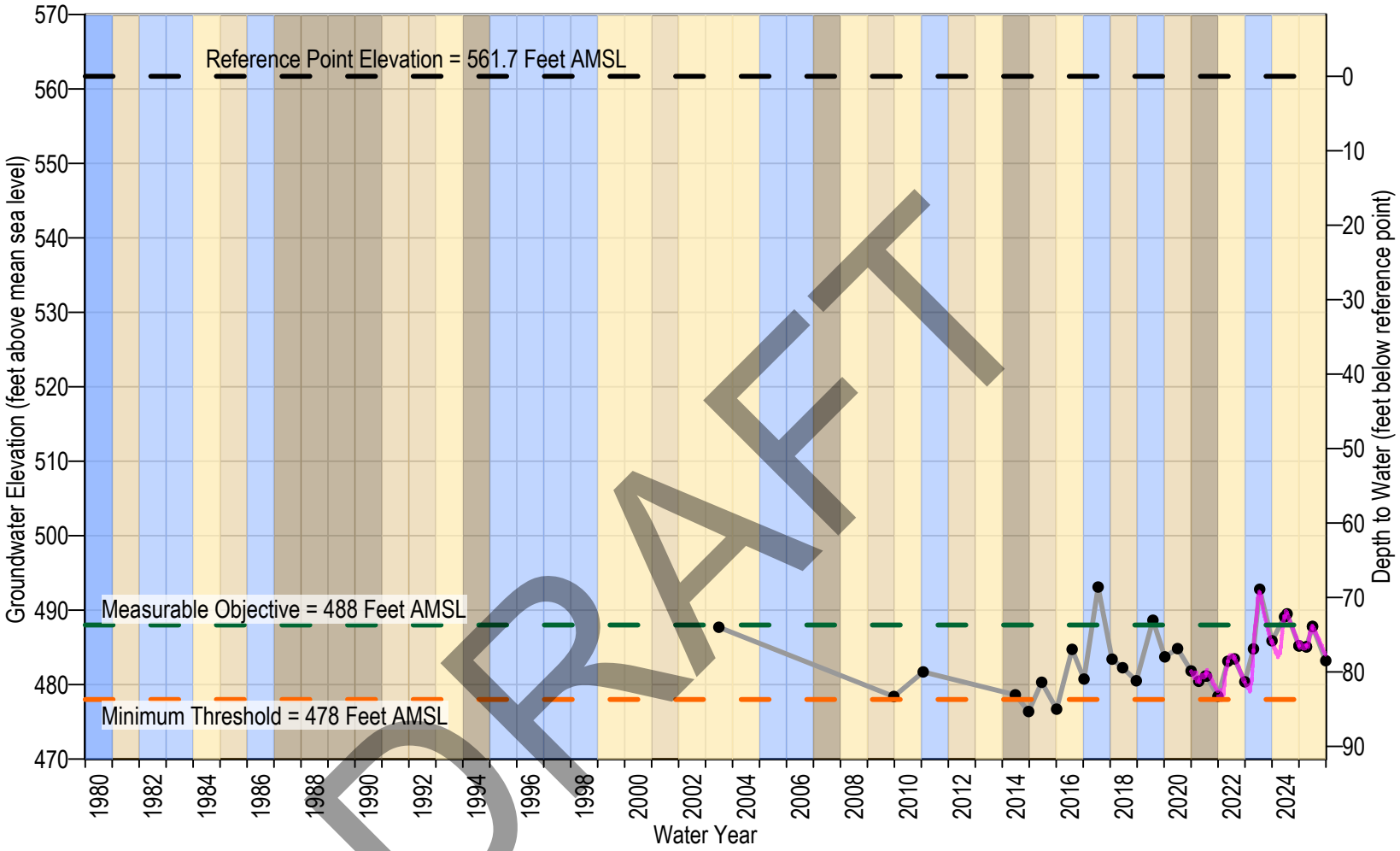
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-9. Hydrograph of SMGWA-6 Quail Hollow

MONTGOMERY & ASSOCIATES

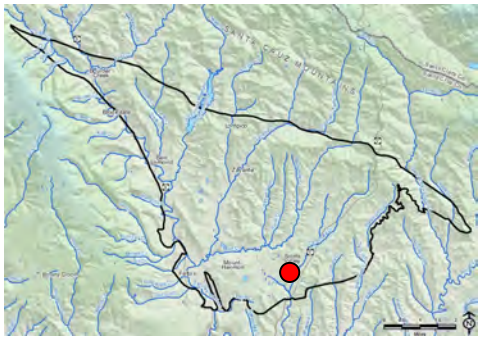


DRAFT

SVWD AB303 MW-1
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 561.7 ft AMSL
Screen Interval: 114-124 ft bgs

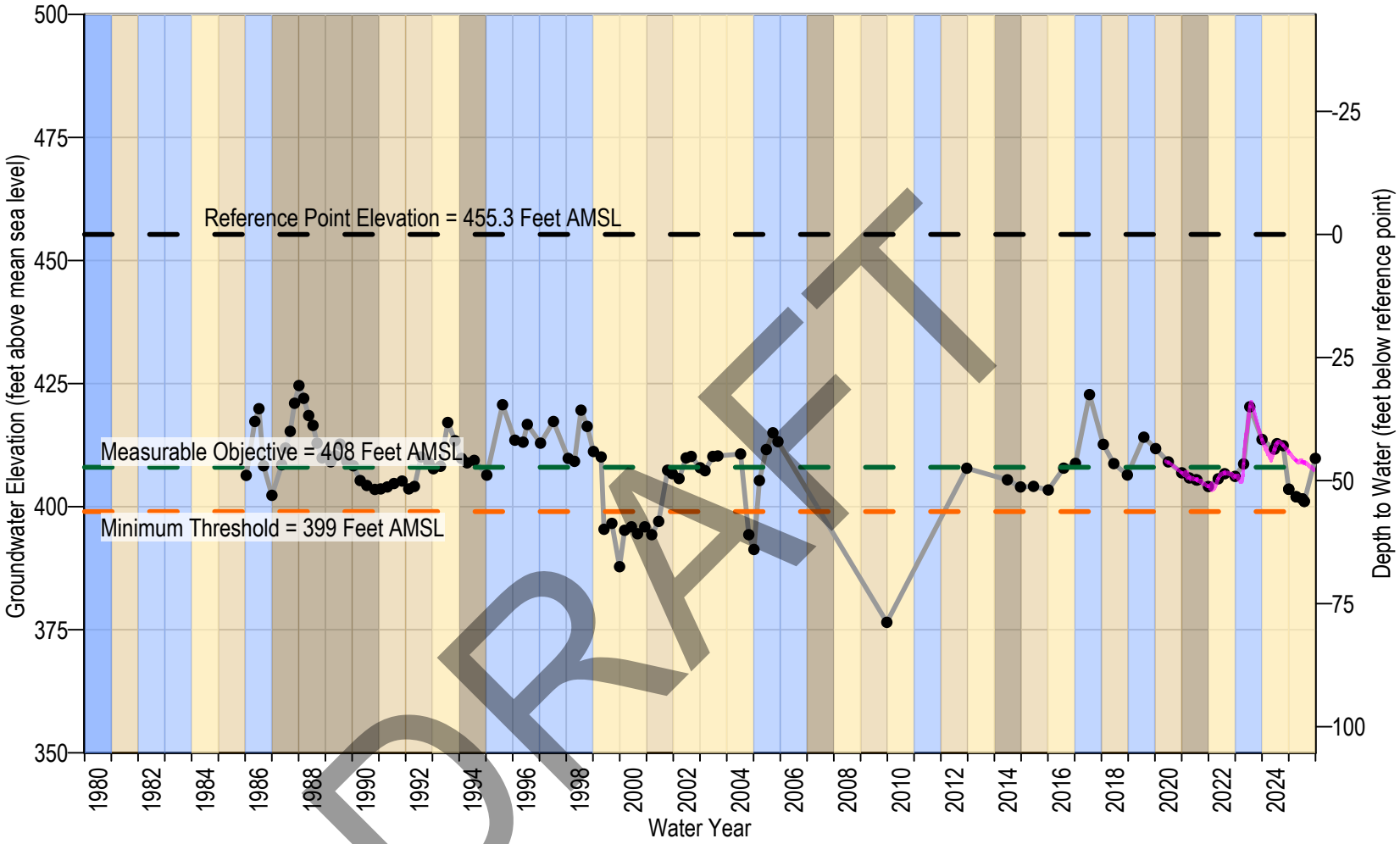
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-10. Hydrograph of SVWD AB303 MW-1

MONTGOMERY & ASSOCIATES

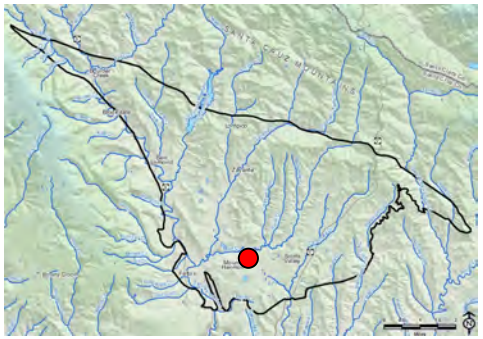


DRAFT

SVWD SV4-MW
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 455.3 ft AMSL
Screen Interval: 50-60 ft bgs

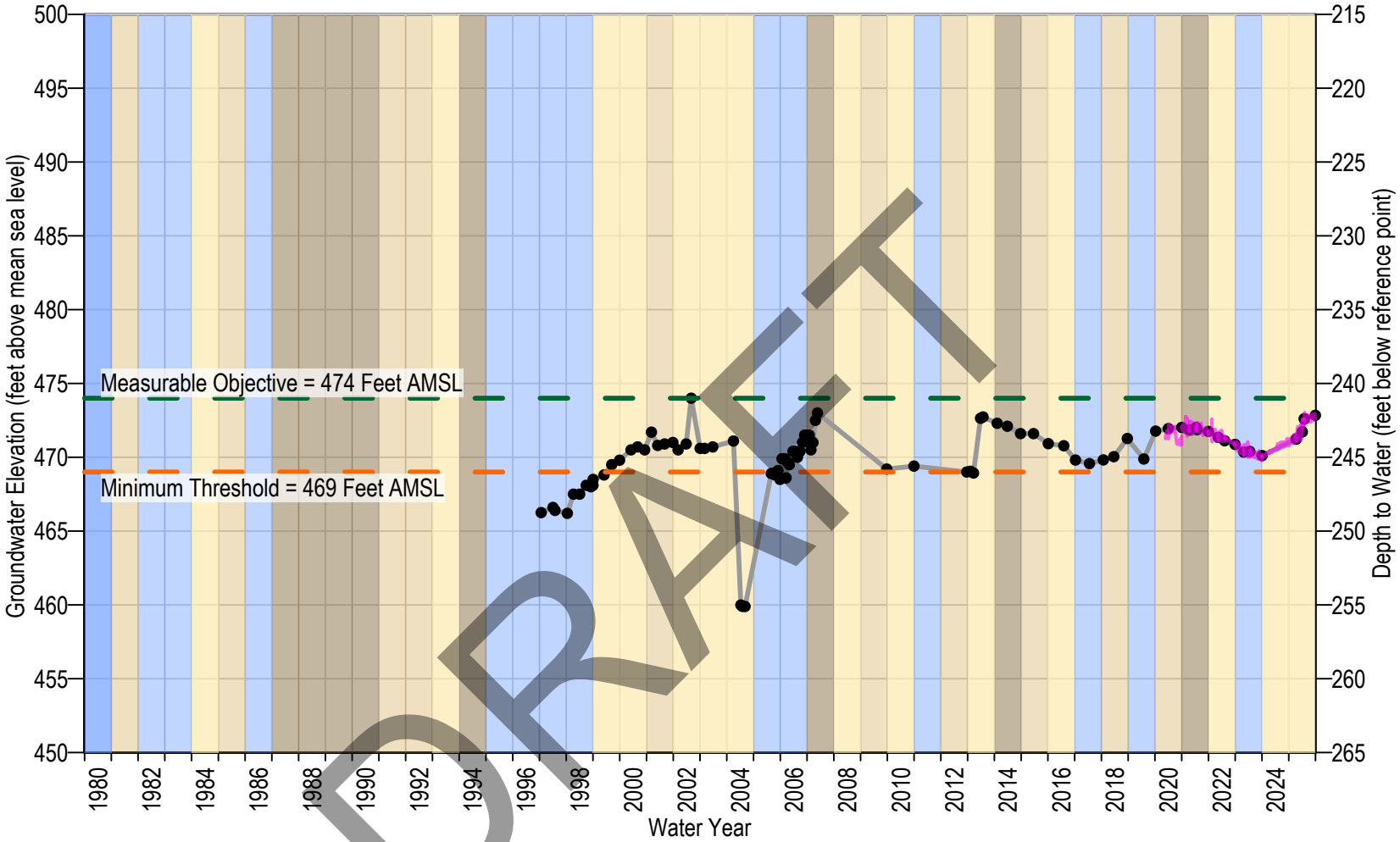
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-11. Hydrograph of SVWD SV4-MW

MONTGOMERY & ASSOCIATES

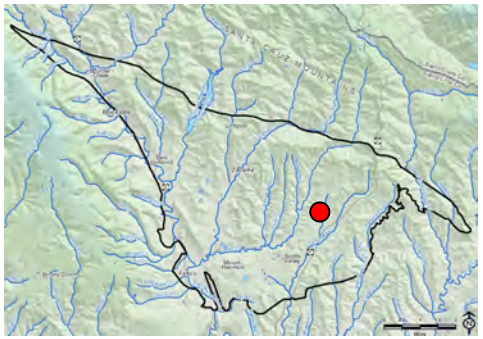


DRAFT

SVWD TW-18
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Unconfined - Santa Margarita
Reference Point Elevation: 715 ft AMSL
Screen Interval: 285-345 ft bgs

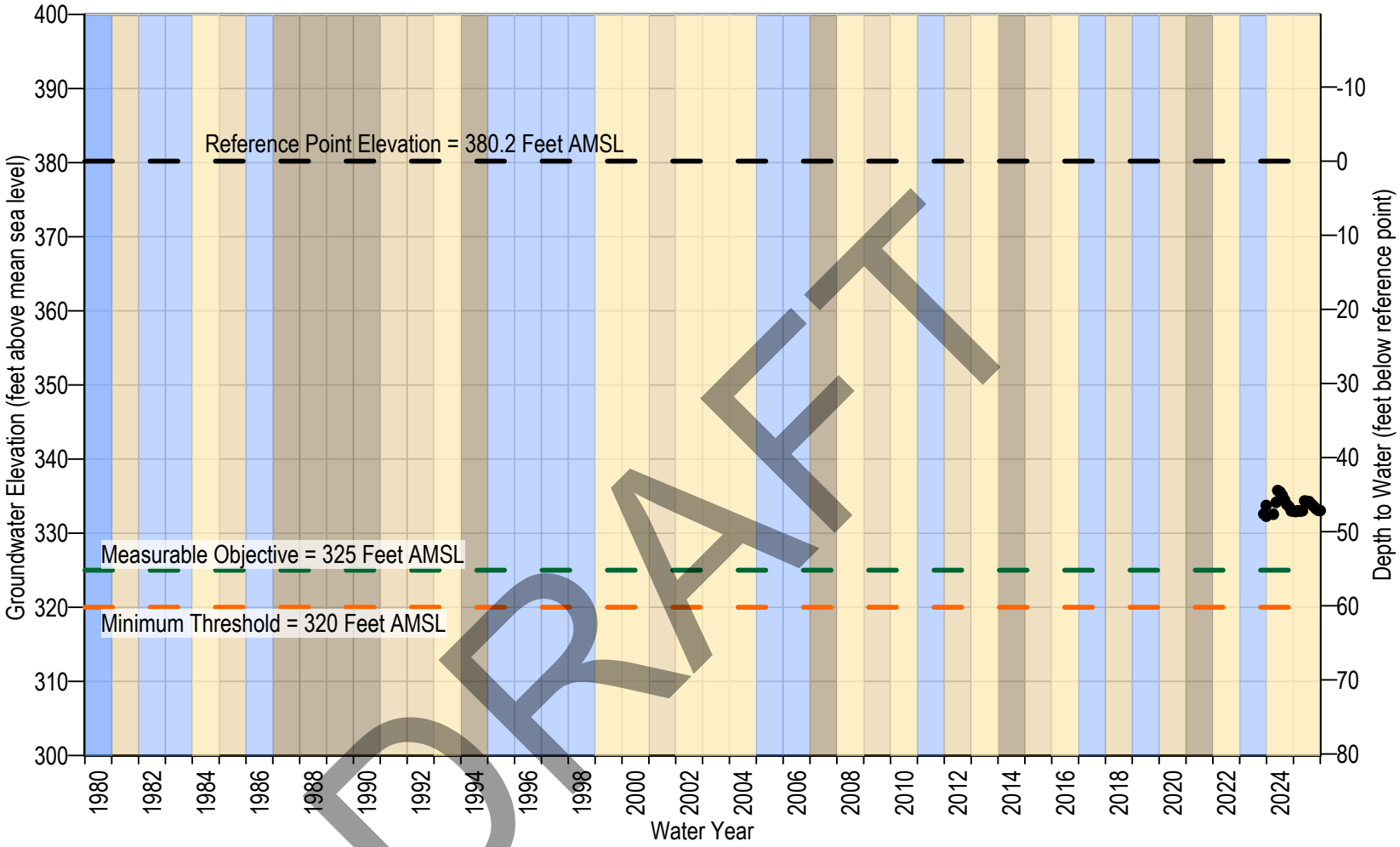
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-12. Hydrograph of SVWD TW-18

MONTGOMERY & ASSOCIATES



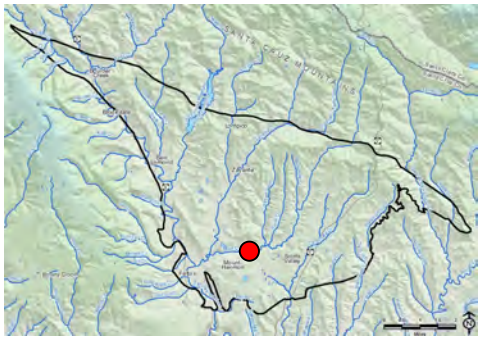
DRAFT

SMGWA-8 Randall Morgan Sandhills Preserve
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Monterey
Reference Point Elevation: 380.2 ft AMSL
Screen Interval: 155-170 ft bgs

Water Year Classification

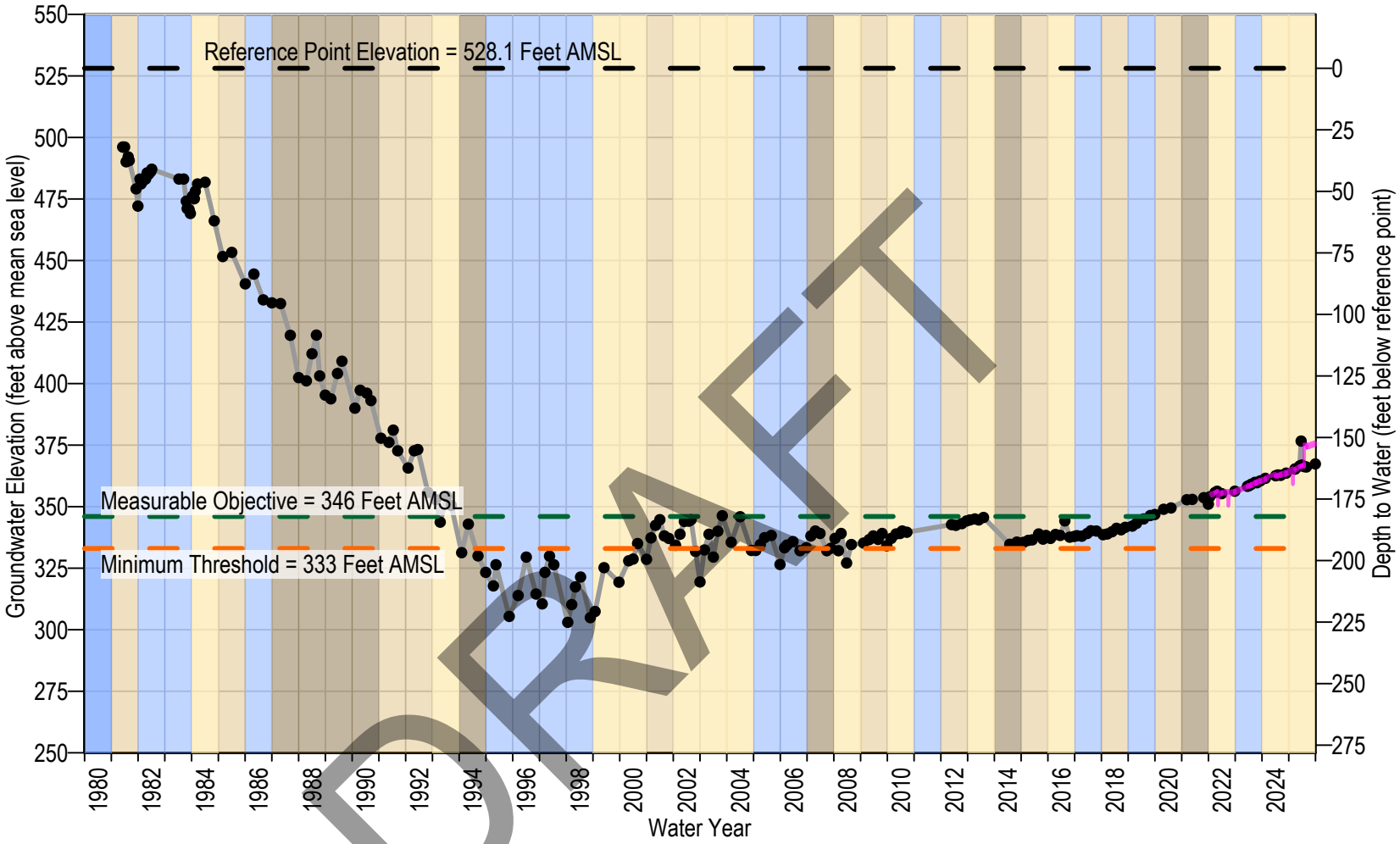
Wet	Dry
Normal	Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-13. Hydrograph of SMGWA-8 Randall Morgan Sandhills Preserve

MONTGOMERY & ASSOCIATES

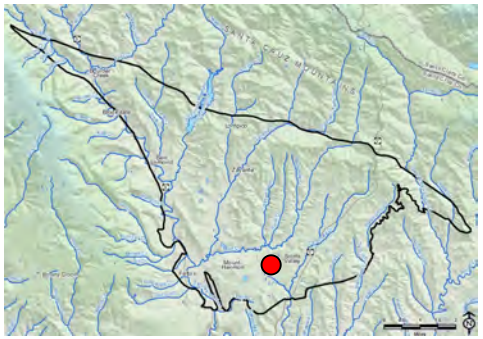


DRAFT

SVWD #9
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Monterey
Reference Point Elevation: 528.1 ft AMSL
Screen Interval: 155-195, 315-355 ft bgs

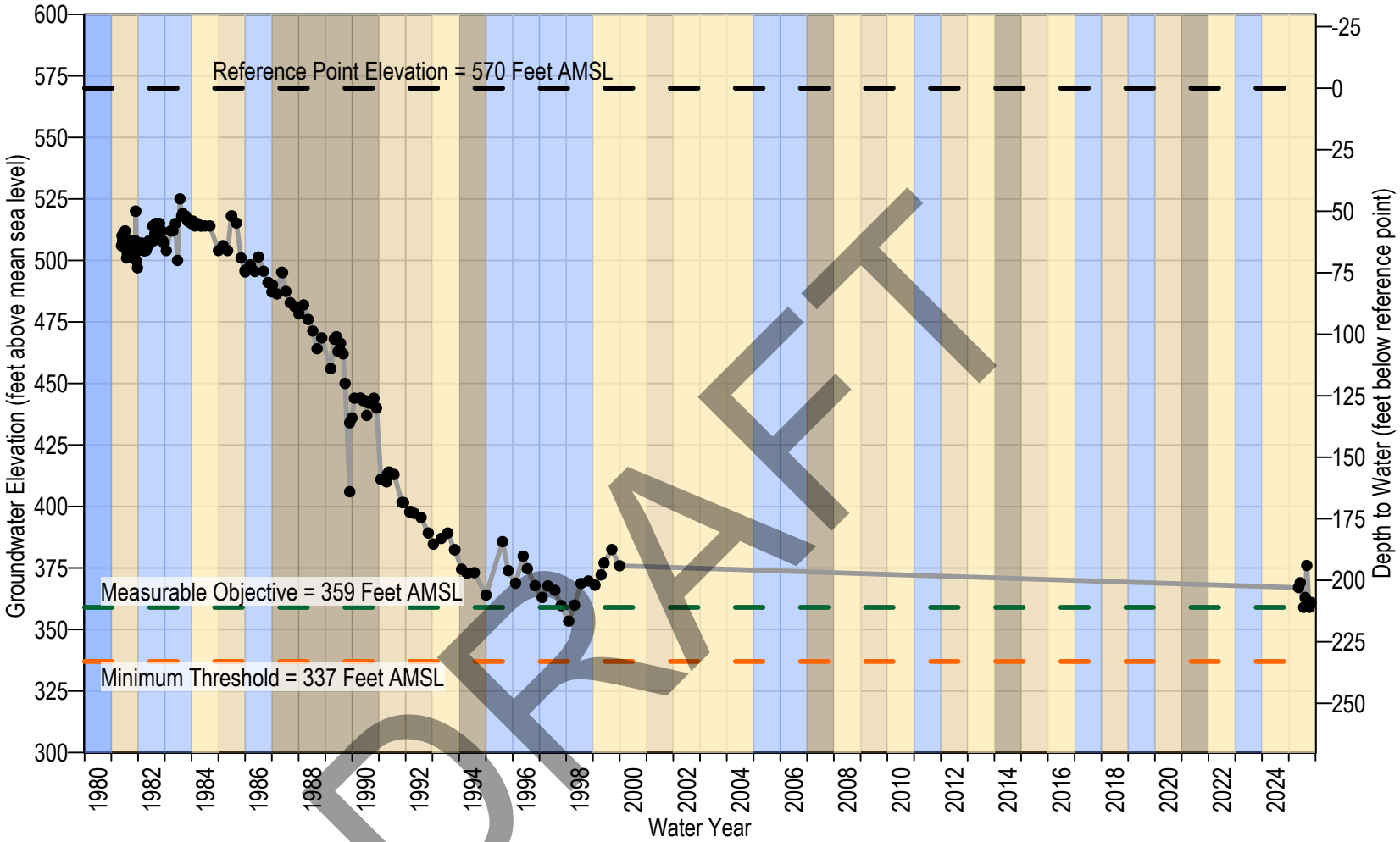
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-14. Hydrograph of SVWD #9

MONTGOMERY & ASSOCIATES

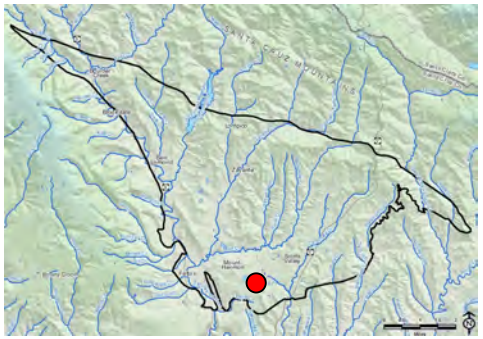


DRAFT

SLVWD Pasatiempo #3 (Estrella)
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 570 ft AMSL
Screen Interval: 23-147, 169-260 ft bgs

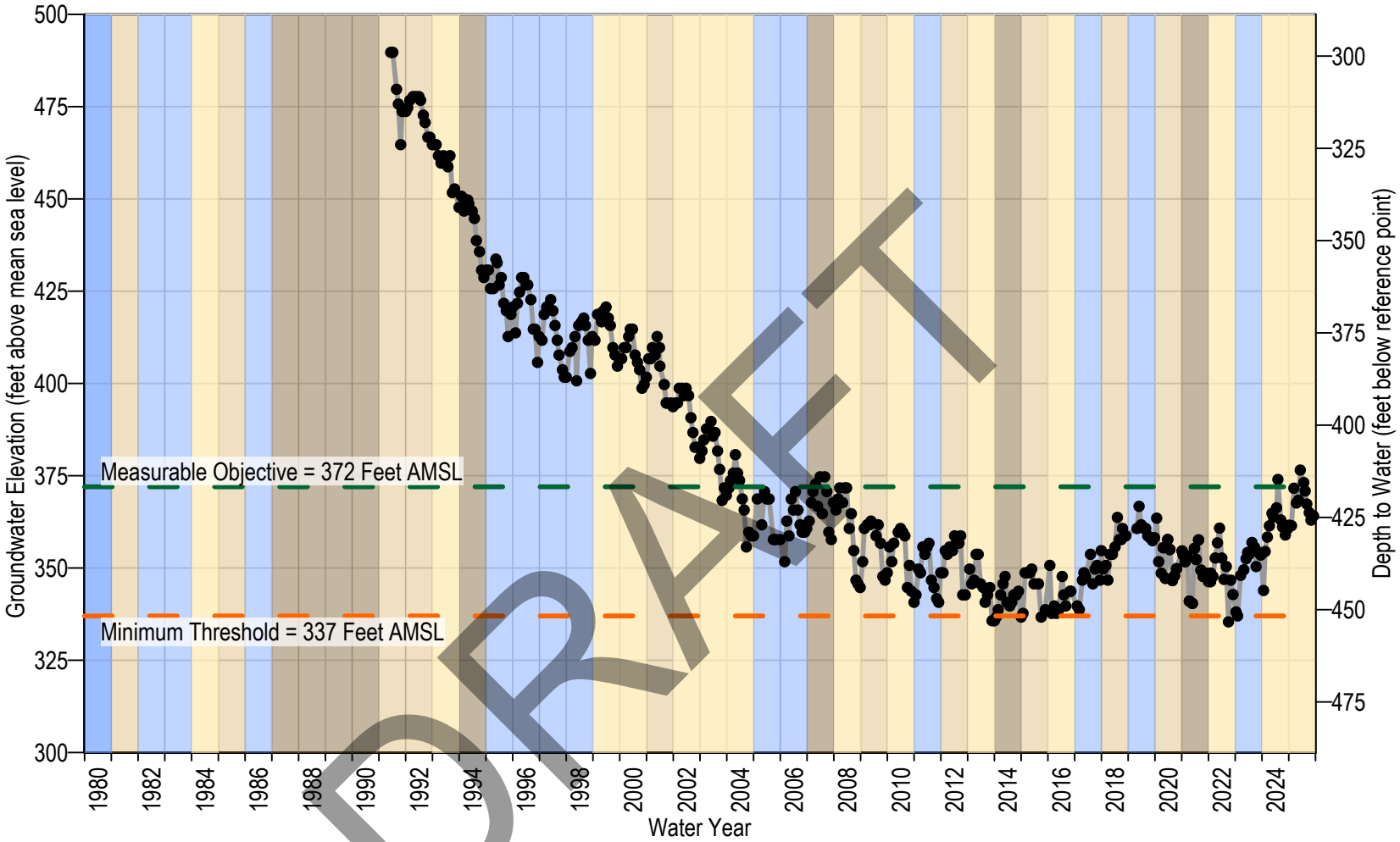
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-15. Hydrograph of SLVWD Pasatiempo #3 (Estrella)

MONTGOMERY & ASSOCIATES

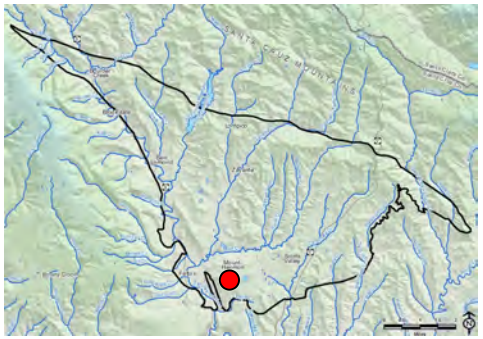


DRAFT

SLVWD Pasatiempo MW-1
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 788.7 ft AMSL
Screen Interval: 599-659 ft bgs

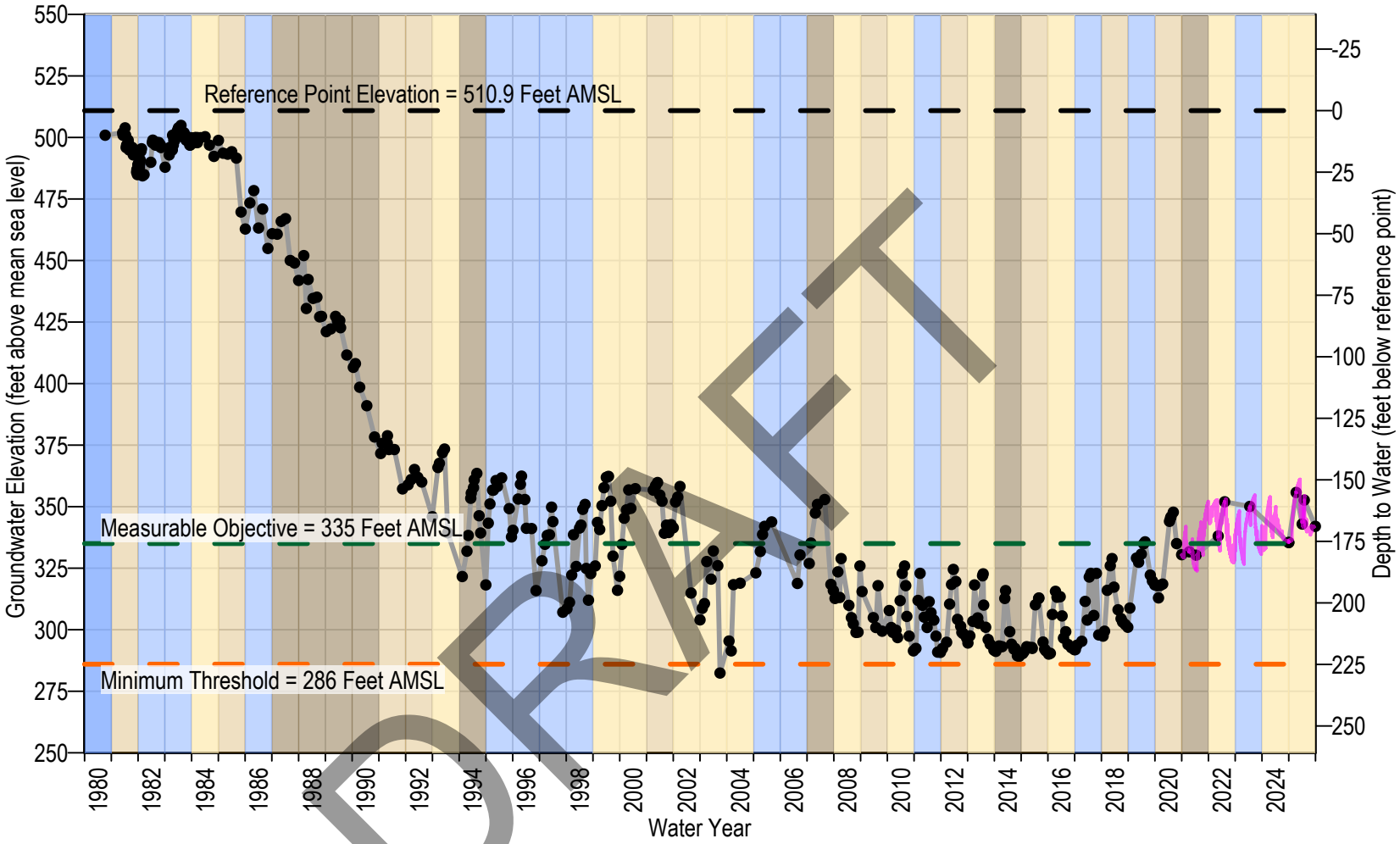
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-16. Hydrograph of SLVWD Pasatiempo MW-1

MONTGOMERY & ASSOCIATES

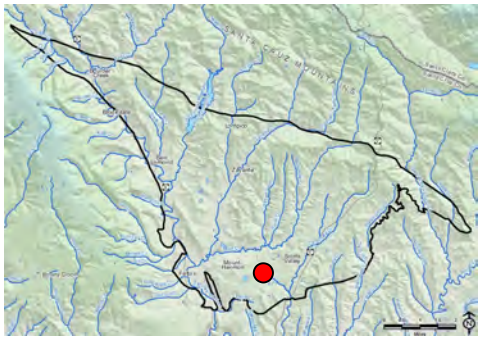


DRAFT

SVWD #10
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 510.9 ft AMSL
Screen Interval: 190-220, 240-270, 325-355 ft bgs

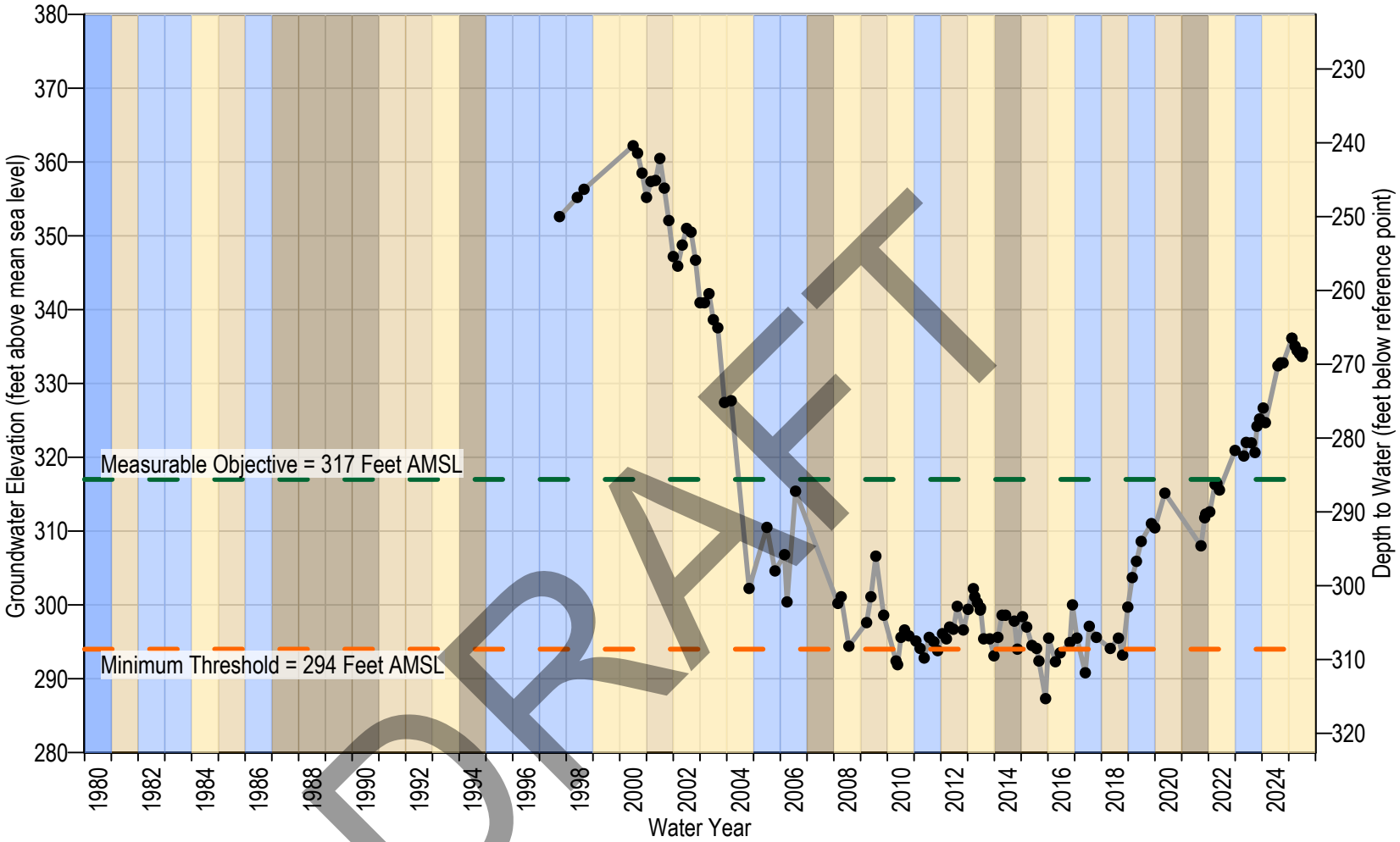
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-17. Hydrograph of SVWD #10

MONTGOMERY & ASSOCIATES

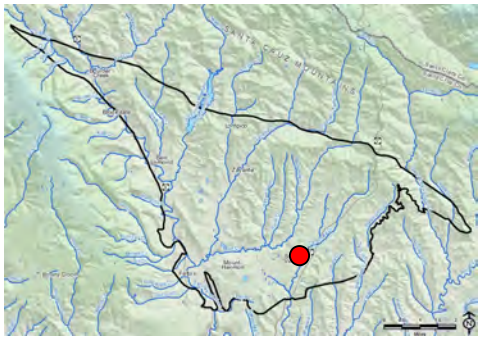


DRAFT

SVWD #11A
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 602.6 ft AMSL
Screen Interval: 399-419, 459-469, 495-515 ft bgs

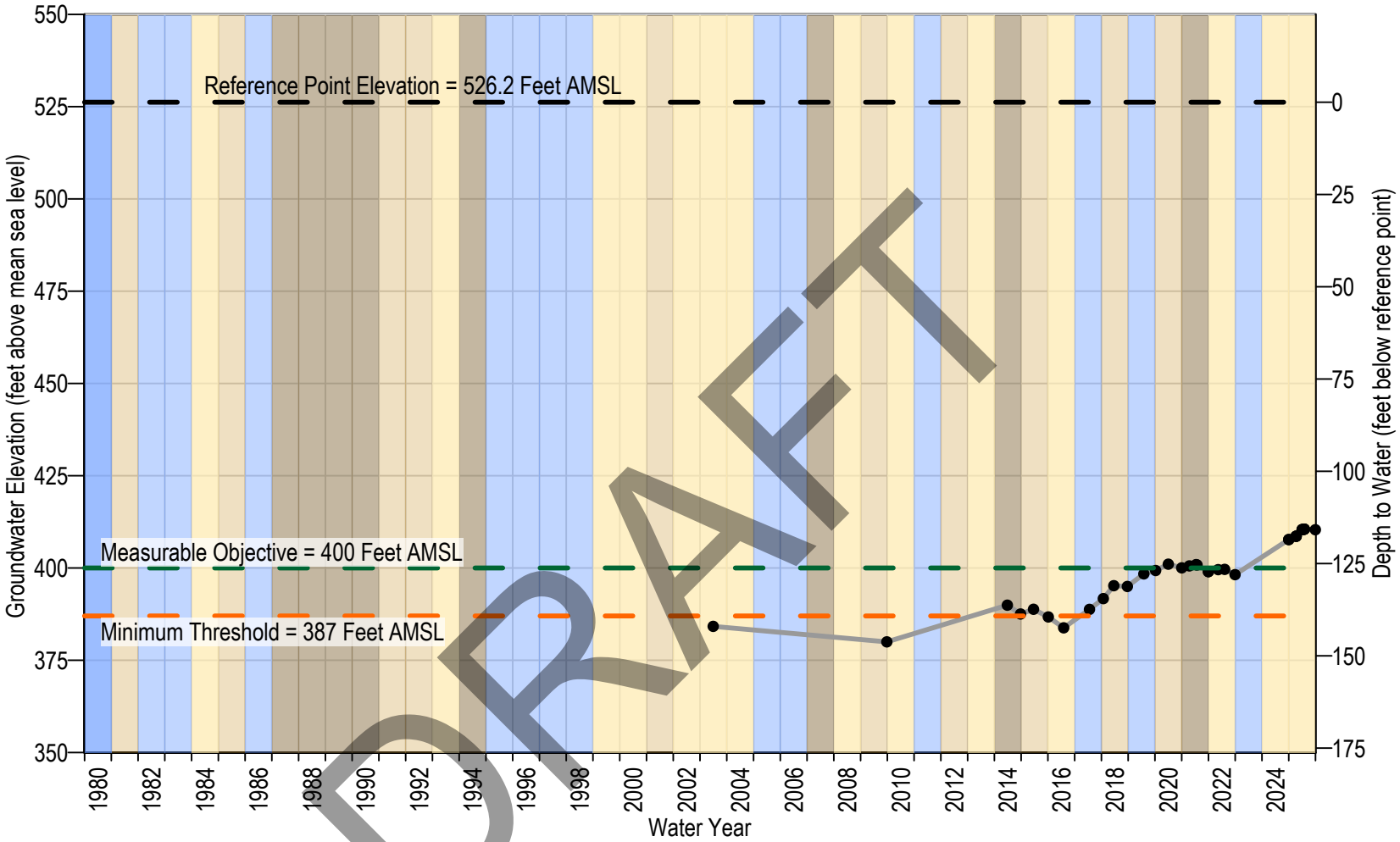
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-18. Hydrograph of SVWD #11A

MONTGOMERY & ASSOCIATES

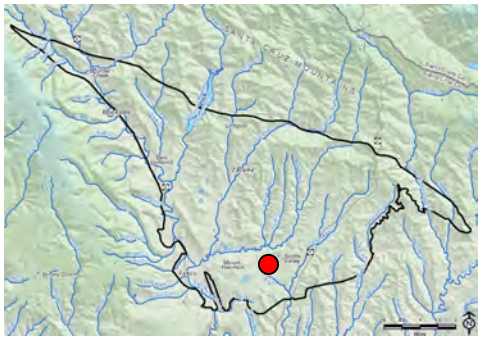


DRAFT

SVWD AB303 MW-2
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 526.2 ft AMSL
Screen Interval: 705-715, 810-850 ft bgs

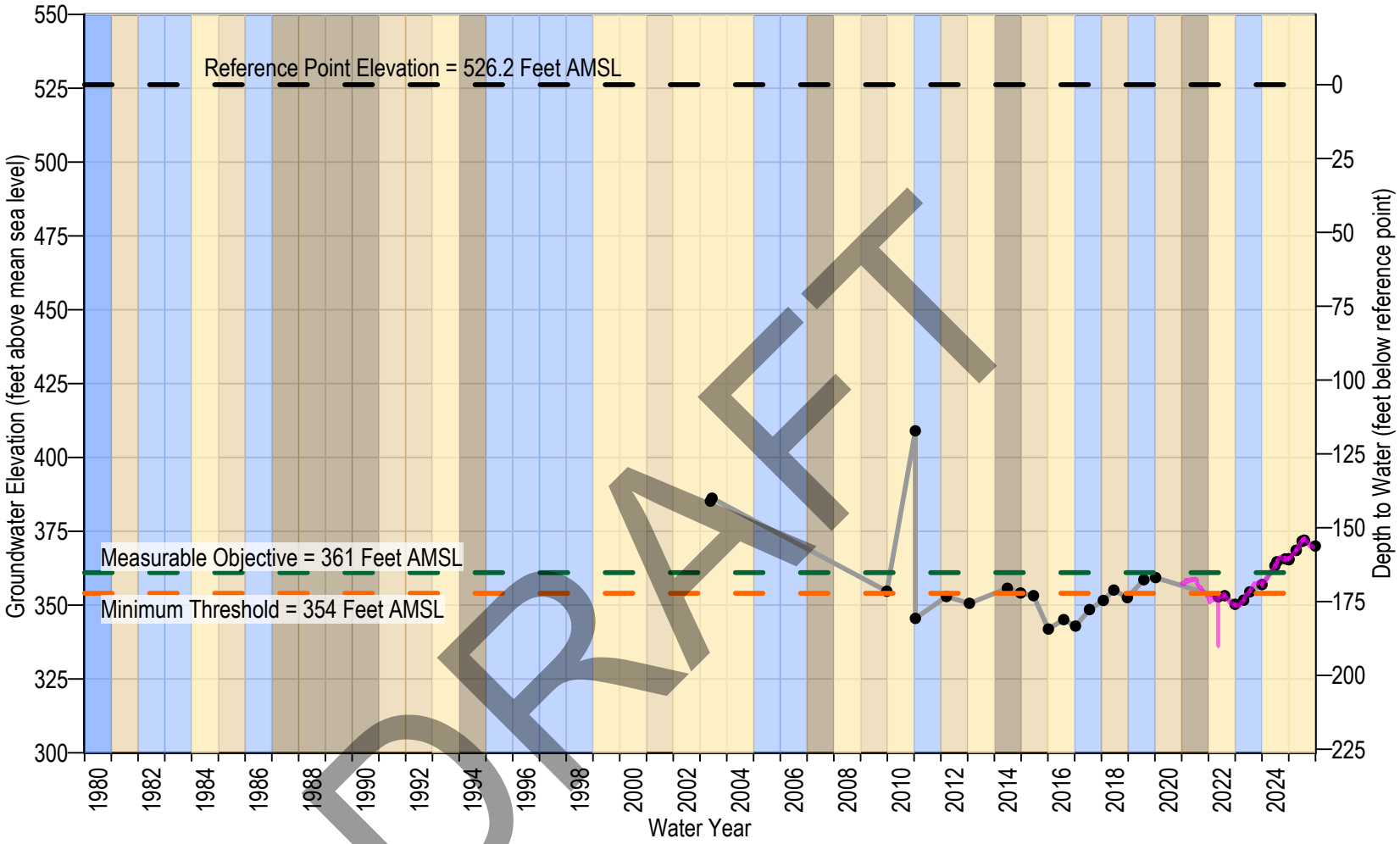
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-19. Hydrograph of SVWD AB303 MW-2

MONTGOMERY & ASSOCIATES

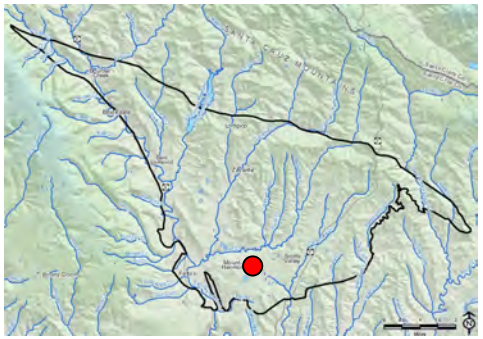


DRAFT

SVWD AB303 MW-3A
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 526.2 ft AMSL
Screen Interval: 630-680 ft bgs

Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-20. Hydrograph of SVWD AB303 MW-3A

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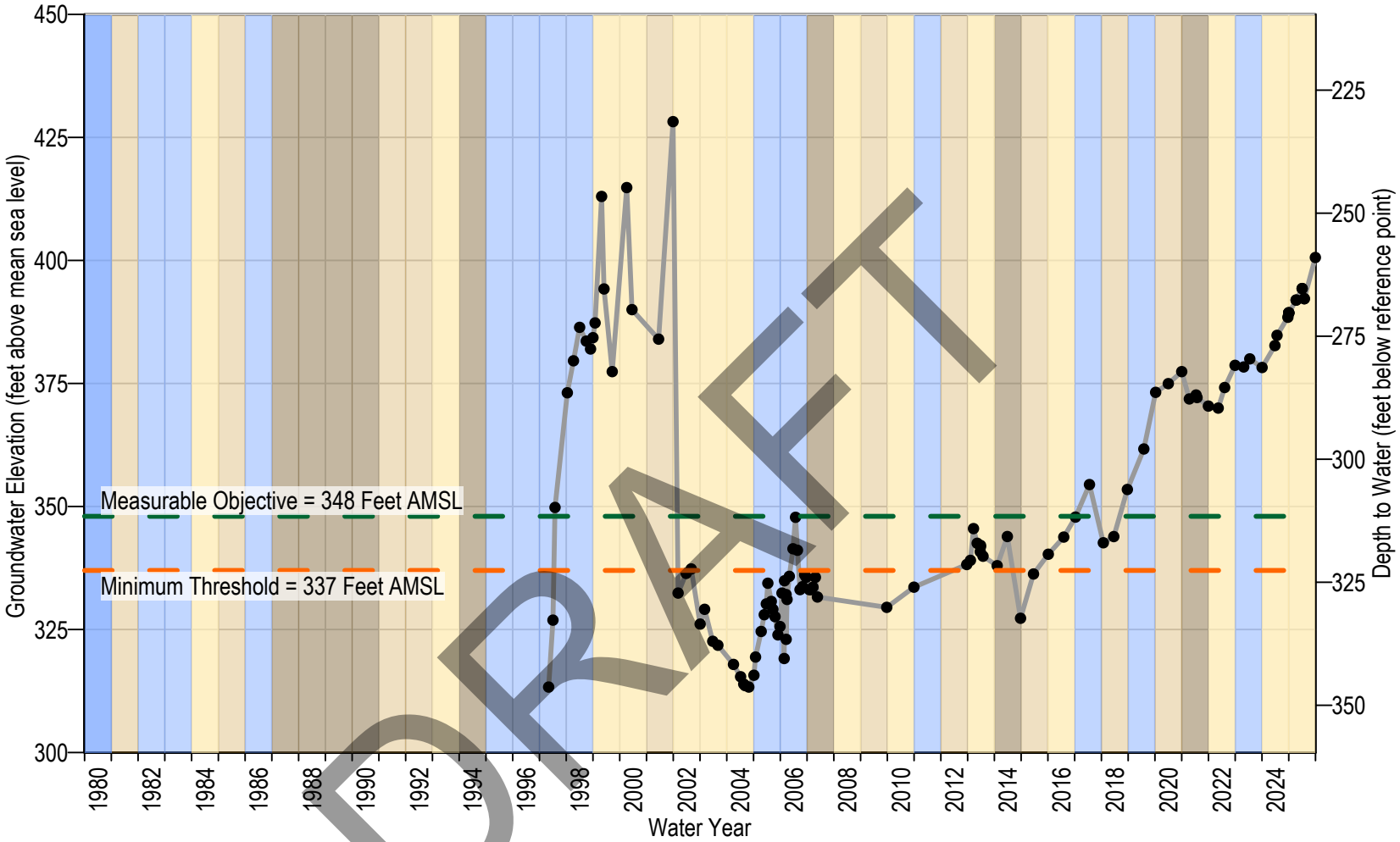
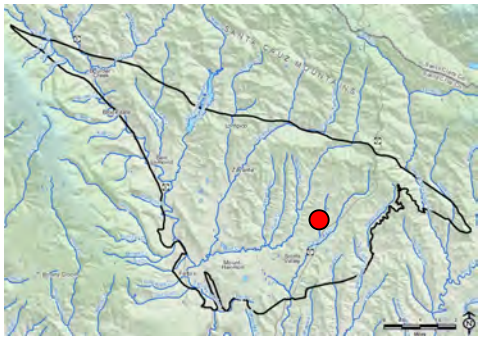


DRAFT

SVWD TW-19
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Lompico
Reference Point Elevation: 659.6 ft AMSL
Screen Interval: 960-1060 ft bgs

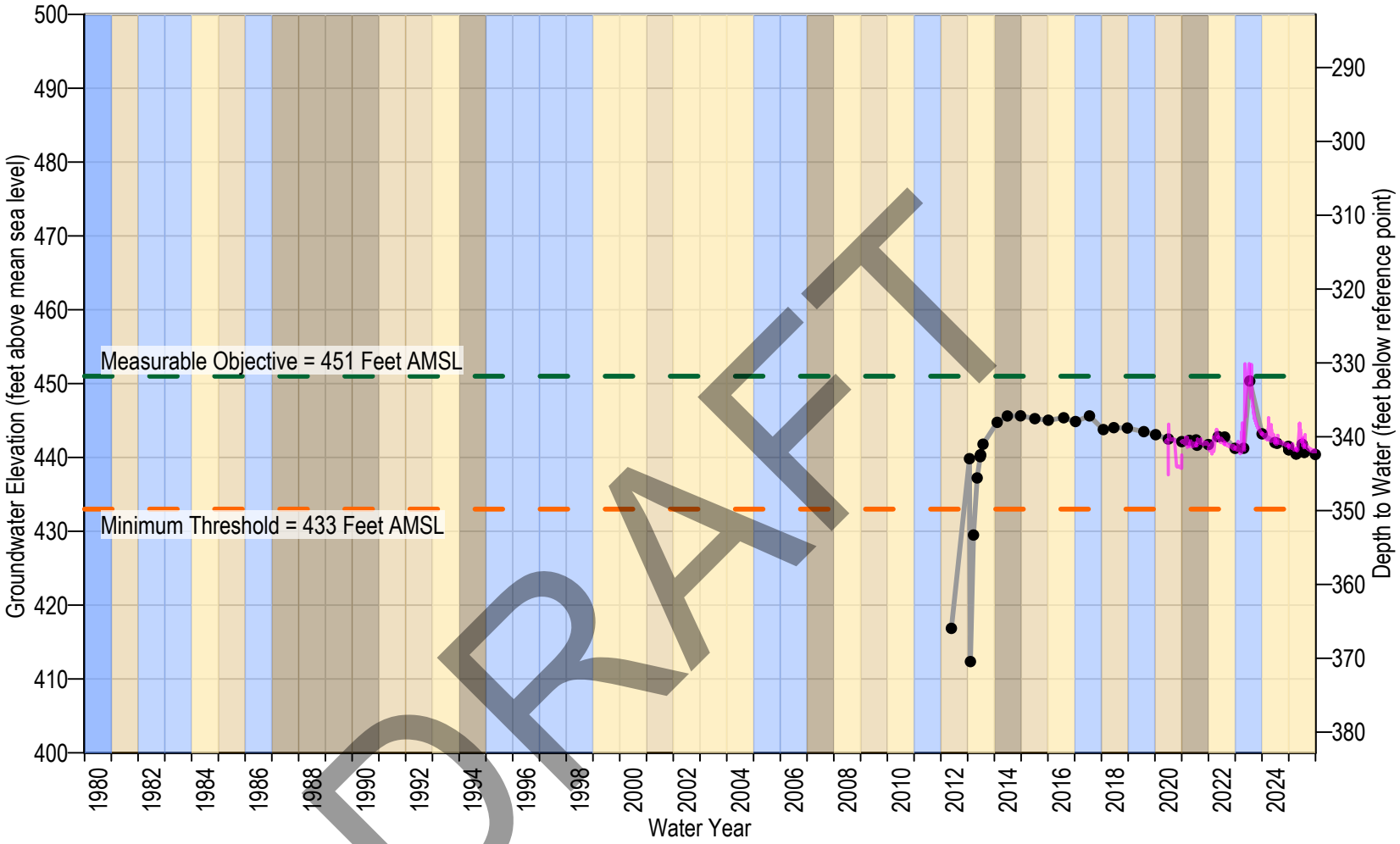
Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-21. Hydrograph of SVWD TW-19

MONTGOMERY & ASSOCIATES

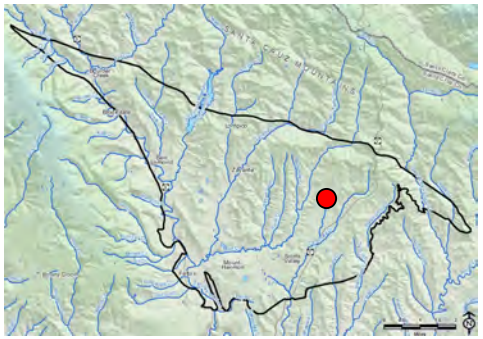


DRAFT

SVWD Canham Well
Transducer
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Butano
Reference Point Elevation: 782.8 ft AMSL
Screen Interval: 1,281-1,381 ft bgs

Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-22. Hydrograph of SVWD Canham Well

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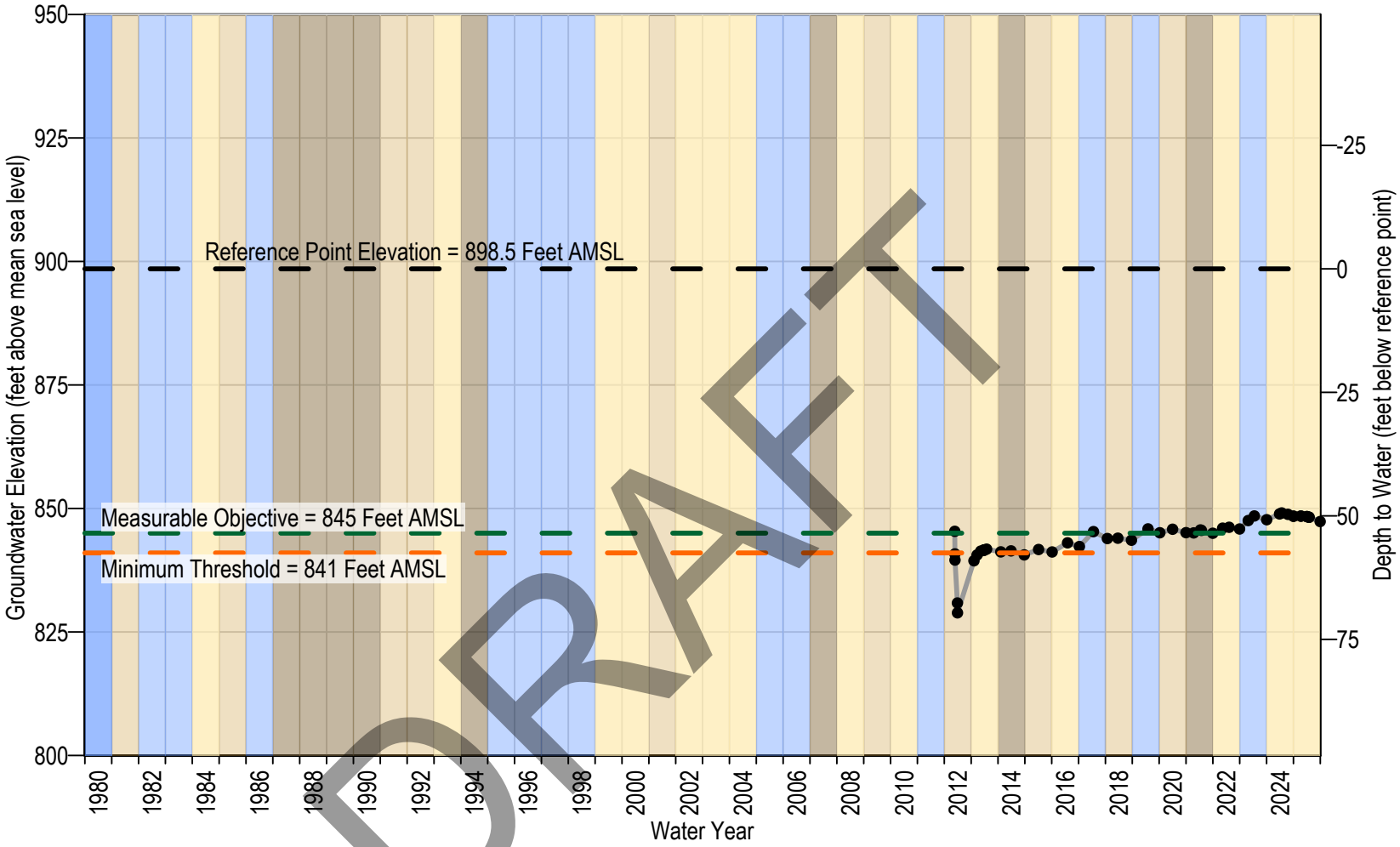
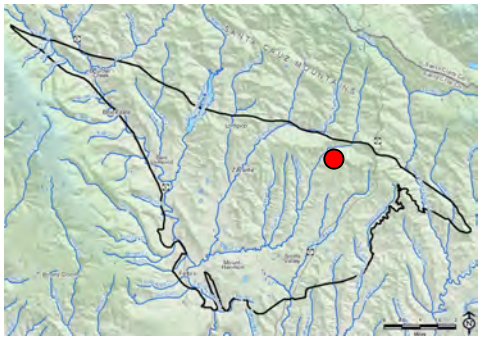


DRAFT

SVWD Stonewood Well
Reference Point Elevation
Minimum Threshold
Measurable Objective

Formation: Confined - Butano
Reference Point Elevation: 898.5 ft AMSL
Screen Interval: 799-859 ft bgs

Water Year Classification
Wet
Dry
Normal
Critically Dry



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface. Pumping measurements are removed from hand soundings but not from transducer data.

Figure 7A-23. Hydrograph of SVWD Stonewood Well

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Appendix 7B

Representative Monitoring Point Chemographs with Sustainable Management Criteria

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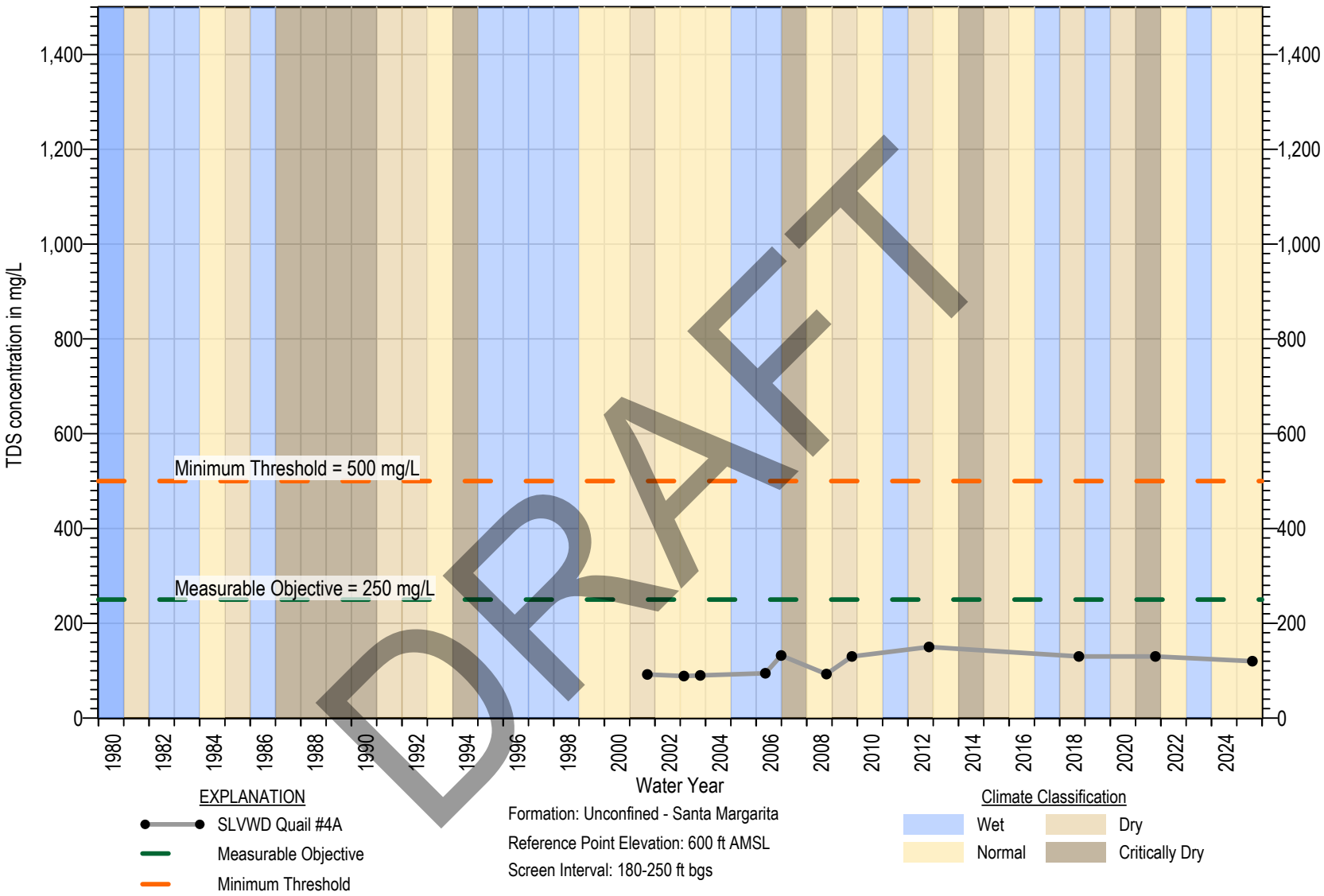

DRAFT

Figure 7B-1. Chemograph of SLVWD Quail #4A

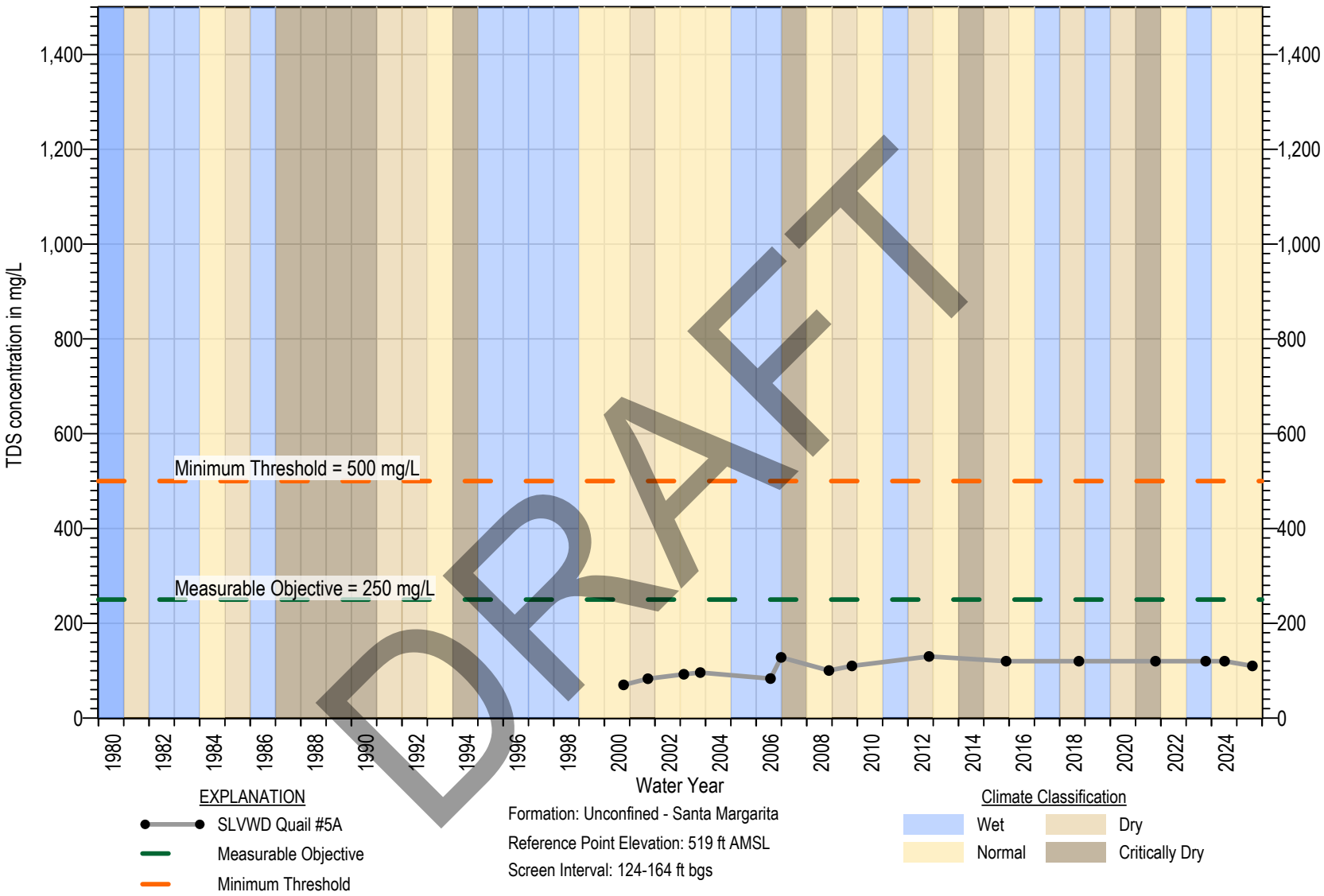

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Figure 7B-2. Chemograph of SLVWD Quail #5A

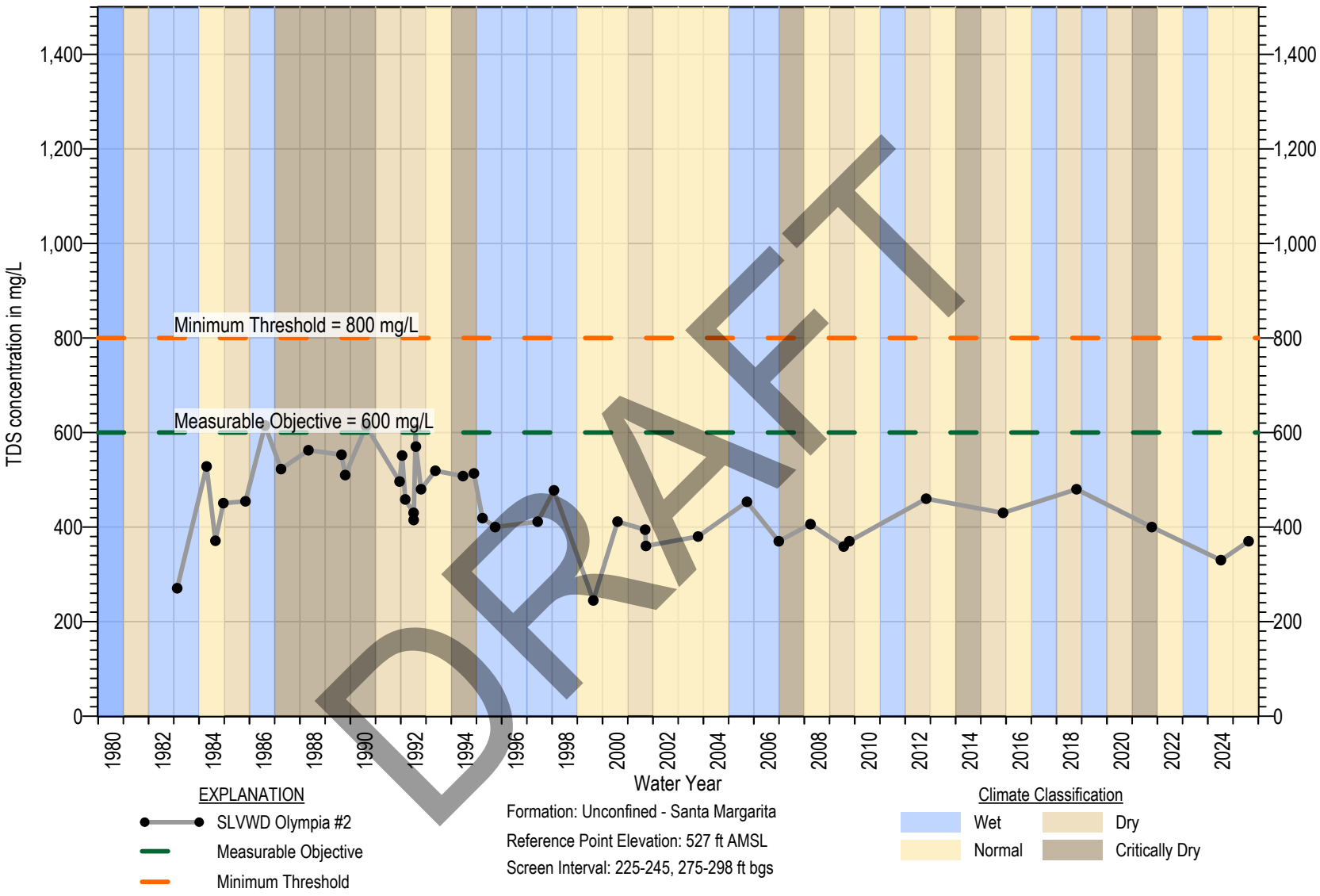

Figure 7B-3. Chemograph of SLVWD Olympia #2

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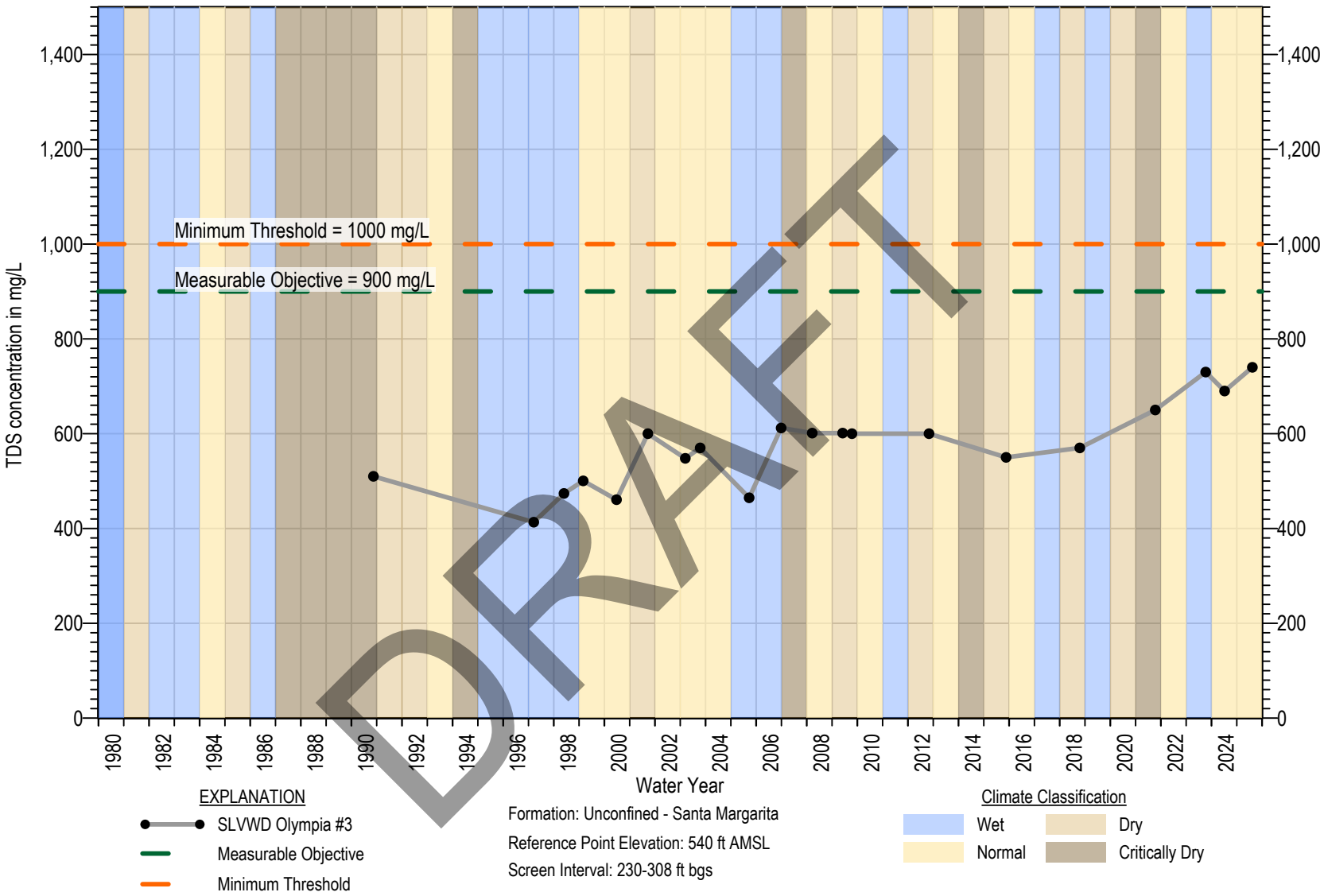
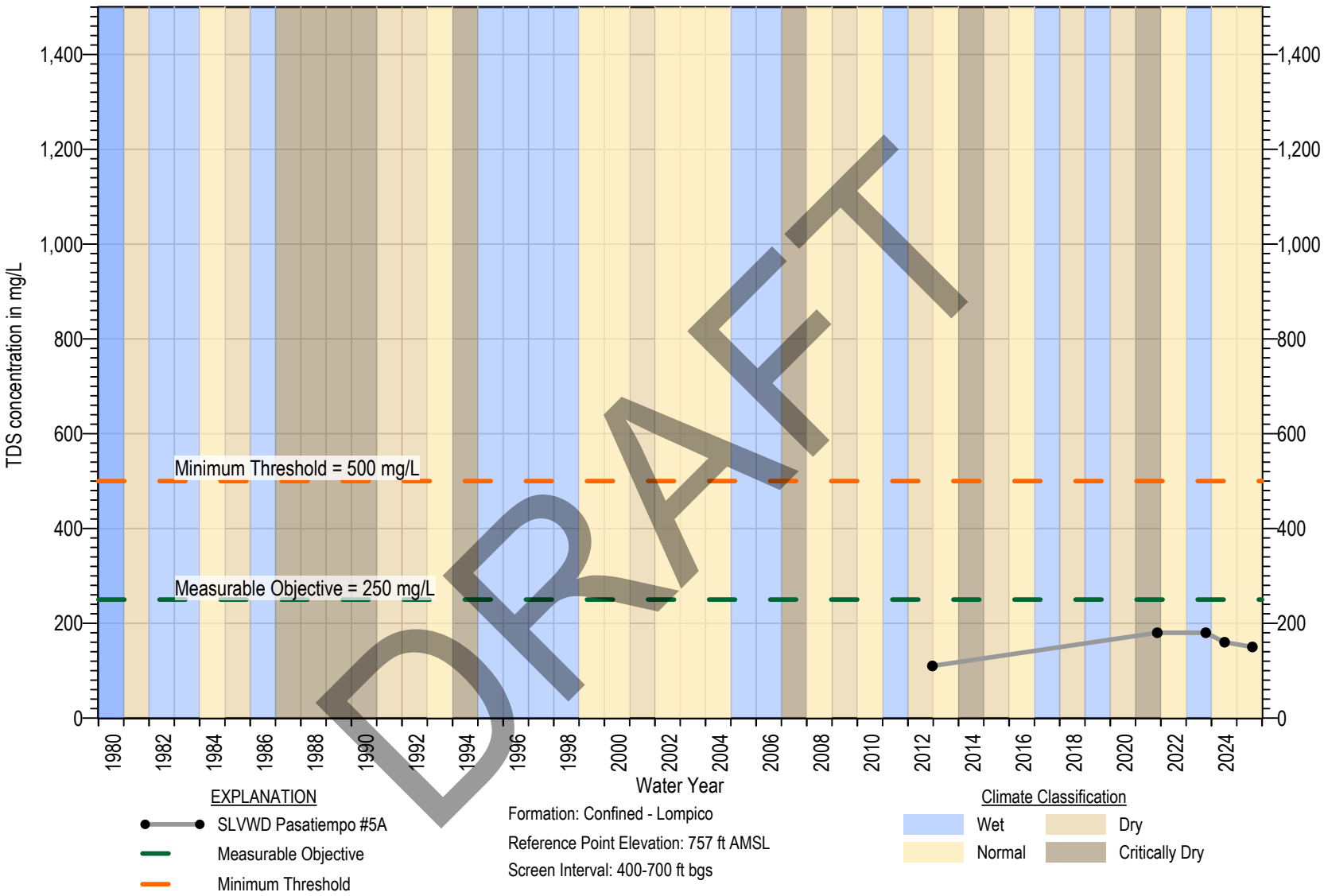


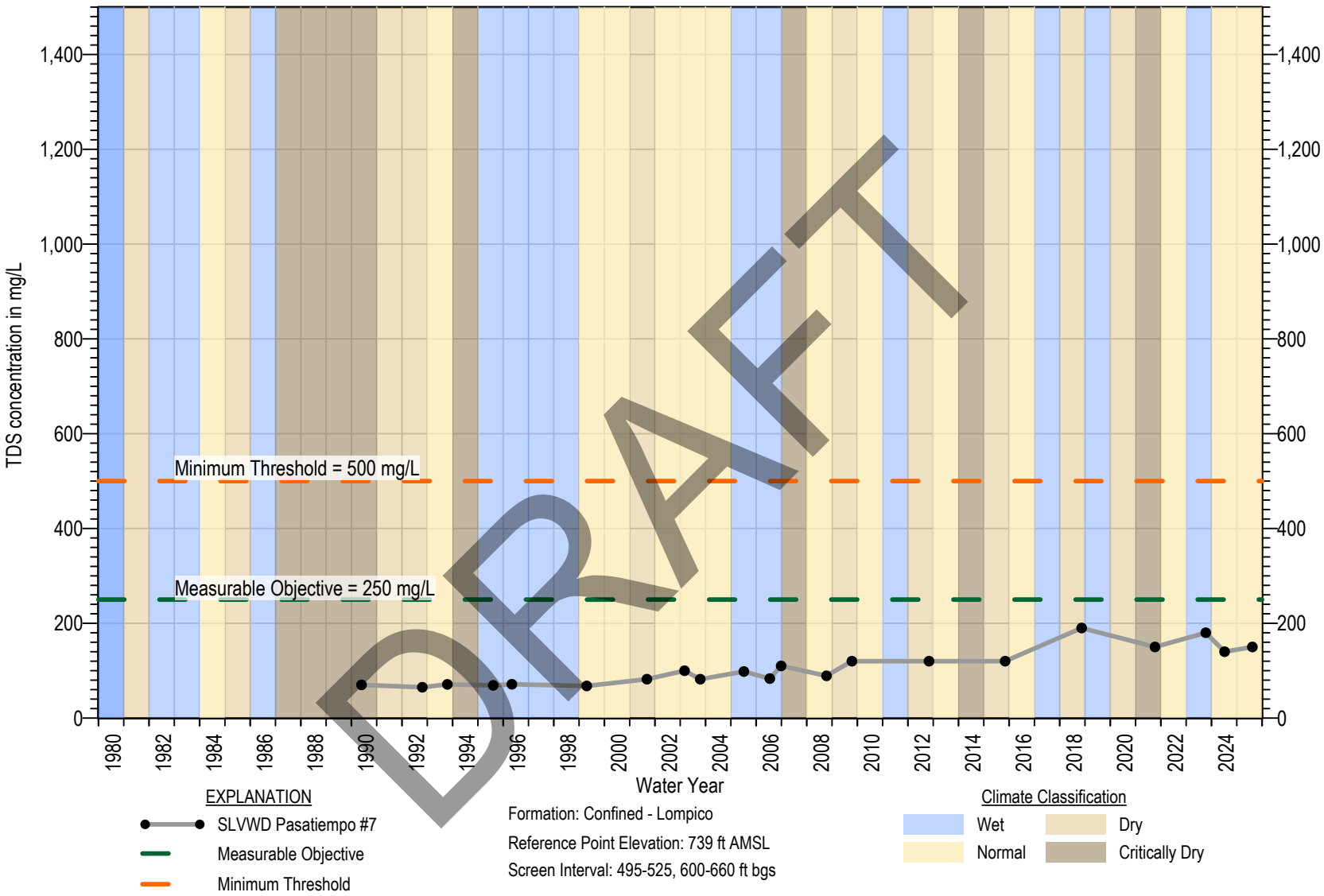
Figure 7B-4. Chemograph of SLVWD Olympia #3

MONTGOMERY & ASSOCIATES



DRAFT

Figure 7B-5. Chemograph of SLVWD Pasatiempo #5A



DRAFT

Figure 7B-6. Chemograph of SLVWD Pasatiempo #7

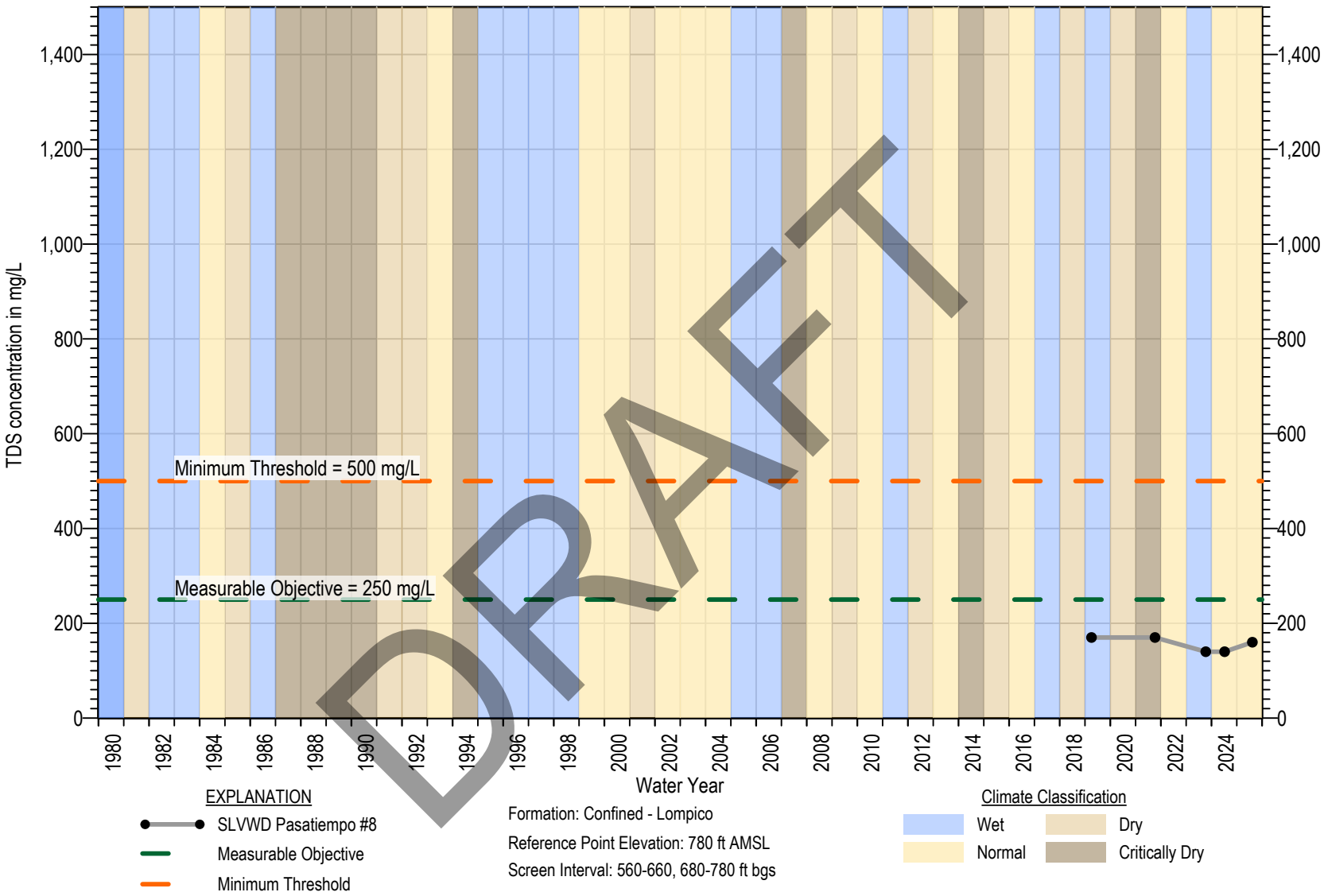


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Figure 7B-7. Chemograph of SLVWD Pasatiempo #8

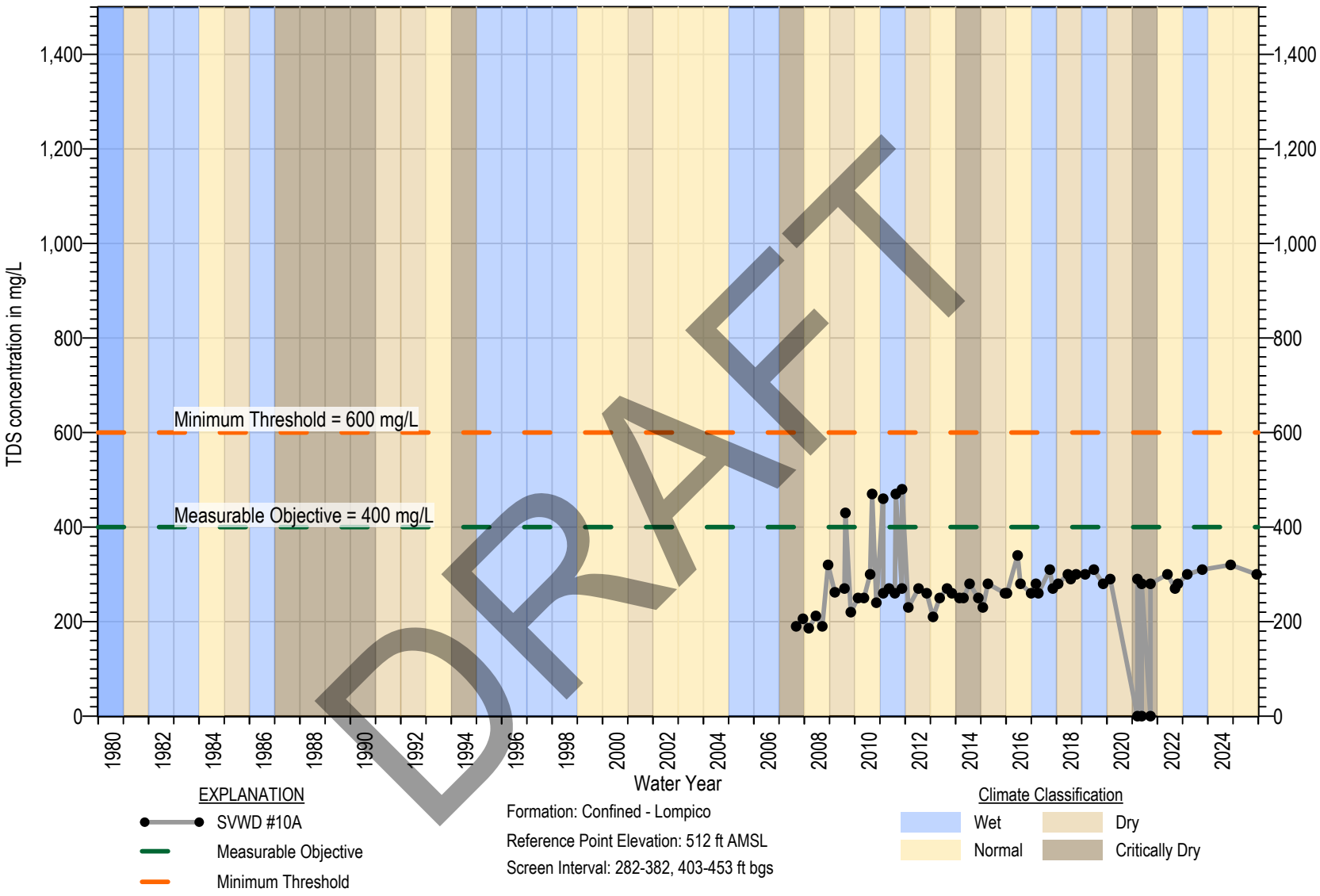

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Figure 7B-8. Chemograph of SVWD #10A

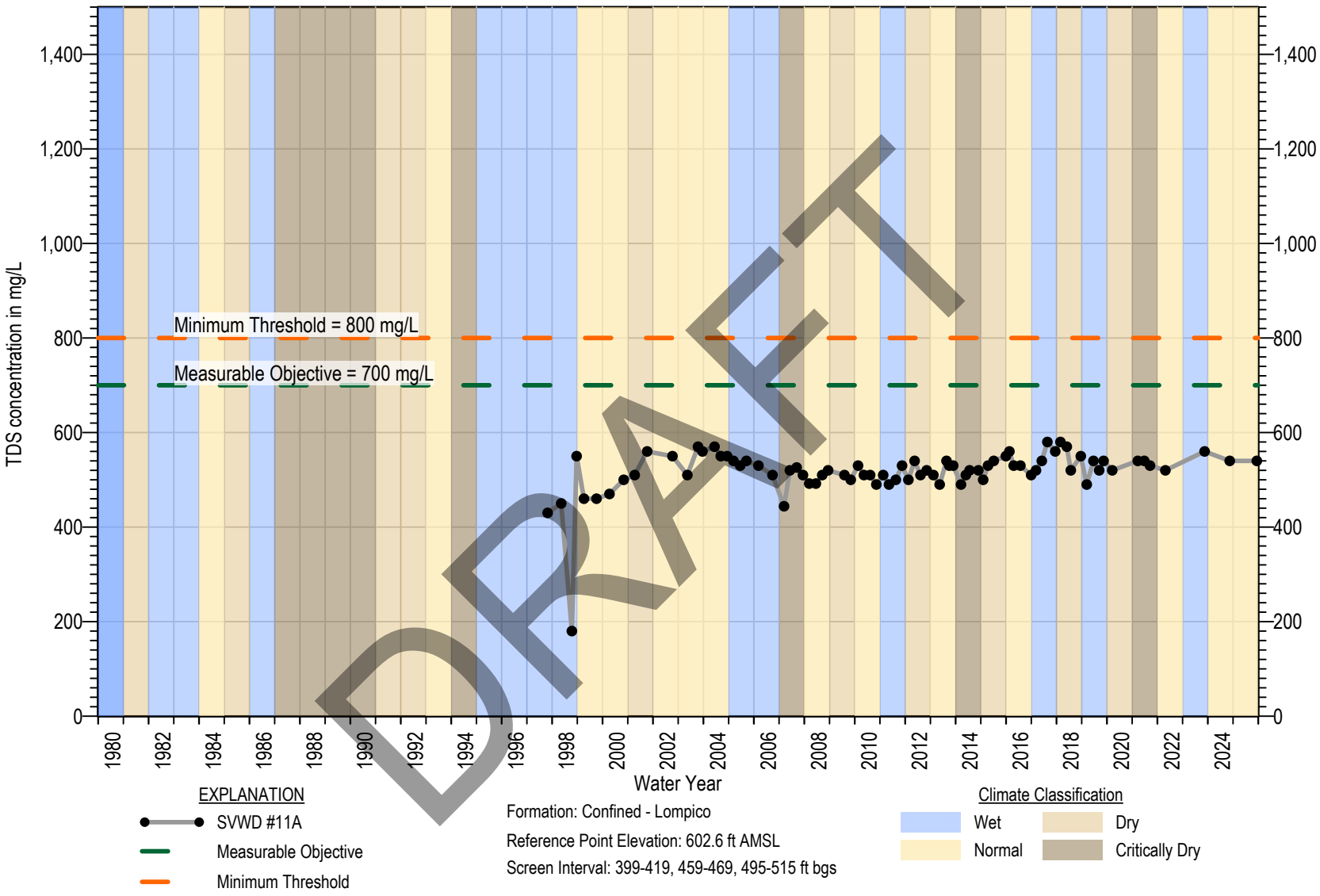

Figure 7B-9. Chemograph of SVWD #11A

MONTGOMERY & ASSOCIATES

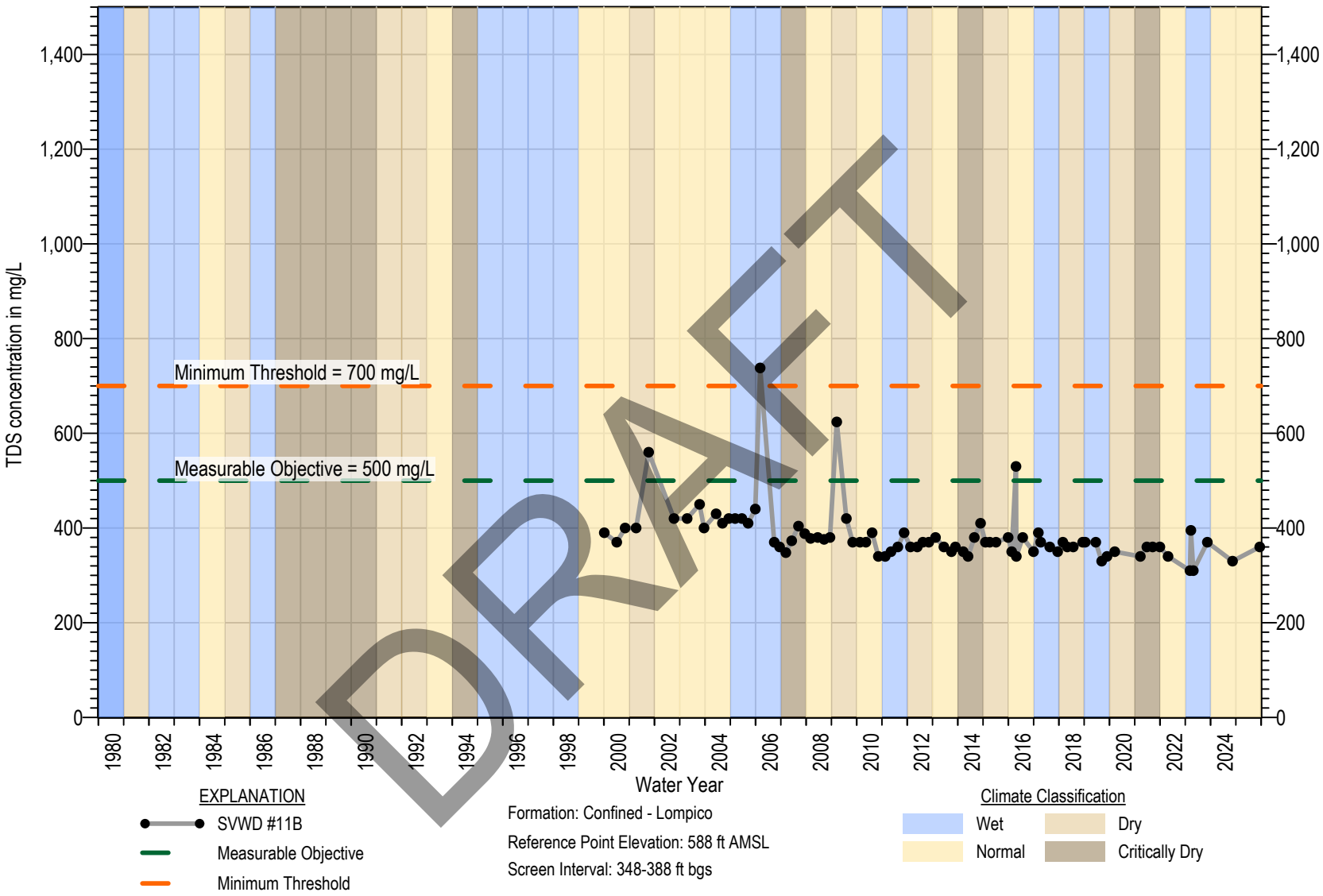

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Figure 7B-10. Chemograph of SVWD #11B

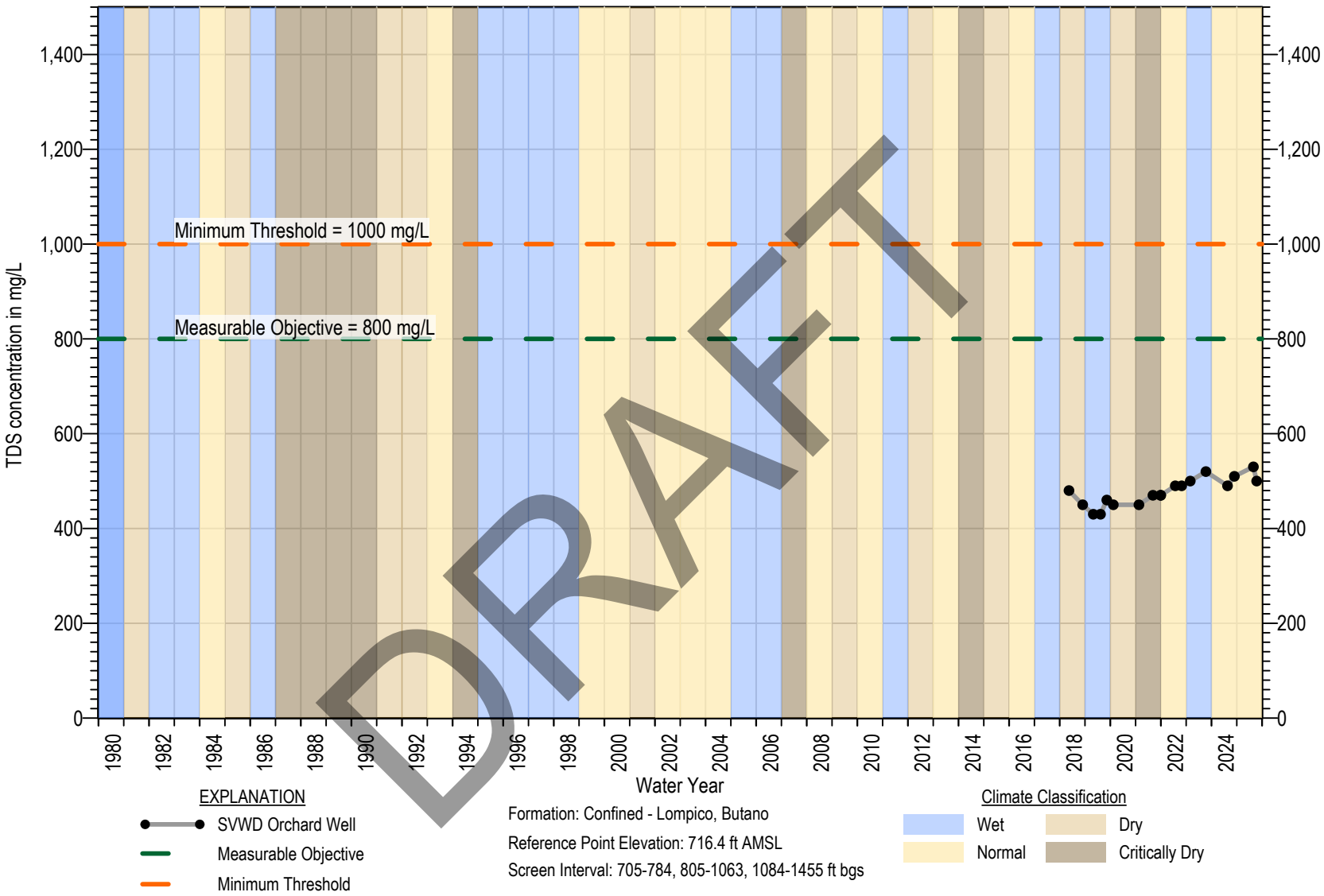

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Figure 7B-11. Chemograph of SVWD Orchard Well

MONTGOMERY & ASSOCIATES

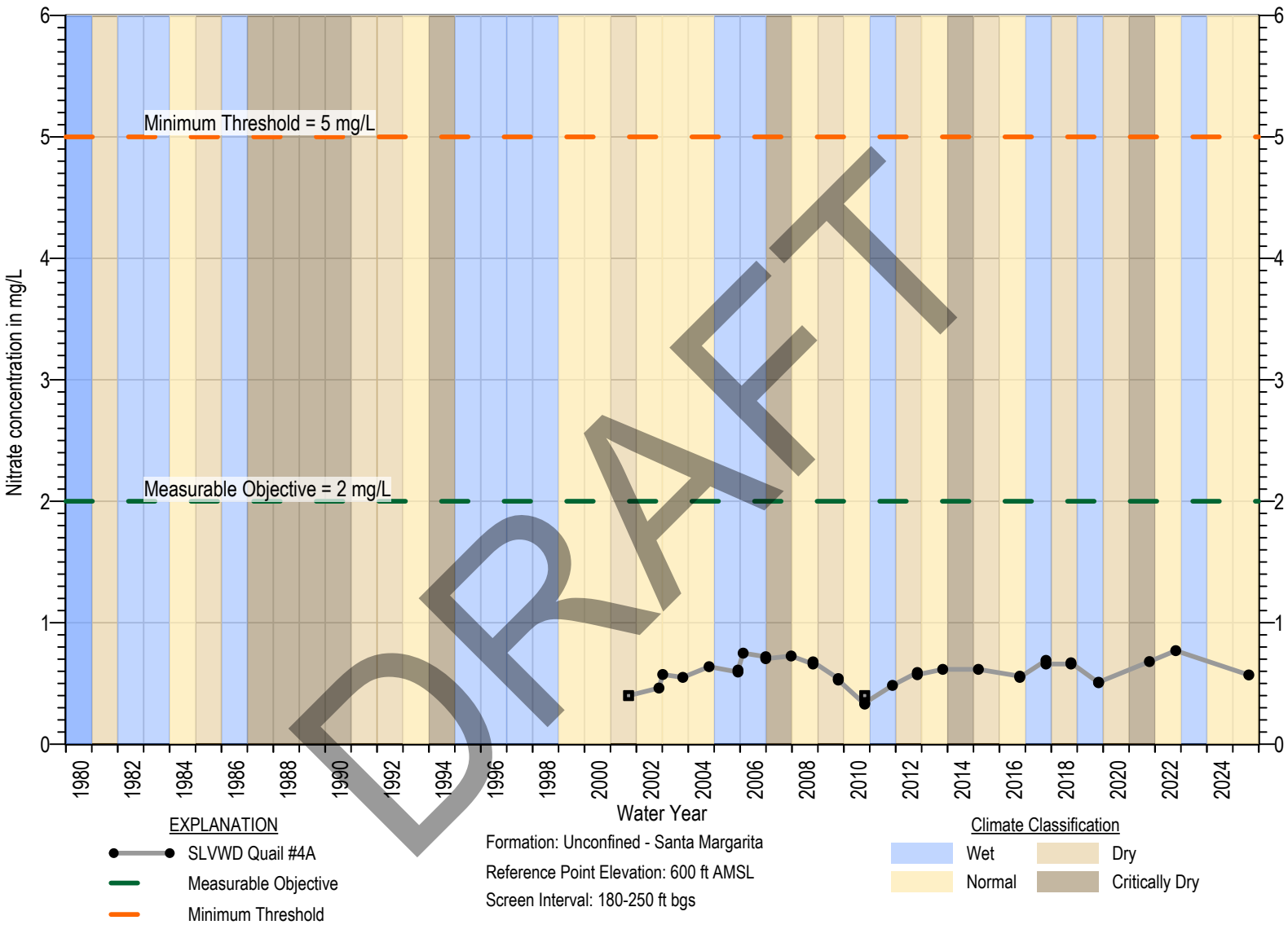

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Figure 7B-12. Chemograph of SLVWD Quail #4A

MONTGOMERY & ASSOCIATES

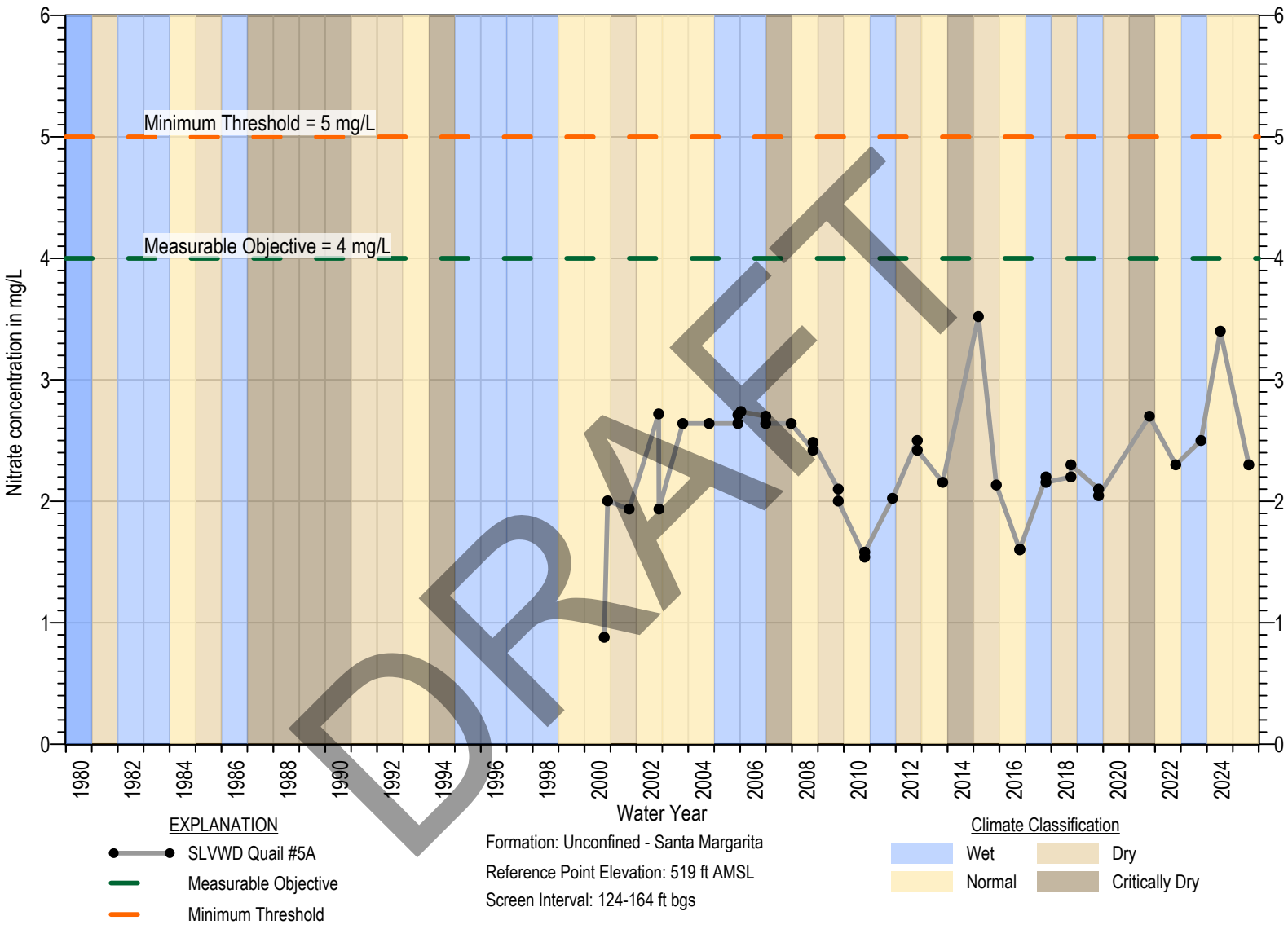
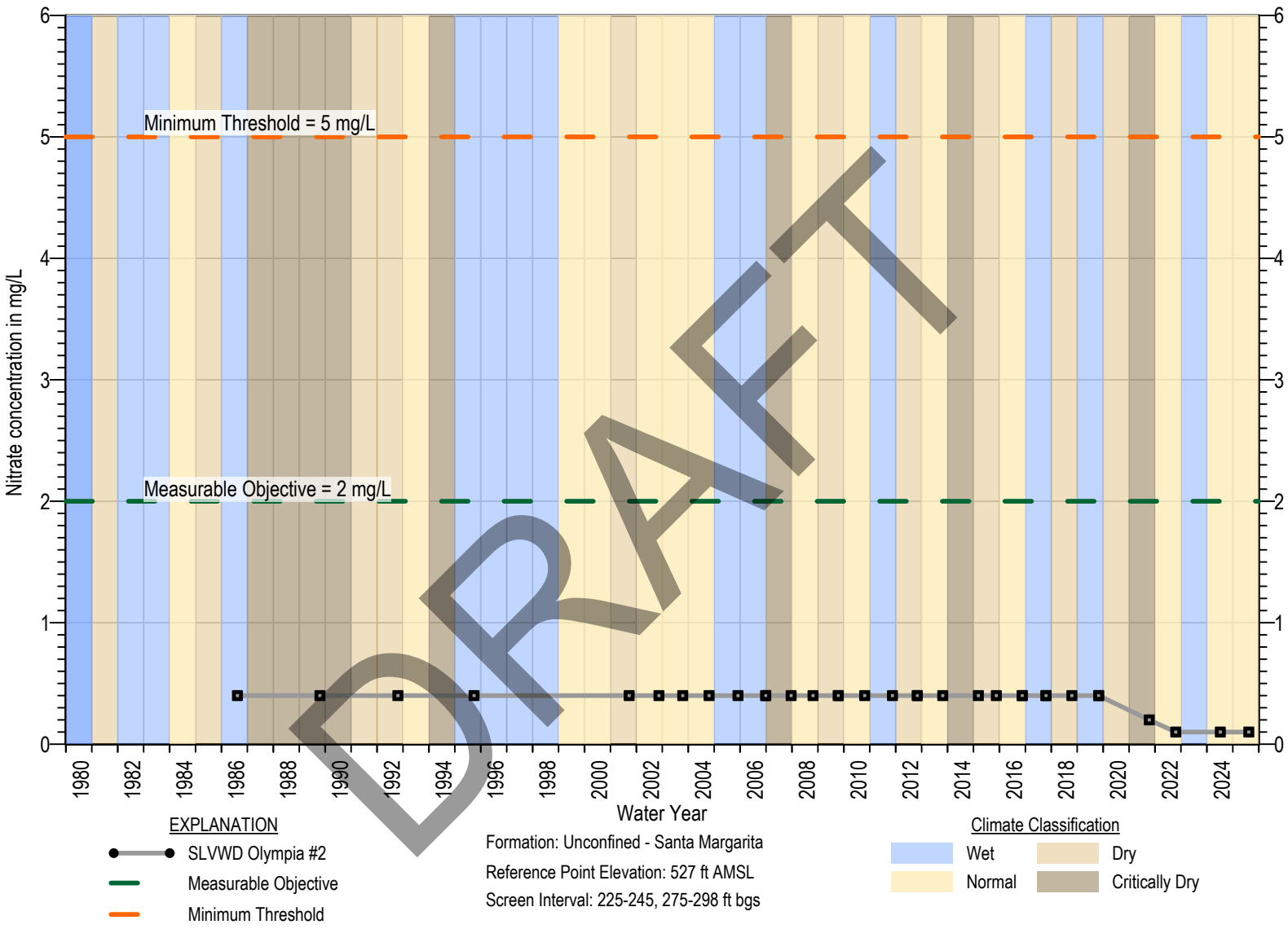


Figure 7B-13. Chemograph of SLVWD Quail #5A

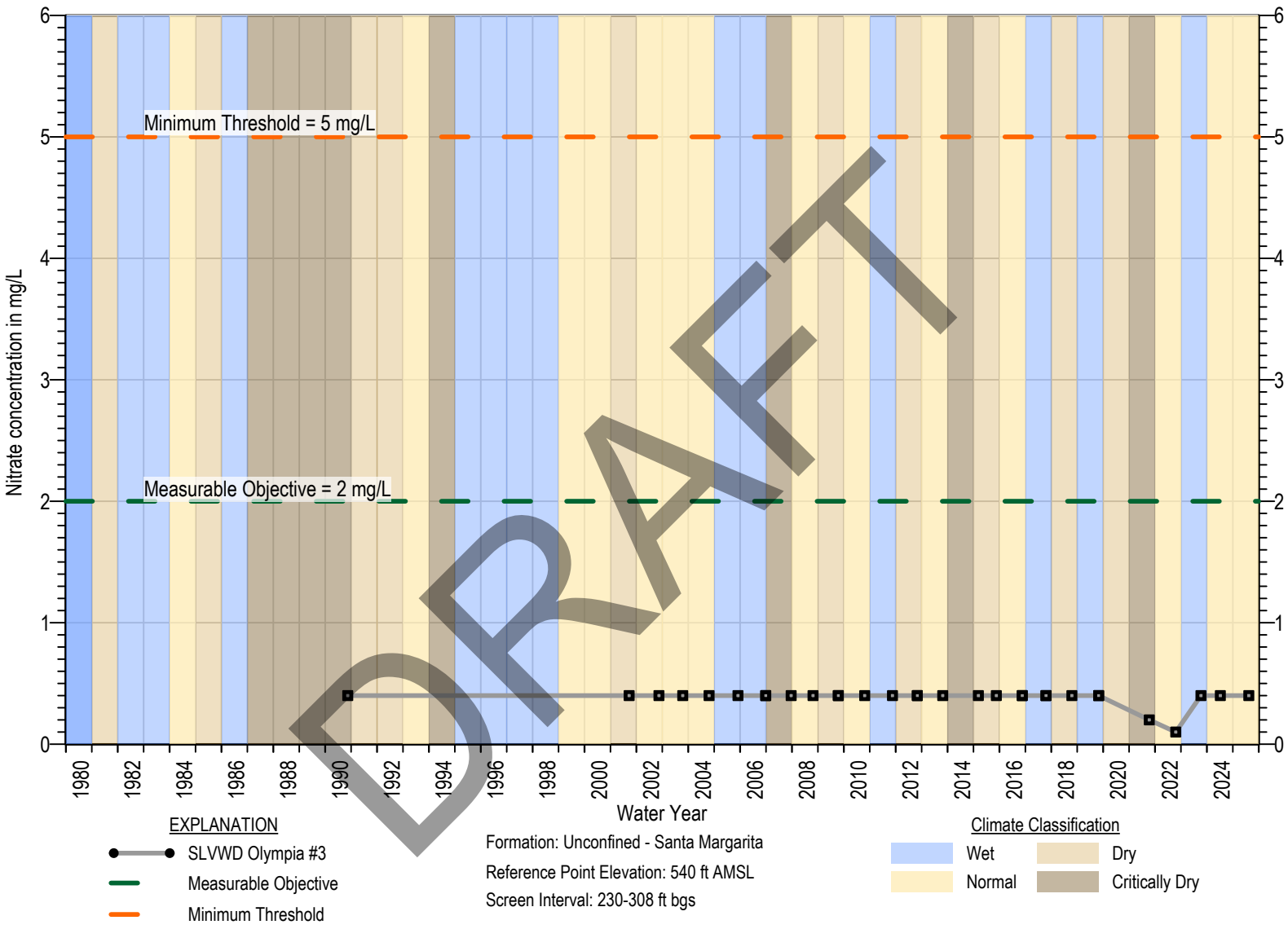
MONTGOMERY & ASSOCIATES



DRAFT

Figure 7B-14. Chemograph of SLVWD Olympia #2

MONTGOMERY & ASSOCIATES



DRAFT

Figure 7B-15. Chemograph of SLVWD Olympia #3

MONTGOMERY & ASSOCIATES

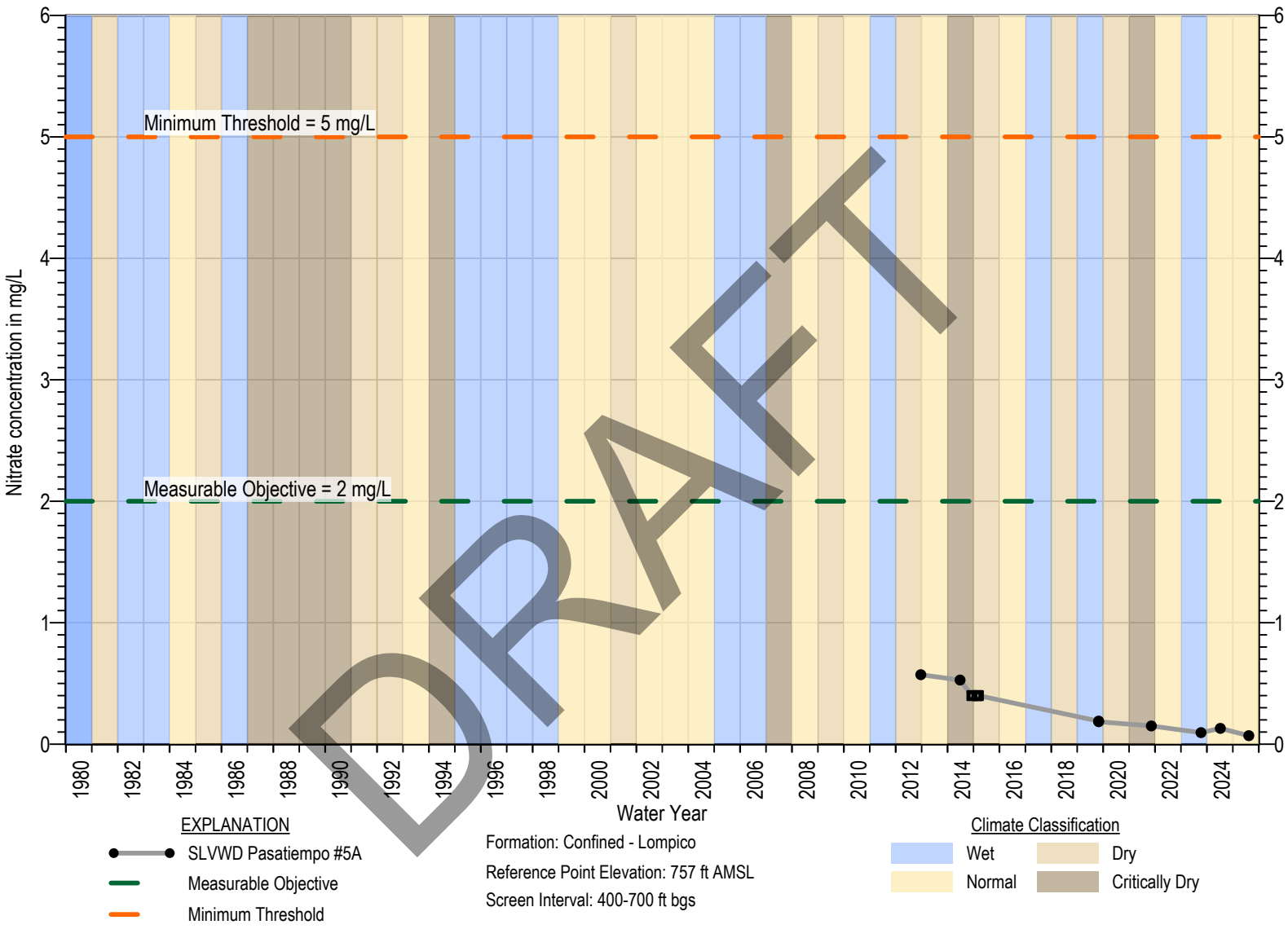


Figure 7B-16. Chemograph of SLVWD Pasatiempo #5A

MONTGOMERY & ASSOCIATES

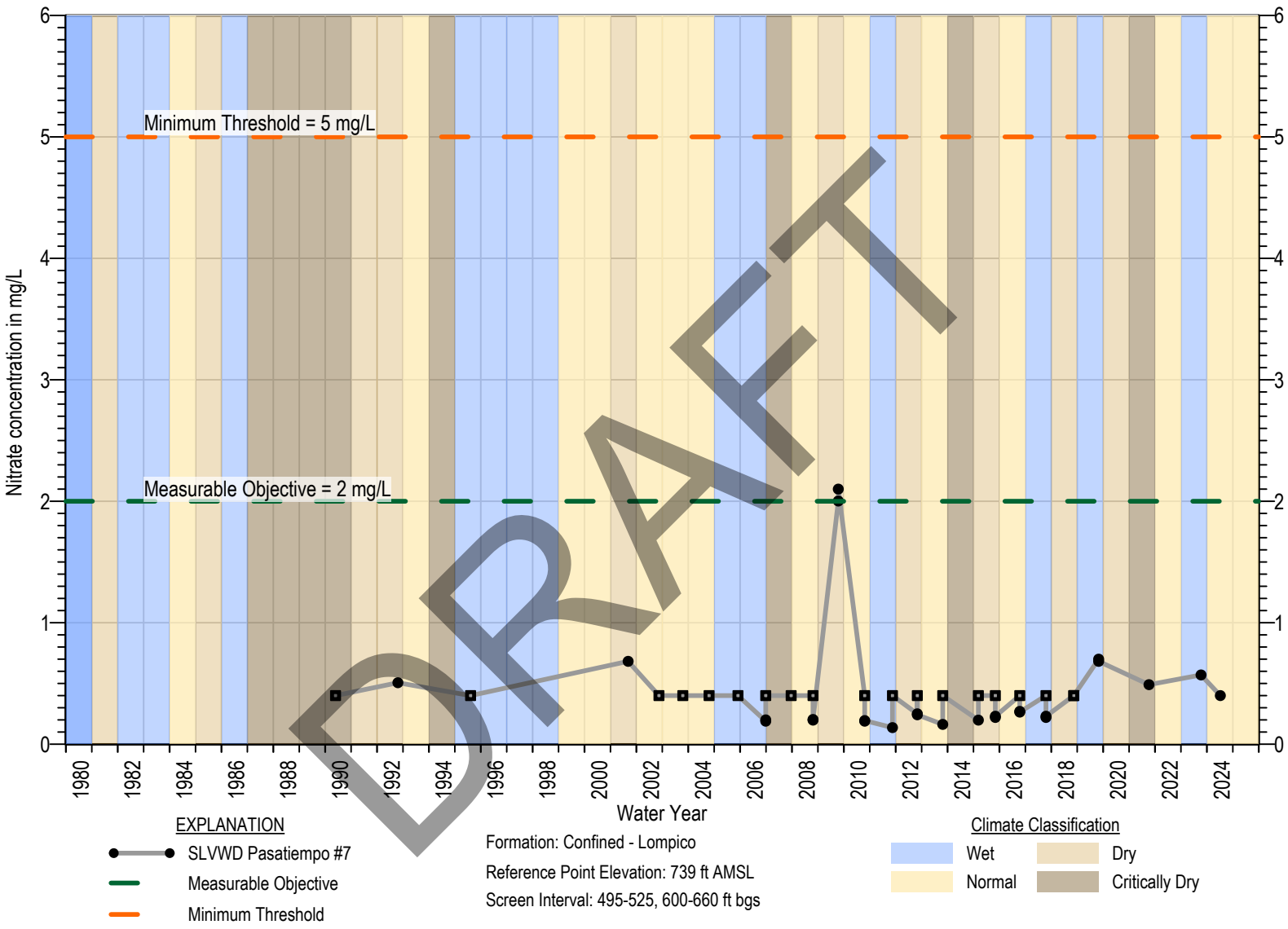


Figure 7B-17. Chemograph of SLVWD Pasatiempo #7

MONTGOMERY & ASSOCIATES

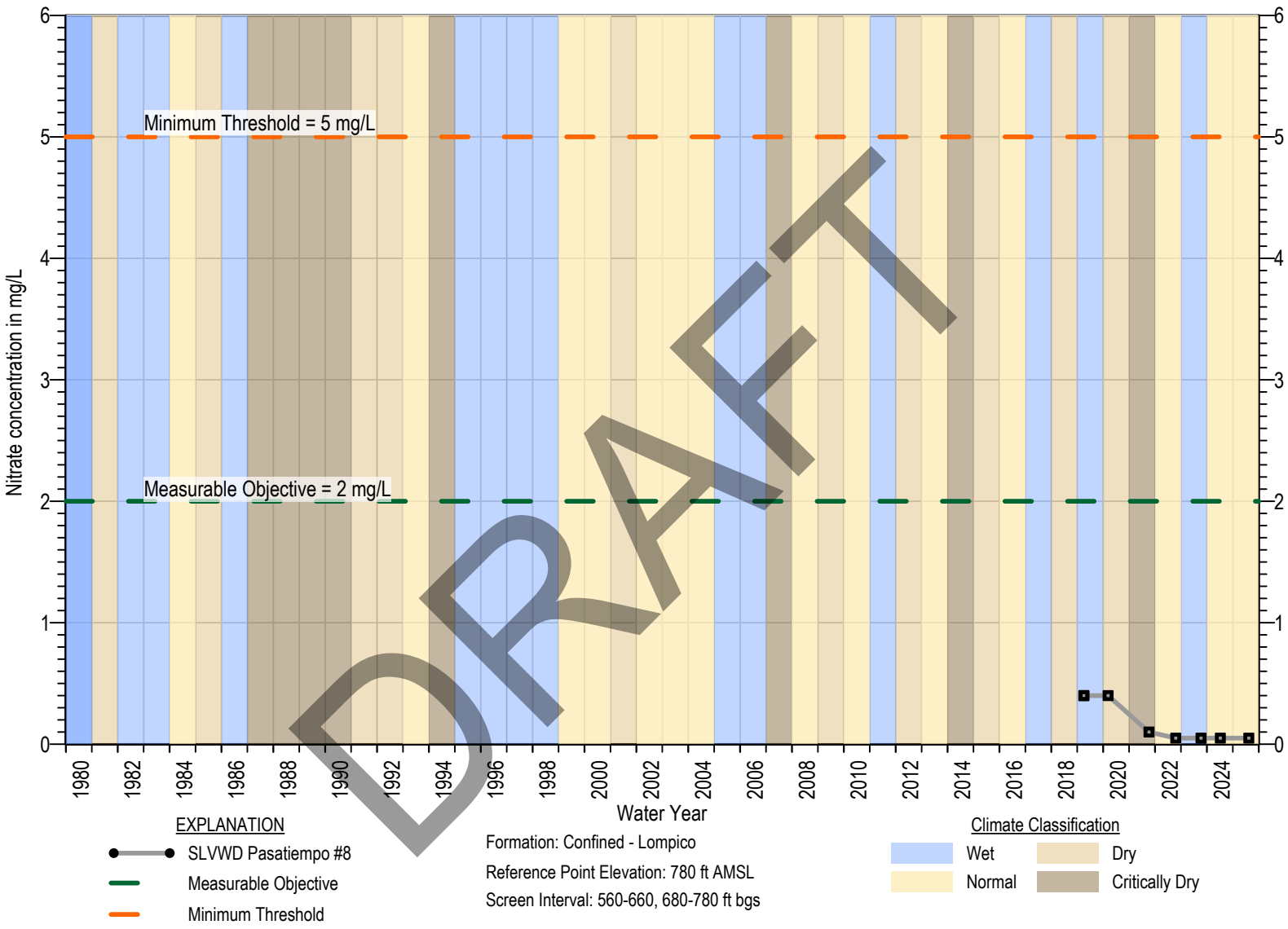


Figure 7B-18. Chemograph of SLVWD Pasatiempo #8

MONTGOMERY & ASSOCIATES

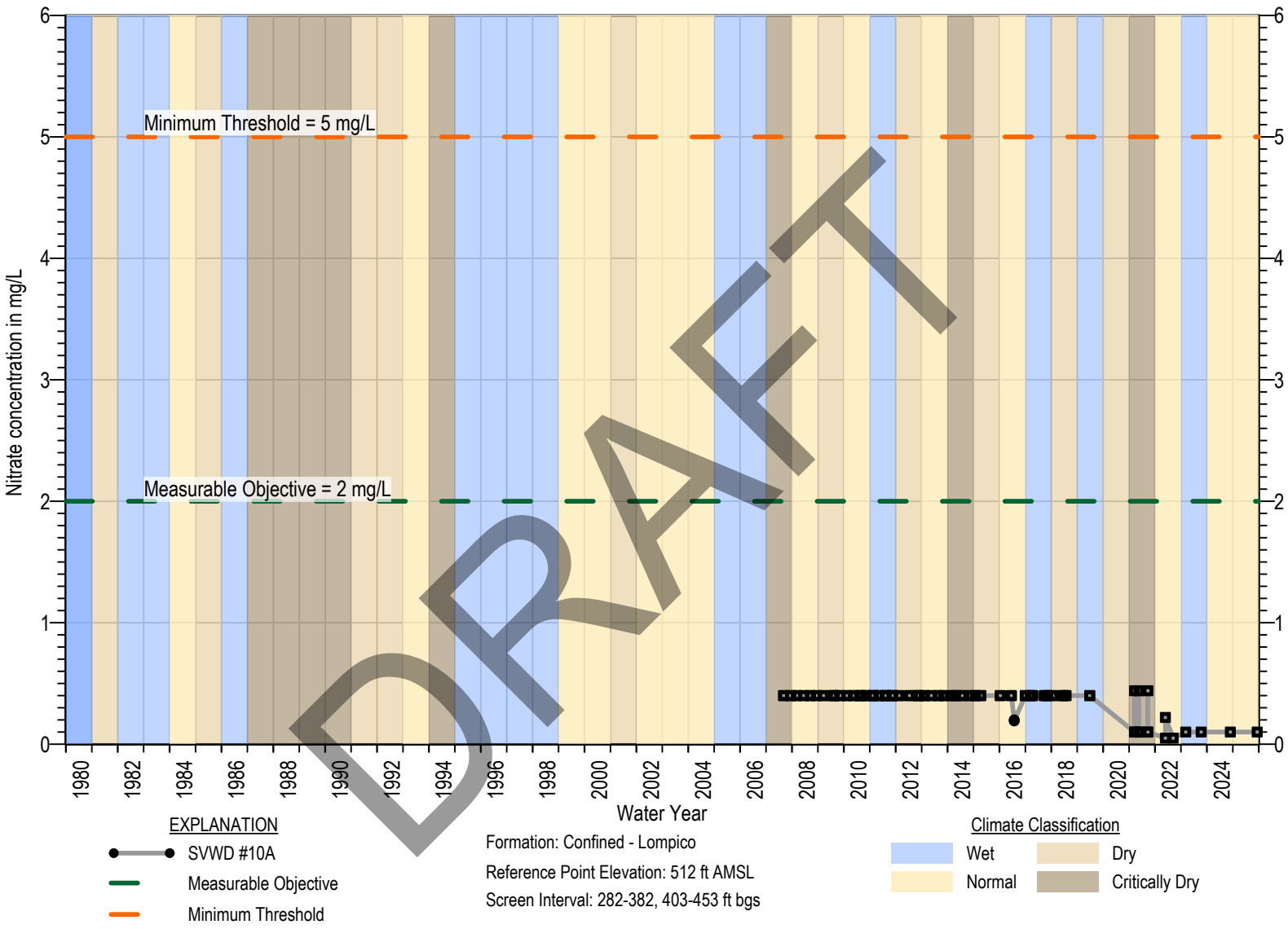
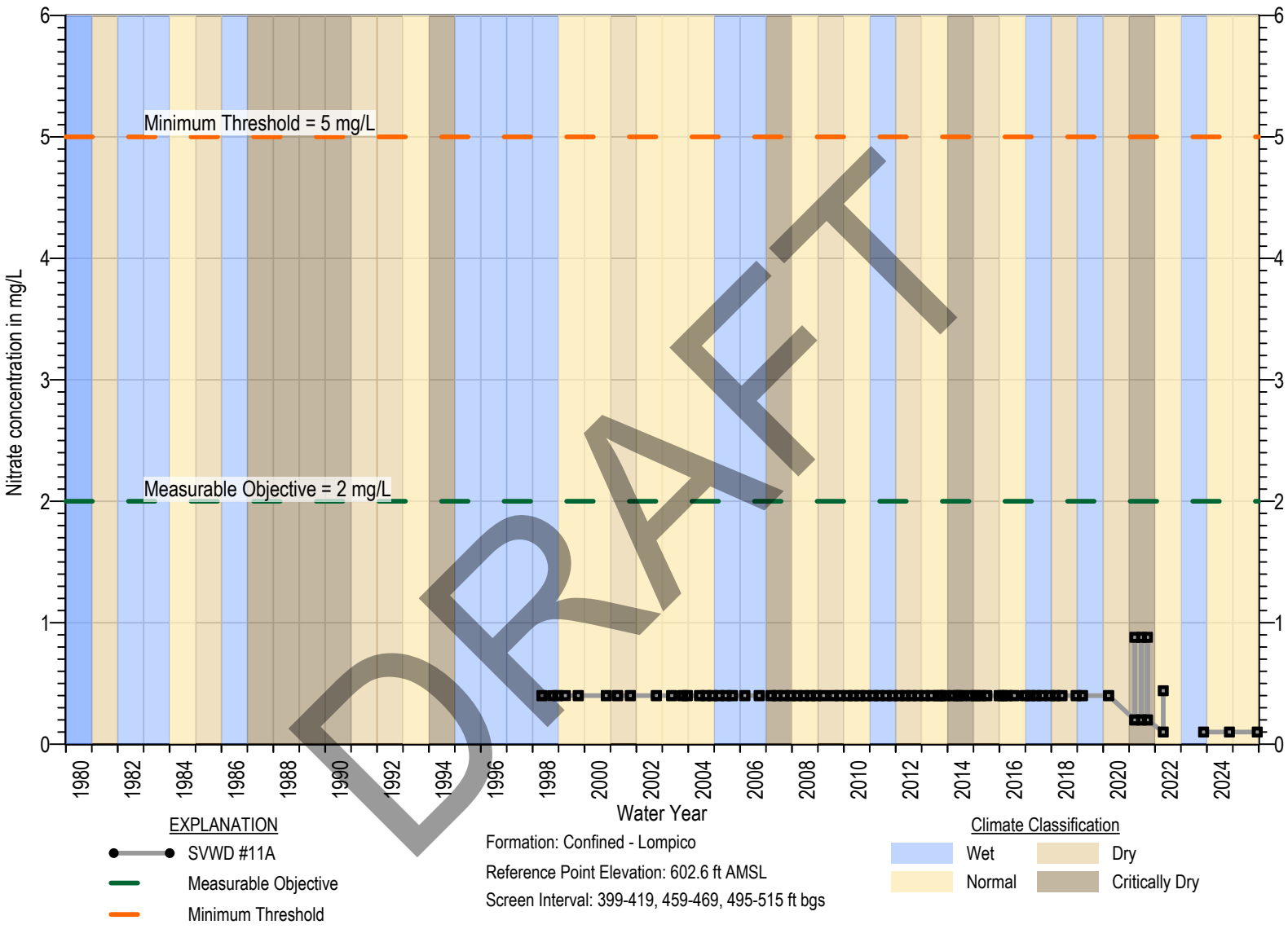


Figure 7B-19. Chemograph of SVWD #10A

MONTGOMERY & ASSOCIATES



DRAFT

Figure 7B-20. Chemograph of SVWD #11A

MONTGOMERY & ASSOCIATES

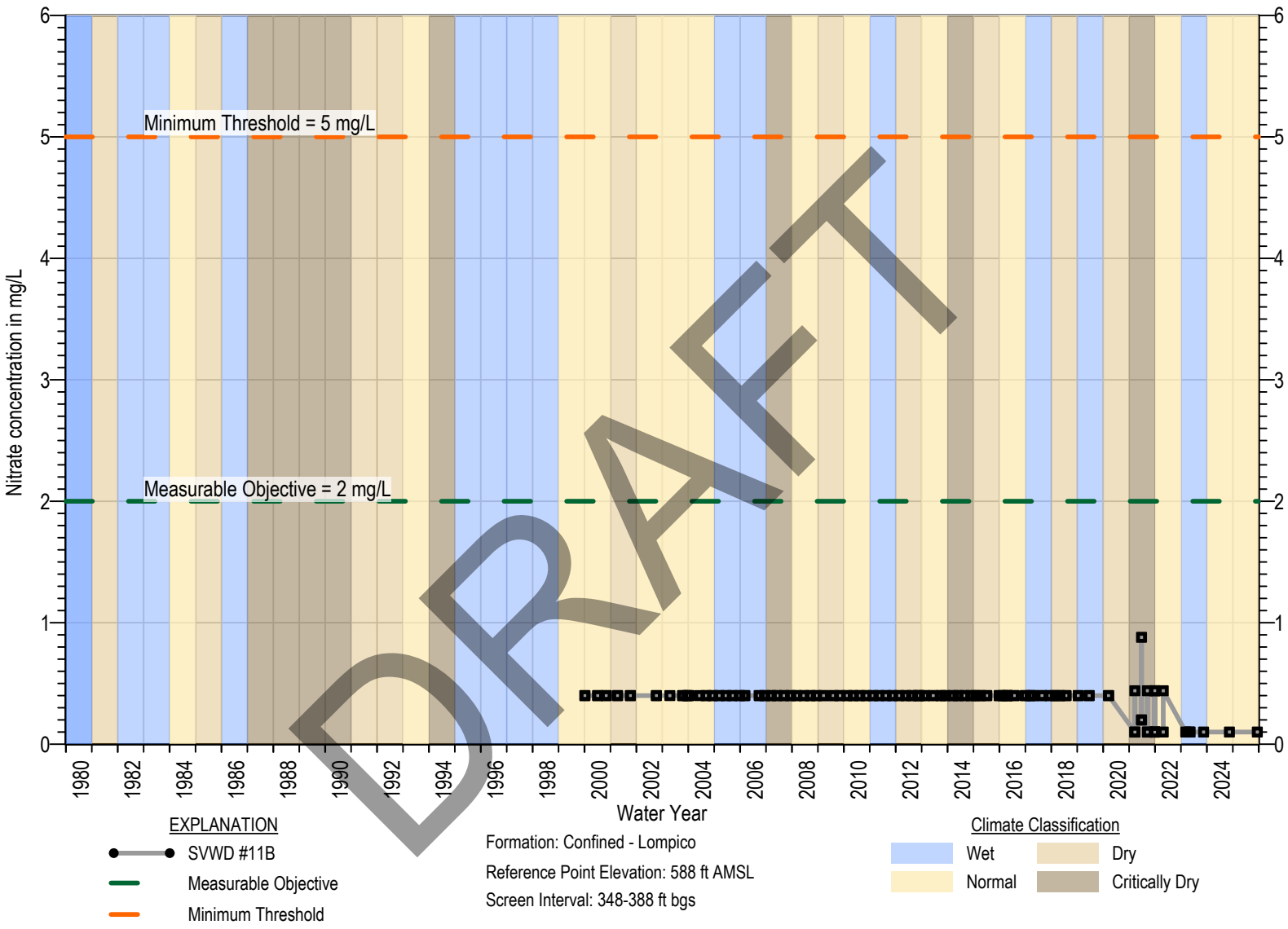


Figure 7B-21. Chemograph of SVWD #11B

MONTGOMERY & ASSOCIATES

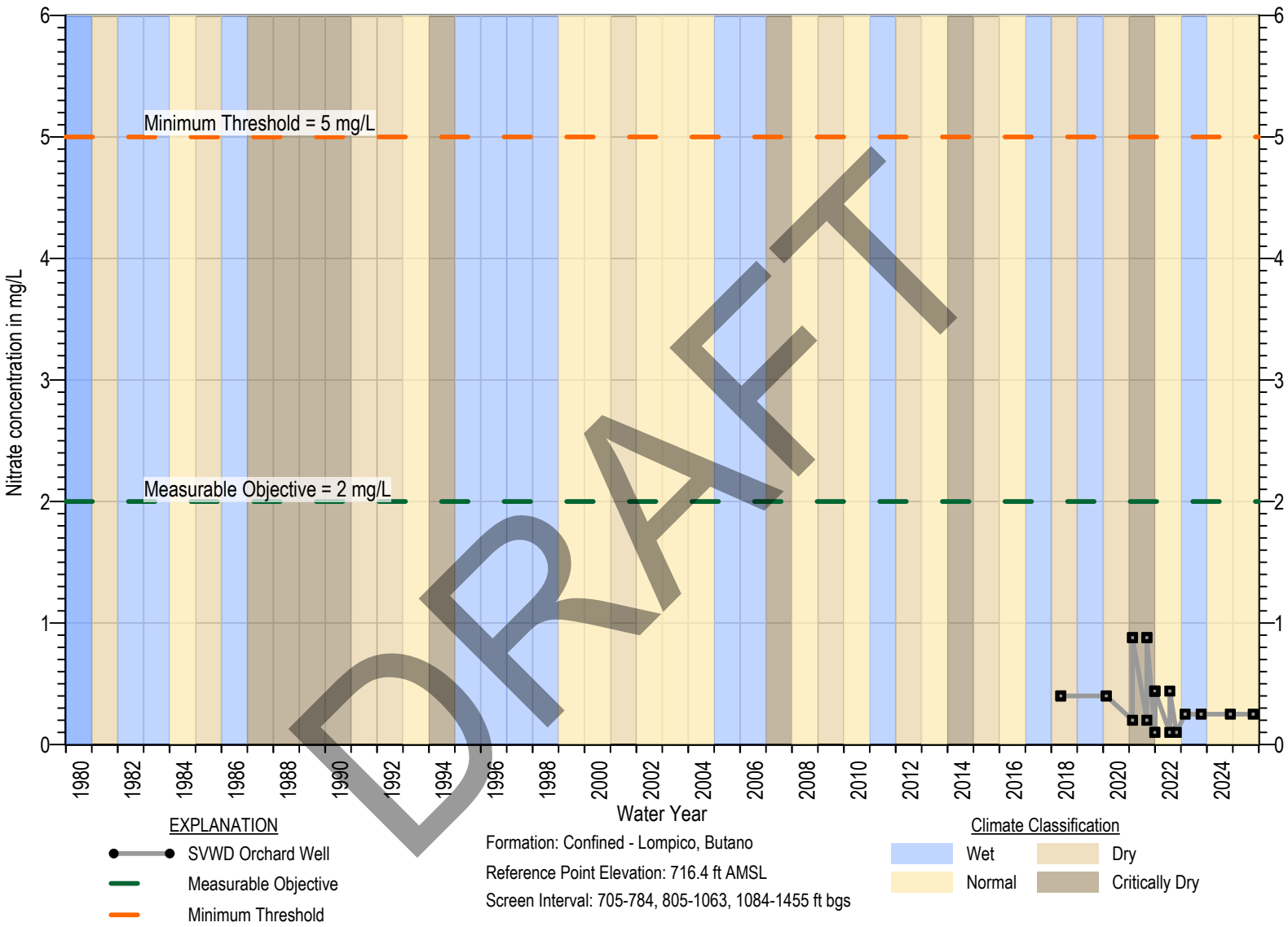
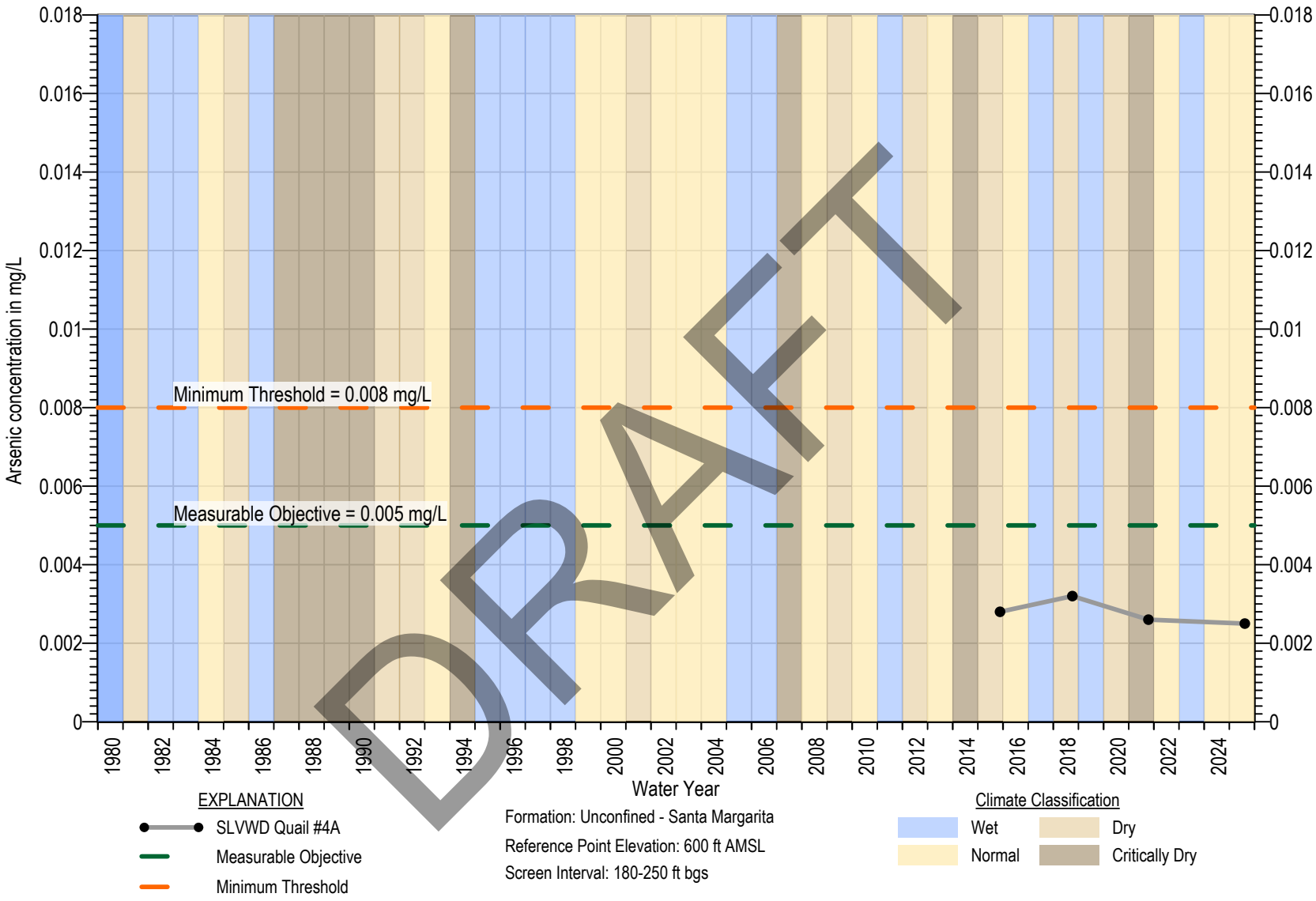


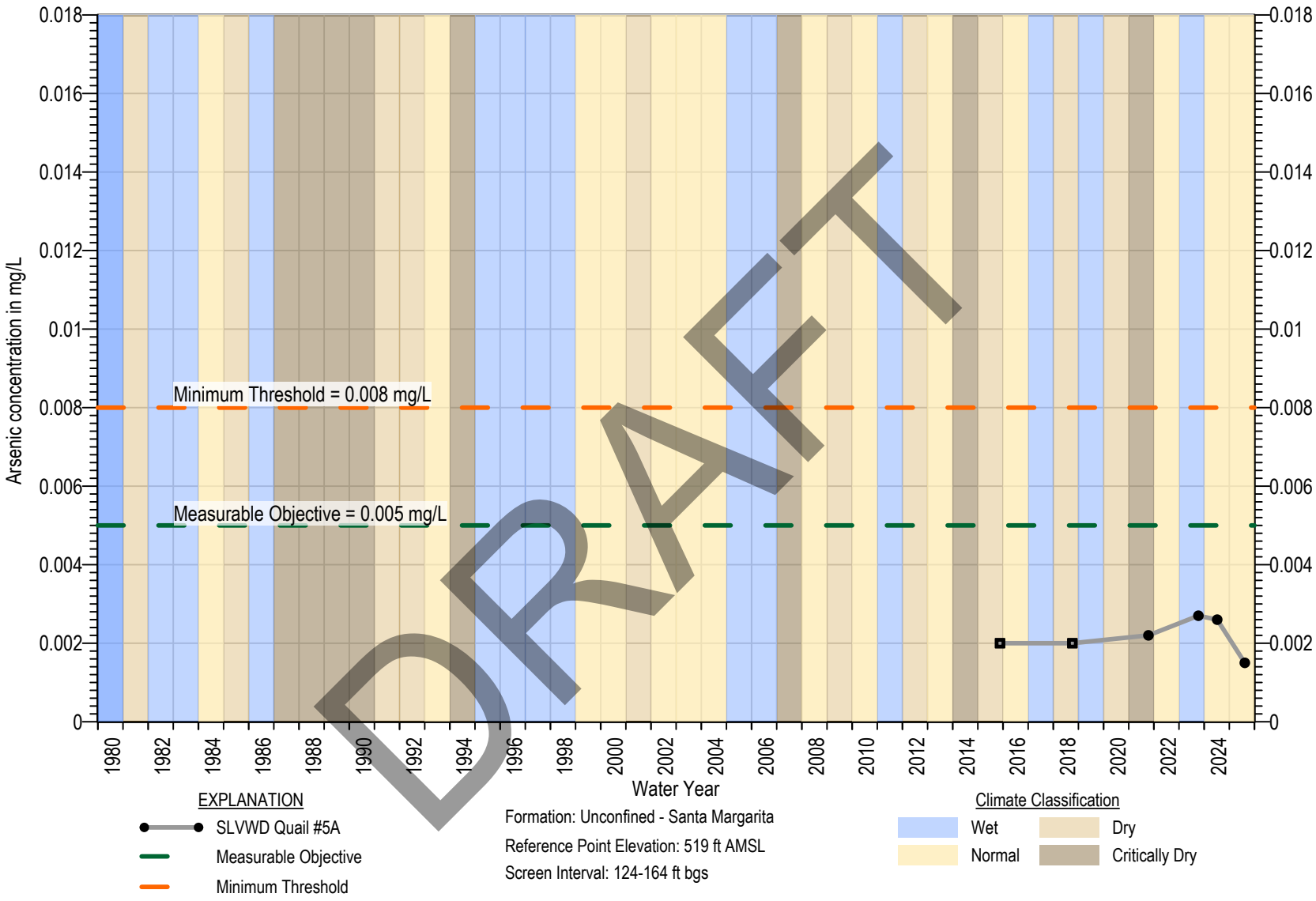
Figure 7B-22. Chemograph of SVWD Orchard Well

MONTGOMERY & ASSOCIATES



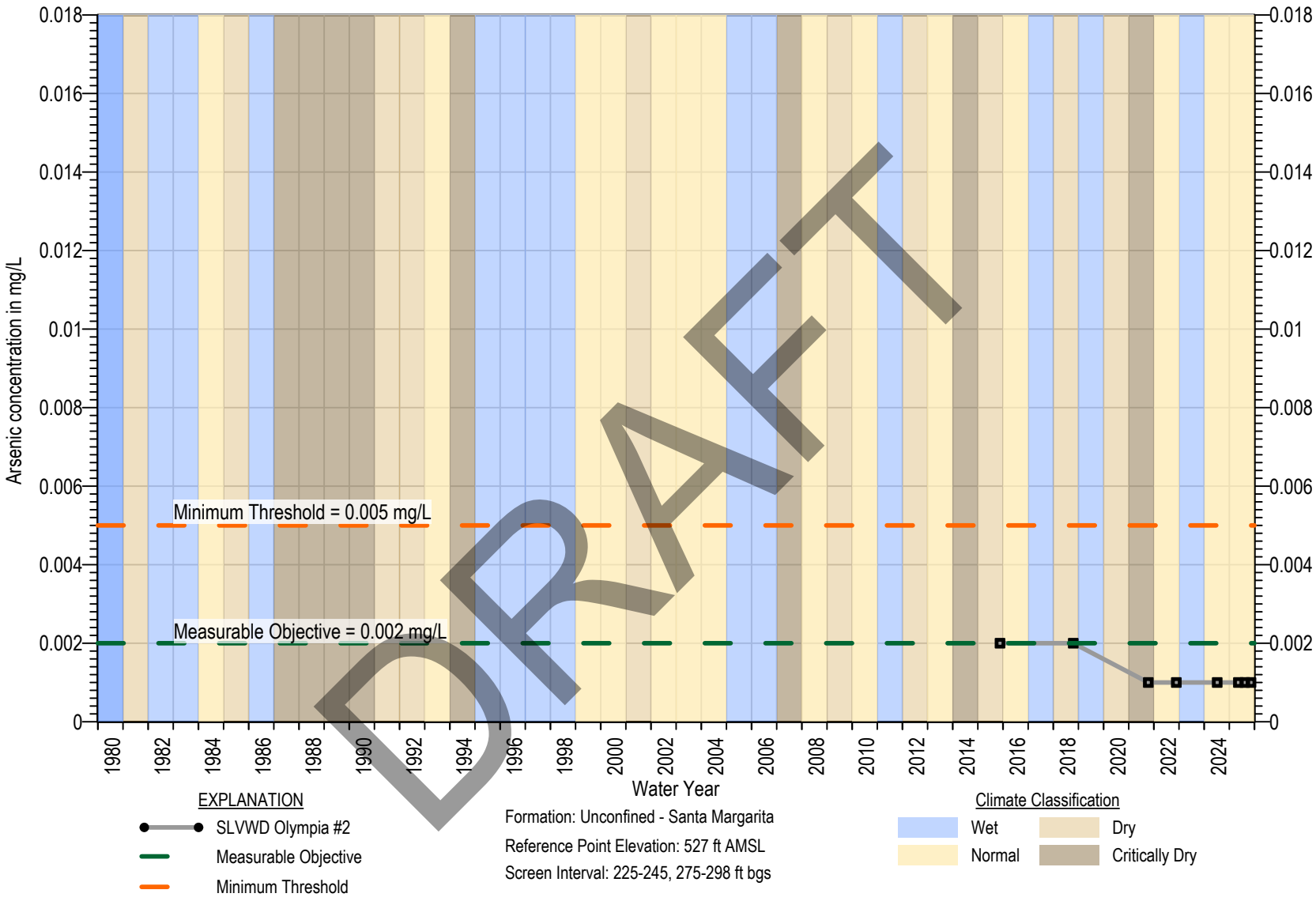
DRAFT

Figure 7B-23. Chemograph of SLVWD Quail #4A



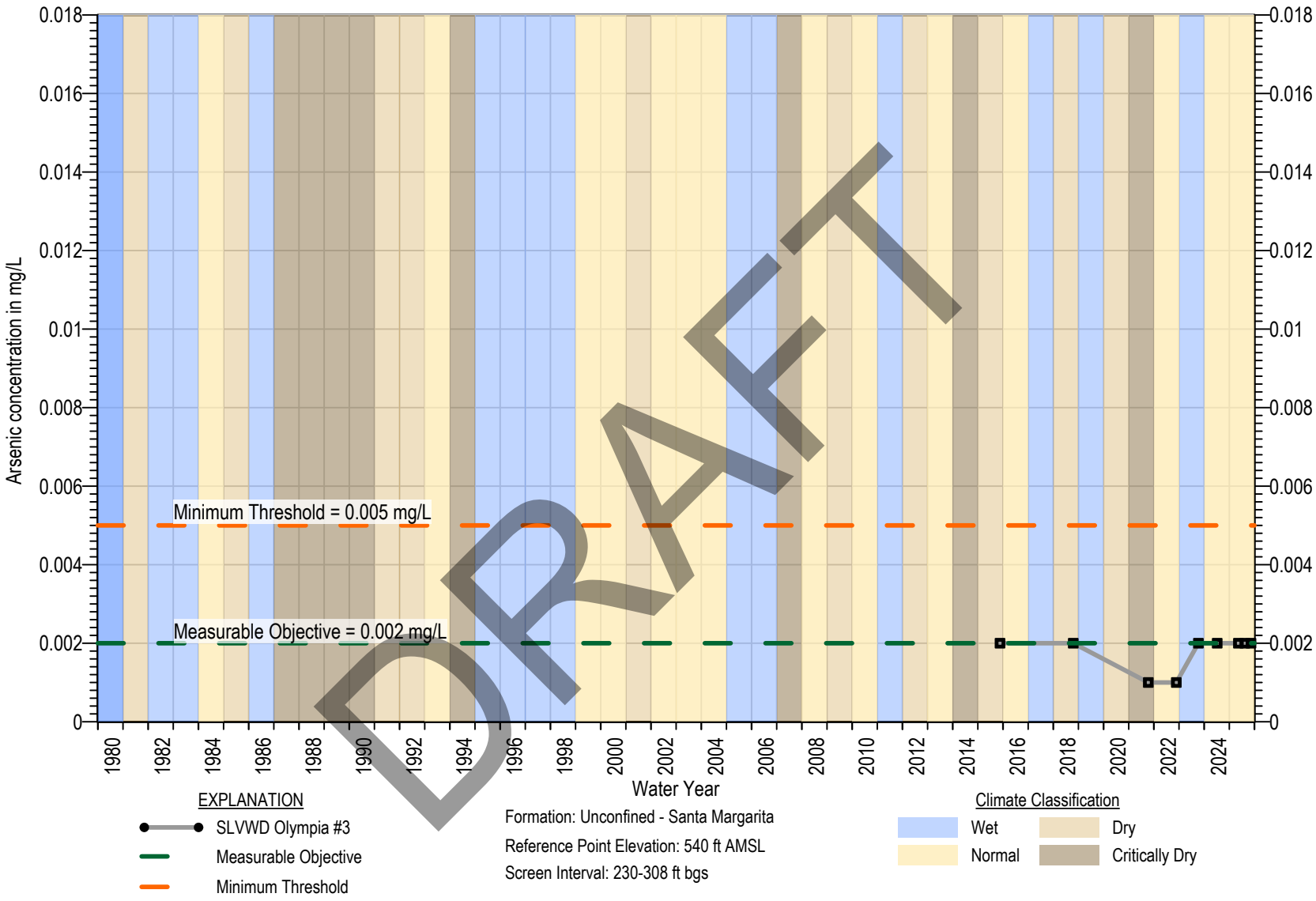
DRAFT

Figure 7B-24. Chemograph of SLVWD Quail #5A



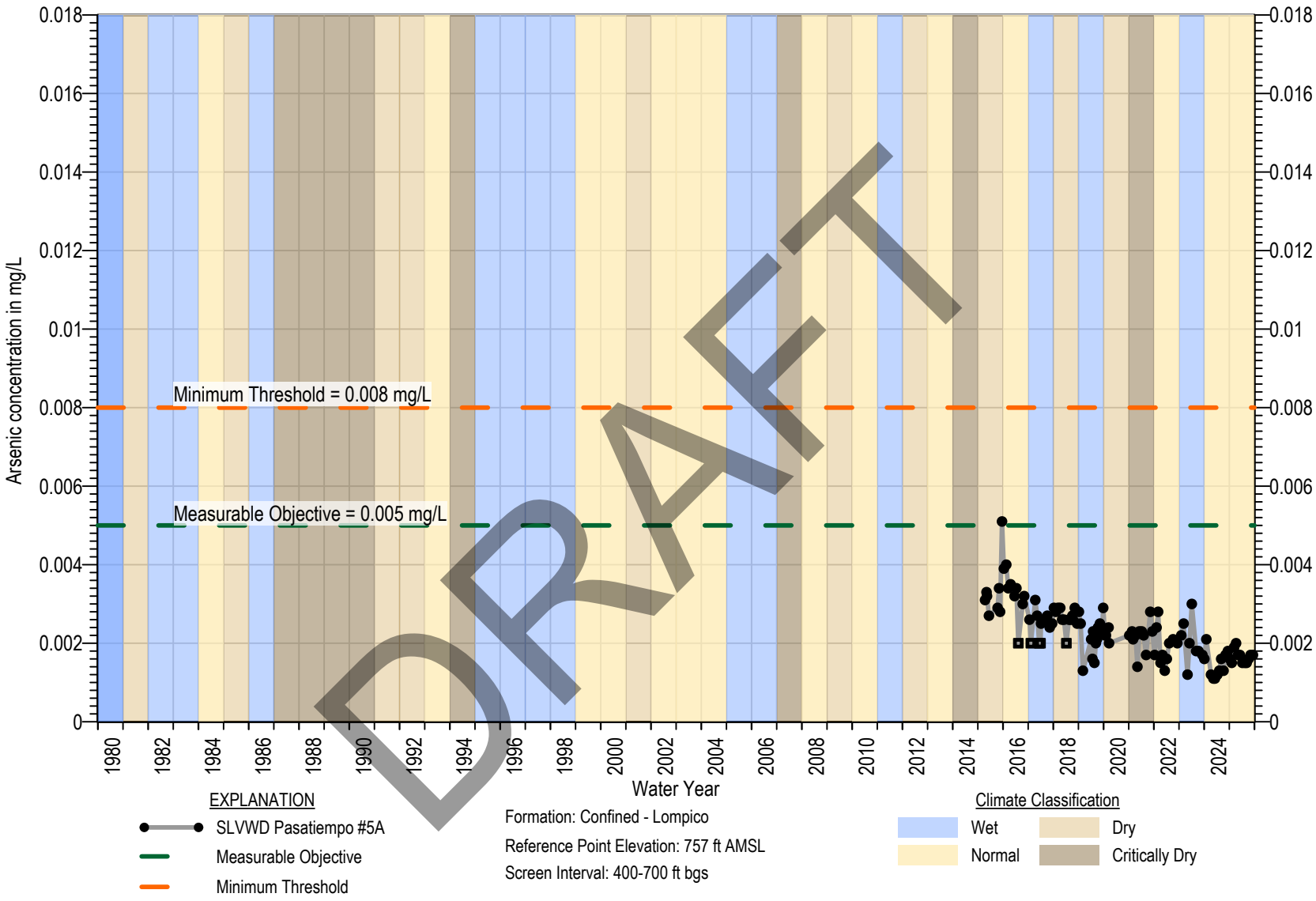
DRAFT

Figure 7B-25. Chemograph of SLVWD Olympia #2



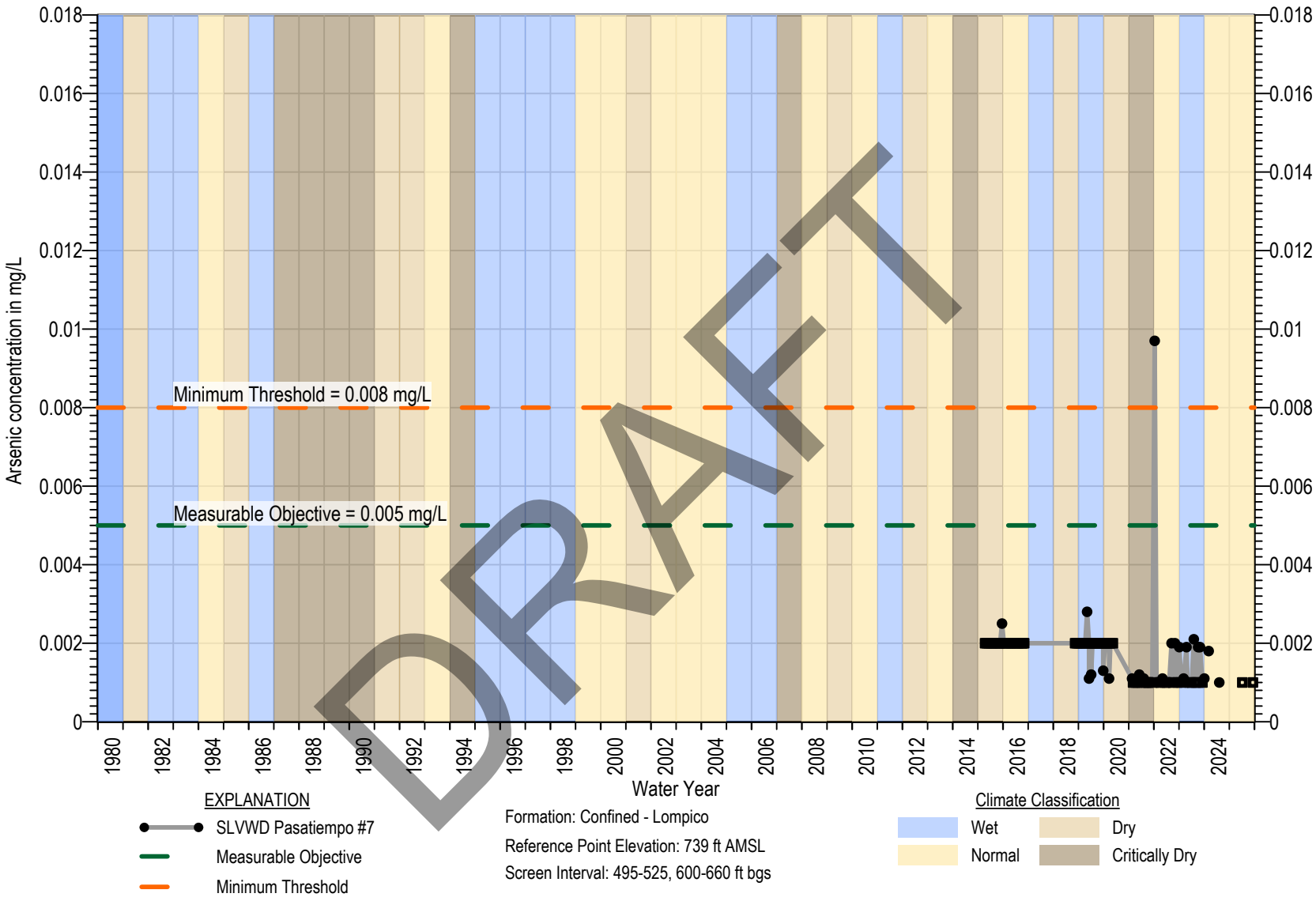
DRAFT

Figure 7B-26. Chemograph of SLVWD Olympia #3



DRAFT

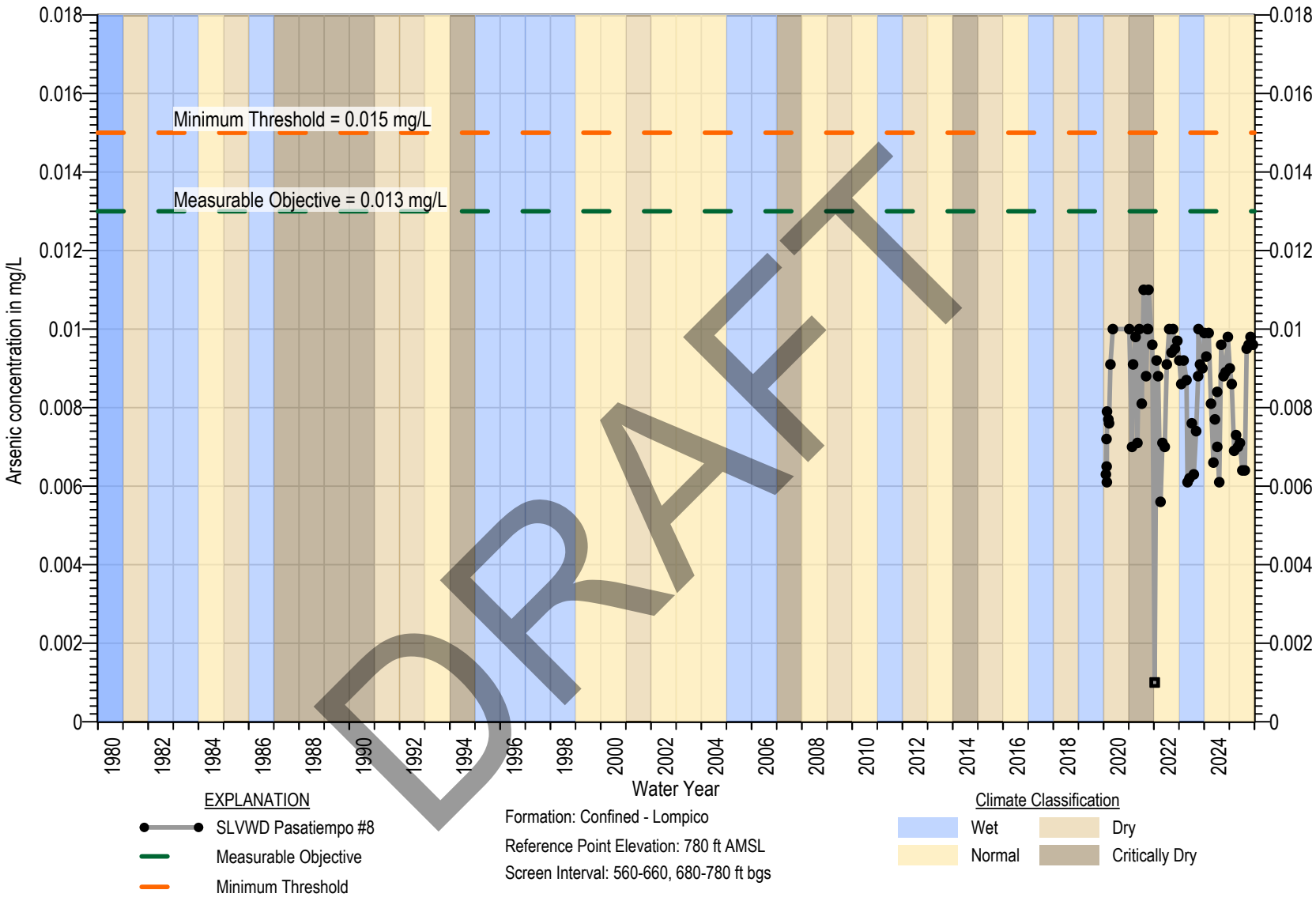
Figure 7B-27. Chemograph of SLVWD Pasatiempo #5A



DRAFT

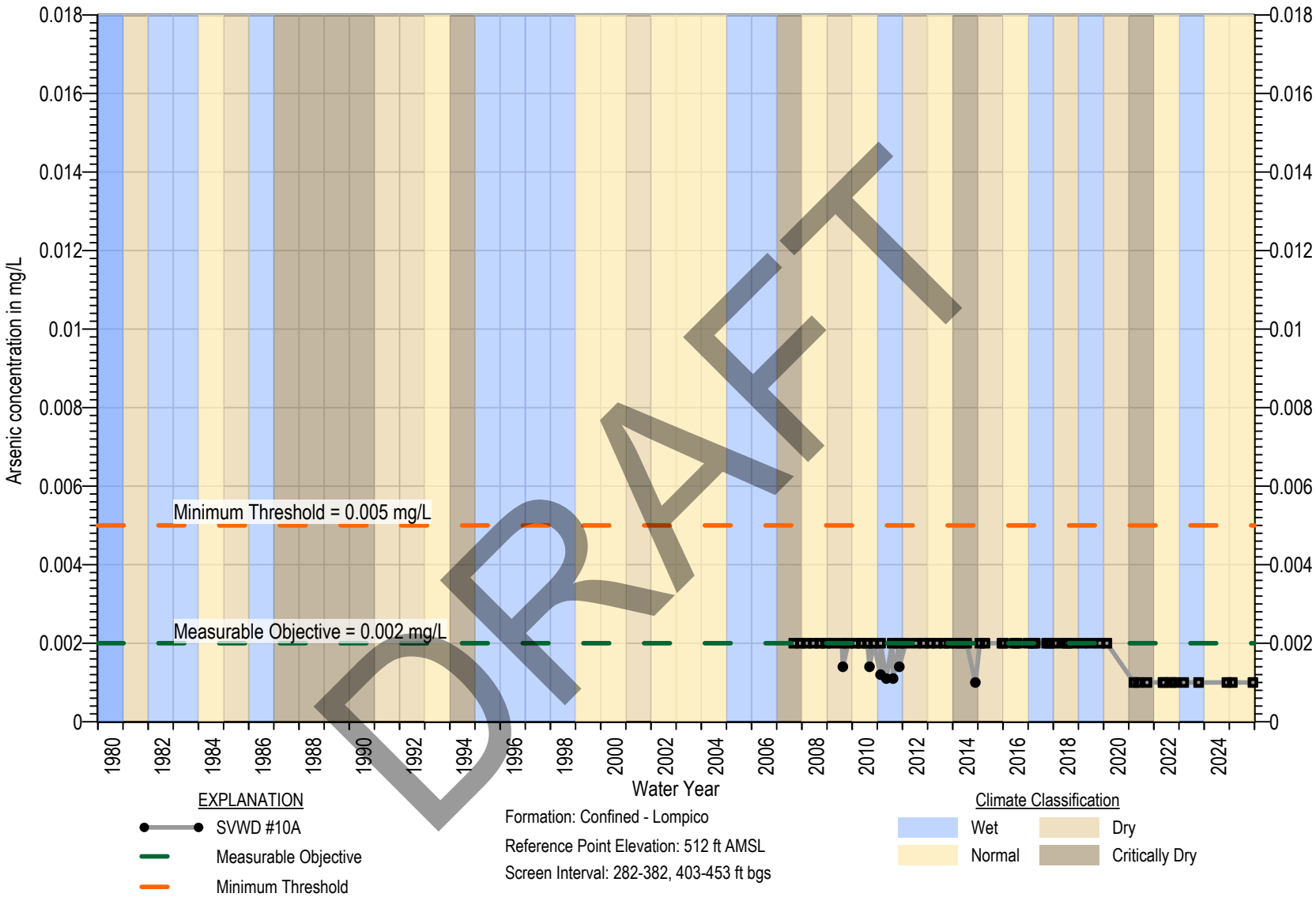
Figure 7B-28. Chemograph of SLVWD Pasatiempo #7

MONTGOMERY & ASSOCIATES



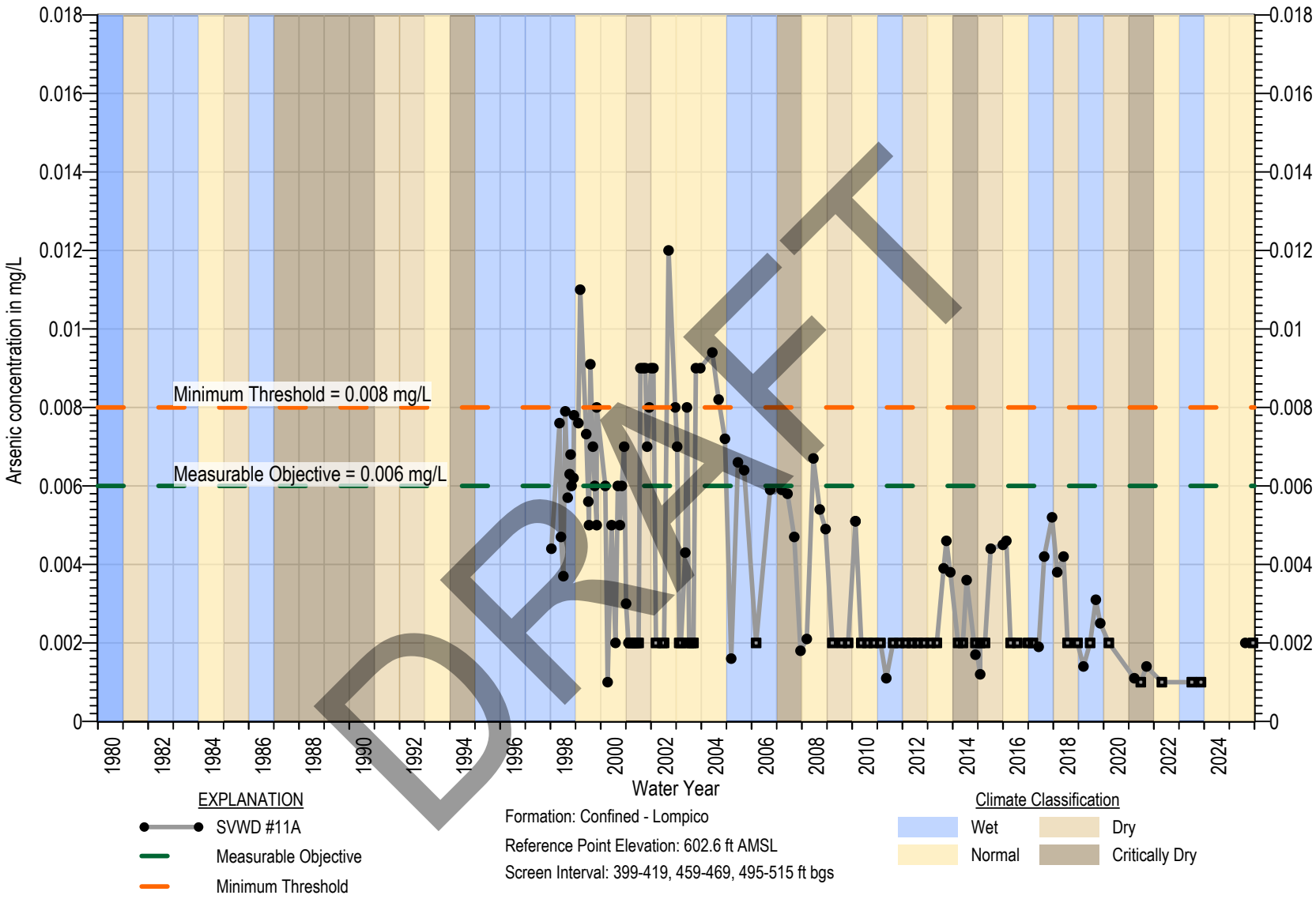
DRAFT

Figure 7B-29. Chemograph of SLVWD Pasatiempo #8



DRAFT

Figure 7B-30. Chemograph of SVWD #10A



DRAFT

Figure 7B-31. Chemograph of SVWD #11A

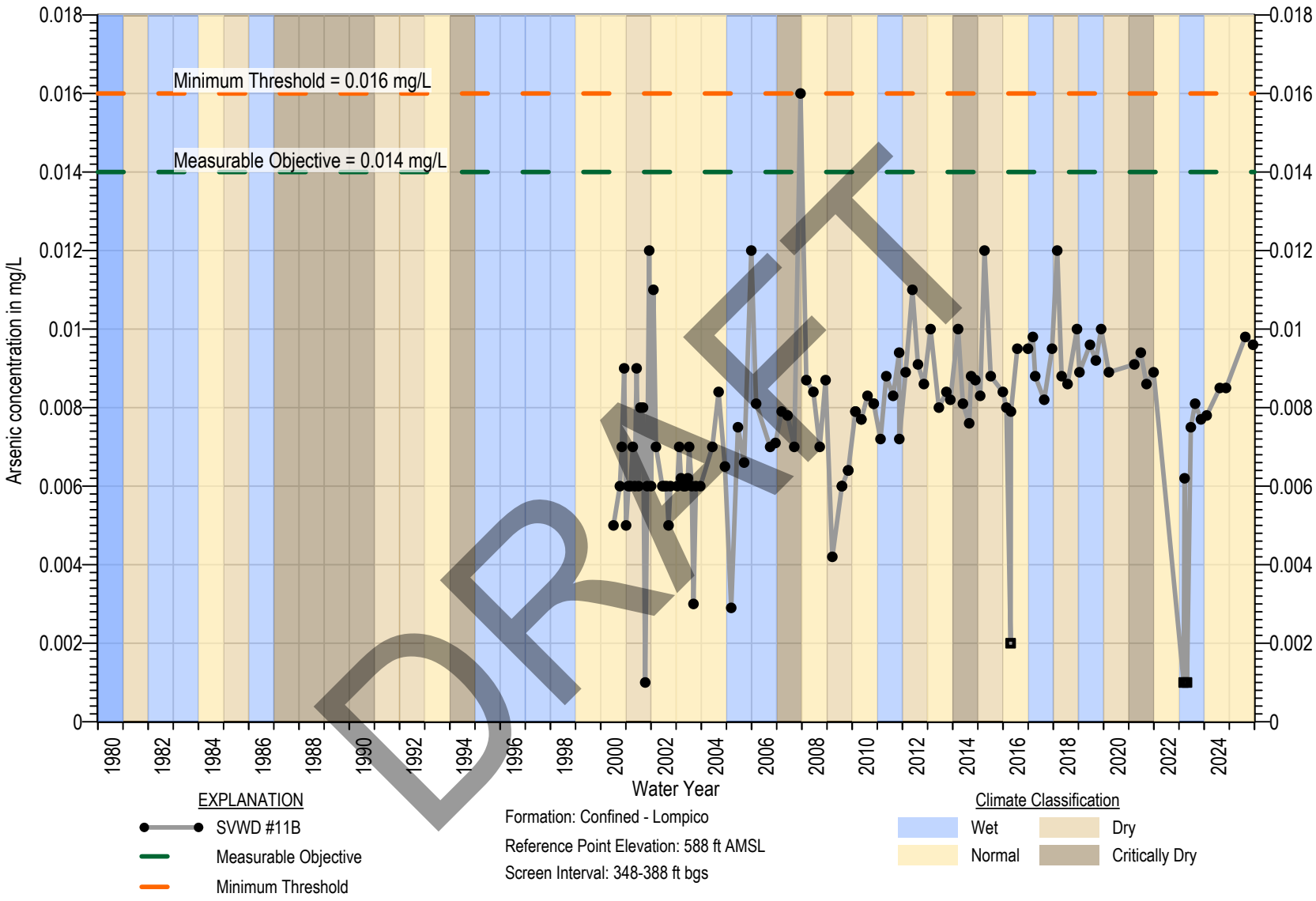


Figure 7B-32. Chemograph of SVWD #11B

MONTGOMERY & ASSOCIATES

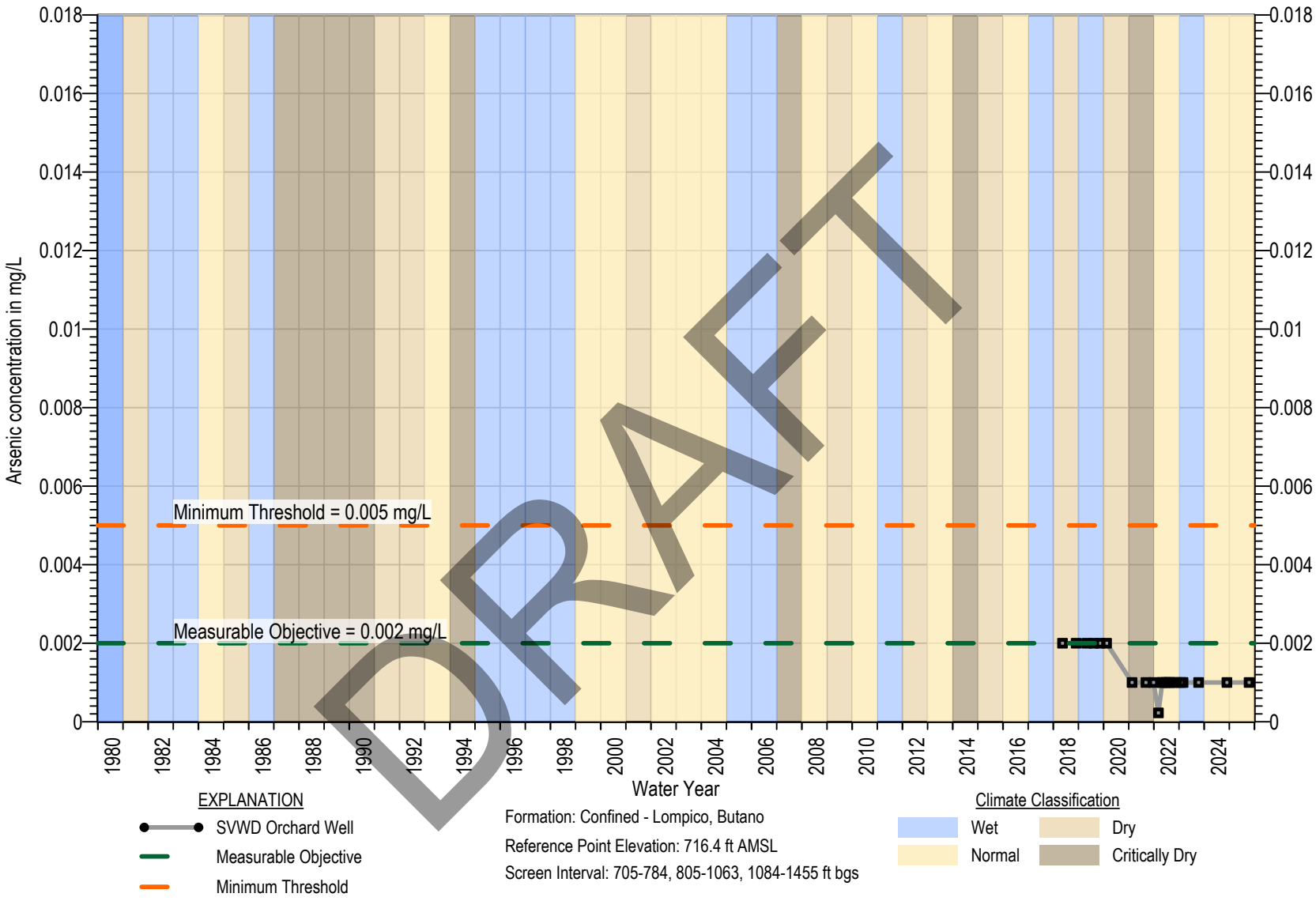


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Figure 7B-33. Chemograph of SVWD Orchard Well

MONTGOMERY & ASSOCIATES