MONTGOMERY & ASSOCIATES
Water Resource Consultants

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Santa Margarita Basin
Water Year 2022 Annual Report

Prepared for:

Santa Margarita Groundwater Agency

Prepared by:

Montgomery & Associates

1970 Broadway, Suite 225, Oakland, California

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ACRONYMS & ABBREVIATIONS

1,2-DCE 1,2-dichloroethene
AF ....acre-feet
AF/yr ....acre-feet per year
amsl ....above mean sea level
Annual Report ....GSP Annual Report
ASR...........................Aquifer Storage and Recovery
Basin ....Santa Margarita Groundwater Basin
Basin Model ....GSP Groundwater Basin Model
County.......................County of Santa Cruz
DAC ....disadvantaged community
DLR...........................detection limit for reporting
DWR ....California Department of Water Resources
EIR ....Environmental Impact Report
ft bgs..........................feet below ground surface
GSA ....Groundwater Sustainability Agency
GSP ....Groundwater Sustainability Plan
JPA ....Joint Powers Agreement
LID ....low impact development
mg/L..........................milligrams per liter
MHA ....Mount Hermon Association
MO ....measurable objective
MT.............................minimum threshold
MTBE ....methyl-tert-butyl ether
ND.............................not detected at laboratory detection limit
PCE ....tetrachloroethene
RMPs.........................representative monitoring point(s)
SCWD ....City of Santa Cruz Water Department
SLVWD ....San Lorenzo Valley Water District
SGMA ....Sustainable Groundwater Management Act
SGMI.........................Sustainable Groundwater Management Implementation
SMC ....sustainable management criteria
SMGWA ....Santa Margarita Groundwater Agency
SVWD.......................Scotts Valley Water District
TCE ....trichloroethene
TDS ....total dissolved solids
µg/L...........................micrograms per Liter
VOCs.........................volatile organic compounds
WY ....Water Year

EXECUTIVE SUMMARY

The Santa Margarita Groundwater Agency (SMGWA) prepared this second Groundwater Sustainability Plan (GSP) Annual Report (Annual Report) to summarize groundwater extractions, overall water use, groundwater conditions, and progress toward achieving sustainability for the Santa Margarita Basin (Basin) in Water Year (WY) 2022. Per the Sustainable Groundwater Management Act (SGMA), an Annual Report must be submitted to the California Department of Water Resources (DWR) by April 1 each year after completing a GSP. This Annual Report covers WY2022 from October 1, 2021, through September 30, 2022.

No undesirable results occurred in the Basin in WY2022. Other than iron and manganese that are naturally occurring at concentrations above regulatory standards and minimum thresholds, no minimum thresholds (MTs) were exceeded for the Sustainable Management Criteria (SMC) relevant to the Basin.

Like much of California, the Basin experienced significantly below-average rainfall from WY2020 through WY2022. Despite drier-than-average conditions in WY2022, groundwater levels largely remained stable compared to WY2021 due to reduced groundwater extraction, which resulted in a modest increase of groundwater in storage.

In WY2022, an estimated total of 2,485 acre-feet (AF) of groundwater was extracted from the Basin, which is the lowest annual volume since at least WY1985. About 74% of groundwater extracted was used for public water supply by the 2 biggest water providers in the Basin: San Lorenzo Valley Water District (SLVWD, 29%) and Scotts Valley Water District (SVWD, 45%). The remaining 26% of groundwater was used by Mount Hermon Association (MHA, 6%), other small water systems and private domestic wells (14%), and non-domestic users (6%). Groundwater in the Basin is predominantly extracted from 3 principal aquifers: the Lompico aquifer (51%), Santa Margarita aquifer (27%), and Butano aquifer (17%).

Surface water from the San Lorenzo River and its tributaries is an important water supply both in the Basin and downstream in the City of Santa Cruz Water Department (SCWD) service area. Surface water availability and use fluctuates annually based on weather, with more surface water use in wet years and less in dry years.

In WY2022, SLVWD reduced its groundwater extraction by about 47% compared to WY2021, a year in which groundwater usage was anomalously high due to the destruction of surface water infrastructure in the August 2020 CZU wildfire. The emergency condition created by the wildfire damage allowed SLVWD to use an emergency intertie to maximize its surface water diversions in the Felton System (while maintaining fish bypass flows) in conveying water to the North and

South Systems to reduce reliance on groundwater. This District-wide conjunctive use made it possible for SLVWD to use surface water exclusively for approximately 30 days in WY2021 and 60 days in WY2022, and to reduce WY2022 total groundwater extraction to an annual volume that is one of the lowest on record, despite having only a single reconstructed surface water intake in the North system. SLVWD plans to rebuild the remaining damaged creek intakes and the raw water pipelines in the North System in order to restore its surface water supply and increase the amount of surface water available for *in lieu* recharge to further reduce groundwater extraction in the Basin.

SVWD reduced its groundwater extraction by about 2% in WY2022 compared to WY2021, with most reductions coming from its Lompico aquifer wells. Groundwater extraction by small water systems, including MHA, have remained stable according to data reported to the County. Un-metered groundwater extraction by private domestic wells and other minor non-domestic users are not expected to fluctuate significantly from year to year.

Reduced groundwater extractions in recent years have allowed groundwater levels to stabilize, thus meeting the Basin's sustainability goals and SMC established in the GSP. At all the representative monitoring points (RMPs) used to assess chronic lowering of groundwater levels and depletion of interconnected surface water, groundwater elevations are higher than MTs. Groundwater elevations in many RMPs are higher than the 2027 interim milestones and the long-term measurable objectives (MO) SMGWA strives to achieve by 2042. The volume of groundwater extracted, used to evaluate the groundwater in storage indicator, is less than the MT but does not quite achieve the MO. This is expected as the MO for groundwater in storage is an aspirational level based on implementation of projects and management actions that are still in the planning phase.

Total water use by the two major water providers in the Basin, SLVWD and SVWD, has been decreasing consistently since the early 2000s, largely due to residents' strong conservation efforts and State regulations regarding water use efficiency in construction, as well as water-efficiency measures undertaken by the water districts. Over this same period, groundwater extraction by SVWD has declined despite continued population growth in the city of Scotts Valley. As a result, in WY2022 the volume of groundwater extracted south of Bean Creek, where the majority of the Basin's population resides, was similar to the volume extracted north of Bean Creek. The two-decade long reduction in groundwater use is consistent with the observation that groundwater elevations in SVWD wells in the South Scotts Valley area appear to be on a recovery trajectory since WY2015, despite recent dry years. These data suggest that current extraction rates in the area of most concern, the Lompico aquifer south of Bean Creek, may be sustainable under present conditions; however, implementation of GSP projects is likely needed to adapt to future climate conditions.

Groundwater in the Basin is generally of good quality and meets primary drinking water standards. Naturally occurring groundwater quality constituents that are present in some aquifers locally in the Basin are iron, manganese, arsenic, and salinity. Nitrate is the main anthropogenic groundwater contaminant that is detected occasionally in a minority of wells. In WY2022, groundwater quality concentrations are lower than MTs for all analyzed constituents except iron and manganese, which regularly exceed applicable secondary drinking water standards. These exceedances of MTs are naturally occurring; hence undesirable results are not being caused by groundwater use. All measured concentrations of iron and manganese were within their respective historical ranges. The concentrations of TDS, chloride, and nitrate were all well below MTs, but exceeded MOs in some but not all wells sampled. Arsenic was detected in 3 of 7 wells sampled. SVWD #11B is the only RMP well that regularly approaches the arsenic MCL and MT of 10 μg/L.

In WY2022, SMGWA member and partner agencies made significant progress in GSP implementation. This included advanced planning efforts for expanded conjunctive use of surface water and groundwater. Although all indicators are that the Basin is now on a positive trajectory, the two decades of overdraft caused losses of groundwater in storage that otherwise would provide a buffer against extended drought. In order to assure sustainability of the Basin under predicted future climate patterns, the 2022 GSP ranked a number of potential projects and management actions that could be implemented in the Basin. The highest-priority projects were continuation and augmentation of conservation and water efficiency projects that began before the 2022 GSP and expansion of *in lieu* recharge in the Basin.

For many years, SLVWD has successfully practiced conjunctive use in its North System to limit groundwater extraction in wet years, so that increased reliance on groundwater in dry years does not cause groundwater overdraft. SLVWD is currently pursuing a change in its water rights to expand conjunctive use within the District so that excess surface flows from the Felton System could be conveyed to the North and South Systems for *in lieu* recharge in order to raise groundwater levels in the overdrafted Lompico aquifer south of Bean Creek, and to support fisheries in the creeks within the Basin. SLVWD plans to complete an Environmental Impact Report (EIR) in WY2024 in support of conjunctive use within the District boundaries.

SLVWD is also planning to complete a study in WY2023 that assesses the feasibility of conveyance and improvements to water treatment necessary in order to utilize its 313 AF allocation of the surface water supply stored in Loch Lomond by the SCWD. Environmental impact studies for use of the Loch Lomond allocation and potentially sending excess surface water to SVWD would be undertaken at a later date, as would changes in District water rights to allow inter-district transfers.

SVWD is exploring various projects and management actions to utilize alternative water supplies to groundwater that will make the District more resilient to climate change and help the Basin reach its sustainability goals. A change in SLVWD water rights could allow SLVWD to provide surface water to SVWD through an existing emergency intertie when excess water is available. In WY2022, SVWD was awarded a 2021 Urban and Multibenefit Drought Relief Grant (Phase 2) to fund design and construction of a bi-directional intertie with SCWD that could potentially provide excess wet-season surface water or purified wastewater to SVWD. The grant also funds construction of a new production well that will be used to extract groundwater stored while SVWD receives alternative water sources. The stored groundwater can be used to supply Basin and neighboring agencies during droughts when surface water is limited. Additionally, the new well will provide redundancy within the SVWD system and eventually replace aging infrastructure.

During WY2022, progress was made toward filling data gaps in the groundwater level monitoring network as identified in the GSP. During the past year, 8 new monitoring well sites were selected, well installation specifications were developed, and access negotiations with landowners were initiated. Well installations at 7 of the sites are planned for WY2023, with 1 significantly deeper well in the Butano aquifer needing additional funding to complete.

SMGWA prepared a Sustainable Groundwater Management Implementation (SGMI) Round 2 Grant application that was submitted in December, 2022, to fund some future GSP implementation efforts. The application requested funds to evaluate project and management actions, develop SMGWA funding mechanisms, perform additional monitoring of streams and groundwater dependent ecosystems, install the deep Butano aquifer monitoring well, provide private well owner assistance, and assist with GSP administration and reporting.

1 INTRODUCTION

This Groundwater Sustainability Plan (GSP) Annual Report (Annual Report) for the Santa Margarita Groundwater Basin (Basin) fulfills the requirements of Water Code §10733.6 and the Sustainable Groundwater Management Act (SGMA). The Santa Margarita Groundwater Agency (SMGWA), the sole Groundwater Sustainability Agency (GSA) for the Basin is required to submit an annual report to the California Department of Water Resources (DWR) by April 1 of each year following the adoption of its GSP. The SMGWA Board of Directors unanimously adopted the final GSP after a public hearing on November 17, 2021. The GSP was submitted to the SGMA Portal (https://sgma.water.ca.gov/portal/) on January 3, 2022. DWR is required under SGMA to complete its technical assessment of the GSP by January 31, 2024.

1.1 Purpose of Annual Report

The SMGWA has until the end of January 2042 to achieve sustainable groundwater conditions as described in the GSP. This Annual Report compiles groundwater data collected for the 2022 Water Year (WY) from October 1, 2021, through September 30, 2022. The purpose of the Annual Report is to evaluate groundwater conditions, summarize total water use, estimate change in groundwater storage, provide progress updates on projects and management actions implemented to achieve sustainability, and outline other GSP implementation tasks. Required Annual Report components are outlined in §356.2 of the GSP Regulations.

1.2 Santa Margarita Groundwater Agency

The SMGWA is the sole GSA for the Basin. It was formed through a Joint Powers Agreement (JPA) in June 2017 among the Scotts Valley Water District (SVWD), San Lorenzo Valley Water District (SLVWD), and the County of Santa Cruz (County). Figure 1 shows the jurisdictional extent of the Basin and member agencies that comprise the SMGWA. The SGMA and JPA grant the SMGWA the legal authority to implement the GSP in the Basin.

The SMGWA is governed by an 11-member Board of Directors comprised of 2 representatives from each member agency, 1 from the City of Scotts Valley, 1 from the City of Santa Cruz, 1 from Mount Hermon Association (MHA), and 2 private well owners. Each of the member agencies and other entities also have an alternate Board member.

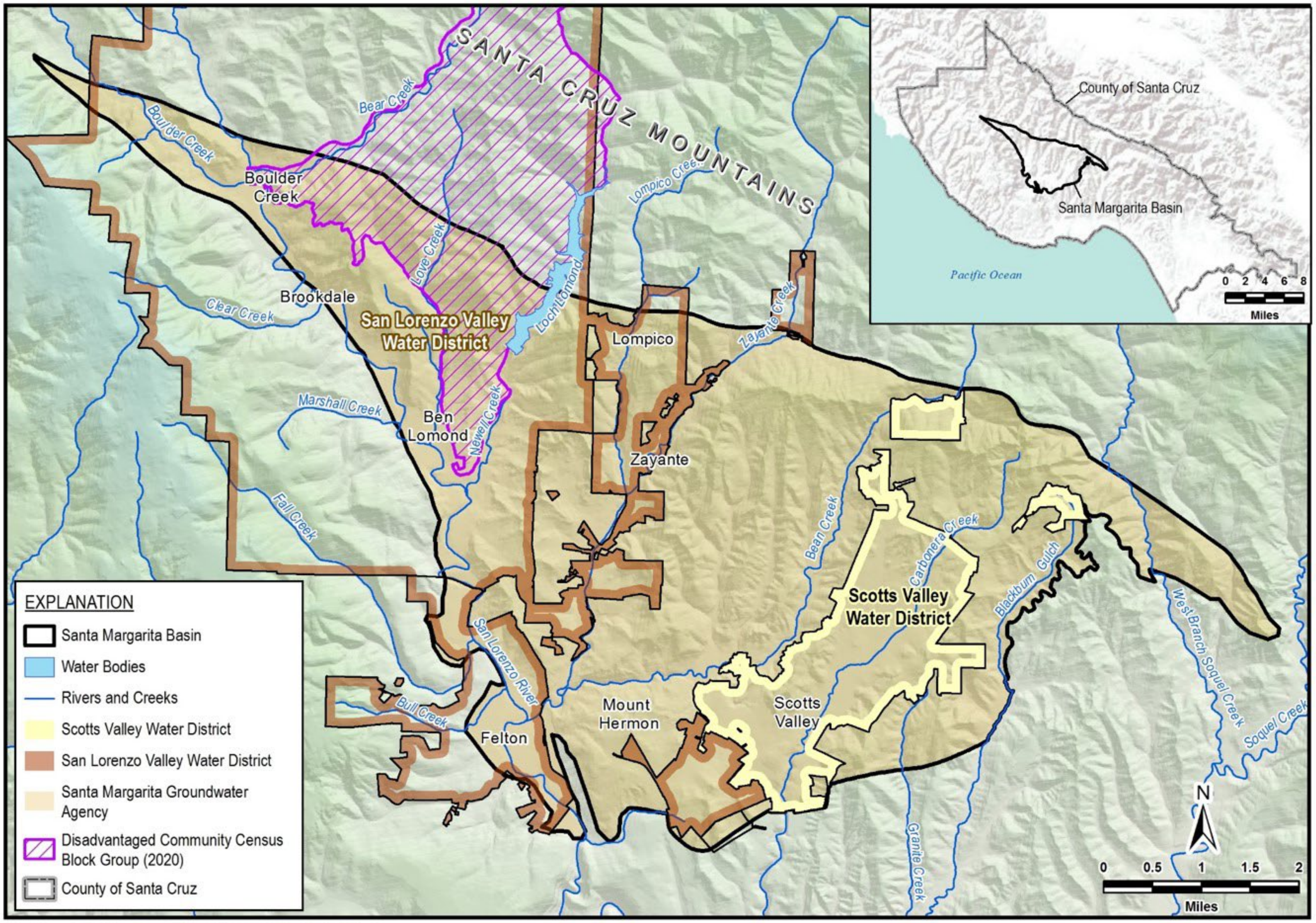

Figure 1. Basin and Member Agency Jurisdictional Boundaries

2 BASIN SETTING

2.1 Basin Description

The Santa Margarita Basin (DWR Basin 3-027) is defined in DWR Bulletin 118 as a medium priority basin (DWR, 2016). 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. Based on 2020 census block data, the population of the Basin is approximately 33,000 (U.S. Census Bureau, 2021).

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 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 in an area previously designated as the Felton Basin. The southern boundary of the Basin with the West Santa Cruz Terrace Basin is located where sedimentary formations thin over a granitic high. A surface geology map of the Basin is shown on Figure 2.

The Basin is filled with Tertiary-age sedimentary rocks that form the principal aquifers. The Butano Sandstone, Lompico Sandstone, Monterey Formation, and Santa Margarita Sandstone are found in that order from deepest to shallowest in the Basin, except where the shallower units are eroded or other less extensive formations outcrop. The sandstone formations form the Basin's principal aquifers. Although used for shallow private wells, the Monterey Formation is not a principal aquifer because it only supports small groundwater extraction volumes. The Purisima Formation is used as a groundwater supply where it occurs on hilltops primarily east of Zayante Creek, but it is not considered a principal aquifer because of its limited extent in the Basin. An example geologic cross-section D-D' from the GSP is shown on Figure 3. Three additional cross-sections are included in the GSP. This cross-section and the geologic basemap show the area in Mount Hermon and Scotts Valley where the Monterey Formation aquitard is absent between the Santa Margarita Sandstone and the underlying Lompico Sandstone.

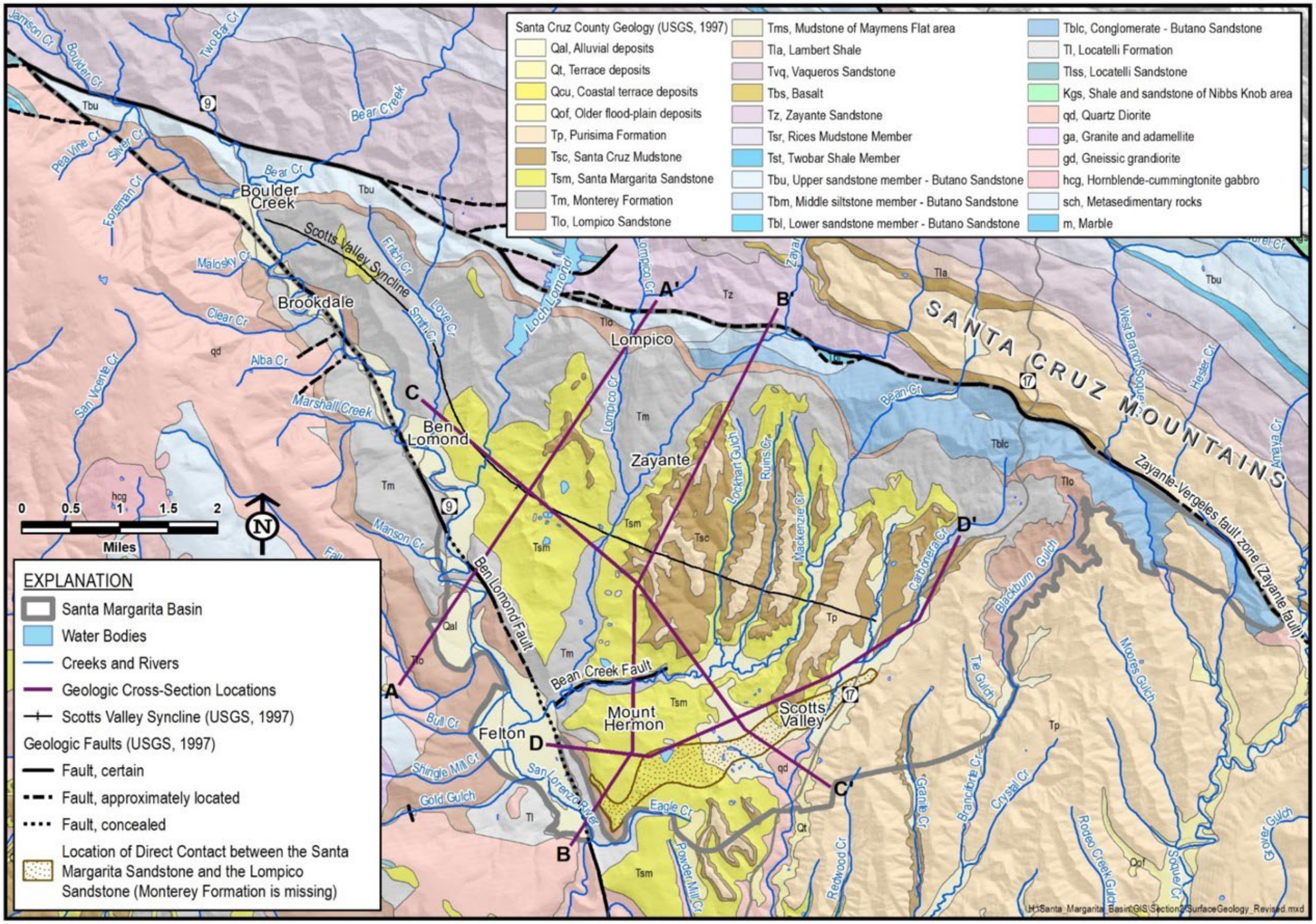

Figure 2. Surface Geology and Geologic Cross-Section Locations

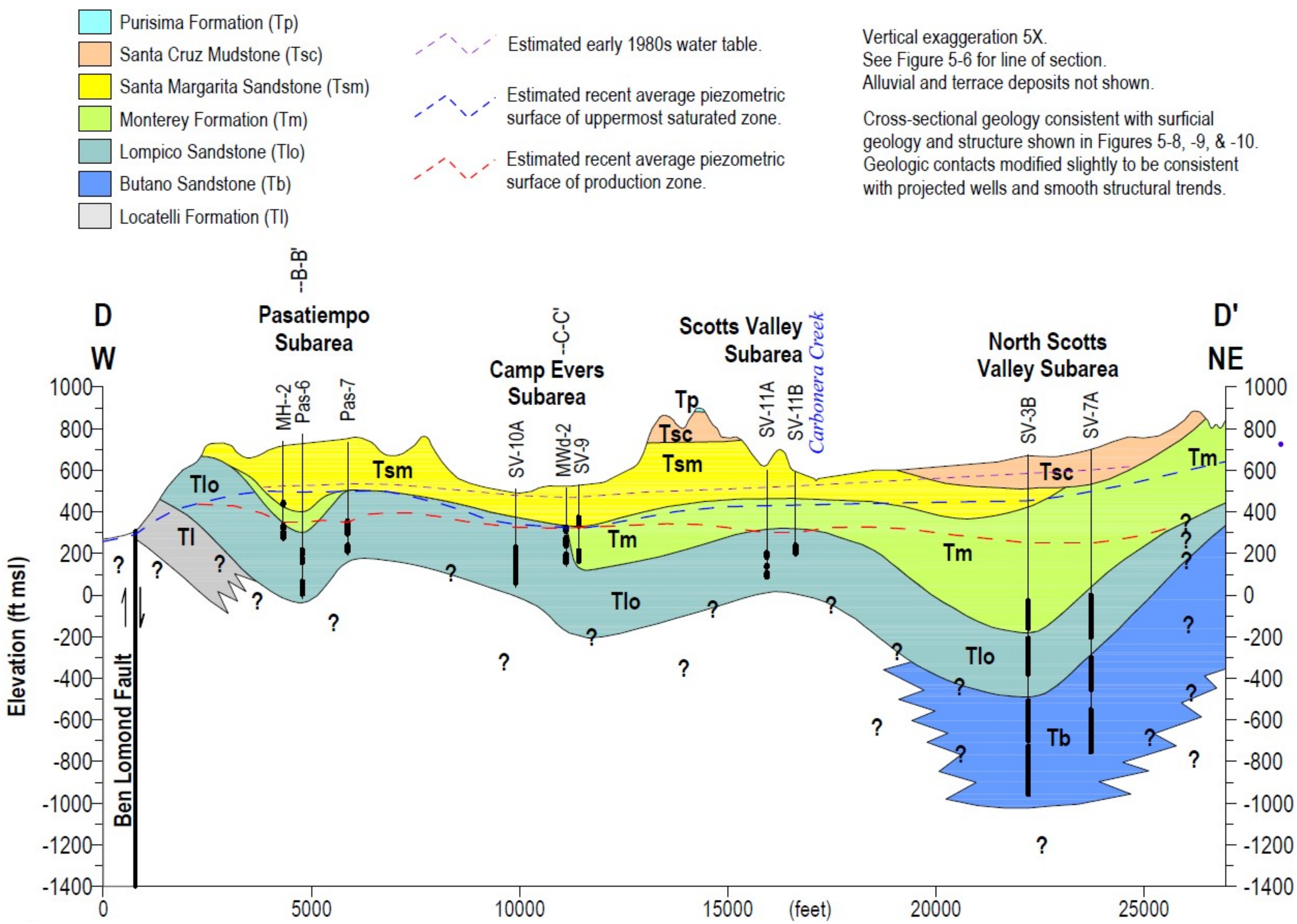

Figure 3. D-D' Geologic Cross-Section

2.2 2020 Census Disadvantaged Community Update

Based on the 2020 census, the census block overlapping the northwest corner of the Basin that was identified in the 2022 GSP as a disadvantaged community (DAC) no longer has that designation; instead, a nearby larger census block with a greater population is now classified as a DAC. The new DAC covers an area of approximately 1,823 acres within the Basin between Newell Creek and Bear Creek (Figure 1). The new DAC is a rural area with 1 small water system and approximately 33 domestic wells, or 5% of the total domestic wells in the Basin.

2.3 Precipitation and Water Year Type

Precipitation is the primary source of recharge in the Basin by both direct rainfall percolation and streamflow infiltration through streambeds. Monitoring annual precipitation is a key component for understanding local water supply trends and groundwater conditions. Long-term precipitation records are available for 2 weather stations in the Basin: (1) the El Pueblo weather station in Scotts Valley, and (2) the Boulder Creek weather station in Boulder Creek (shown on Figure 4).

WY2022 precipitation was below average. Total precipitation was 27.3 inches in Scotts Valley, and 34.6 inches in Boulder Creek, which is about 67% of long-term averages (Figure 4). The year was mostly dry except for 2 large atmospheric river precipitation events in October and December 2021 that produced about 70% of the annual precipitation. WY2022 is classified as a normal water year, but is one of the drier normal water years on record (Figure 4).[1]

Lower than average rainfall in WY2022 continues a long-term drier climate pattern since WY2006. The average annual rainfall during the past 16 years is about 5 inches less than the long-term average in Scotts Valley and 7 inches less than the long-term average in Boulder Creek. The climate pattern since WY2012 has been more variable than the historical record. Drought from WY2012 to WY2015 was followed by near-record precipitation in WY2017, then another severely dry period from WY2020 to WY2022.

[1] The water year type presented in hydrographs in this report is determined using the City of Santa Cruz water year classification system. This system is based on total annual runoff between October and September as measured at the United States Geological Survey Big Trees gauge in the San Lorenzo River just downstream of the confluence with Bean Creek.

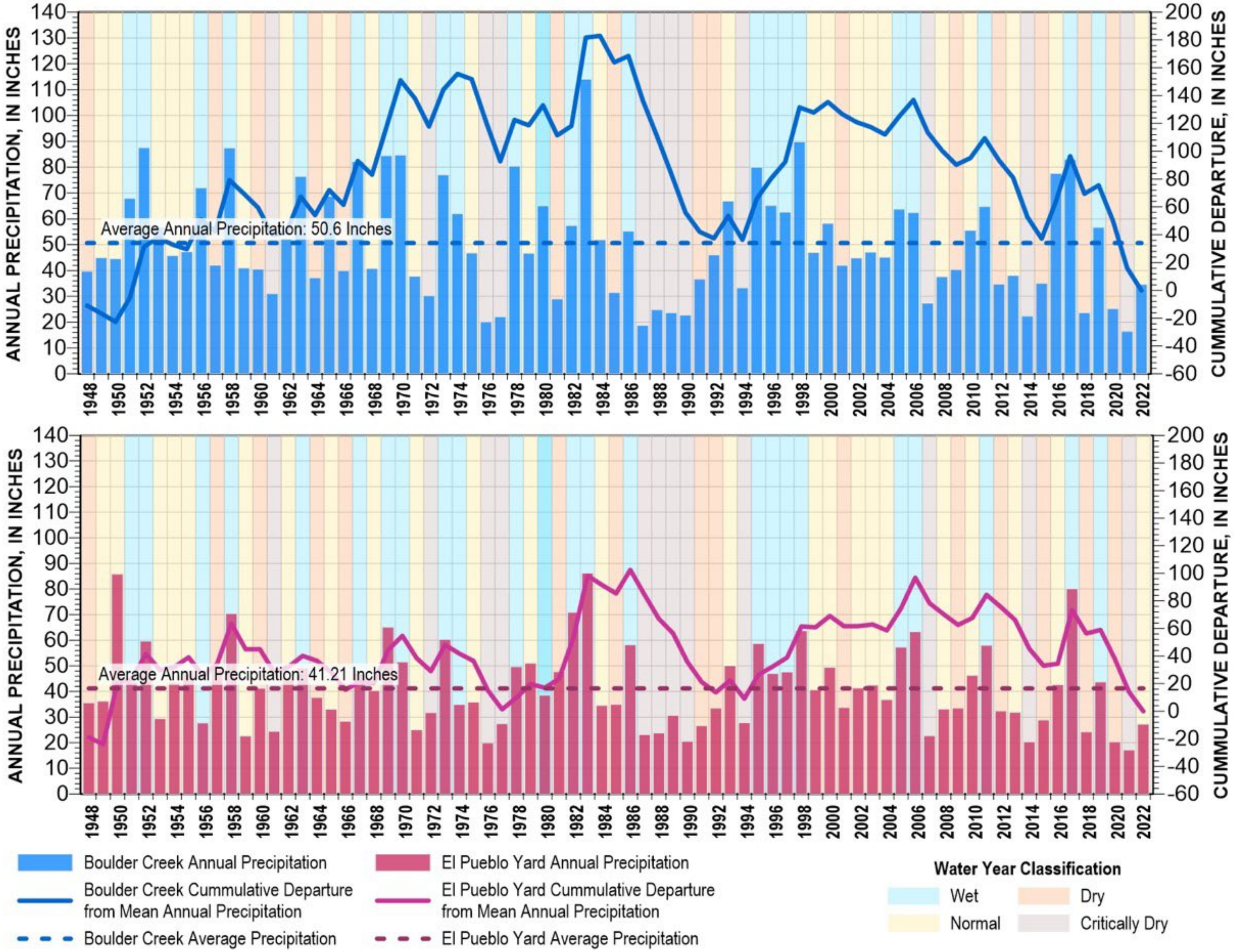

Figure 4. Annual Precipitation, Cumulative Departure from Mean Annual Precipitation, and Water Year Type, WY1948-2022

3 BASIN CONDITIONS

3.1 Groundwater Elevations

Groundwater elevations in the Basin are monitored using a network of 36 wells, 14 of which were selected as representative monitoring points [RMP(s)] for evaluating groundwater level sustainable management criteria (SMC). The monitoring network is comprised of either production wells or monitoring wells installed by SLVWD, SVWD, or MHA, many of which have been used for decades to evaluate short-term, seasonal, and long-term groundwater trends for groundwater management purposes. Nearly all wells are located in areas currently used for municipal groundwater extraction. To address data gaps in areas near interconnected streams and areas with concentrations of domestic wells, additional monitoring wells will be installed in WY2023. Clusters of monitoring wells completed in different aquifers at the same location are used by agencies to understand seasonal and temporal changes in vertical gradients between aquifers.

Groundwater levels are hand-measured in monitoring wells using electric sounders at least semi-annually. SVWD wells also have pressure transducers that measure and record groundwater level data every 6 hours. Groundwater level measurements collected from active extraction wells are noted and later removed from the datasets used to generate hydrographs and groundwater elevation contour maps. Groundwater elevation is calculated from depth to groundwater using each well's unique reference point elevation. Groundwater level data are uploaded by the agencies collecting the data to the regional data management system.

Groundwater elevations are used to generate seasonal groundwater elevation contour maps for each principal aquifer (Figure 5 through Figure 10). Seasonal groundwater elevation contour maps show measured minimum groundwater elevations from April and May 2022 on the Spring contour maps and minimum groundwater elevations in September 2022 on the Fall contour maps. Spring groundwater elevations typically represent seasonal high conditions, whereas Fall groundwater elevations typically represent seasonal low conditions. For the GSP, groundwater elevation contours for portions of the Basin without measured groundwater elevation data were calculated using the calibrated GSP Groundwater Basin Model (Basin Model). For the Annual Report, groundwater elevation contours are shown only for areas where groundwater elevation data are available. New monitoring wells planned for installation in WY2023 will allow expansion of the area with groundwater elevation contours in future annual reports.

Hydrographs are used to evaluate long-term trends in groundwater elevation. All available non-pumping groundwater elevation data collected in each well through WY2022 is plotted against a background that indicates water-year type to demonstrate the relationship between precipitation and groundwater elevations. Minimum thresholds and measurable objectives are included on the hydrographs for groundwater level RMPs.

Hydrographs are compiled in the appendices, grouped by RMPs and non-RMPs as follows:

- Appendix A: Pages A-2 through A-18: Chronic Lowering of Groundwater Level RMP Well Hydrographs
- Appendix B: Pages B-1 and B-2: Depletion of Interconnected Surface Water RMP Well Hydrographs
- Appendix C: Pages C-1 through C-39: GSP Monitoring Network Well Hydrographs

Locations of groundwater elevation monitoring wells are shown in Appendix A, Page A-1.

3.1.1 Santa Margarita Aquifer

The Santa Margarita Sandstone is the most permeable formation in the Basin, and it is exposed widely at the surface in the southern and central portions of the Basin. As a result, the mostly unconfined Santa Margarita aquifer recharges quickly in response to rainfall, but its groundwater levels drop when rainfall is limited. The Santa Margarita aquifer supplies about 27% of the total groundwater extracted from the Basin for municipal, domestic, landscape, and sand quarry uses. It is the aquifer that is most important for supporting groundwater-dependent ecosystems, springs, and baseflow to creeks.

Seasonal patterns in groundwater levels in the Santa Margarita aquifer are different north and south of Bean Creek. In areas north of Bean Creak (Quail Hollow and Olympia/Mission Springs areas), the Santa Margarita aquifer exhibits greater seasonal fluctuations in groundwater level than in other areas (or, for that matter, in other aquifers) in the Basin due to pumping at SLVWD wells in the Quail Hollow and Olympia/Mission Springs areas. Groundwater levels in this area increased slightly in WY2022 compared to WY2021 (Appendix C, pages C-5 through C-6 and C-8 through C-12), because in WY2022 there was more precipitation and less extraction of groundwater.

South of Bean Creek (Mount Hermon/South Scotts Valley and North Scotts Valley areas), the Santa Margarita aquifer is partially dewatered. Dewatering occurred in the South Scotts Valley area due to overpumping in the 1990s. Groundwater elevations in this area have not recovered fully even though the Santa Margarita aquifer is no longer used for municipal supply. In the MHA and SLVWD Pasatiempo wellfields and in North Scotts Valley, the Santa Margarita aquifer was never used extensively as a water source; hence, it is not dewatered in these areas. The hydrographs for SLVWD’s Pasatiempo MW-2 (Appendix C, page C-7) and SVWD TW-18

(Appendix C, page C-14) illustrate the long-term stable groundwater levels in this area, with slight fluctuations depending on precipitation.

Groundwater elevation contour maps for the Santa Margarita aquifer are shown on Figure 5 and Figure 6 for WY2022 Spring and Fall, respectively. During WY2022, groundwater elevations fell only 1 to 3 feet between Spring and Fall in Santa Margarita aquifer wells, except in wells installed close to active extraction wells. Groundwater flow in the aquifer generally mimics topography, flowing toward areas where groundwater discharges to springs and creeks along Bean and Zayante Creeks. Locally, groundwater in the aquifer also flows toward depressions around extraction wells in the Quail Hollow and Olympia/Mission Springs areas.

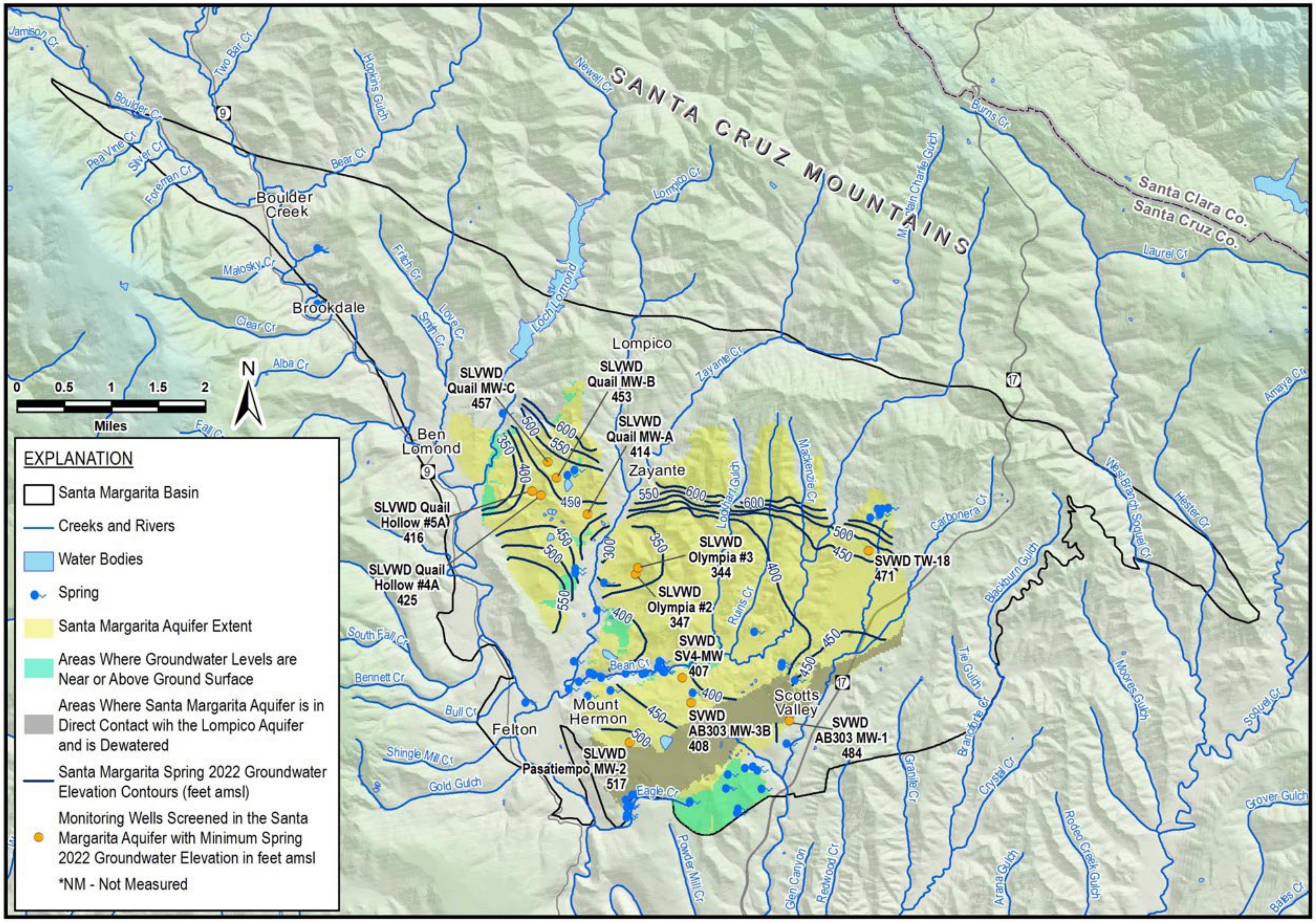

Figure 5. Santa Margarita Aquifer Groundwater Elevations and Contours, Spring 2022

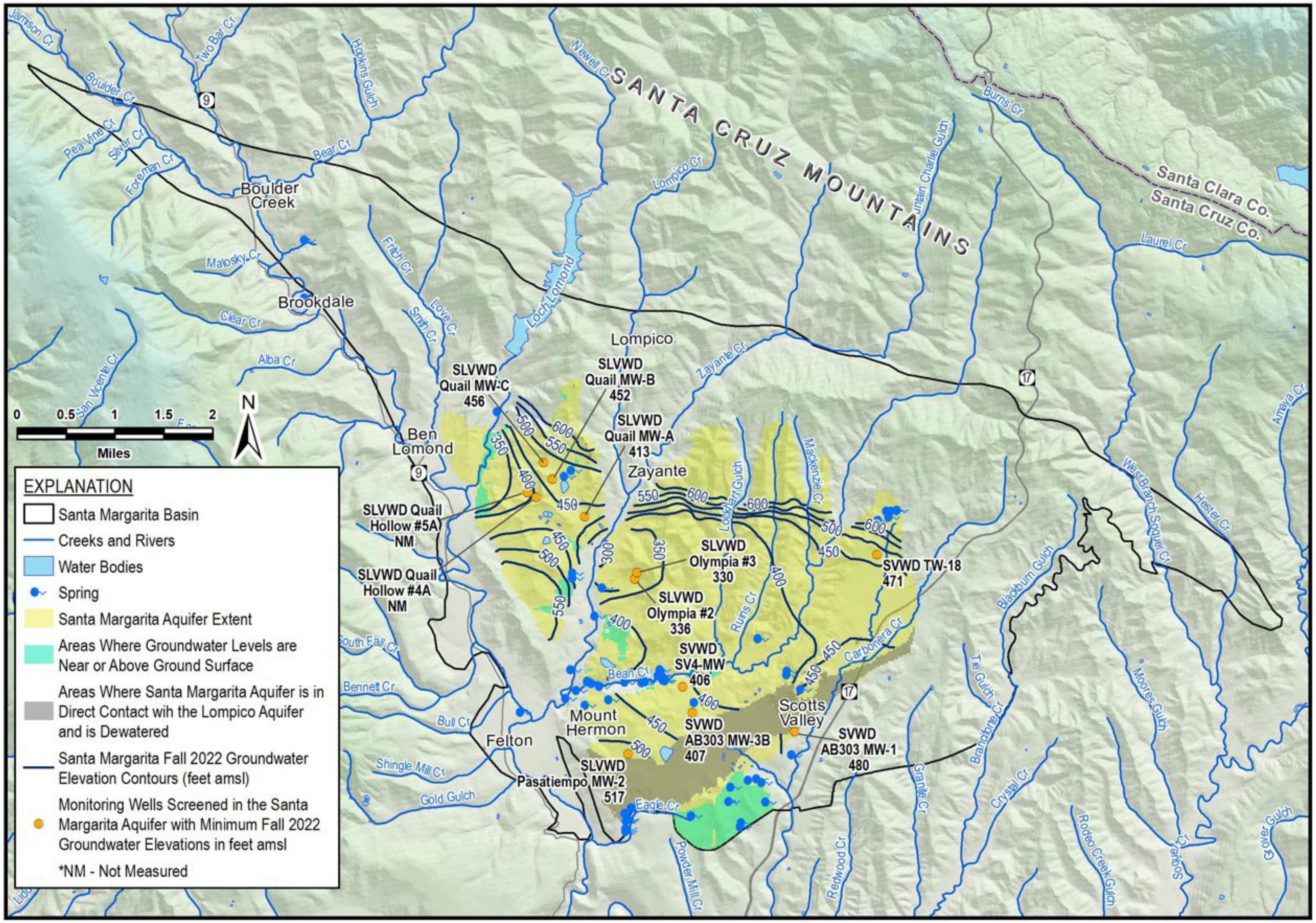

Figure 6. Santa Margarita Aquifer Groundwater Elevations and Contours, Fall 2022

3.1.2 Monterey Formation

The Monterey Formation is not considered a principal aquifer, even though it is used by some Basin residents who have low demands or no alternative water source. Only about 4% of groundwater extracted in the Basin is from the Monterey Formation. This fine-grained, relatively impermeable formation is present across much of the Basin and forms an important aquitard that separates the Santa Margarita and Lompico aquifers. Where the Monterey Formation is absent, the Santa Margarita aquifer may be dewatered due to percolation into overdrafted Lompico aquifer with lowered groundwater levels directly below (Figure 2 and Figure 3).

SVWD Well #9, an inactive production well, is the only monitoring well in the Monterey Formation. By the early 1990s, the groundwater elevation in the well had fallen 200 feet from pre-1980 levels due to the combination of less-than-average precipitation and increased groundwater extraction in the overlying Santa Margarita aquifer and in the Lompico aquifer below. Groundwater extraction in the area decreased during the 1990s, and, as a result, groundwater elevations in the Monterey Formation have risen by about 50 feet since 1998. Nevertheless, the groundwater elevation in SVWD Well #9 is still about 150 feet below the 1980 elevation (Appendix C, page C-16), because recharge is inhibited by the low permeability of the formation. In WY2022 groundwater elevation fluctuated by a few feet, similar to last year.

Given that SVWD Well #9 is the only monitoring network well, a groundwater elevation contour map is not presented for the Monterey Formation. In WY2023, SMGWA plans to install 2 additional monitoring wells in areas where the Monterey Formation is used heavily for residential supply.

3.1.3 Lompico Aquifer

The Lompico Sandstone is found throughout most of the Basin, but outcrops only along the Basin margins and in a few locations along the San Lorenzo River. The semi-confined Lompico aquifer is the primary aquifer tapped by SVWD, SLVWD, and MHA supply wells in the area south of Bean Creek. The Lompico aquifer accounts for about 51% of total groundwater extracted in the Basin (see Section 3.2). The Lompico aquifer is also an important source of baseflow to the San Lorenzo River in the few areas where it outcrops in or near the river. There is little extraction from the Lompico aquifer north of Bean Creek because it is much deeper there than it is south of Bean Creek; for the same reason, there are no historical or current Lompico aquifer groundwater level monitoring wells north of Bean Creek.

Reliance on groundwater from the Lompico aquifer in the Mount Hermon/Pasatiempo/South Scotts Valley area has contributed to historical groundwater level declines of up to 200 feet since before the 1980s (see SVWD Well #10's hydrograph in Appendix C, page C-27). Starting in 2005, groundwater levels in the Lompico aquifer stabilized, and since 2015 have risen in the South Scotts Valley area (see SLVWD Pasatiempo #7's hydrograph in Appendix C, page C-23).

Groundwater elevation contour maps for the Lompico aquifer are shown on Figure 7 and Figure 8 for WY2022 Spring and Fall, respectively. Groundwater elevations in the Lompico aquifer fluctuate little seasonally, with most wells exhibiting less than 5 feet of groundwater level decline between Spring and Fall, except close to active production wells.

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 (Figure 2). This is the only area where the Lompico aquifer is recharged directly by percolation of precipitation or streamflow; elsewhere it is largely covered by younger geologic units that prevent direct recharge. The small areas of exposure of the Lompico Formation along the San Lorenzo River, near Felton and further upstream near the communities of Ben Lomond and Boulder Creek (Figure 2), are located downgradient, so the Lompico aquifer is a source of groundwater discharge that contributes to San Lorenzo River baseflow.

Groundwater flow in the southern portion of the Lompico aquifer is primarily controlled by municipal extraction in the South Scotts Valley area by SVWD and in the Mount Hermon/Pasatiempo area by SLVWD and MHA. Extraction in these areas has formed localized depressions in groundwater levels.

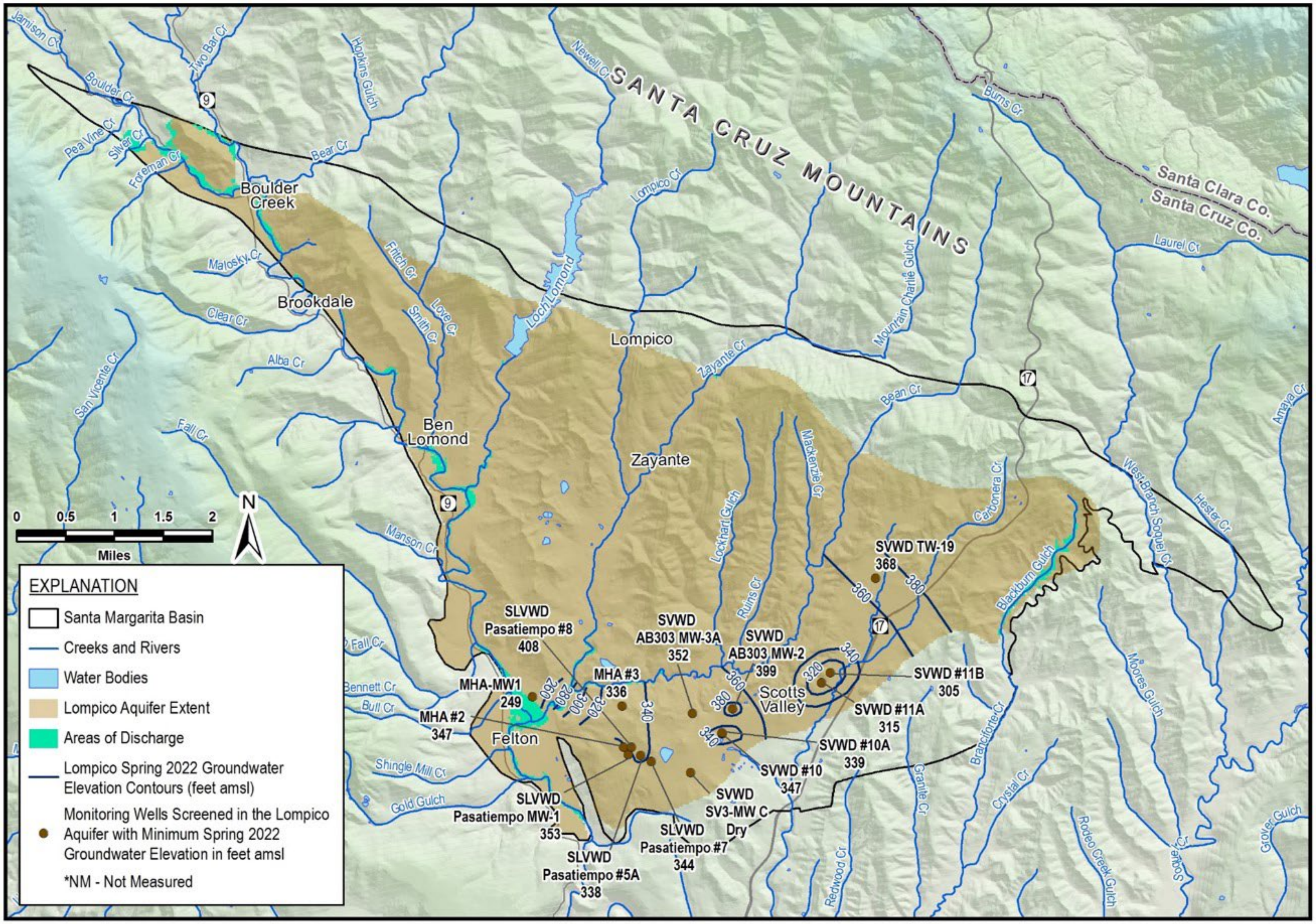

Figure 7. Lompico Aquifer Groundwater Elevations and Contours, Spring 2022

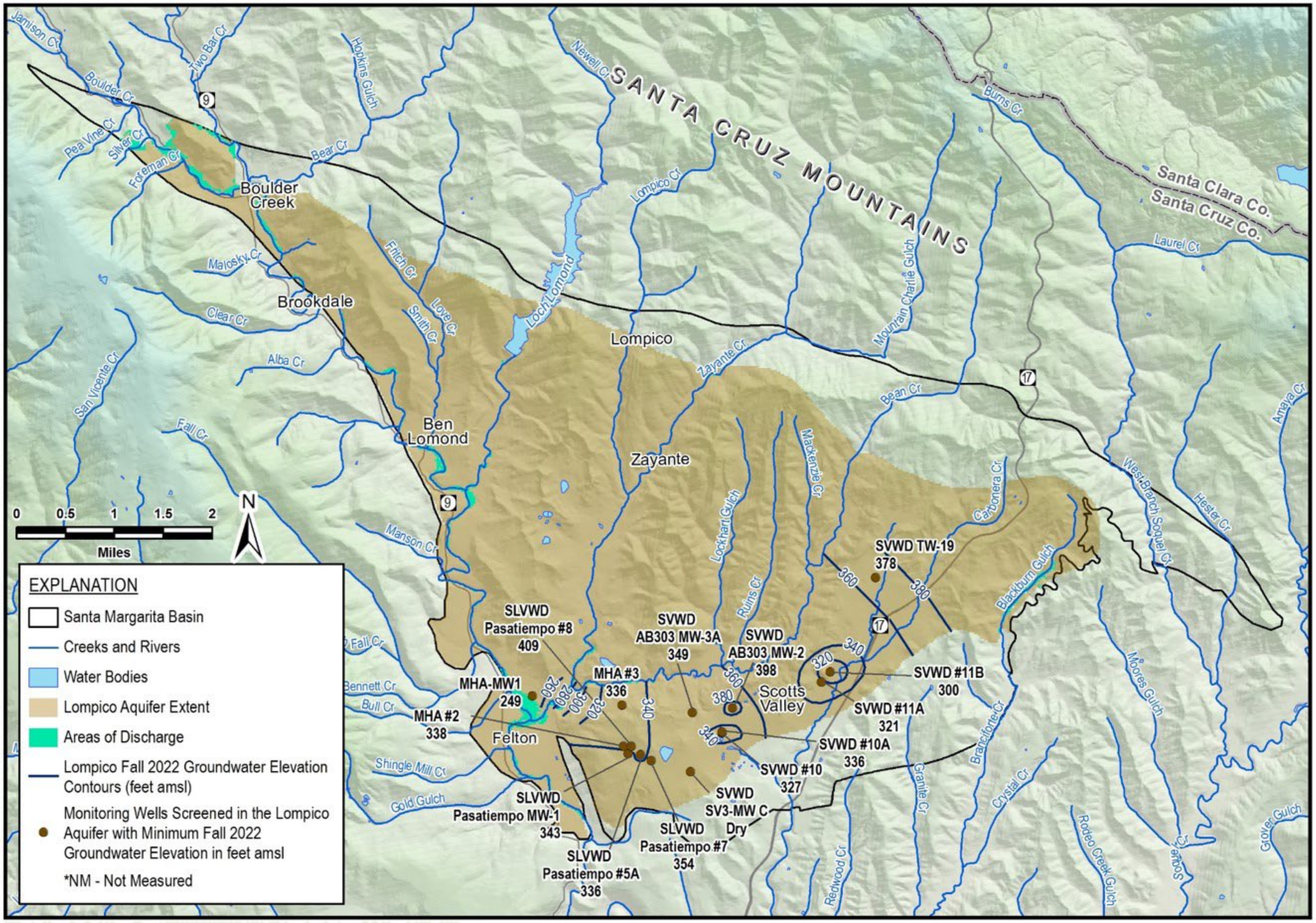

Figure 8. Lompico Aquifer Groundwater Elevations and Contours, Fall 2022

3.1.4 Butano Aquifer

The stratigraphically oldest of the three main aquifers, the Butano Sandstone, is the deepest, except where it outcrops in the northern limb of the Scotts Valley syncline, along the northern Basin boundary (Figure 2). SVWD has 2 deep supply wells in the northeast portion of its service area that extract groundwater from both the Lompico and Butano aquifers. The Butano aquifer accounts for about 17% of groundwater extracted from the Basin (see Section 3.2).

Due to its great depth, there are currently only 2 dedicated monitoring wells solely in the Butano aquifer: SVWD Canham and Stonewood. Originally drilled as exploratory wells in search of additional water resources north of the SVWD service area, neither well encountered sizable groundwater resources; hence, they were converted to monitoring wells. The SVWD Stonewood well is located where the Butano aquifer outcrops near the Basin's northern boundary; the Canham well lies further south (Figure 9). Groundwater elevations over time in the dedicated Butano aquifer monitoring wells are stable (Appendix C, pages C-37 and C-38).

There are 3 SVWD wells in the northeastern portion of the SVWD service area that are screened in both the Lompico and Butano aquifers: the production wells SVWD Orchard and SVWD #3B and monitoring well SVWD #15. Due to extraction from the production wells, all show more seasonal fluctuations in groundwater levels than the dedicated Butano wells located upgradient from the municipal supply wells (Appendix C, pages C-34 through C-36). Long-term groundwater elevations in the Lompico/Butano wells have been relatively stable since the late 1990s, as is the case for many of the wells screened exclusively in the Lompico aquifer.

Groundwater elevation contour maps for the Butano Aquifer for WY2022 Spring and Fall are shown on Figure 9 and Figure 10, respectively. Groundwater flow is mostly north to south, mimicking the topography from the aquifer's higher elevation recharge area at the Basin's northern boundary toward the lower elevations of Scotts Valley. Contingent on grant funding, a new deep monitoring well screened solely in the Butano aquifer will be drilled in the next two years near the northern SVWD wellfield in order to determine the effect of SVWD production wells on groundwater levels in the Butano aquifer and to provide an additional, more southerly, monitoring point to allow better delineation of groundwater elevation contours.

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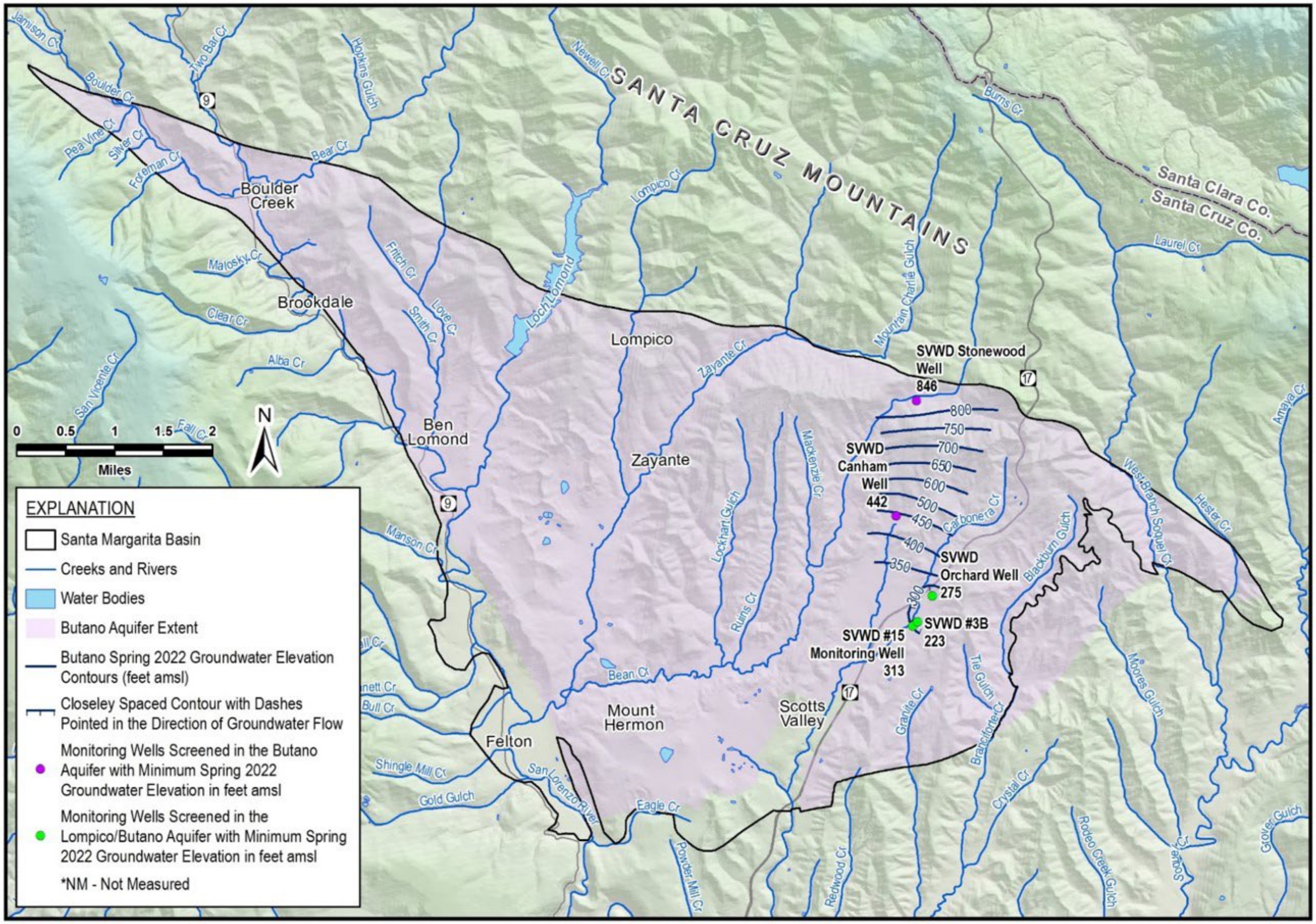

Figure 9. Butano Aquifer Groundwater Elevations and Contours, Spring 2022

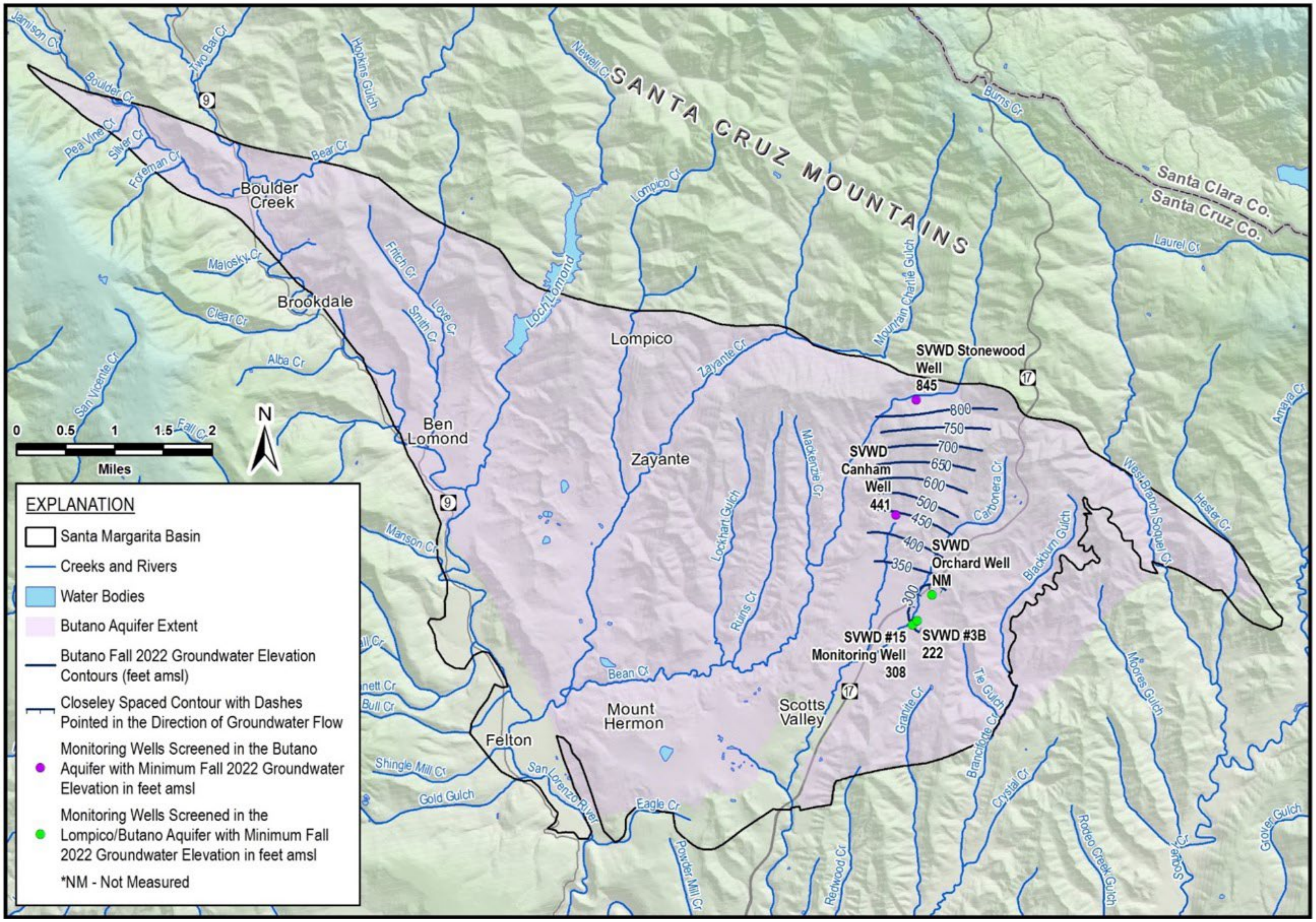

Figure 10. Butano Aquifer Groundwater Elevations and Contours, Fall 2022

3.2 Groundwater Extraction in WY2022

The total volume of groundwater extracted in WY2022 is 2,485 acre-feet (AF), about 21% less than extracted in WY2021. WY2022 had the lowest total volume extracted since WY1985 when reliable record keeping began. Most of the groundwater extraction from the Basin is from wells located south of Bean Creek. Only the Santa Margarita aquifer has significant extraction north of Bean Creek. Table 1 summarizes groundwater extraction for WY2022 by water use sector and aquifer. The basis for these estimates and their accuracy is explained in footnotes to Table 1. Figure 11 shows the locations of groundwater extraction sites, the aquifers used, and the relative volumes of groundwater extracted in WY2022.

There are 3 principal aquifers and 2 formations that are used for groundwater supplies in the Basin. The Lompico aquifer supplies 51% of the total groundwater extracted, the Santa Margarita aquifer supplies 27%, and Butano aquifers supplies approximately 17% from SVWD supply wells screened across both the Lompico and Butano. The remaining 5% of groundwater is extracted from non-principal aquifers, the Monterey Formation and Purisima Formation, primarily for rural domestic use.

Most groundwater extraction in the Basin is used for municipal supplies. In WY2022, about 74% of all groundwater was extracted by SLVWD and SVWD. SLVWD extracted 732 AF (29%) and SVWD extracted 1,108 AF (45%). About 70% of SLVWD extraction was from the Santa Margarita aquifer north of Bean Creek and about 30% was from the Lompico aquifer south of Bean Creek. About 65% of SVWD extraction is from the Lompico aquifer and 35% from the Butano aquifer. MHA extracted 154 AF (6%), all from Lompico aquifer supply wells.

In WY2022, SLVWD reduced its groundwater extraction by about 47% compared to WY2021, a year in which groundwater usage was anomalously high due to the destruction of surface water infrastructure in the August 2020 CZU wildfire. The volume extracted in WY2022 was about 10% less than the average annual extraction for the 6-year period before the wildfire (from WY2014 to WY2019). The emergency condition created by the wildfire damage allowed SLVWD to engage in conjunctive use between all three of its systems, thereby maximizing its surface water use to reduce WY2022 groundwater extraction.

SVWD reduced its groundwater extraction by about 2% in WY2022 compared to WY2021, with most reductions coming from the Lompico aquifer wells. SVWD pumping from the Butano aquifer nearly doubled from WY2021 to WY2022 because the SVWD Lompico/Butano supply wells were out of service for water treatment upgrades for much of 2021. WY2022 extraction from the Lompico/Butano supply wells was, however, slightly less than in the 7 years prior to WY2021.

Groundwater extractions by users other than SLVWD, SVWD and MHA are not well measured, but extraction for non-municipal use is estimated to make up about 20% of the total groundwater extraction in the Basin, including 9% for private domestic use, 5% for small water systems, 5% for landscaping, irrigation, and pond filling, and 1% for quarries. Small water system groundwater extractions do not fluctuate substantially from year to year, based on metered data reported to the County. Unmetered domestic, landscape, pond filling, and quarry extractions are assumed to be the same in WY2022 as estimated for WY2018 in the GSP. It is not expected that year-to-year usage would vary significantly because there has been little change in the commercial and domestic use in these sparsely populated rural areas of the Basin.

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Table 1. Groundwater Extraction, WY2022

Agency / Extraction Type	Principal Aquifer Extraction (AF)			Non-Principal Aquifer Extraction (AF)		Total (AF)	Percentage of Total Extraction
	Santa Margarita	Lompico	Butano	Monterey	Purisima		
San Lorenzo Valley Water District[1]	505	227	0	0	0	**732**	**29%**
Scotts Valley Water District[1, 2]	0	711	397	0	0	**1,108**	**45%**
Mount Hermon Association[1]	0	154	0	0	0	**154**	**6%**
Private Domestic Wells[2]	62	28	26	87	30	**232**	**9%**
Non-Domestic Private Groundwater Users[3]	38	84	0	0	0	**122**	**5%**
Small Water Systems[4]	53	55	0	4	0	**112**	**5%**
Quail Hollow Quarry[5]	25	0	0	0	0	**25**	**1%**
Total by Aquifer (AF)	**683**	**1,258**	**423**	**91**	**30**	**2,485**	**100%**
Aquifer Percentage of Total Extraction	**27%**	**51%**	**17%**	**4%**	**1%**	**100%**	

[1] Direct measurement by flow meter (most accurate).

[2] For SVWD extraction wells screened in both the Lompico and Butano aquifers, its assumed they extract 40% of their water from the Lompico aquifer and 60% from the Butano aquifer.

[2] Estimated based annual water use factor per connection determined from metered Small Water Systems and applied to each residence outside of municipal water service areas (less accurate). The water use factor for WY2022 was 0.3 AF per connection. Number of private wells is assumed to be 777.

[3] Other private non-domestic uses include landscape irrigation and water for landscape ponds. Extraction is not metered so the volume is estimated (less accurate).

[4] Metered data are reported to County, but timing of reporting is too late for inclusion into the Annual Report. Therefore, only October through December 2021 are from WY2022, while January through September 2022 are from January through September 2021). While this reduces accuracy, the volumes from year to year generally do not vary significantly.

[5] Estimated based on historical usage (less accurate).

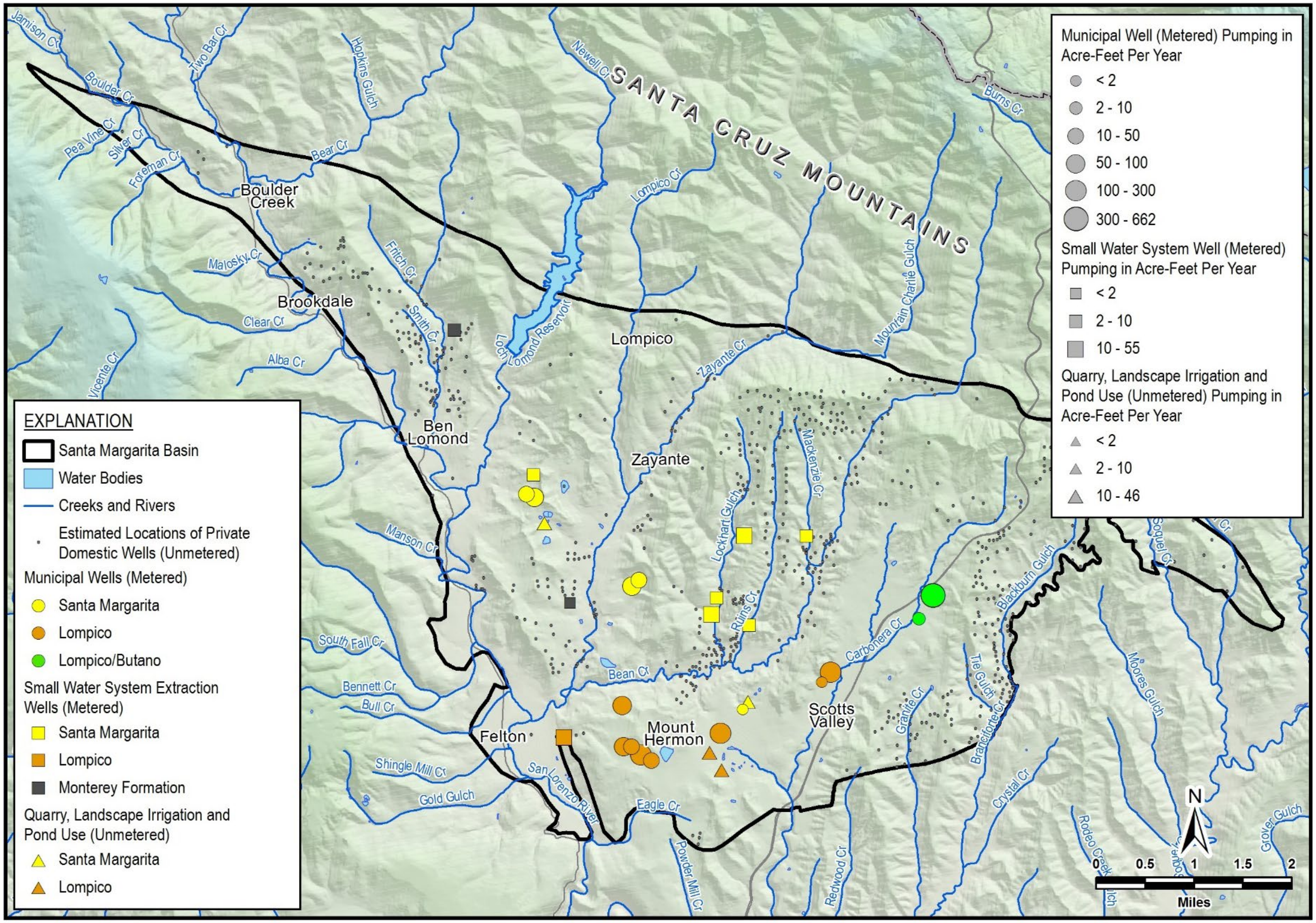

Figure 11. Groundwater Extraction, WY2022

3.3 Surface Water Supply Used for Groundwater Recharge or In-Lieu Use

Managed aquifer recharge in the Basin currently takes two forms: (1) use of excess surface flows for *in lieu* recharge by SLVWD, and (2) percolation of stormwater in Scotts Valley.

SLVWD has implemented conjunctive use in their North System for decades. In the North System, SLVWD optimizes the use of surface water and groundwater by utilizing stream flows for water supply while they are high and relying more on groundwater during the dry season. The benefits of conjunctive use in the North System are reduced groundwater pumping in the Santa Margarita aquifer at the Quail Hollow and Olympia wellfields. The conjunctive use of these sources has met annual water demands since 1984, without a substantial decline in groundwater levels.

Since the August 2020 CZU wildfire, SLVWD has used the emergency intertie to maximize its surface water diversions in the Felton System (while maintaining fish bypass flows) to convey water to the North and South Systems and reduce reliance on groundwater. This District-wide conjunctive use made it possible for SLVWD to use surface water exclusively for approximately 30 days in WY2021 and 60 days in WY2022, and to reduce WY2022 total groundwater extraction to an annual volume that is one of the lowest on record.

SVWD and other private developments capture stormwater and recharge groundwater at low-impact development (LID) sites in Scotts Valley. Table 2 shows the total volume of known managed aquifer recharge using LID at SVWD managed sites. The stormwater infiltration volume is relatively small, with a maximum of about 40 AF in WY2019. In WY2022 about 16 AF of LID recharge was measured, though this total is an underestimate by a few AF because a transducer malfunctioned for most of the wet season at the Scotts Valley Library site.

Table 2. LID Infiltration, WY2018-2022

Water Year	Volume Infiltrated, AF			
	Transit Center	Woodside HOA	Scotts Valley Library	Total
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	0.55**	**16.18****

*Volumes estimated using available data

**Transducer malfunction resulted in no data collection at Library LID between October and February 2022. Since this is when nearly all annual precipitation occurred, the total WY2022 LID recharge volume is underestimated.

3.4 Total Water Use in WY2022

Water used in the Basin is sourced by groundwater extraction wells, surface water diversions within the San Lorenzo River watershed in and surrounding the Basin, and recycled water. Figure 12 illustrates total water use by water source for all users for the period WY1985 to WY2022. Table 3 summarizes WY2022 total water use by user, use, and water source type. Footnotes to Table 3 explain how the values were determined and provide estimates of their relative accuracy.

The City of Santa Cruz Water Department (SCWD) is the largest user of water resources in the Basin and surrounding watershed. In WY2022, SCWD diverted 4,159 AF of water from the San Lorenzo River to serve its customers.

WY2022 total water use by all other providers that serve residents of the Basin and the surrounding watershed was 3,719 AF. Total water used in the Basin decreased by about 300 AF from WY2021, a decrease of 7%.

Table 3. Total Water Use by Source, WY2022

Water Supplier	Groundwater Use (AF)	Surface Water Use (AF)	Recycled Water Use (AF)	Imported Water Use (AF)	Total WY2022 Water Use (AF)
Water Use Within the Santa Margarita Basin and Adjacent Areas of the San Lorenzo River Watershed					
San Lorenzo Valley Water District[1]	732	1,021	0	0	1,753
Scotts Valley Water District [1]	1,108	0	174	0	1,282
Mount Hermon Association[1]	154	0	0	0	154
Private Domestic Wells[2]	232	0	0	0	232
Other Non-Domestic Private Groundwater Users[3]	122	0	0	0	122
Small Water Systems[4]	112	1	0	38	151
Quail Hollow Quarry[5]	25	0	0	0	25
	2,485	**1,022**	**174**	**38**	**3,719**
Water Diverted and Used Primarily Downstream and Outside the Santa Margarita Basin and Adjacent Areas					
City of Santa Cruz[1]	0	0[6] 4,159[7]	0	0	4,159
Total	**2,485**	**5,181**	**174**	**38**	**7,878**

[1] Direct measurement by flow meter (most accurate).

[2] See note in Table 1. Volume is estimated using population and water use data.

[3] Other private non-domestic uses include landscape irrigation and water for landscape ponds. Extraction is not metered so the volume is estimated (less accurate).

[4] See note in Table 1. Volume is partially estimated using prior water year data.

[5] Estimated based on historical usage (less accurate).

[6] City of Santa Cruz's San Lorenzo River diversion from Felton to Loch Lomond - inactive in WY2022. This diversion is in the Basin but is only used in wet years.

[7] City of Santa Cruz's San Lorenzo River diversion at Tait Street (5 miles downstream of the Basin) to the City treatment plant. Water is primarily sourced from within the Santa Margarita Basin but is used outside of the Santa Margarita Basin.

3.4.1 Surface Water Use in WY2022

As is apparent from Figure 12, surface water is the most used supply by volume utilized in the Basin and surrounding watershed of the San Lorenzo River. Surface water diversions totaled 5,181 AF in WY2022 (Table 3). About 80% of this total (4,159 AF) was diverted by SCWD from the San Lorenzo River 5 miles downstream of the Basin. Water is occasionally diverted at Felton, at the southern end of the Basin in wet years and pumped to Loch Lomond reservoir for later use in dry seasons by the SCWD. WY2022 diversions from the San Lorenzo River by SCWD increased by about 1,500 AF compared to WY2021, an increase of 56%. Surface water flows in WY2022 were higher than in WY2021, allowing the SCWD to divert closer to their long-term average since 2015.

SLVWD is the only other major surface water user in the Basin and adjacent watershed, diverted 1,021 AF in WY2022. SLVWD has historically sourced about half of its annual water supply from surface water diversions located on the eastern slope of Ben Lomond Mountain, outside the limits but upstream of the Santa Margarita Basin. The Felton System has 2 diversions on creeks tributary to the San Lorenzo River plus a source at Bennett Springs. The North system has 6 diversions on creeks tributary to Boulder Creek and the San Lorenzo River. The August 2020 CZU Complex wildfire destroyed all 6 creek diversions in the North System and miles of supply pipelines, including the one from Bennett Springs in the Felton System. The diversion on Foreman Creek was reconstructed a few months after the wildfire, but replacement of the other 5 diversions in the North System will take years due to the necessary engineering and environmental studies, now underway. A raw water line for Bennett Springs was replaced shortly after the fire; hence the Felton System was fully operational for WY2022[2]. During WY2022, SLVWD was able to able to make full use of excess surface flows on Fall Creek in the Felton System to convey water to the North and South Systems using the emergency intertie. As a result, total surface water diversions by SLVWD in WY2022 returned to values typical of the period before the fire (Figure 12), even though only 1 reconstructed water intake was operating in the North System.

An emergency intertie is available to transfer water between SLVWD and SVWD but is rarely used. Table 4 summarizes emergency intertie usage between SLVWD and SVWD since spring WY2016. There were no intertie transfers between the districts in WY2022.

[2] The Bull Creek diversion in the Felton System was badly damaged in the January 2023 atmospheric river storms and will be unavailable for much of WY2023.

Table 4. Emergency Intertie Transfer Between SLVWD and SVWD, WY2016-2022

Water Year	SLVWD to SVWD (AF)	SVWD to SLVWD (AF)
2016	0	0.3
2017	5.4	0
2018	0	0
2019	0	0
2020	9.1	0
2021	10.1	0
2022	0	0

3.4.2 Trends in Total Water Use by SLVWD and SVWD

Total water use by the two major water providers in the Basin, SLVWD and SVWD, has been decreasing consistently since the early 2000s (Figure 12), largely due to residents' strong conservation efforts and State regulations regarding water use efficiency in construction, as well as water-efficiency measures undertaken by the water districts.

The effect of these conservation and water efficiency efforts are well-illustrated by Figure 13, which shows the volumes of water used north and south of Bean Creek by user and source. Despite continued population growth, Scotts Valley water use has declined significantly from the amounts used in the early 2000s. As a result, in WY2022 the volume of water used south of Bean Creek, where the majority of the Basin's population resides, was similar to water used north of Bean Creek. This is consistent with the observation that groundwater elevations in SVWD wells in the South Scotts Valley area appear to be on a recovery trajectory since WY2015, despite recent dry years.

These data suggest that current extraction rates in the area of most concern, the Lompico aquifer south of Bean Creek, may be sustainable under present conditions. Nevertheless, the two decades of overdraft resulted in reductions of groundwater in storage such that there is an insufficient buffer to be confident that we can adapt to future climate change without further conservation, *in lieu* recharge, and potentially other projects in the Basin.

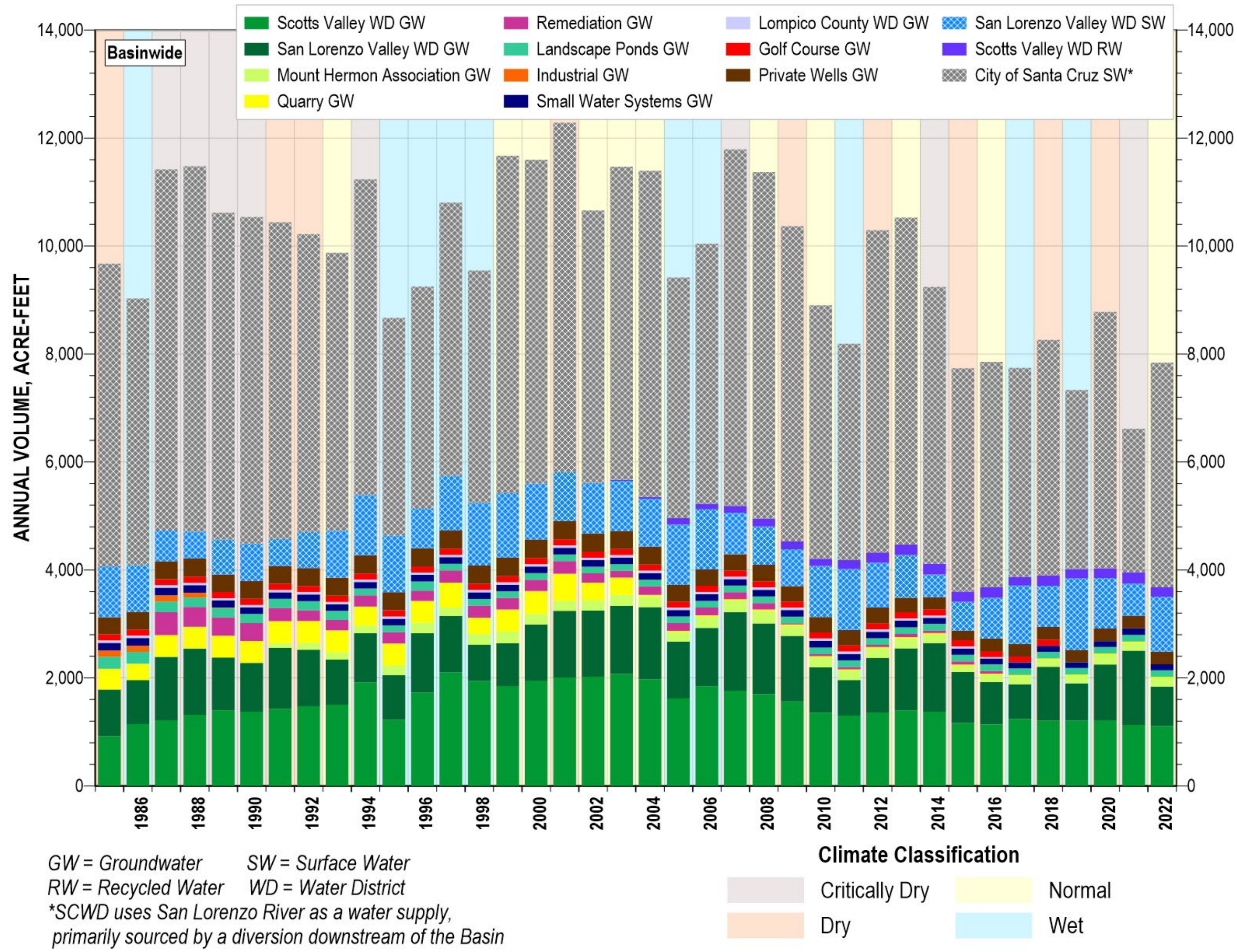

Figure 12. Total Basin Water Use, WY1985-2022

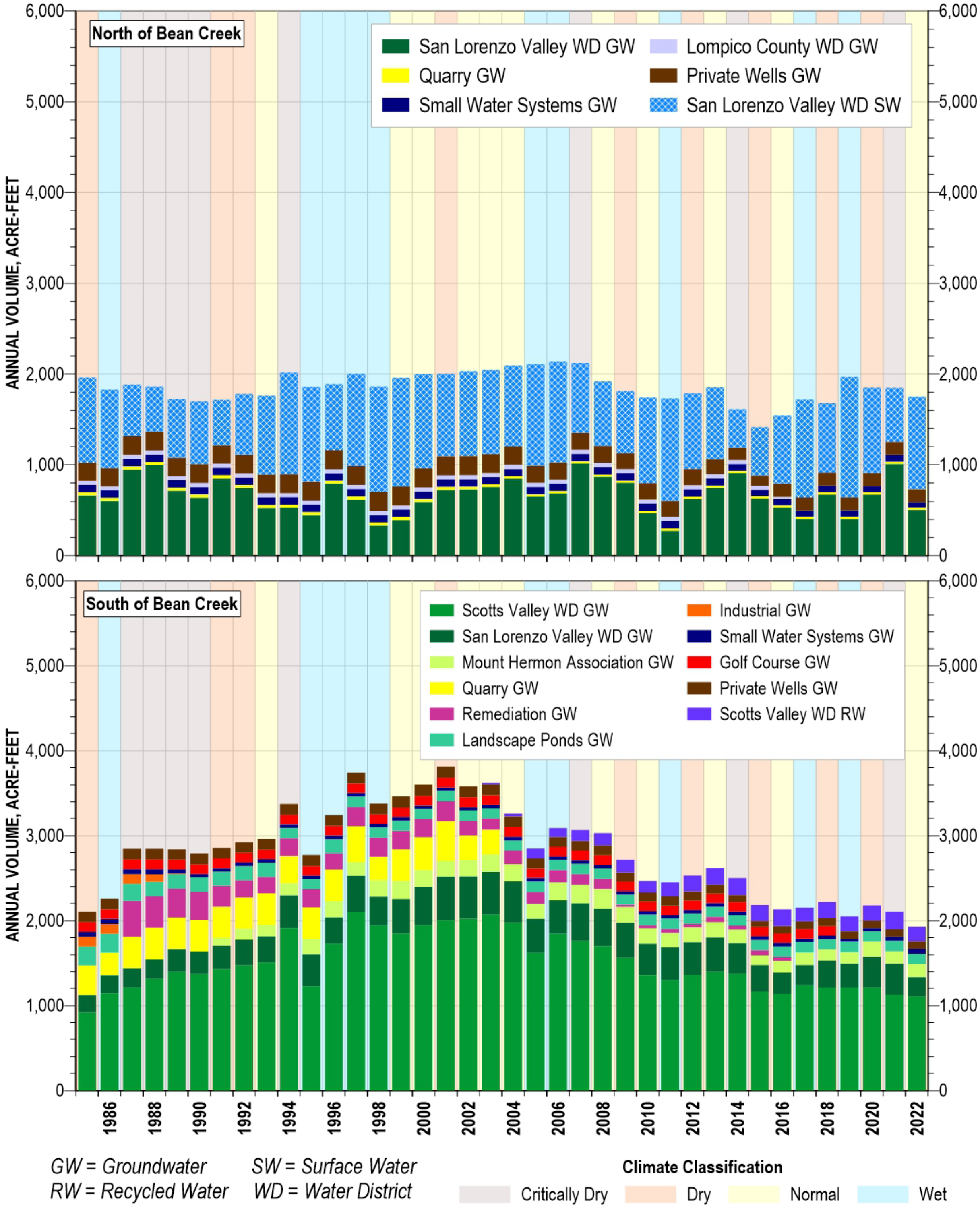

Figure 13. Total Water Use by Source, WY1985-2022

3.5 Change in Groundwater in Storage in WY2022

The change of groundwater in storage is estimated annually using the Basin Model. The Basin Model was updated with WY2022 climate and groundwater extraction data, including the following:

- Monthly precipitation and temperature data from the Parameter-elevation Regressions on Independent Slopes Model[3] (known as "PRISM") were used to update precipitation, evapotranspiration, recharge, runoff, and streamflow
- Extraction volumes provided by SLVWD, SVWD, and MHA
- Small water system extraction volumes provided by the County

Parameters assumed to have remained constant at the 2018 baseline levels in the GSP are domestic, quarry, landscape, and pond use groundwater extraction, and septic return flows. Parameters such as surface water and groundwater interactions, stream stage, and groundwater elevations are simulated by the Basin Model. The Basin Model was not recalibrated for this Annual Report and SMGWA intends to re-calibrate the model during the GSP 5-year evaluation process to be completed by 2027, after data is collected from new groundwater level monitoring wells that fill data gaps.

During preparation of this Annual Report, a model input error related to using scientific number format instead of integers for some recent data was discovered that had resulted in overestimation of storage losses in WY2019 and smaller differences in storage change in WY2020 and WY2021. Overall, the modeling error resulted in an overestimate of cumulative storage loss of about 3,900 AF, most of which occurred in WY2019. The error was corrected in this report as shown in Table 5.

Table 5. Correction to WY2021 Change in Storage Calculations

Water Year	WY2021 Report (AF)	Correction to WY2021 Report (AF)	WY2022 Report (AF)
2019	-1,300	3,900	2,600
2020	-5,700	500	-5,200
2021	-5,100	-500	-5,600
CUMULATIVE TOTAL	-12,100	3,900	-8,200

[3] https://prism.oregonstate.edu/

3.5.1 Change in Groundwater in Storage for the Entire Santa Margarita Basin WY2022

Figure 14 shows the annual and cumulative change of groundwater in storage and groundwater extraction for the Basin from WY1985 through WY2022. Singular annual increases of groundwater stored in the Basin correlate with wet years and some normal years if they follow large storage losses in previous dry or critically dry years (Figure 14). Historically, normal or drier water years generally result in decreased groundwater in storage.

The calculated groundwater in storage in the Basin increased modestly, about 1,090 AF, in WY2022, which is classified as a normal rainfall water year. This annual increase is greater than 70% of prior normal water years since 1985, in part because WY2022 followed 2 years of drought.

Starting in the 1970s, or perhaps earlier, there was a consistent reduction of groundwater stored in the Basin, mostly due to over-pumping of the Lompico aquifer in the South Scotts Valley area, but also due to drier than average conditions. These 2 decades of overpumping were succeeded, starting in the early 2000s, by 2 decades of progressively reduced groundwater extraction by SVWD. This reduction in groundwater extraction slowed the storage loss in the South Scotts Valley area and possibly stabilized groundwater in storage in the Basin. Since WY2015, cumulative change in storage appears to be leveling out, though annual variability related to precipitation persists (Figure 14).

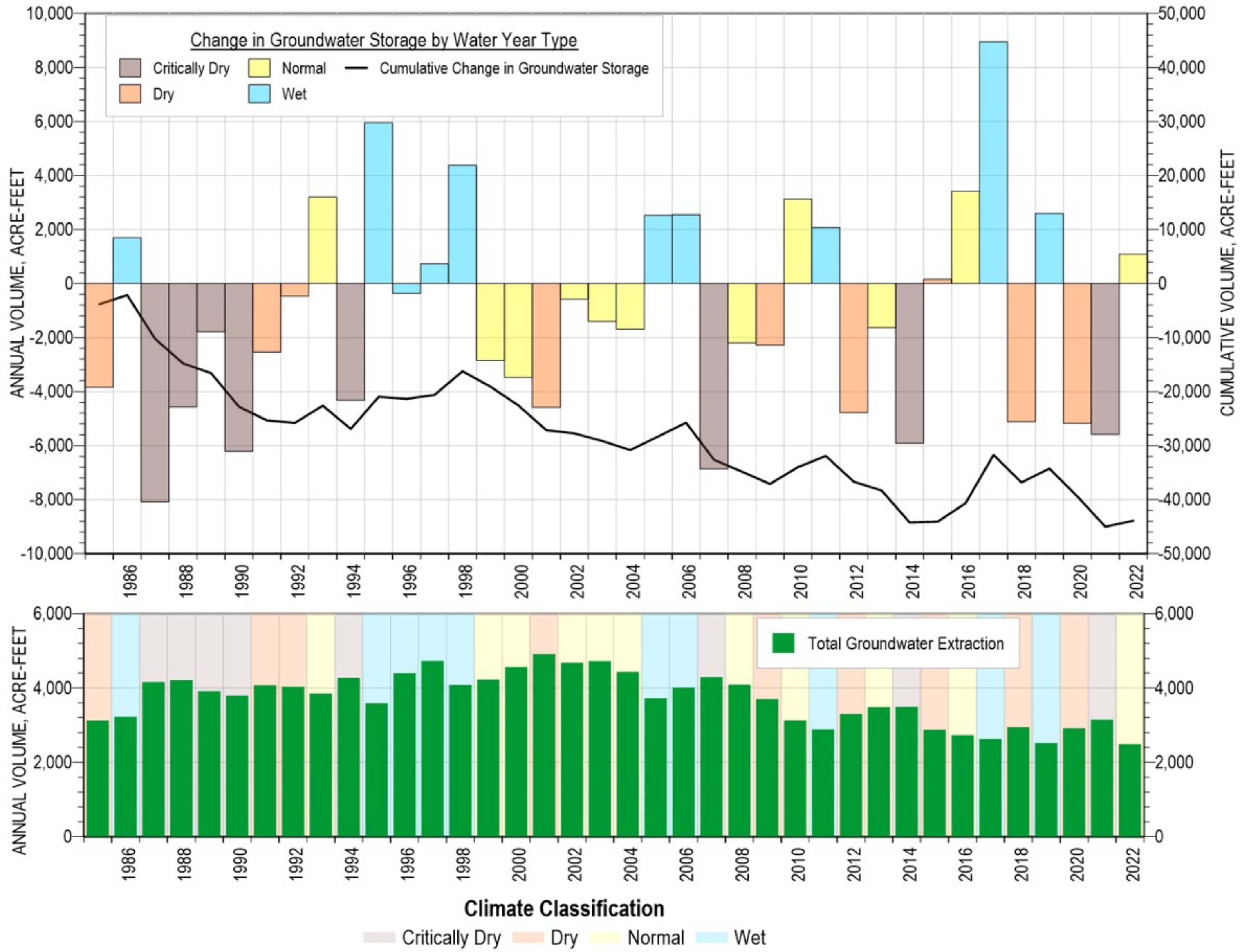

Figure 14. Annual Change in Groundwater in Storage for the Basin, WY1985-2022

3.5.2 Change in Groundwater in Storage for the Three Principal Aquifers and the Monterey Formation in WY2022

Given that groundwater elevations in principal aquifers and the Monterey Formation did not change substantially from WY2021 to WY2022, one would expect that changes in groundwater in storage for particular aquifers would not change significantly, except potentially near active extraction wells and active recharge or discharge areas. Figure 15 through Figure 18 show contour maps of calculated changes in groundwater in storage from the Basin Model between Fall WY2021 and Fall WY2022. Maps are shown for the Santa Margarita aquifer, Monterey Formation, Lompico aquifer, and Butano aquifer, respectively. The change in storage values of acre-feet per acre on the maps are very small numbers that are difficult to contextualize. The focus of the maps is to show relative differences in change of storage, where the cooler blue-green colors reflect increases in storage and the warmer yellow reflect decreases in storage.

In viewing these contour maps it is important to keep in mind that they are products of calculations using the Basin Model, not measured values. The accuracy of the contour maps depends on the degree to which the Basin Model is calibrated for a particular aquifer and spatial locations. Given that there are few monitoring wells in the Monterey Formation and the Butano aquifer, the model is not well-calibrated for these aquifers, so care must be taken in interpreting results for these aquifers. There are more monitoring data from the Lompico and Santa Margarita aquifers, but there are still large areas of the Basin where there are no wells to calibrate the Lompico and Santa Margarita aquifers in the Model. In addition, the results for all aquifers are dependent on model inputs, such that small calculated differences should be regarded with some skepticism in the absence of sensitivity analyses that test how the results of model simulations change if small changes in input parameters (such as hydraulic conductivity) are implemented.

The amount of groundwater stored in the unconfined and highly conductive Santa Margarita aquifer is strongly correlated with precipitation. Groundwater levels and groundwater storage decrease when conditions are dry but rise quickly during wet years. The location and relative storage volume changes for WY2022 shown on Figure 15 depict large areas of the Santa Margarita aquifer having similar groundwater in storage to WY2021 (green and tan colors). Groundwater in storage increased around SLVWD Quail Hollow and Olympia wellfields that rested more than WY2021 (blue-green and blue colors). Scattered areas where the aquifer is used for private domestic supply have the greatest reductions in storage in WY2022 (orange and red colors). However, these are also areas where there are no monitoring data to calibrate the Model and so changes in storage in these areas are likely not as accurate as areas that are calibrated, i.e., near public water supply wells.

The Monterey Formation has low permeability and, therefore, changes in storage would be expected to be much smaller on an annual basis than in the Santa Margarita aquifer. The Monterey Formation generally gained groundwater in storage or had very slight decreasing storage in WY2022 (Figure 16). The greatest increase in storage is in the northern upland areas where the Monterey Formation outcrops near creeks and is able to recharge. The largest decrease in storage is south of Bean Creek where the Formation pinches out between the Santa Margarita and Lompico aquifers.

The mostly confined Lompico and Butano aquifers are less subject to storage changes resulting from fluctuations in precipitation than the shallower, unconfined Santa Margarita aquifer. The recharge areas for these aquifers are limited to where they are exposed in narrow strips along the northern boundary of the Basin. This is where they are used as sources by private domestic wells (Figure 17 and Figure 18).

Modest increases in groundwater in storage were calculated where the Lompico aquifer was used for public supply. In the Mount Hermon / Pasatiempo area SLVWD was able to rest the Pasatiempo wellfield and decreased extraction by about 150 AF compared to WY2021 (Figure 17). However, the model shows a decrease in storage in much of the area surrounding the immediate vicinity of gaining supply wells. The declining storage calculation cannot be verified by measured groundwater levels since there are no monitoring wells to the south of the Pasatiempo wellfield. A possible explanation could be that because this is an area where the Santa Margarita aquifer is dewatered, recharge from precipitation through the Santa Margarita aquifer and into the underlying Lompico aquifer is limited because infiltrating rainwater would preferentially fill the much more conductive Santa Margarita aquifer than the Lompico aquifer. A modest increase in storage is also calculated for the Lompico aquifer around the SVWD supply wells #11A and #11B in North Scotts Valley which had decreased extraction of about 160 AF compared to WY2021. Groundwater in storage is shown as decreasing around South Scotts Valley supply well SVWD #10A even though total extraction decreased by 45 AF in WY2022, because the groundwater level declined in this well that was resting in September 2021. The only other area with decreasing storage is north of Scotts Valley where the Lompico aquifer outcrops and is used for domestic supply.

The Butano Aquifer had a small increase in storage near SVWD's Orchard Well screened in both the Lompico and Butano aquifers. The well extracted at slightly higher rates towards the end of last year after being down for maintenance for much of the year (Figure 18). Areas where the Butano aquifer is used for domestic supply at the northern margin of the Basin show both increases and decreases in groundwater in storage. Due to limited groundwater level data, the Basin Model is not well calibrated for the Butano aquifer, so the calculated storage changes in other areas of the Model where there are no monitoring wells are likely artifacts of a poorly constrained model.

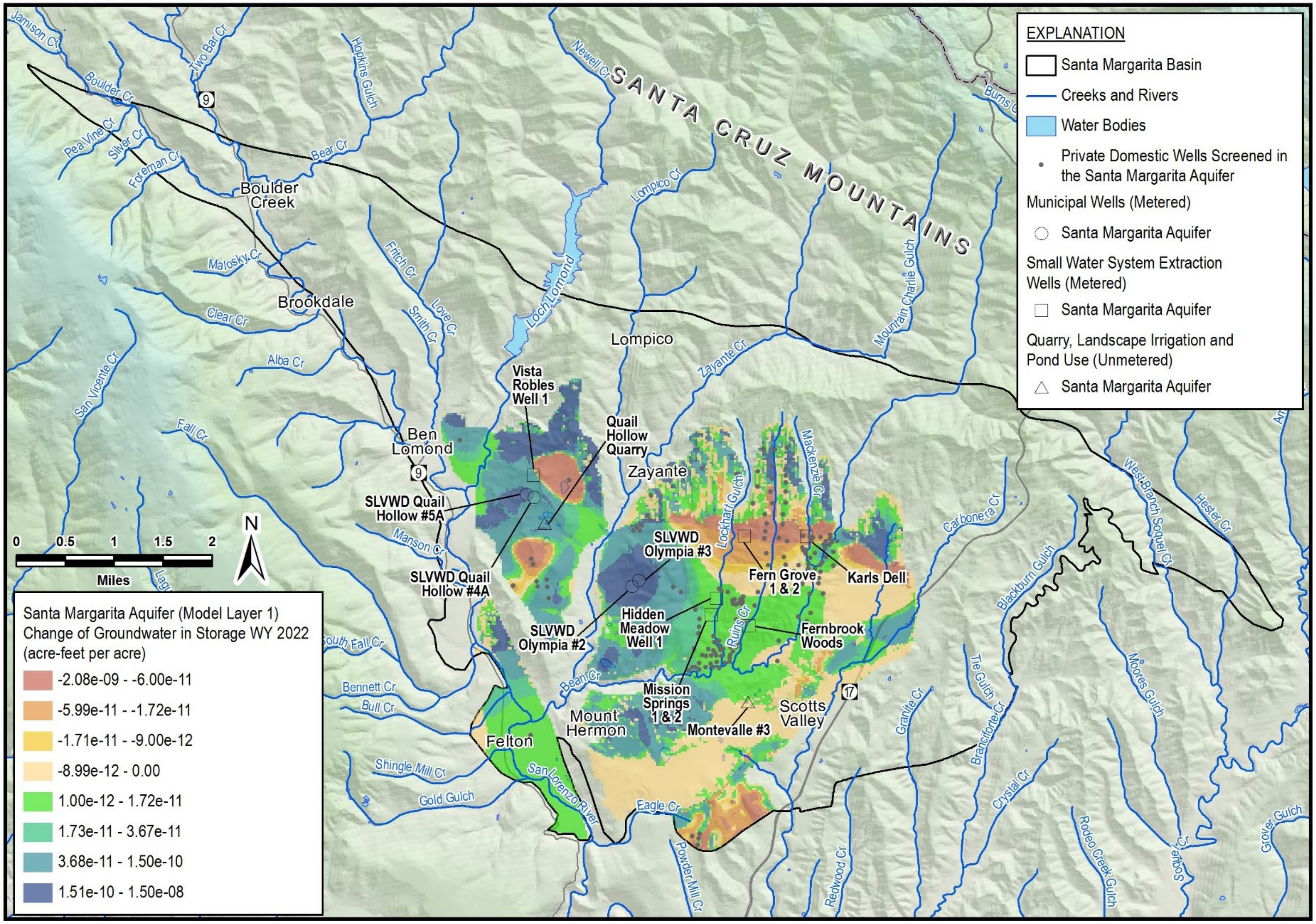

Figure 15. Change of Groundwater in Storage in Santa Margarita Aquifer, WY2022

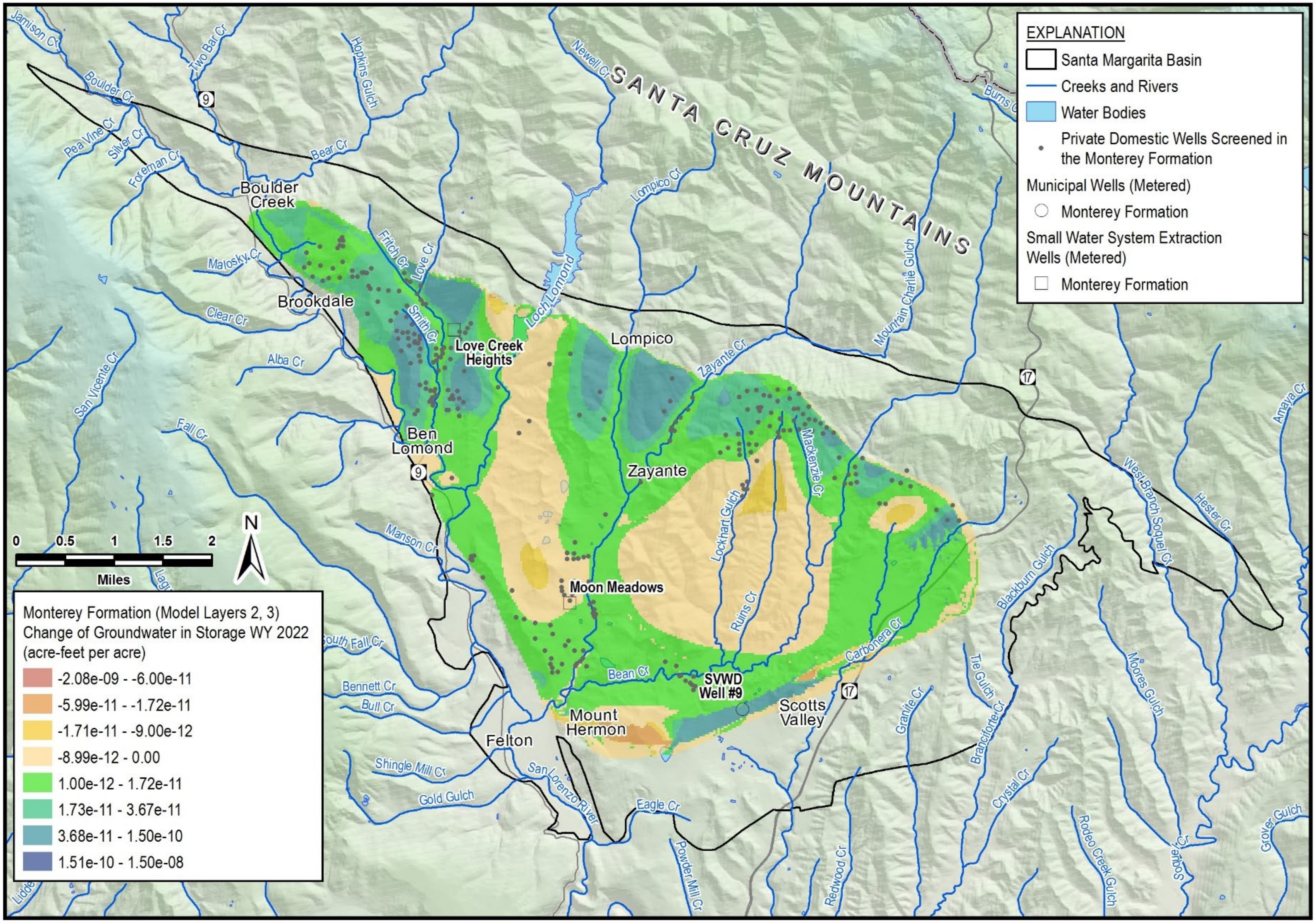

Figure 16. Change of Groundwater in Storage in Monterey Formation, WY2022

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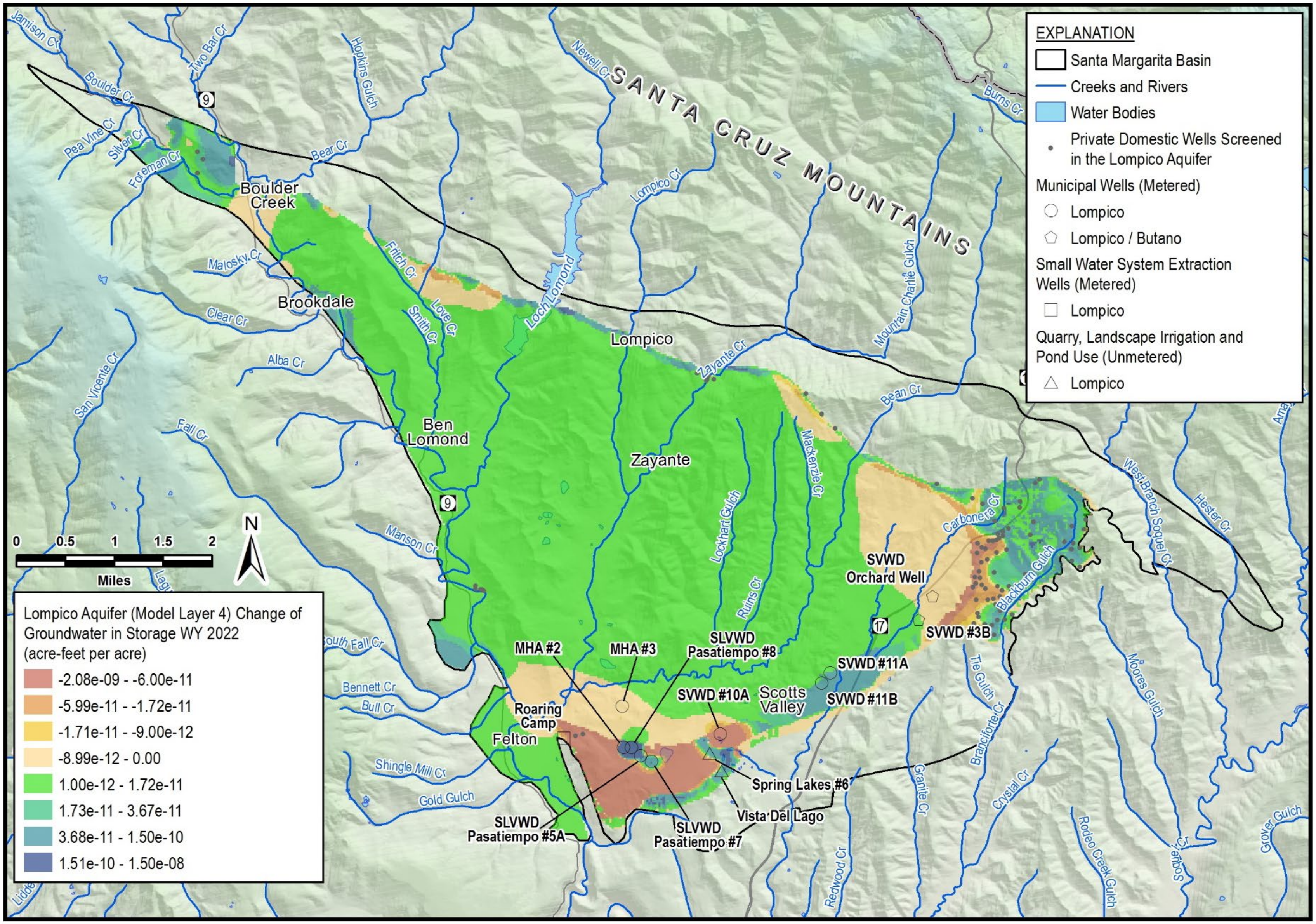

Figure 17. Change of Groundwater in Storage in Lompico Aquifer, WY2022

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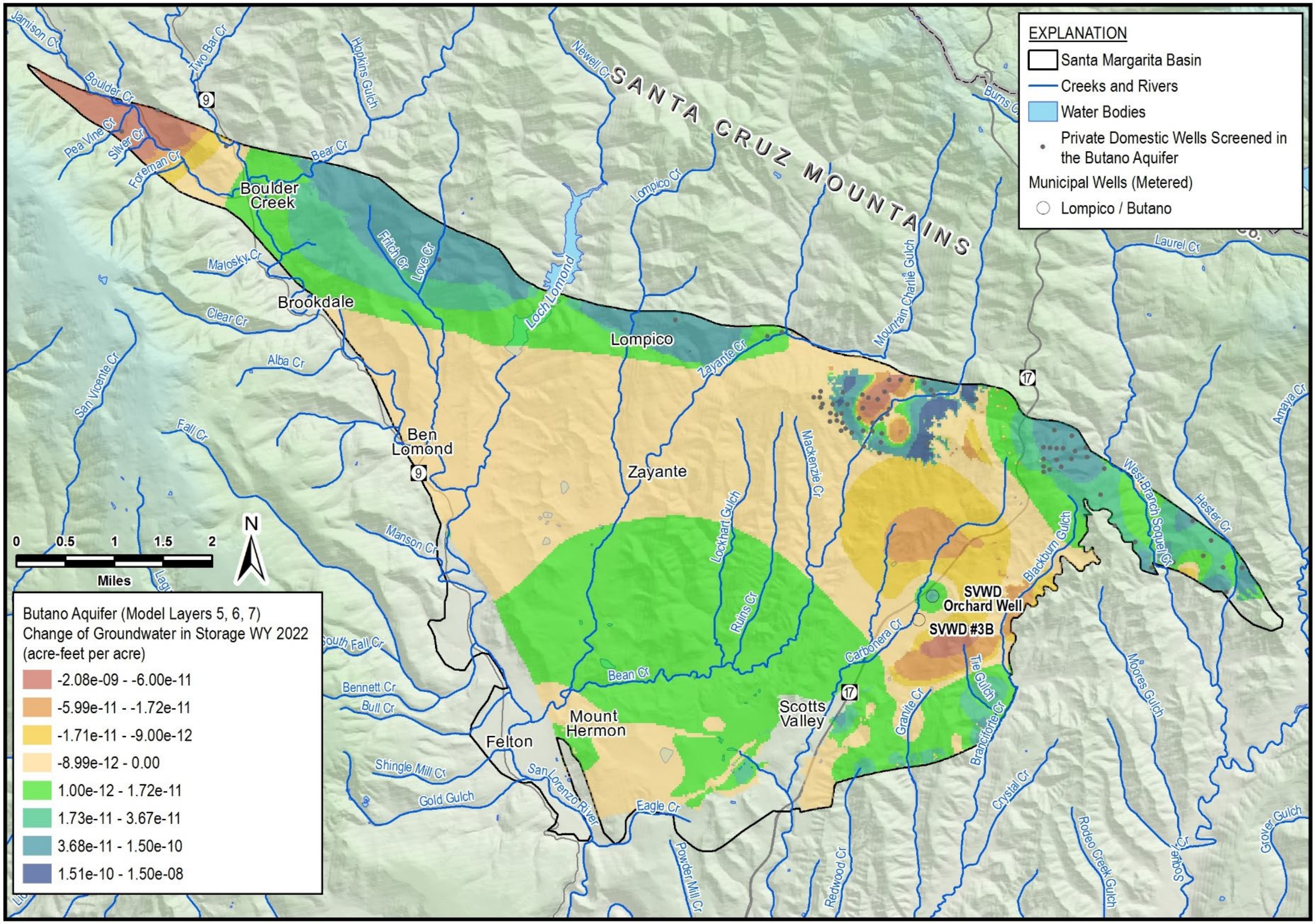

Figure 18. Change of Groundwater in Storage in Butano Aquifer, WY2022

4 PROGRESS TOWARD IMPLEMENTING THE PLAN

This section provides an update on WY2022 GSP implementation and progress toward sustainability. First, groundwater conditions are compared to the SMC defined in the GSP. Then the section outlines progress towards planning and implementing project and management actions and improving GSP monitoring networks. Finally, the section summarizes SMGWA's implementation priorities from the SGMA Implementation Round 2 Grant funding application submitted to DWR in December 2022.

Sustainability is defined by GSP Regulations as the absence of undesirable results for relevant groundwater conditions sustainability indicators. The sustainability indicators are evaluated with data collected from representative monitoring points (RMPs). The minimum threshold [(MT(s)] is the point at which undesirable results may start to occur. The measurable objective [(MO(s)] is the goal designed to provide operational flexibility and ensure that future droughts and unforeseen changes to water supplies do not cause unsustainable conditions. Interim milestones are 5-year goals to help SMGWA manage the Basin over the next 20 years to meet MOs by 2042. Land subsidence and seawater intrusion are not applicable sustainability indicators in the Basin and are not addressed in this report.

Overall, groundwater conditions in the Basin are relatively stable and sustainable, with annual changes primarily related to variation in precipitation and streamflow recharge of the shallow Santa Margarita aquifer.

4.1 Chronic Lowering of Groundwater Levels

There are 12 RMPs used to evaluate chronic lowering of groundwater levels relative to SMC. Annual groundwater elevations are reviewed in this section to assess whether they remain within the target operational range between the MT and MO, and if they are on track to meet the 2027 interim milestone. Undesirable results for the chronic lowering of groundwater levels indicator occur if the groundwater elevation in any RMP falls below the MT in 2 or more consecutive non-drought years. Temporary groundwater level declines caused by emergency operational issues or extended droughts are not considered an undesirable result. Table 6 shows the annual minimum, (not the Fall 2022 minimum) groundwater elevation at each RMP since WY2018, relative to the MT, MO, and the 2027 interim milestone. Hydrographs in Appendix A (pages A-3 through A-18) show all historical data collected at RMPs relative to the MTs and MOs.

Throughout WY2022 groundwater elevations at all 12 RMPs are above MTs; hence undesirable results did not occur for the groundwater level SMC. Groundwater elevations are stable or increasing in most wells. The 2027 interim milestone is met for 7 RMPs (green and yellow colors in Table 6), 4 of which also meet MOs (green color in Table 6).

4.1.1 Santa Margarita Aquifer

There are 4 Santa Margarita aquifer RMPs:

- SLVWD Quail Hollow wellfield: SLVWD Quail MW-B
- SLVWD Olympia and Mission Springs wellfields: SLVWD Olympia #3
- Mount Hermon/Pasatiempo/South Scotts Valley wellfields: SLVWD Pasatiempo MW-2
- North Scotts Valley: SVWD TW-18

In WY2022, groundwater elevations remained relatively stable compared to the prior water year, and are within the target operational range (Table 6):

- Two RMPs are below 2027 interim milestone: SVWD TW-18 and SLVWD Quail MW-B
- Two RMPs are above MOs: SLVWD Olympia #3 and SLVWD Pasatiempo MW-2

Groundwater elevations in SLVWD Olympia #3, Pasatiempo MW-2, and Quail MW-B declined in WY2020 and WY2021 (Appendix A, pages A-3 through A-5) because, in addition to these being dry and critically dry water years, SLVWD had to extract more groundwater during parts of these water years because of the loss of most of its surface water intakes in the August 2020 CZU Fire. In WY2022, groundwater elevations rose in Olympia #3 and Pasatiempo MW-2, and declined only slightly in Quail MW-B (Appendix A, pages A-3 through A-5), in part because of implementation of emergency conjunctive use throughout the District.

Groundwater elevations in the North Scotts Valley area, at SVWD TW-18, have been stable and close to or above the MO since 2000 (Appendix A, page A-6), because SVWD does not use this area for production from the Santa Margarita aquifer and the underlying Monterey Formation has low permeability.

4.1.2 Monterey Formation

The only Monterey Formation RMP is SVWD Well #9 in the South Scotts Valley area. This well has a long-term trend of increasing groundwater elevation (Appendix A, page A-8). In WY2022 the groundwater elevation is within the target operational range, above the 2027 interim milestone and very close to the MO (Table 6).

4.1.3 Lompico Aquifer

There are 4 Lompico aquifer RMPs:

- Mount Hermon / Pasatiempo wellfield: SLVWD Pasatiempo MW-1

- South Scotts Valley: SVWD Well #10
- Central Scotts Valley: SVWD Well #11A
- North Scotts Valley: SVWD TW-19

Groundwater elevations remained relatively stable in Lompico aquifer RMPs in WY2022 compared to the prior water year and are within the target operational range (Table 6). The MO and interim milestone were set at groundwater elevations predicted by the Basin Groundwater Model assuming the implementation of an additional 540 AF/yr in conjunctive use as one of the high-priority projects and management actions described in Section 4.5.2. Given that this project is still in the planning stage, it is expected that the 2027 interim milestone is not met:

- One RMP is above the MO (SVWD Well #10)
- Two RMPs are well above the 2027 interim milestone and slightly below the MO (SVWD Well #11A and SVWD TW-19)
- One RMP is below the 2027 interim milestone (SLVWD Pasatiempo MW-1)

The 3 SVWD Lompico aquifer RMPs have increasing groundwater elevation trends since about WY2015; the SLVWD RMP in Pasatiempo MW-1 does not (Appendix A, pages A-10 through A-13). The groundwater level in Pasatiempo MW-1 has decreased slightly since 2019, which reflects increased pumping during and in the aftermath of the August 2020 CZU wildfire affecting groundwater elevation levels in WY2019 and WY2020, with recovery of the aquifer being inhibited by the recent dry years and the limited direct recharge to the semi-confined Lompico aquifer.

4.1.4 Lompico/Butano Aquifer

SVWD #15 monitoring well in the Northern Scotts Valley area is the only RMP screened in both the Lompico and Butano aquifers. This well is located near the 2 Lompico/Butano SVWD production wells: SVWD #3B and SVWD Orchard. Groundwater elevations in SVWD #15 monitoring well fluctuate seasonally, with Spring measurements frequently greater than the MO and Fall measurements below the 2027 interim milestone (Appendix A, page A-15). The minimum groundwater elevation in WY2022 is within the target operational range at a level slightly below the 2027 interim milestone. Like Lompico aquifer wells, the MO and 2027 interim milestone are based on a project that has yet to be implemented.

4.1.5 Butano Aquifer

There are 2 Butano aquifer RMPs (SVWD Stonewood and Canham) located in the Northern Scotts Valley area upgradient of the SVWD #3B and Orchard Lompico/Butano wellfield. Both

Butano aquifer RMP wells exhibit long-term stable groundwater elevation trends (Appendix A, pages A-17 and A-18). Groundwater elevations remain within the target operational range (Table 6):

- One RMP is above the MO (Stonewood well)
- One RMP is below the 2027 interim milestone (Canham well)

The Canham well MO and 2027 interim milestone are aspirational goals, higher than any groundwater elevations measured in the well since monitoring began in 2011 since they are based on a project that has not been implemented yet.

Table 6. Groundwater Elevations Compared to Chronic Lowering of Groundwater Levels SMC, WY2018-2022

Aquifer	Well Name	Annual Minimum Groundwater Elevation (feet amsl)							
		Minimum Threshold	Interim Milestone #1 (2027)	Measurable Objective	WY2018	WY2019	WY2020*	WY2021*	WY2022
Water Year Type					Dry	Wet	Dry	Critically Dry	Normal
Santa Margarita	SLVWD Quail MW-B	449	472	472	462.4	460.4	462.4	455.8	451.8
	SLVWD Olympia #3	302	307	307	344.0	332.0	351.4	335.9	330.1
	SLVWD Pasatiempo MW-2	498	514	514	523.7	517.7	519.6	512.7	516.3
	SVWD TW-18	462	471	471	469.9	469.9	471.8	471.8	470.9
Monterey	SVWD #9	301	340	358	338.6	342.1	346.7	351.0	354.0
Lompico	SLVWD Pasatiempo MW-1	334	339	372	346.7	357.4	346.6	340.4	335.4
	SVWD #10	286	302	322	297.4	308.8	317.9	330.3	338.1
	SVWD #11A	288	299	317	292.6	302.3	310.4	308.0	312.6
	SVWD TW-19	314	357	376	342.5	361.6	373.1	370.4	370.0
Lompico/Butano	SVWD #15 Monitoring Well	291	310	333	308.5	298.1	302.8	307.1	307.9
Butano	SVWD Stonewood Well	836	844	844	846.8	849.1	848.3	845.0	845.8
	SVWD Canham Well	427	447	467	443.2	443.0	442.0	441.7	441.2

* Damage to SLVWD surface water intakes caused by the August 2020 CZU Wildfire caused groundwater extraction to increase and groundwater levels to decline in some areas of the Basin.
amsl – above mean sea level

Minimum threshold not met
Minimum threshold met but 2027 interim milestone and measurable objective not met
Minimum threshold and 2027 interim milestone met, but measurable objective not met
Measurable objective met

4.2 Reduction of Groundwater in Storage

The reduction of groundwater in storage SMC are annual groundwater extraction volumes for the principal aquifers and Monterey Formation. Groundwater sustainable yield estimates are developed using groundwater model projections. The MTs are related to groundwater extraction volumes without implementation of additional projects or management actions, and the MOs are related to groundwater extraction volumes assuming implementation of a 540 AF/yr conjunctive use project. The 2027 interim milestones are equal to the MT through 2027, and thereafter are equal to the MO through 2042. Undesirable results occur if groundwater extraction volumes exceed the reduction in groundwater storage MTs in 1 or more principal aquifers.

In WY2022, groundwater extraction is within the operational range between the MT and MO. The total extraction from each aquifer and formation is less than the MT but exceeds the MO in the Santa Margarita, Lompico, and Butano aquifers. Since the MO is based on implementation of projects that are still in the planning stages, the latter result is expected. Table 7 lists WY2022 groundwater extraction in each aquifer relative to MTs and MOs. Given that no MTs were exceeded, WY2022 extraction volumes did not result in undesirable results for this sustainability indicator.

Although total extraction is not a sustainability metric in the GSP, it is a useful value to assess sustainability progress. Total extraction in the principal aquifers and Monterey Formation is 2,455 AF in WY2022, which is midway between the extraction MO (2,125 AF) and extraction MT (2,820 AF). Implementation of planned projects and management actions described in Section 4.5 will help the SMGWA further reduce groundwater extractions to meet the sustainable yield and reduction in groundwater storage SMC.

Table 7. Groundwater Extractions Compared to Reduction in Groundwater in Storage SMC, WY2022

Aquifer	Groundwater Extraction, AF/yr		
	Minimum Threshold*	Measurable Objective	WY2022
Santa Margarita	850	615	683
Monterey	140	130	91
Lompico**	1,290	1,000	1,258
Butano**	540	380	423
TOTAL	**2,820**	**2,125**	**2,455**

* The first interim milestone in 2027 is equal to the minimum threshold.
** Assumes that the SVWD extraction wells screened in both the Lompico and Butano aquifers pump 40% of their water from the Lompico aquifer and 60% from the Butano aquifer.

Minimum threshold not met
Minimum threshold and 2027 interim milestone met, but measurable objective not met
Measurable objective met

4.3 Degraded Water Quality

Groundwater in the Basin is generally of good quality and meets primary drinking water standards. However, both naturally occurring and anthropogenic groundwater quality constituents of concern are present in some aquifers and areas. The main naturally occurring groundwater quality constituents in the Basin that occasionally approach or are greater than drinking water standards are iron, manganese, arsenic, and salinity. Anthropogenic groundwater quality constituents that are occasionally detected, though at concentrations less than drinking water standards, are nitrate, organic point-source contaminants from several industrial sites. The GSP noted that constituents of emerging concern from wastewater sources are also a concern for some Basin stakeholders but are not part of the RMP analyte list at this time as they are not routinely monitored in groundwater supply wells.

The MTs for degraded water quality are the drinking water standards for each constituent, except for nitrate, which is set to half the MCL drinking water standard. The MOs are the average concentrations at each well between January 2010 and December 2019. Interim milestones for groundwater quality are the same as MOs. The SMC for this sustainability indicator are met when concentrations are at or below the criteria. The MTs and WY2022 maximum concentrations for degraded groundwater RMPs are summarized in Table 8. Chemographs in Appendix D show groundwater quality in RMPs over time, relative to the MTs and MOs.

All SVWD RMP wells were sampled in WY2022 except SVWD Well #9, which is an inactive extraction well screened in the Monterey Formation. In WY2022 SLVWD analyzed only iron, manganese, arsenic, and nitrate in RMP wells [plus volatile organic compounds (VOCs) in Quail Hollow #5A]. Although not measured in WY2022, levels of total dissolved solids (TDS), chloride, and VOCs were all below MOs and/or detection limits when last analyzed in WY2021.

In WY2022, groundwater quality concentrations are lower than MTs for most analyzed constituents except iron and manganese. At least 1 constituent is reported at a concentration greater than the MO in all RMP wells except SLVWD Olympia #3 (Appendix D). Since the MOs are based on long-term average concentrations, small exceedances of MOs are expected.

Iron and manganese are naturally elevated in the Lompico aquifer and in parts of the Santa Margarita aquifer, such as the Olympia wellfield. Iron and manganese concentrations in untreated groundwater regularly exceed applicable secondary drinking water standards, so SLVWD and SVWD treat or blend raw groundwater to meet state drinking water standards. Since these are naturally occurring exceedances of MTs, and the exceedances are not being caused by groundwater use, they do not constitute undesirable results.

Table 9 shows the WY2022 maximum concentrations for iron and manganese relative to MOs for RMPs that do not meet the MT. The MOs are based on long-term average concentrations for these wells and, therefore, have higher concentrations than the MT. In WY2022, 5wells have lower concentrations than the MO and 1 has higher concentrations than the MO. WY2022 iron and manganese concentrations in SVWD #3B are greater than the MO, but are within their respective historical ranges.

Besides iron and manganese, other constituents detected at concentrations above the MO include TDS, chloride, arsenic, and nitrate:

- TDS concentrations between 300 and 730 milligrams per Liter (mg/L) are below the MT of 1,000 mg/L but exceeded the MO in 3 of 5 sampled wells.
- Chloride concentrations between 12 and 54 mg/L are below the MT of 250 mg/L but exceeded the MO in 4 of 5 sampled wells.
- Arsenic concentrations of 3.7, 8.6 and 9.7 micrograms per Liter (µg/L) were measured in SVWD #11A, SVWD #11B and SLVWD Pasatiempo #7, respectively. Concentrations were below detection limits in 4 other sampled wells. Examination of the chemograph for SLVWD Pasatiempo #7 (Appendix D, Page D-12) suggests that 9.7 µg/L is an anomalous result for the well. The levels measured in SVWD #11A and SVWD #11B were slightly above and slightly below the respective MOs for those wells. SVWD #11B is the only RMP well that regularly approaches the arsenic MCL and MT of 10 µg/L (Appendix D, Page D-16).
- Nitrate was detected only at SLVWD Quail Hollow #5A (2.3 mg/L) and Pasatiempo #7 (0.29 mg/L). The detection at SLVWD Quail Hollow #5A is slightly higher than the MO of 2.13 mg/L but well below the MT of 5 mg/L.

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Table 8. Groundwater Quality Compared to Minimum Thresholds, WY2022

Aquifer	Well Name	Concentration milligrams per Liter (mg/L)										
		TDS	Chloride	Iron	Manganese	Arsenic	Nitrate as Nitrogen	Methyl-tert-butyl-ether	Chlorobenzene	Trichloroethylene	Tetrachloroethylene	1,2-Dichloroethylene
Minimum Threshold		***1,000***	***250***	***0.3***	***0.05***	***0.01***	***5***	***0.013***	***0.07***	***0.005***	***0.005***	***0.07***
Santa Margarita	SLVWD Quail Hollow #5A	NA	NA	ND	NA	NA	2.3	NA	ND	ND	ND	NA
	SLVWD Olympia #3	NA	NA	0.31	0.15	ND	ND	NA	NA	NA	NA	NA
Monterey	SVWD Well #9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Lompico	SLVWD Pasatiempo #7	NA	NA	0.39	0.10	0.0097	0.29	NA	NA	NA	NA	NA
	SVWD #10A	300	32	0.79	0.099	ND	ND	ND	ND	ND	ND	ND
	SVWD #11A	520	29	0.26	ND	0.0037	ND	ND	0.0005	ND	ND	ND
	SVWD #11B	340	22	0.68	0.076	0.0086	ND	ND	ND	ND	ND	ND
Lompico/ Butano	SVWD #3B	730	12	0.44	0.12	ND	ND	ND	ND	ND	ND	ND
	SVWD Orchard Well	490	54	0.010	0.003	ND	ND	ND	ND	ND	ND	ND

Minimum threshold not met
Minimum threshold met, but measurable objective not met (see Appendix D for MO)
Minimum threshold and measurable objective met, or analyte not detected (ND)
NS – not sampled
NA – not analyzed

Table 9. Groundwater Quality Compared to Iron and Manganese Measurable Objectives, WY2022

Aquifer	Well Name	Iron Concentration (mg/L)		Manganese Concentration (mg/L)	
		Measurable Objective	WY2022 Maximum	Measurable Objective	WY2022 Maximum
Santa Margarita	SLVWD Olympia #3	0.502	0.31	0.157	0.15
Lompico	SLVWD Pasatiempo #7	0.539	0.39	0.099	0.10
	SVWD #10A	1.51	0.79	0.099	0.099
	SVWD #11A	0.459	0.26	0.112	ND
	SVWD #11B	0.826	0.68	0.077	0.076
Lompico/ Butano	SVWD #3B	0.380	0.44	0.042	0.12

Measurable objective not met

Measurable objective met

4.4 Depletion of Interconnected Surface Water

Depletion of interconnected surface water is assessed at 2 RMPs using groundwater elevations as a proxy. The approach for evaluating sustainability is identical to the approach described for the chronic lowering of groundwater levels indicator in Section 4.1. Table 10 compares 5 years of annual minimum groundwater elevations for depletion of interconnected surface water RMPs with MTs and MOs. Hydrographs for depletion of interconnected surface water RMPs are shown in Appendix B, pages B-2 and B-3.

WY2022 groundwater elevations in both RMPs remained stable and higher than the MTs despite 3 consecutive years of below-average rainfall. The groundwater elevation in SVWD SV4-MW is 18.7 feet higher than the MO, while the groundwater elevation in SLVWD Quail MW-A is 2.9 feet lower than the MO.

Table 10. Groundwater Elevations Compared to Depletion of Interconnected Surface Water SMC, WY2018-2022

Aquifer	Well Name	Minimum Groundwater Elevation (feet amsl)						
		Minimum Threshold	Measurable Objective*	WY2018	WY2019	WY2020	WY2021	WY2022
Water Year Type				**Dry**	**Wet**	**Dry**	**Critically Dry**	**Normal**
Santa Margarita	SLVWD Quail MW-A	413	416	413.7	413.7	414.4	413.3	413.1
	SVWD SV4-MW	381	387	398.9	406.6	401.6	404.1	405.7

* 2027 interim milestones are equal to the measurable objective

Minimum threshold not met
Minimum threshold met, but measurable objective not met
Measurable objective met

4.5 Update on Implementation of Projects and Management Actions

SMGWA's member agencies have managed groundwater proactively in the Basin for the past several decades. There are management activities predating the SGMA that are ongoing during GSP implementation. Historical groundwater level declines have been mitigated over the past 2 decades by reduced consumption, water use efficiency programs, reduction in system leaks, use of recycled water for non-potable uses by SVWD, and conjunctive use of surface water and groundwater by SLVWD. Groundwater elevations in wells and calculated groundwater in storage stabilized around 2015 and since then groundwater levels have risen in many wells, suggesting that current extraction levels may be sustainable under present conditions. However, to ensure that SMGWA's sustainability goals are met under future climate conditions and to improve water supply reliability for individual agencies and the region, SMGWA is proceeding with high-priority projects and management actions that maximize *in lieu* recharge, and is investigating other types of projects to implement should these efforts prove insufficient.

This section summarizes progress during WY 2022 toward implementing projects and management actions for groundwater sustainability. The estimated costs, timing, and benefits of ongoing, planned, and potential projects and management actions are described in detail in the GSP. They fall into the following groups:

- Group 1 – projects and management actions that are already being implemented
- Group 2 – projects and management actions that have not been implemented yet, but are the most likely options to be pursued during GSP implementation
- Group 3 – additional conceptual projects and management actions that may be evaluated in the future if Group 1 and 2 projects are not feasible or do not achieve sustainability

Many of the projects and management actions under consideration focus on conjunctive use, which is the optimized, sustainable use of multiple water sources throughout repeated climatic cycles under physical, legal, and environmental constraints. SLVWD has demonstrated effective conjunctive management of surface water and groundwater in their North System since 1984 and has successfully employed it throughout the District since the August 2020 CZU wildfire to reduce groundwater use.

4.5.1 Existing Projects and Management Actions (Group 1)

This section summarizes the existing projects and management actions already being implemented in the Basin.

4.5.1.1 Conservation and Water Use Efficiency

SLVWD, SVWD, SCWD, and the County continue to implement conservation activities that reduce water demand in the region by building awareness about indoor and outdoor water use efficiencies, promoting water-efficient behaviors, and reducing water waste. The agencies individually implement a variety of water conservation programs focused on education, outreach, rebates, and enforcement of water waste policies. They are all members of the Water Conservation Coalition of Santa Cruz County, which serves as a regional information source for countywide water reduction measures, rebates, and educational materials. The organization's outreach efforts to improve water conservation include press releases, local advertisements, and informational booths at events.

While education and outreach programs increase awareness and efficiency on the customer side, SLWVD, SVWD, and SCWD also focus on improving efficiency within their respective distribution systems through upgrades to the metering infrastructure, reduction of non-revenue water, and evaluation of system pressure. New metering infrastructure allows for increased accuracy, leak detection, and improved customer accountability. In 2016, SLVWD began deploying new meters in its Lompico service area, and a multi-year system-wide meter change-out program has upgraded 33% of meters through WY2022. The District recently received a grant to upgrade an additional one-third of the meters. In 2016, SVWD began deploying advanced metering infrastructure and achieved 100% completion in WY2021. SVWD tested and calibrated all production meters in WY2022.

Systemically addressing non-revenue water losses increases overall efficiency and decreases groundwater extraction. SVWD conducted a leak detection audit in WY2022. SLVWD has increased the frequency of contracted system-wide leak detection from every 3 years to every 2 years. As part of regular capital improvements, SLVWD is in the process of replacing older storage tanks and pipelines. Old, redwood storage tanks are known sources of water loss. SLVWD replaced 4 redwood tanks in WY2022 and has applied for grant funding to replace additional redwood tanks in future years.

4.5.1.2 SVWD Low Impact Development (LID) Projects

SVWD monitors 3 LID facilities, which were developed prior to SGMA. As Table 2 shows, a minimum of 16 AF of stormwater was captured in WY2022 at the three LID facilities. LID-infiltrated stormwater recharges the Santa Margarita aquifer in a manner similar to natural processes, augmenting groundwater levels and sustaining groundwater contributions to creek baseflows that support local fish habitats. The three LID facilities overlie and infiltrate stormwater into the Santa Margarita Sandstone in areas where the presence of intervening Monterey Formation restricts recharge of that water into the Lompico aquifer below. The relatively small size of the area where the Monterey Formation is absent limits the potential of

LID facilities to recharge the Lompico aquifer, which is the aquifer most affected by past overdraft and is the source of most of SVWD's water. Another factor complicating LID implementation in the Scotts Valley area is that there is no centralized stormwater collection system, which limits the scale of projects and the ability to direct recharge to the most beneficial areas.

SVWD continues to evaluate opportunities for additional LID expansion in the future. Costs of past projects have been in large part offset by grant funding. SVWD applied for a 2022 Urban Community Drought Relief grant to expand the Transit Center LID project to contribute approximately 1 to 4 AF/yr of additional stormwater recharge to the Santa Margarita aquifer.

4.5.1.3 SVWD Recycled Water Program

The SVWD Recycled Water Program is a cooperative effort between SVWD and the City of Scotts Valley. Recycled water has been used *in lieu* of groundwater by SVWD for non-potable uses since 2002 to augment the water supply and help SVWD meet water-use efficiency goals. Recycled water is produced at the City of Scotts Valley Tertiary Wastewater Treatment Plant, where it undergoes nitrate removal, ultra-violet disinfection, and chlorination. Recycled water is then distributed by SVWD to customers through a dedicated recycled water system. Recycled water is used mostly for landscape irrigation and to a lesser extent for dust control. SVWD continues to explore options to maximize the beneficial use of recycled water in the future. Costs of operating the recycled water system are built into SVWD and City of Scotts Valley budgets and are not anticipated to be passed on to SMGWA.

Use of recycled water results in a reduction in groundwater extraction and an increase in groundwater levels in the Basin. Figure 19 charts recycled water demand since it was made available to SVWD customers in 2012. SVWD distributed 174 AF of recycled water in WY2022.

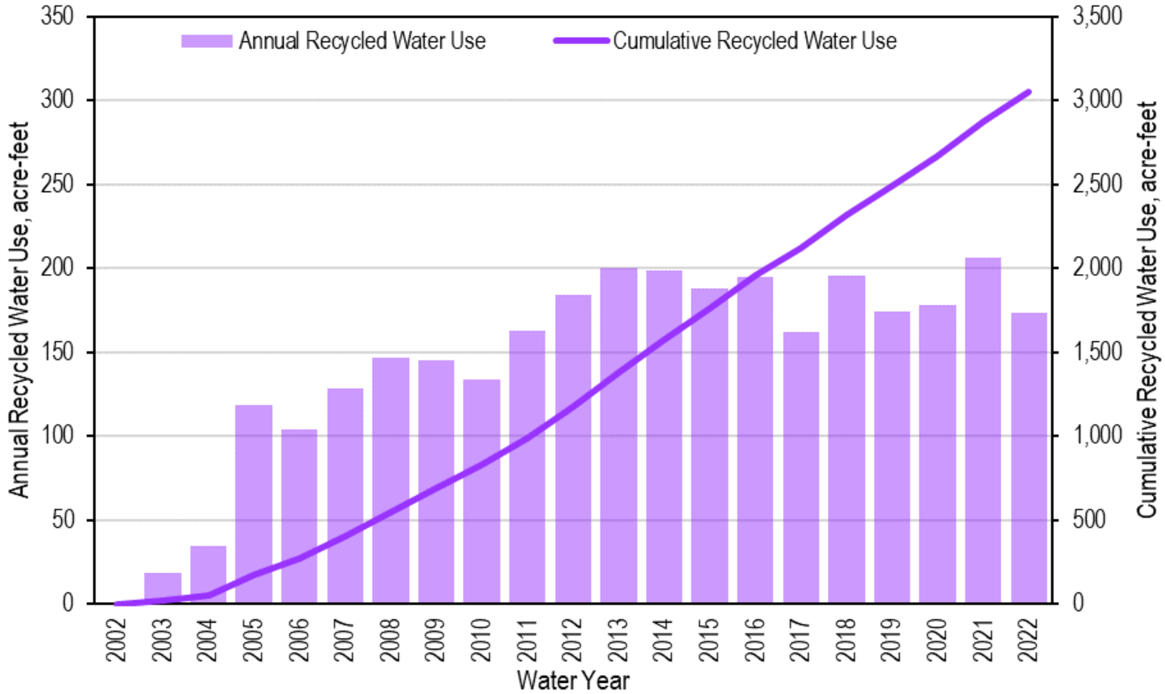

Figure 19. Recycled Water Use by SVWD Customers, WY2002-2022

4.5.1.4 SLVWD Conjunctive Use

The SLVWD owns, operates, and maintains 2 water systems that supply different water sources to distinct areas in the Basin. The San Lorenzo Valley System, made up of the connected North and South distribution systems, and the Felton System, which only serves the community of Felton and surrounding areas in the southern portion of the Basin (Figure 20). The North System uses surface water and groundwater conjunctively, the South System uses groundwater and surface water conveyed from the North System, and the Felton System only uses surface water. The Felton System is connected to the San Lorenzo Valley System by an intertie that is only for emergency use.

A successful conjunctive use program has been implemented by SLVWD in their North System for decades. In the North System, the SLVWD optimizes the use of surface water and groundwater by utilizing stream flows while they are high and groundwater when stream flows are low. The benefits of conjunctive use in the North System are reduced groundwater pumping of the Santa Margarita aquifer in the Quail Hollow and Olympia wellfields, increased groundwater levels around the wells that are resting. The conjunctive use of these sources has met annual water demands since 1984, without a substantial decline in groundwater levels. On average, the North System obtains 56% of its water supply from stream diversions and 44% from groundwater extraction (Figure 13).

Since the August 2020 CZU wildfire, SLVWD has practiced District-wide conjunctive use that has shown the effectiveness of this approach for reducing groundwater use, and has demonstrated the feasibility and benefits of expanding conjunctive use well beyond SLVWD's North system. The destruction of all the surface water intakes and raw water pipelines in the North System by the wildfire created an emergency situation that allowed the District to use the emergency intertie with the Felton System. As a result, SLVWD was able to maximize its surface water diversions in the Felton System (while maintaining fish bypass flows) in conveying water to the North and South Systems and reduce reliance on groundwater (resulting in *in lieu* recharge). This District-wide conjunctive use made it possible for SLVWD to use surface water exclusively (i.e., rest the wells in both the North and the South Systems) for approximately 30 days in WY2021 and 60 days in WY2022, and to reduce WY2022 groundwater extraction to an annual volume that is one of the lowest on record.

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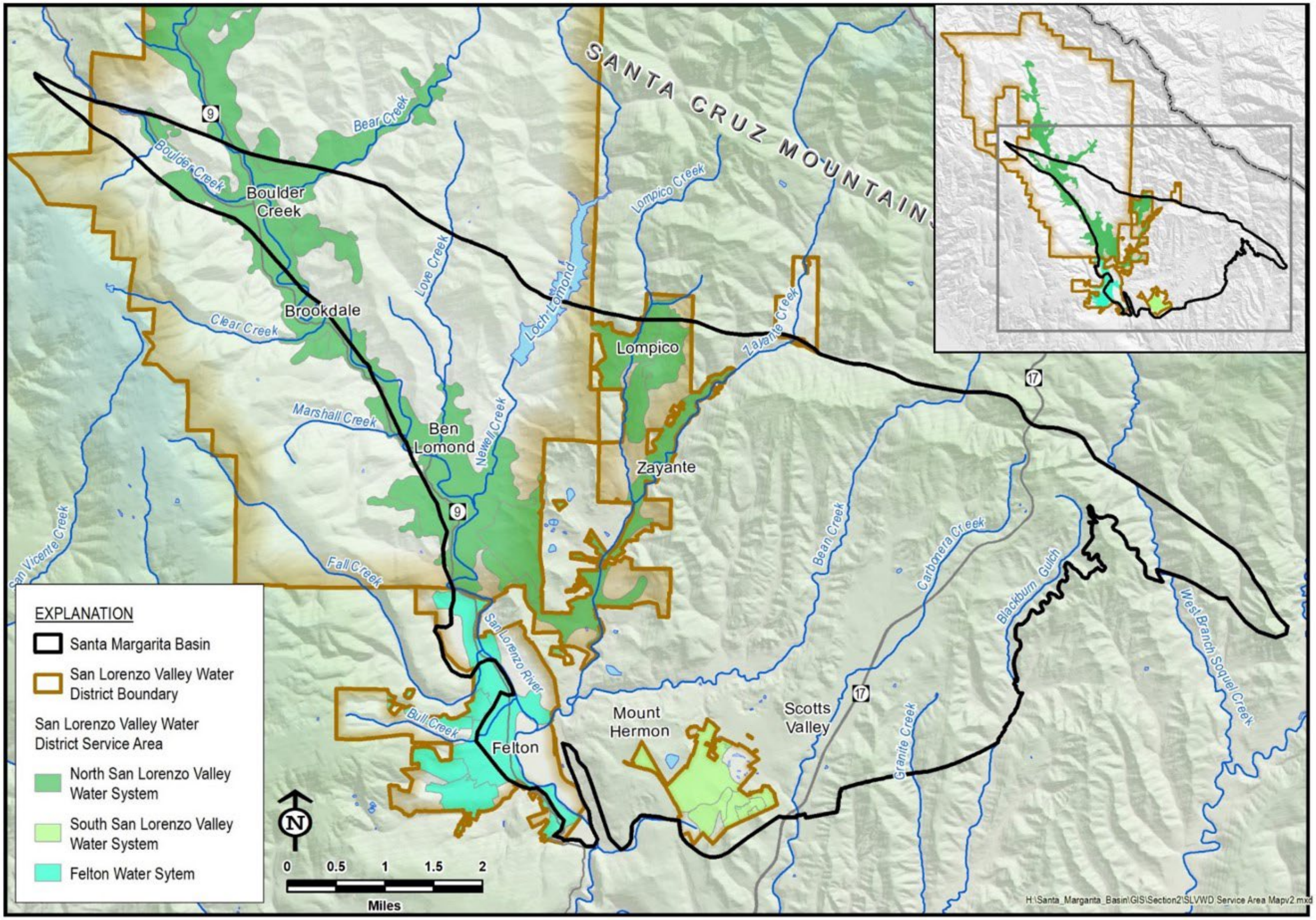


Figure 20. San Lorenzo Valley Water District Systems

4.5.2 Projects and Management Actions Using Existing Water Sources Within the Basin (Group 2, Tier 1)

Group 2, Tier 1 projects and management actions identified in the GSP focus on expansion of conjunctive use in the Basin using existing water sources within the Basin. The amount of excess surface water available for conjunctive use is a function of factors such as annual precipitation, required minimum bypass flows for fish, the capacity of drinking water treatment facilities, and water rights restrictions on place-of-use.

Expanding conjunctive use will involve 2 phases with different sources, conveyance infrastructure, and regulatory frameworks:

Phase 1 of Expanded Conjunctive Use: Excess surface water from existing diversion points in SLVWD's Felton and North Systems is available for expanded conjunctive use in the South System and can be conveyed with minimal modifications to existing infrastructure to other areas of the Basin where surface water is not currently used.

There is on average an estimated 227 AF/yr of excess surface water from SLVWD's North and Felton Systems available for expanded conjunctive use in the South System or other parts of the Basin. This estimated excess surface water amount would be refined with future analysis.

Phase 2 of Expanded Conjunctive Use: SLVWD's contractual allocation of 313 AF/yr of raw water from Loch Lomond reservoir is currently unused. This water could be available for conjunctive use in the Basin with improvements to water treatment and conveyance infrastructure, subject to completion of environmental compliance permitting and agreements with SCWD.

Expanded conjunctive use of water sources in the Basin requires modifications to SLVWD's water rights regarding place-of-use to allow the District to use surface water from the Felton System throughout the District, and to convey water to SVWD on a non-emergency basis. SLVWD submitted an Initial Study and Mitigated Negative Declaration in support of its water rights petition as part of the California Environmental Quality Act review in July 2021. State agency comments were received from the State Water Resources Control Board and Department of Fish and Wildlife. The Mitigated Negative Declaration filing was met with numerous formal objections by SCWD. As a result, the District is currently undertaking an Environmental Impact Report of intra-District water transfers, which is anticipated to be completed by the end of 2024. Once those are completed, SLVWD will proceed with environmental studies and water rights petitions that address inter-district water transfers. SLVWD plans to complete an updated engineering feasibility study and environmental impact report by the end of 2024 for conjunctive use of its contracted 313 AF/yr allocation of Loch Lomond water. In parallel the District will continue to pursue discussions with SCWD about purchasing an equivalent amount of treated water instead. SLVWD and SCWD entered a formal agreement in 2021 to work collaboratively on reaching agreement on SLVWD's utilization of its Loch Lomond allocation and resolving water rights issues in the San Lorenzo River watershed.

4.5.3 Projects and Management Actions Using Surface Water Sources Outside the Basin (Group 2, Tier 2)

Group 2, Tier 2 projects rely on water sources from outside the Basin.

4.5.3.1 Water Transfer from Other Basins for Inter-District Conjunctive Use

Water transfer from sources outside of the Basin for inter-district conjunctive use is similar to the transfers described above, but they rely on import of treated surface water during the wet season months to offset groundwater extraction demands. Treated surface water would be provided by SCWD from its San Lorenzo River and North Coast sources when excess water is available.

In WY2022 SVWD was awarded a 2021 Urban and Multibenefit Drought Relief grant for $9.5 million to implement a Regional Drought Resiliency Project. The project, anticipated to be completed by early 2026, includes the design and construction of 2 critical pieces of infrastructure to improve drought resiliency for SVWD and SCWD:

1. A 12-inch-diameter, bi-directional, intertie pipeline and pump station between the SCWD and SVWD distribution systems to facilitate transfers of water in droughts or other emergencies
2. A new production groundwater 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

Together, the 2 new infrastructure elements create an opportunity to increase groundwater stored in the Basin for beneficial use. This could be done by *in lieu* conjunctive use (i.e., use SCWD excess surface water to rest SVWD wells, resulting in natural recovery of groundwater levels in the Basin) and/or by injection of surface water into the Lompico aquifer.

4.5.3.2 Aquifer Storage & Recovery Project in Scotts Valley Area of the Basin

Over the past few years, SCWD has explored the possibility of an aquifer storage and recovery (ASR) project in the area of Scotts Valley where groundwater levels in the Lompico aquifer have been lowered and there is the most storage capacity. The potential project would use treated surface water from SCWD's San Lorenzo River and North Coast sources to create an underground reservoir in the Basin for drought supply. SCWD has used the Basin groundwater model to simulate preliminary options for ASR configurations and operations.

4.5.4 Projects Using Purified Wastewater Sources (Group 2, Tier 3)

There are several potential project alternatives included in the GSP that would use purified wastewater to supplement water supplies in the Basin. SVWD and SCWD have both completed initial feasibility studies of projects involving injection and storage of purified wastewater prior to WY2022. No additional investigations were advanced on this topic in WY2022.

4.5.5 Other Projects and Management Actions Requiring Future Evaluation

In 2022, SMGWA submitted an application for a Sustainable Groundwater Management Implementation (SGMI) Round 2 grant that includes funding to evaluate the managed aquifer recharge strategies, including conjunctive use of Loch Lomond reservoir water and imported treated surface water, and ASR involving treated surface water or purified wastewater. Should the actions described above in Sections 4.5.2, 4.5.3, and 4.5.4 prove to not be feasible or insufficient to achieve sustainability goals, SMGWA may look into the feasibility of additional projects and management actions identified in the GSP as Group 3. These will be evaluated as necessary and discussed in future annual reports or the 5-year GSP update.

4.6 Update on Improvement of Monitoring Network

SMGWA identified data gaps in the monitoring network that should be filled as funding allows during implementation of the GSP. This section describes improvements to the GSP monitoring network made in WY2022 and planned for the near future.

4.6.1 Groundwater Level Monitoring Improvements

Progress was made in WY2022 towards adding new groundwater level monitoring wells to the GSP monitoring network. A unifying elevation survey of monitoring wells is a lower priority data gap that will be performed as funding becomes available.

4.6.1.1 Groundwater Level Monitoring Well Installations

During WY2022, SMGWA advanced plans to install up to 8 new groundwater level monitoring wells in areas of the Basin where groundwater is extracted, but no historical or current monitoring wells exist. Monitoring wells are planned in locations shown on Figure 21 for the purposes described in Table 11, as summarized below:

- Santa Margarita aquifer and Monterey Formation well installations are planned near communities with many private domestic wells but no groundwater level monitoring. Some of these well locations will also be used to assess interconnection between shallow groundwater and surface water and to evaluate whether groundwater extraction is causing depletion of surface water.
- One Butano aquifer monitoring well is planned where SVWD extraction wells are installed in both the Lompico and Butano aquifers but no dedicated Butano monitoring well exists.

Sites for 9 new monitoring wells were selected in WY2021, shortly after the GSP was submitted. In WY2022, SMGWA acquired site access, developed well installation technical specifications, prepared public bid documents, and coordinated well permits for 8 of the sites. A monitoring well in the Monterey Formation in the northern portion of the Basin that was identified as “Weston Road” in the GSP cannot be installed at this time because an accessible location could not be identified.

SMGWA plans to install 7 monitoring wells in the Santa Margarita aquifer and Monterey Formation in WY2023. The installation of these shallow monitoring wells is to be funded using remaining Proposition 68 funds and SMGWA contributions. The deeper Butano aquifer monitoring well will be installed on a different timeline. This well will be constructed at a school where installation can only occur in the summer when school is out of session. The Butano aquifer monitoring well is also much more expensive than the other wells because it is substantially deeper. SMGWA requested additional funding to install the Butano monitoring well in the SGMI Round 2 grant application, as discussed in Section 4.7.

Table 11. Rationale for Proposed New Monitoring Well Locations

Well ID	Location Name	Location Description	Target Aquifer / Formation	Anticipated Well Depth (ft bgs)	Sustainability Indicator Monitoring	Rationale for Well
SMGWA-1	Vine Hill School	West side of Scotts Valley Drive just inside Vine Hill Elementary school's northern gate.	Butano	800	Groundwater levels	Establish a monitoring well screened only in the Butano aquifer near SVWD extraction wells.
SMGWA-2	Bean Creek Downstream of Mackenzie Creek	County right-of-way on the east side of Bean Creek Road near the 0.94 mile marker	Santa Margarita	80	Interconnected surface water	Collect groundwater data near a portion of Bean Creek that periodically runs dry in summer months near newly installed stream gage.
SMGWA-3	Ruins Creek	County right-of-way on the west side of Nelson Road, and approximately 500 feet north of 0.88 mile marker	Santa Margarita	300	Groundwater levels	Address a data gap in the aquifer where there is groundwater pumping but no historical groundwater level data.
SMGWA-4	Nelson Road / Lockhart Gulch	County right-of-way on the north side of Nelson Road approximately 350 feet north of the intersection between Nelson and Lockhart Gulch Roads	Santa Margarita	100	Interconnected surface water	Monitor an area that has a high concentration of private domestic pumping and is the location where Bean Creek flow resurfaces when the upgradient reach is dry.
SMGWA-5	Bahr Drive	North side of Bahr Dr opposite 310 Bahr Road, Scotts Valley.	Santa Margarita	200	Interconnected surface water	Monitor an area where groundwater seeps out of the valley side and into Zayante Creek.
SMGWA-6	Quail Hollow Road	SLVWD-owned parcel with an inactive extraction well (Well #8).150 feet past 0.31 mile marker.	Santa Margarita	300	Interconnected surface water	Monitor groundwater levels in the Quail Hollow subarea near upgraded Newell Creek stream gage
SMGWA-7	Love Creek	County right-of-way on the west east side of Love Creek Road opposite 10545 Love Creek Road, Ben Lomond	Monterey	300	Groundwater levels	Collect data from an area with a high concentration of private domestic pumping and no records of historical groundwater levels.
SMGWA-8	Randall Morgan Sandhills Preserve	Land Trust of Santa Cruz County property. Well will be drilled through an existing concrete pad.	Monterey	200	Interconnected surface water	Establish a correlation between groundwater levels and surface water stage in Bean Creek at Mount Hermon Camp in an area downgradient of a high concentration of private domestic users.

ft bgs – feet below ground surface

MONTGOMERY & ASSOCIATES

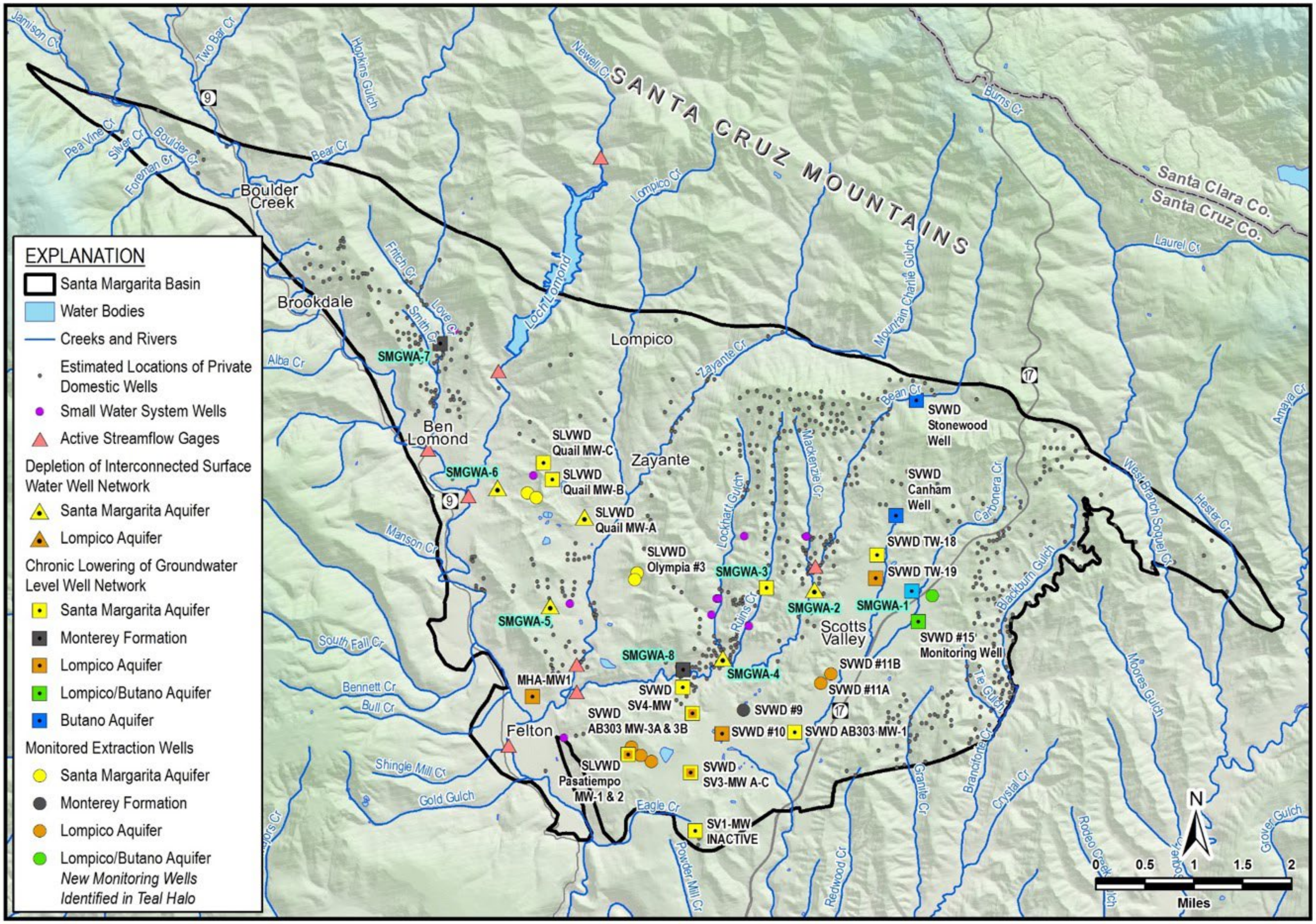


Figure 21. Proposed New Monitoring Wells, Existing Monitoring Locations, and Supply Wells

4.6.1.2 Survey of Reference Point Elevations in Groundwater Level Monitoring Wells

Reference-point elevations in groundwater monitoring wells are used to convert depth-to-groundwater in wells to groundwater elevations that can be used to assess groundwater flow directions. Reference point elevations in wells were compiled during GSP preparation from several member agency datasets. The reference points were established over many years and measured using a variety of survey techniques or estimates. A comprehensive survey would improve understanding of groundwater flow in the Basin by standardizing the reference elevations at each monitoring location. Such a survey is a lower-priority monitoring network improvement and is being considered by the SMGWA as funding allows.

4.6.2 Groundwater Extraction Monitoring Improvements

As part of GSP implementation, the SMGWA will initiate a new well metering program requiring measurement and reporting of all non-*de minimis* groundwater extraction greater than 2 AF/yr. Currently active non-municipal extractors using more than 2 AF/yr include the Quail Hollow Quarry, users that pump groundwater for large-scale irrigation or to fill landscape ponds, and small water systems with more than 5 connections. Small water systems with more than 5 connections have been metered since 2015. Development of a non-*de minimis* metering program will commence in WY2023, with implementation of the program anticipated in WY2024. SMGWA requested funding to advance the non-*de minimis* metering program in the SGMI Round 2 Grant application, discussed in Section 4.7.

4.6.3 Groundwater Quality Monitoring Improvements

Groundwater quality sampling is conducted routinely in public extraction wells; therefore, there are no spatial data gaps in this network. However, the sampling frequency in some public extraction wells is suboptimal because some analytes are sampled only once every 3 years per the requirements of the State Water Resources Control Board Division of Drinking Water. Increasing the frequency of groundwater quality sampling will generate a better data set that can be used to detect promptly any degradation of groundwater quality from projects and management actions implemented to achieve the Basin's sustainability goals. SLVWD will increase the sampling frequency on their groundwater quality RMP wells (Olympia #3, Quail Hollow #4A, and Pasatiempo #7).

4.6.4 Streamflow Monitoring Improvements

One streamflow monitoring data gap along Carbonera Creek was identified in the GSP. As this creek is not as connected to groundwater as most other creeks in the Basin, this is a data gap with a low priority and will be addressed by SMGWA as funding becomes available.

4.7 SGMA Implementation Round 2 Grant Application

SMGWA submitted a DWR SGMI Round 2 grant application in December 2022 to help fund GSP implementation. The grant application requests funds for evaluating projects and management actions, developing long-term agency funding mechanisms, improving monitoring networks, and assisting private well owners. The implementation plans described below are specific to the grant application and may not be prioritized by SMGWA if the request is not successful.

4.7.1 Project and Management Action Prioritization

The GSP identified the need to further evaluate, prioritize, and refine projects and management actions described in this Annual Report in Sections 4.5.2 through 4.5.5. All of the projects being considered for implementation already have feasibility-level engineering studies and cost estimates, but in order to compare projects, more analysis is required. The goal is to combine existing or more detailed engineering studies (30% design) and updated cost estimates with groundwater modeling and qualitative analyses to arrive at an optimized combination of projects and management actions that achieve sustainability as cost-effectively as possible.

In order to proceed with the high-priority Group 2, Tier 1 projects that expand conjunctive use with surface water sourced from the San Lorenzo River watershed, the grant application lists funding for a focused environmental impact report in support of SLVWD's water rights petitions (as described in Section 4.5.2) to change point of use. It also requests funding for a 30% design engineering analysis and updated cost estimate for water treatment and conveyance infrastructure required for SLVWD to make use of its 313 AF/yr allotment of raw surface water from Loch Lomond reservoir.

Evaluation of the Group 2, Tier 2 and Tier 3 projects using surface water sources outside the Basin and purified wastewater sources (Sections 4.5.3 and 4.5.4 above) will include a review of existing reports and information to outline and describe key project attributes, including the following:

- Timing, location, and quantity of available water sources (e.g., potable surface water, stormwater, recycled water, purified wastewater)
- Storage and recovery mechanisms (e.g., direct through injection or surface impoundment, in-lieu conjunctive use)
- Frequencies (e.g., water availability at different times of years and in different water year types)

- Need for and relative cost of new infrastructure, especially as compared to existing infrastructure

After the project and management action options are defined consistently, their costs and benefits will be evaluated relative to SMGWA member and partner agency goals. Projects will be evaluated individually and in conceptual bundles of complementary projects that could be implemented together. The highest-ranking options will be evaluated for cost, infrastructure need, permitting requirements, schedule, local support, and other factors. The benefits and impacts of the most promising options will also be evaluated using the existing Basin Model and state-of-the-art machine learning modeling techniques.

4.7.2 GSP Implementation Activities

The SGMI Round 2 grant application also requests funds to carry out other GSP implementation activities that are not directly related to projects and management actions.

4.7.2.1 Agency Membership and Funding Structure Evaluation

The grant application requests funds to evaluate and establish long-term funding options for SMGWA. The evaluation will include research, planning and development of potential funding models based on the following:

- Assessment of parcel and groundwater use characteristics
- Understanding previous fee and rate discussions
- Consideration of SMGWA, stakeholder, and community preferences

Following the assessment, a technical memorandum on funding options will be prepared. SMGWA will use the information gathered to advance long-term funding strategies.

4.7.2.2 Monitoring and Reporting

The grant application requests funds to cover monitoring and assessment of groundwater conditions. Monitoring will include dry-season stream gauge monitoring at 5 sites, and semi-annual monitoring of groundwater-dependent ecosystems at another 5 locations. Recorded data will include stream flow, specific conductance, temperature, and observations of general site conditions. The grant application requests funds to comprehensively assess groundwater conditions and GSP implementation progress in future Annual Reports.

4.7.2.3 Non-De Minimis Metering Program

The grant application requests funds for a groundwater metering program for non-*de minimis* pumpers, as discussed in Section 4.6.2. The program will include:

- Research and verification of non-*de minimis* groundwater pumpers
- Preparation of guidance documents, reporting tools, and focused outreach
- Evaluation of options and consideration of mechanisms for ensuring compliance with program requirements

Program implementation will include participant tracking and coordination of annual reporting by participants.

4.7.2.4 Addressing Data Gaps

The grant application requests funds for installing a deep monitoring well, as discussed in Section 4.6.1.1. The plan is to install an 800-foot deep, 4-inch-diameter monitoring well to expand the monitoring network in the Butano aquifer near active Lompico/Butano SVWD extraction wells. Site access, preliminary design, and preparation of a Notice of Exemption to comply with the California Environmental Quality Act have already been completed. Future activities will include:

- Procuring drilling contractor and professional services contractor to oversee construction
- Securing well permit and filing California Environmental Quality Act Notice of Exemption
- Drilling borehole, performing geophysical logging of borehole, completing final well design, constructing and developing monitoring well
- Collecting and analyzing groundwater samples
- Purchasing and installing a pressure transducer for continuous groundwater level monitoring
- Preparing well completion report and as-built well design drawing

4.7.3 Private Well Owner Assistance

The grant application requests funding to assist private well owners with the following:

- Identifying which private wells may have a viable option to connect to existing water systems in the Basin
- Conducting additional outreach to private well owners on alternative water supply options in the event of loss of supply from their well
- Installing 2 bulk potable water stations provided with SLVWD water so residents in the Basin experiencing a well outage will have access to water 24 hours per day

REFERENCES

[DWR] California Department of Water Resources, 2016. Bulletin 118 Interim Update 2016. December 22. Accessed June 5, 2020. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/B118-Interim-Update-2016_ay_19.pdf

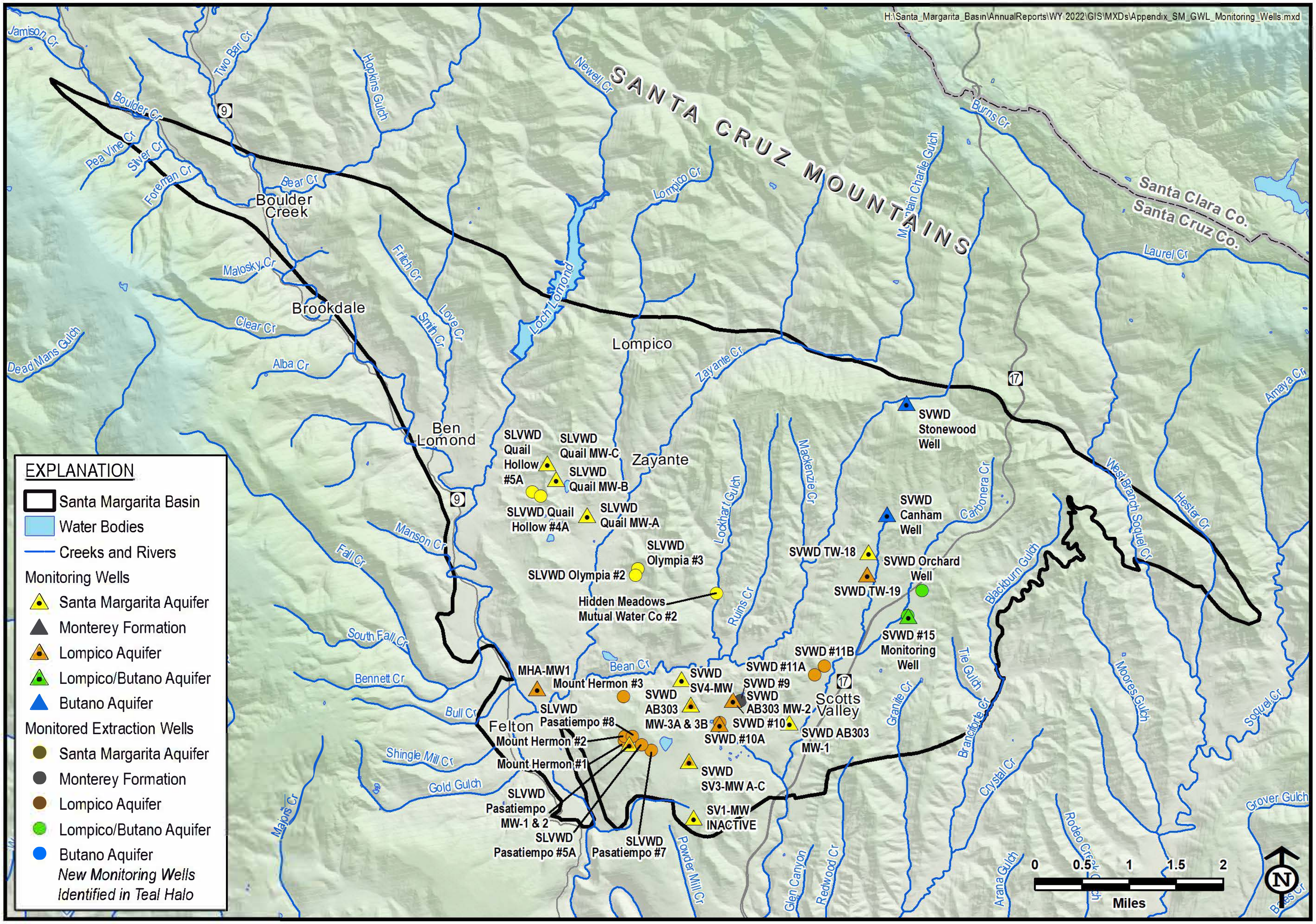
U.S. Census Bureau, 2021. Decennial Census Total Population, 2020 Census Redistricting Data (Public Law 94-171). https://data.census.gov/cedsci/table?q=scotts%20valley,%20ca%20population&y=2020&tid=DECENNIALPL2020.P1

Appendix A

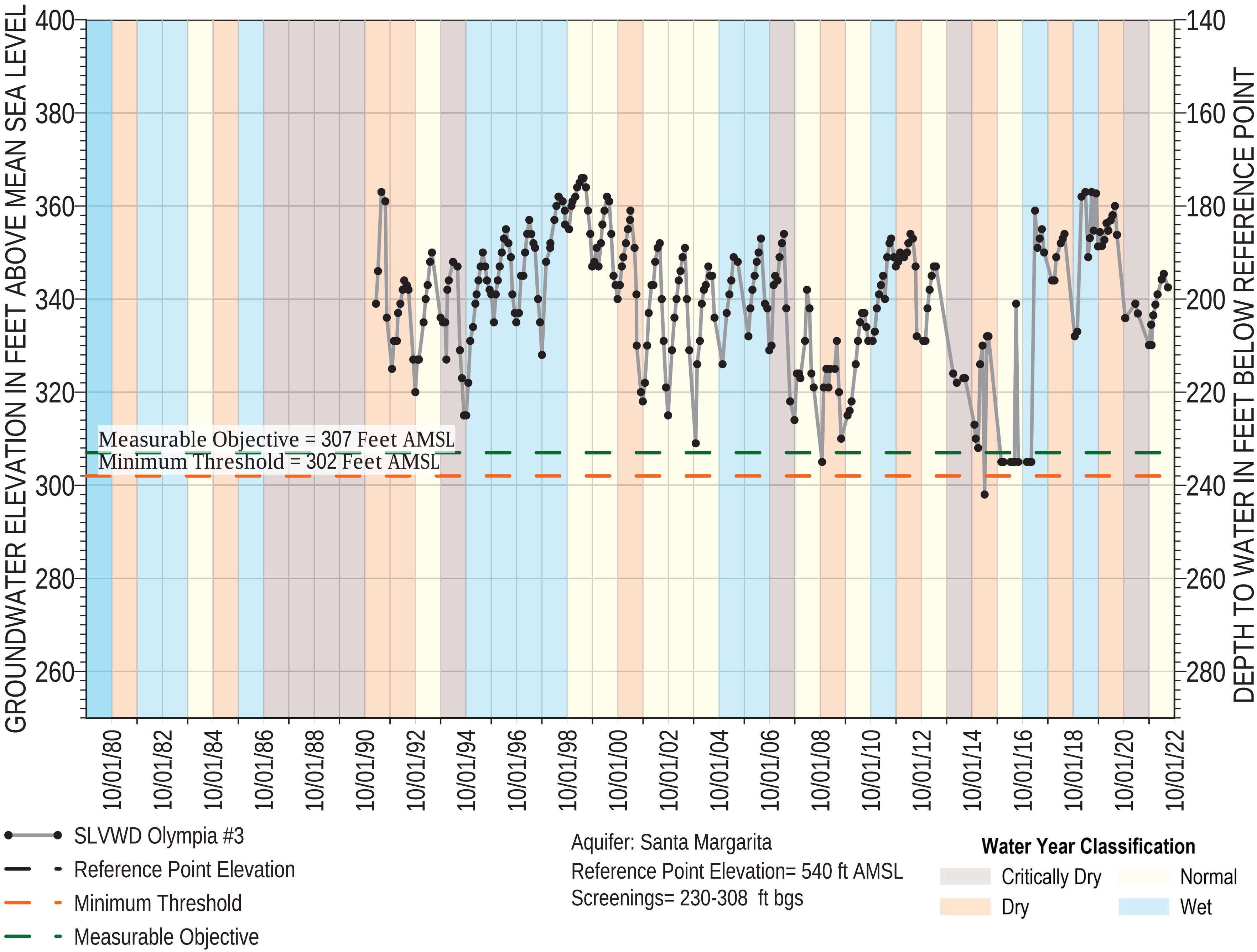
Chronic Lowering of Groundwater Levels Representative Monitoring Point Hydrographs with Sustainable Management Criteria

Well Locations and Screened Aquifer Shown on Figure A-1

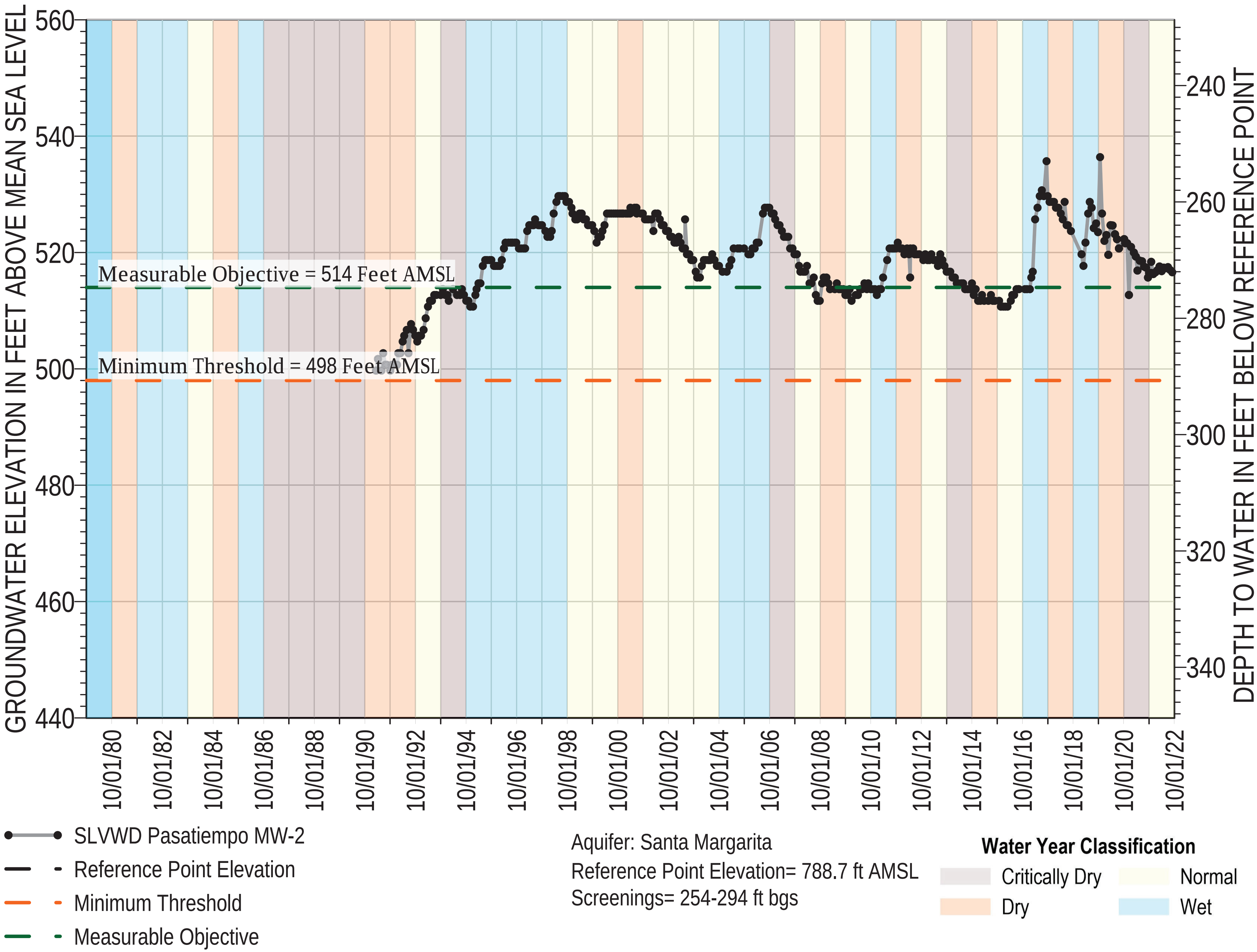
Figure A-1. Groundwater Level Monitoring Network



Santa Margarita Sandstone



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



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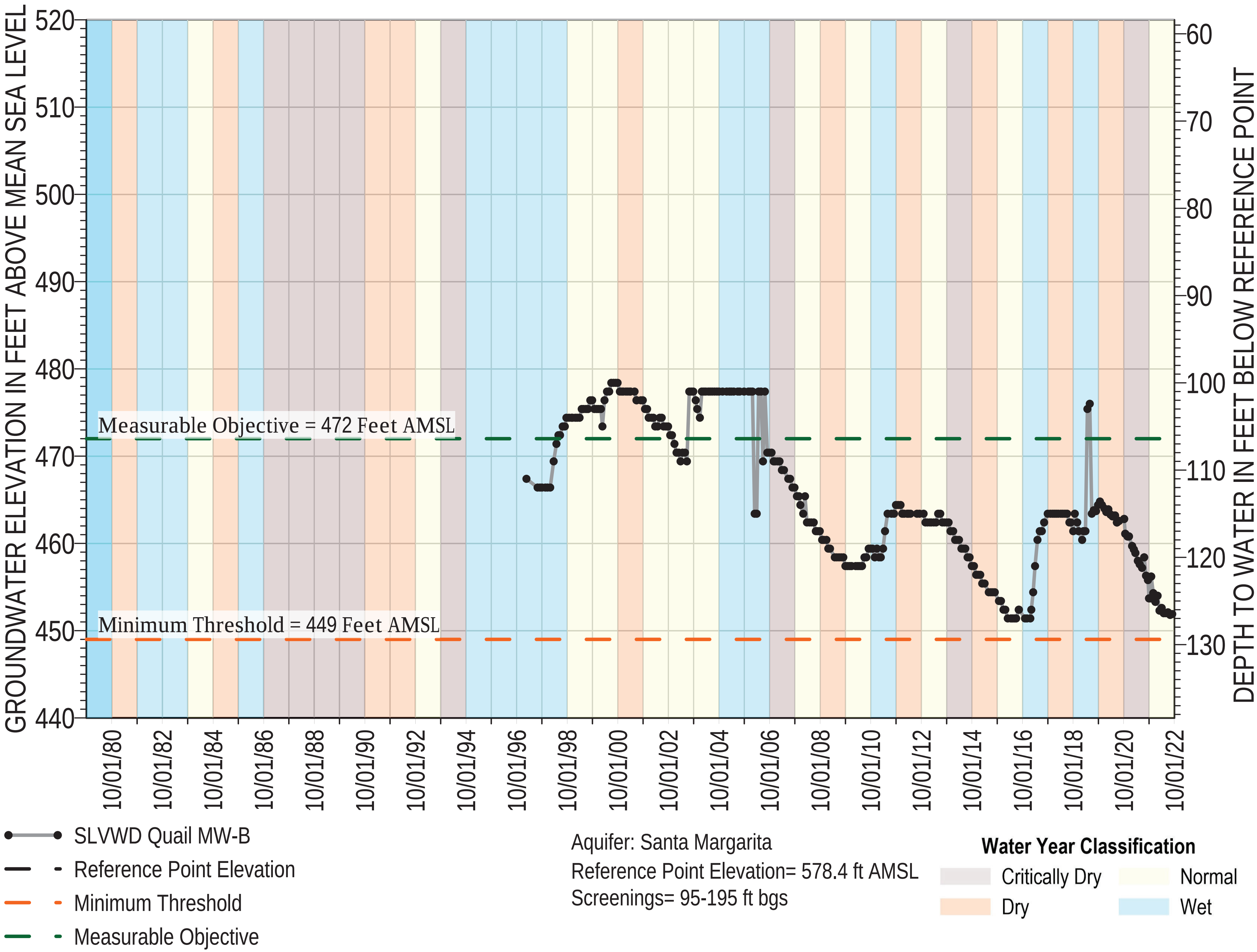

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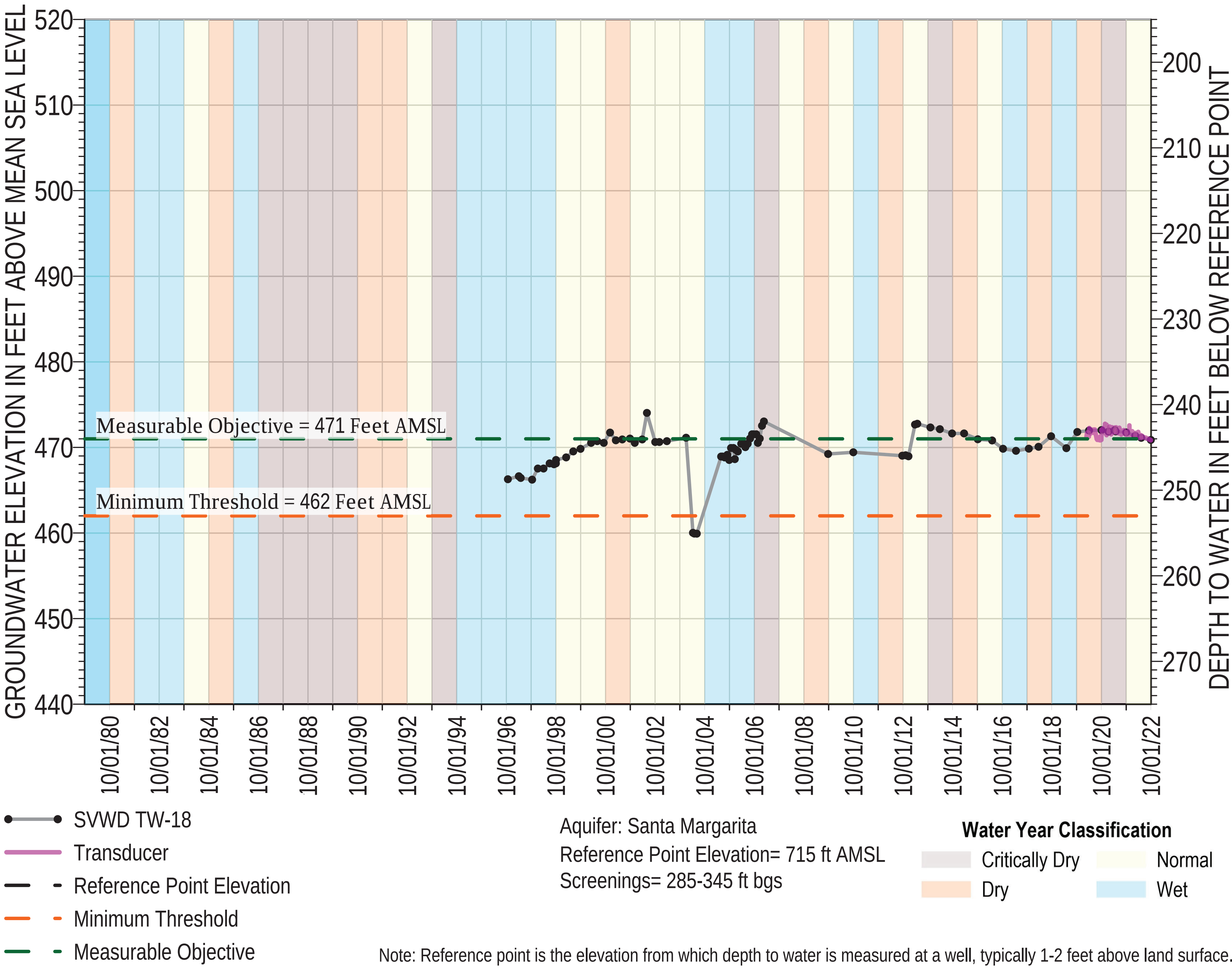
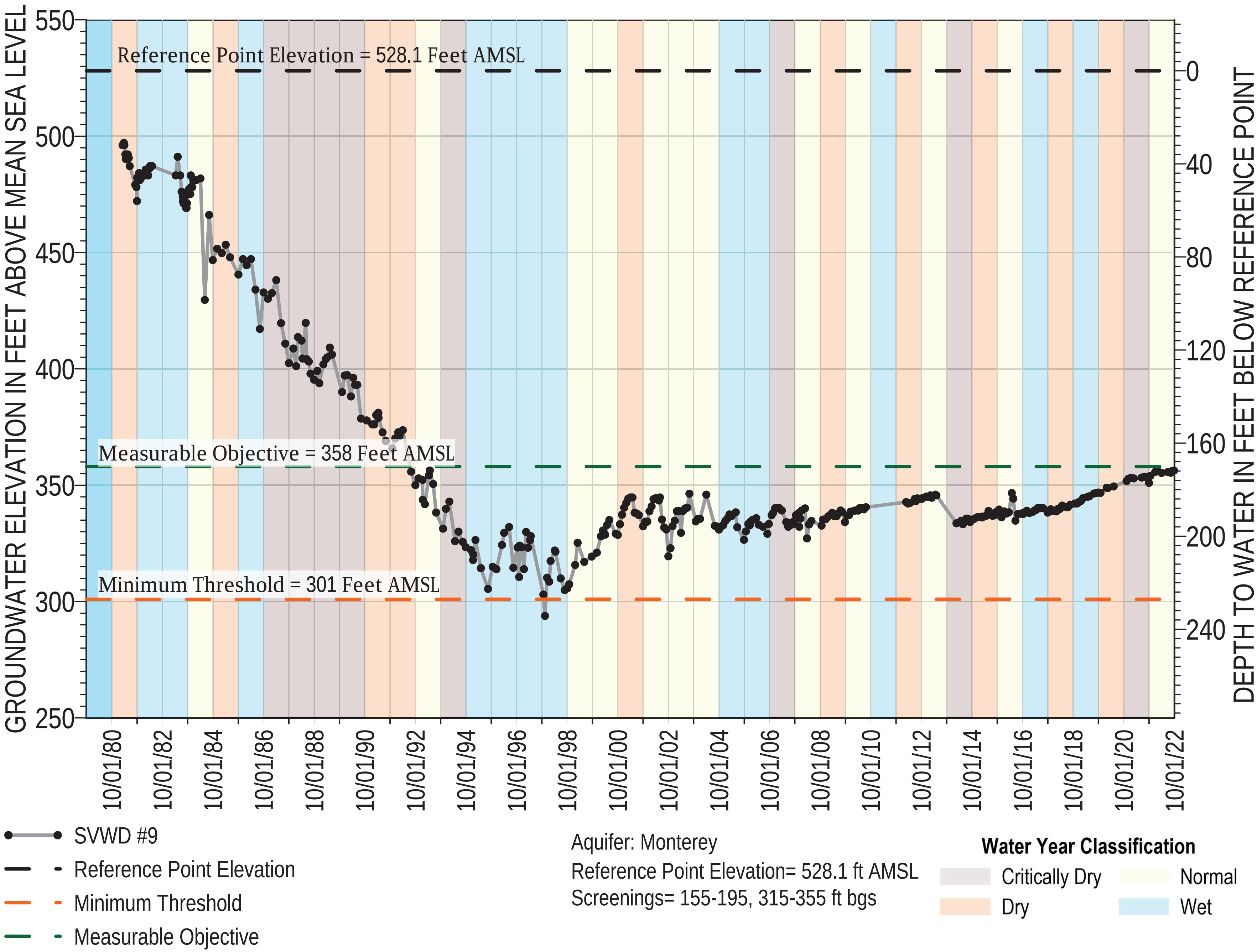


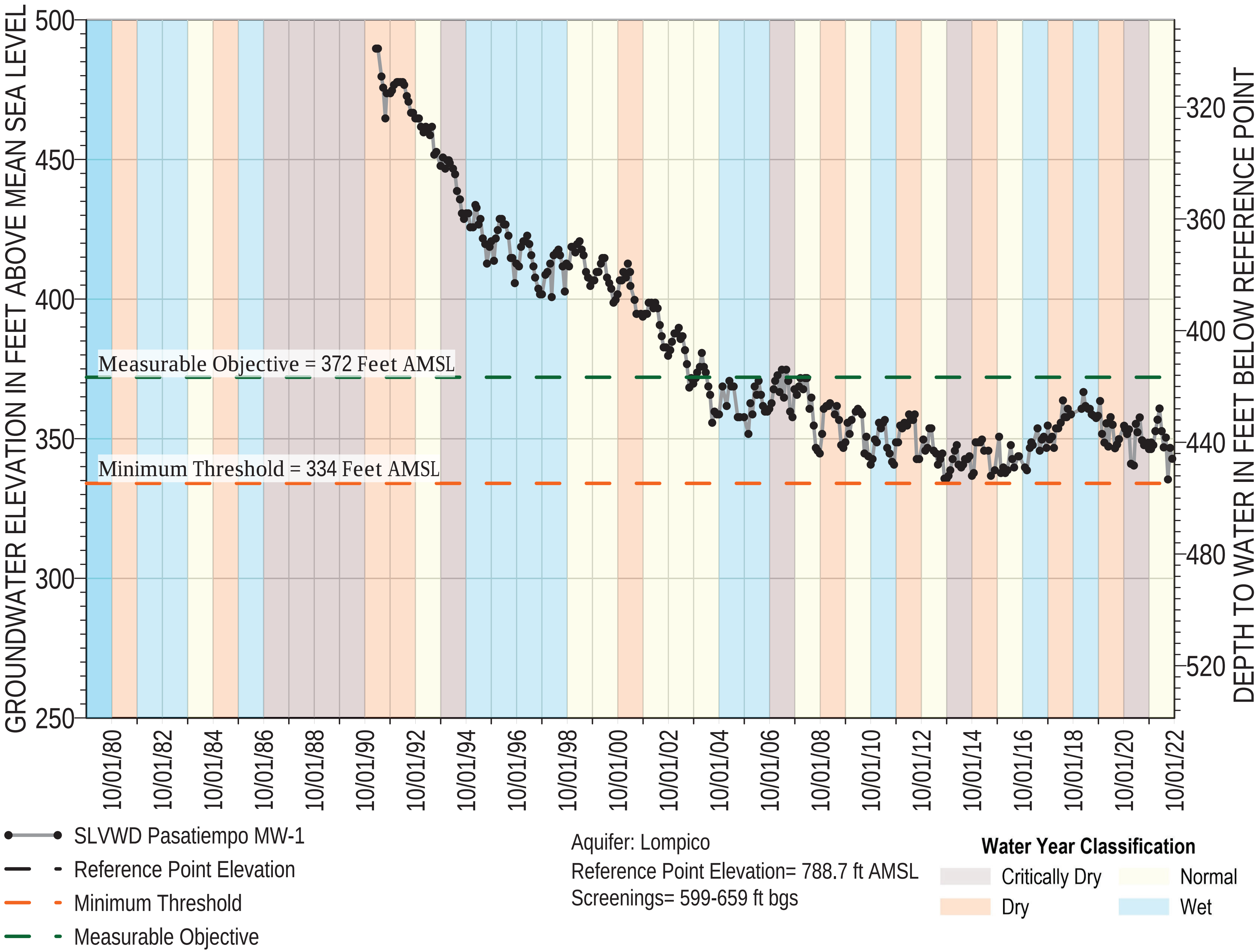
Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

Monterey Formation



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

Lompico Sandstone



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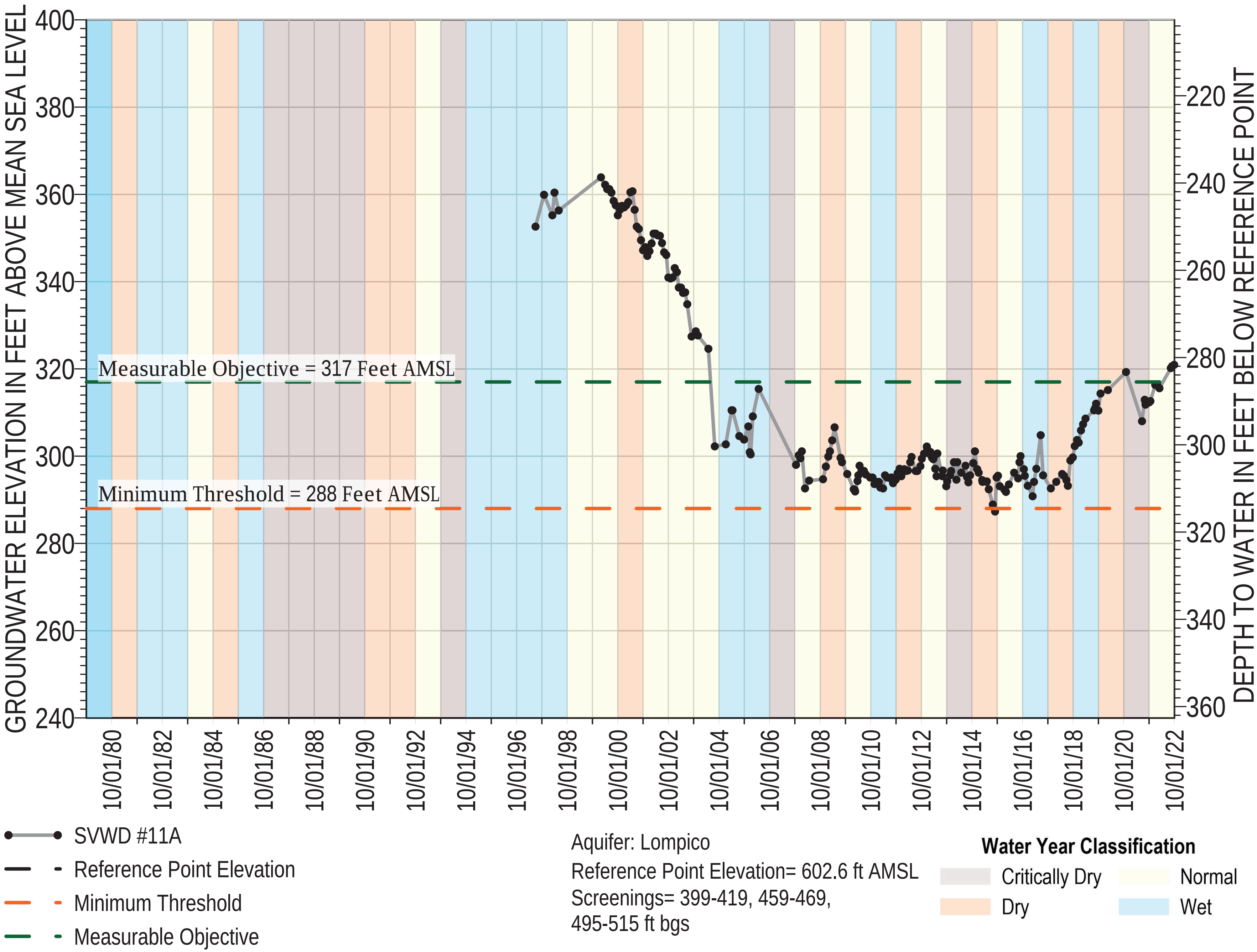
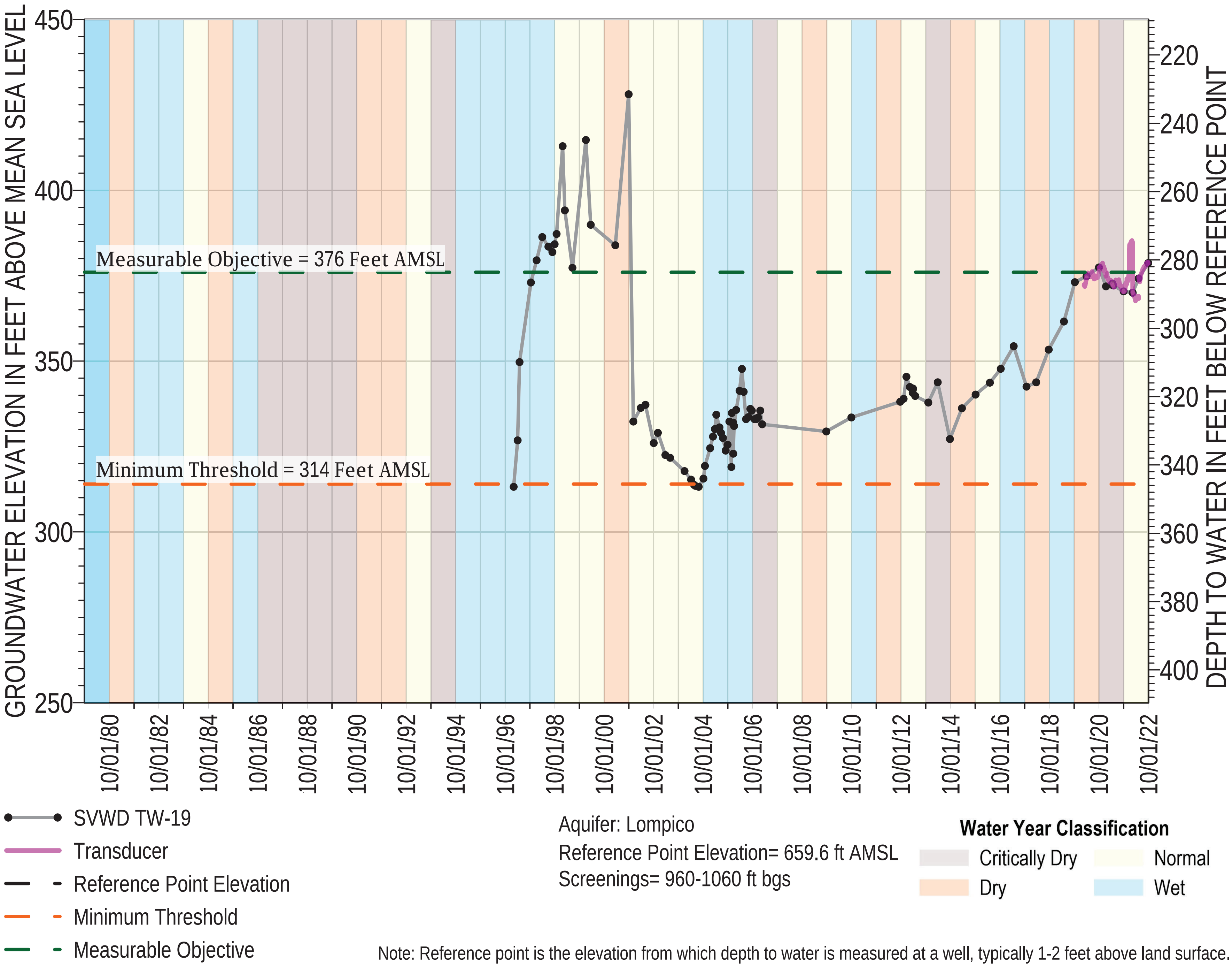
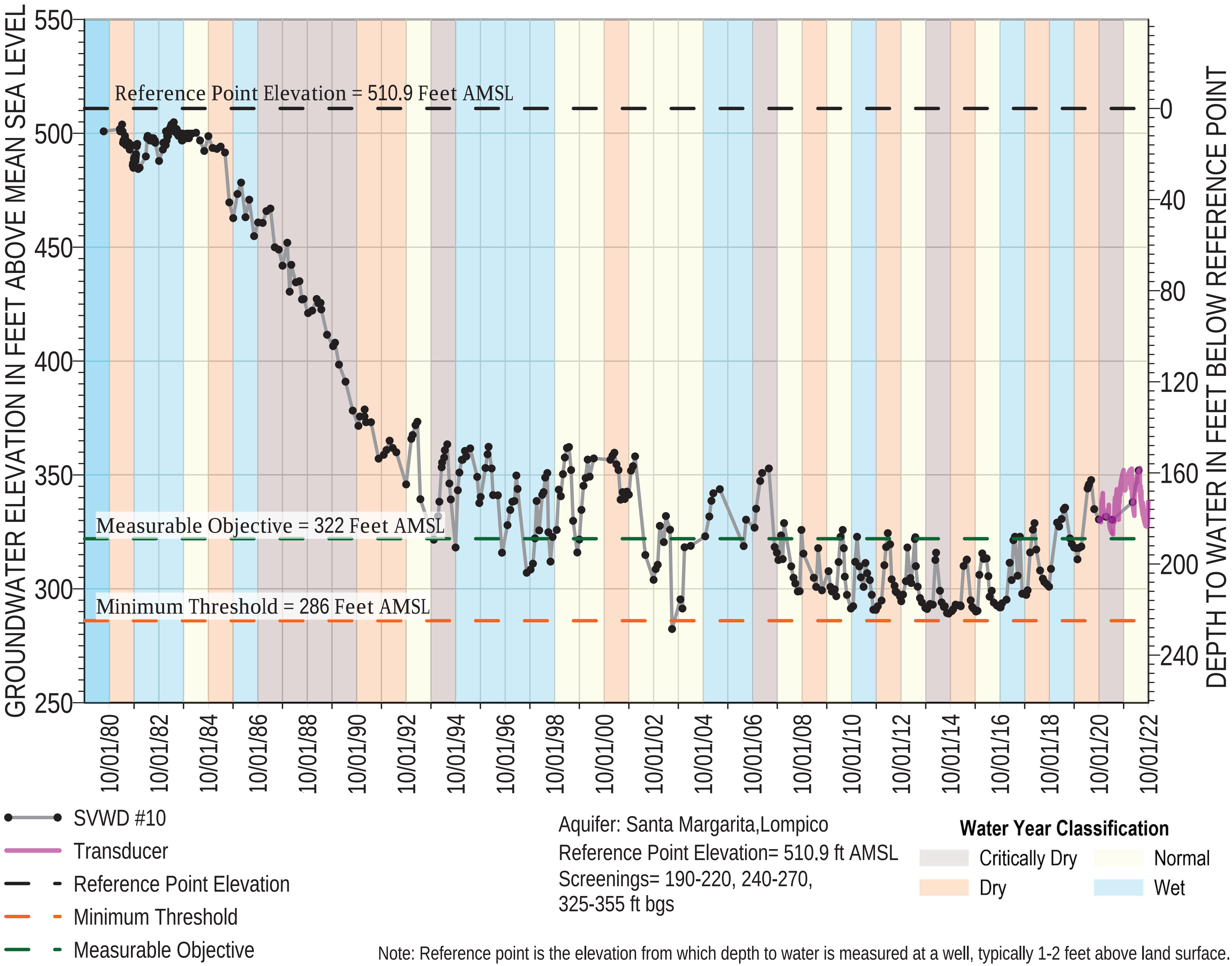


Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

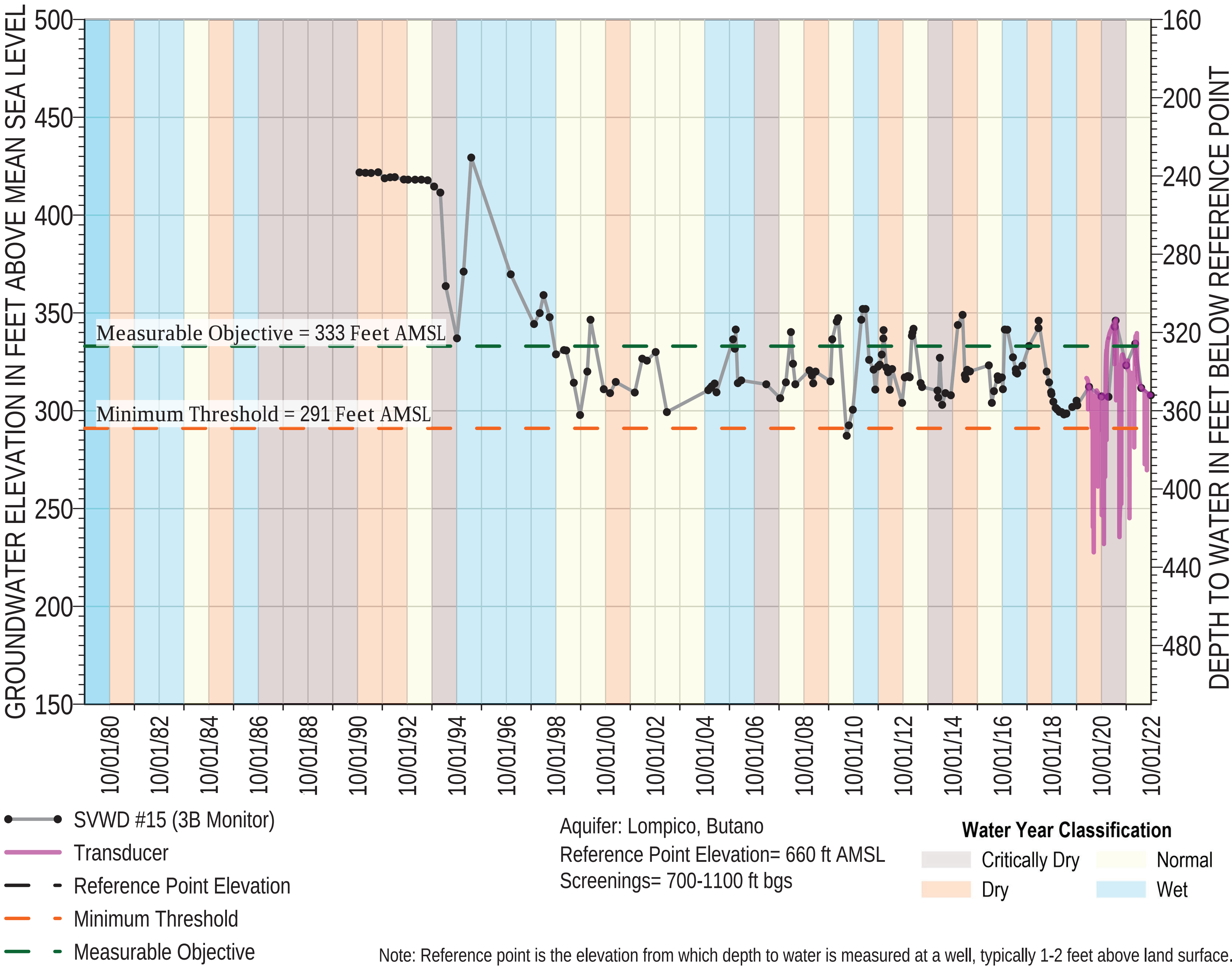


Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

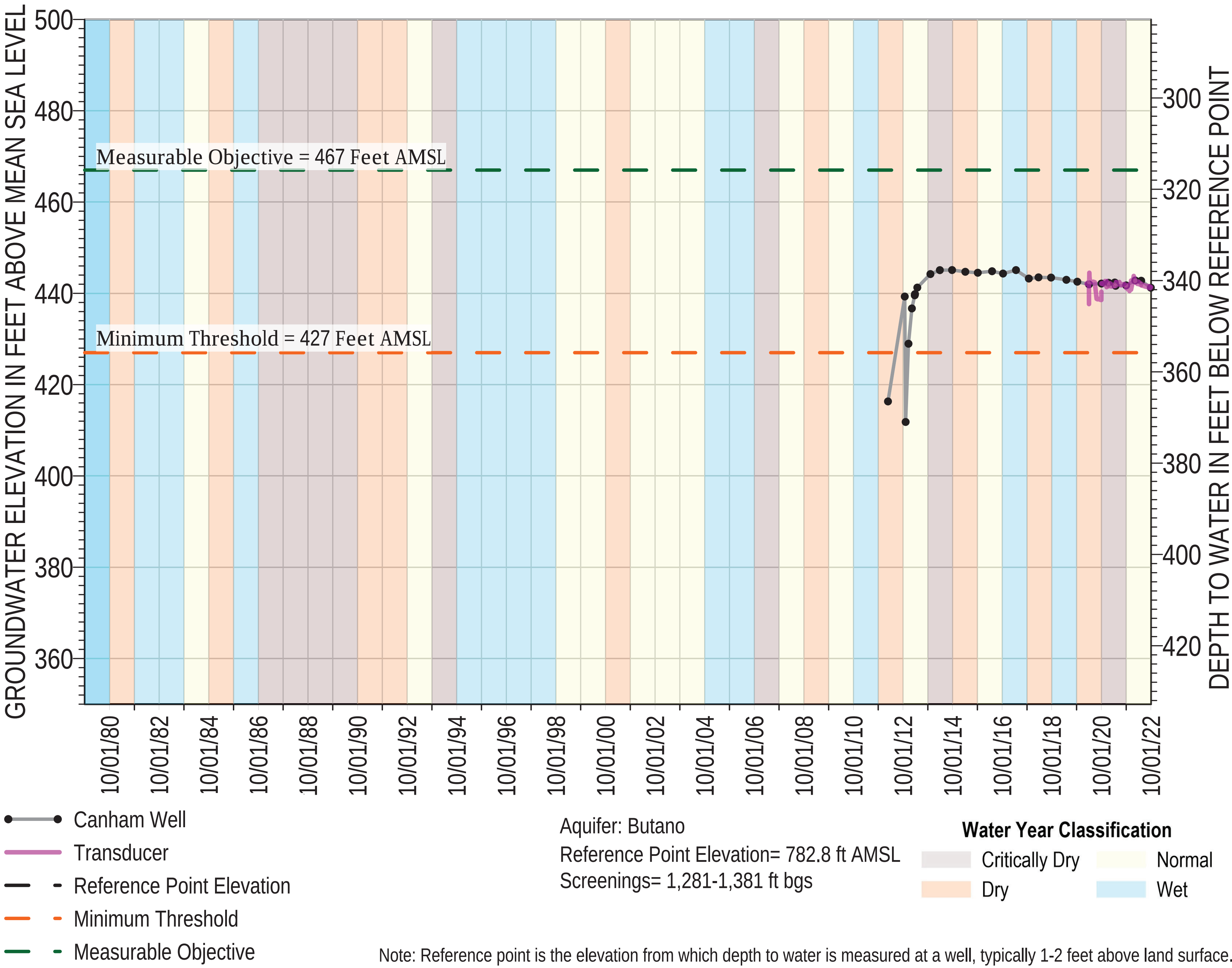
Lompico/Butano Sandstone



Aquifer: Lompico, Butano
Reference Point Elevation= 660 ft AMSL
Screenings= 700-1100 ft bgs

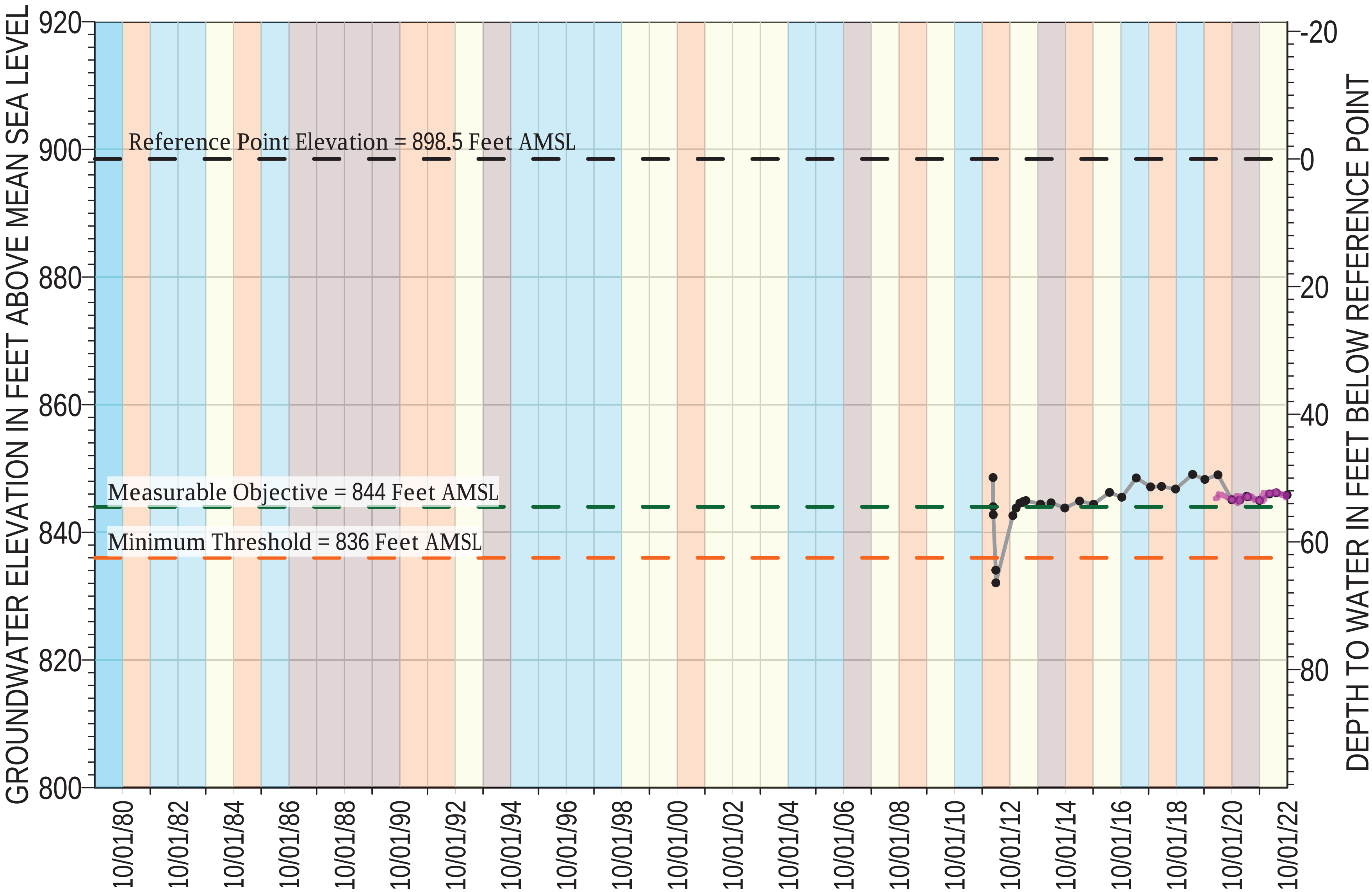
Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

Butano Sandstone



Aquifer: Butano
Reference Point Elevation= 782.8 ft AMSL
Screenings= 1,281-1,381 ft bgs

Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



Stonewood Well

Transducer

Reference Point Elevation

Minimum Threshold

Measurable Objective

Aquifer: Butano
Reference Point Elevation= 898.5 ft AMSL
Screenings= 799-859 ft bgs

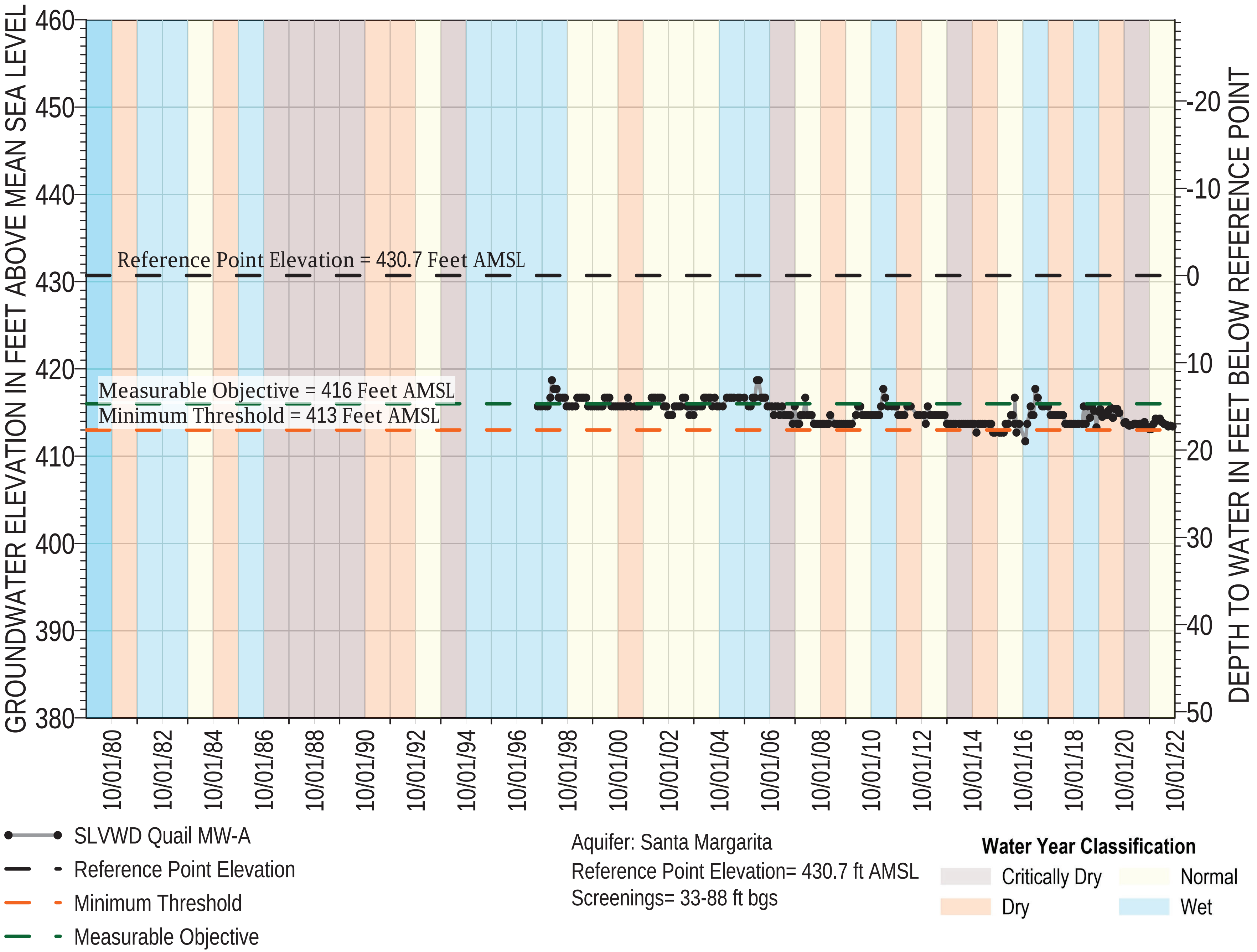
Water Year Classification

Critically Dry | Normal | Dry | Wet

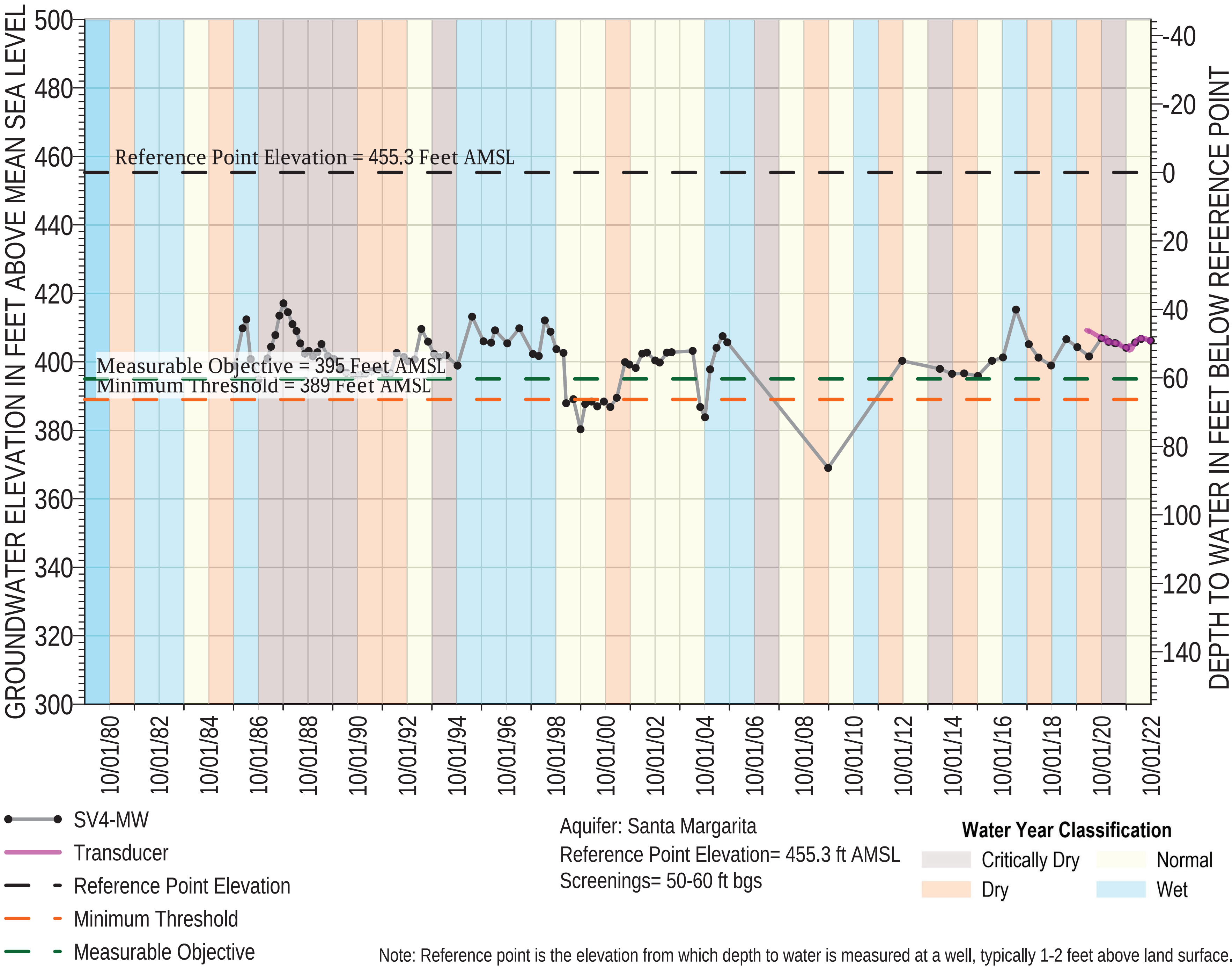
Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

Appendix B

Depletion of Interconnected Surface Water Representative Monitoring Point Hydrographs with Sustainable Management Criteria



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



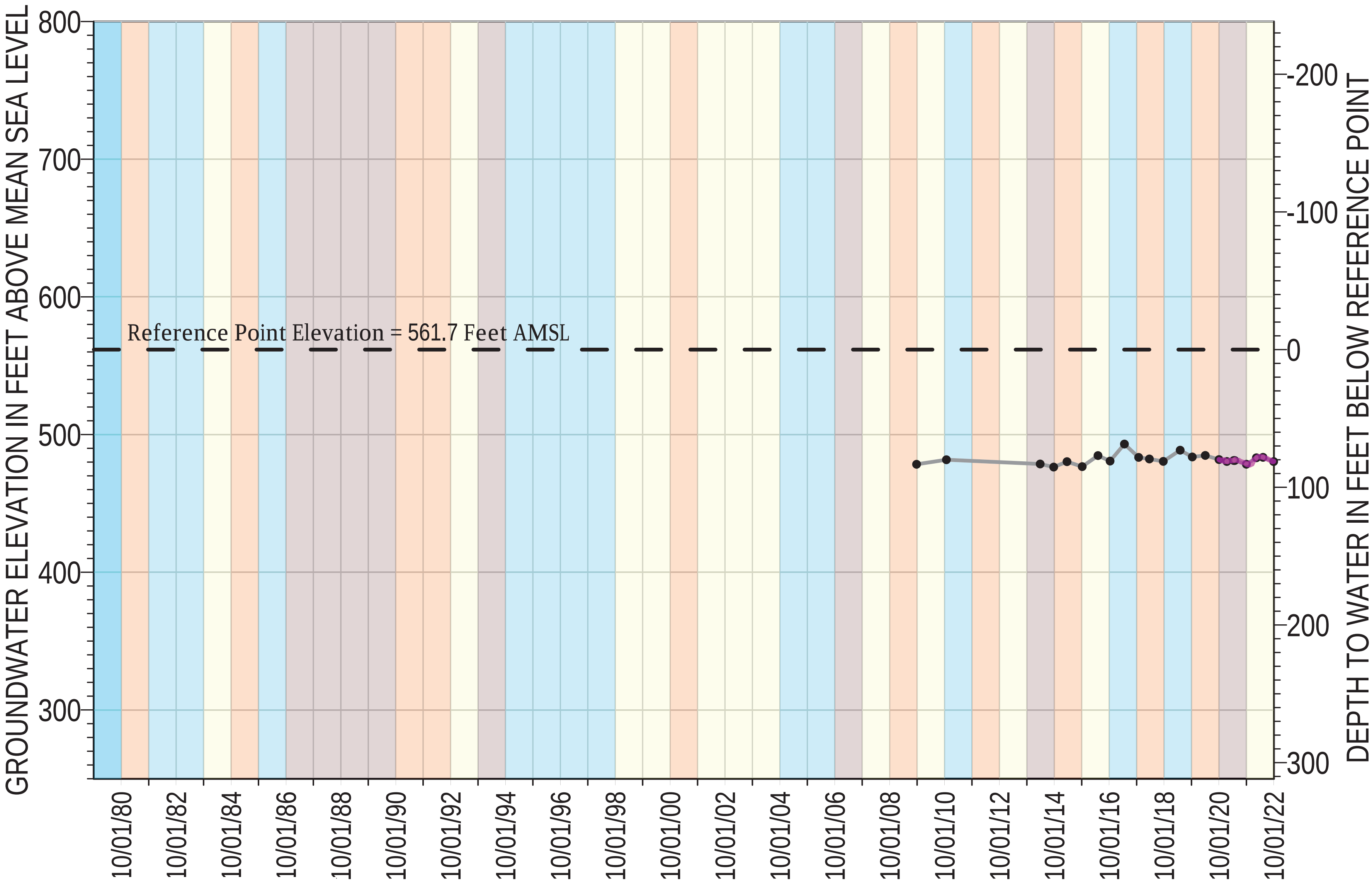
Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

Appendix C

GSP Monitoring Network Hydrographs

Well Locations and Screened Aquifer Shown on Figure A-1

Santa Margarita Sandstone



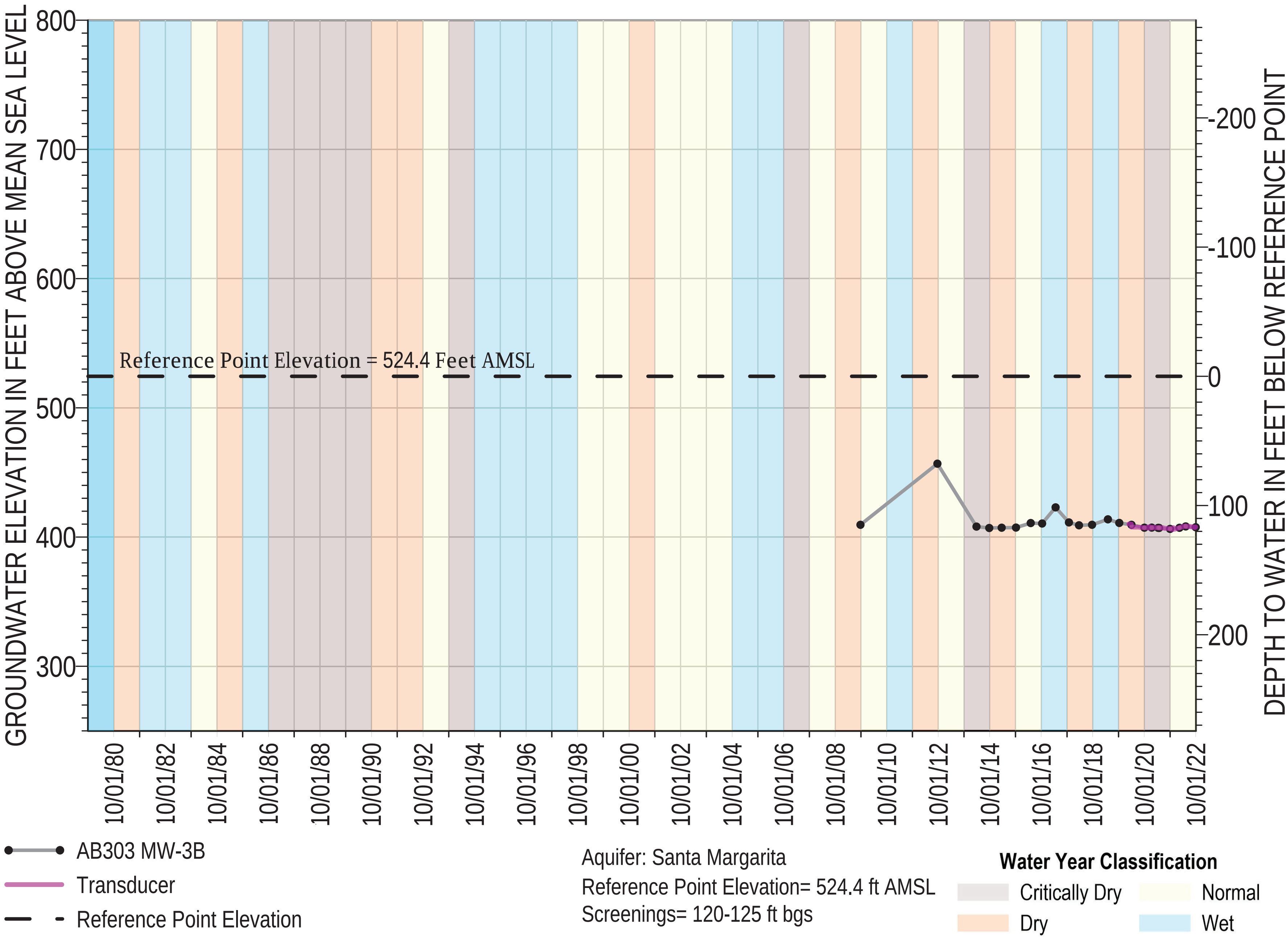
AB303 MW-1
Transducer
Reference Point Elevation

Aquifer: Santa Margarita
Reference Point Elevation= 561.7 ft AMSL
Screenings= 114-124 ft bgs

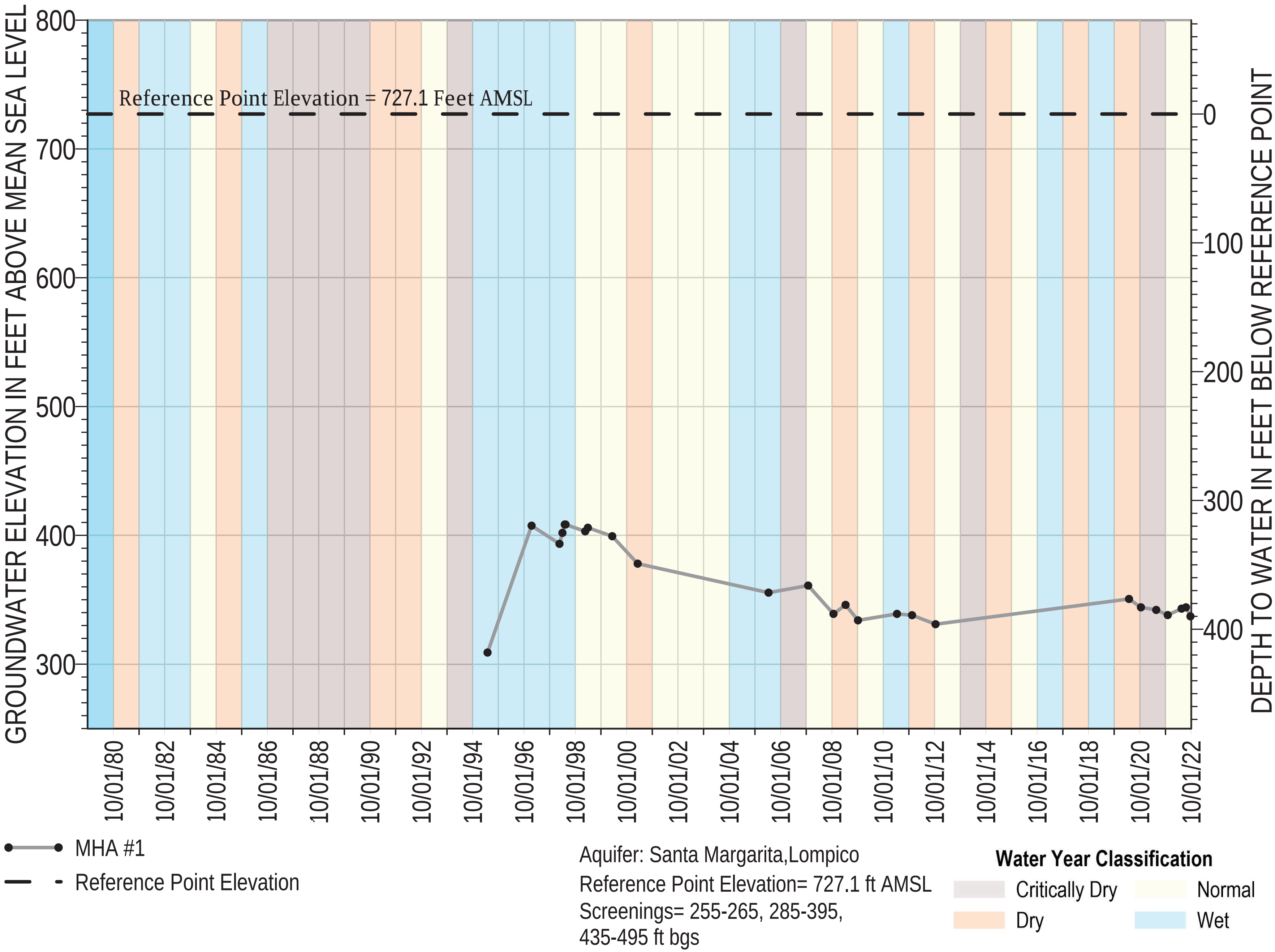
Water Year Classification

Critically Dry
Normal
Dry
Wet

Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



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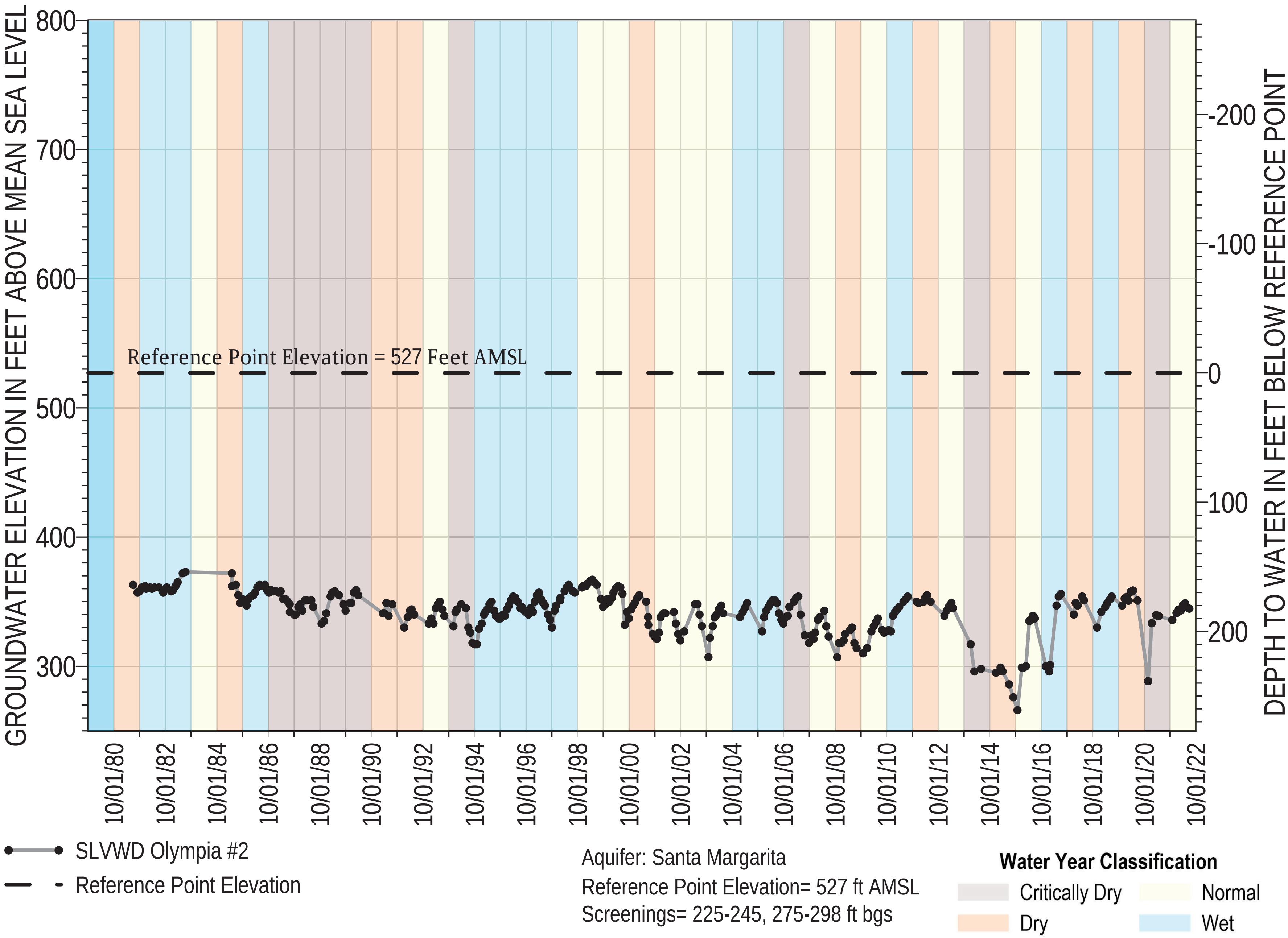

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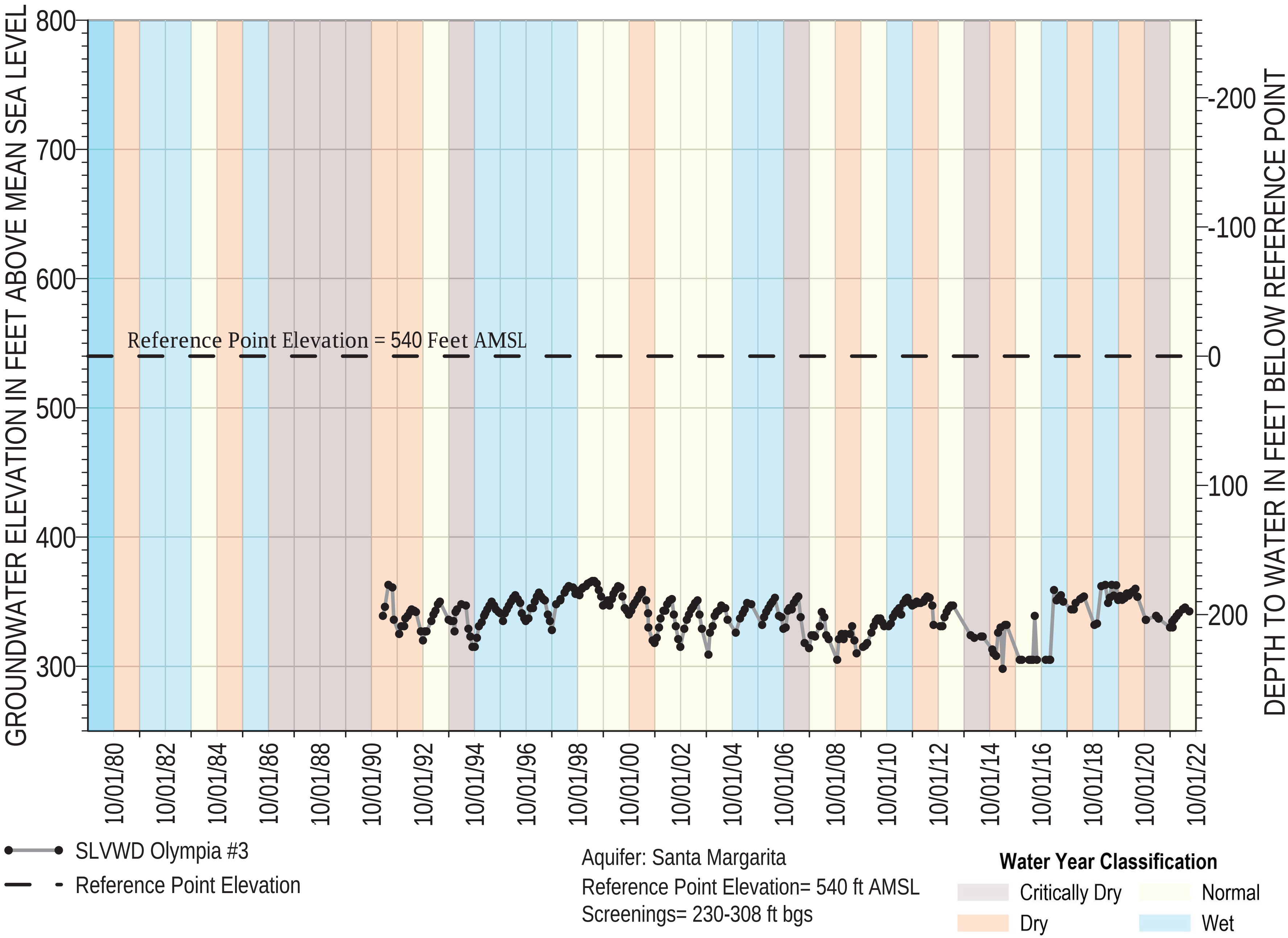

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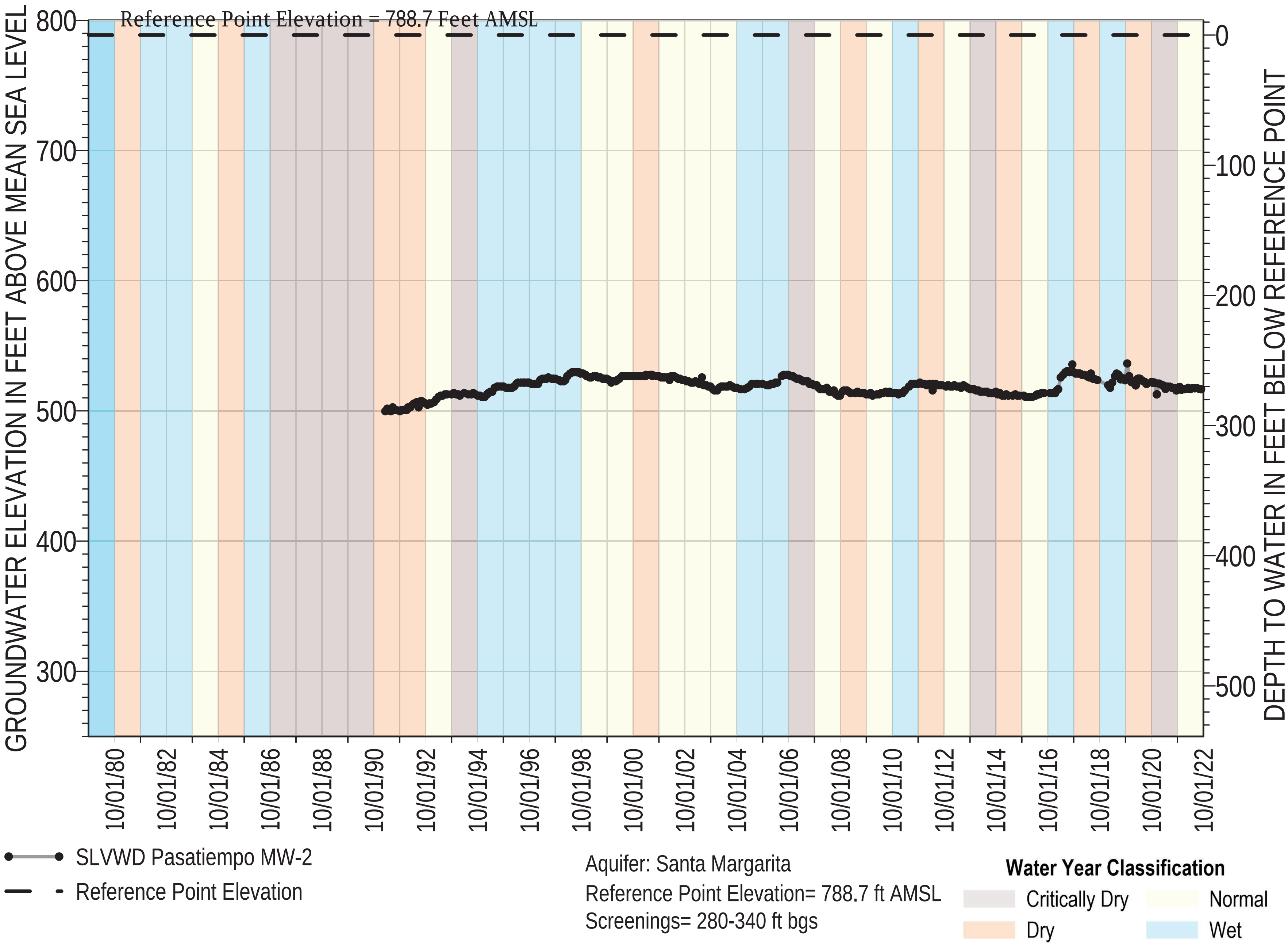

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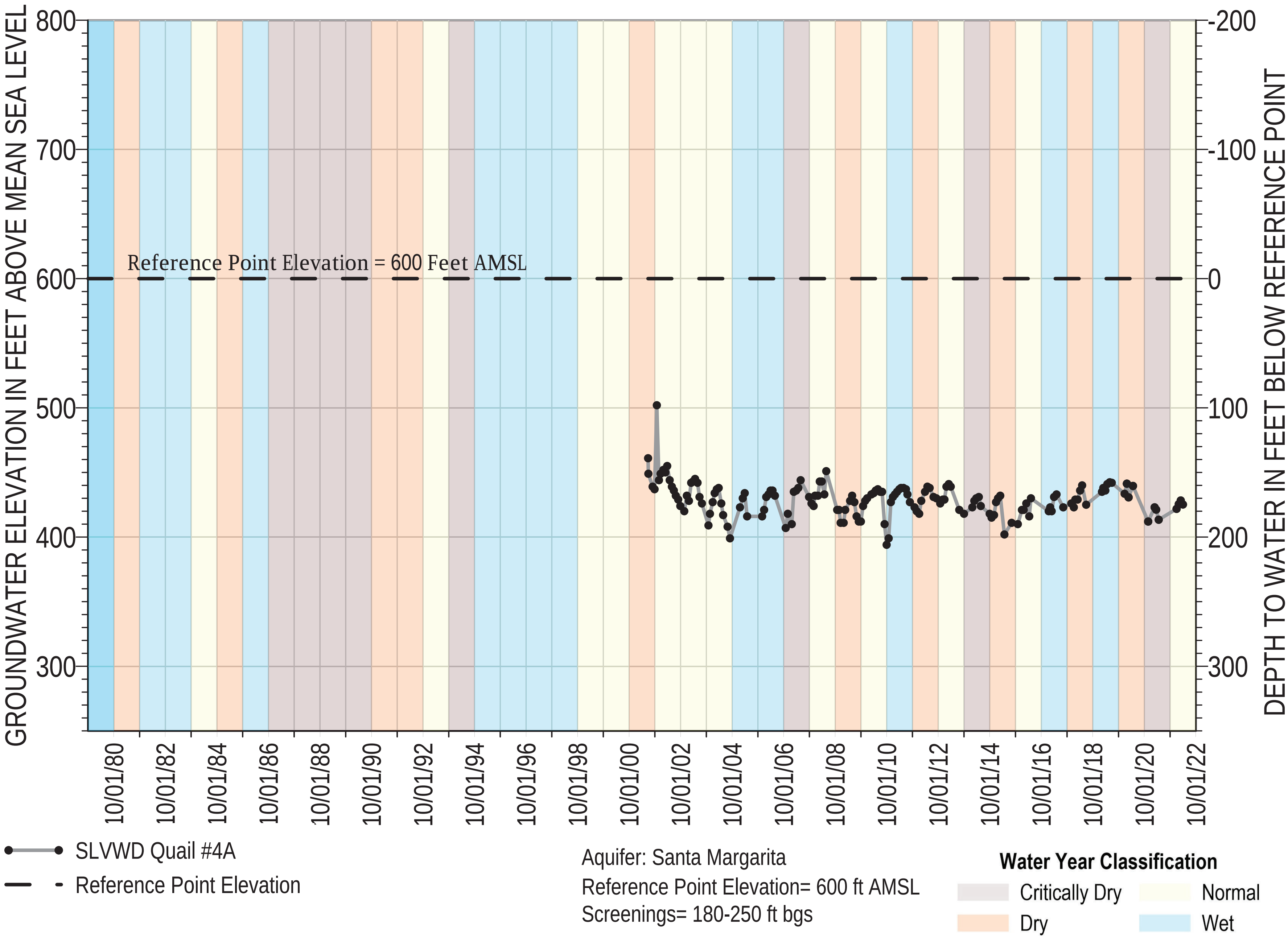

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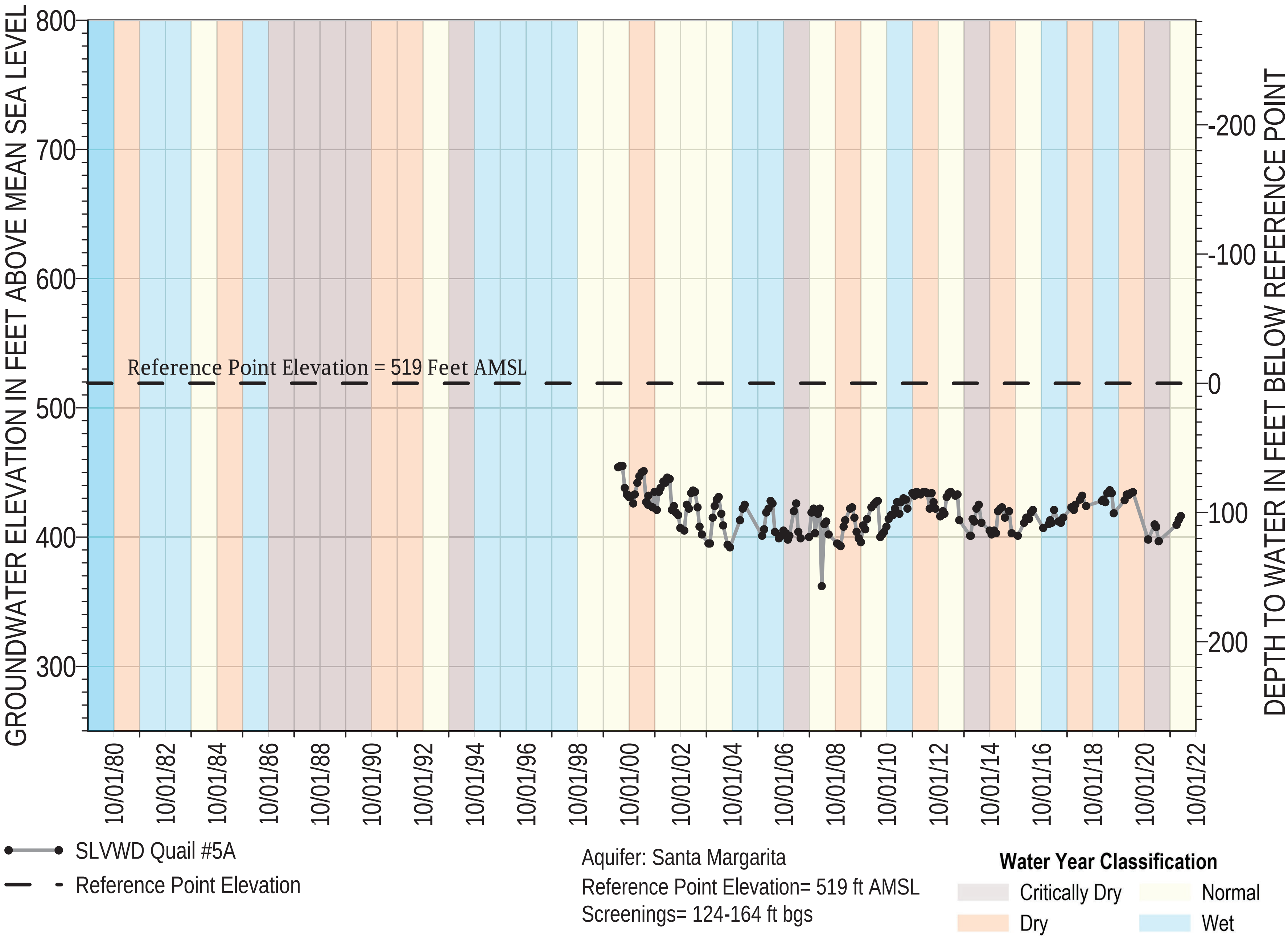
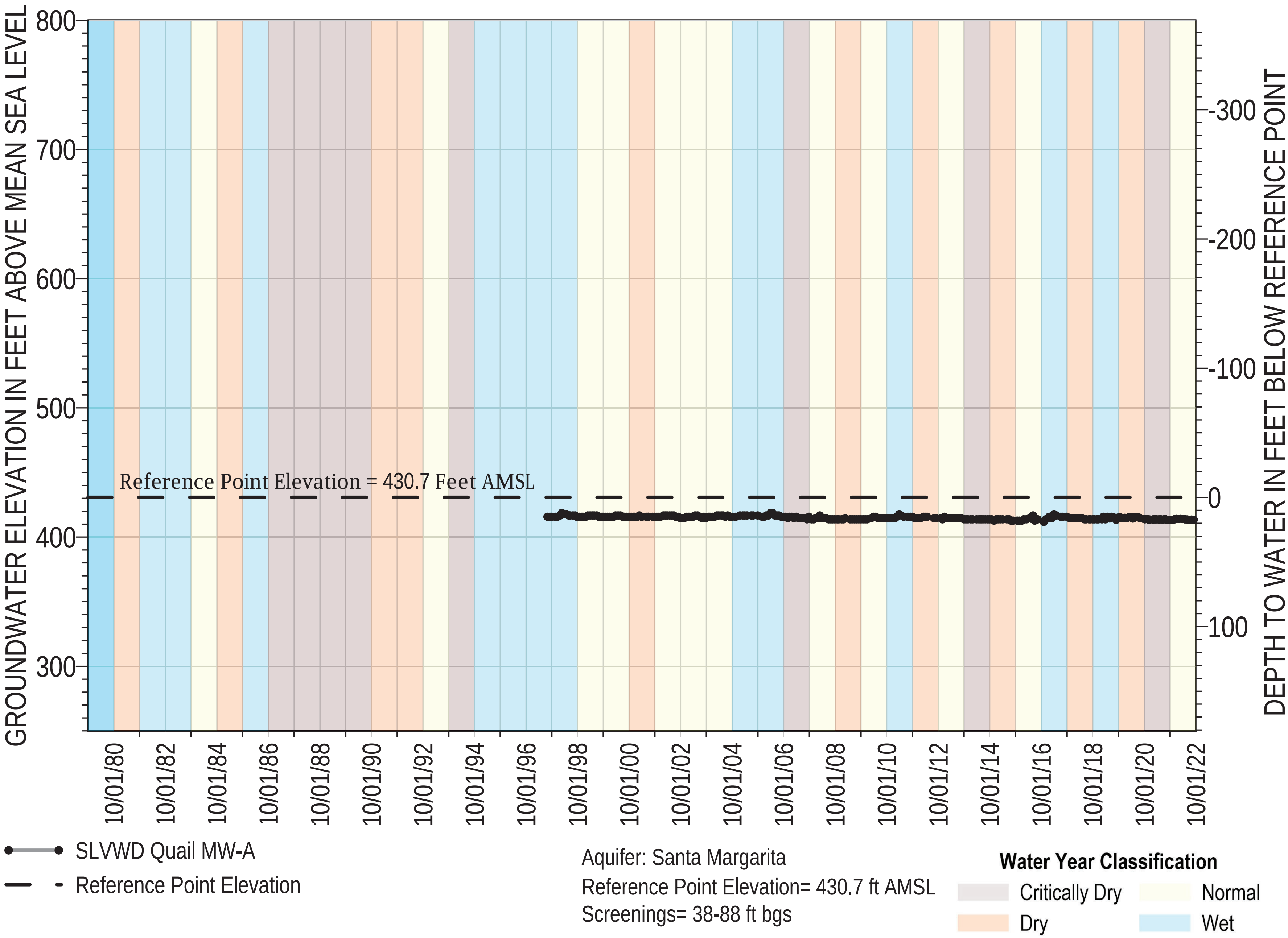
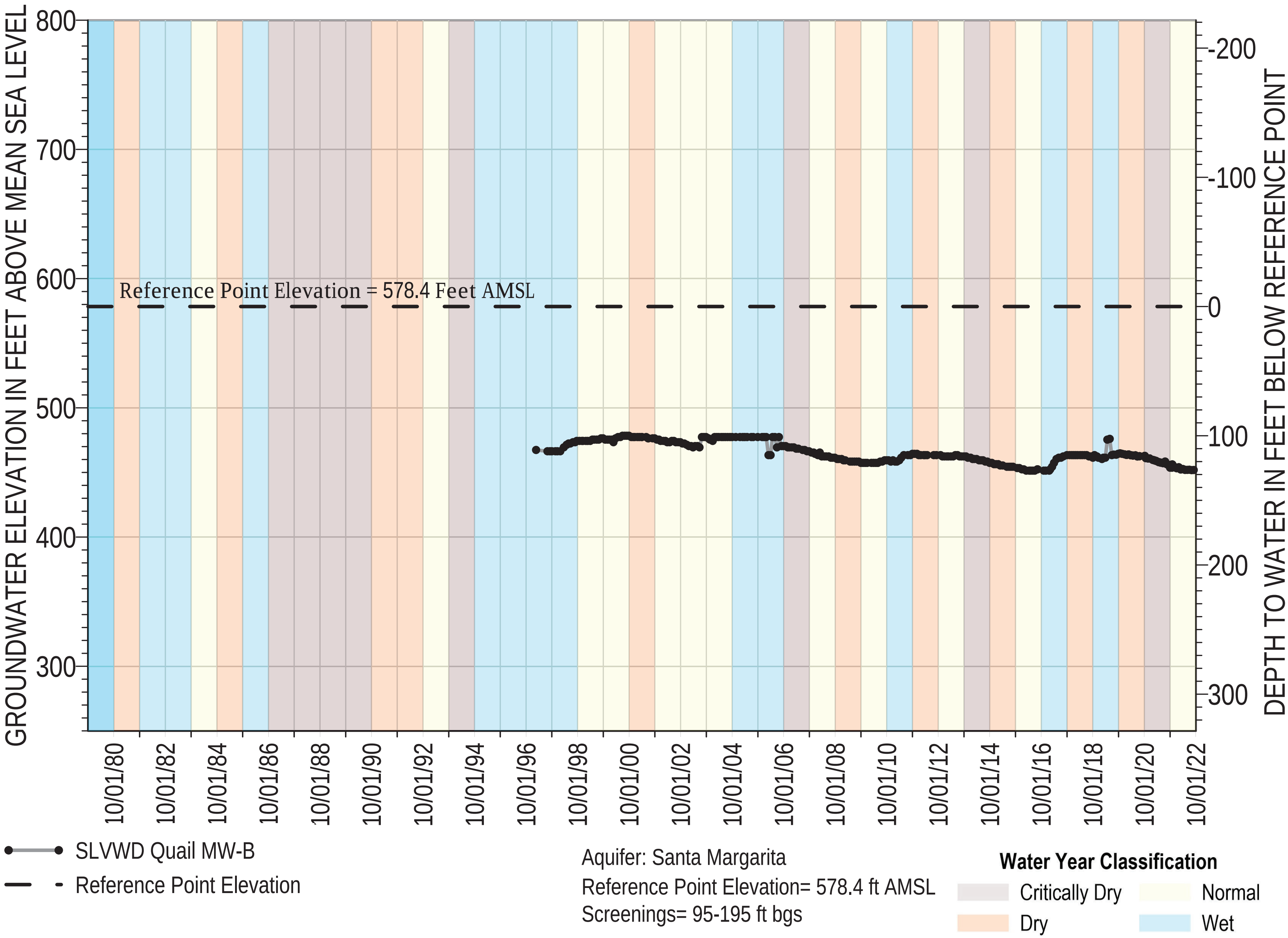


Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



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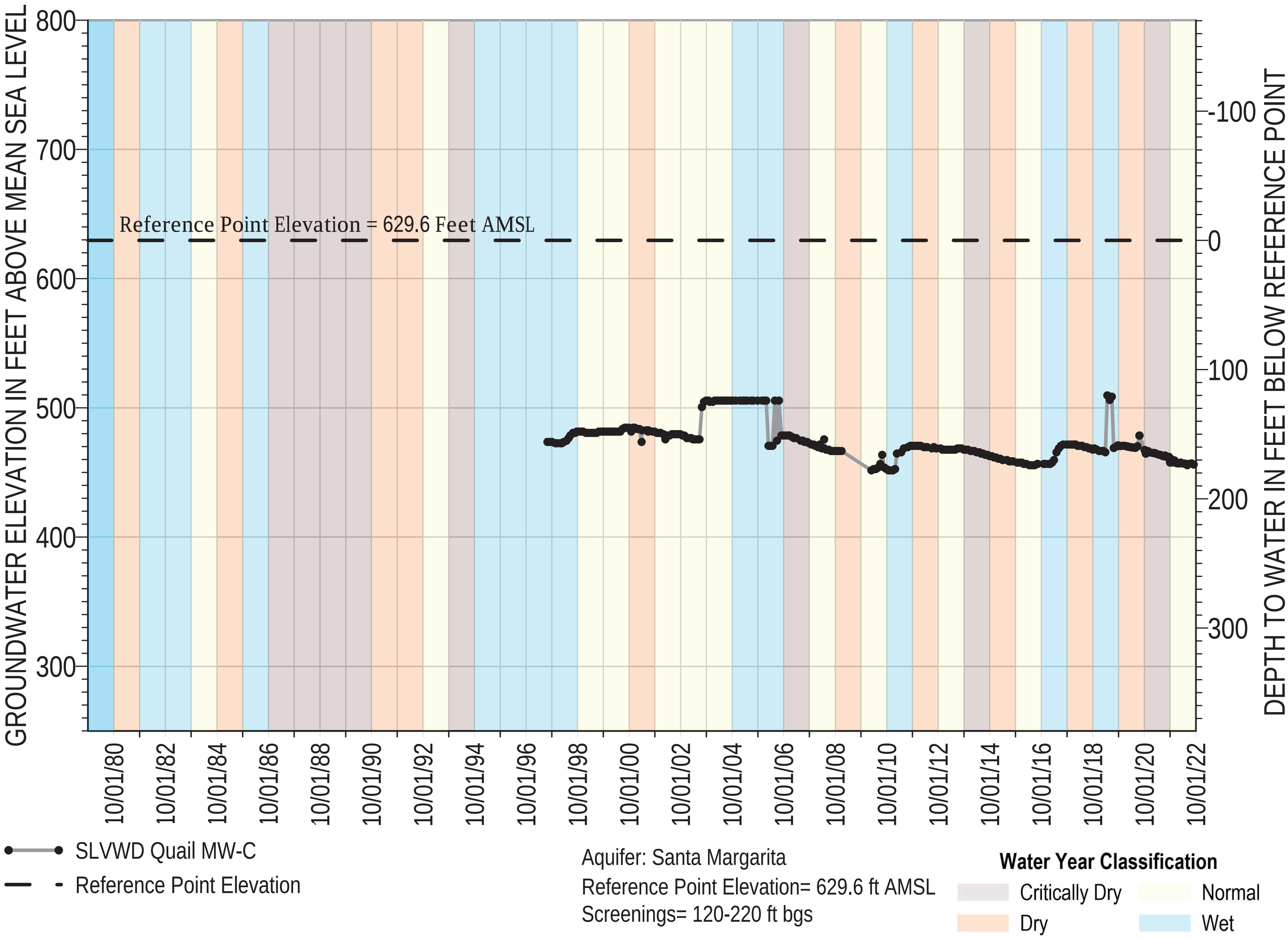
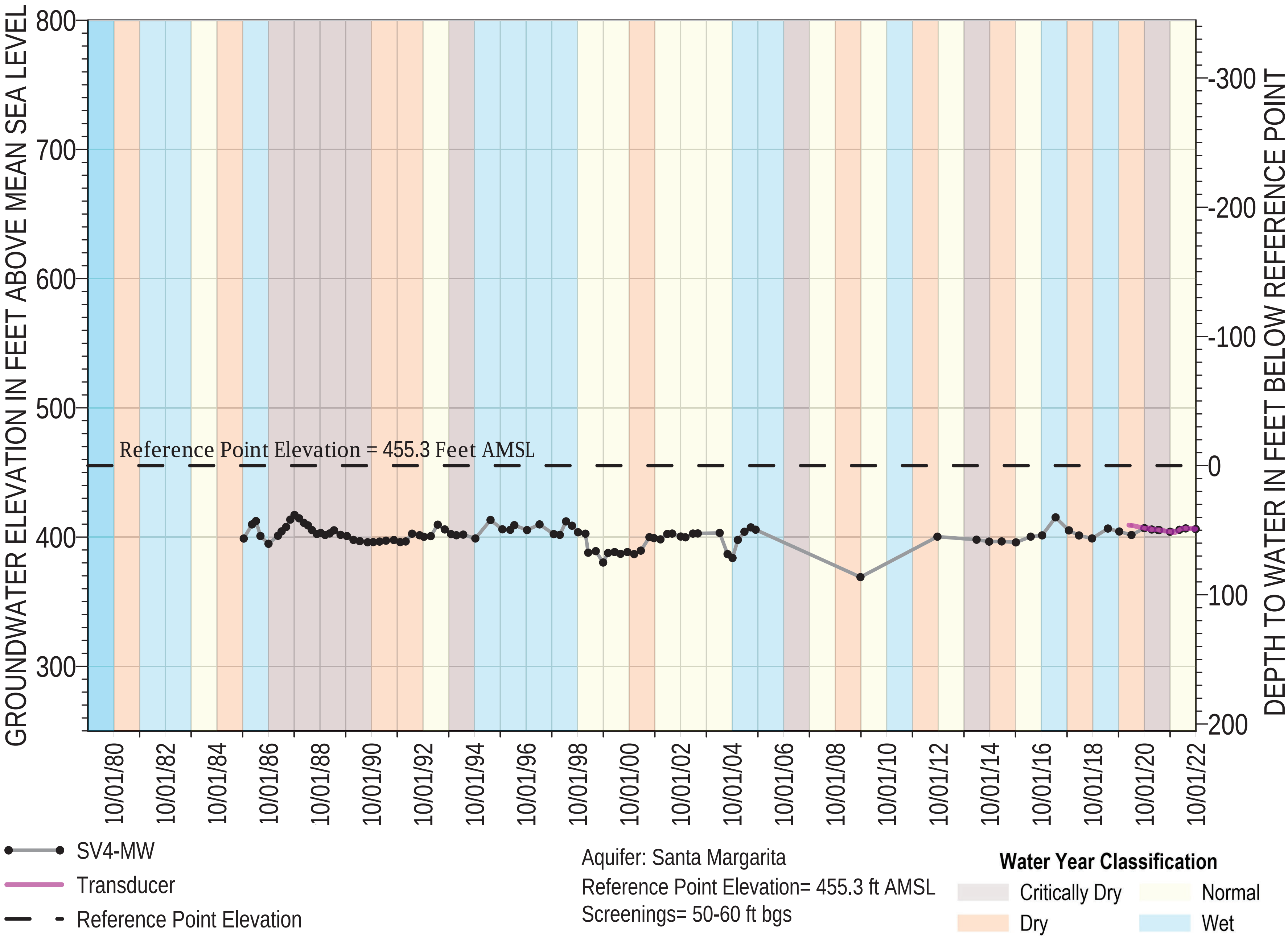
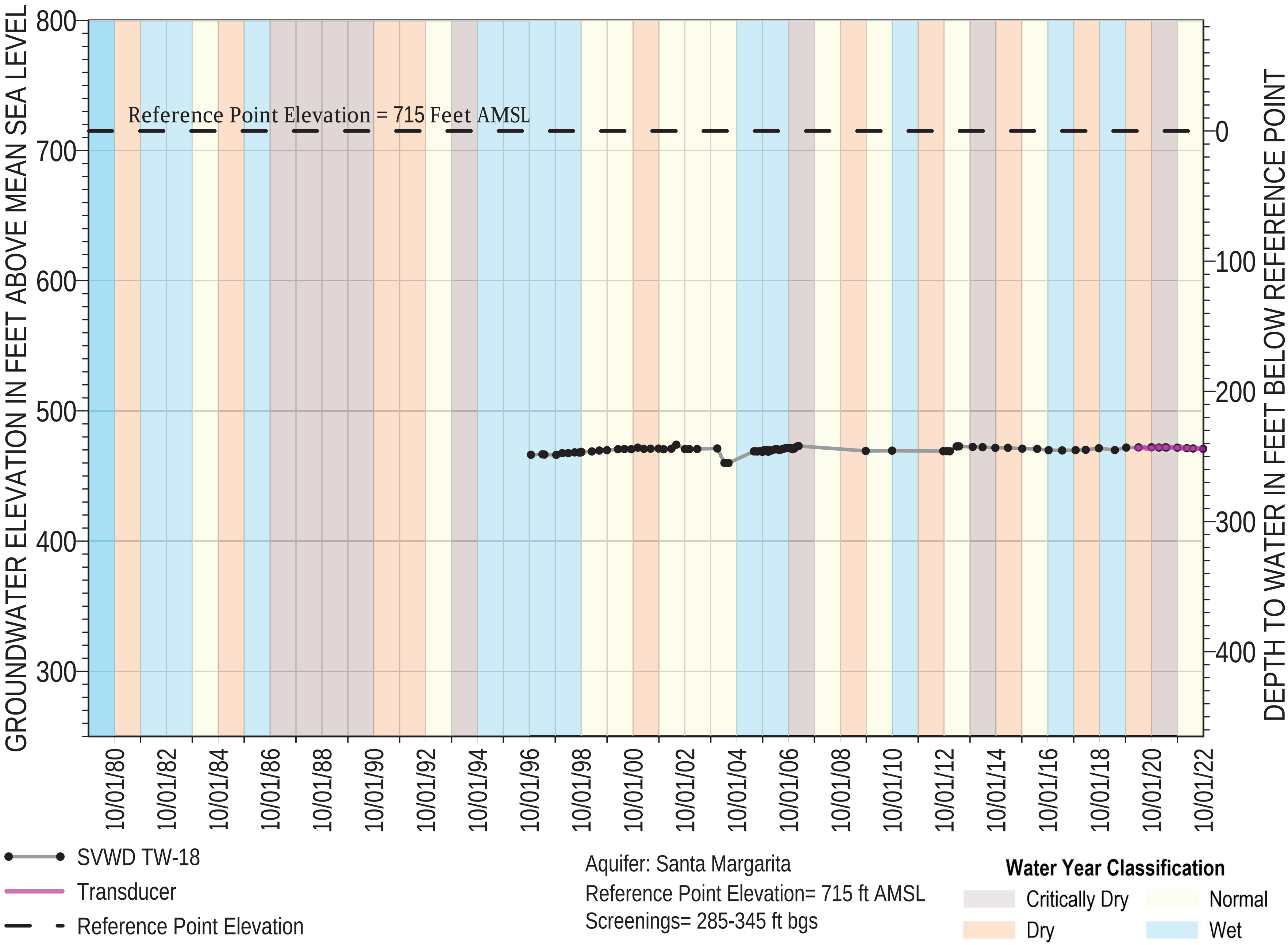


Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

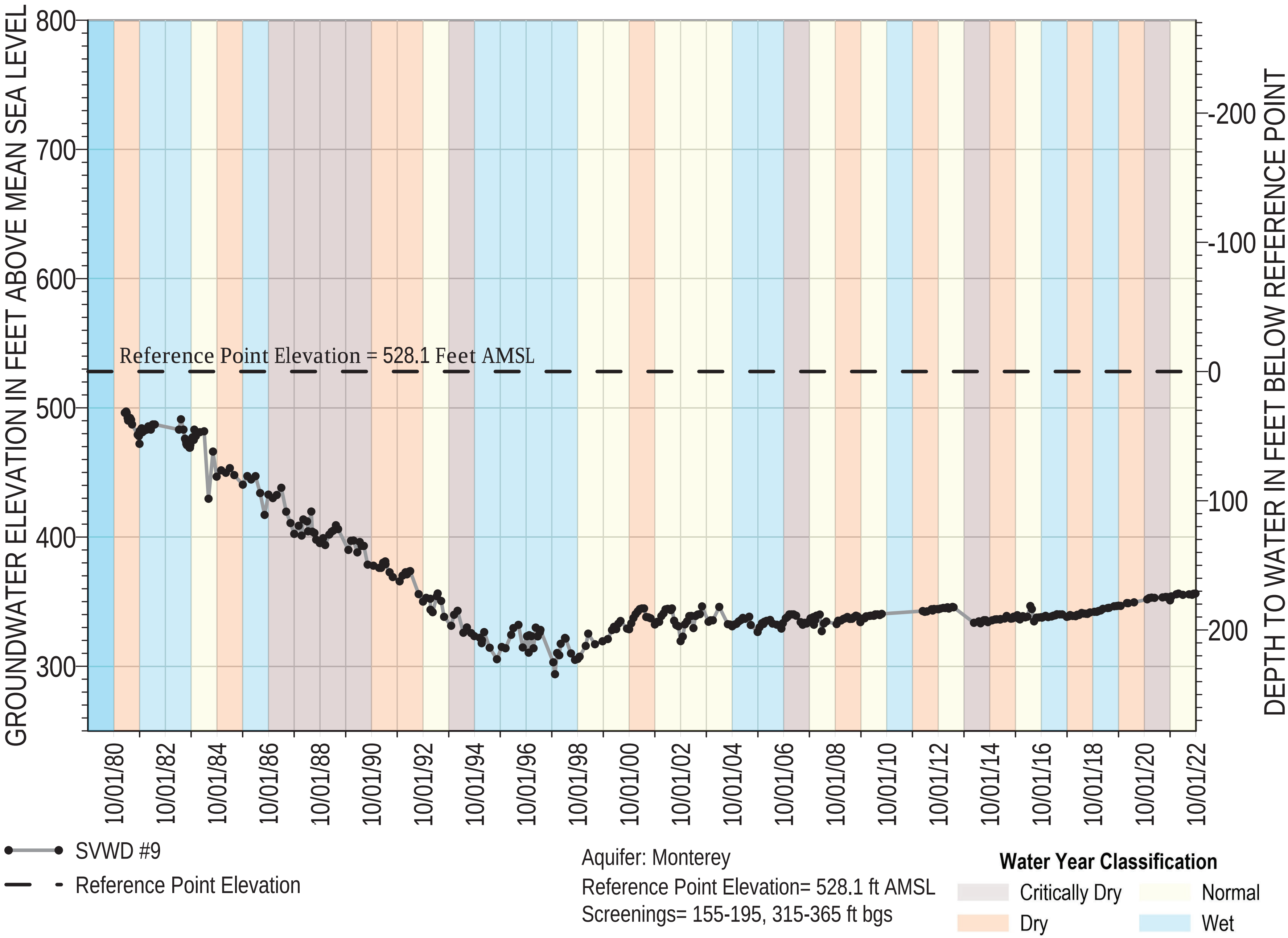


Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



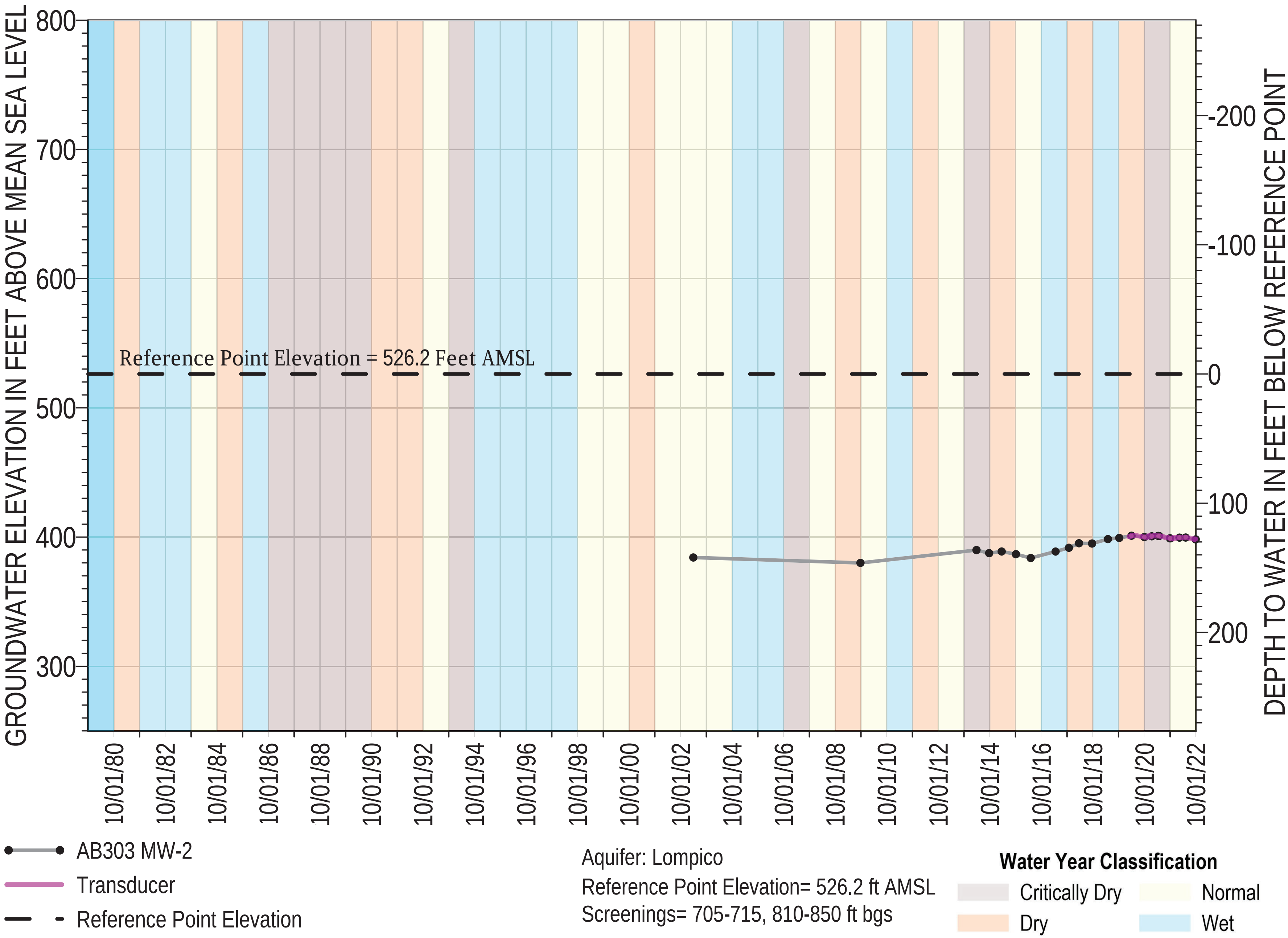
Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

Monterey Formation



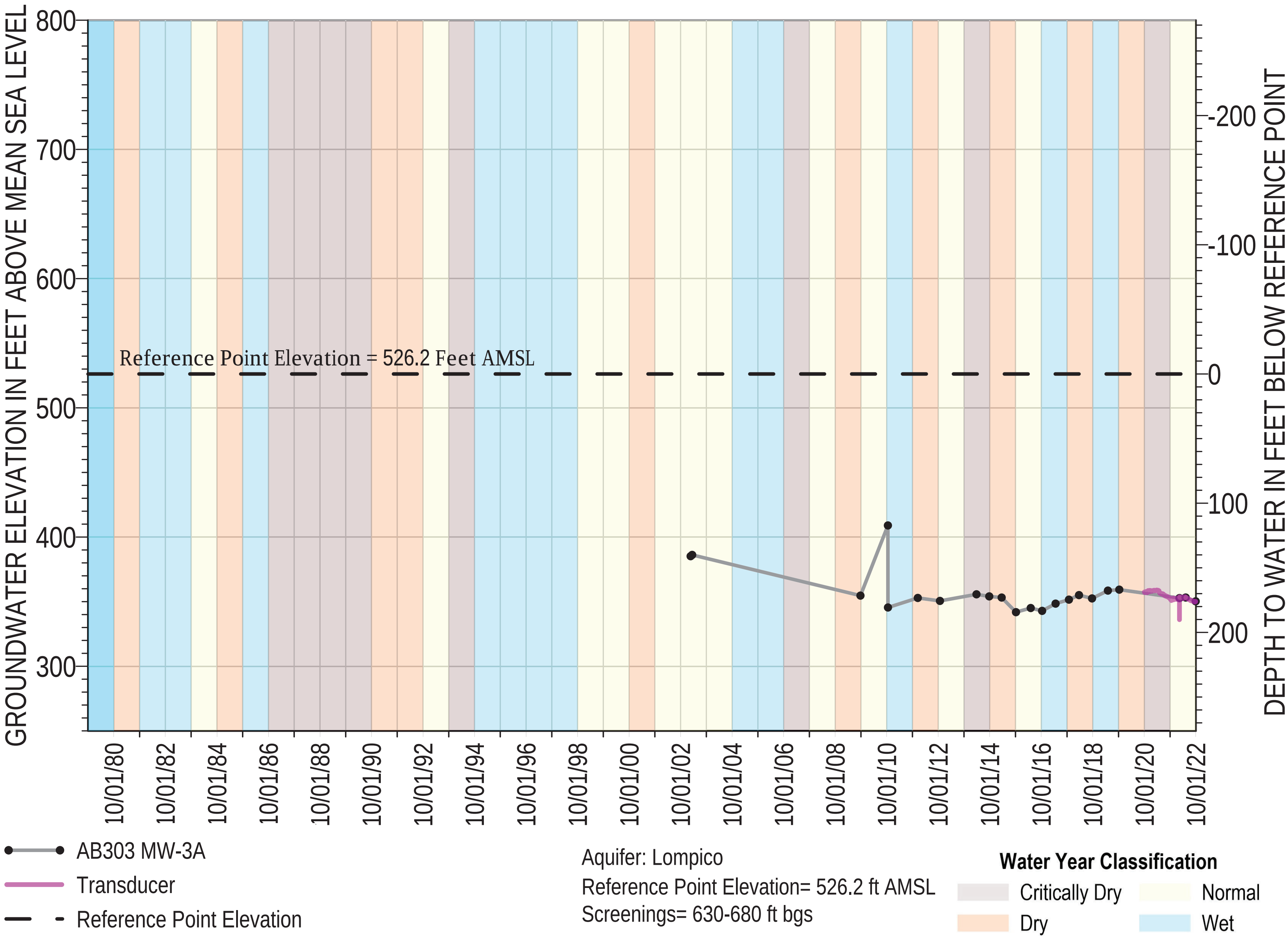
Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

Lompico Sandstone

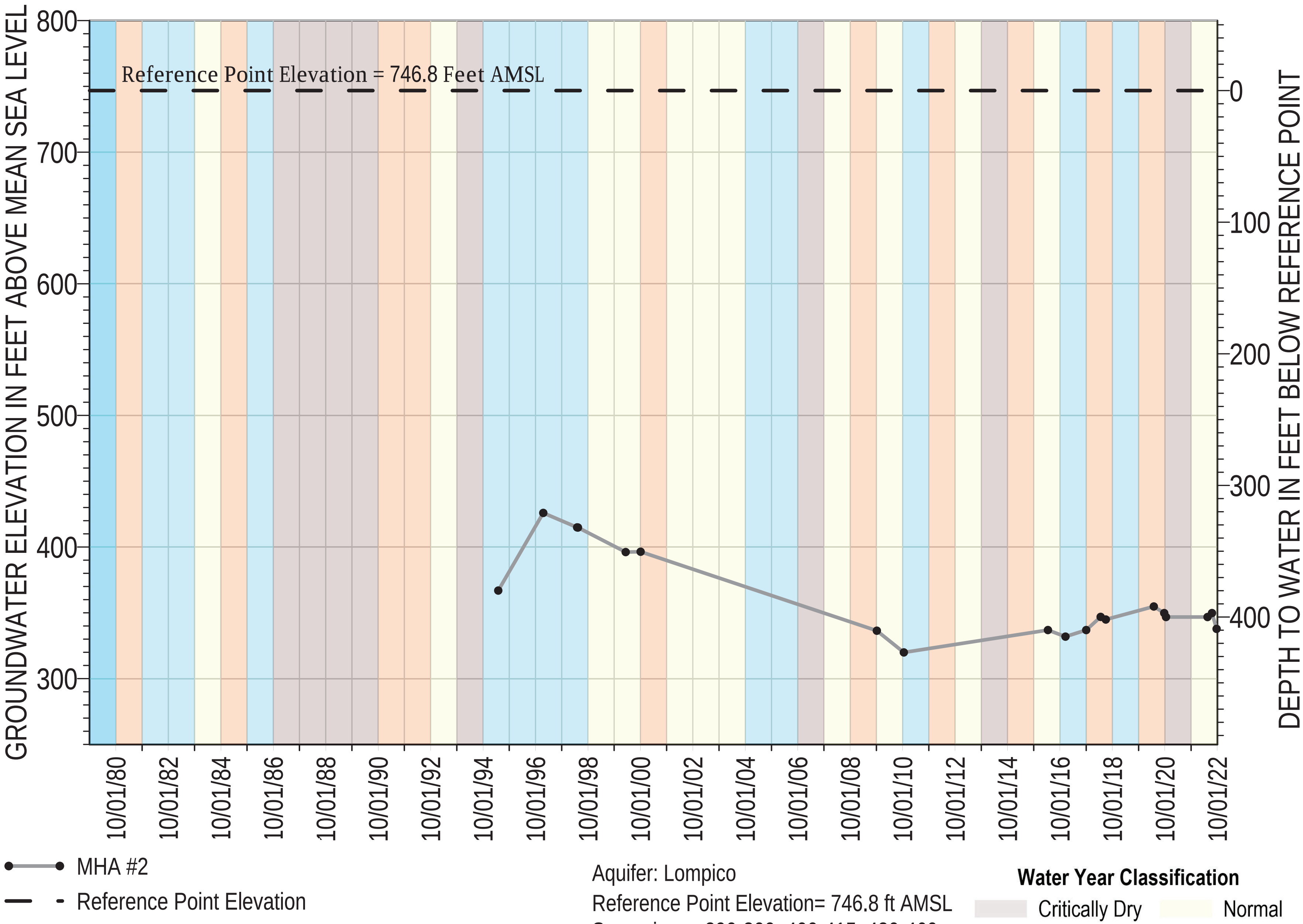


Aquifer: Lompico
Reference Point Elevation= 526.2 ft AMSL
Screenings= 705-715, 810-850 ft bgs

Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

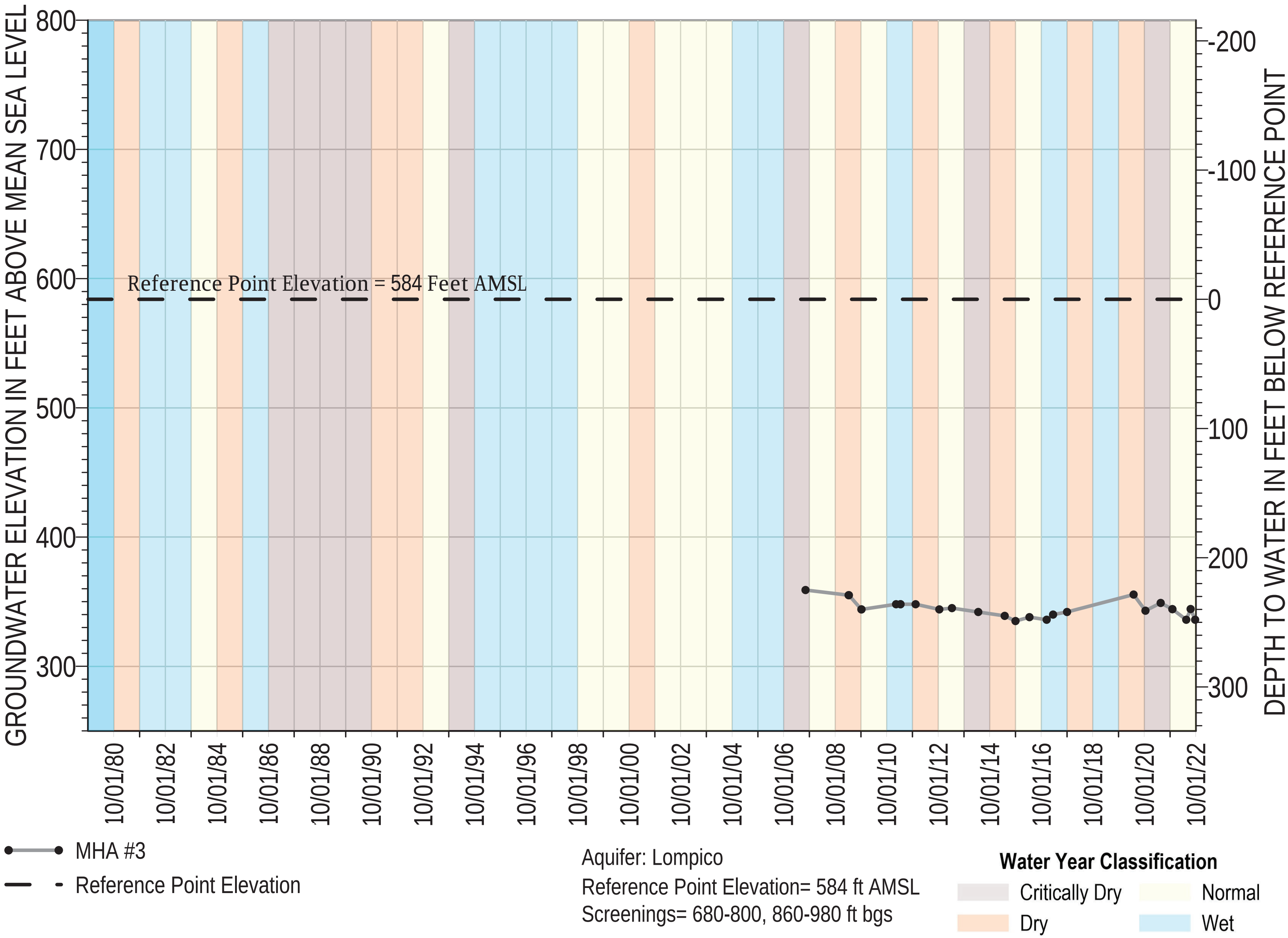


Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

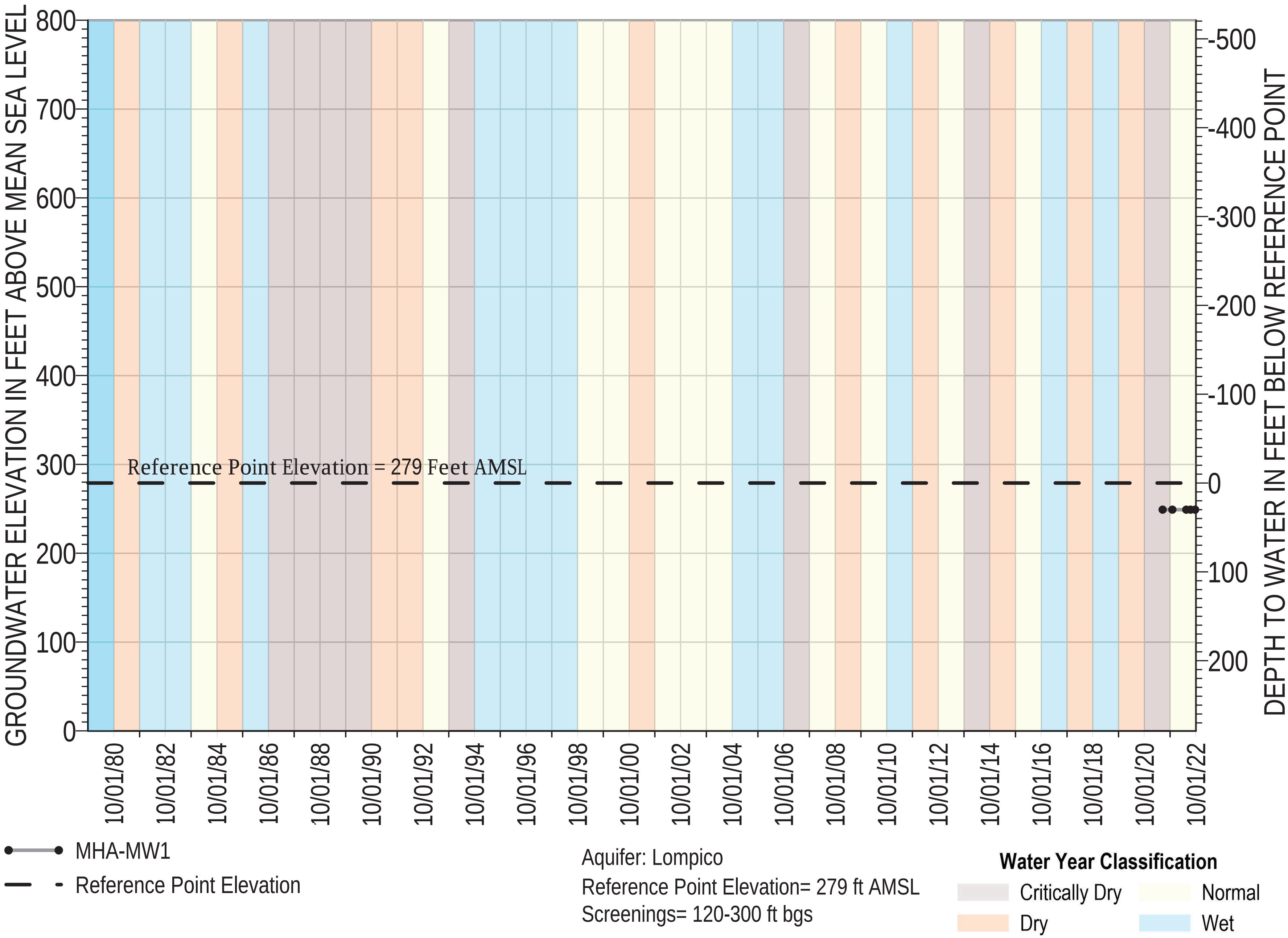


Aquifer: Lompico
Reference Point Elevation= 746.8 ft AMSL
Screenings= 290-300, 400-415, 430-460, 490-590, 600-725 ft bgs

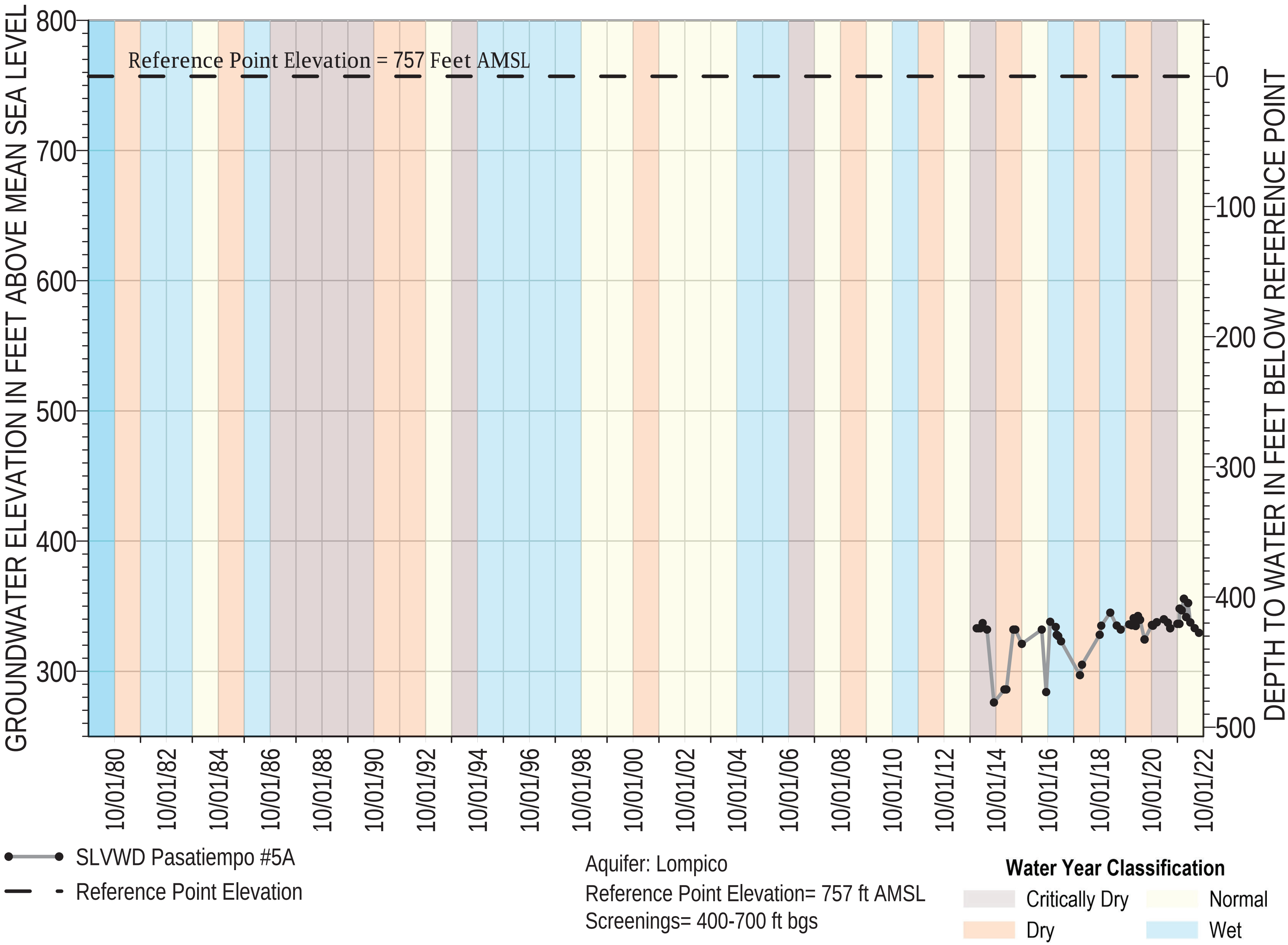
Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



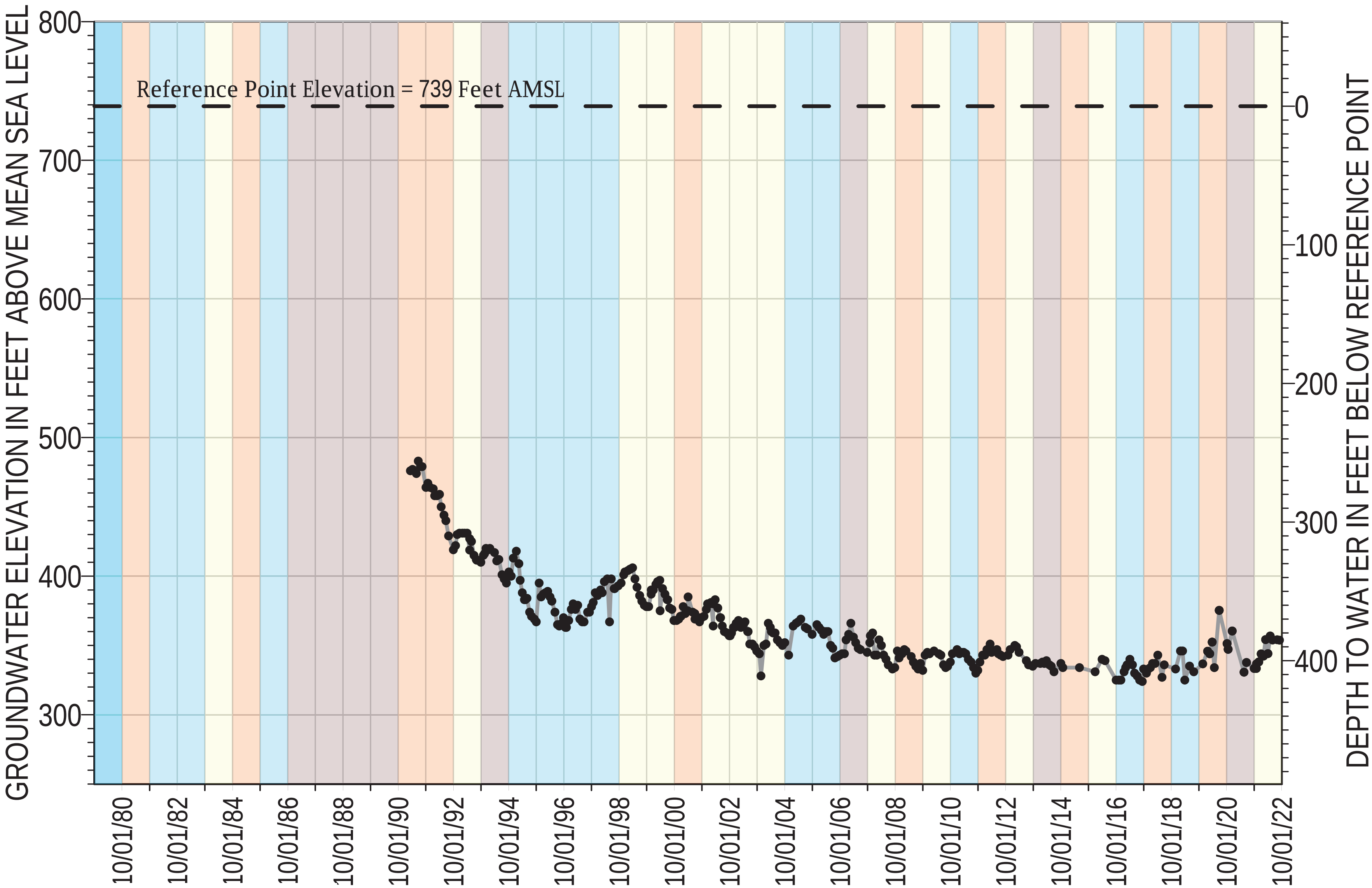
Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



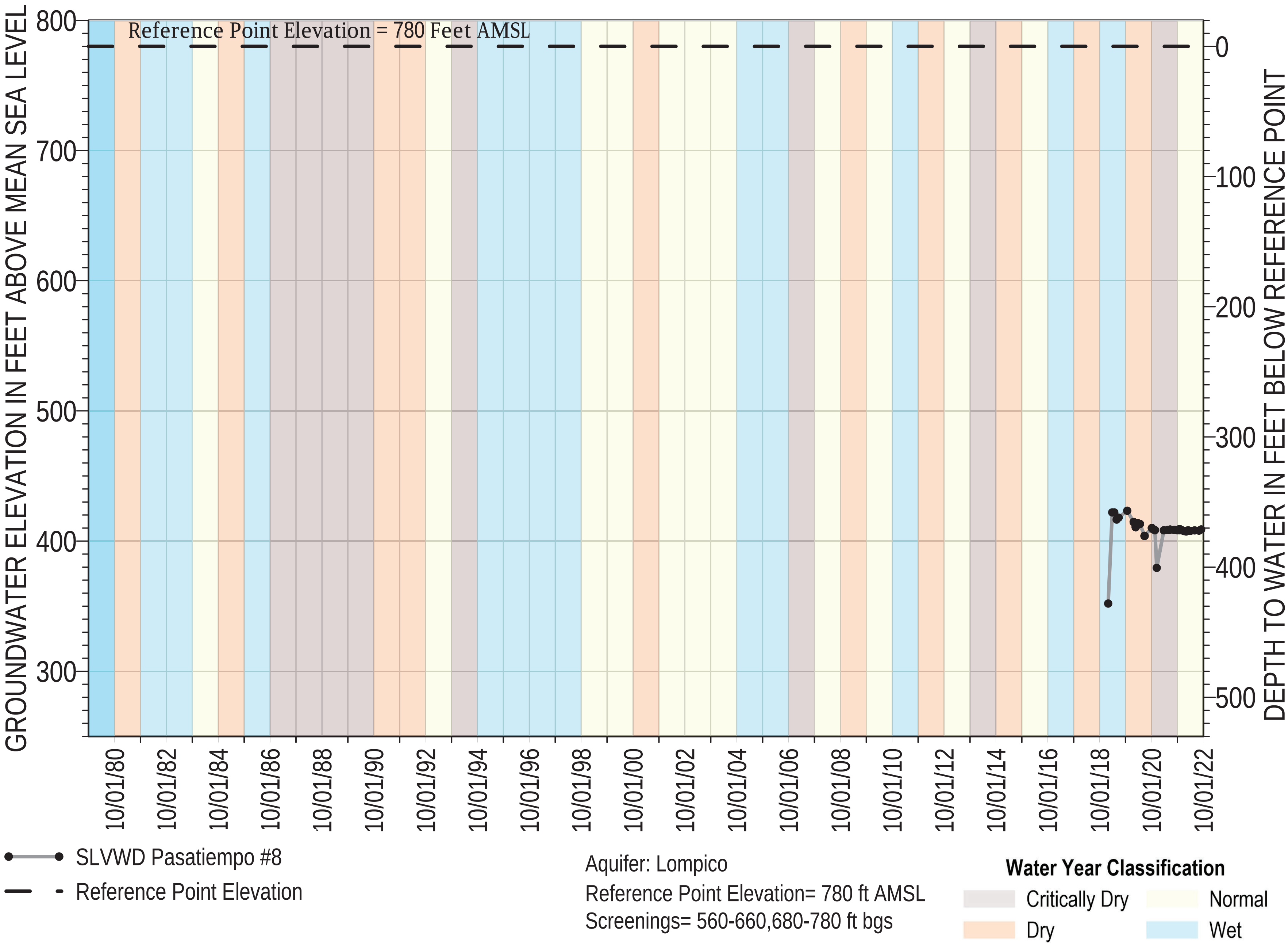
Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



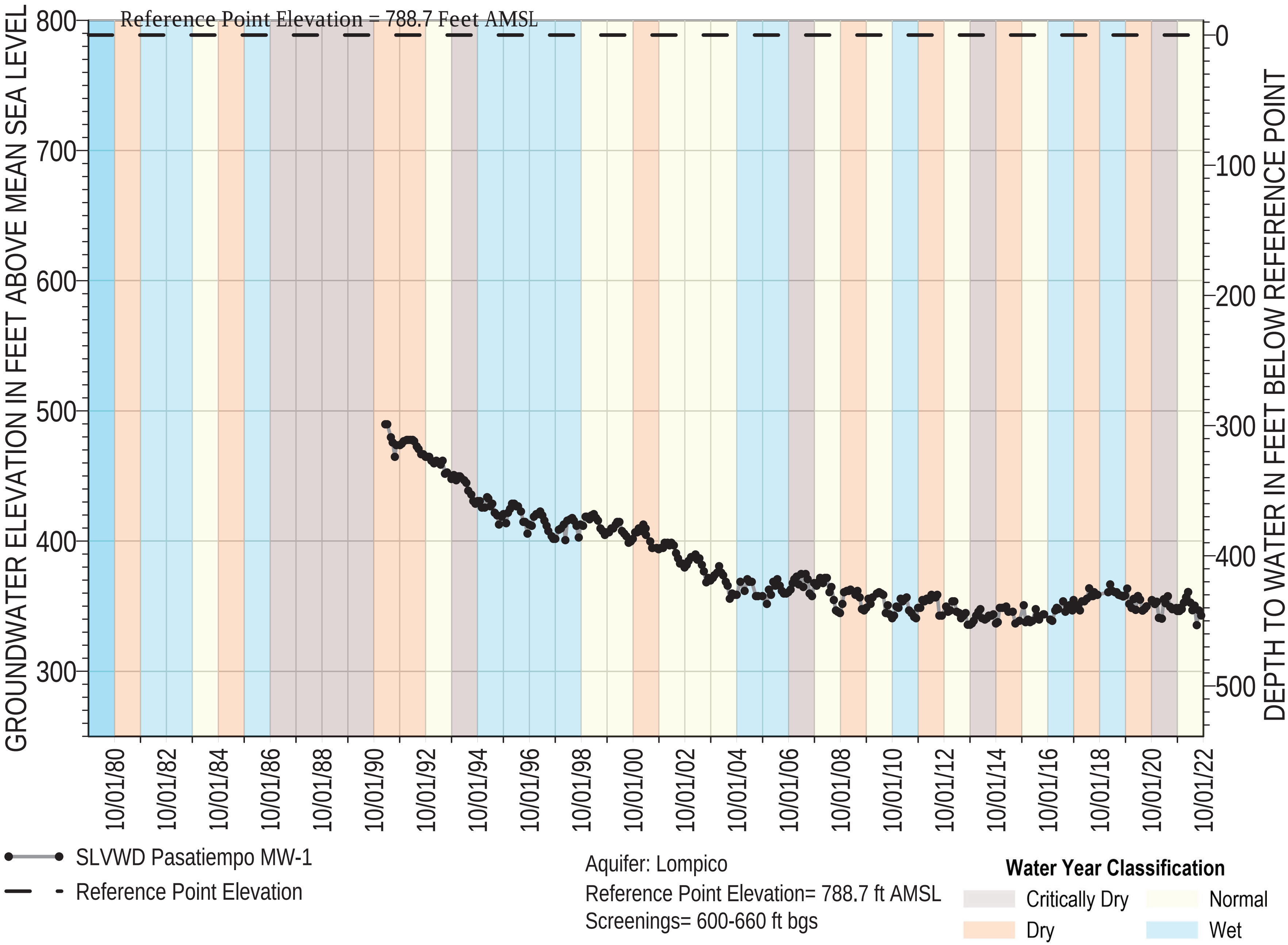
Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



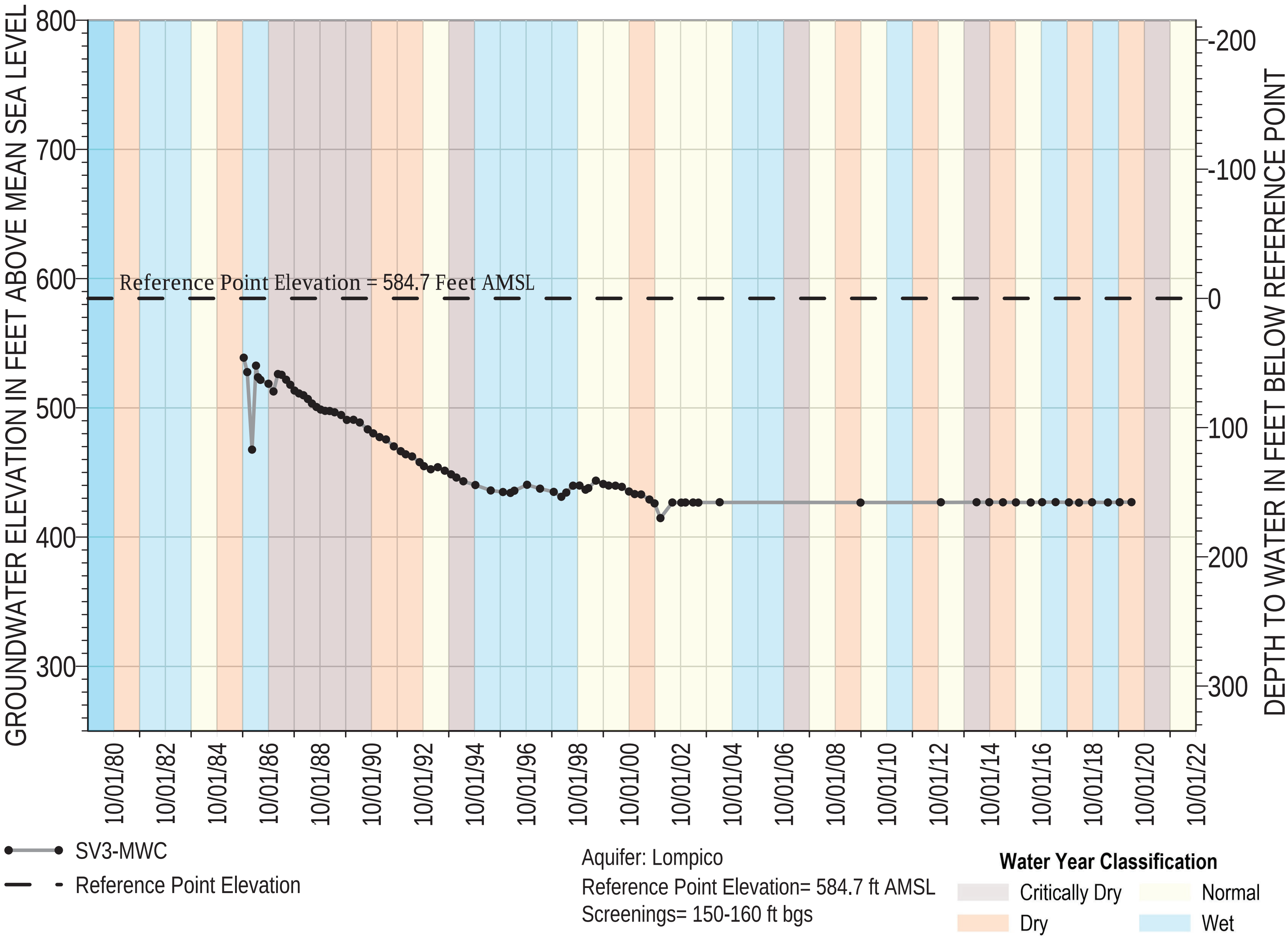
Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



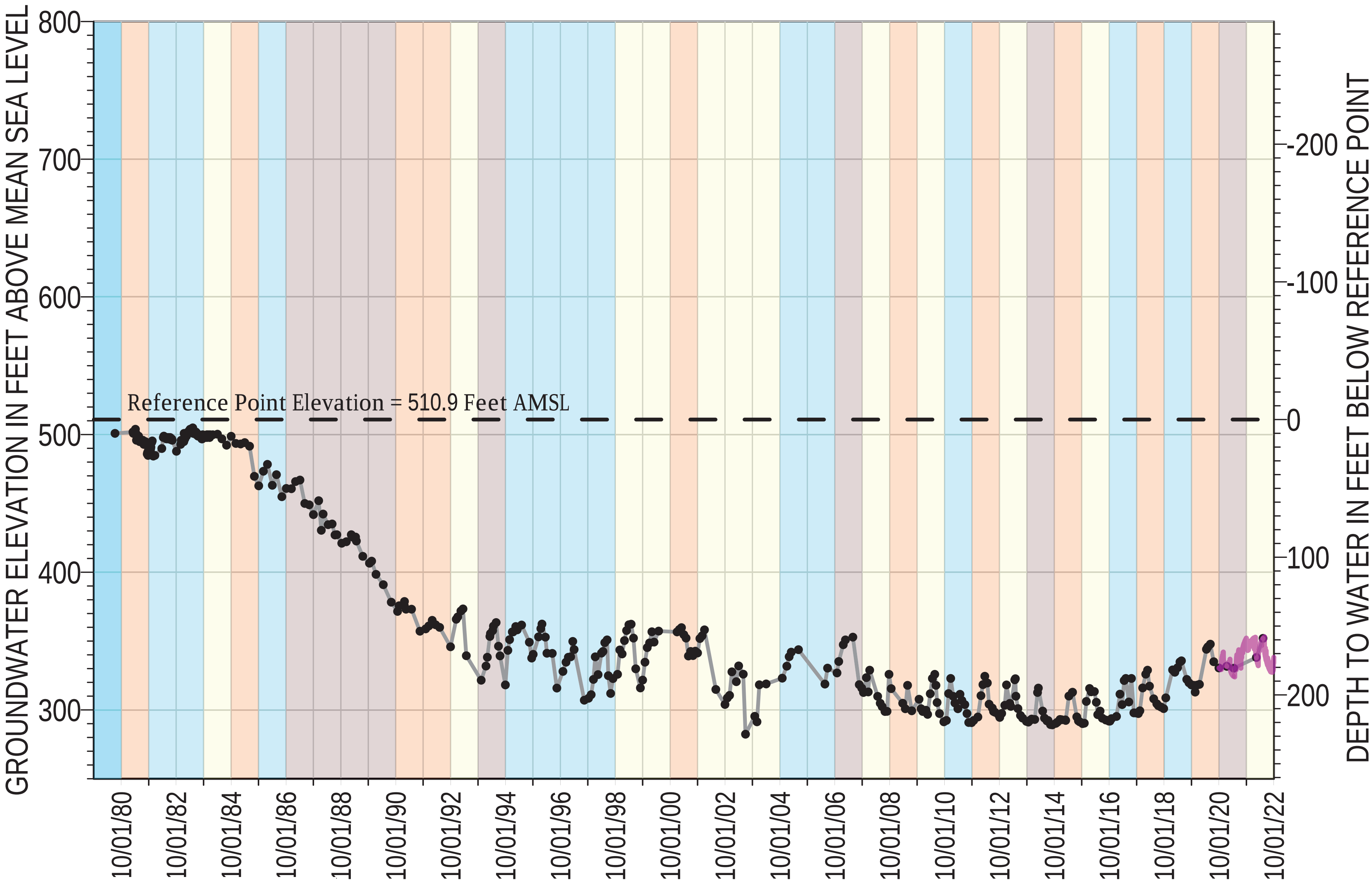
Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



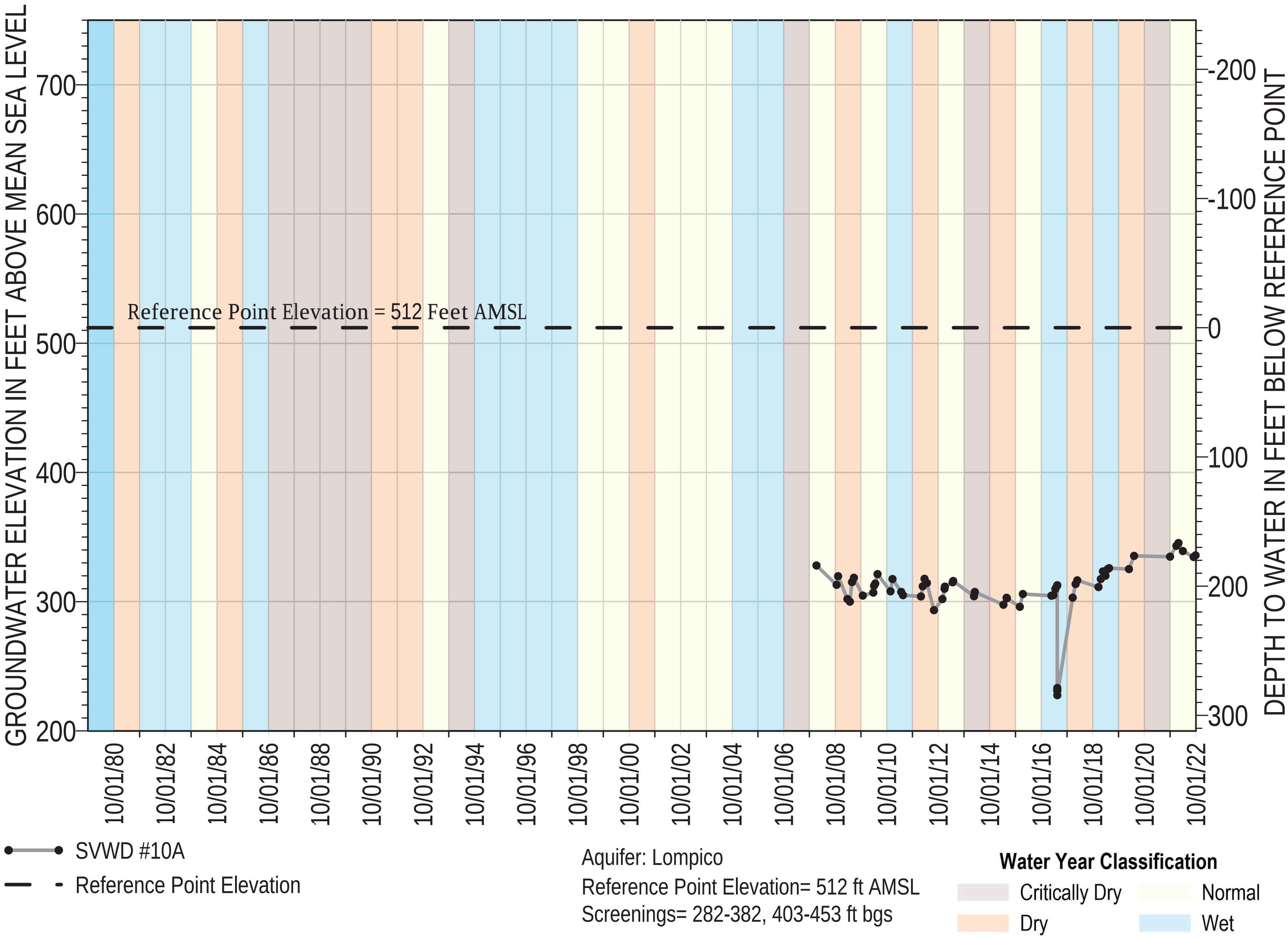
SVWD #10
Transducer
Reference Point Elevation

Aquifer: Lompico
Reference Point Elevation= 510.9 ft AMSL
Screenings= 190-220, 240-270,
325-355 ft bgs

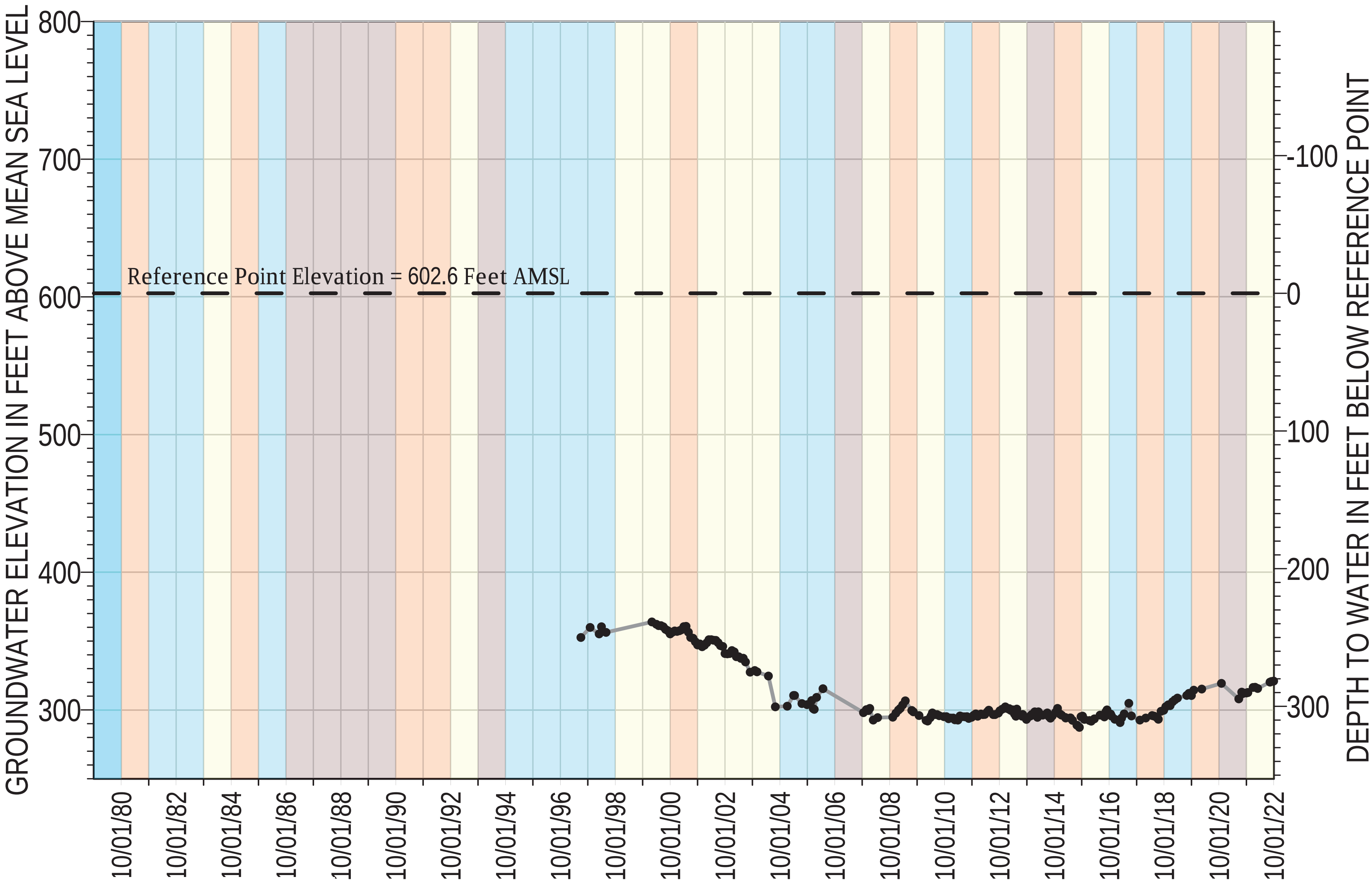
Water Year Classification

Critically Dry
Normal
Dry
Wet

Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.



SVWD #11A

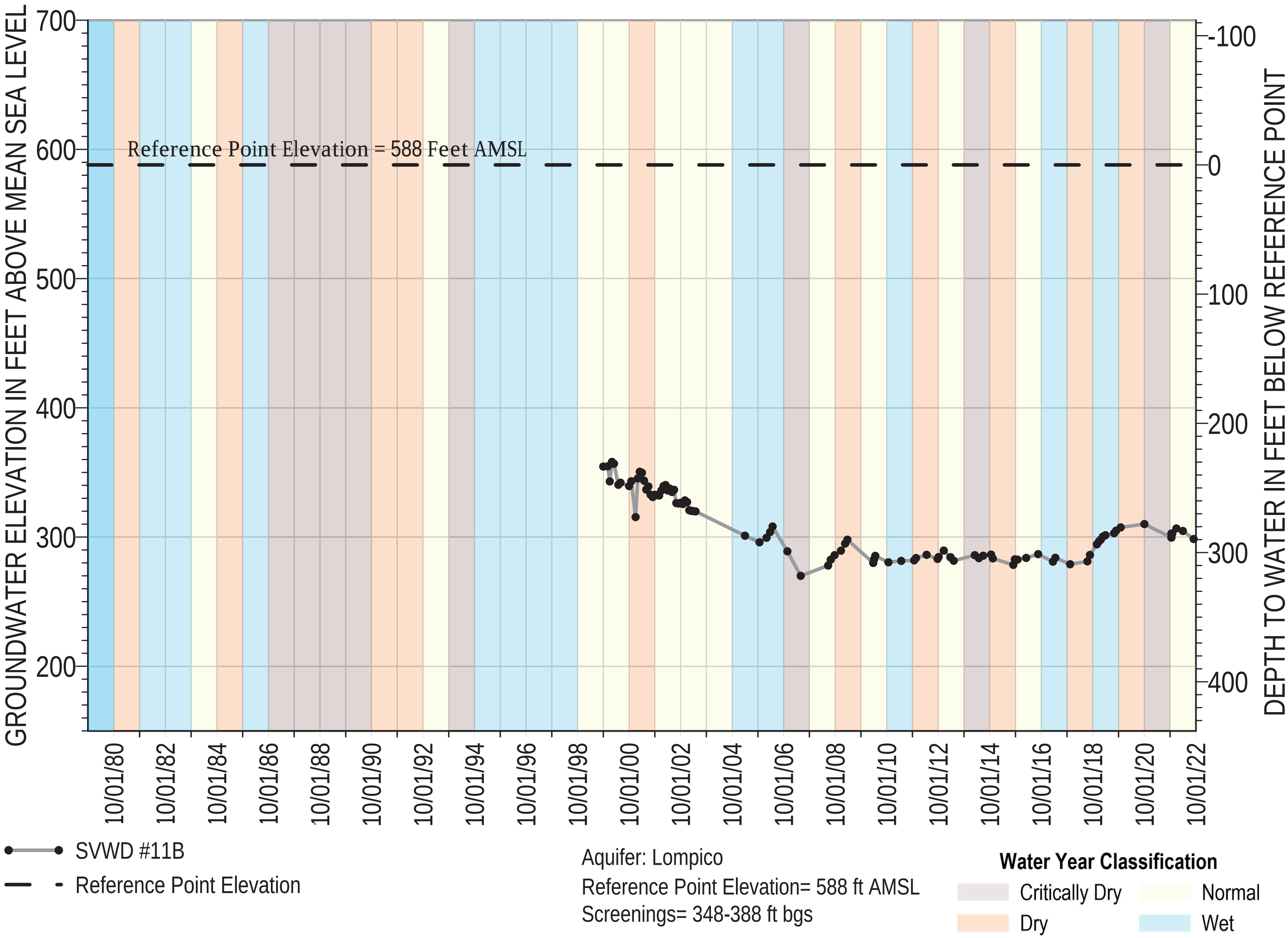
Reference Point Elevation

Aquifer: Lompico
Reference Point Elevation= 602.6 ft AMSL
Screenings= 399-419, 459-469,
495-515 ft bgs

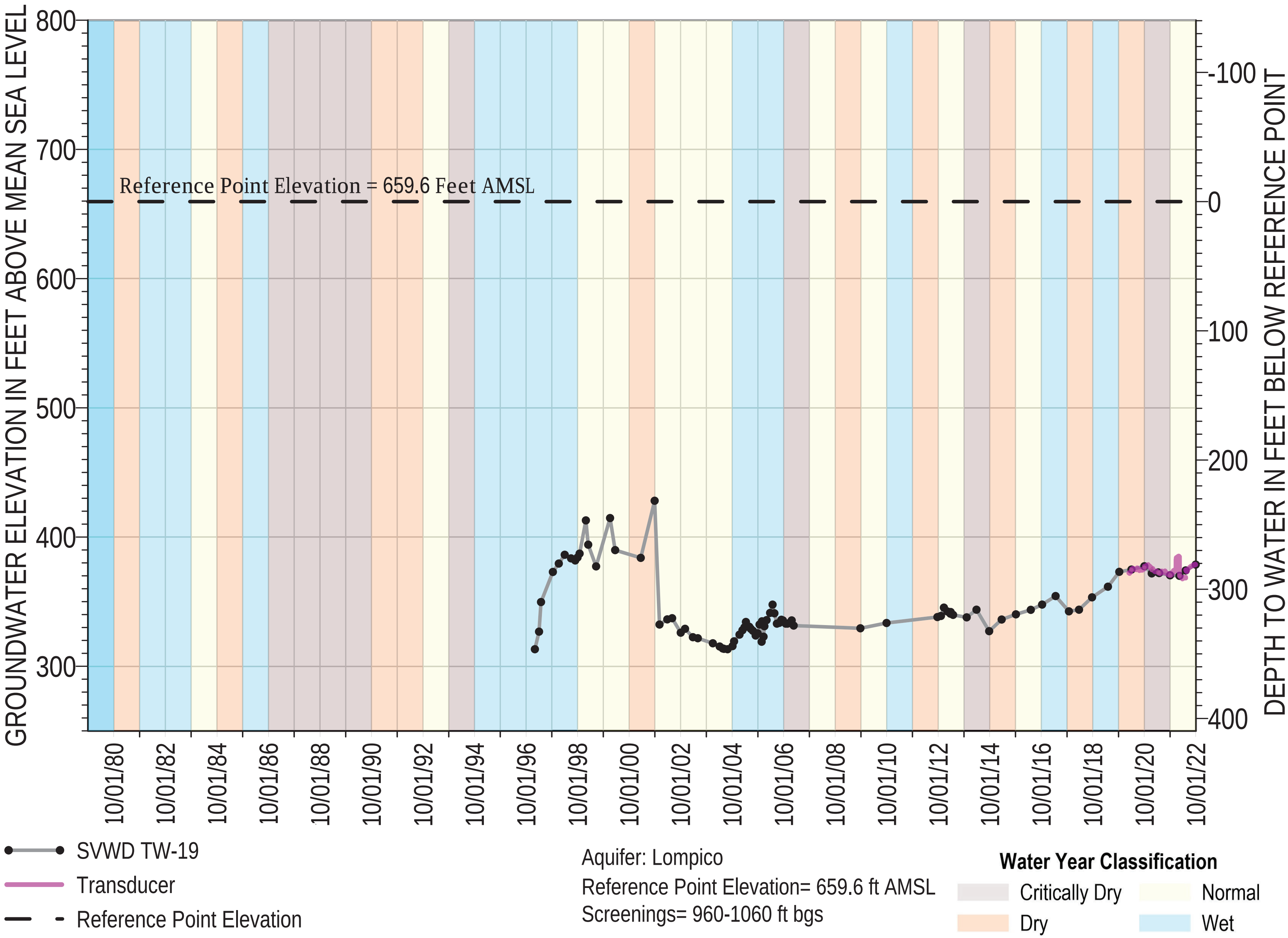
Water Year Classification

Critically Dry
Normal
Dry
Wet

Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

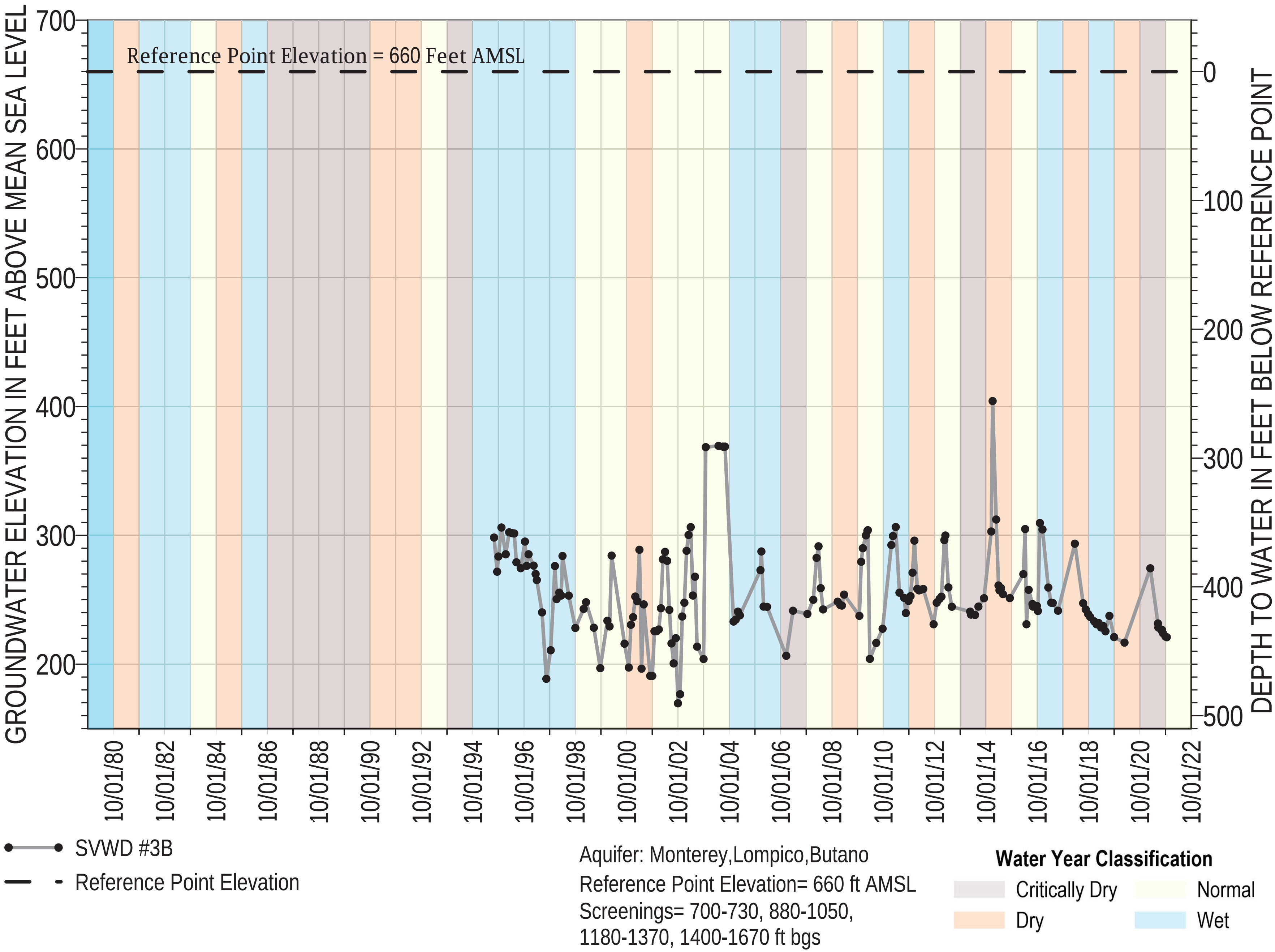


Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

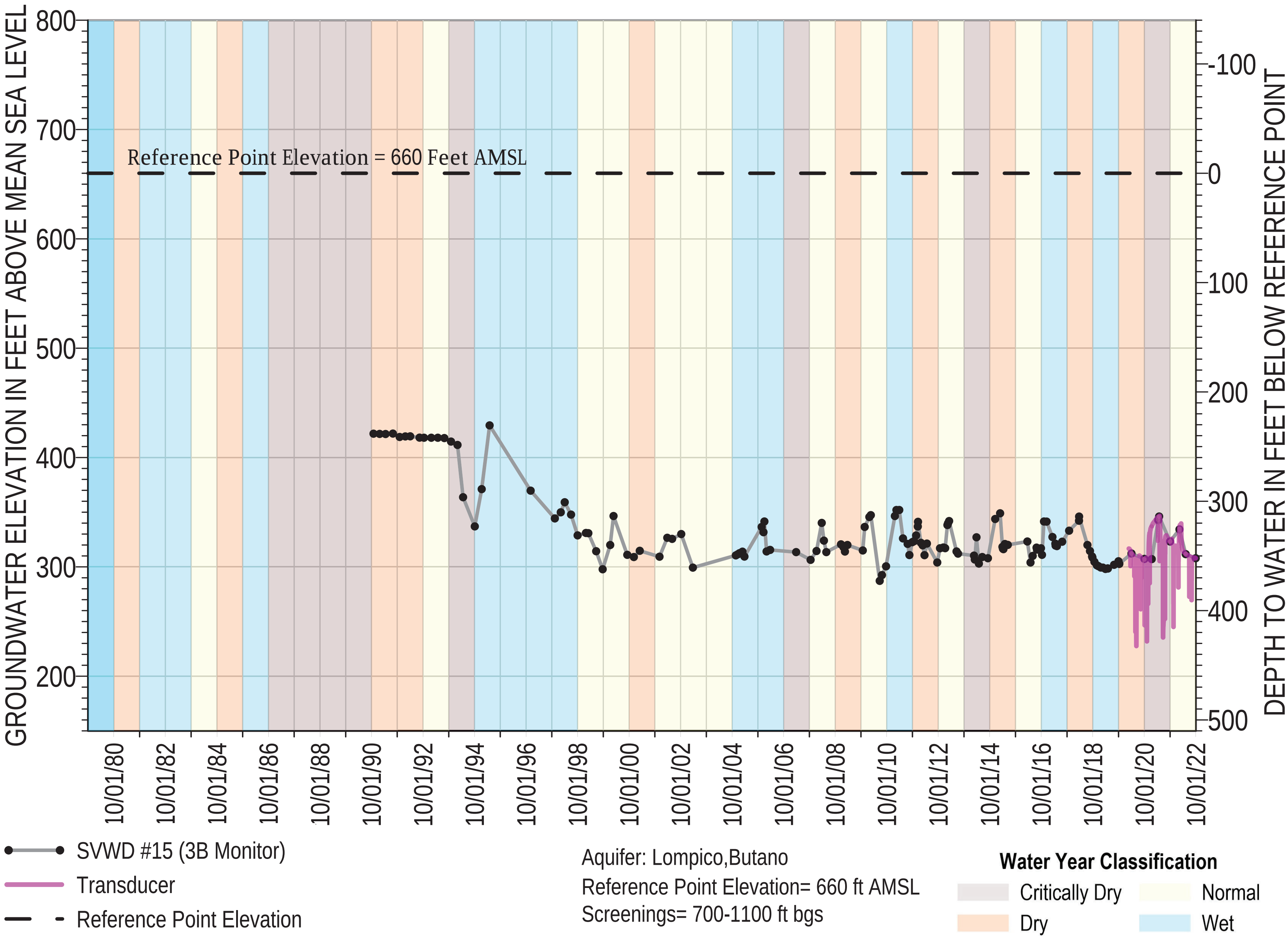


Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

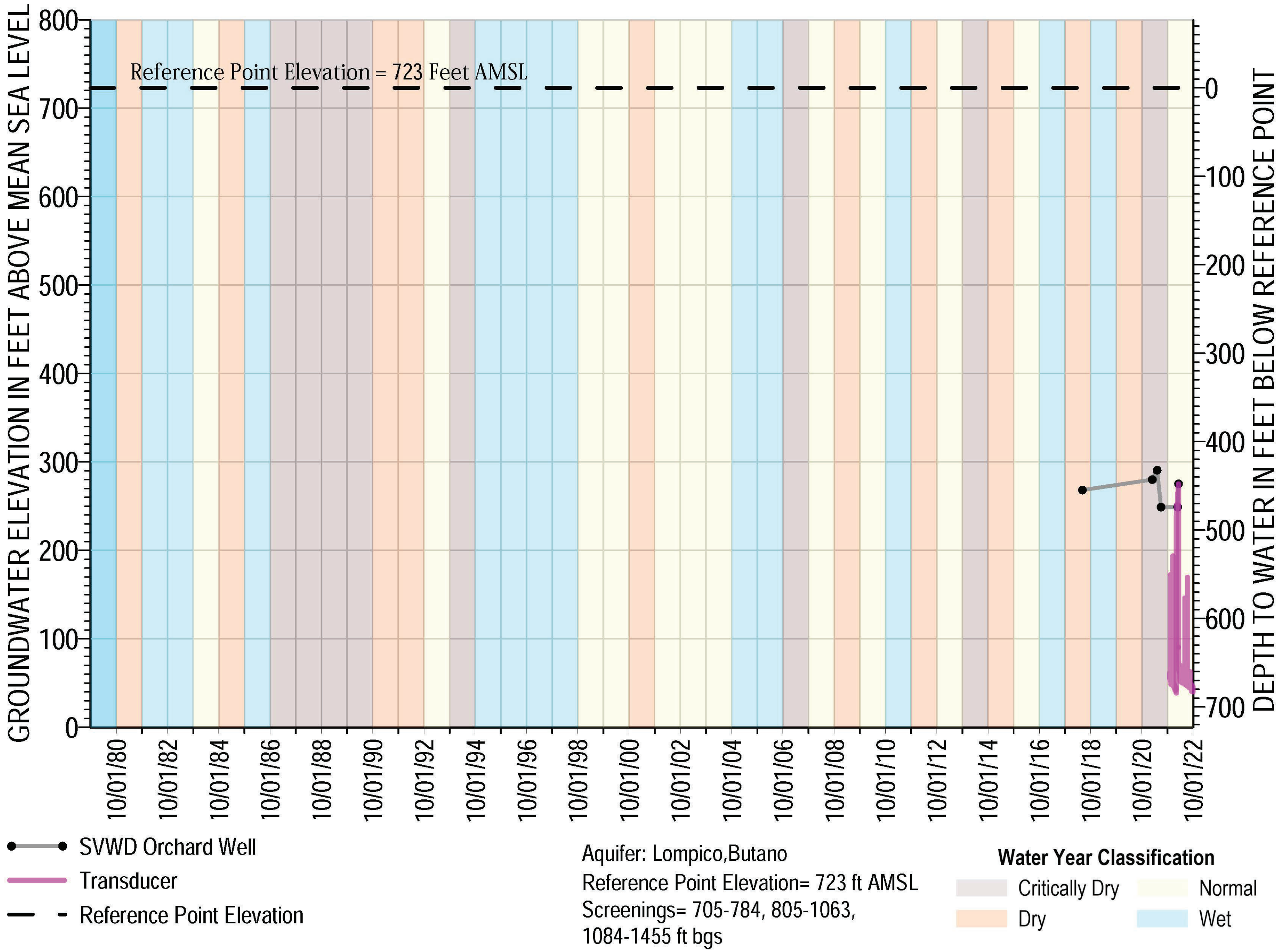
Lompico/Butano Sandstone



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

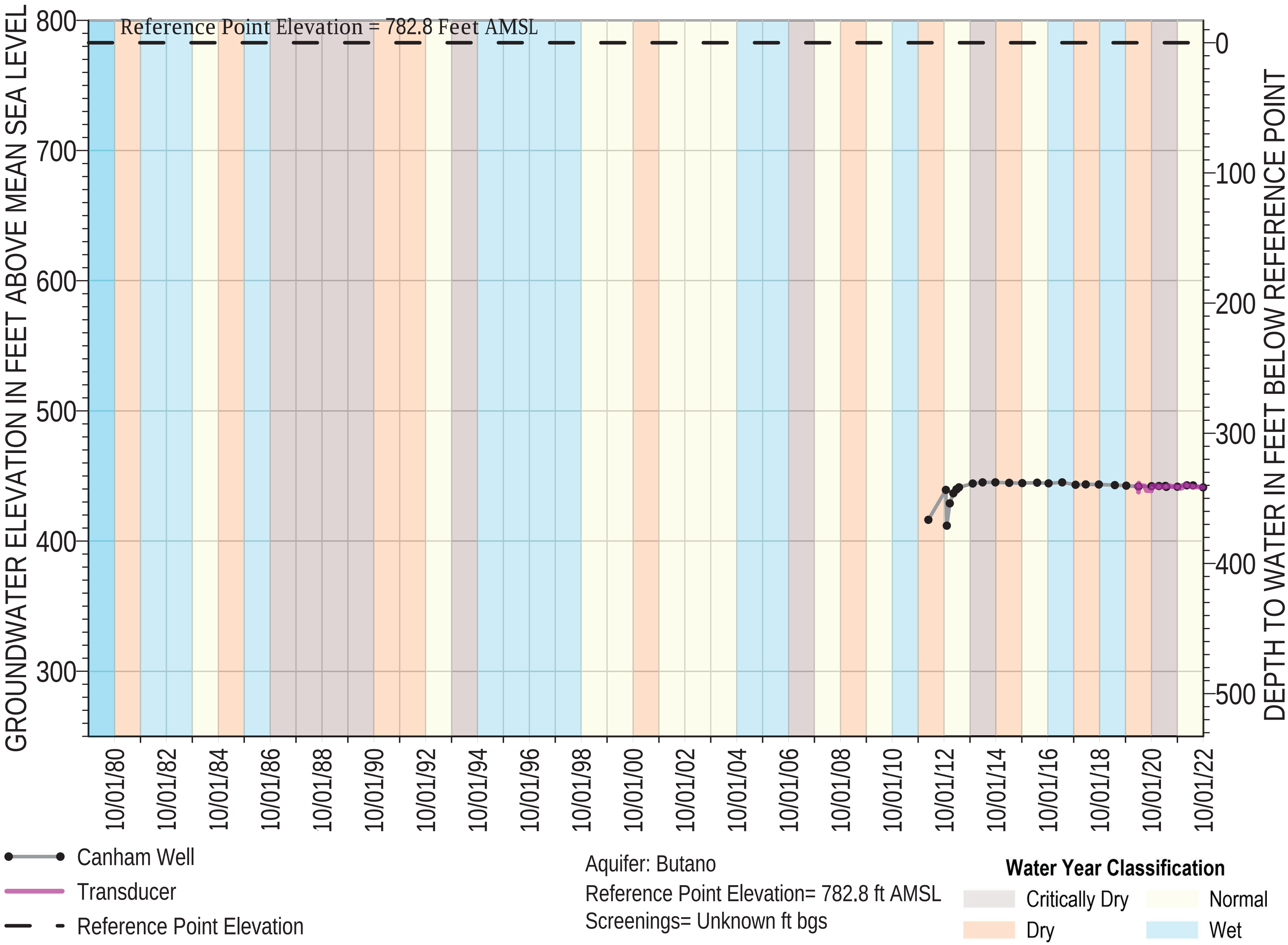


Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

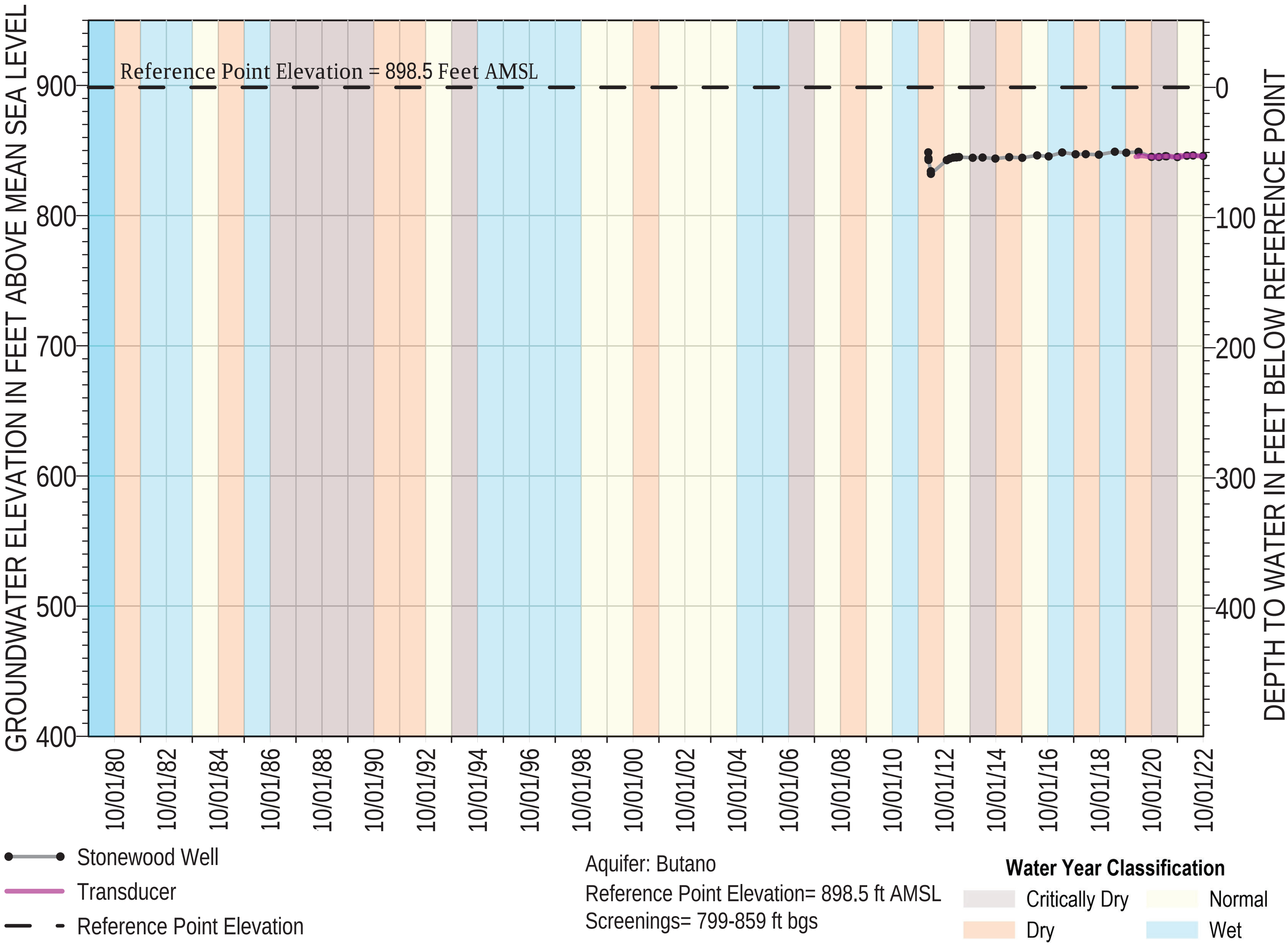


Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

Butano Sandstone



Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

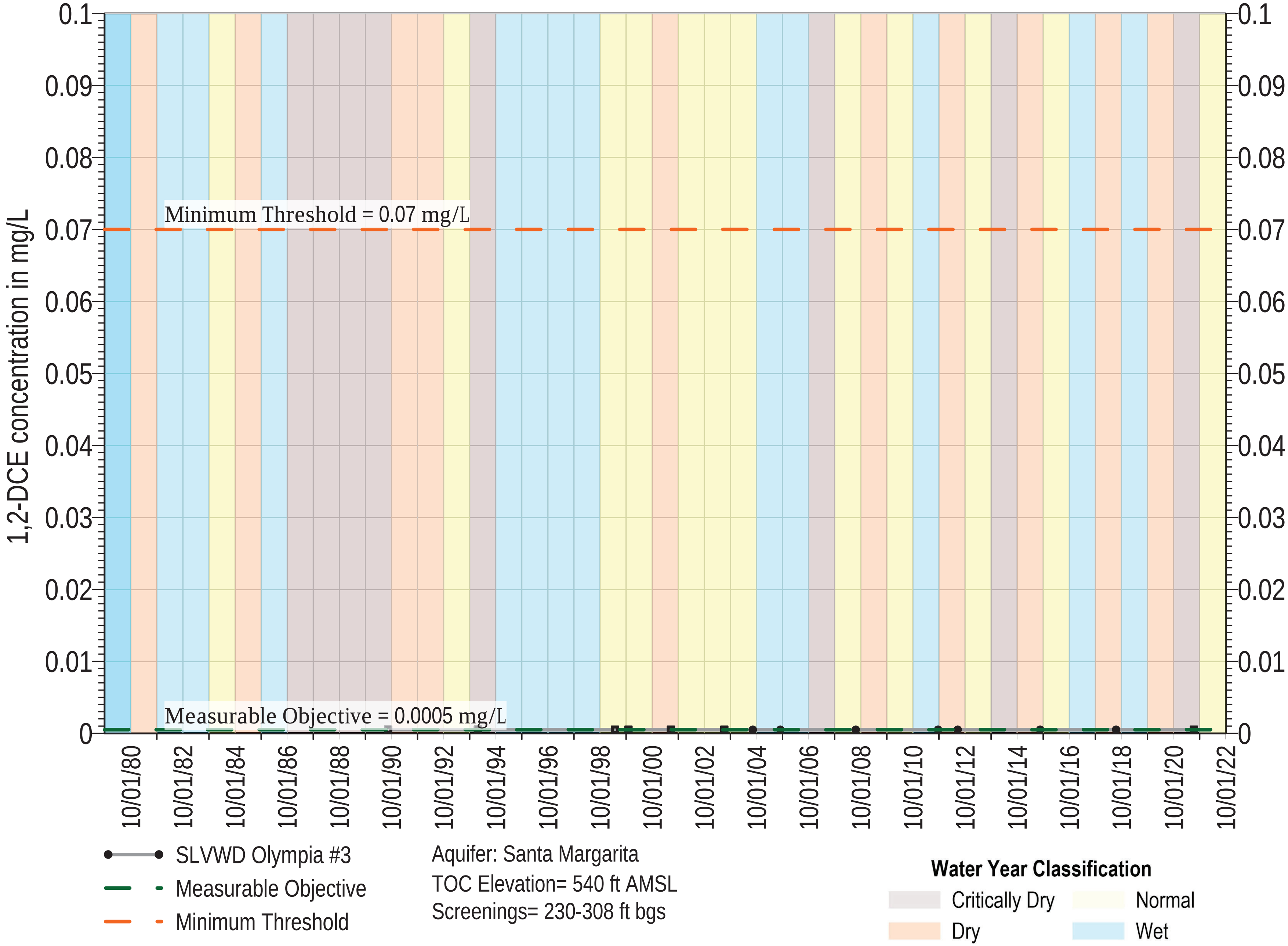


Note: Reference point is the elevation from which depth to water is measured at a well, typically 1-2 feet above land surface.

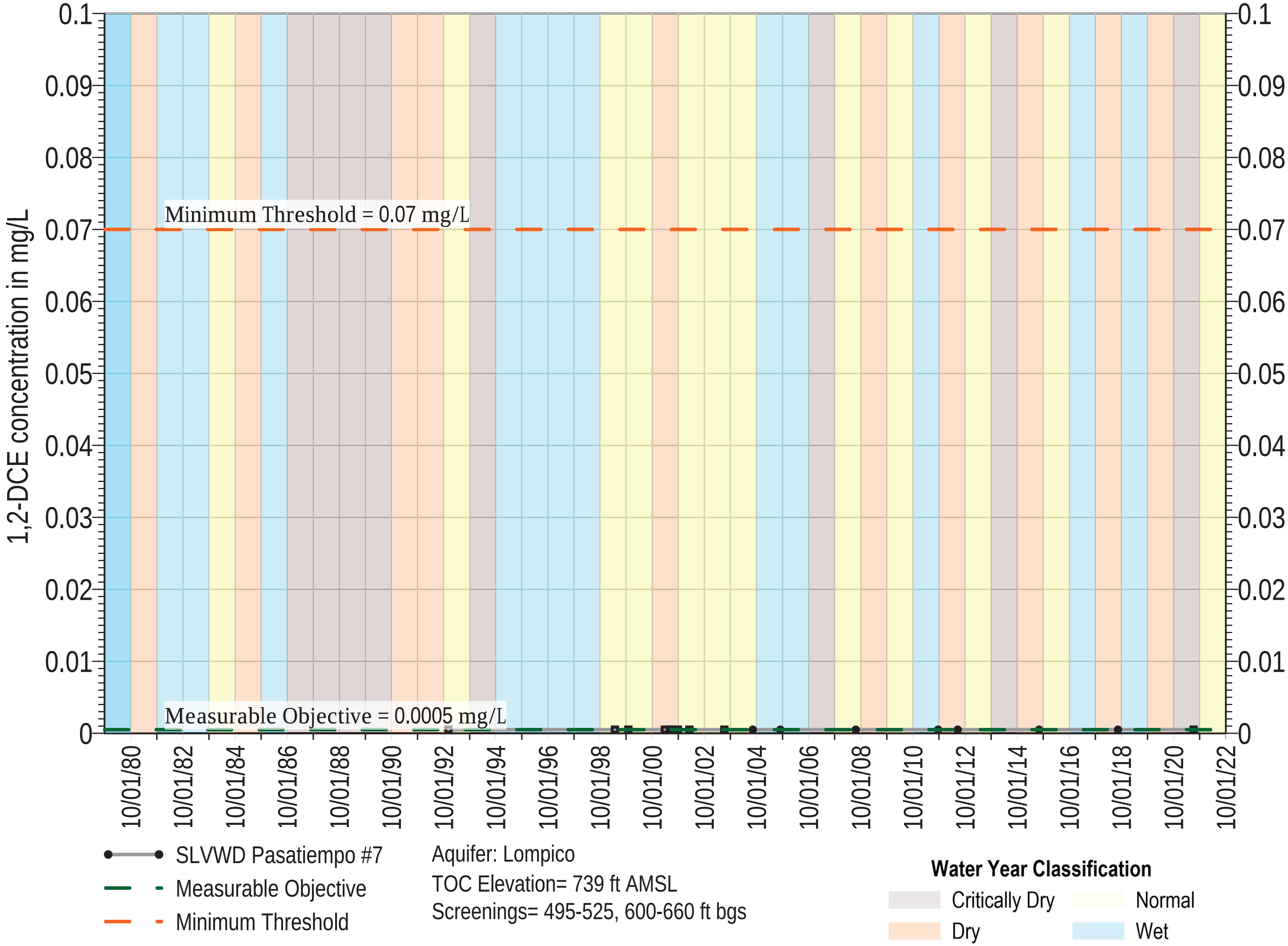
Appendix D

Well Chemographs

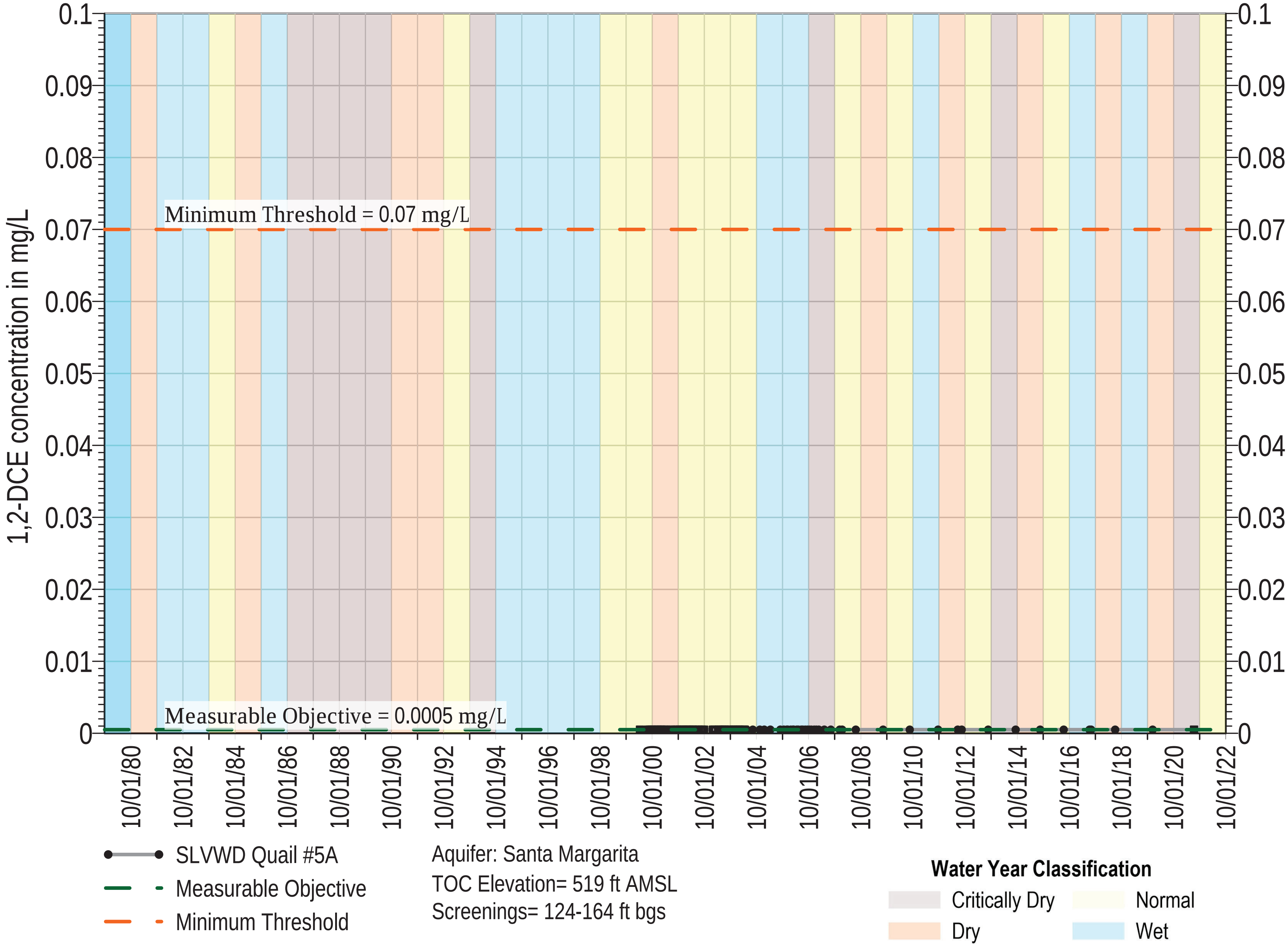
1,2-DCE



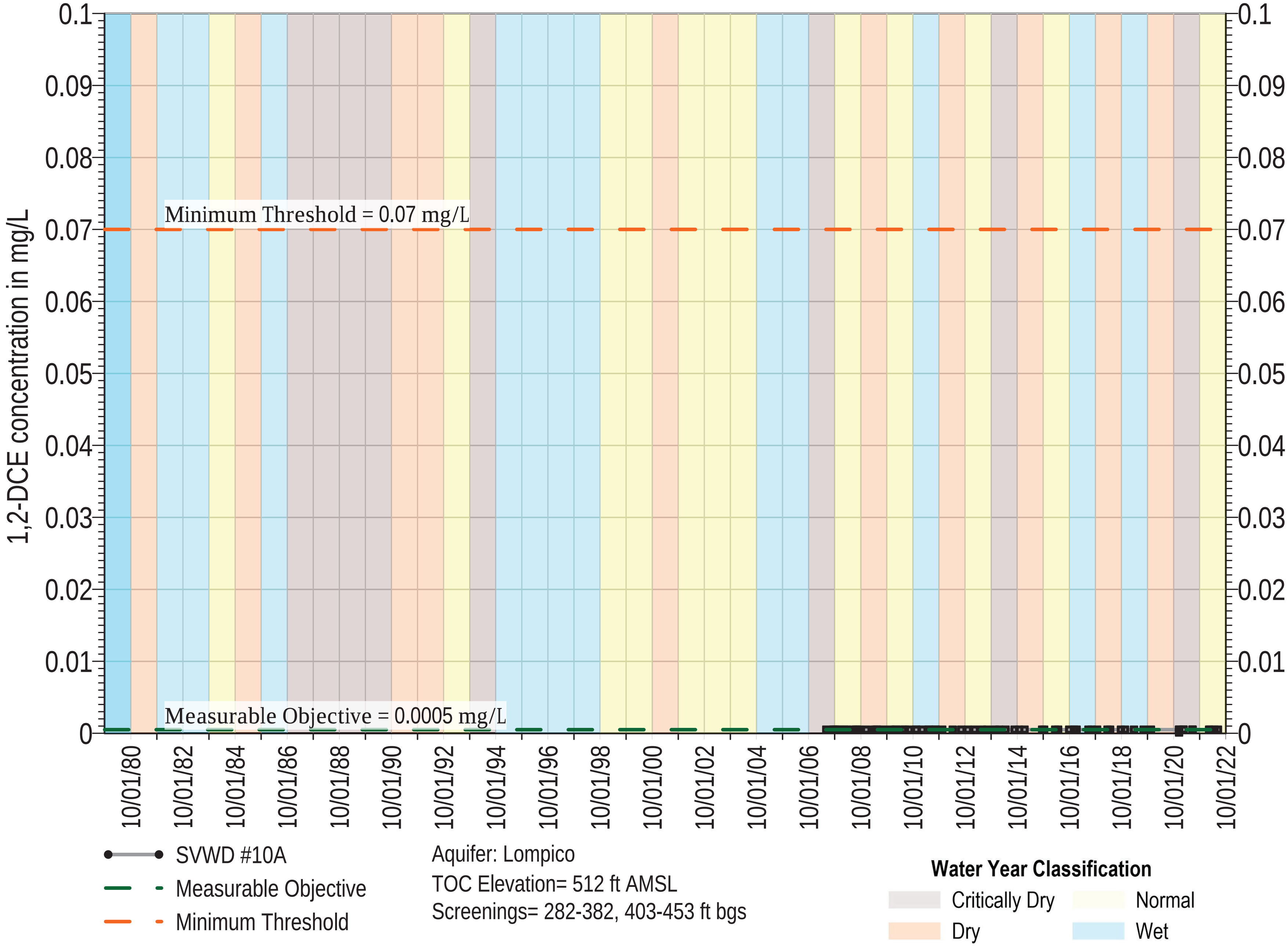
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



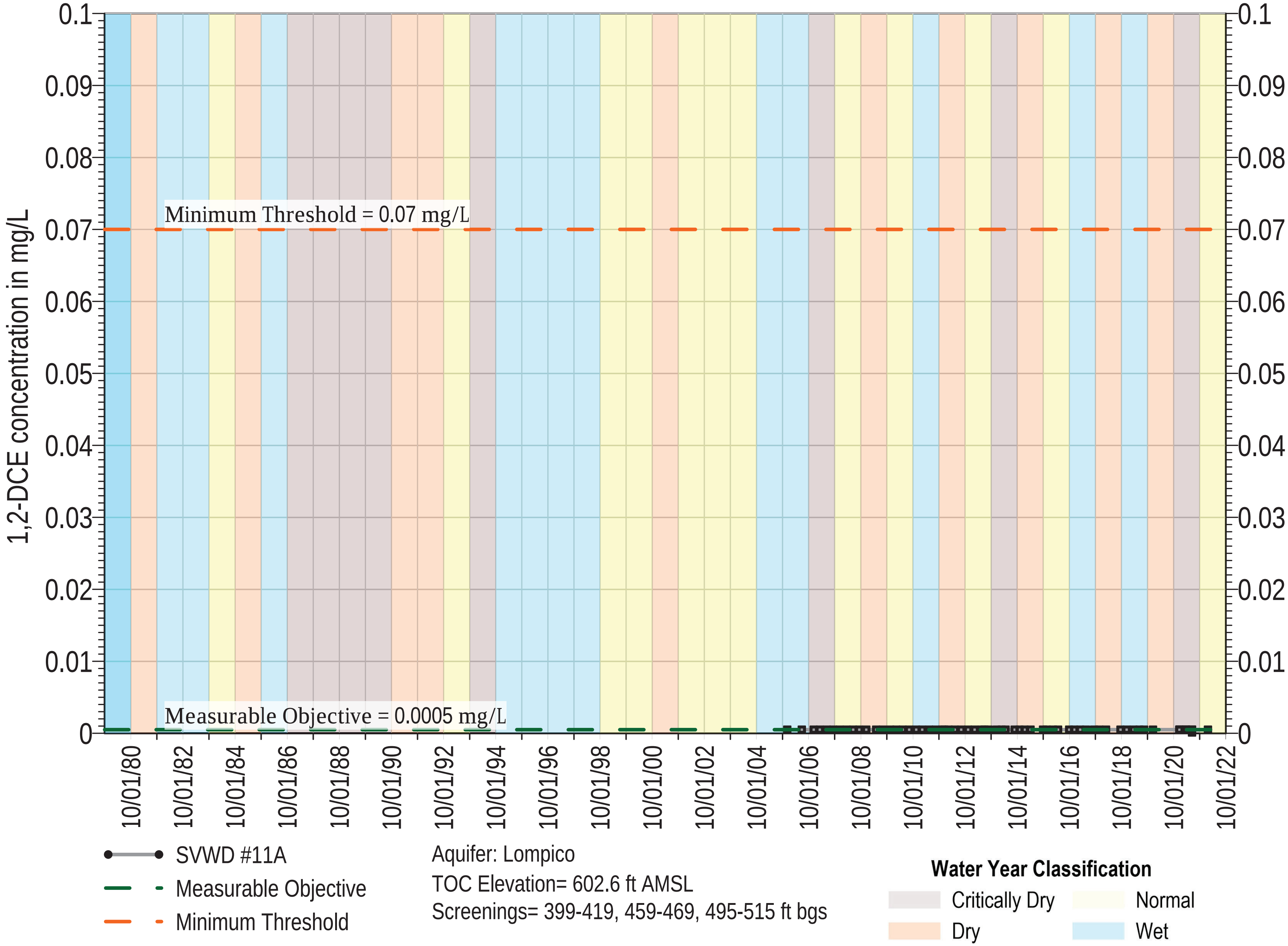
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



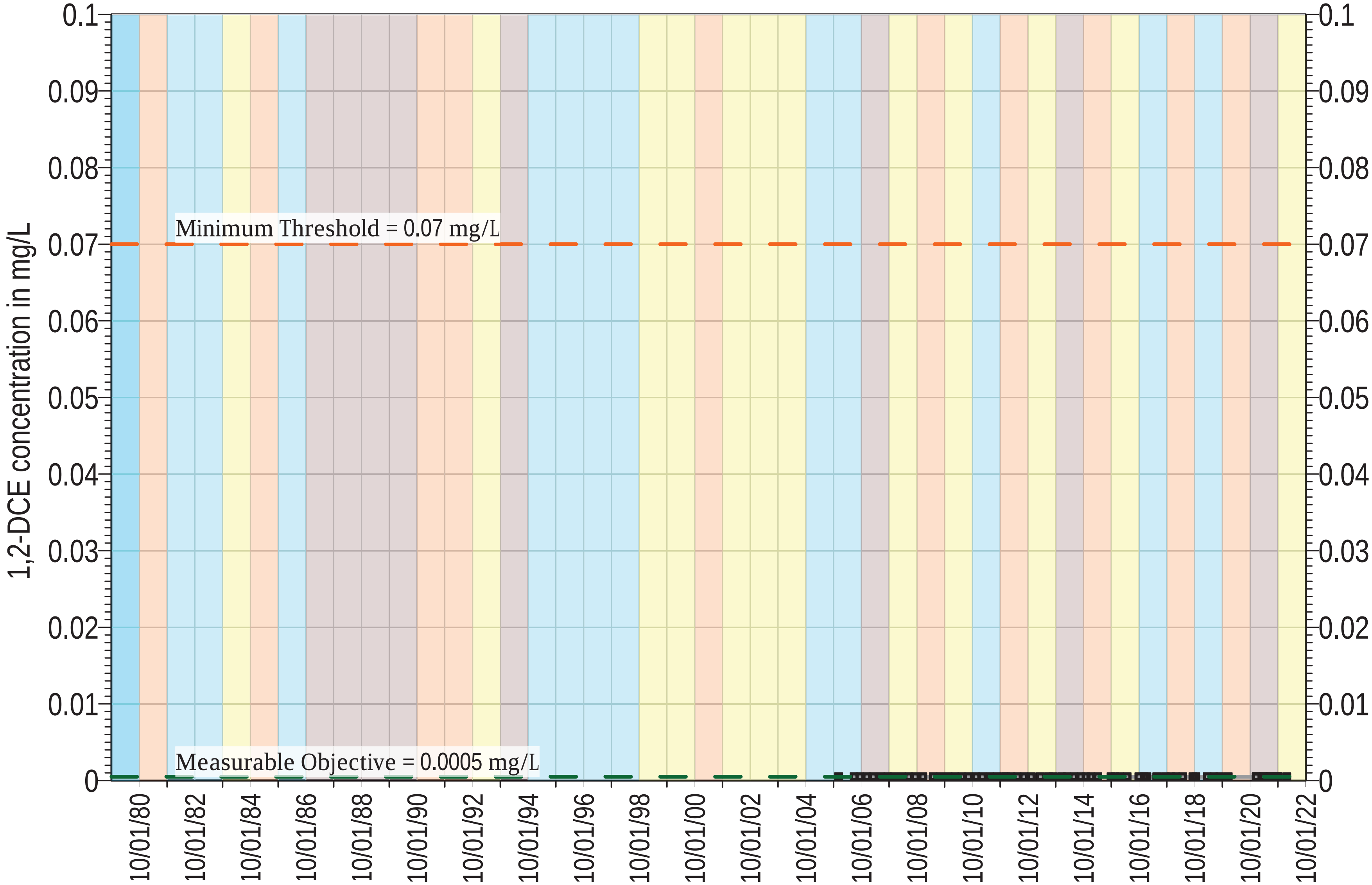
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

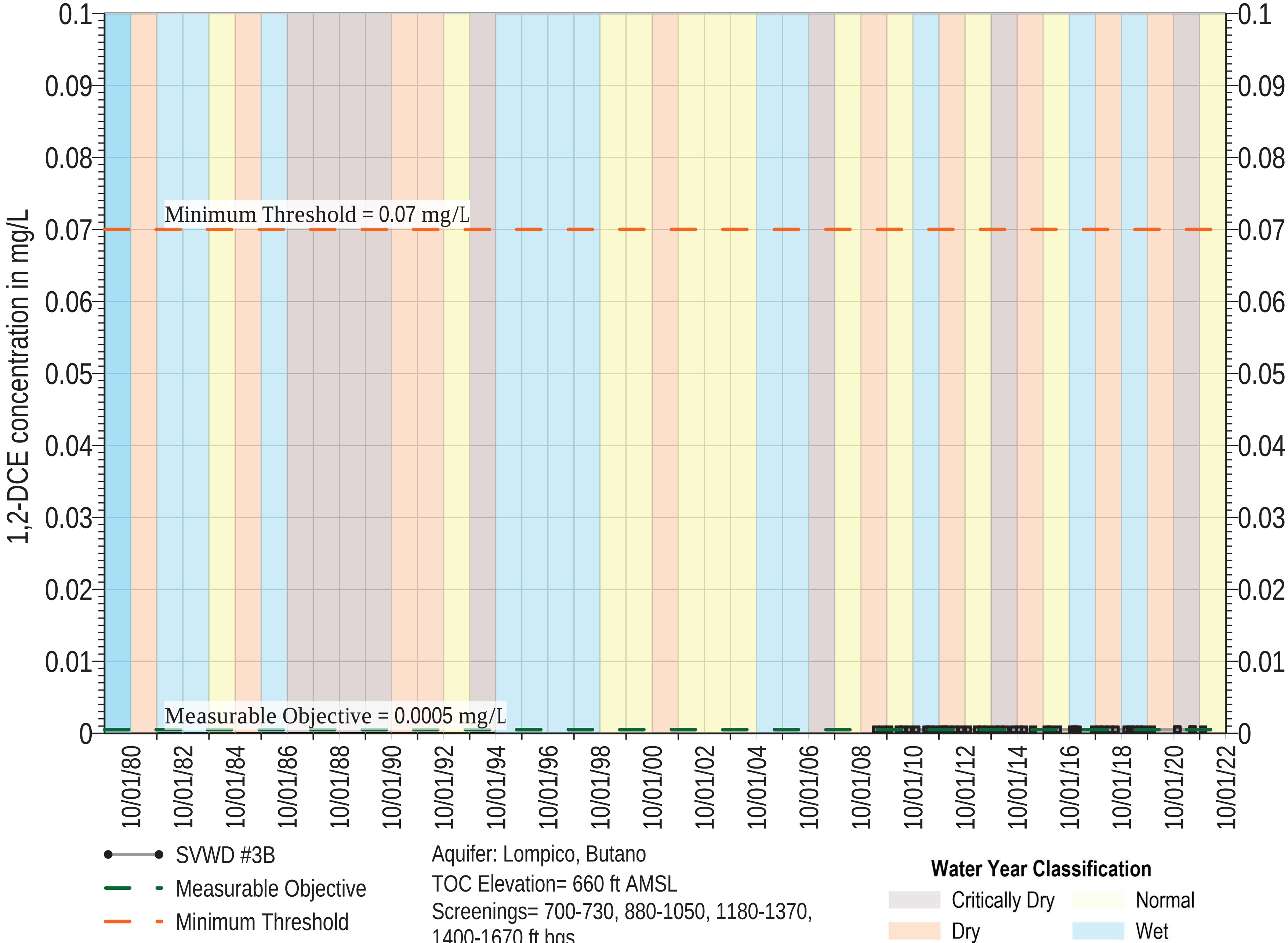


SVWD #11B
Measurable Objective
Minimum Threshold

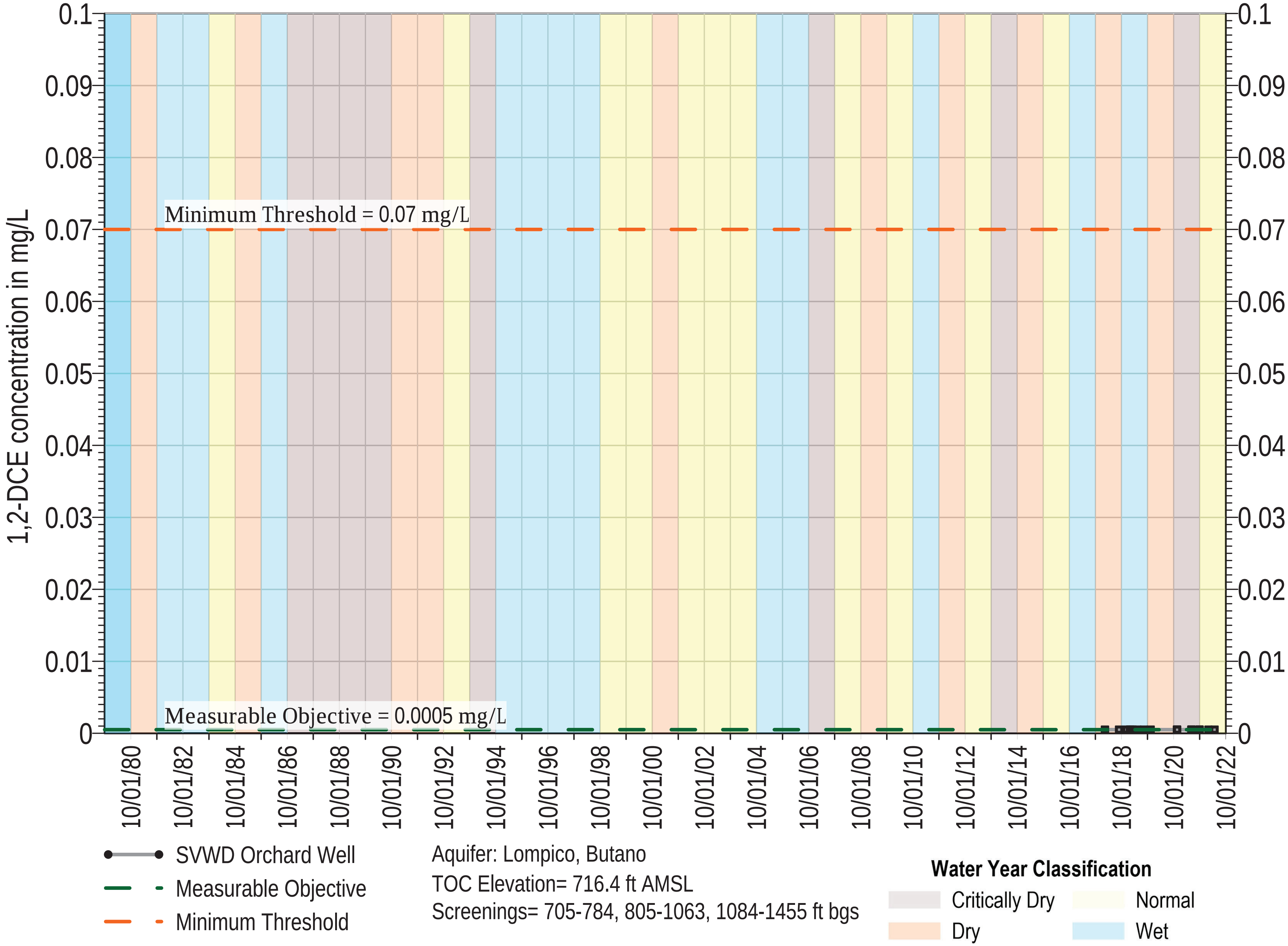
Aquifer: Lompico
TOC Elevation= 588 ft AMSL
Screenings= 348-388 ft bgs

Water Year Classification
Critically Dry
Normal
Dry
Wet

Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

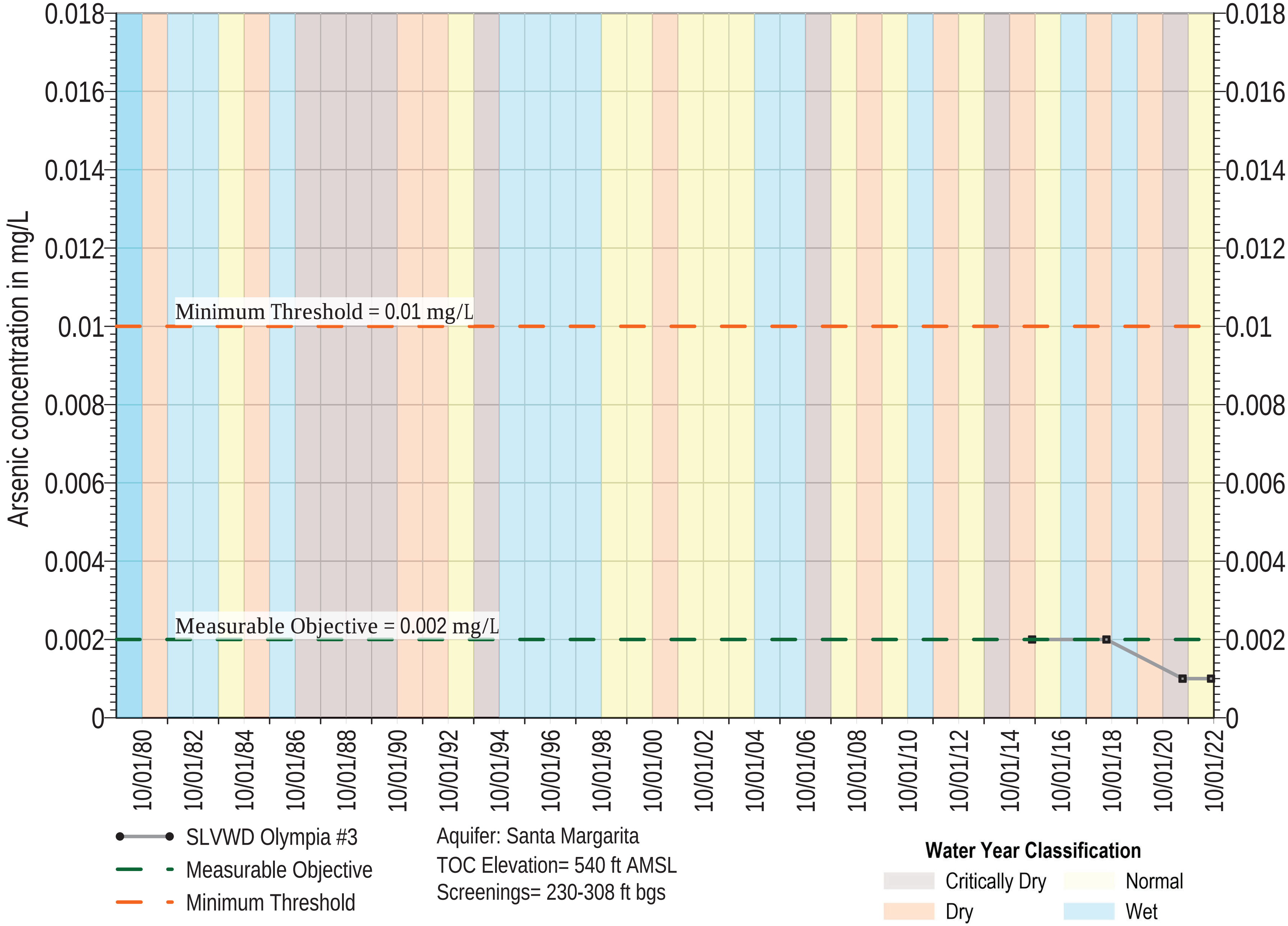


Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

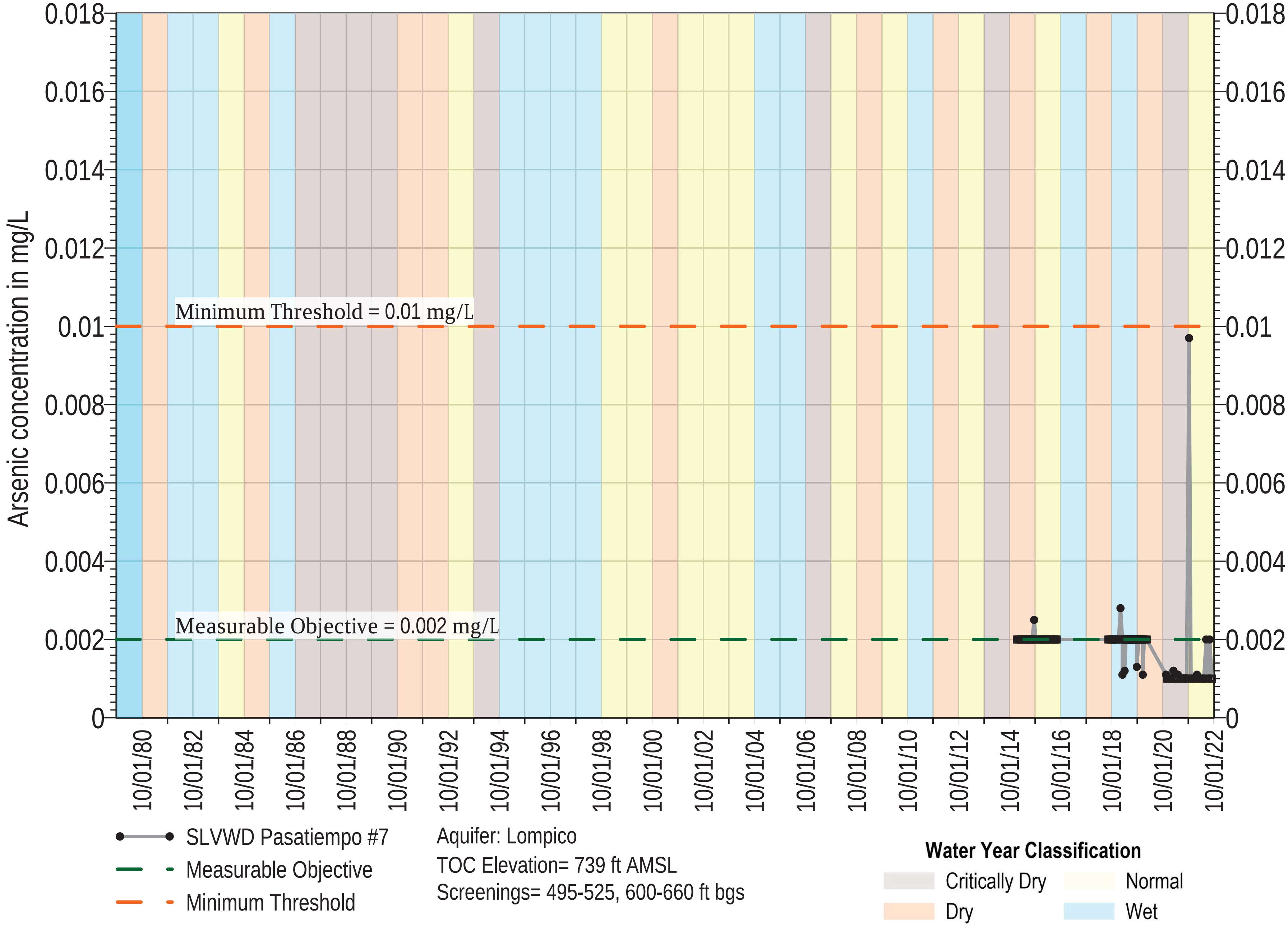


Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

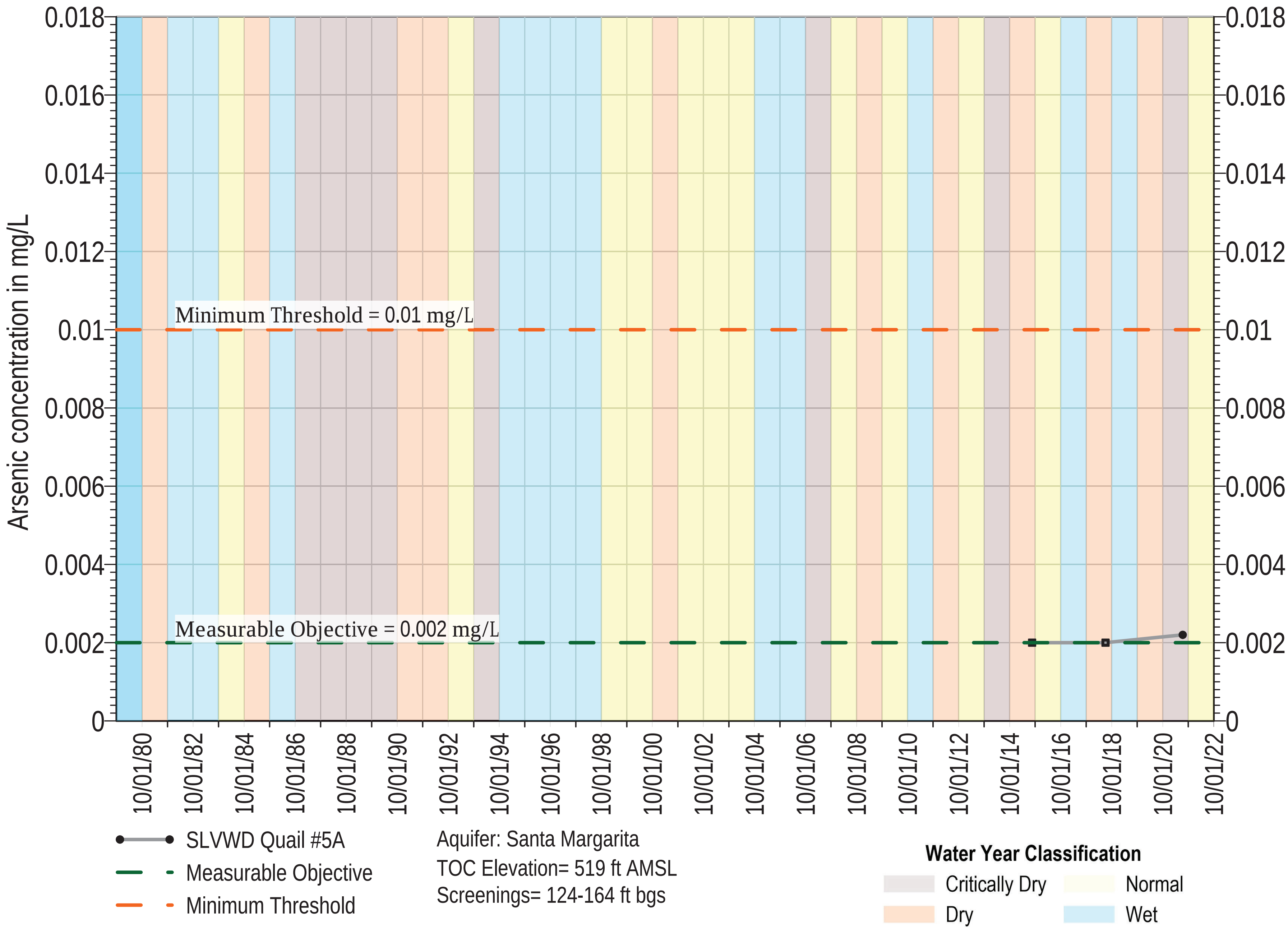
Arsenic



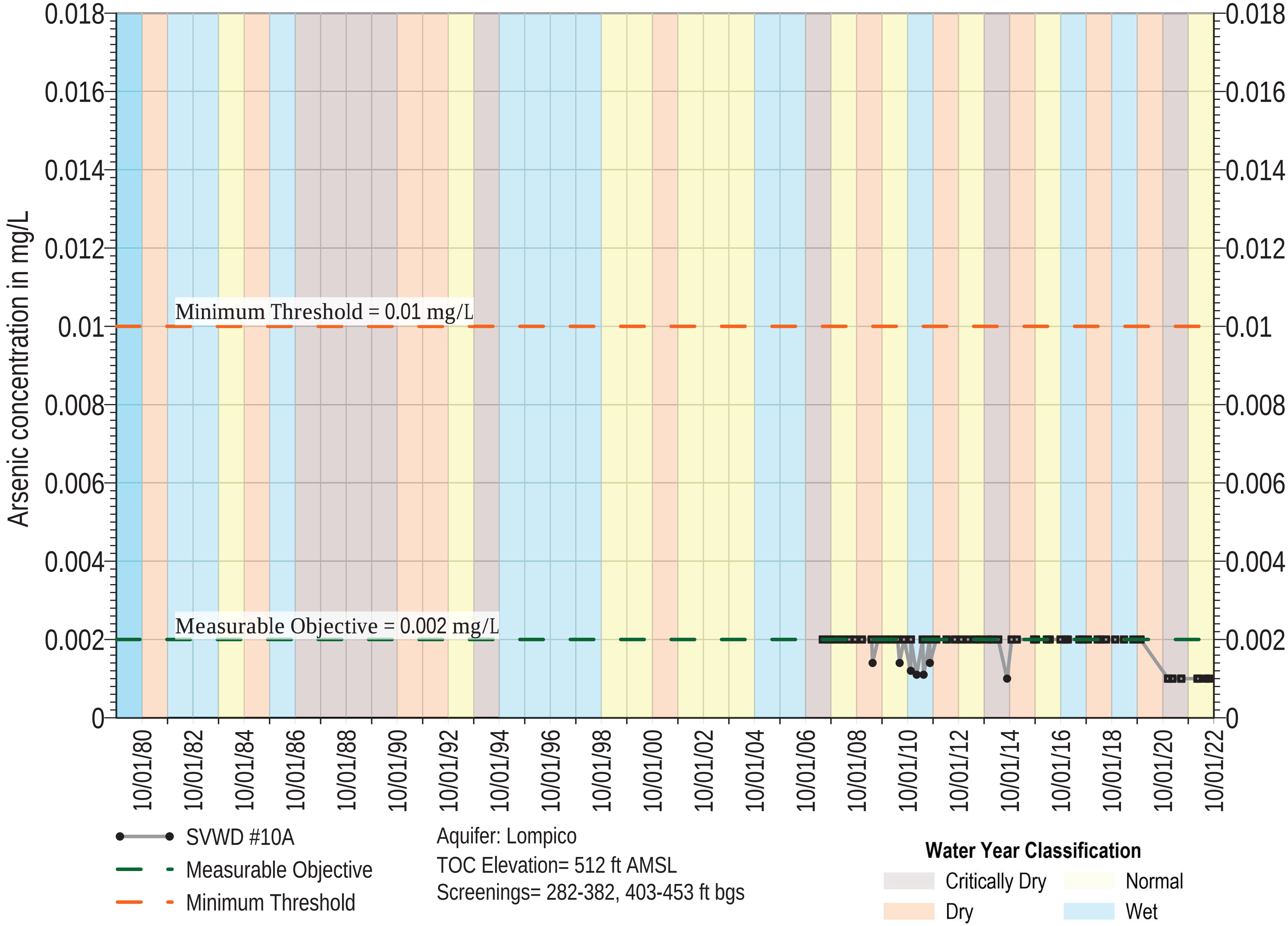
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



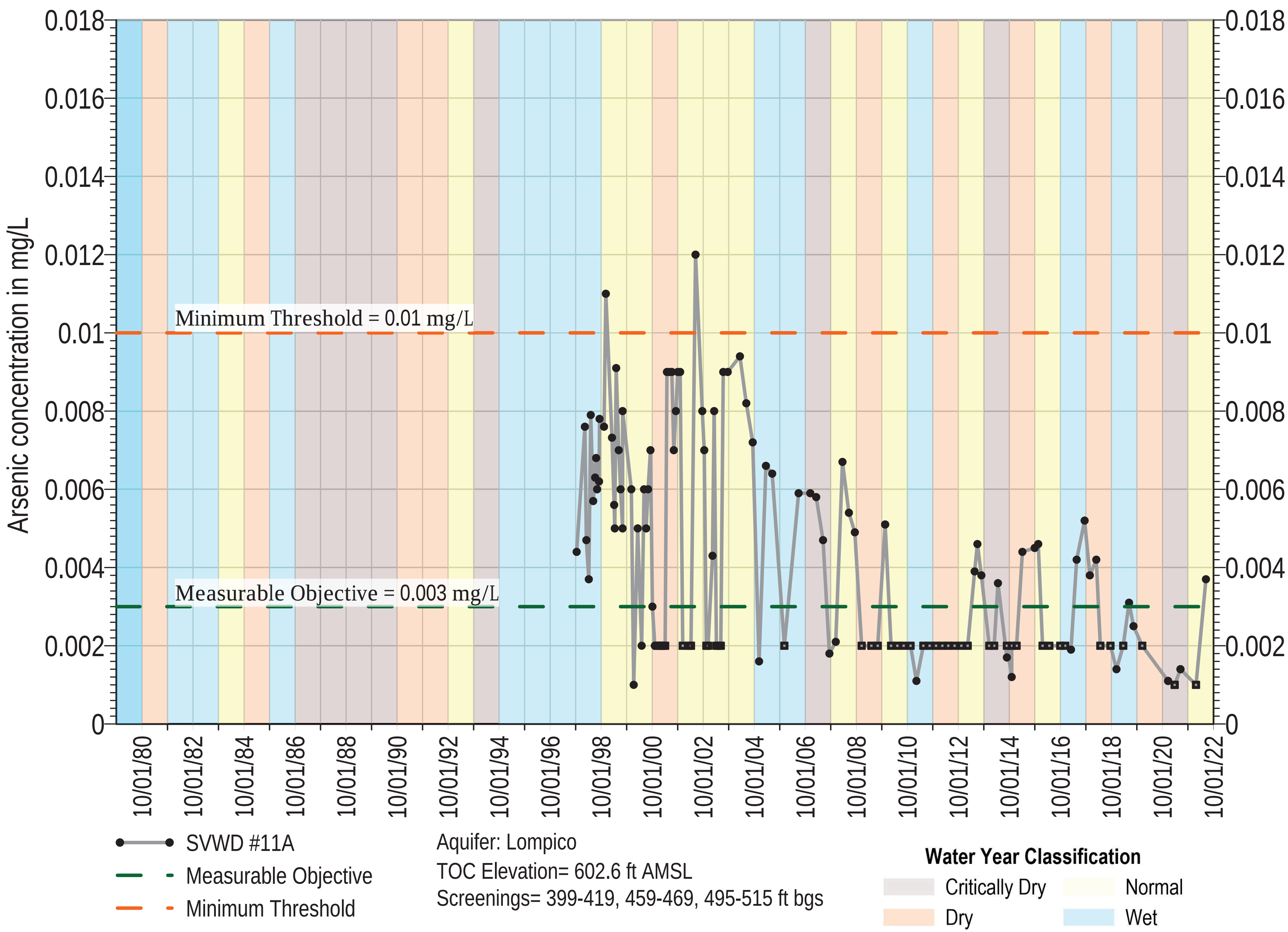
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



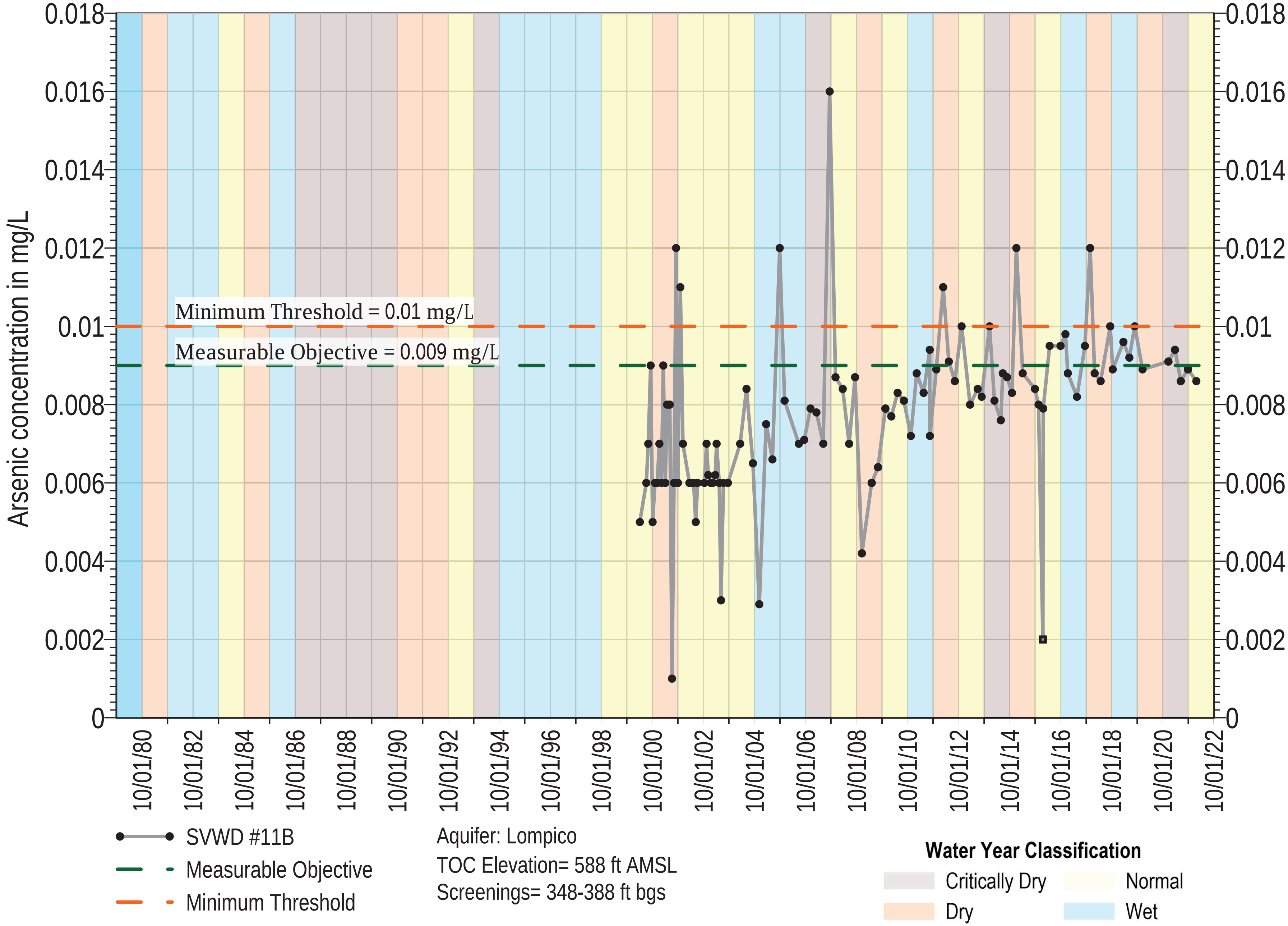
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



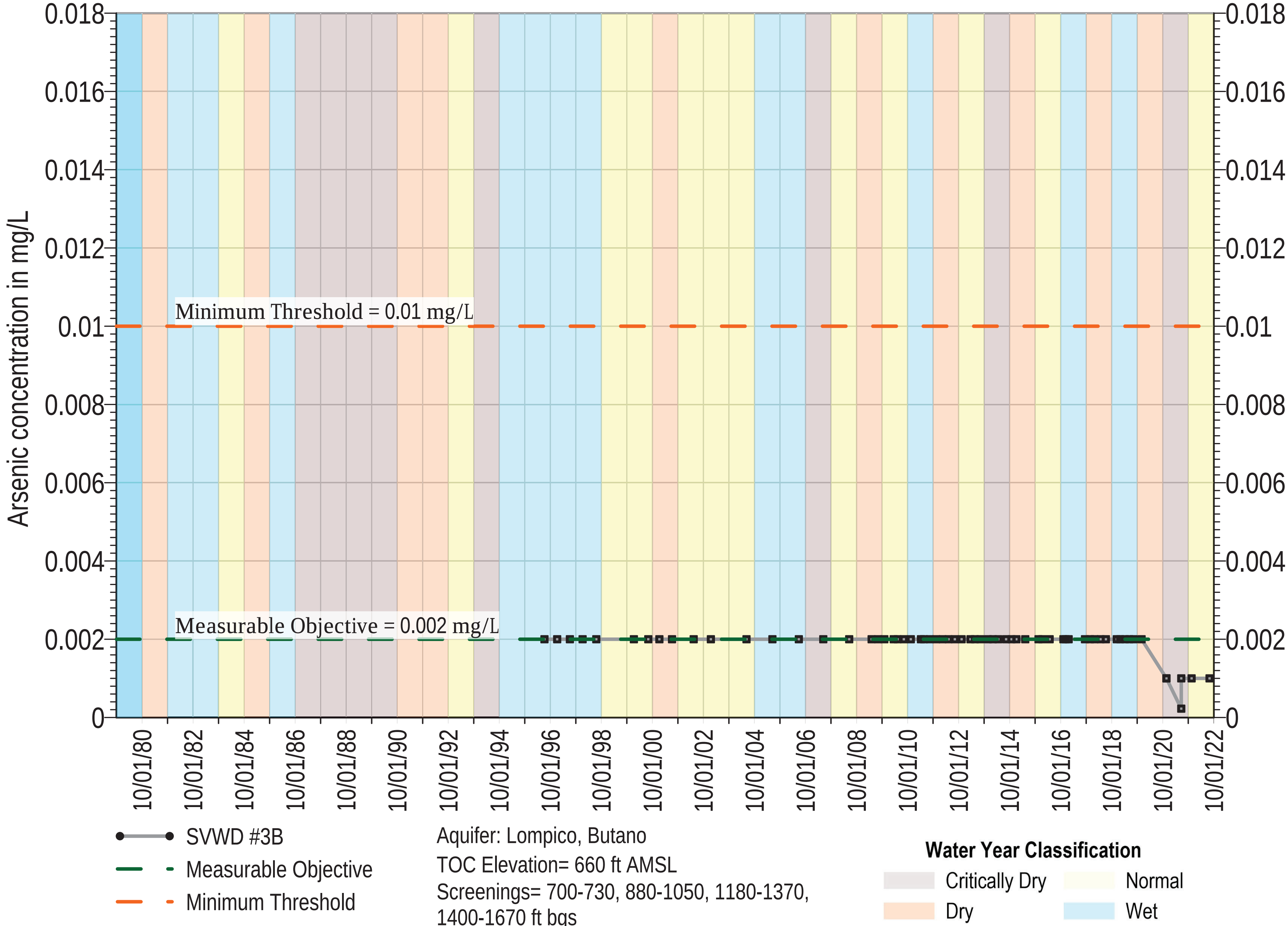
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



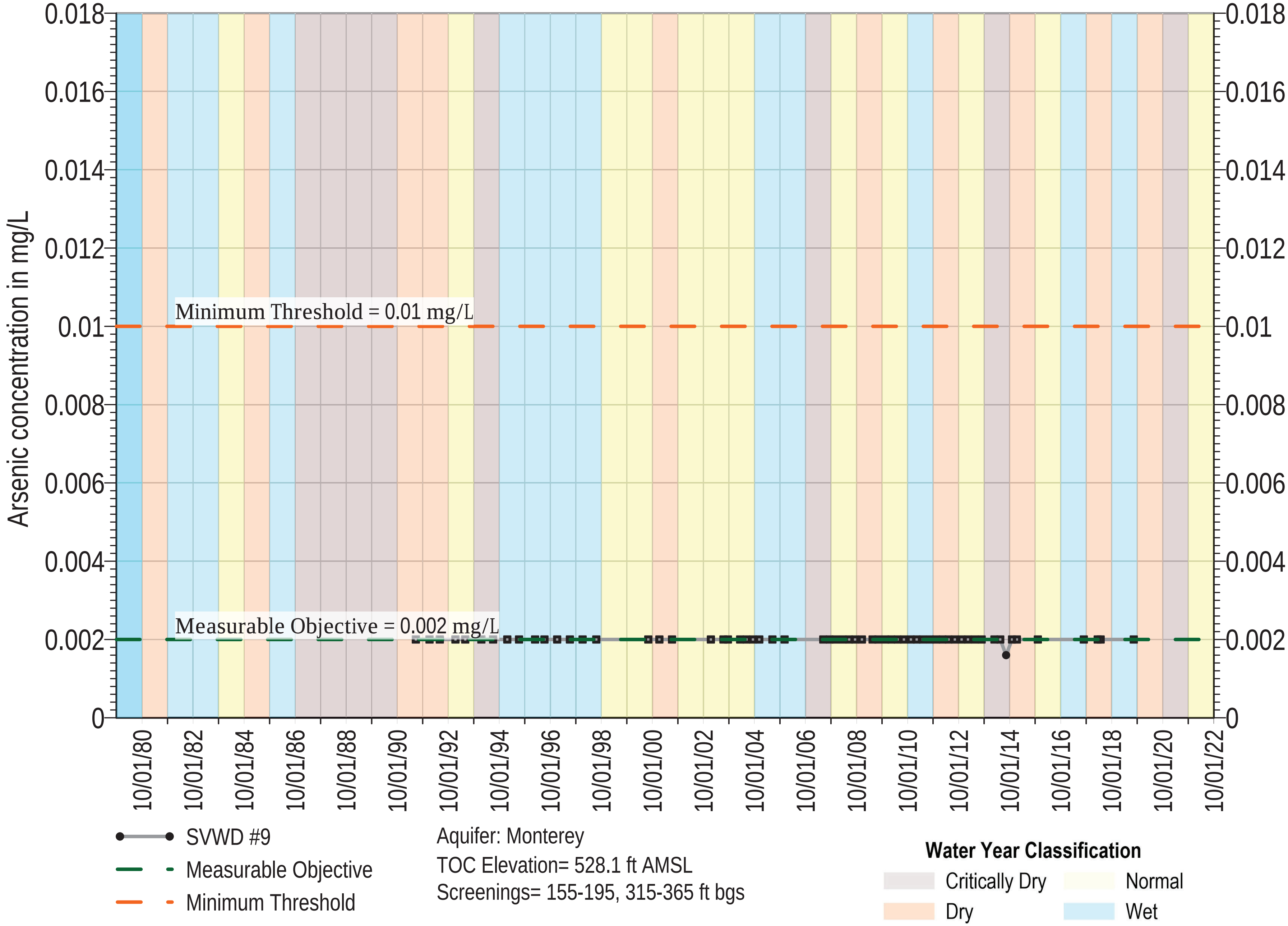
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



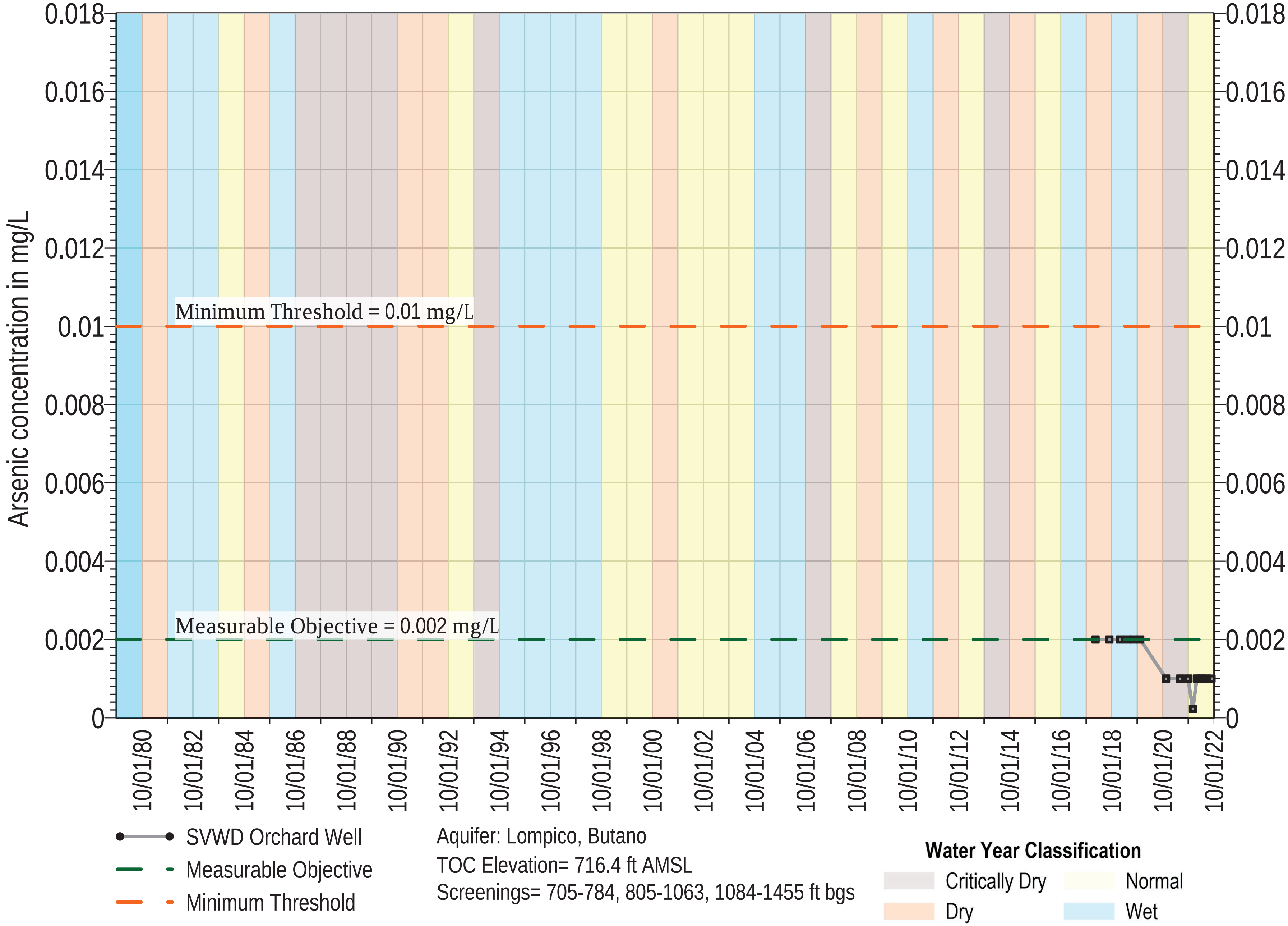
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

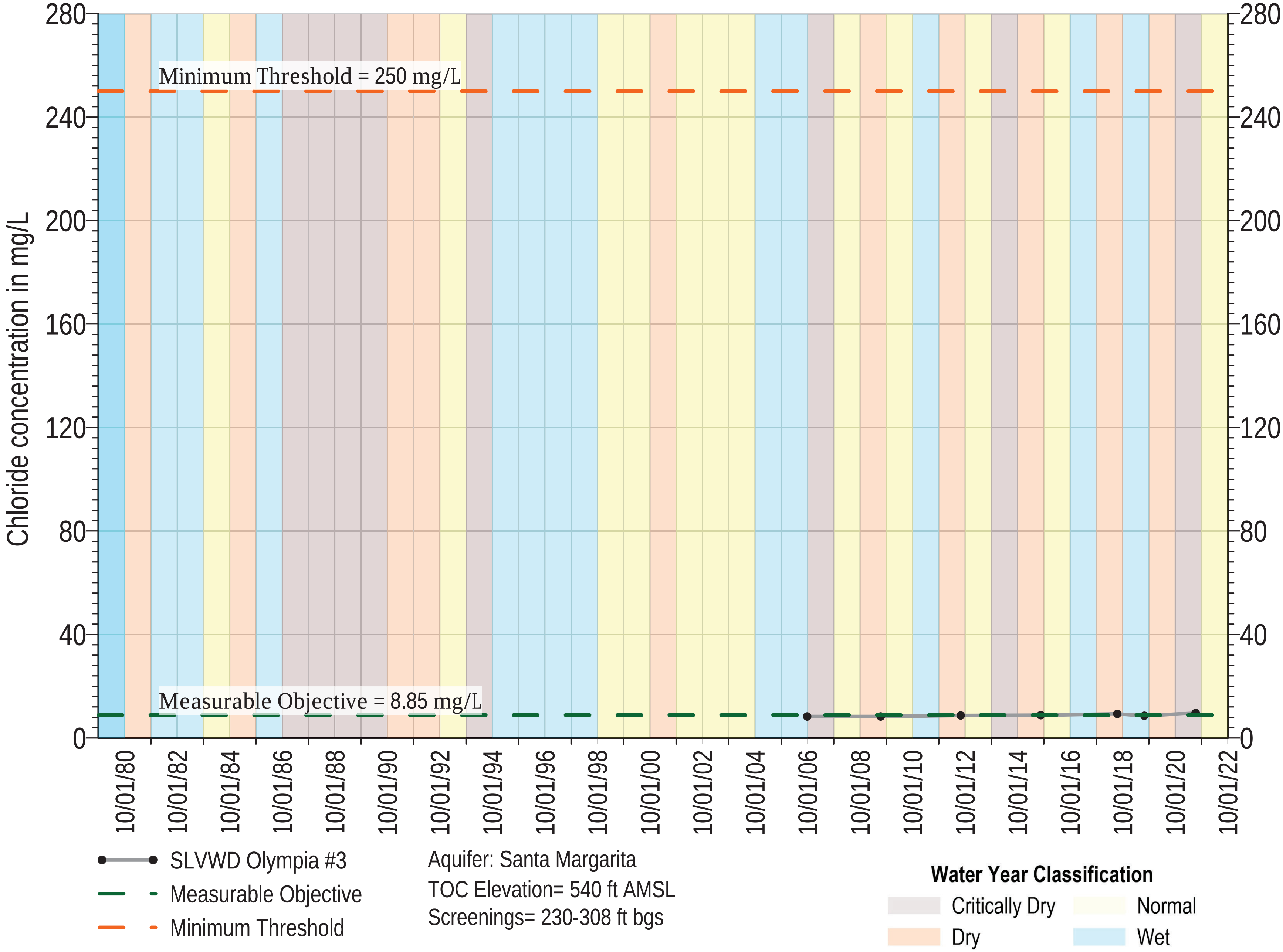


Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

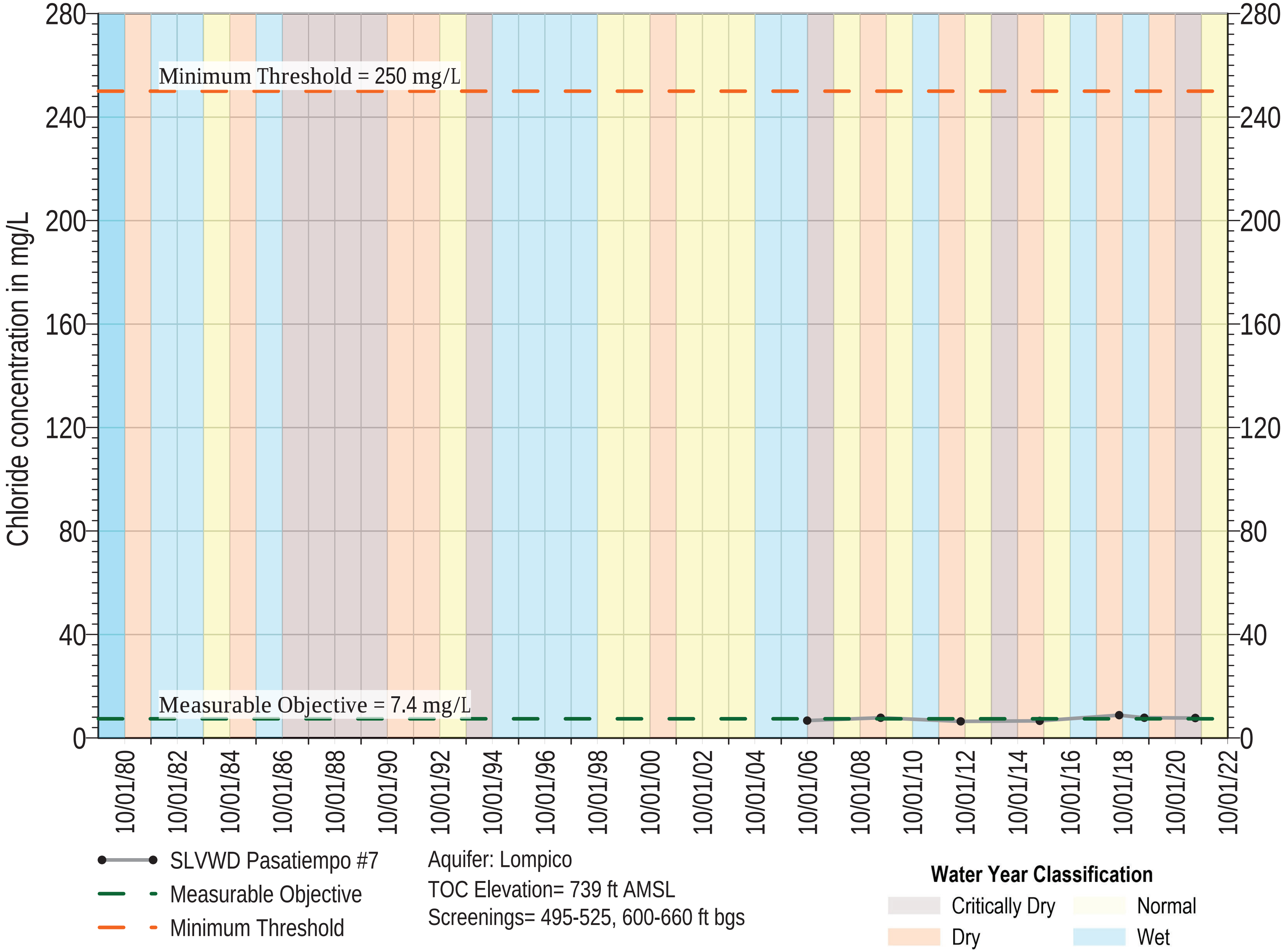


Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

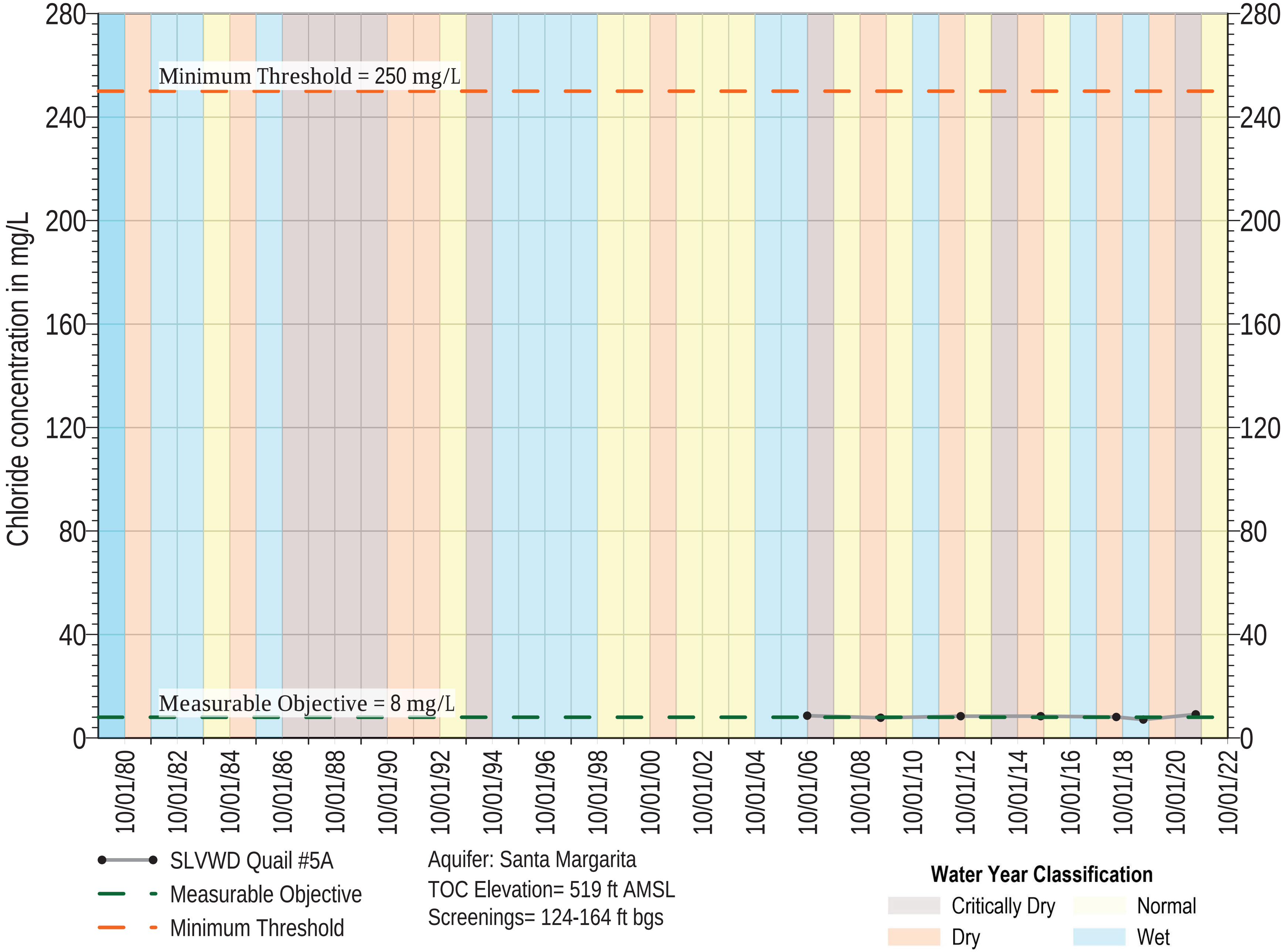
Chloride



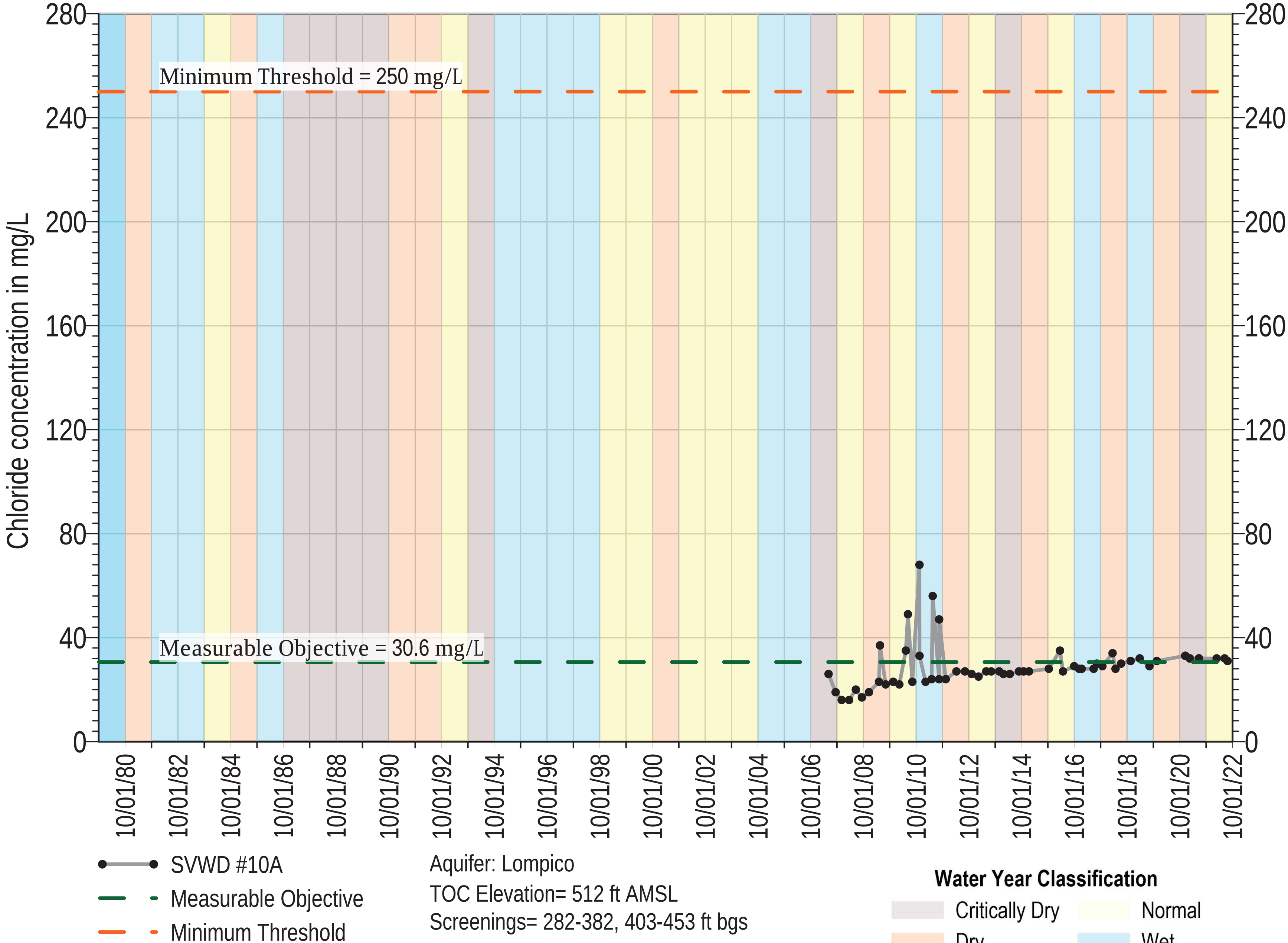
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



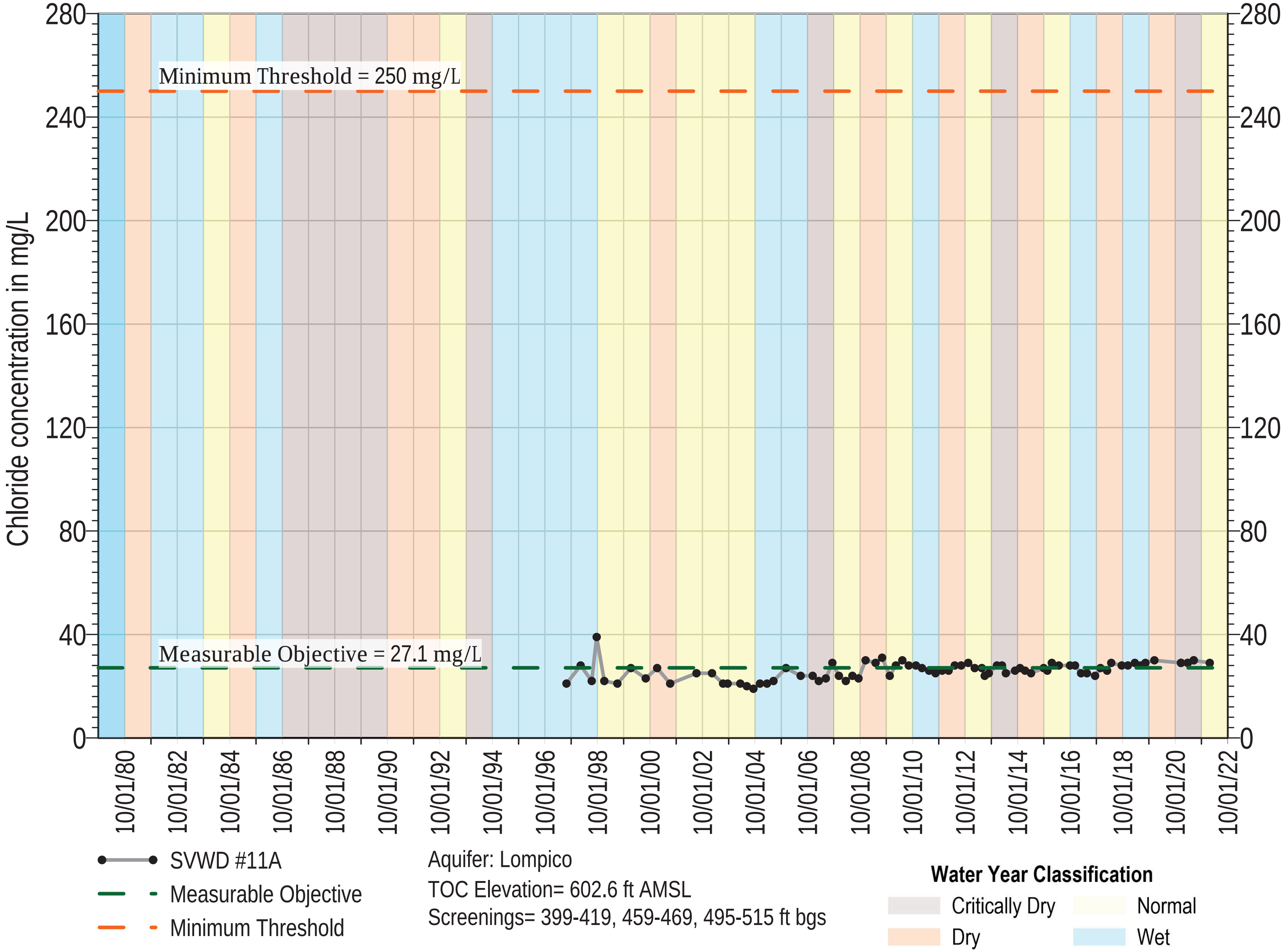
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



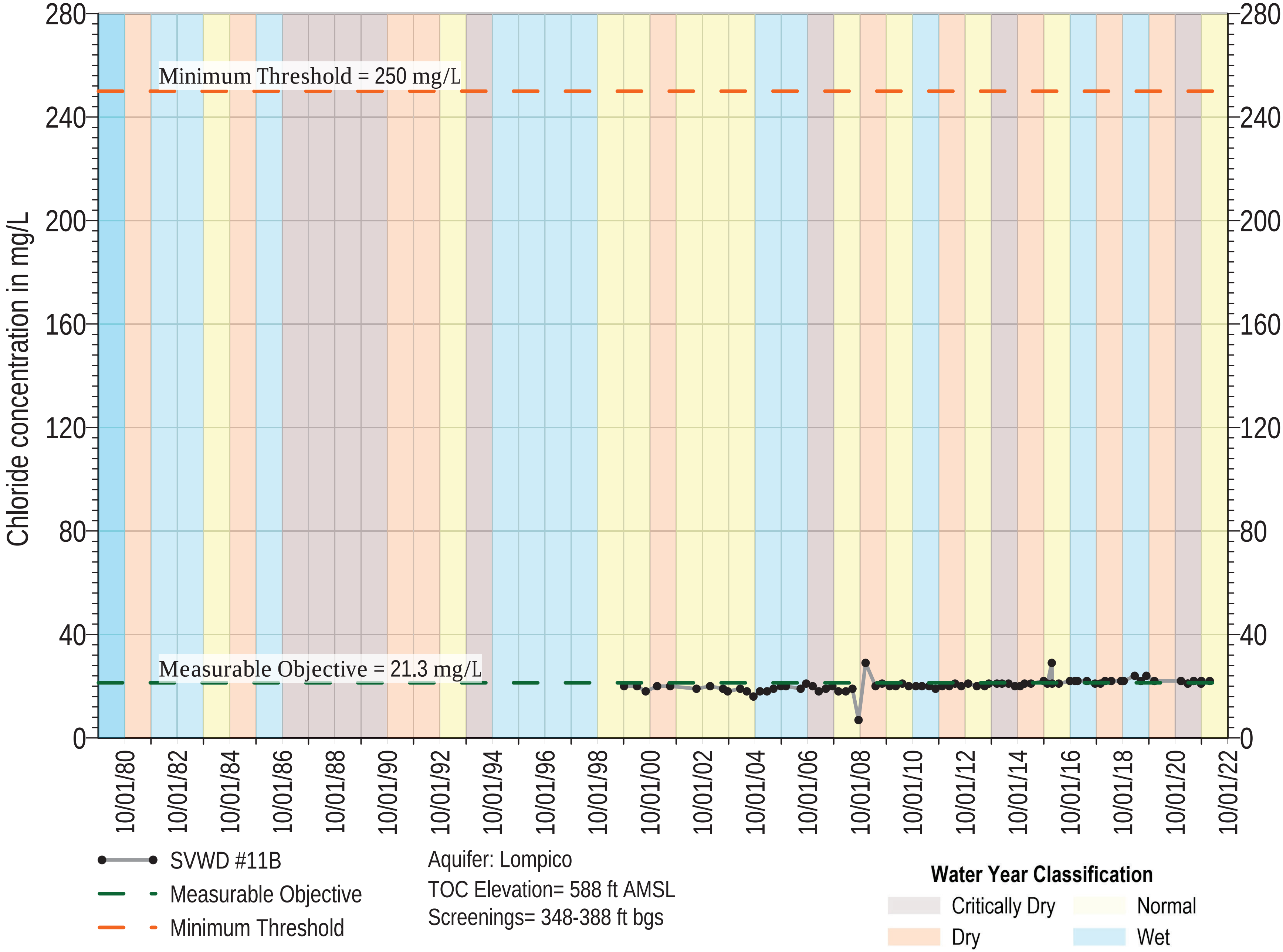
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



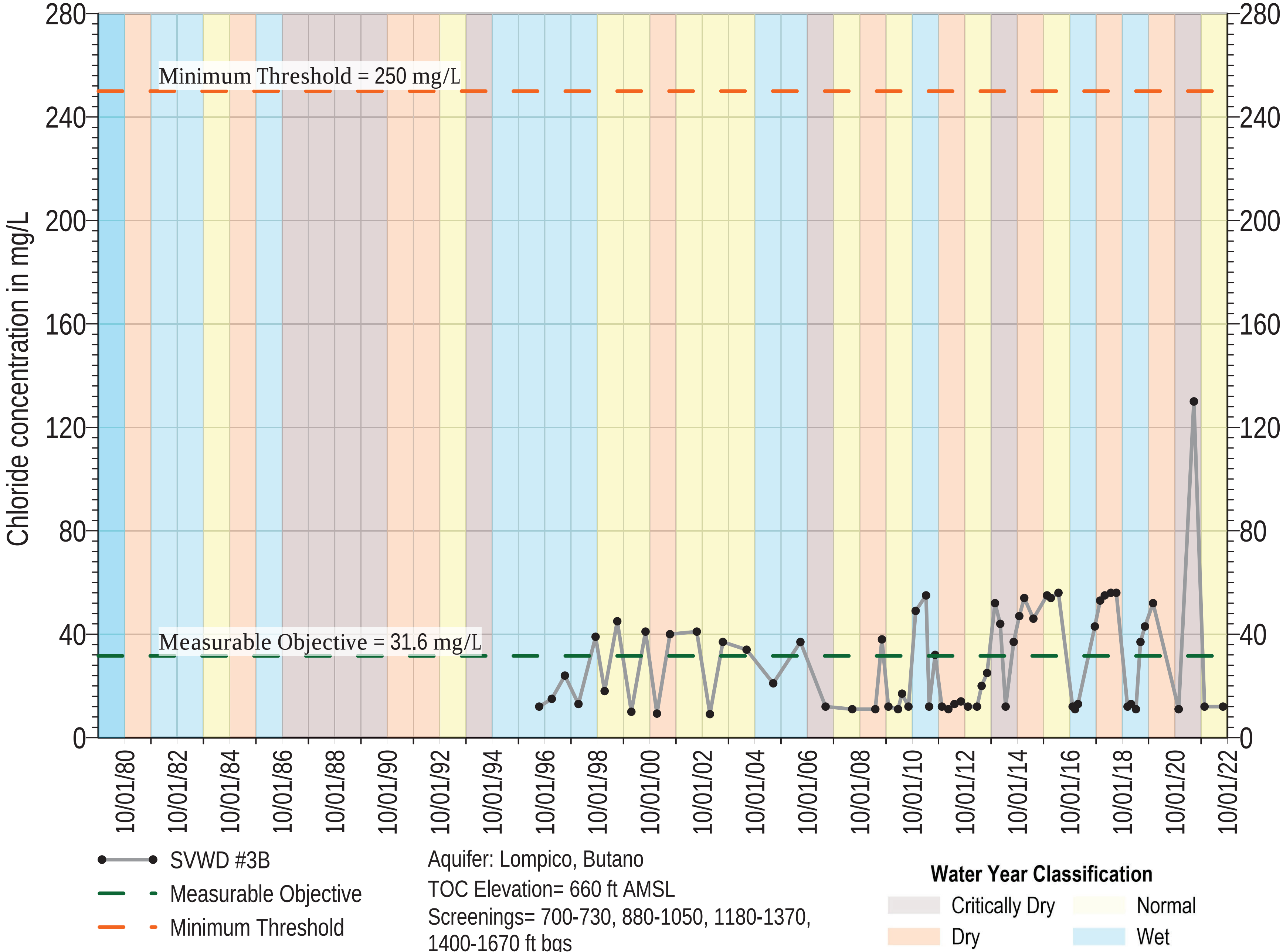
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



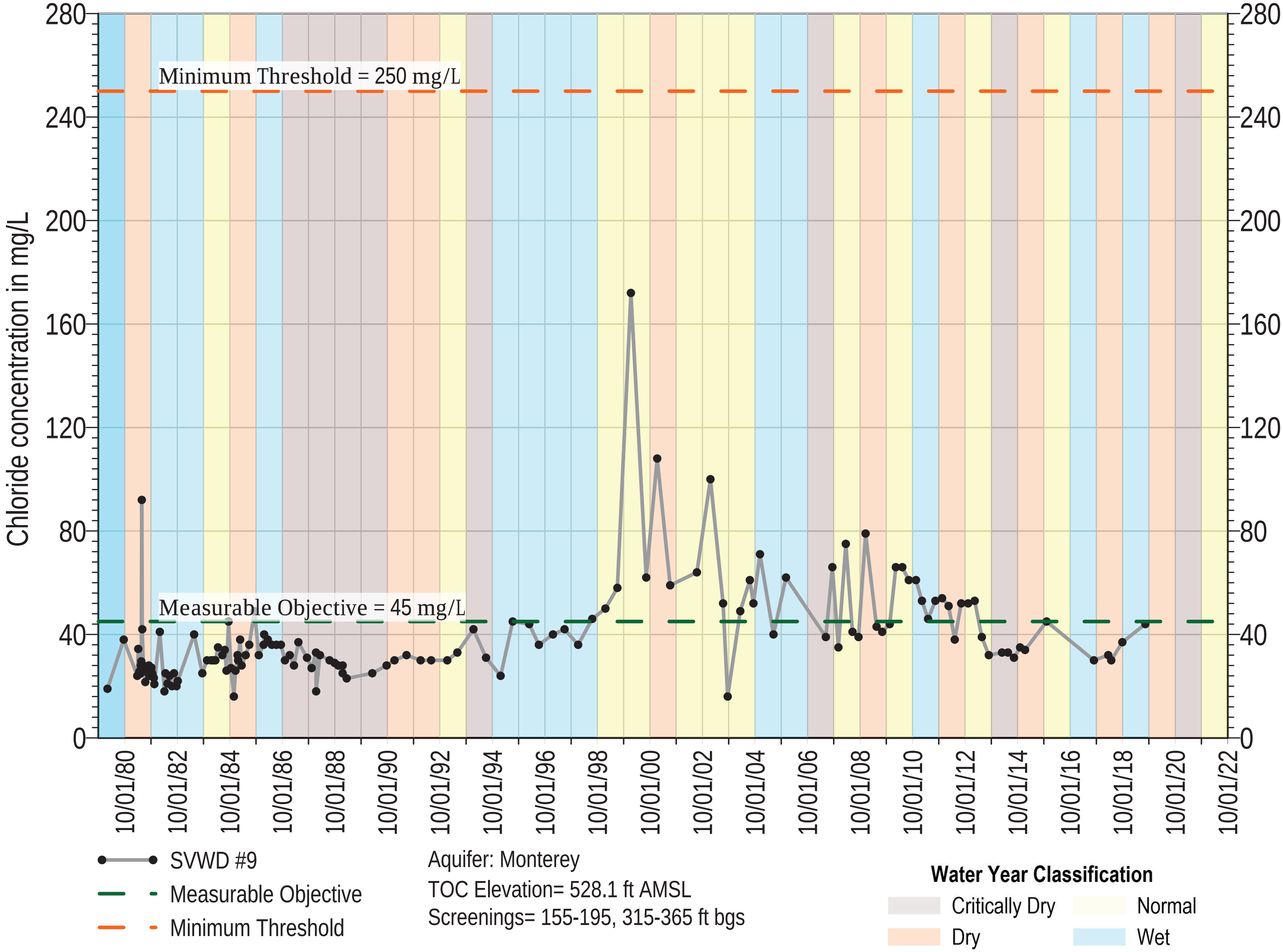
Square symbols indicate non-detects (ND)

ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)

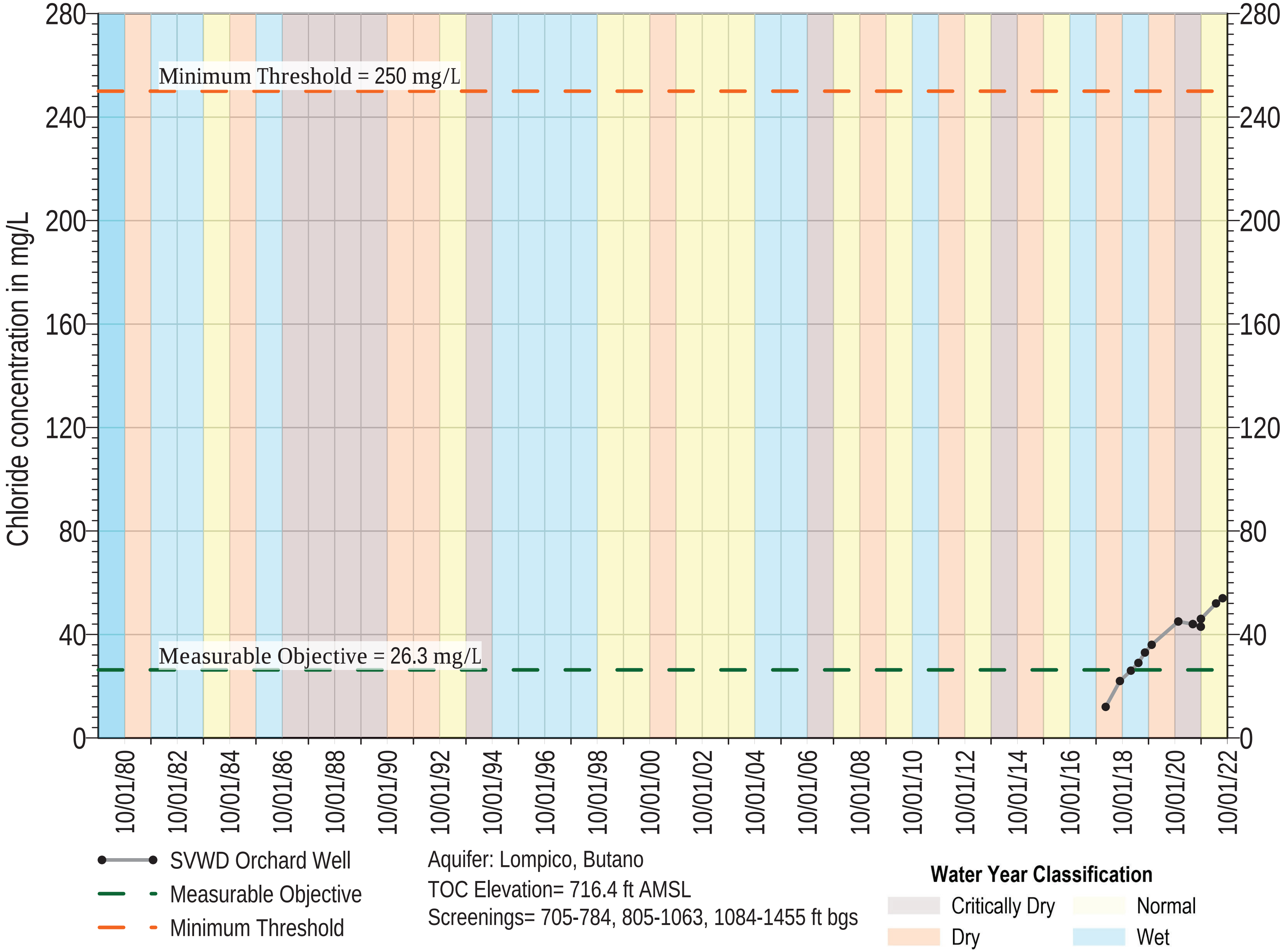
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

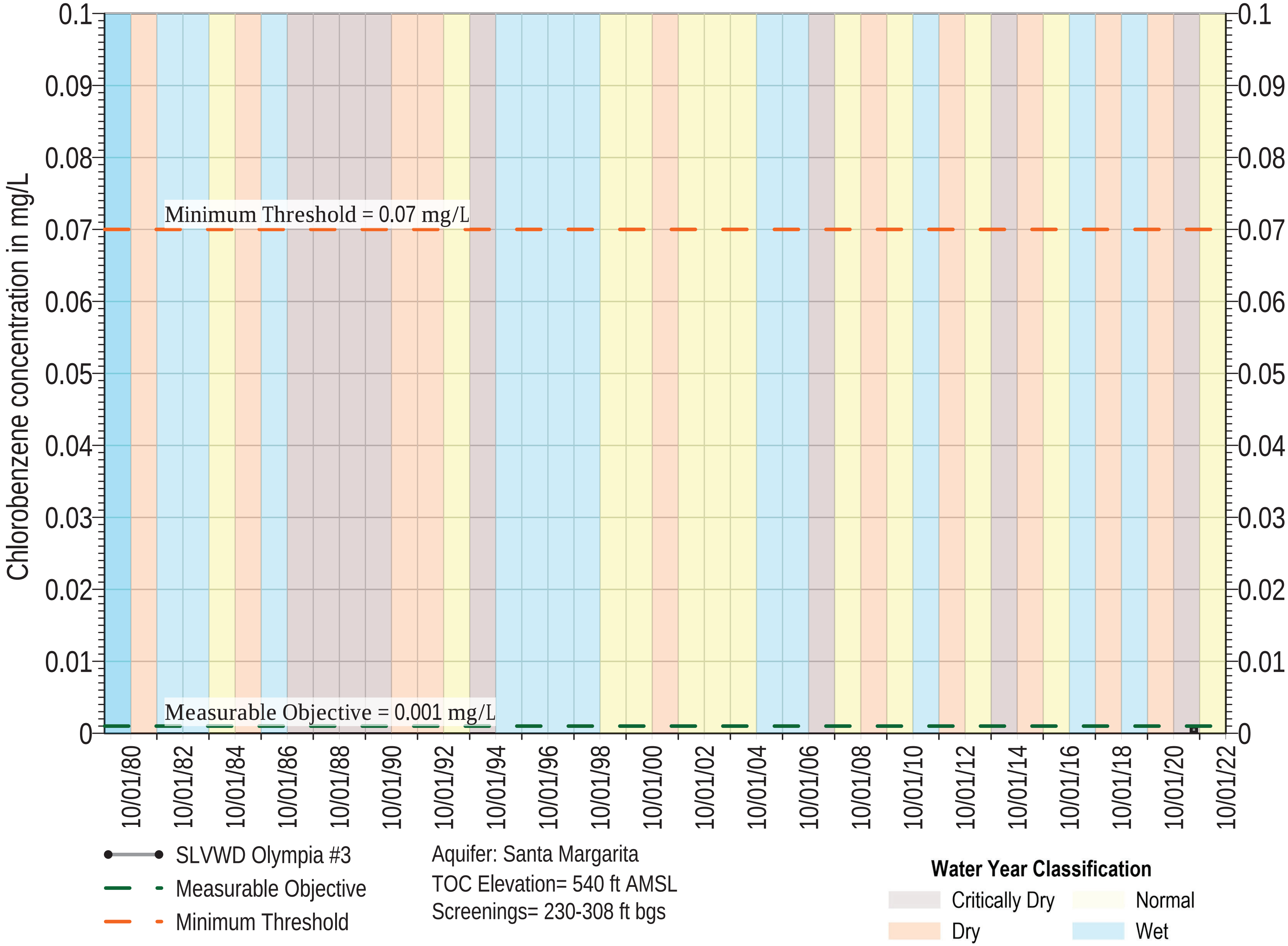


Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

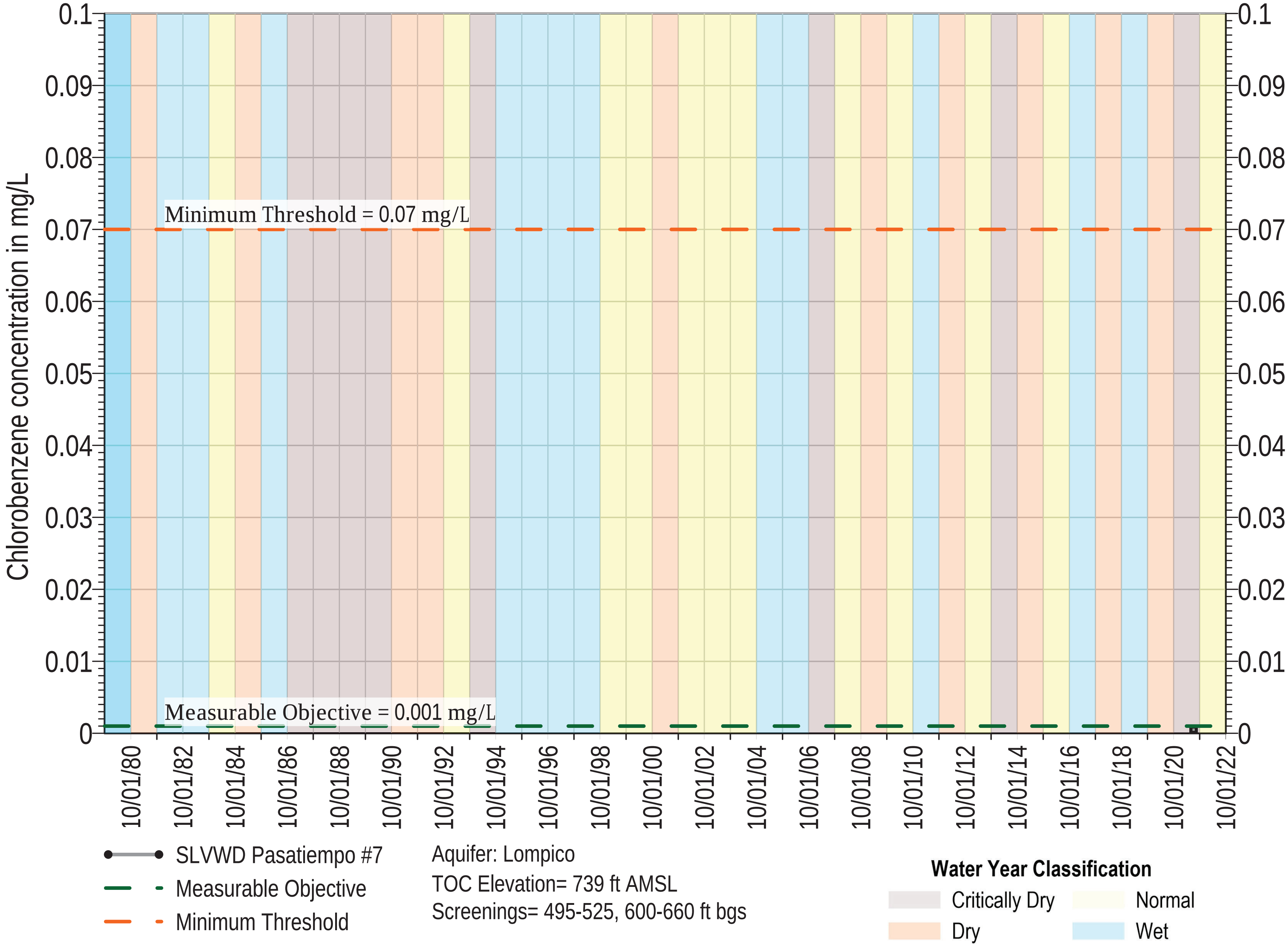


Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result

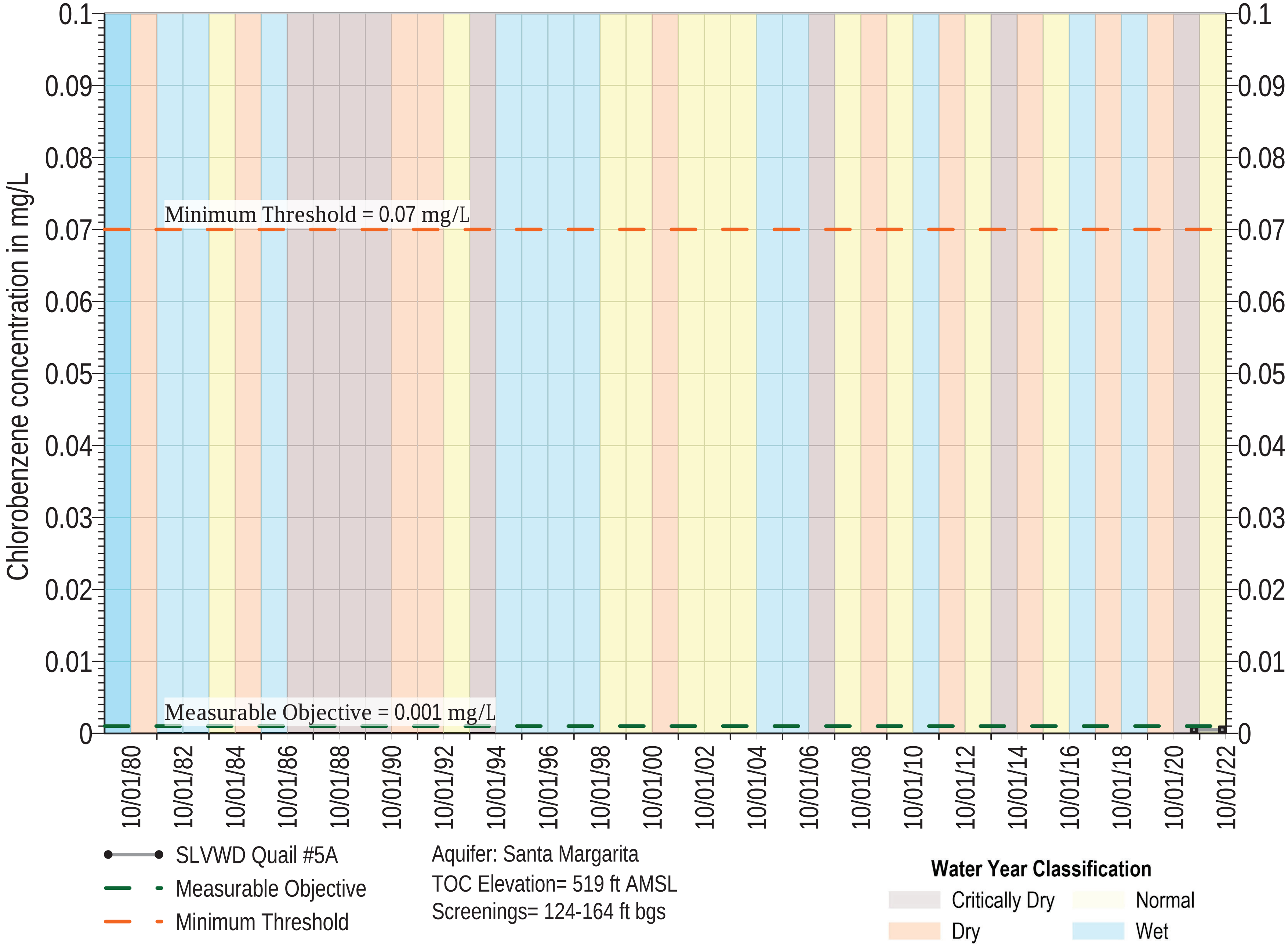
Chlorobenzene



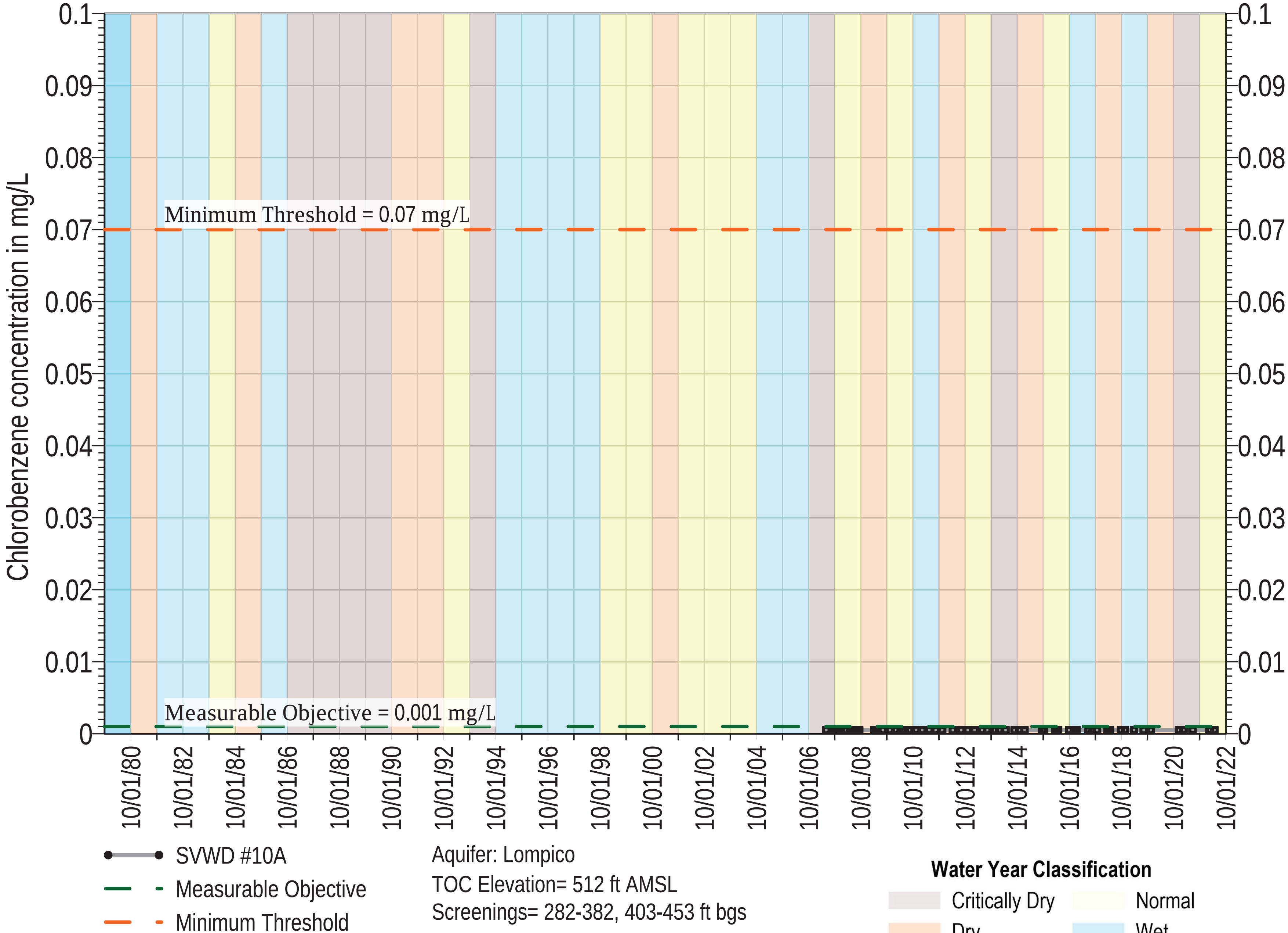
Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



Square symbols indicate non-detects (ND)
ND are set at the state detection limits for purposes of reporting (DLR) (Title 22 §64400.34)
Measurable Objective set at DLR when Measurable Objective is non-detect. In wells with MO above MT, MT exceedance is not considered an Undesirable Result



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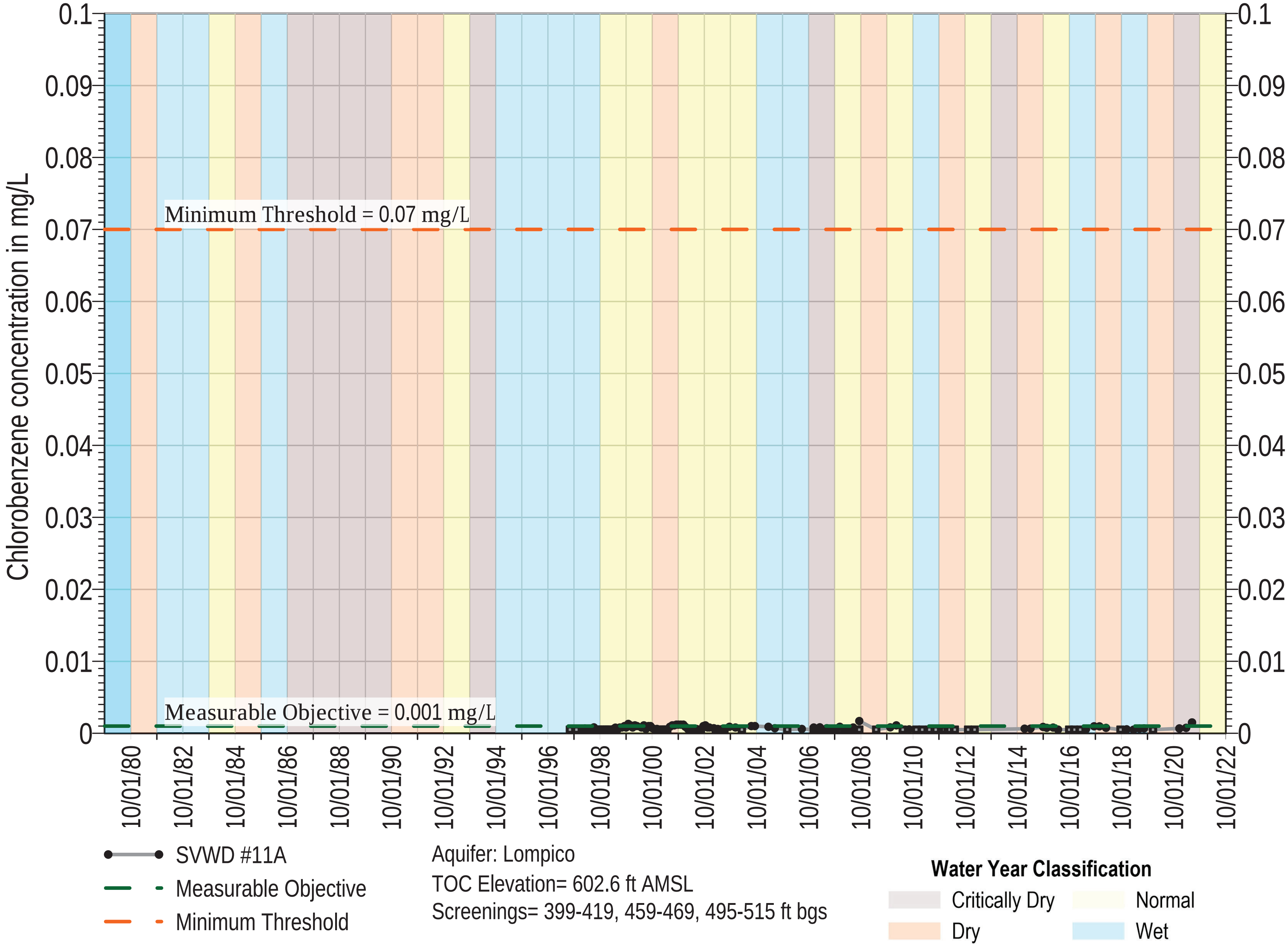

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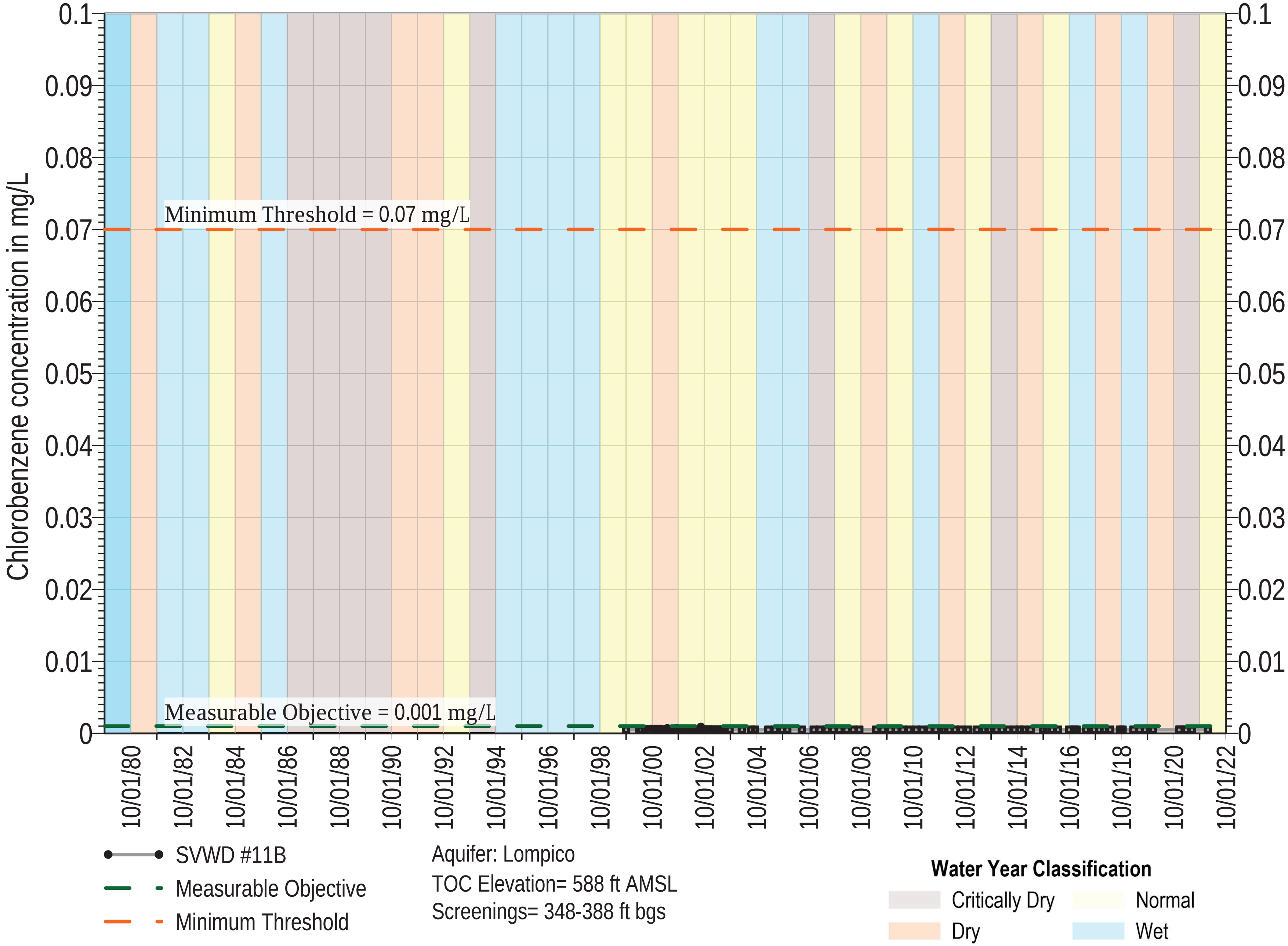

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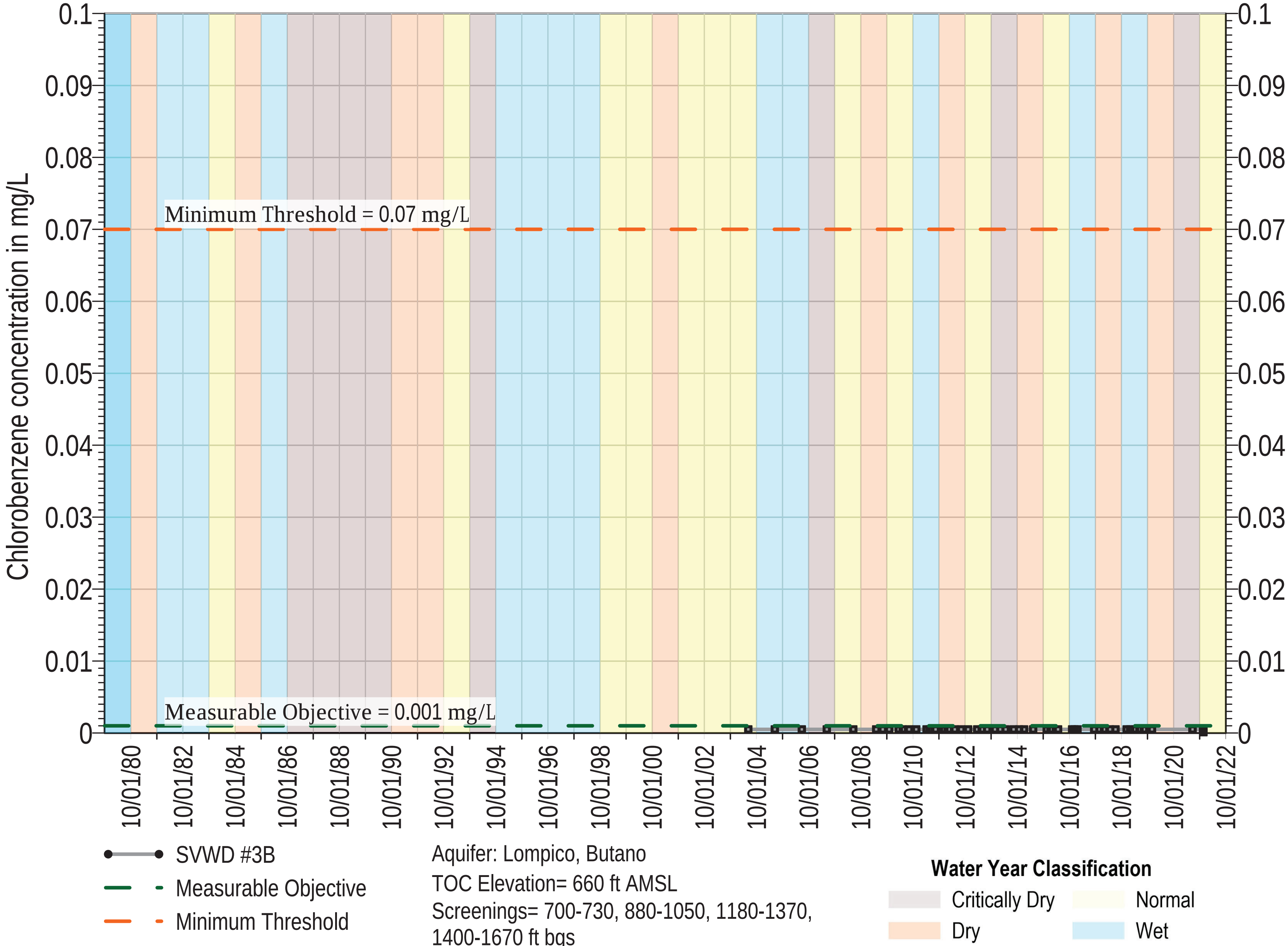

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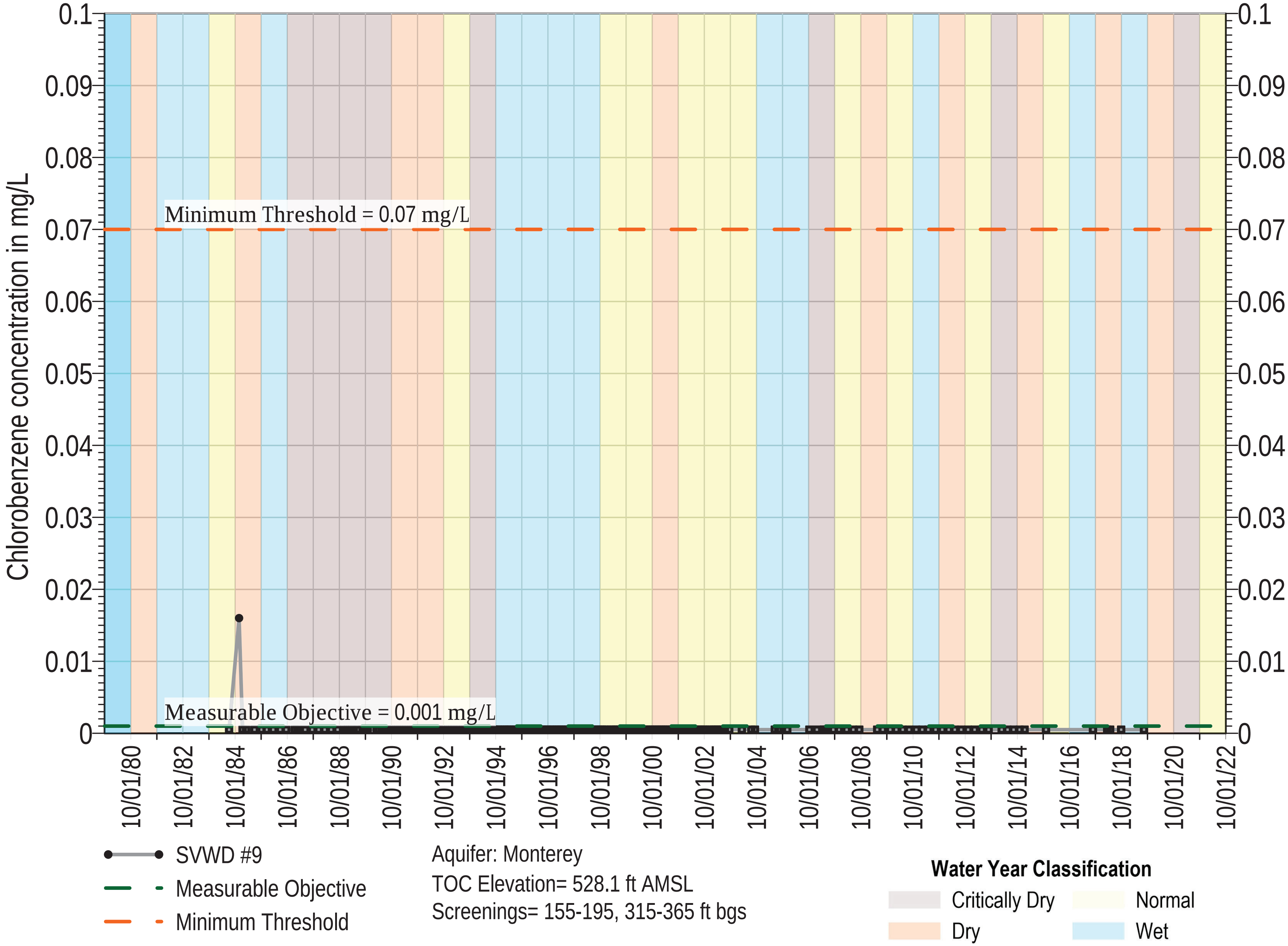

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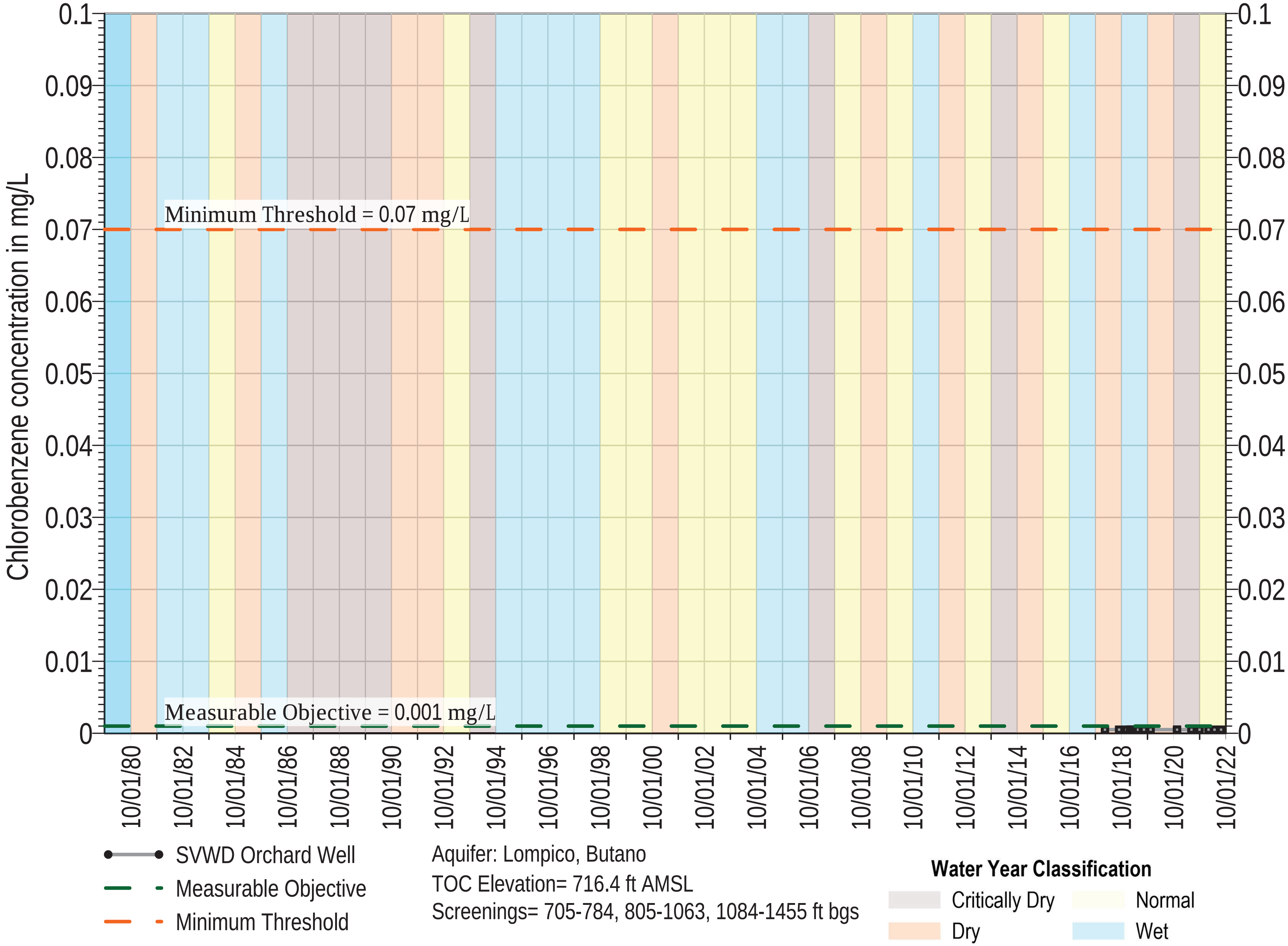

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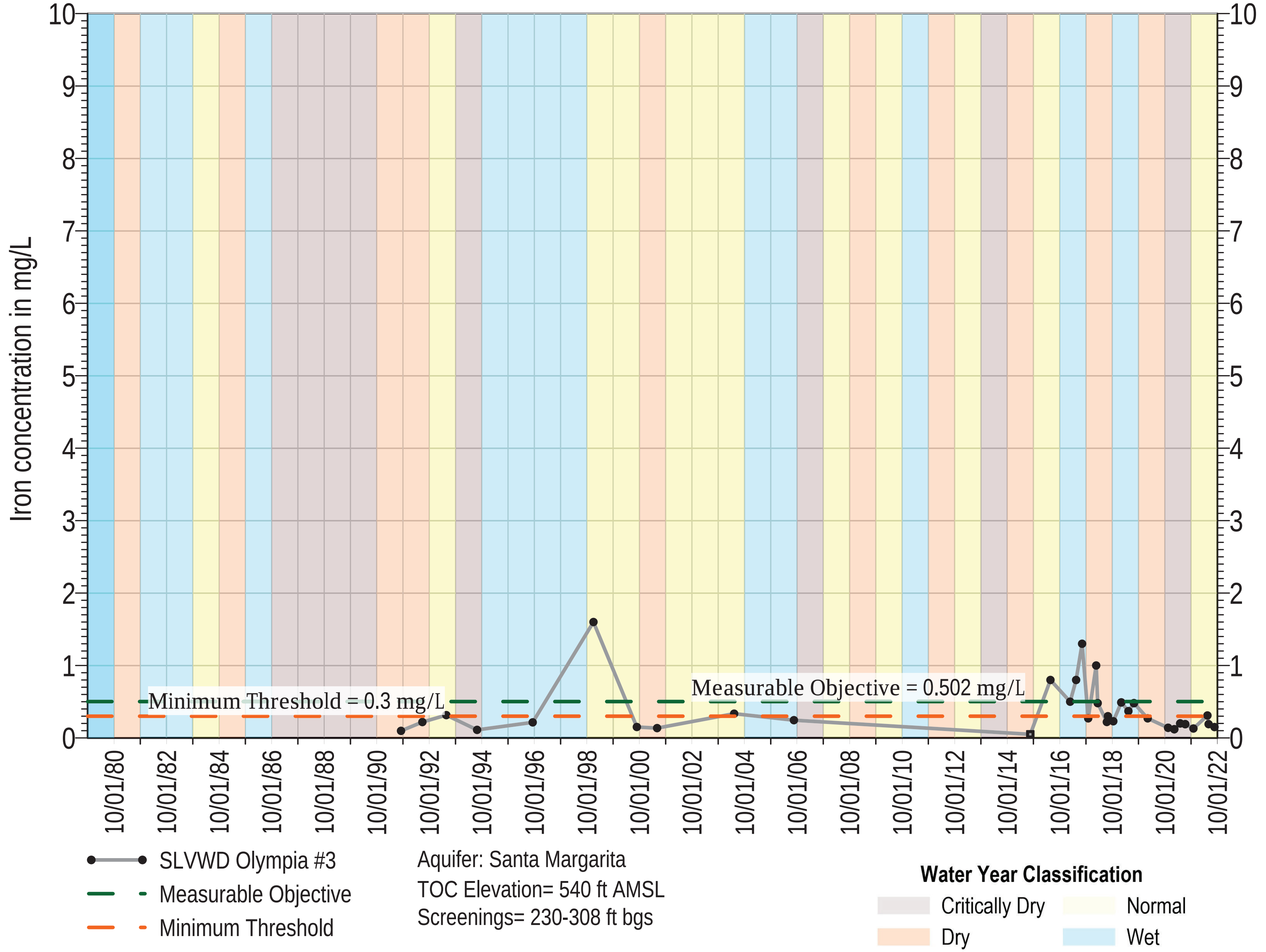
Iron



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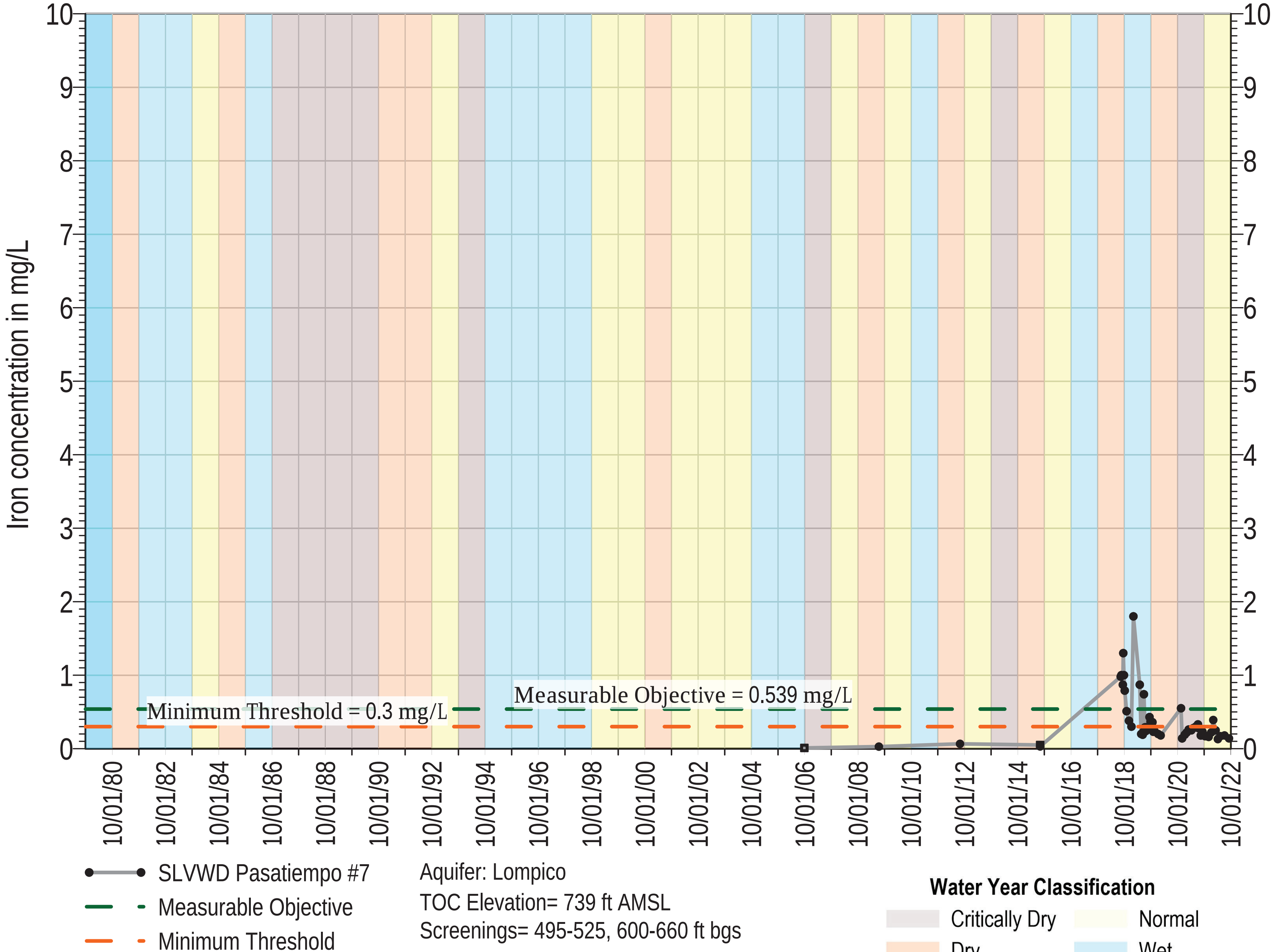

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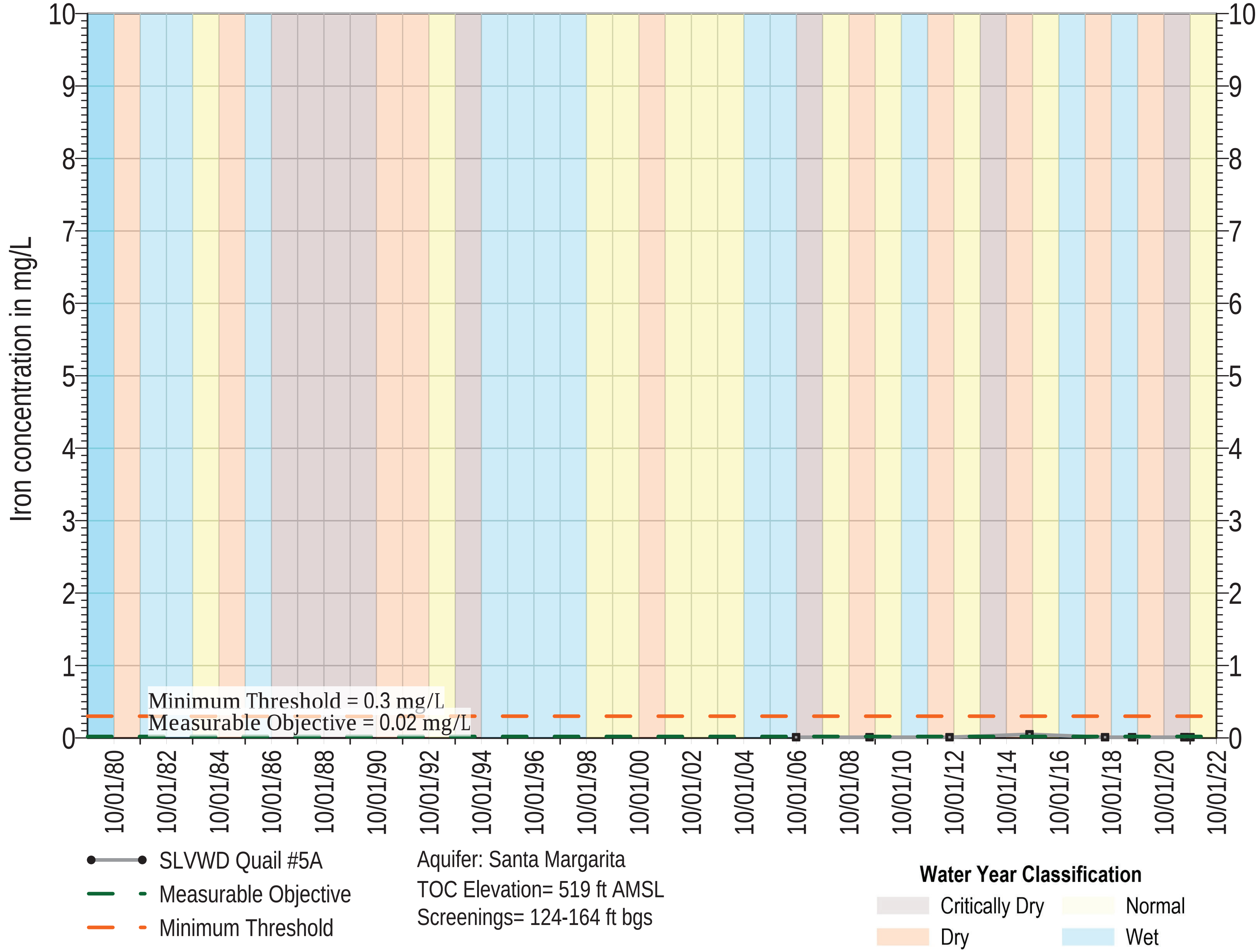

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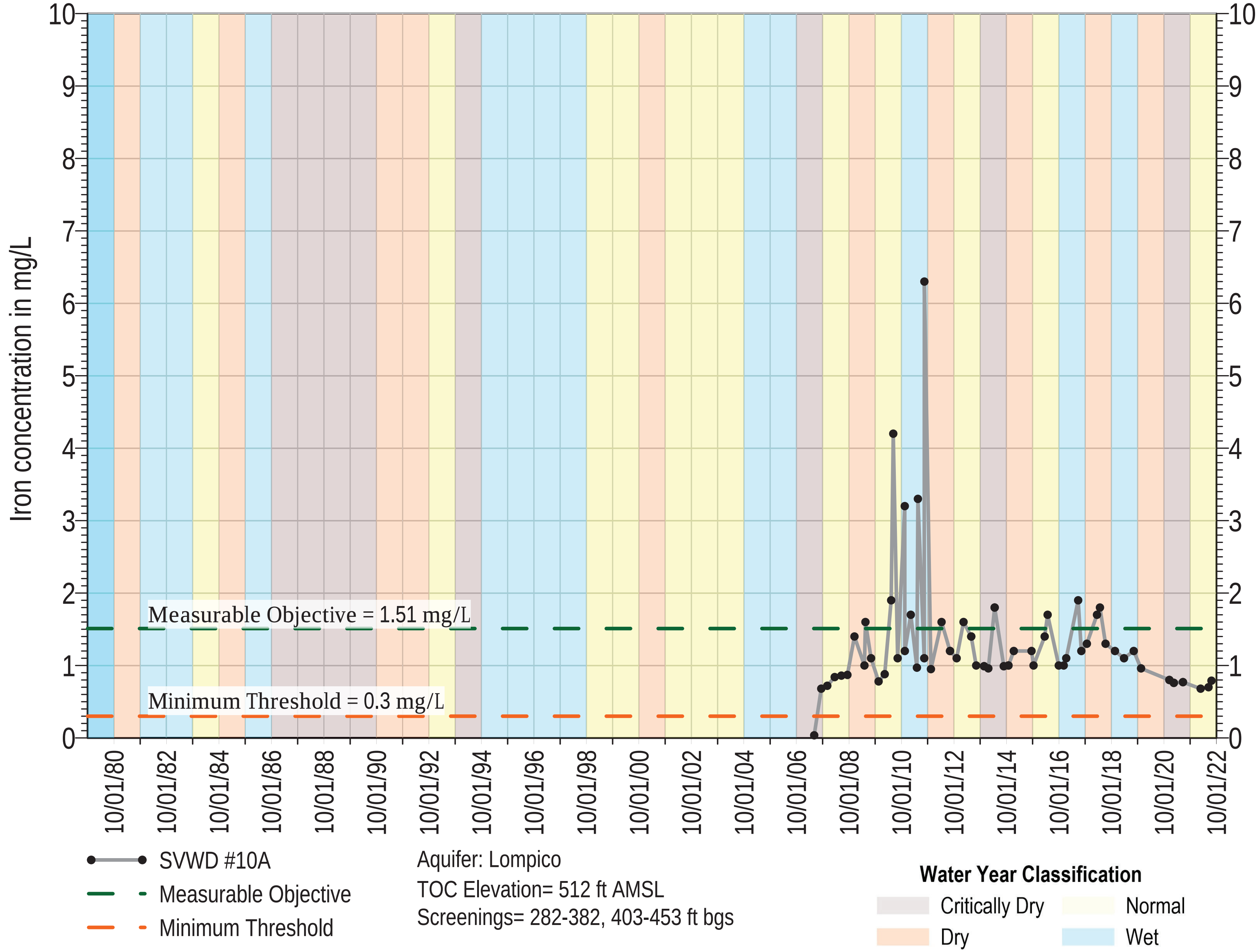

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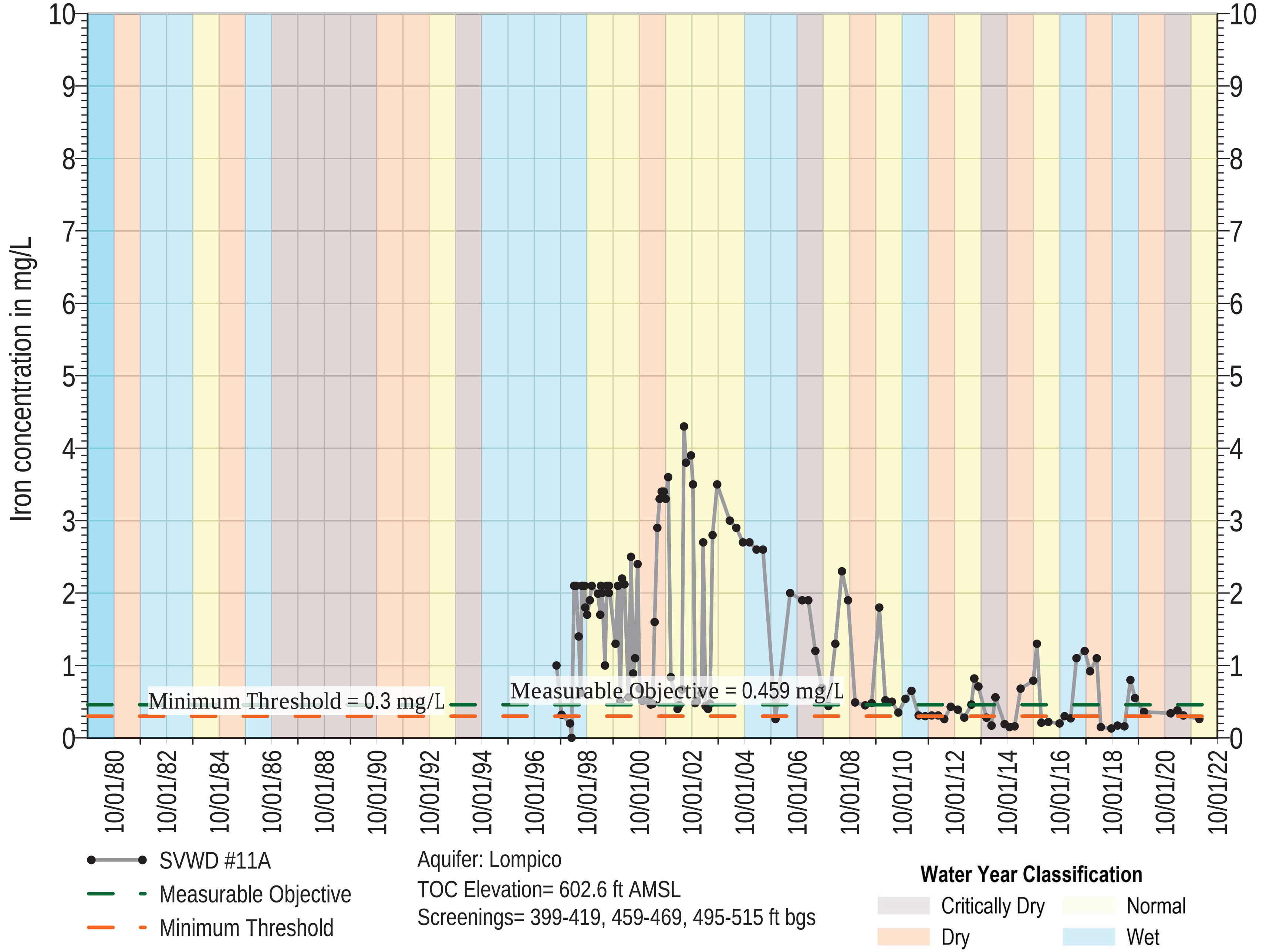

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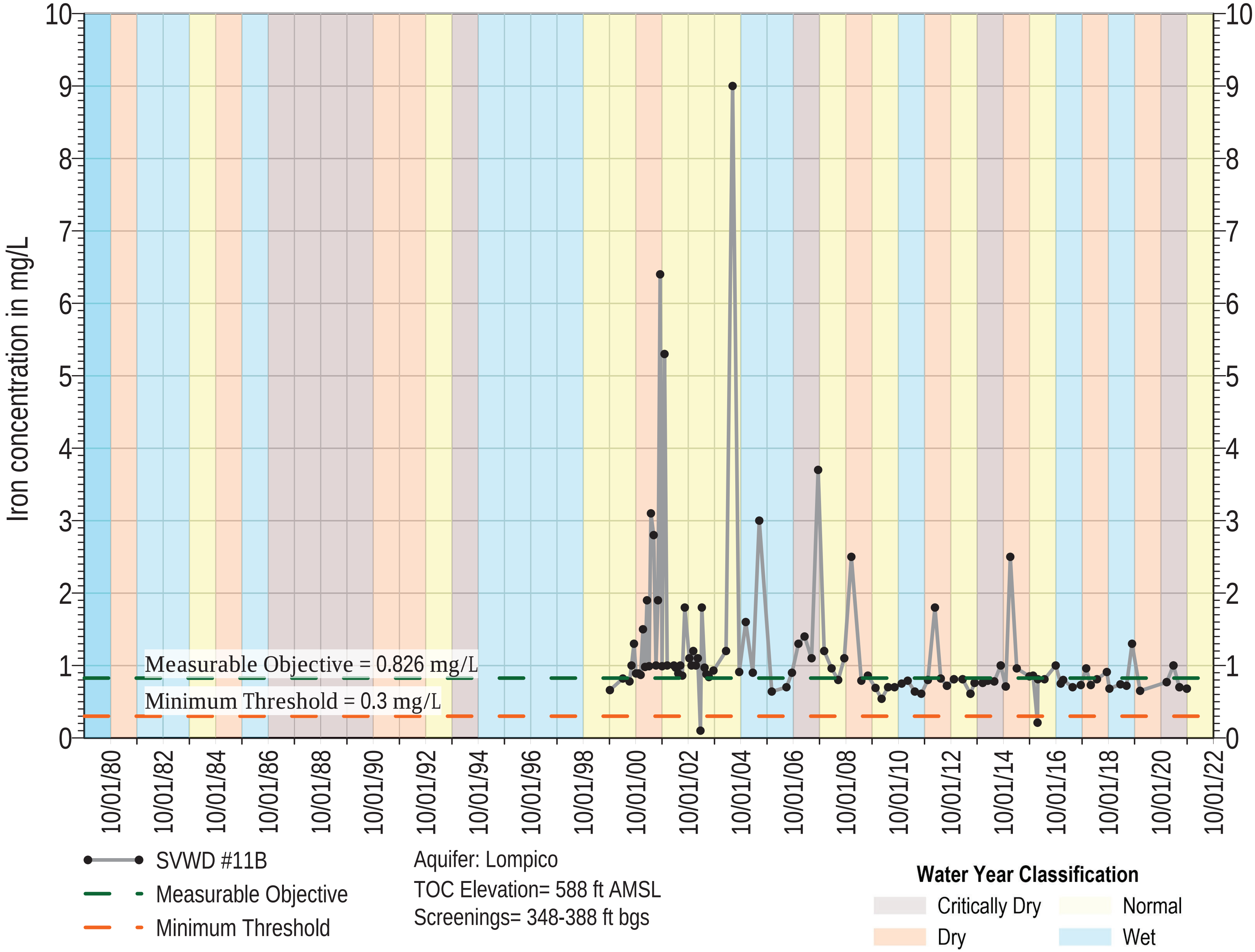

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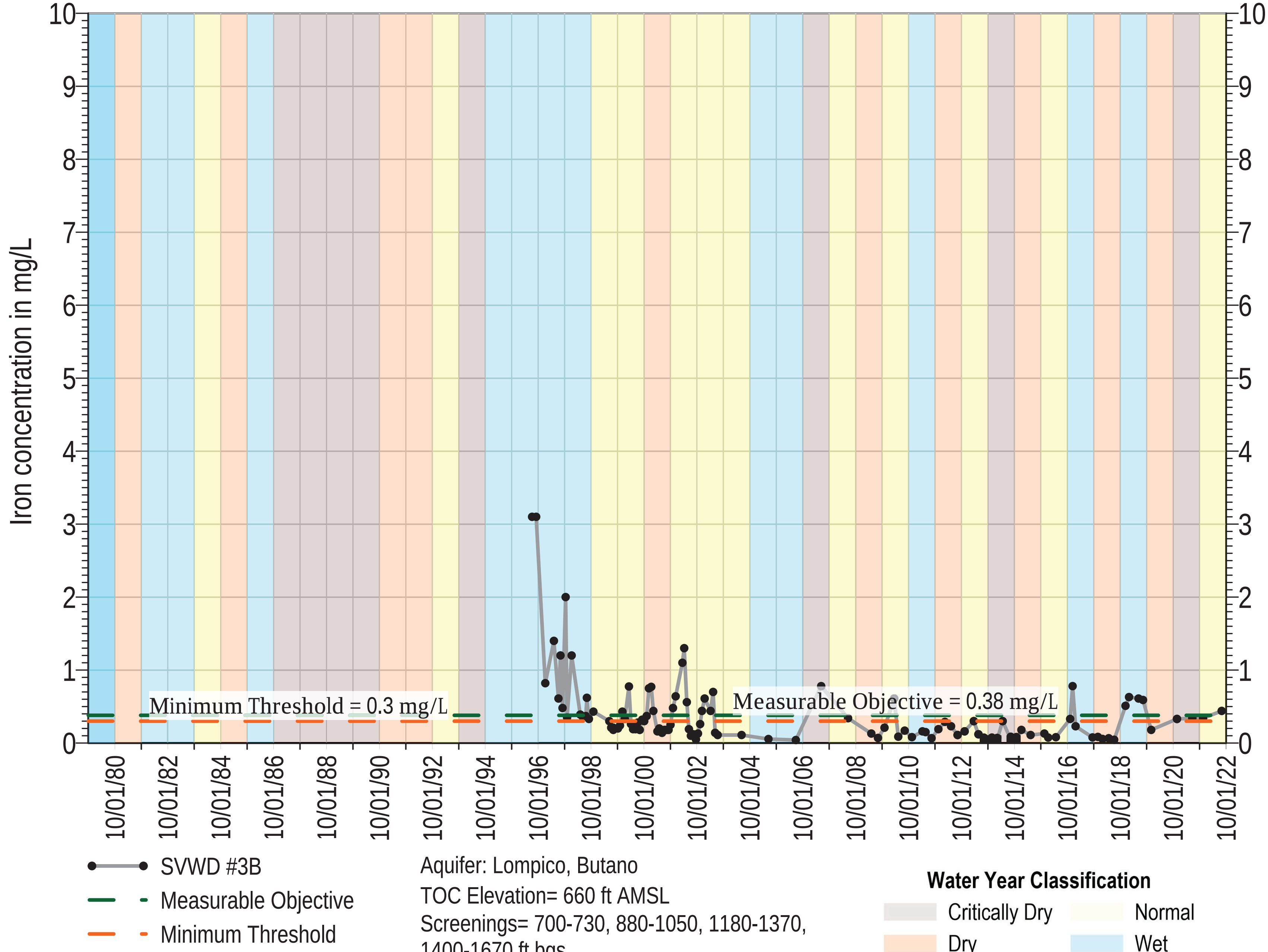

Aquifer: Lompico, Butano
TOC Elevation= 660 ft AMSL
Screenings= 700-730, 880-1050, 1180-1370, 1400-1670 ft bgs

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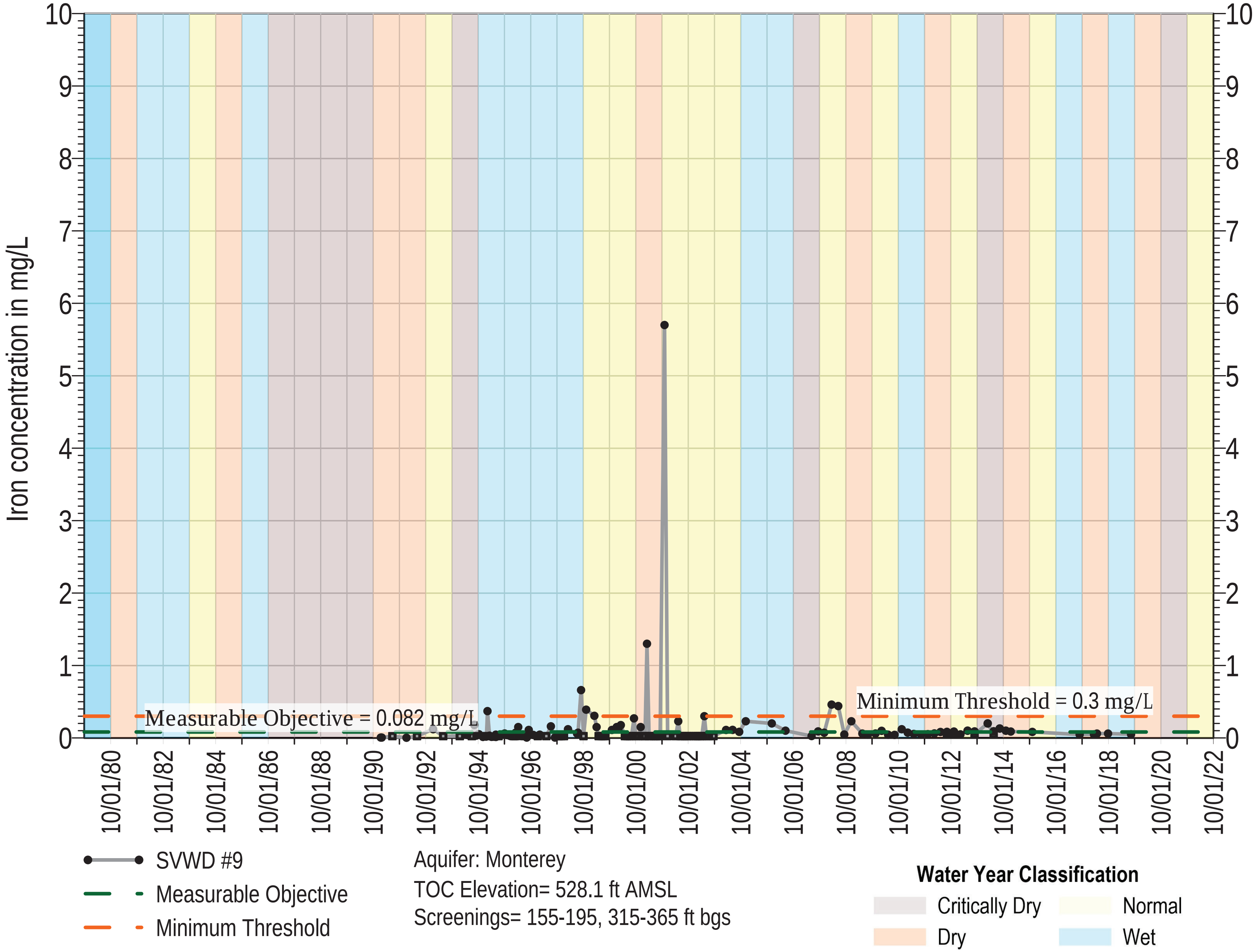

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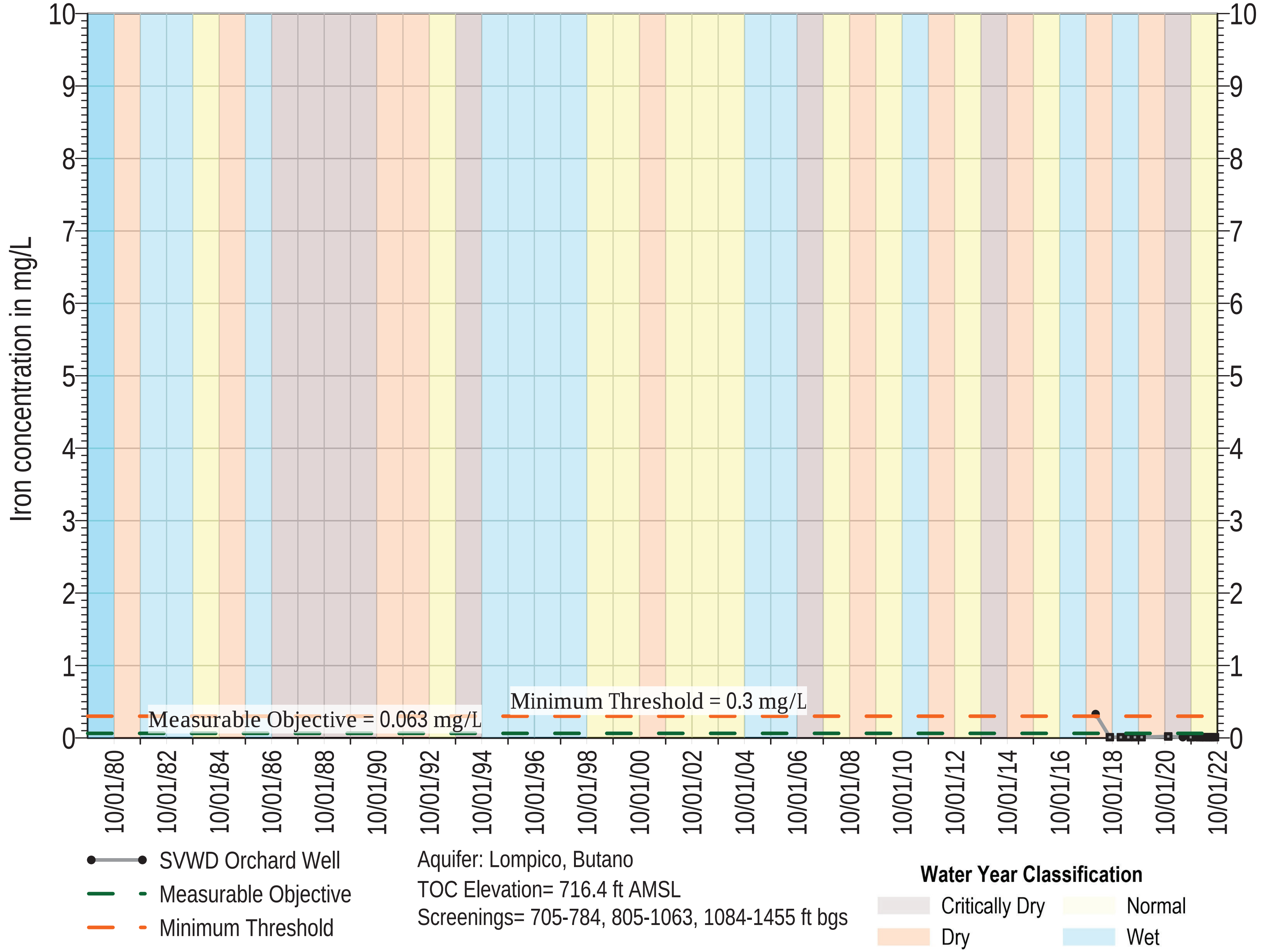

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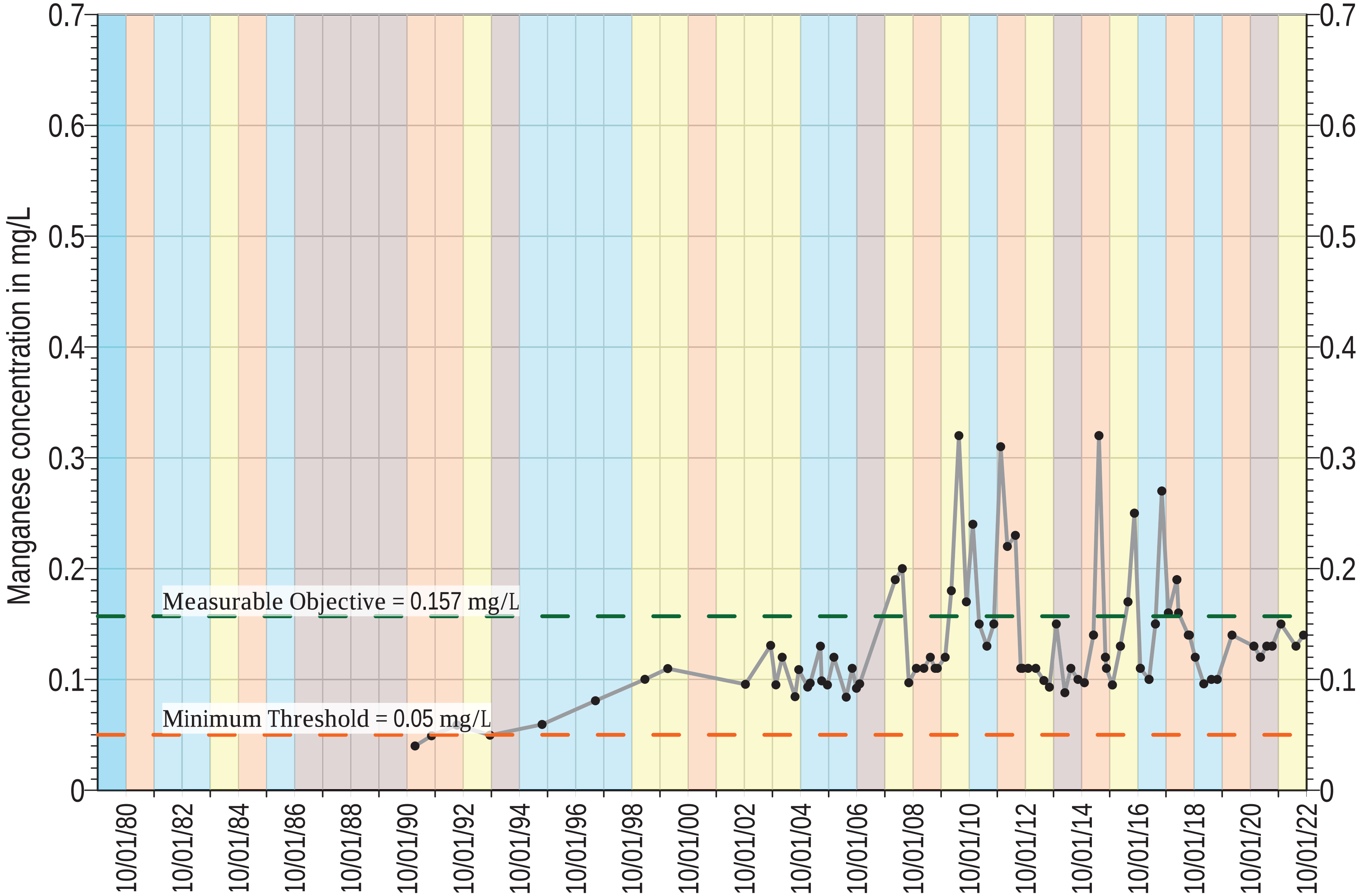
Manganese



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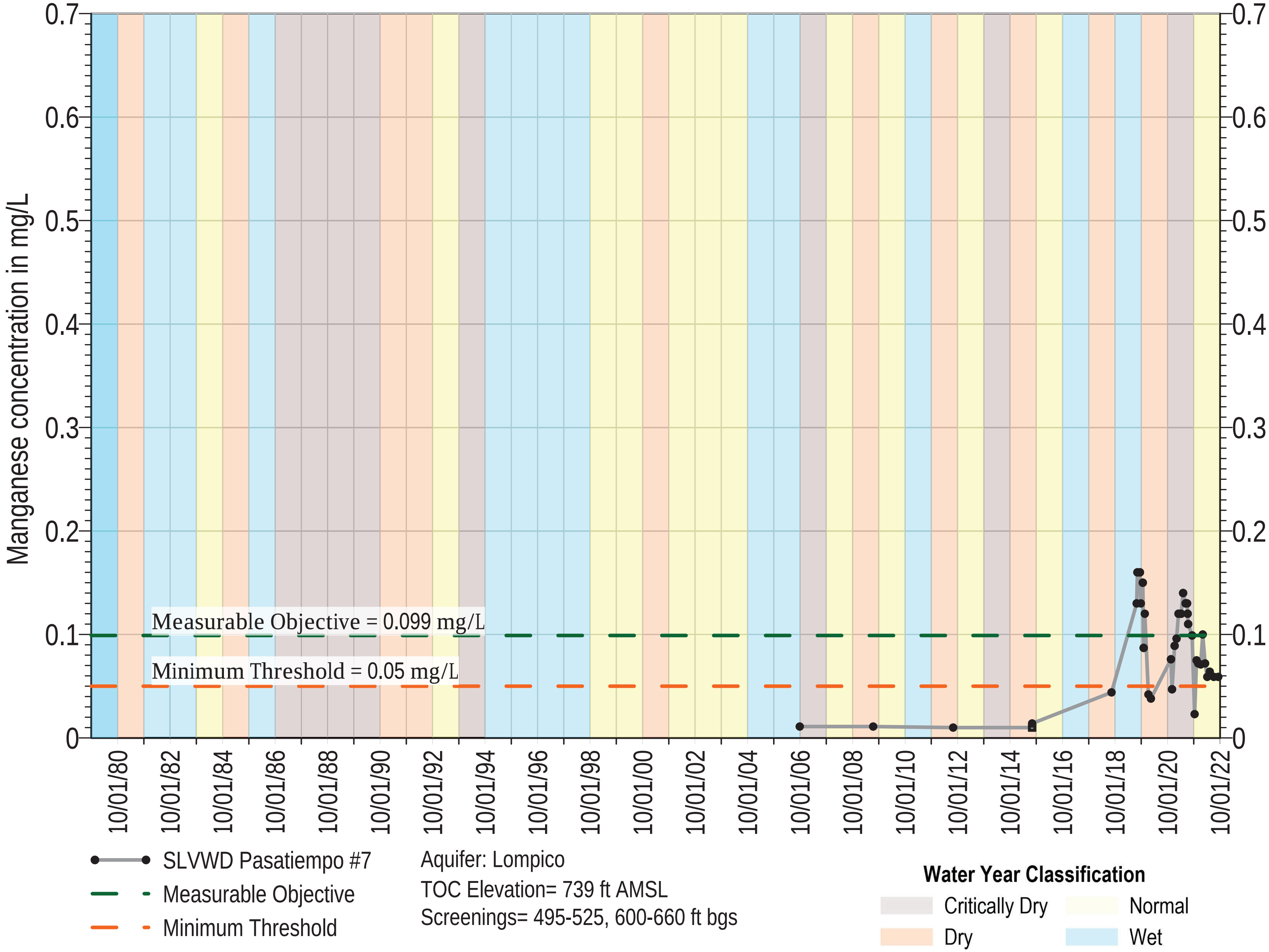

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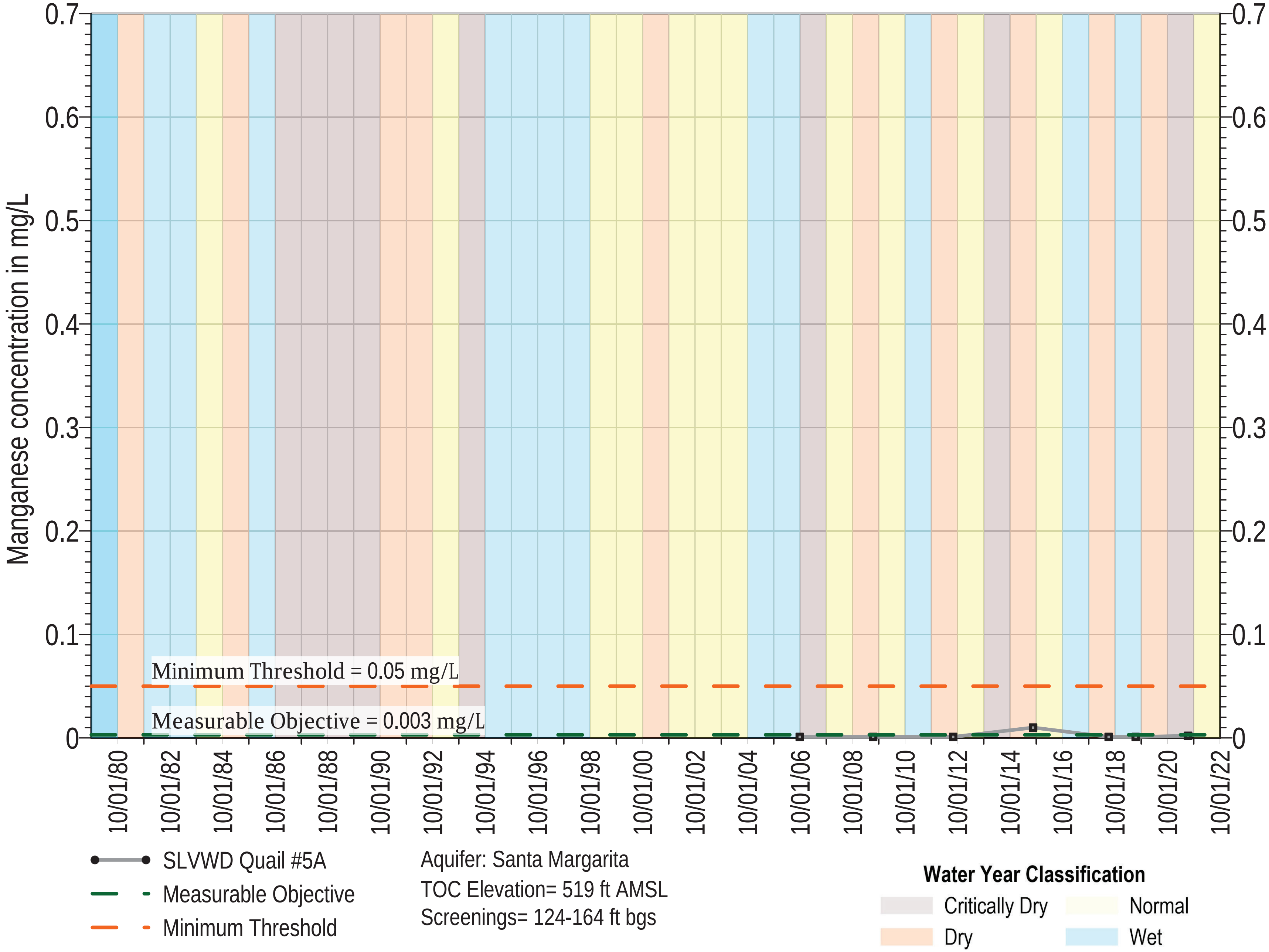

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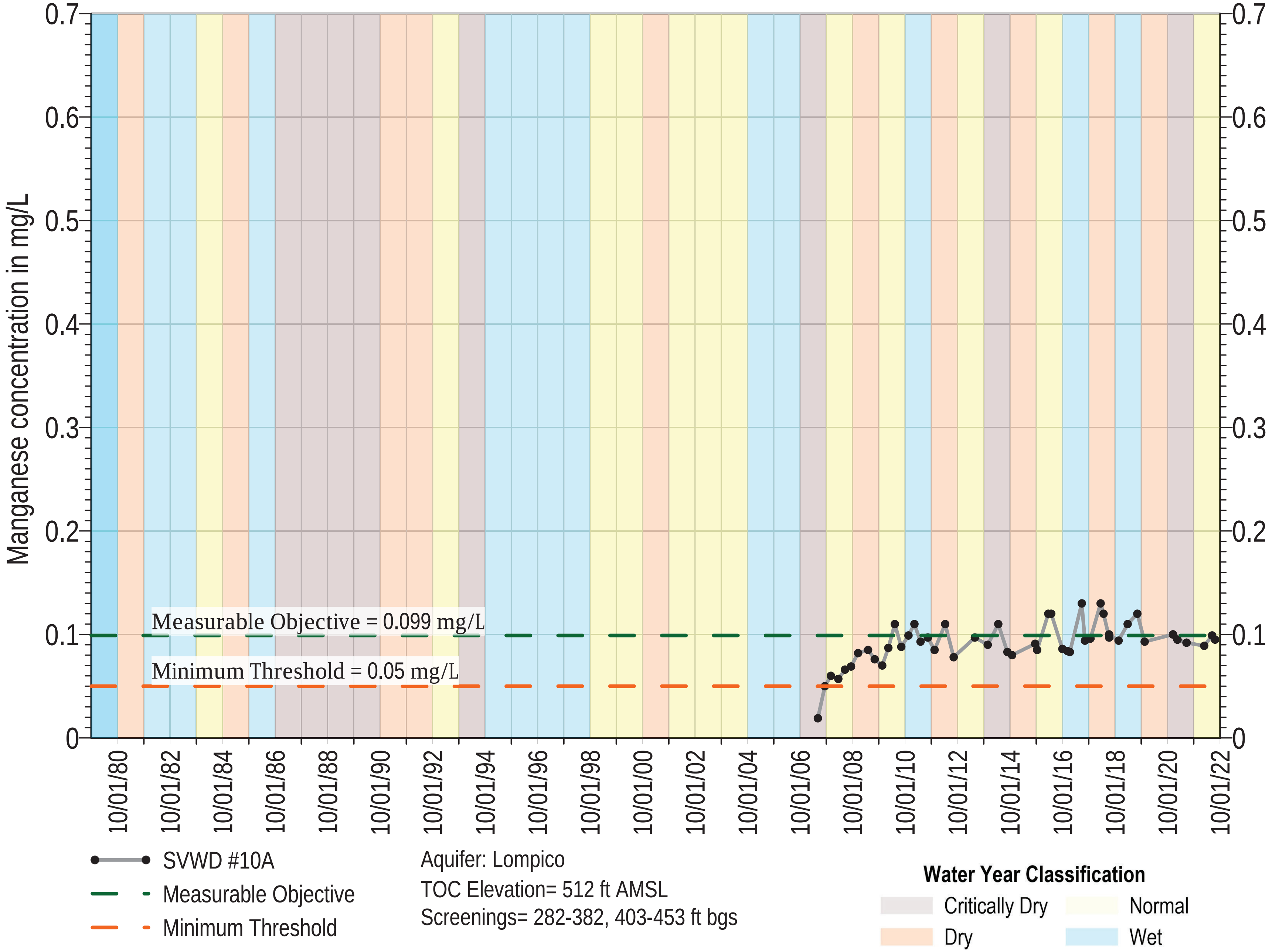

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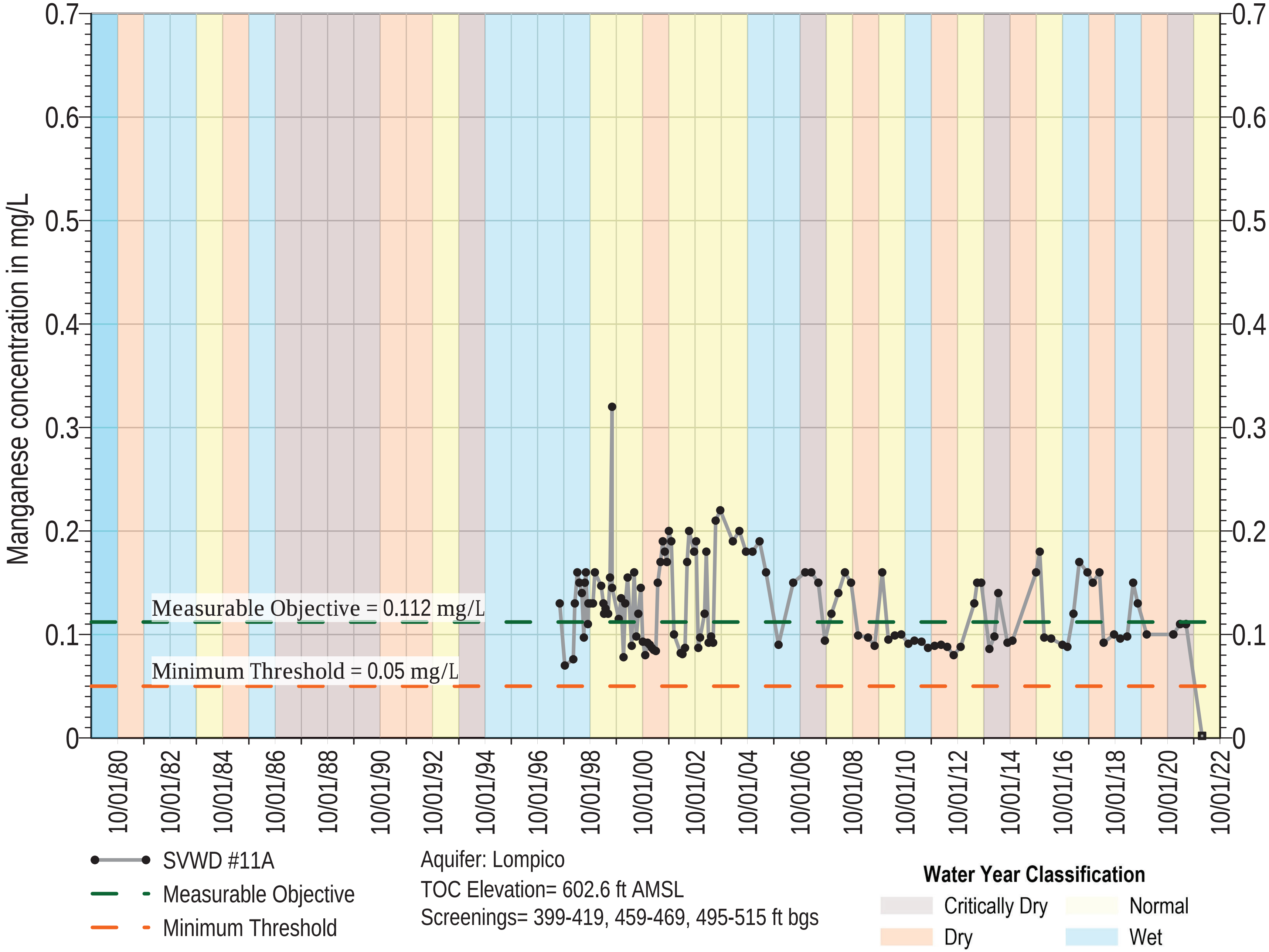

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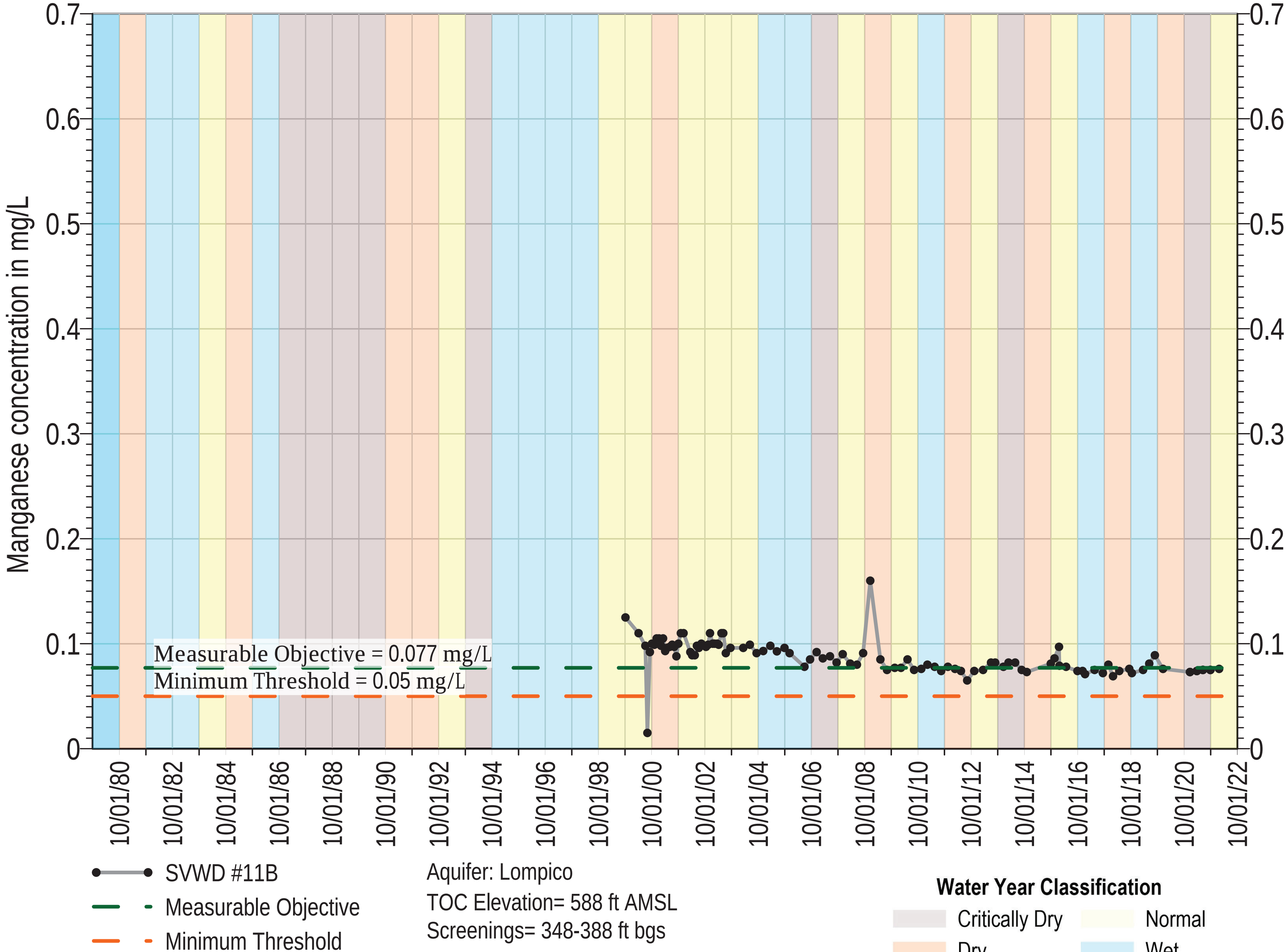

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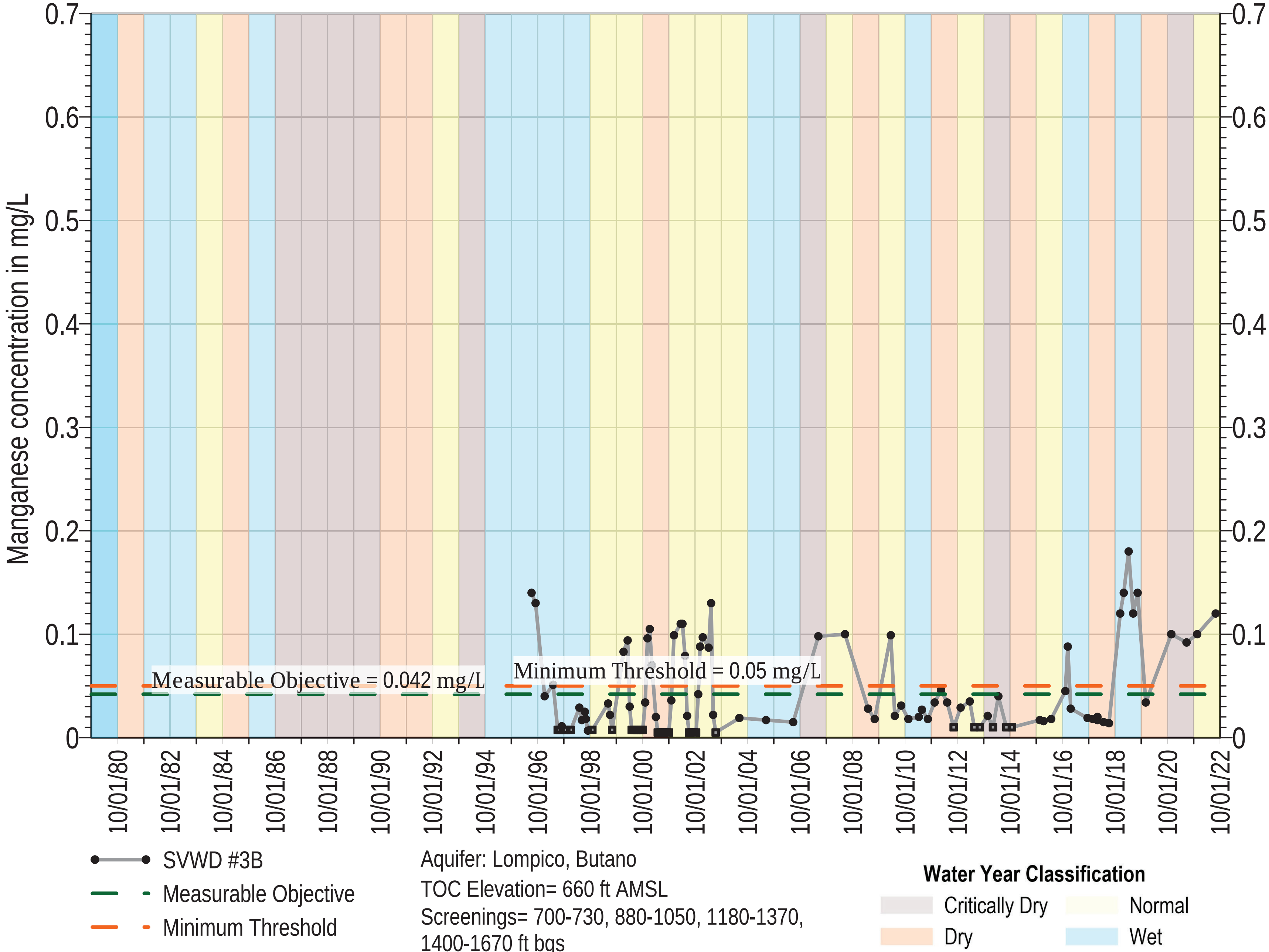

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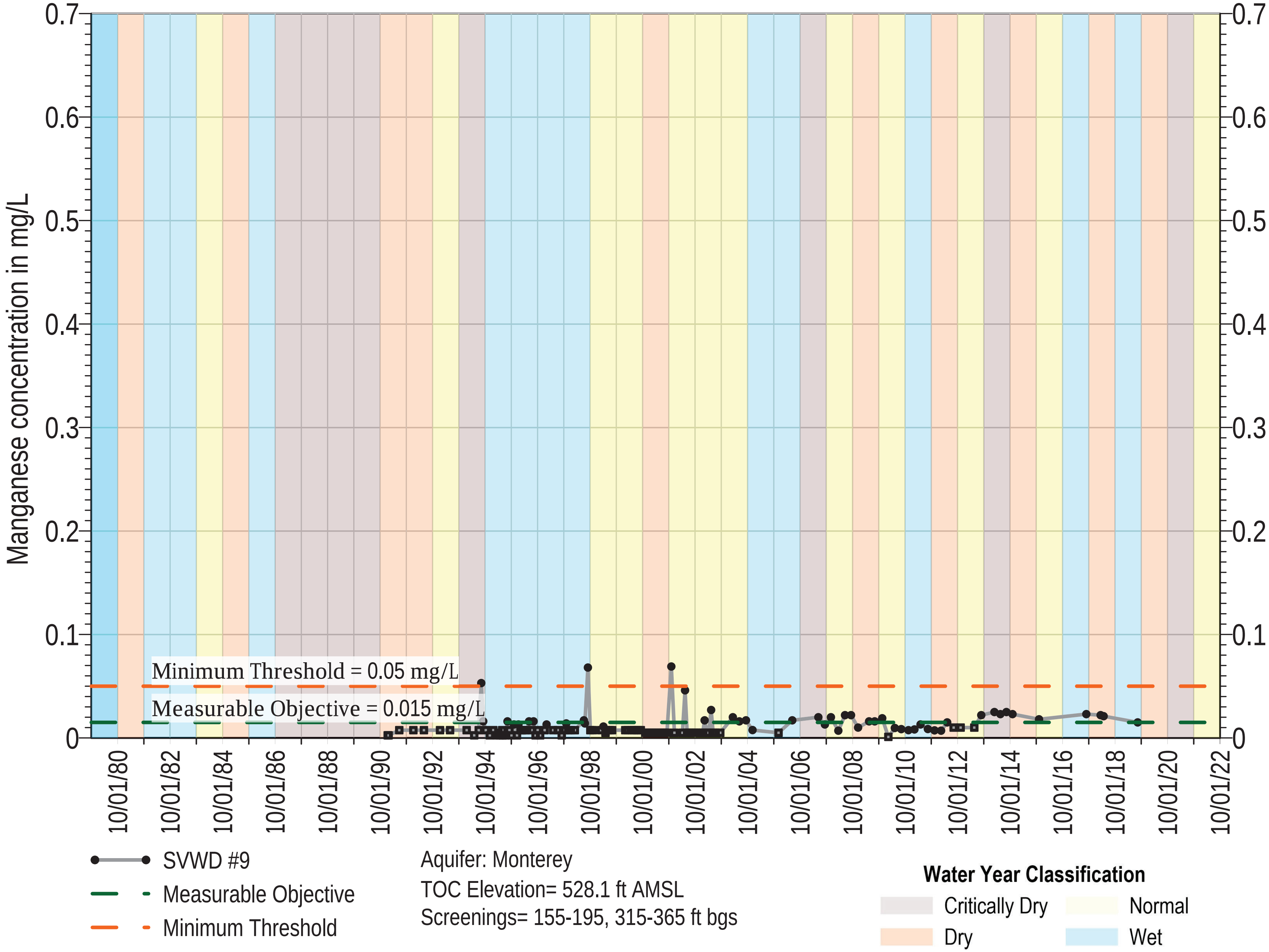

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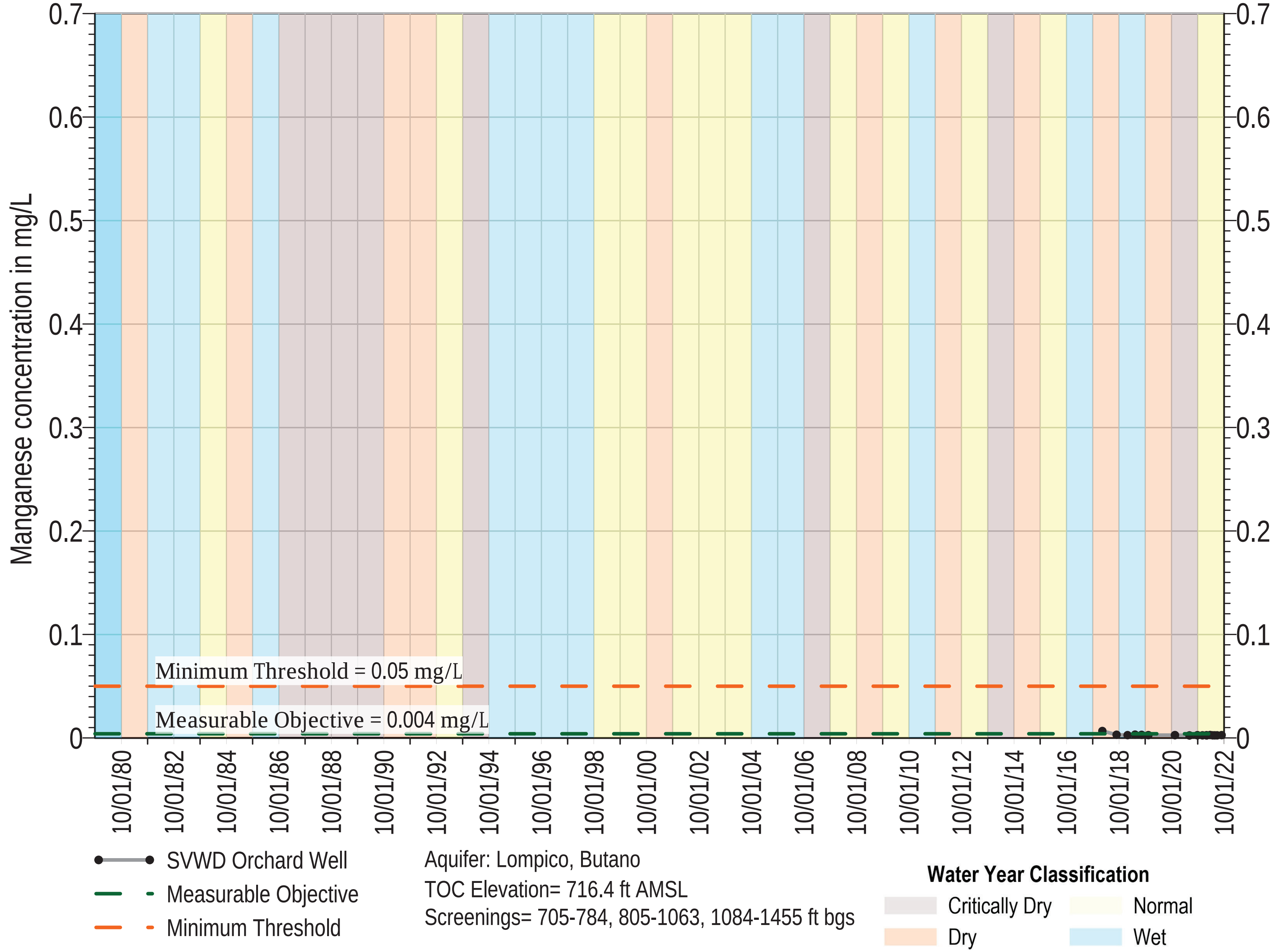

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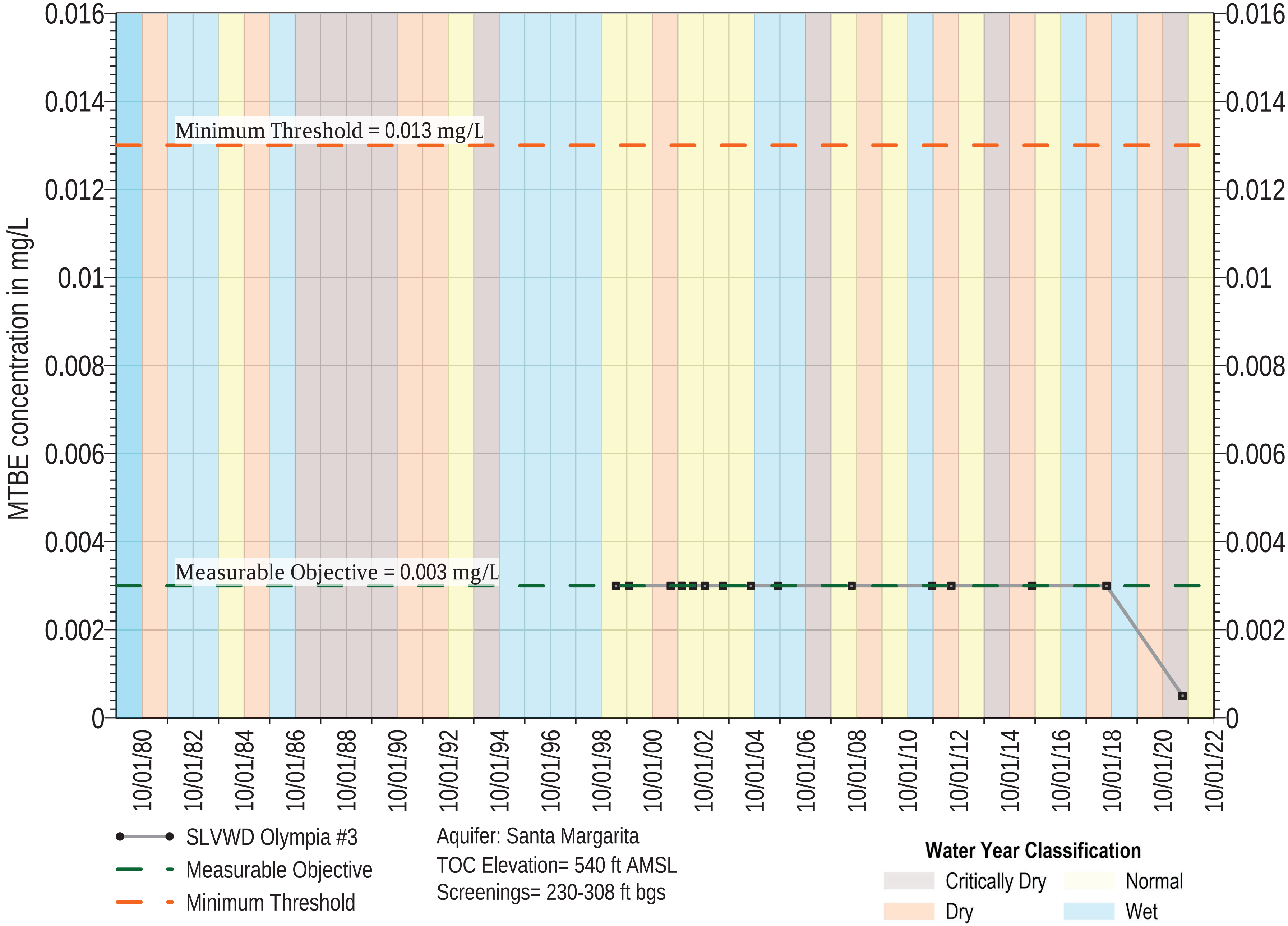
MTBE



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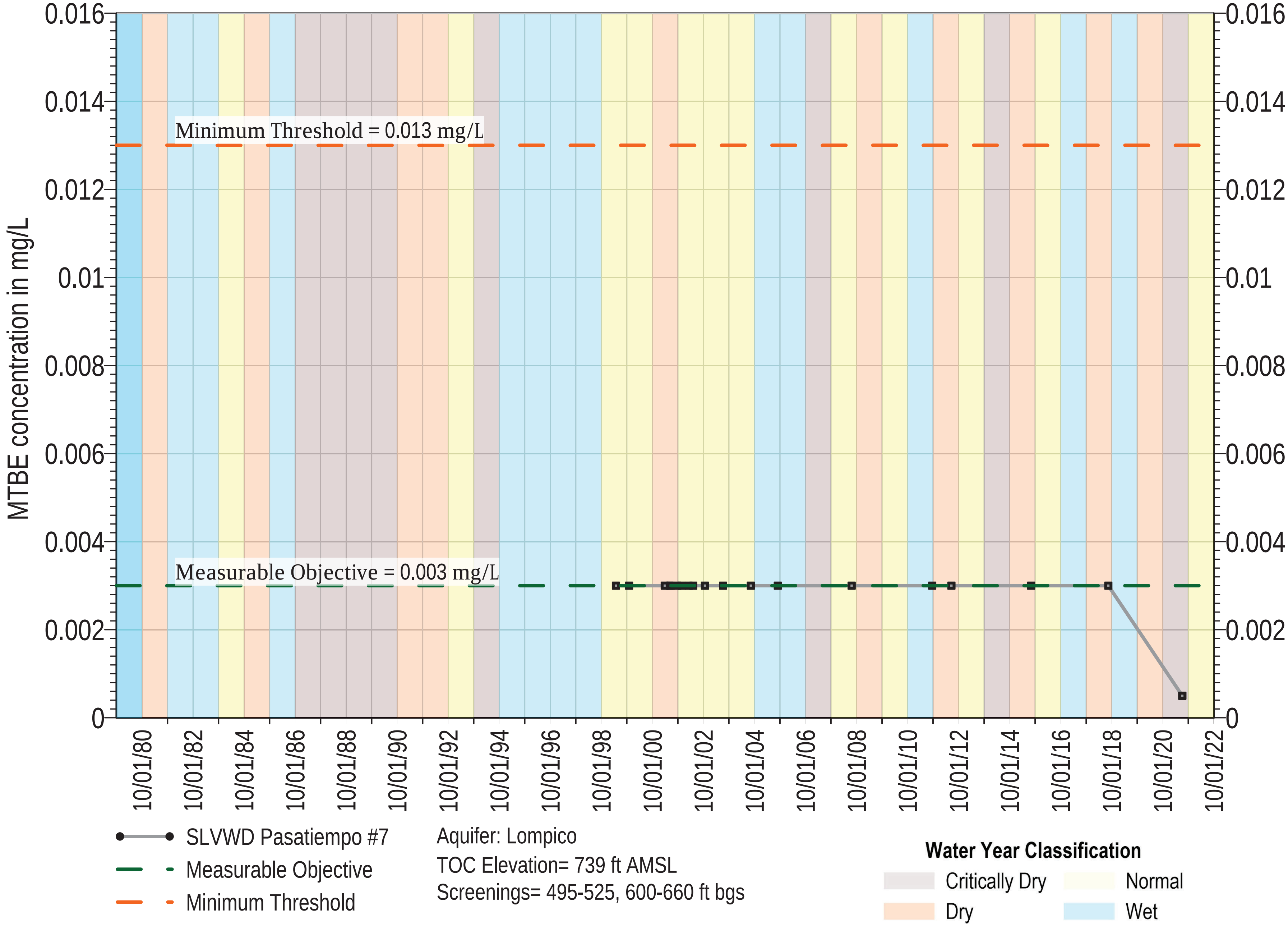

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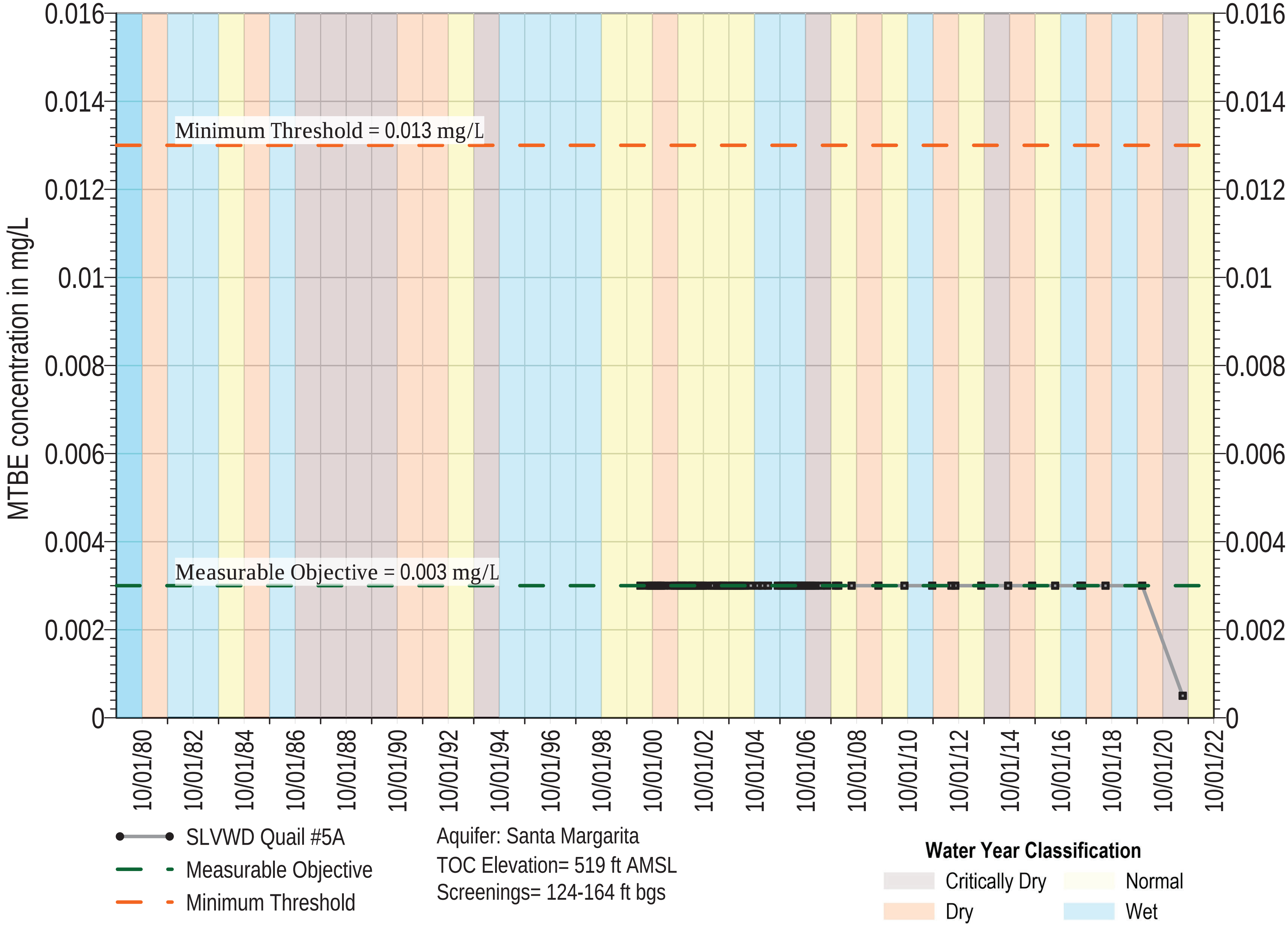

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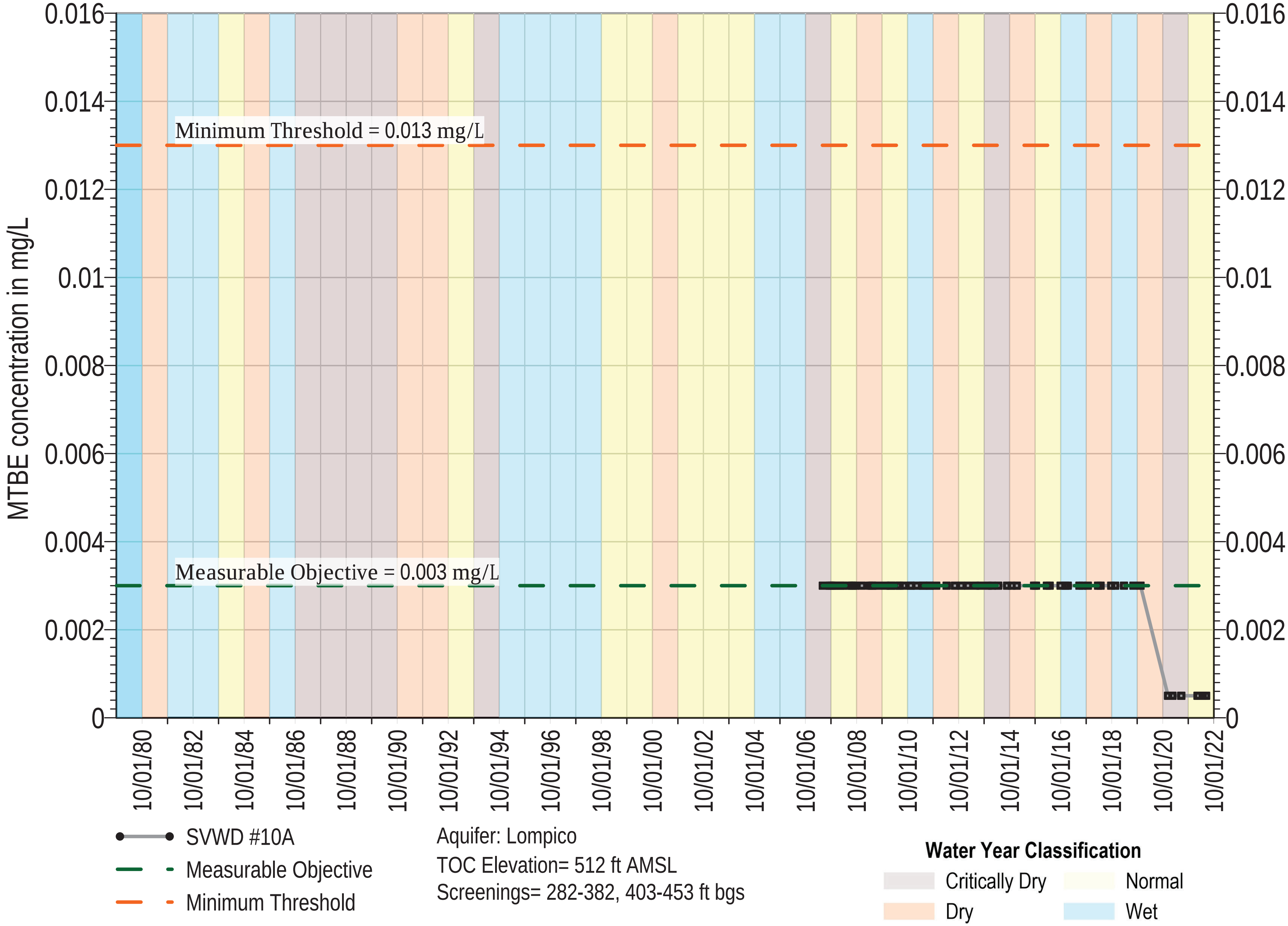

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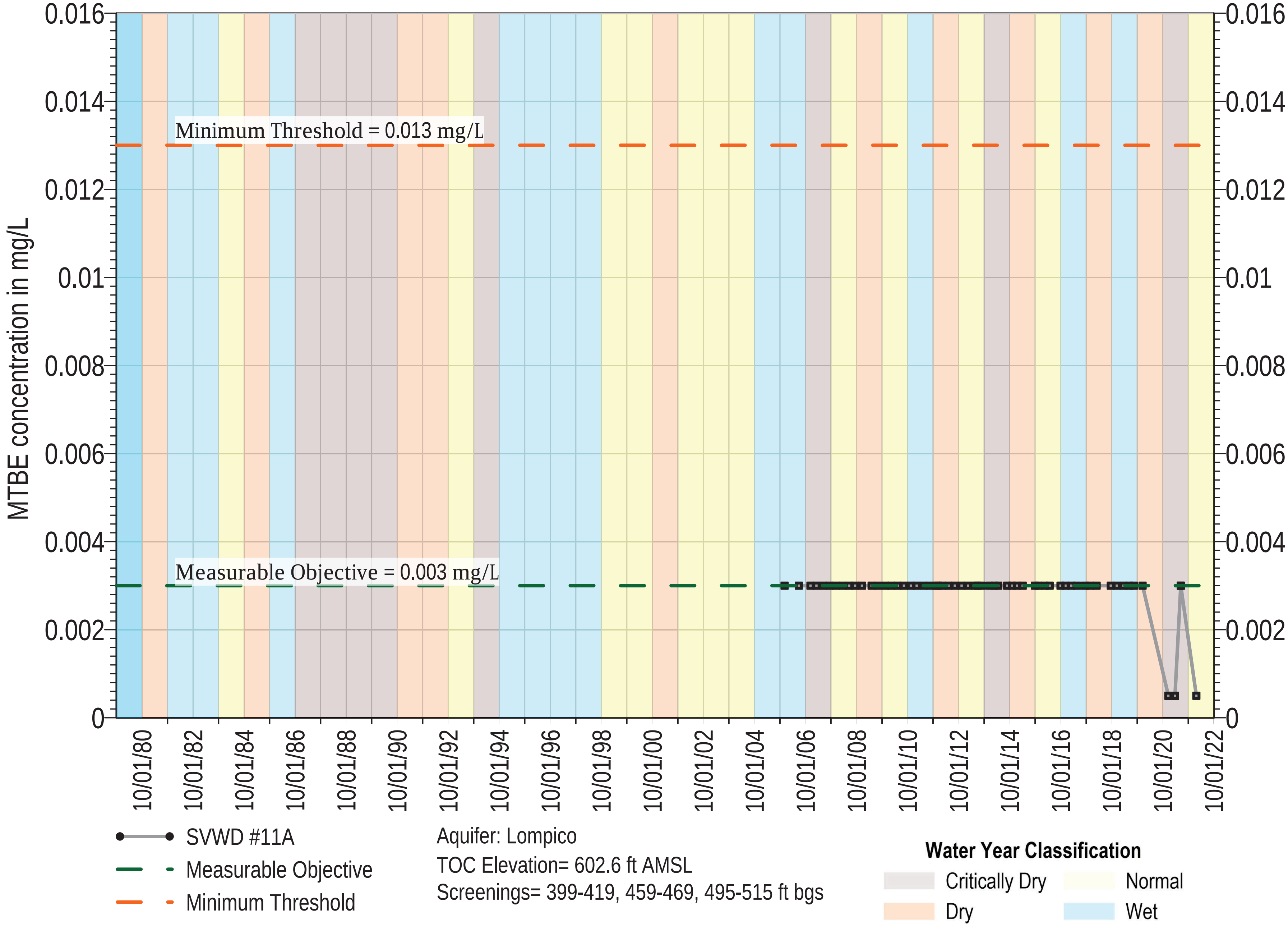

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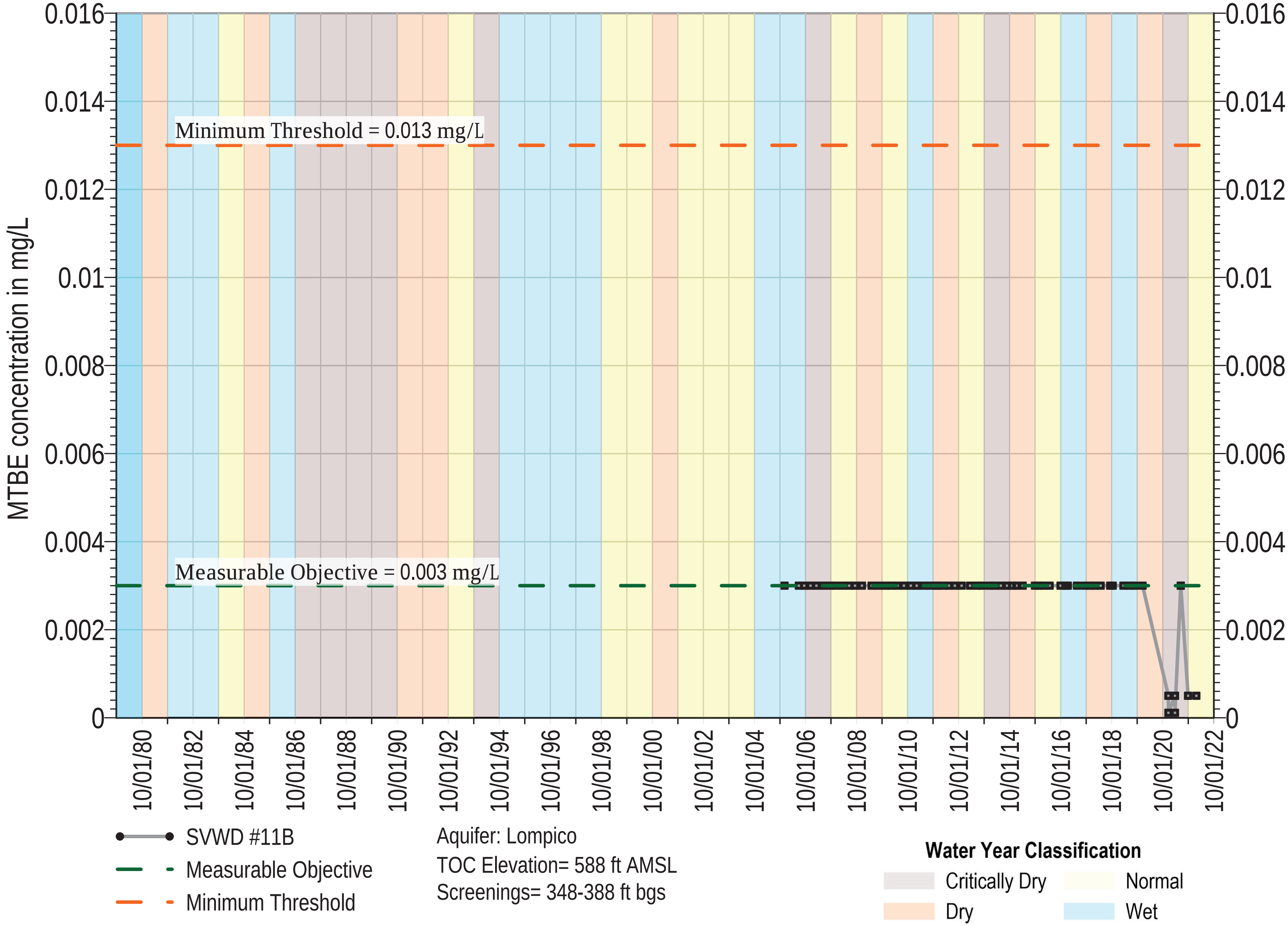

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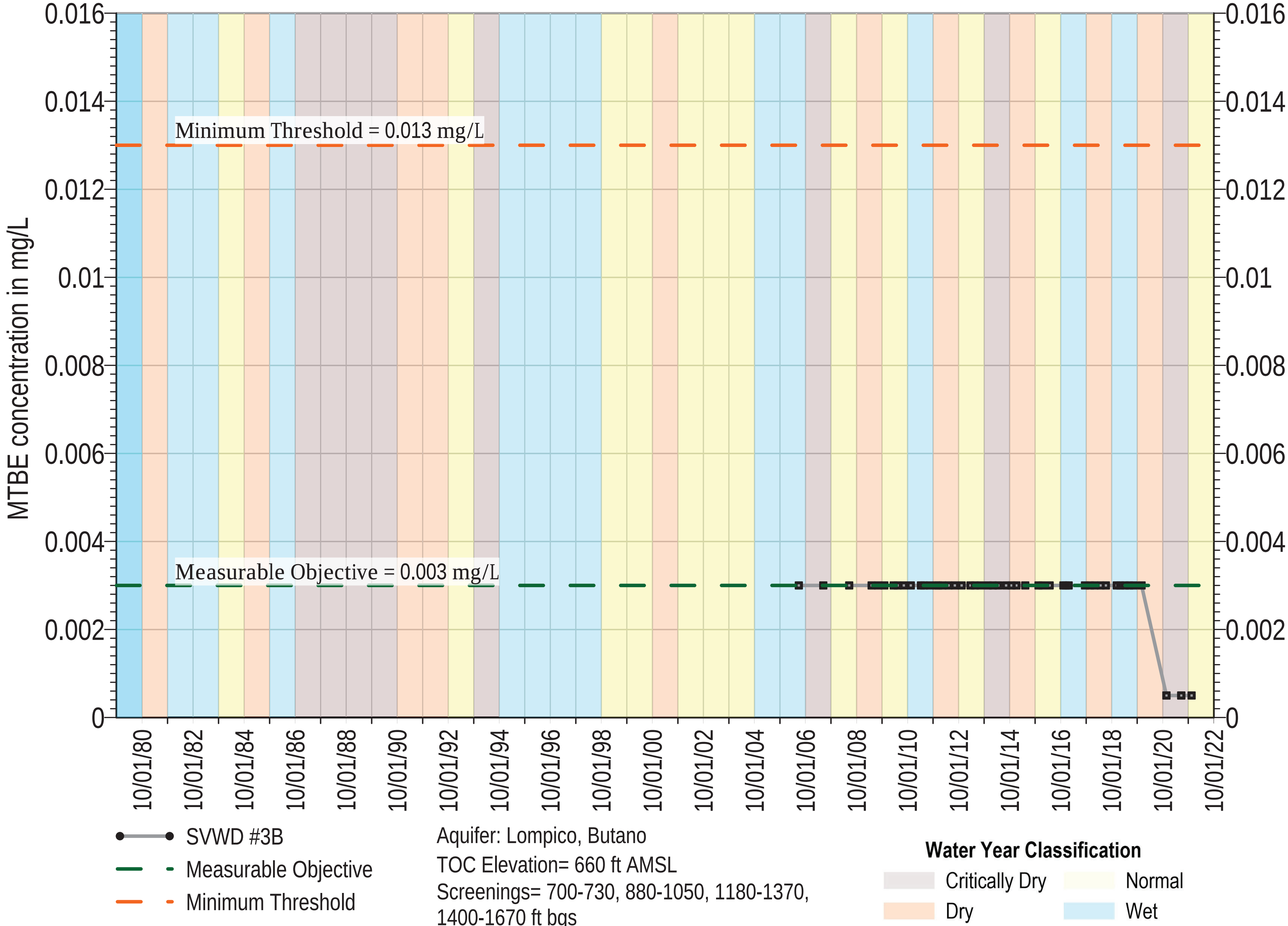

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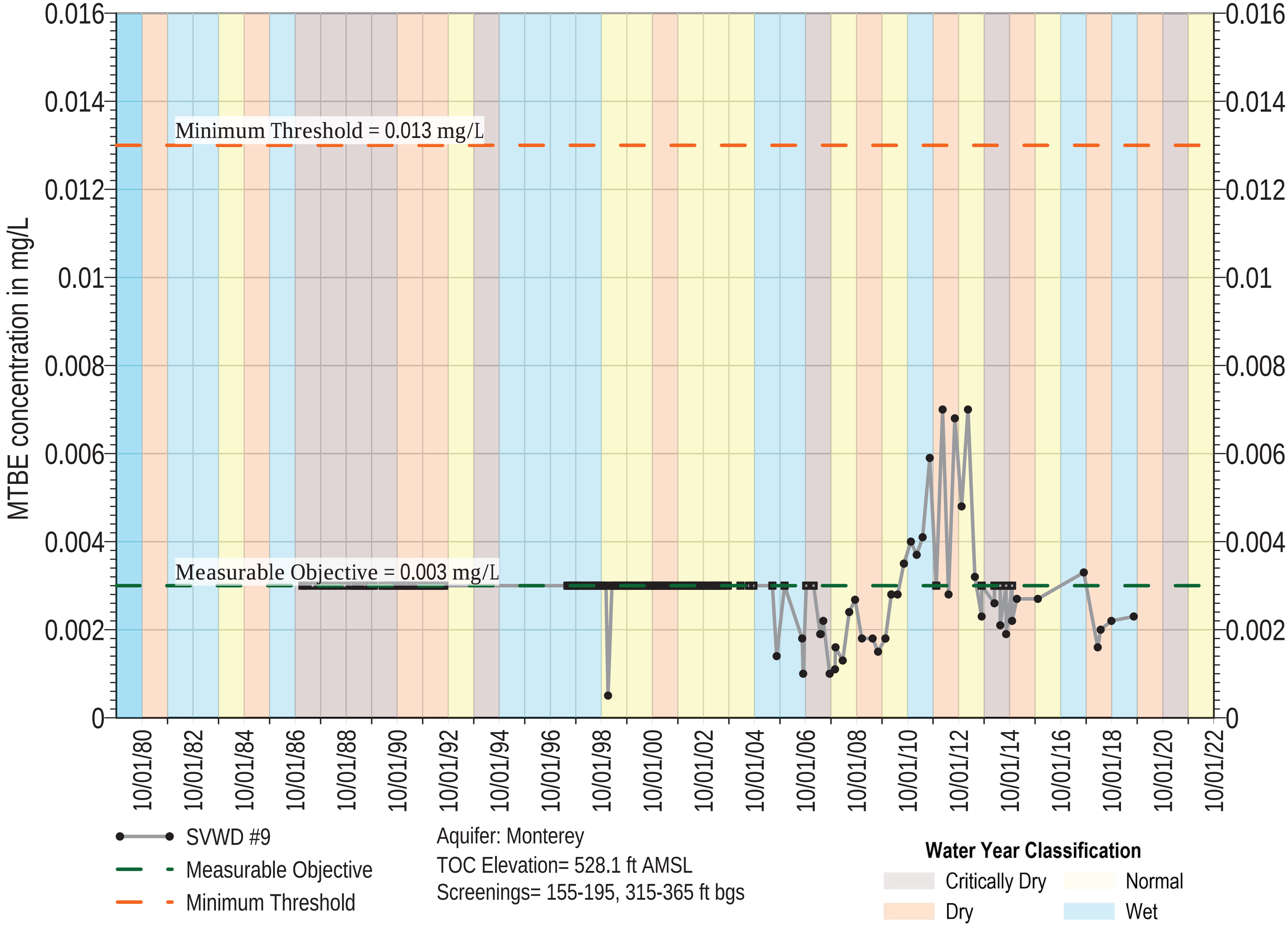

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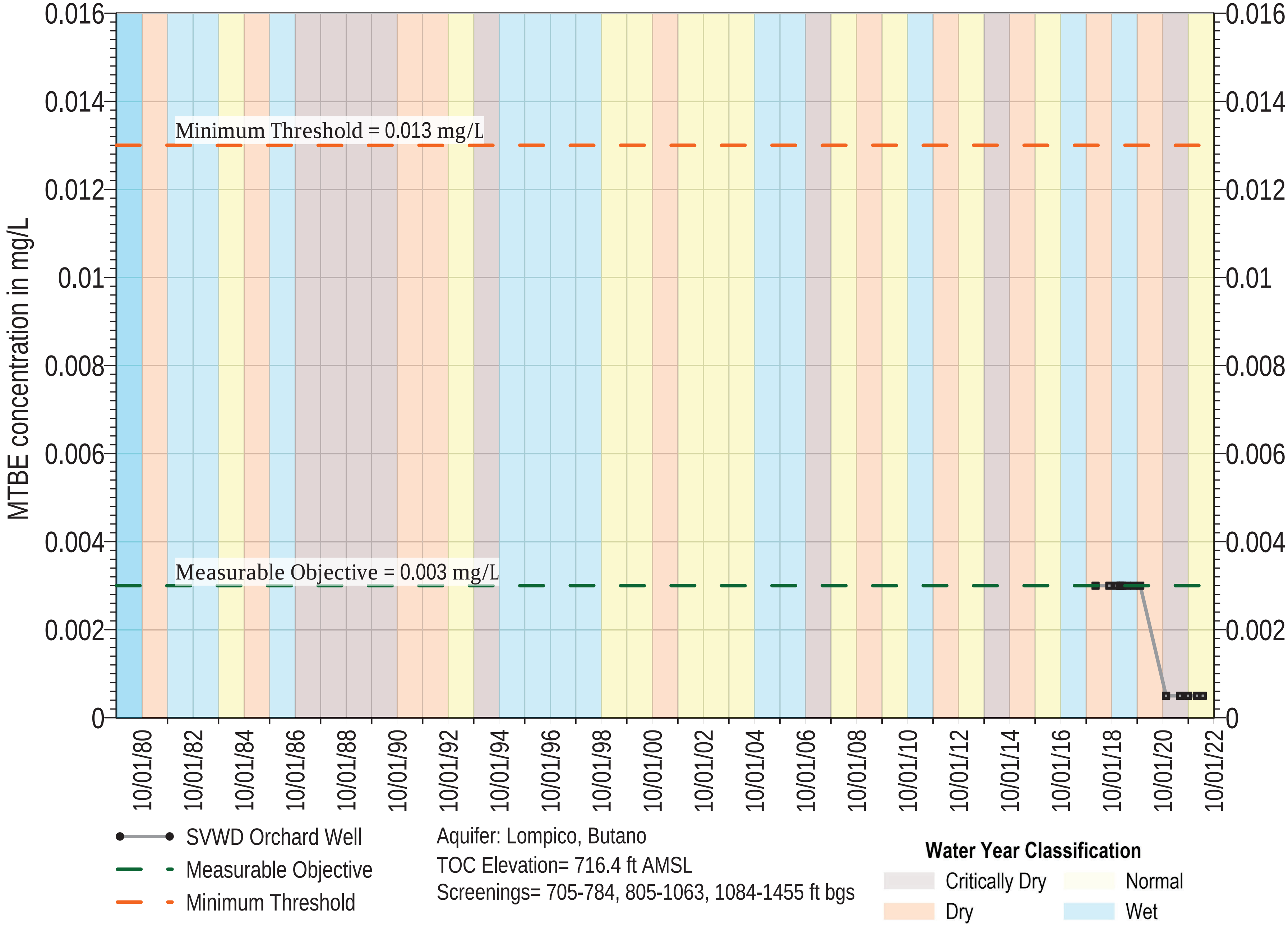

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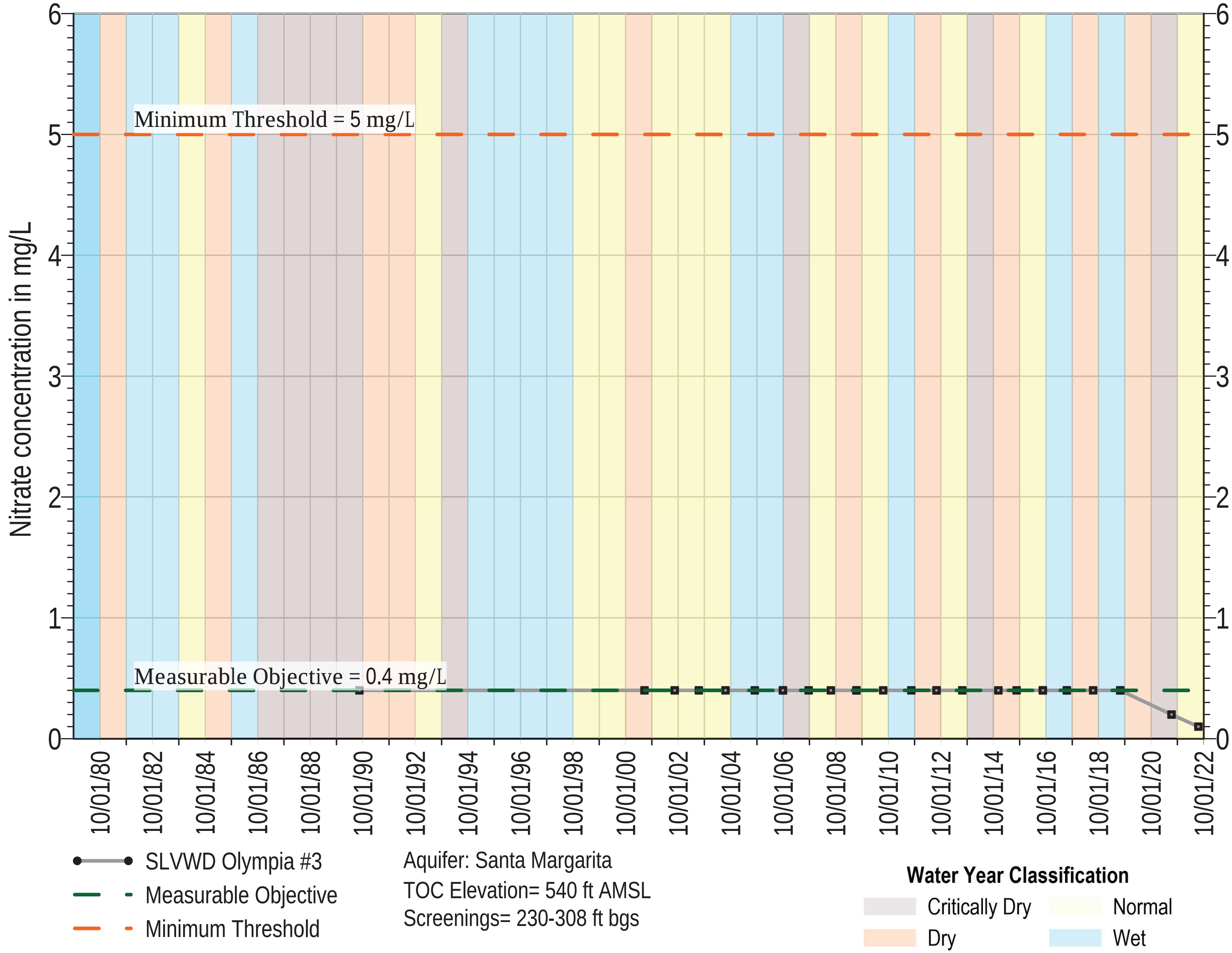
Nitrate as N



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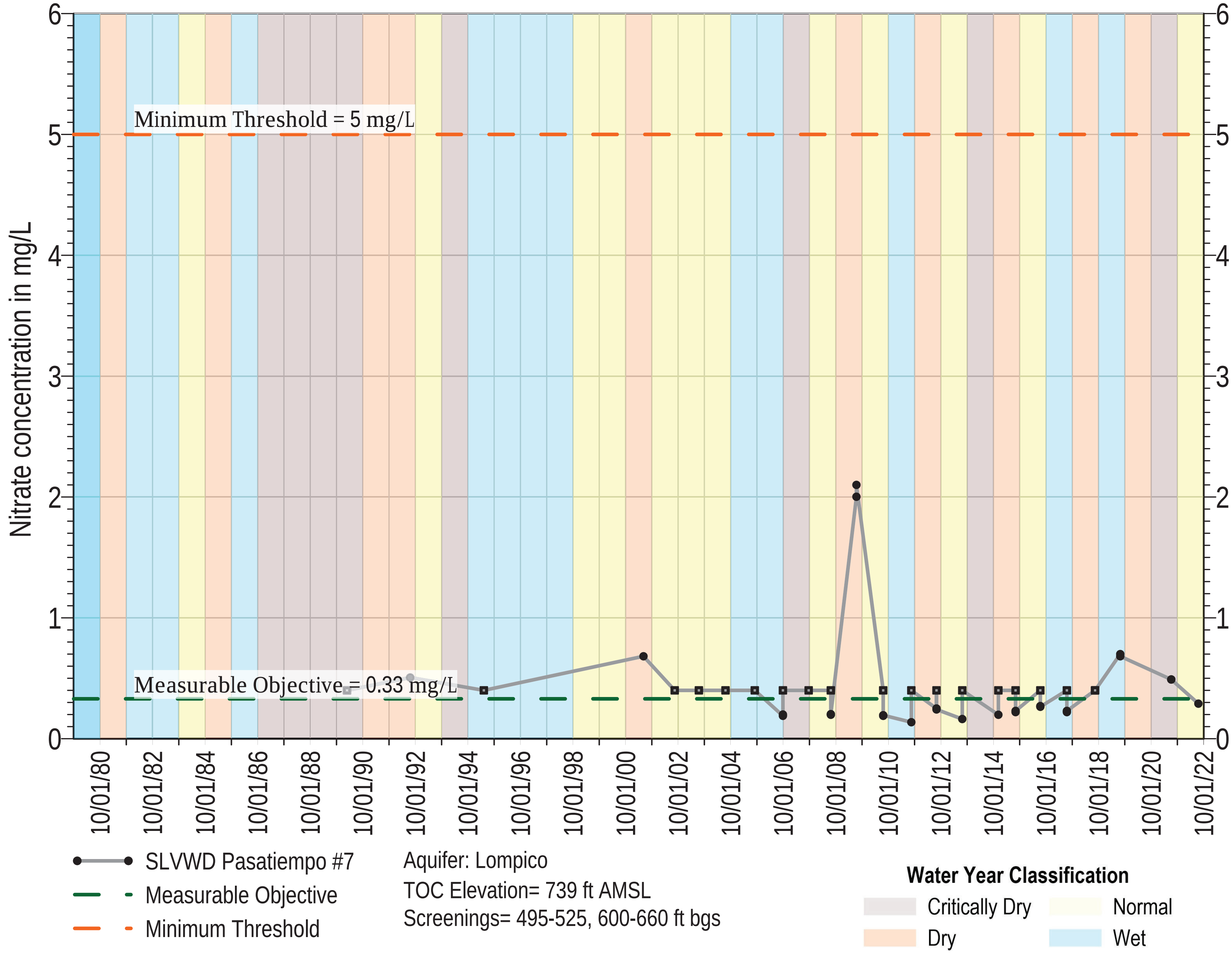

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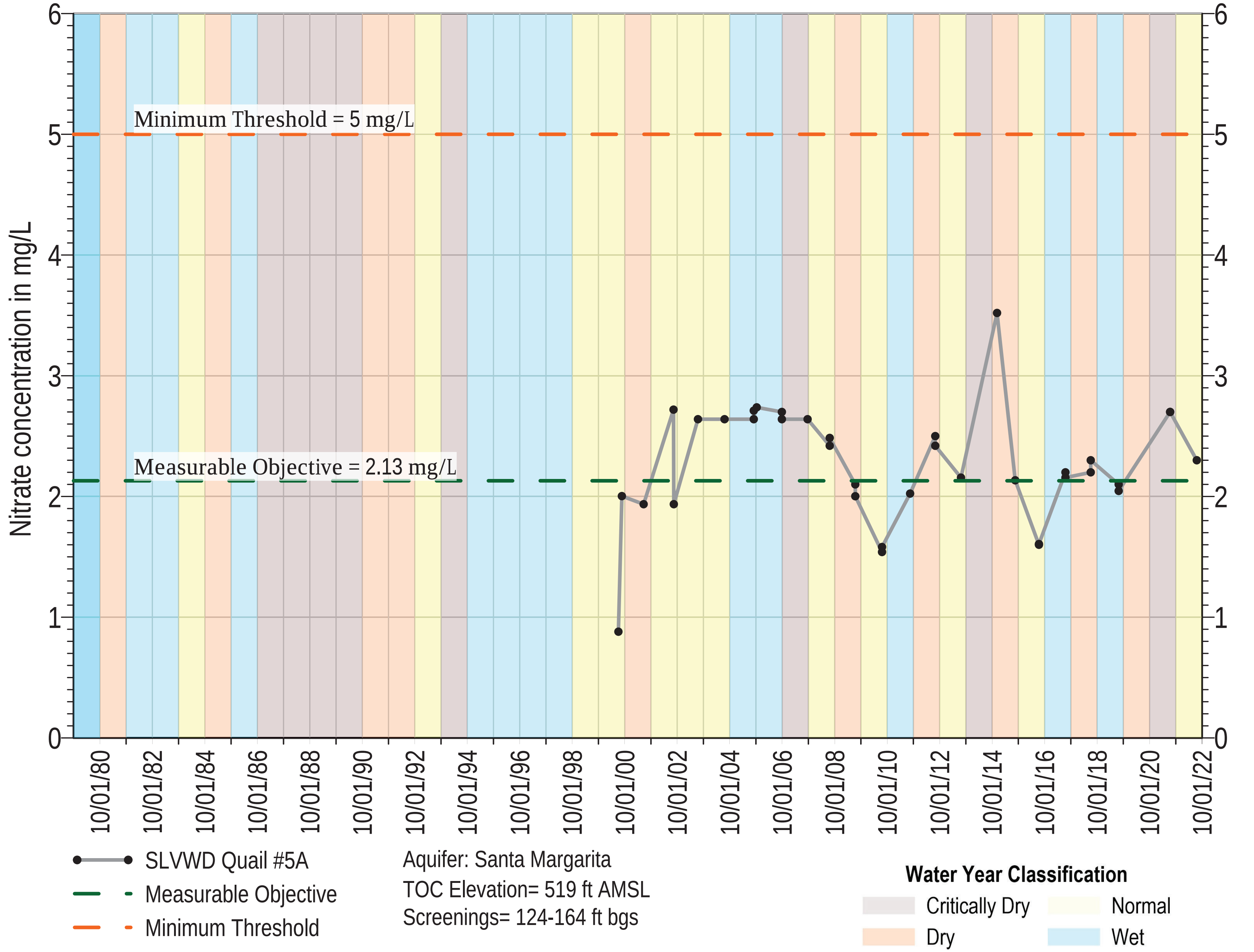

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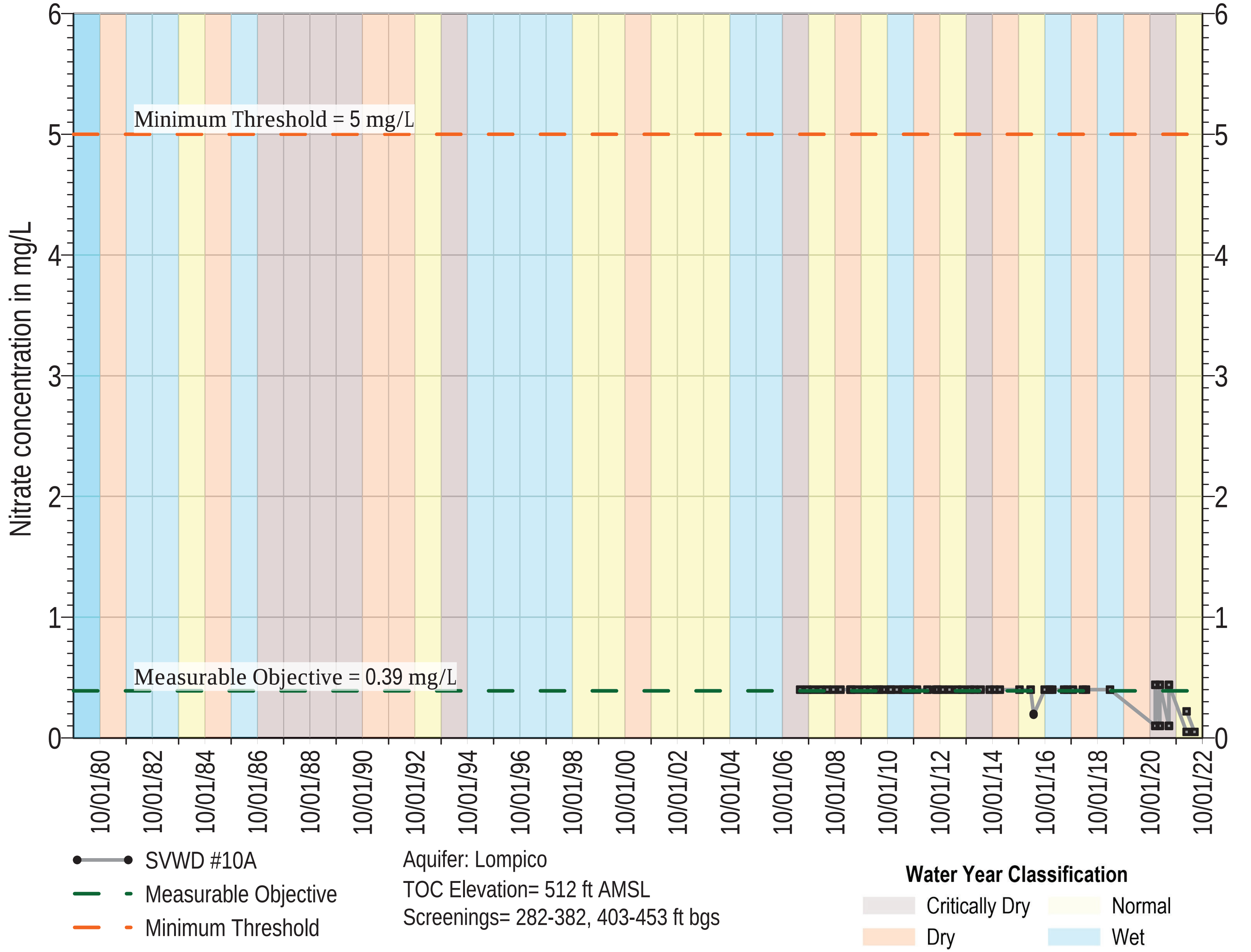

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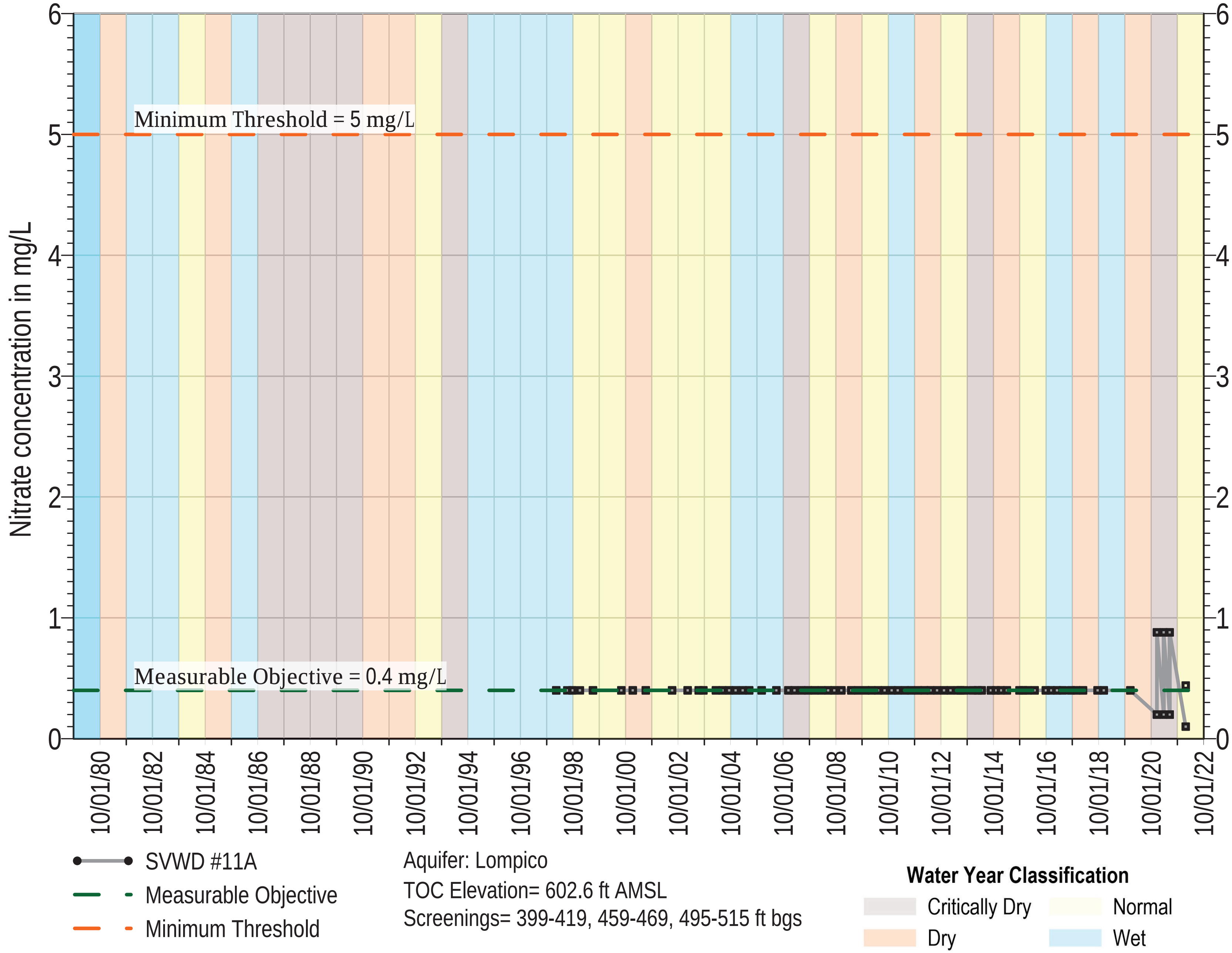

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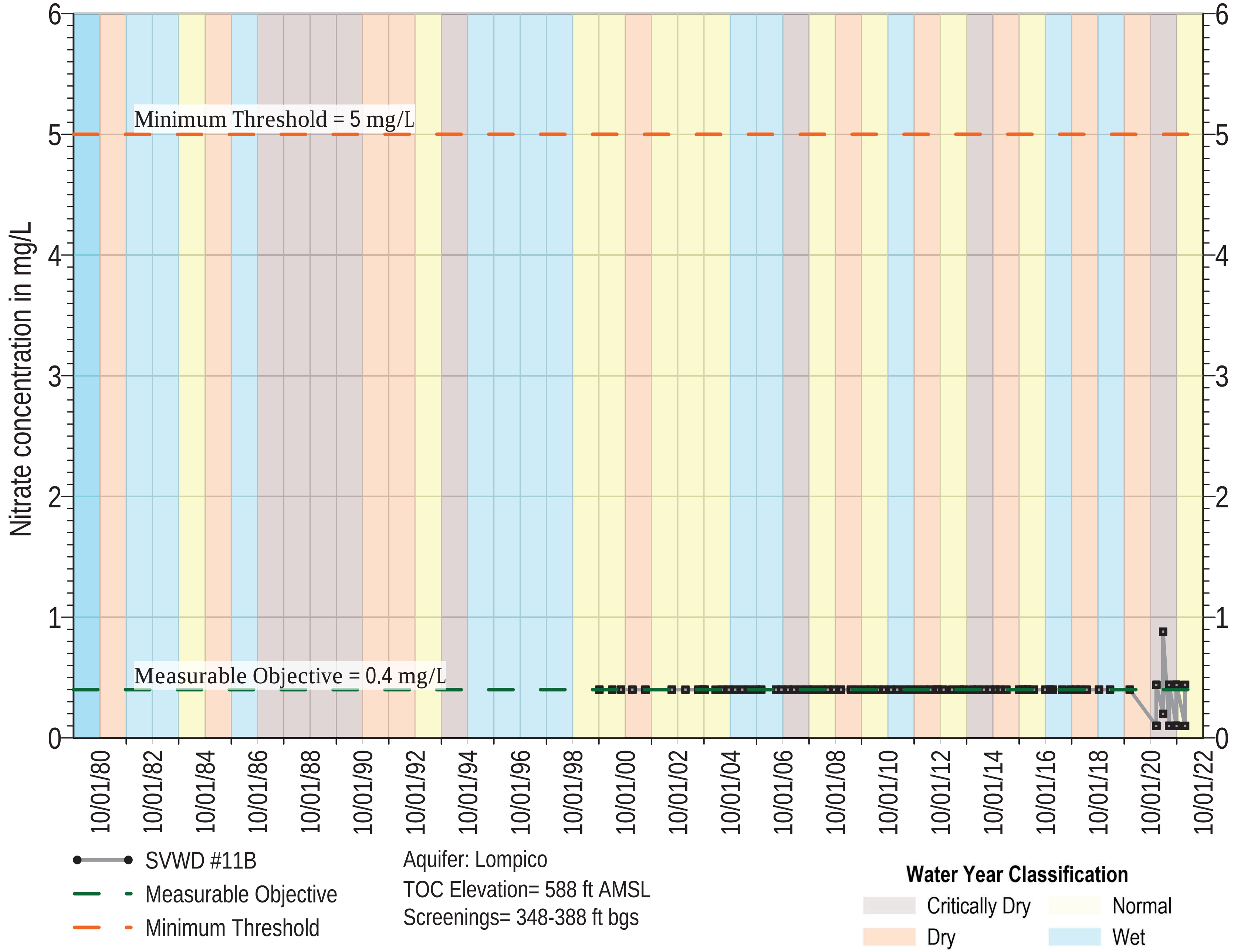

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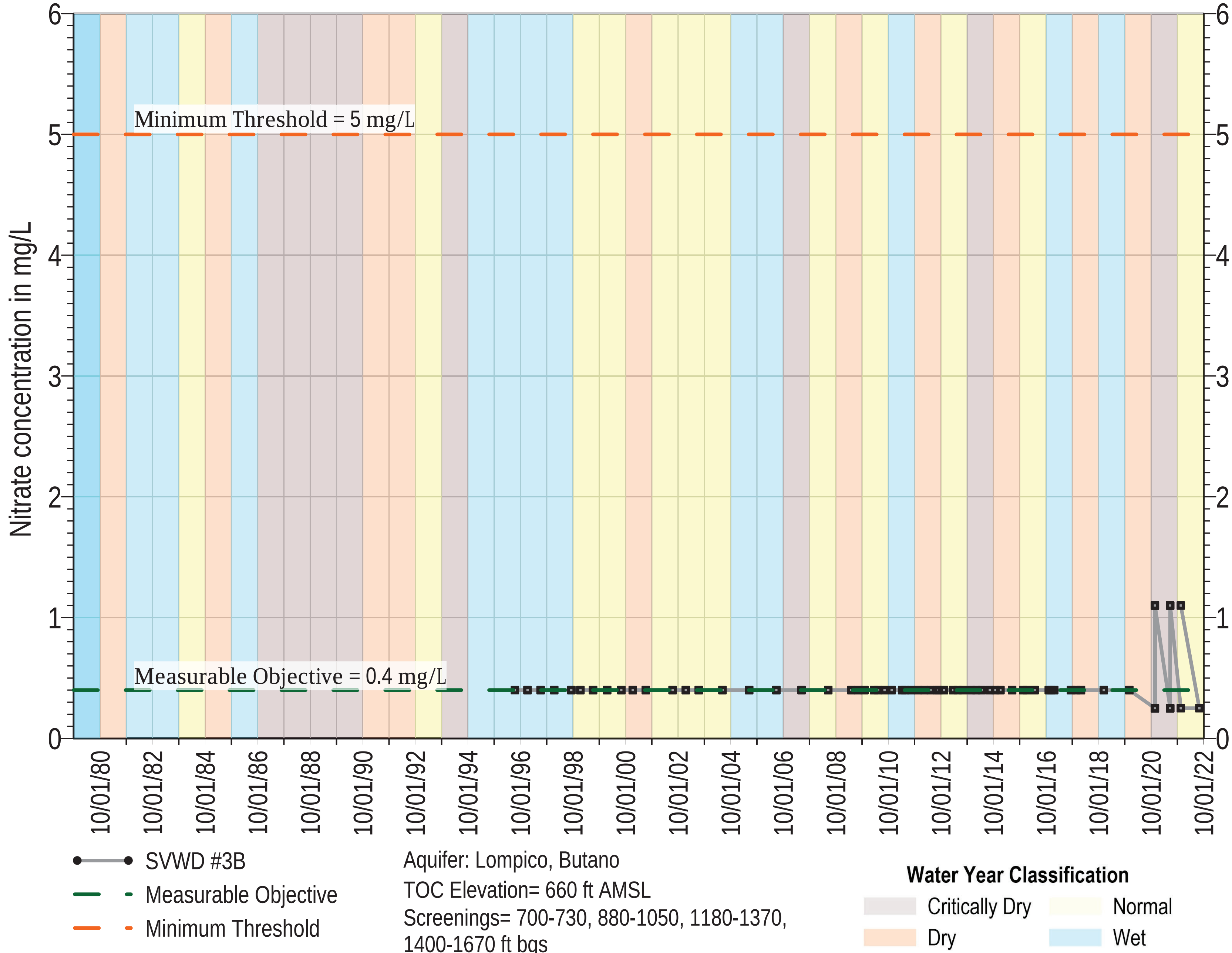

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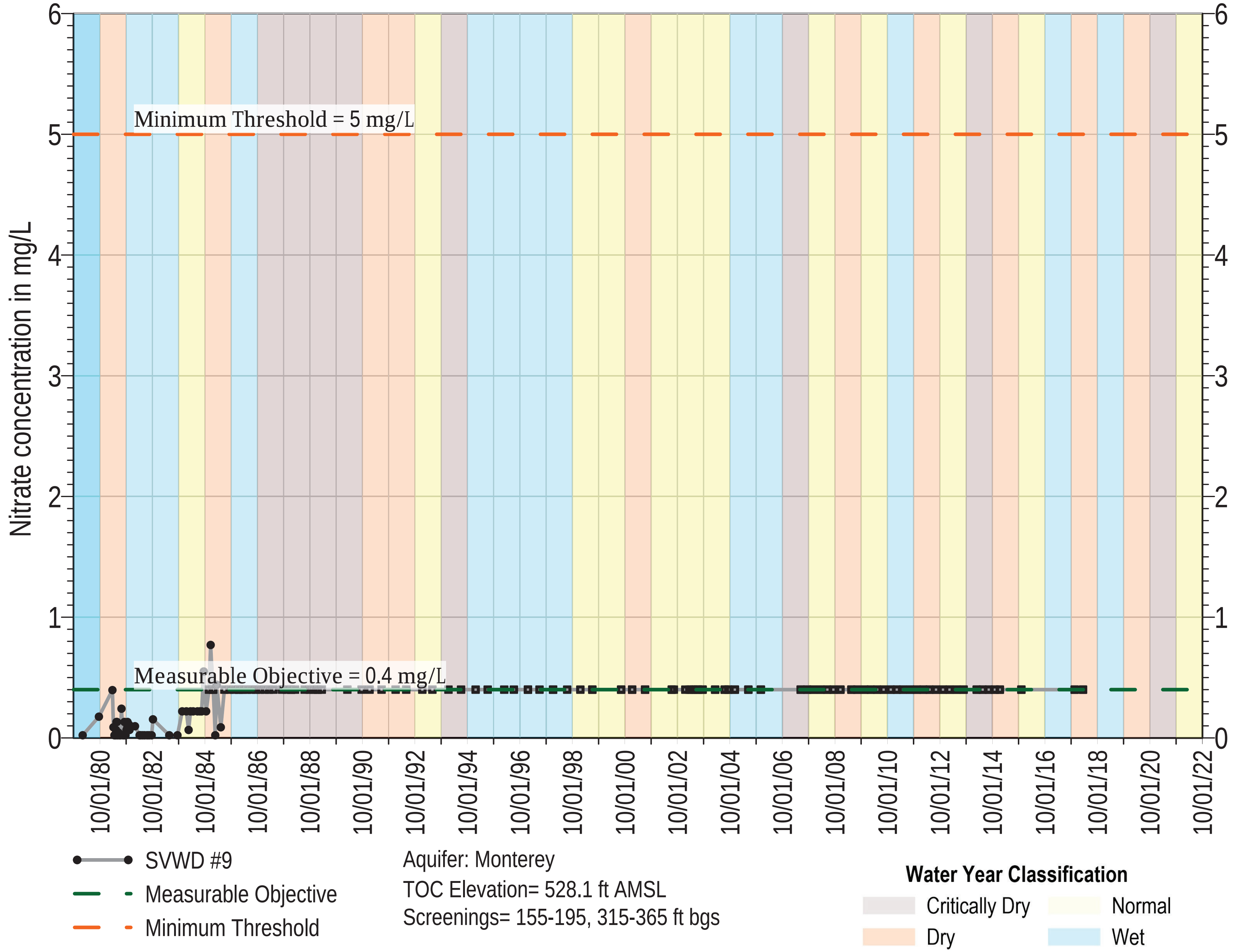

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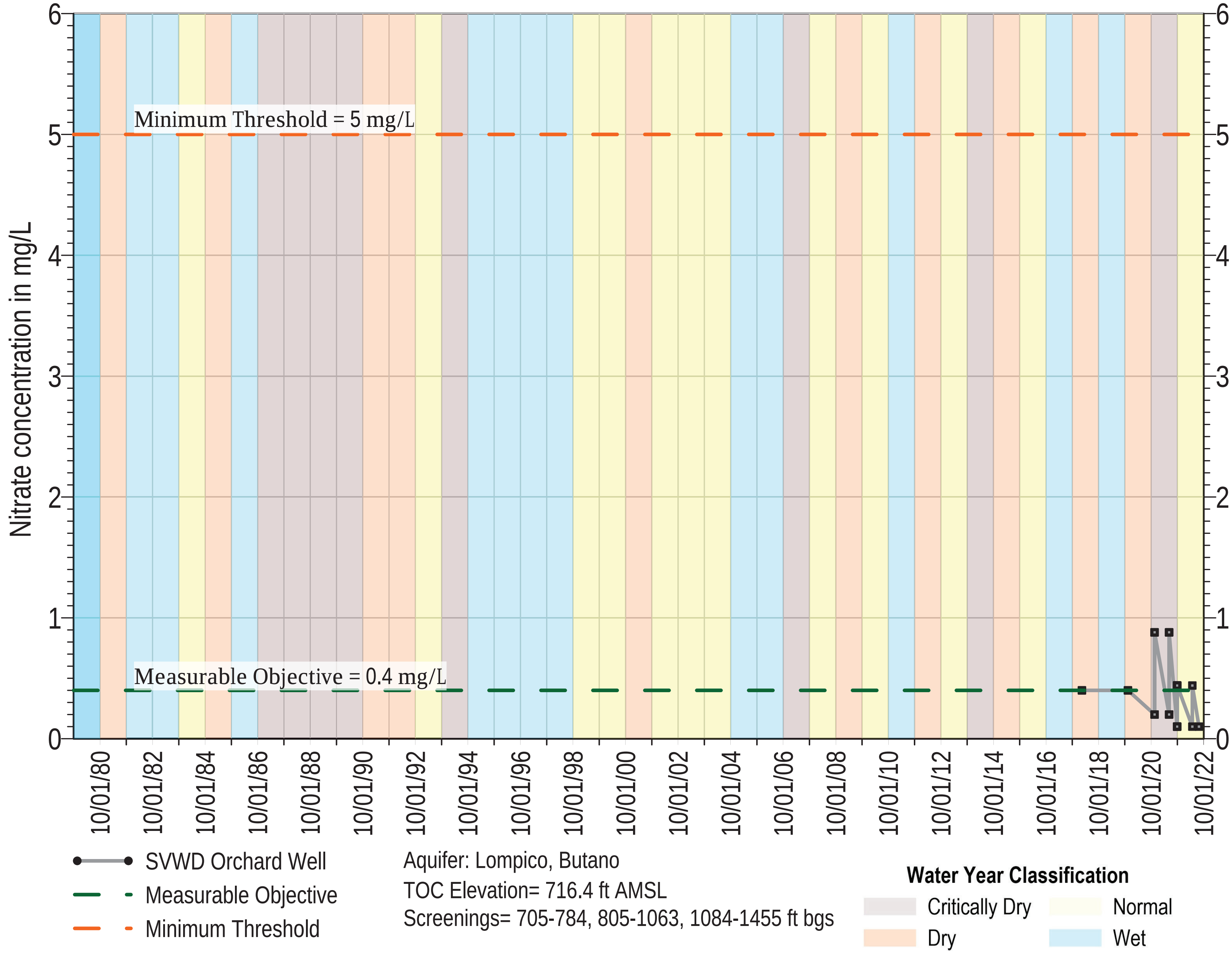

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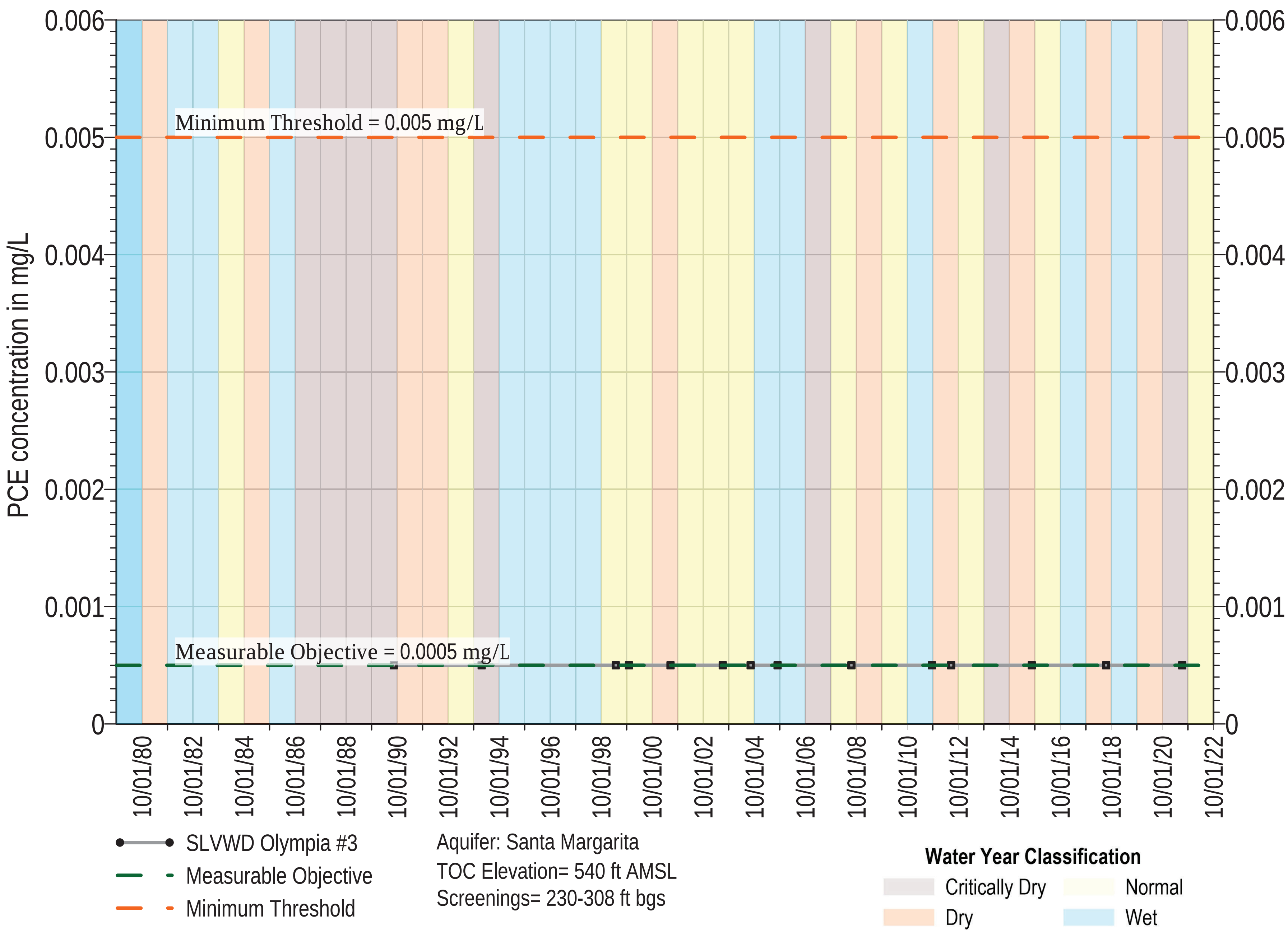
PCE



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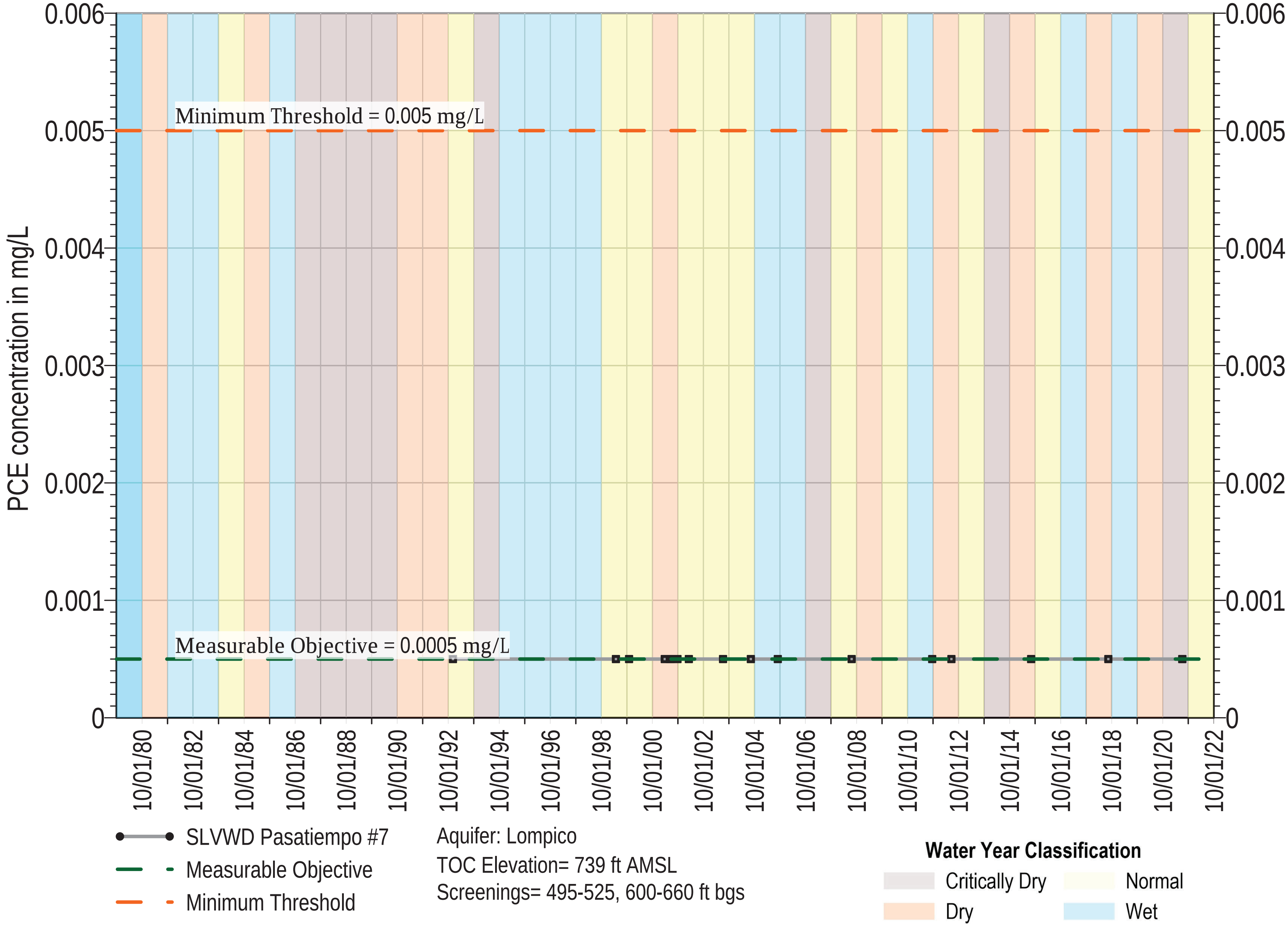

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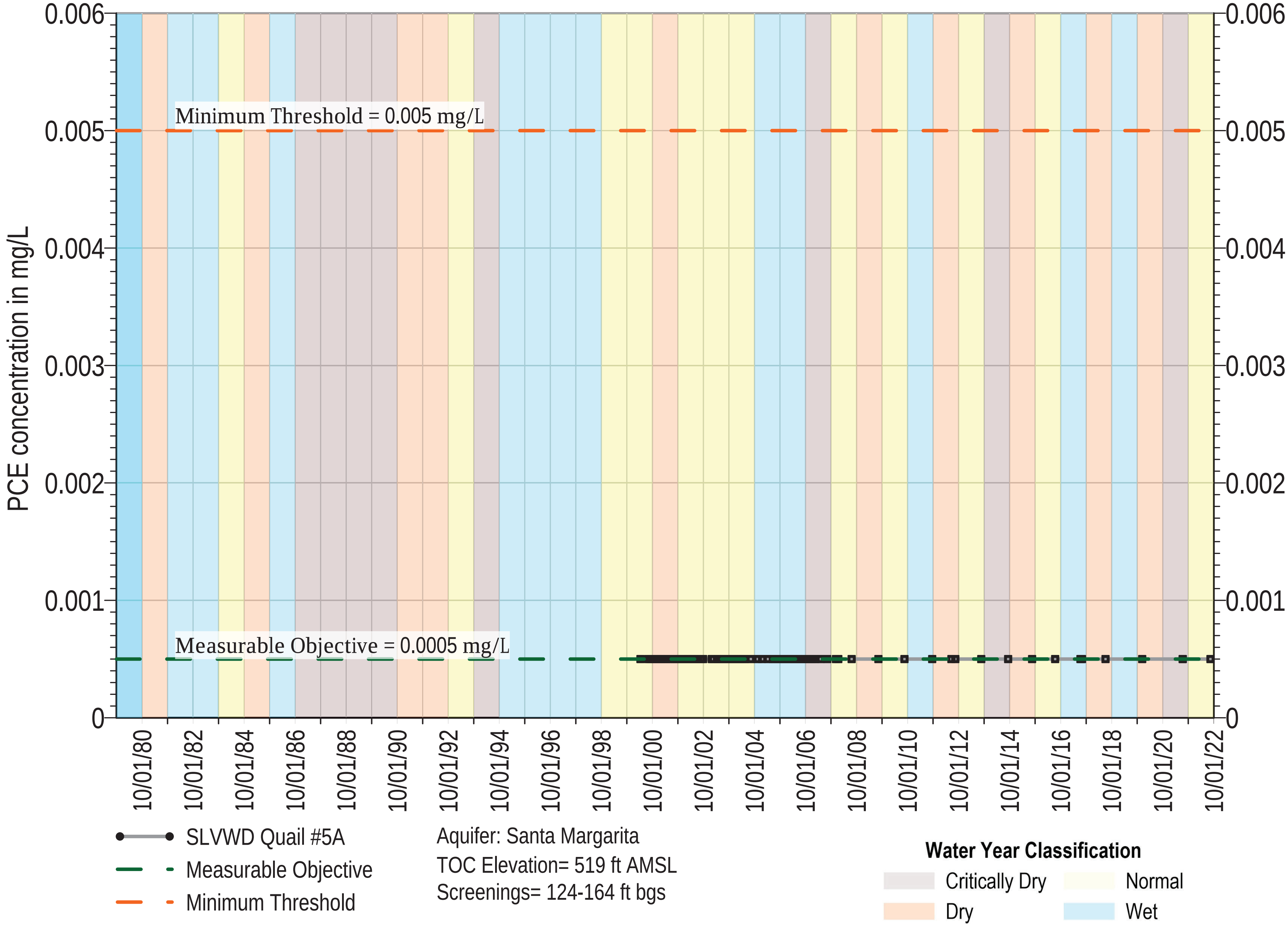

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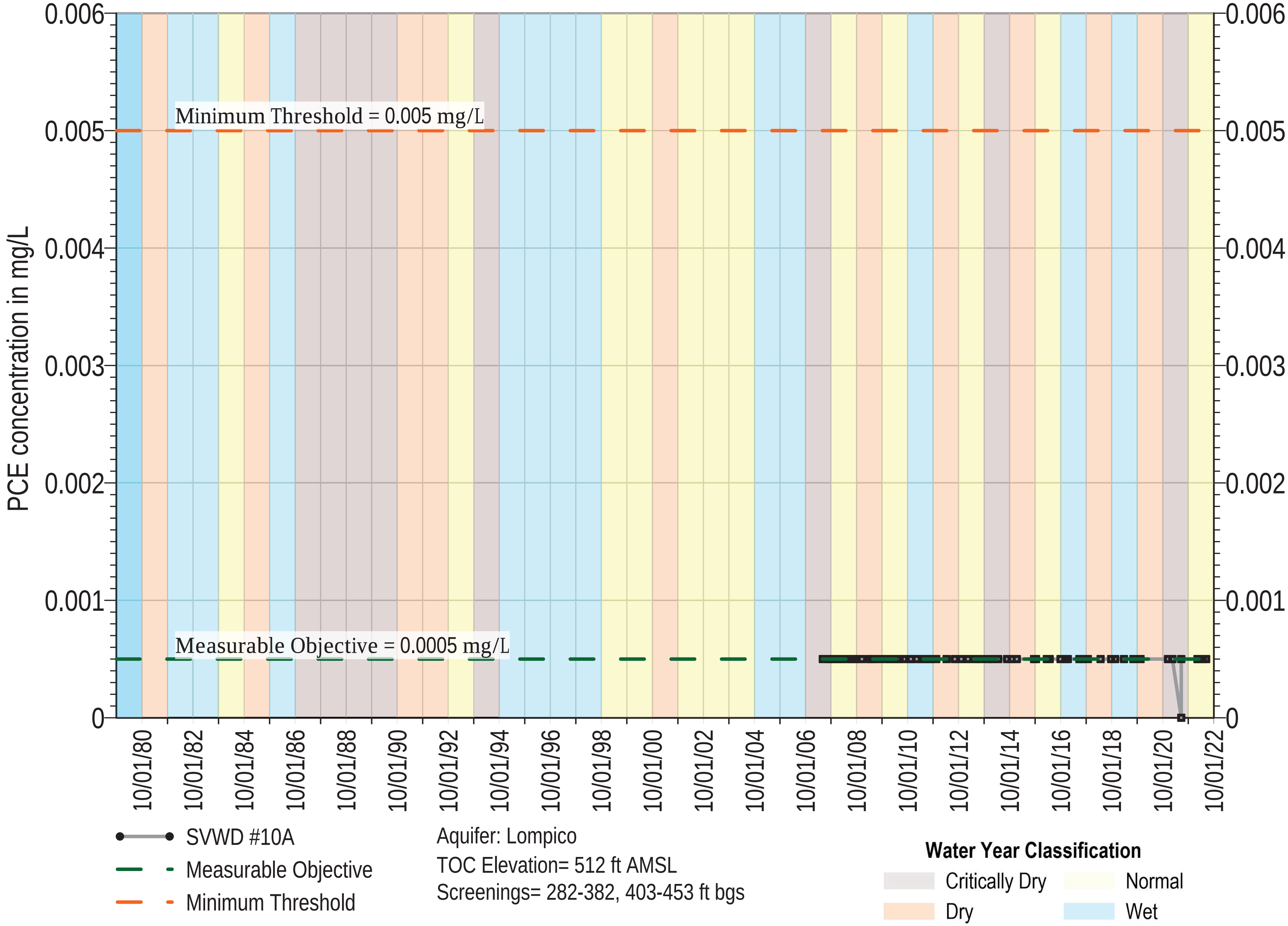

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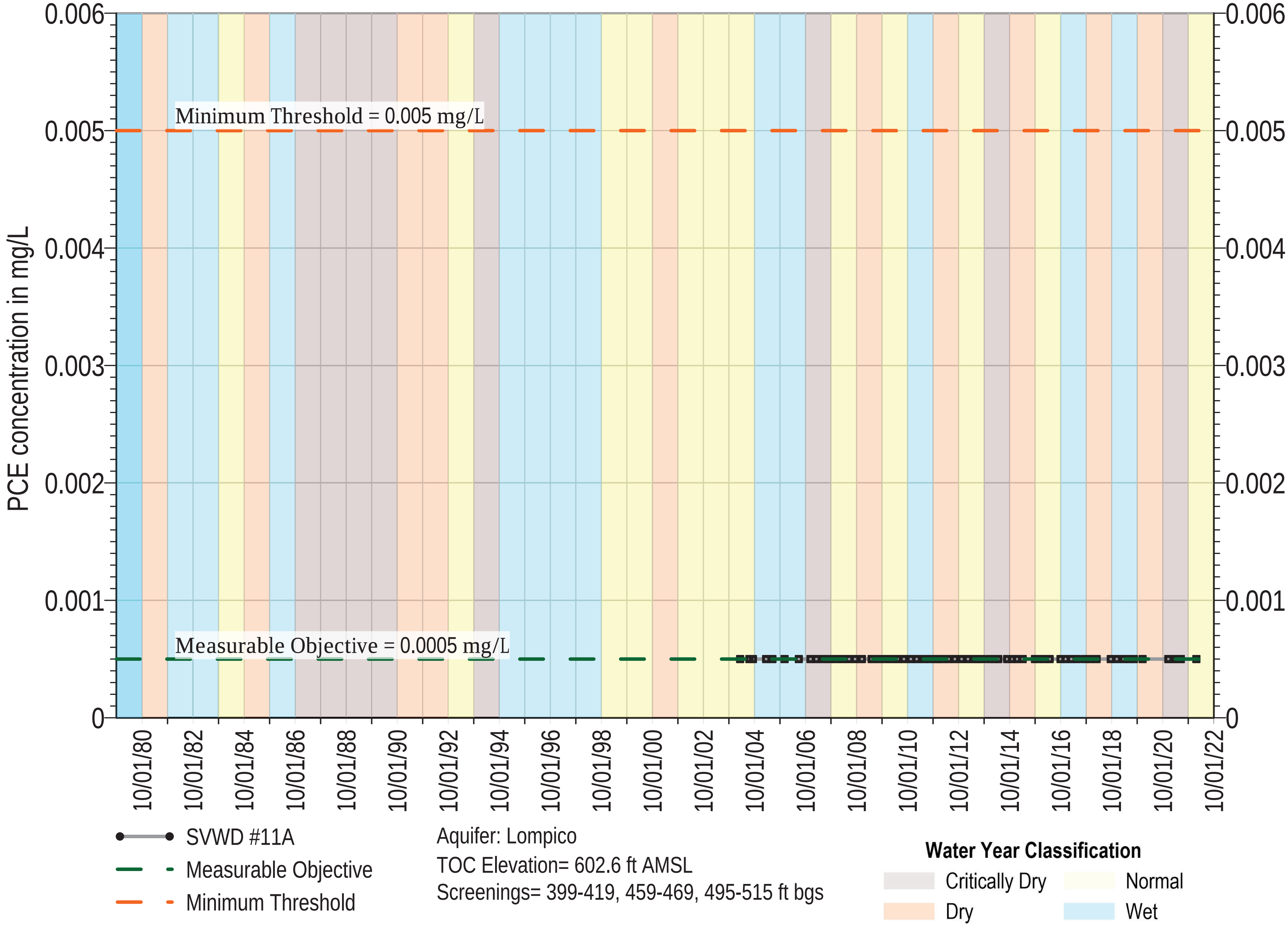

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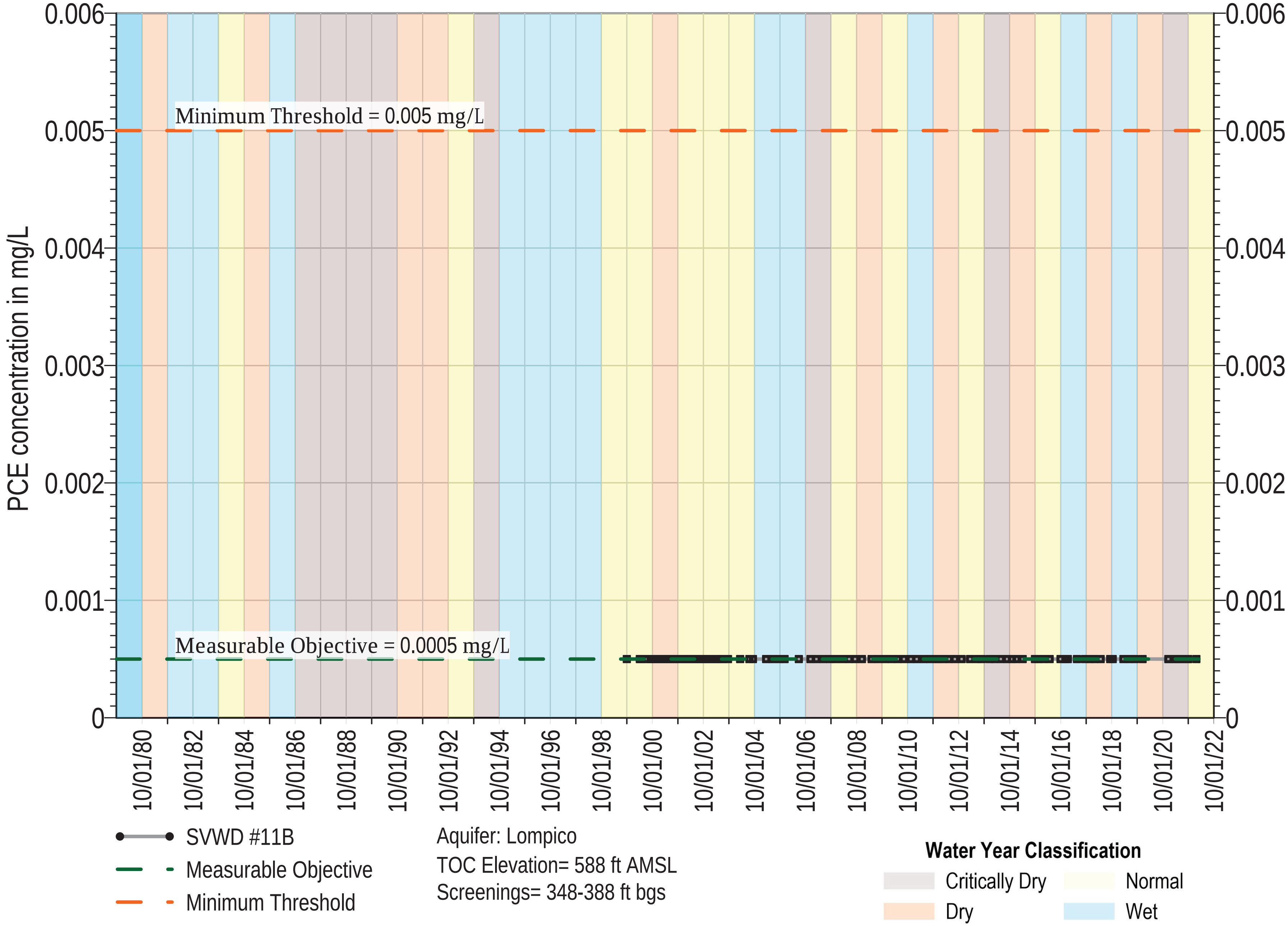

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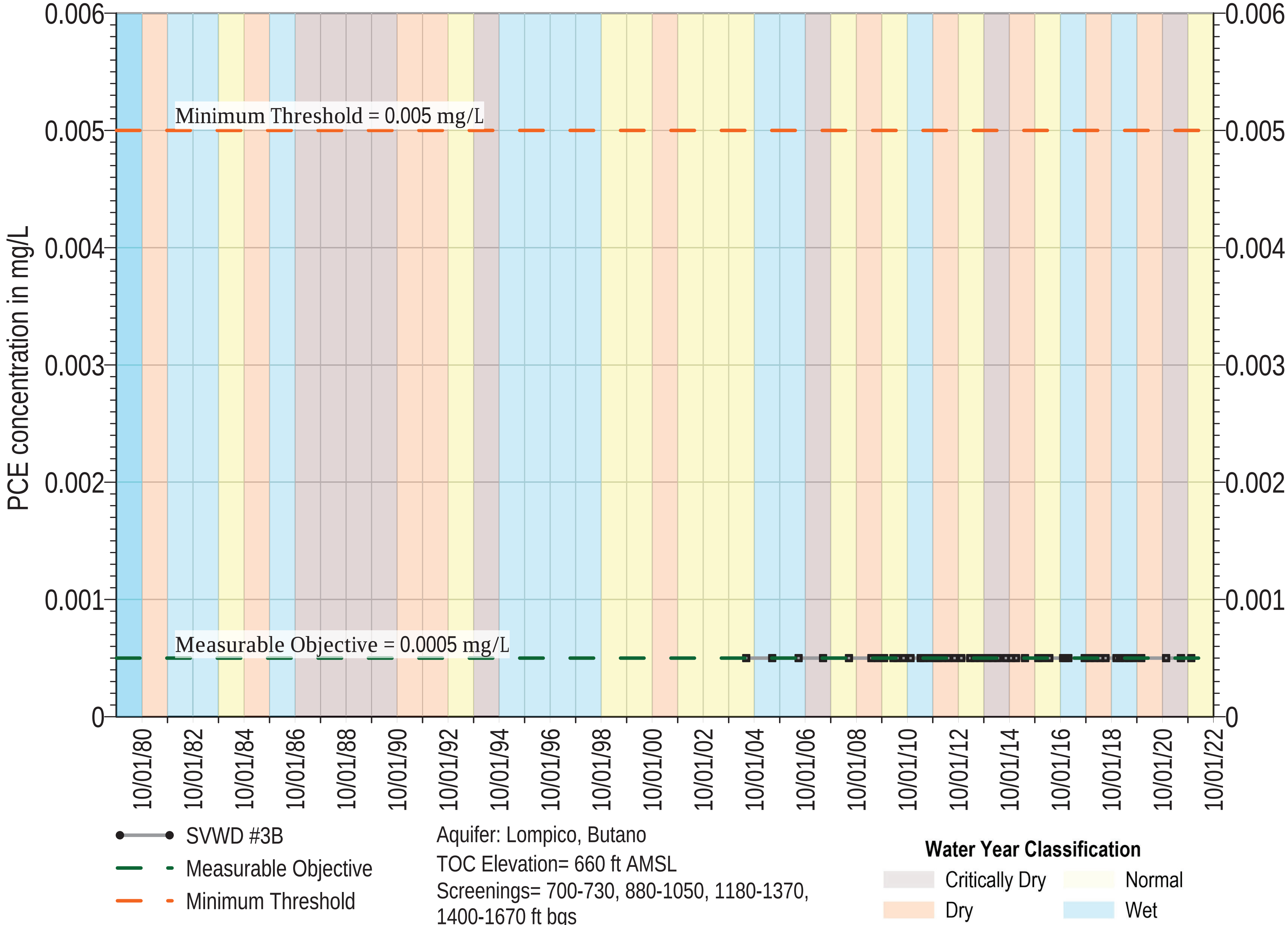

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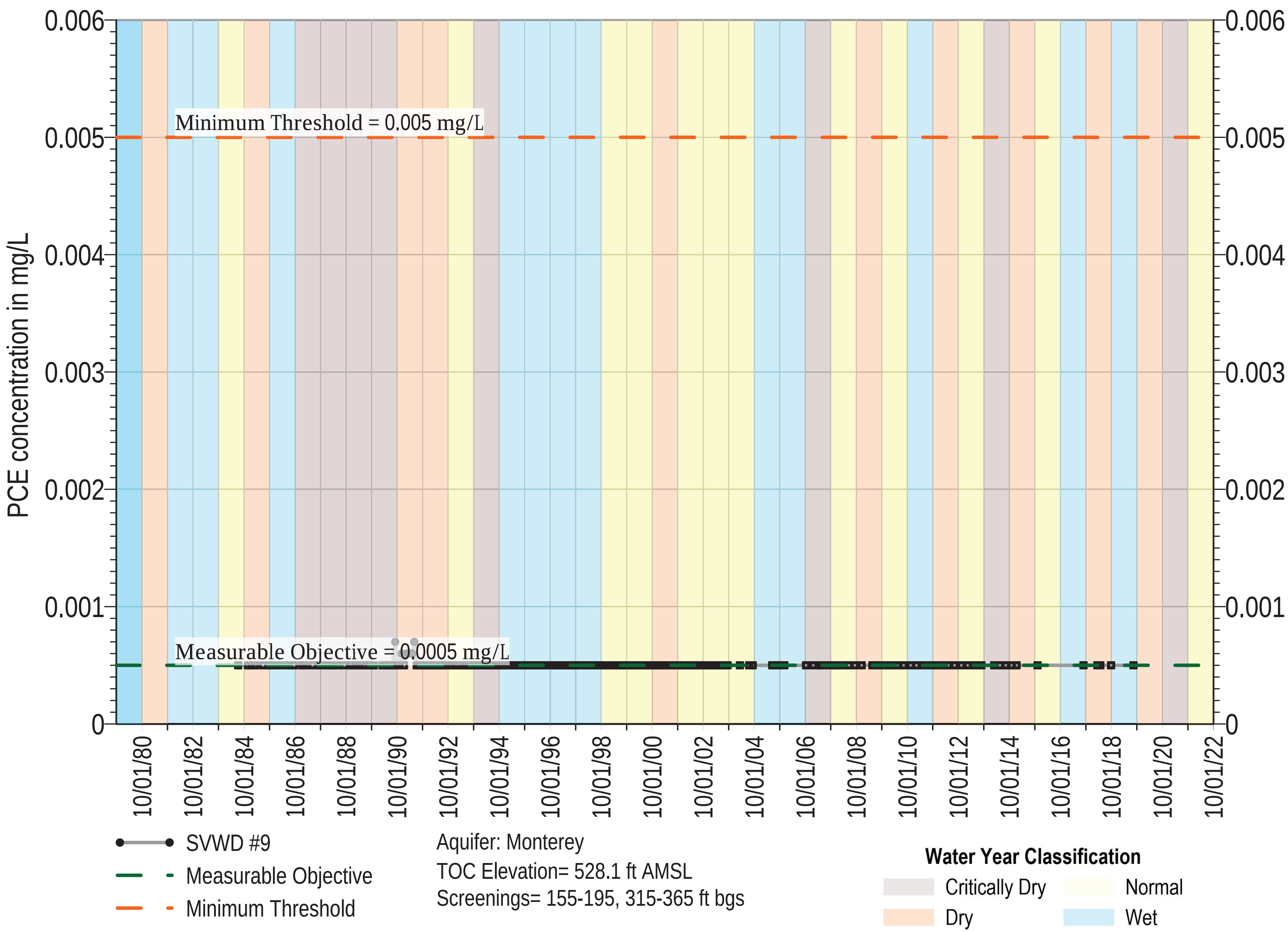

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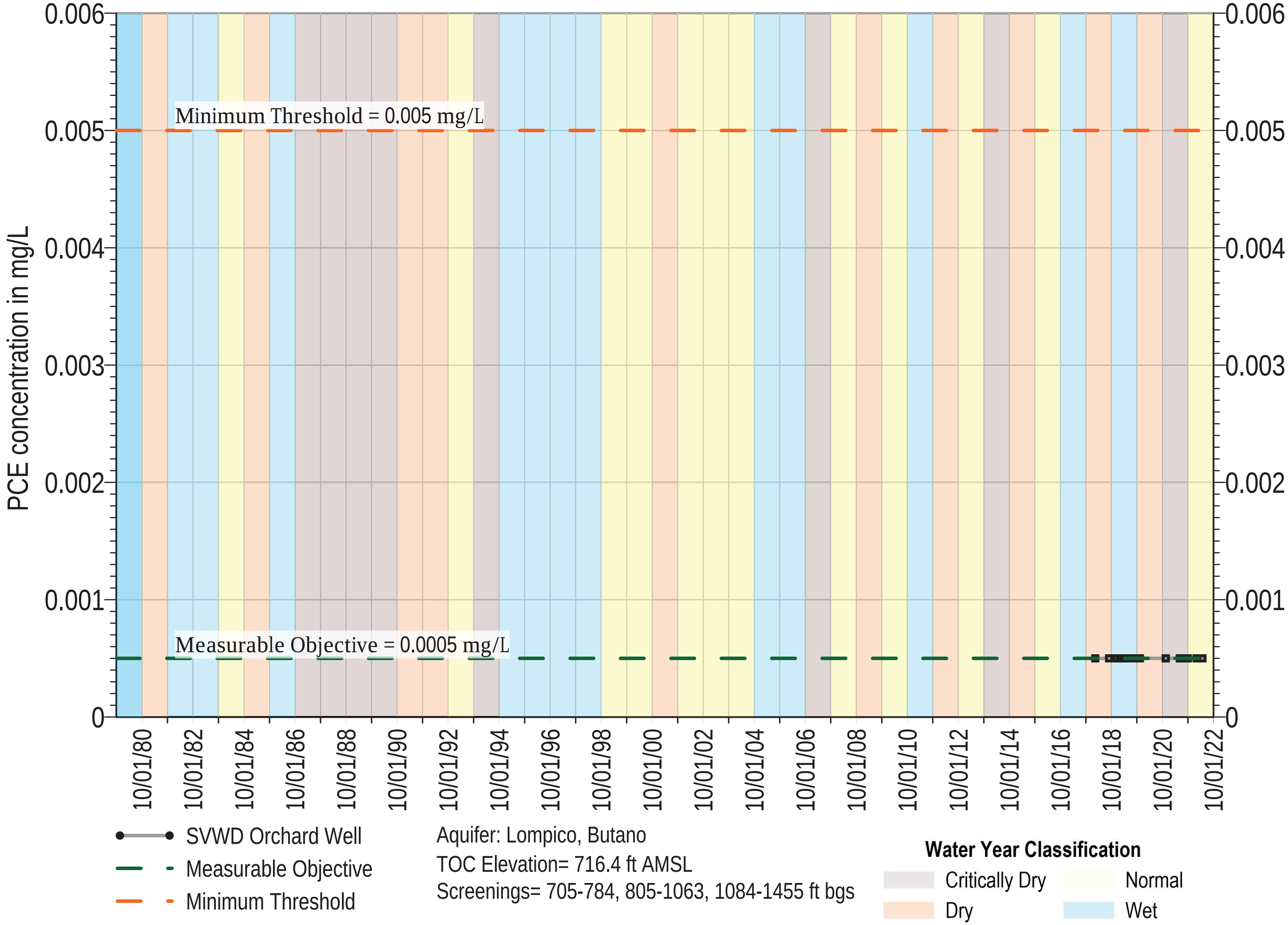

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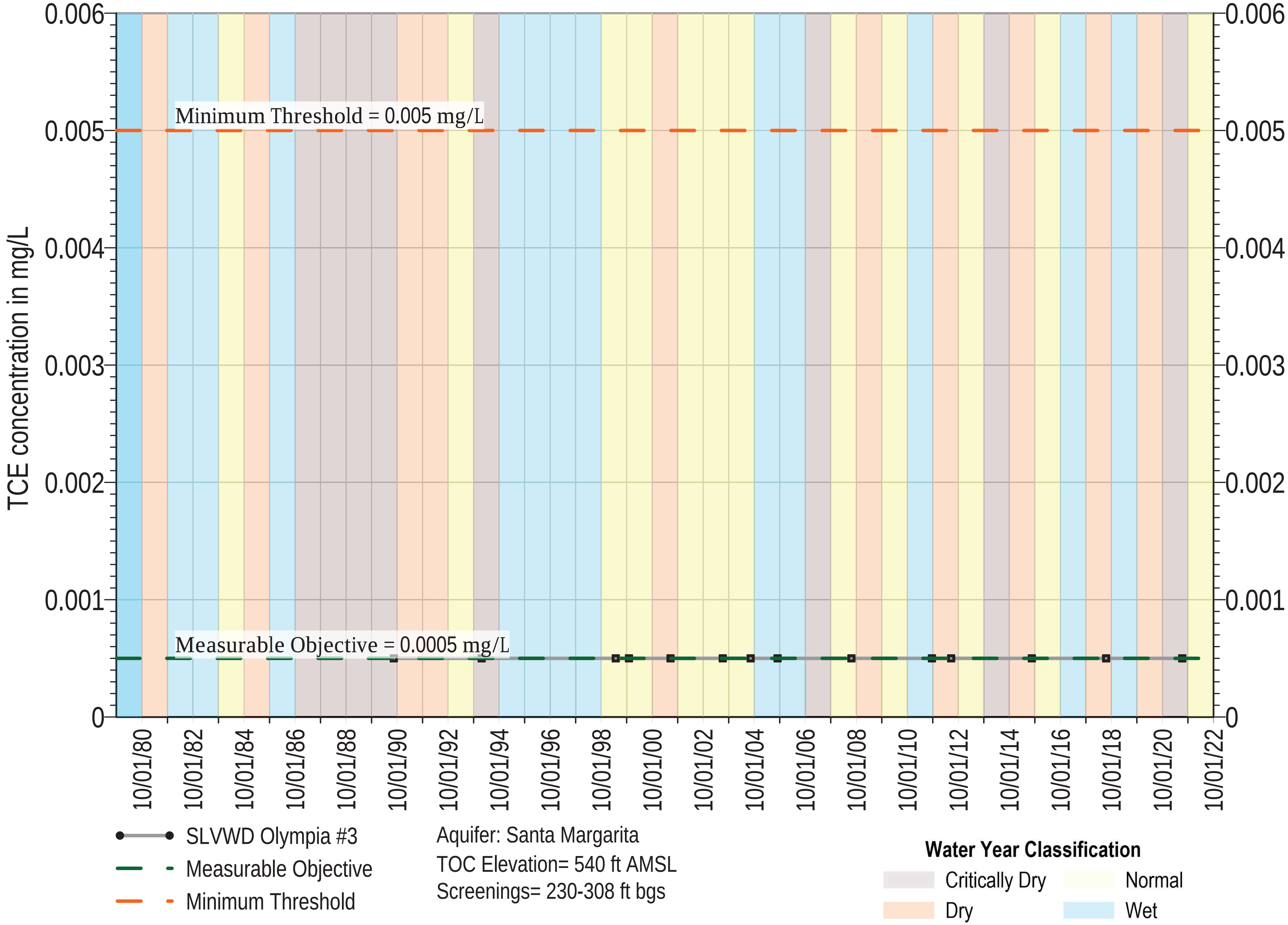
TCE



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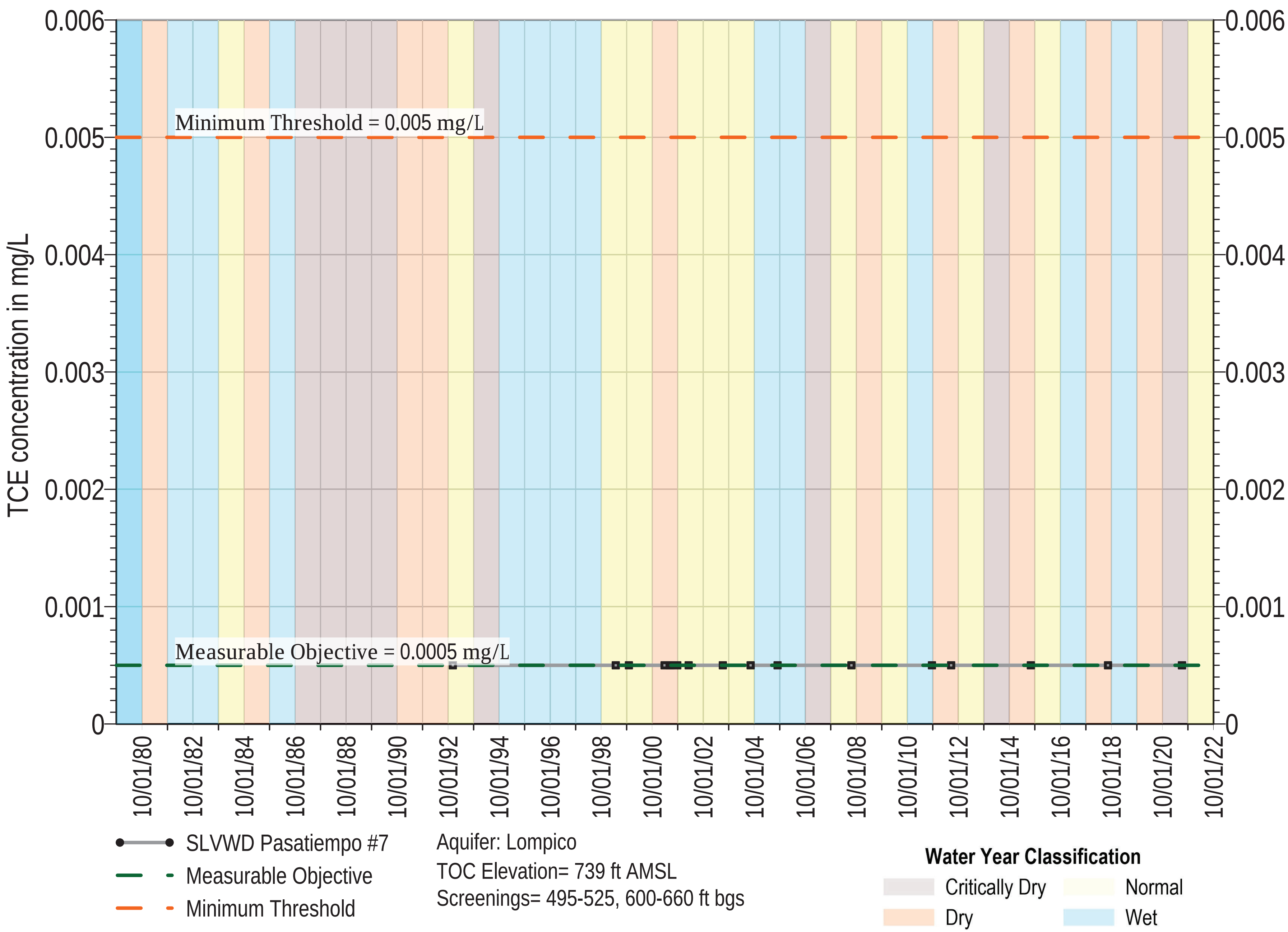

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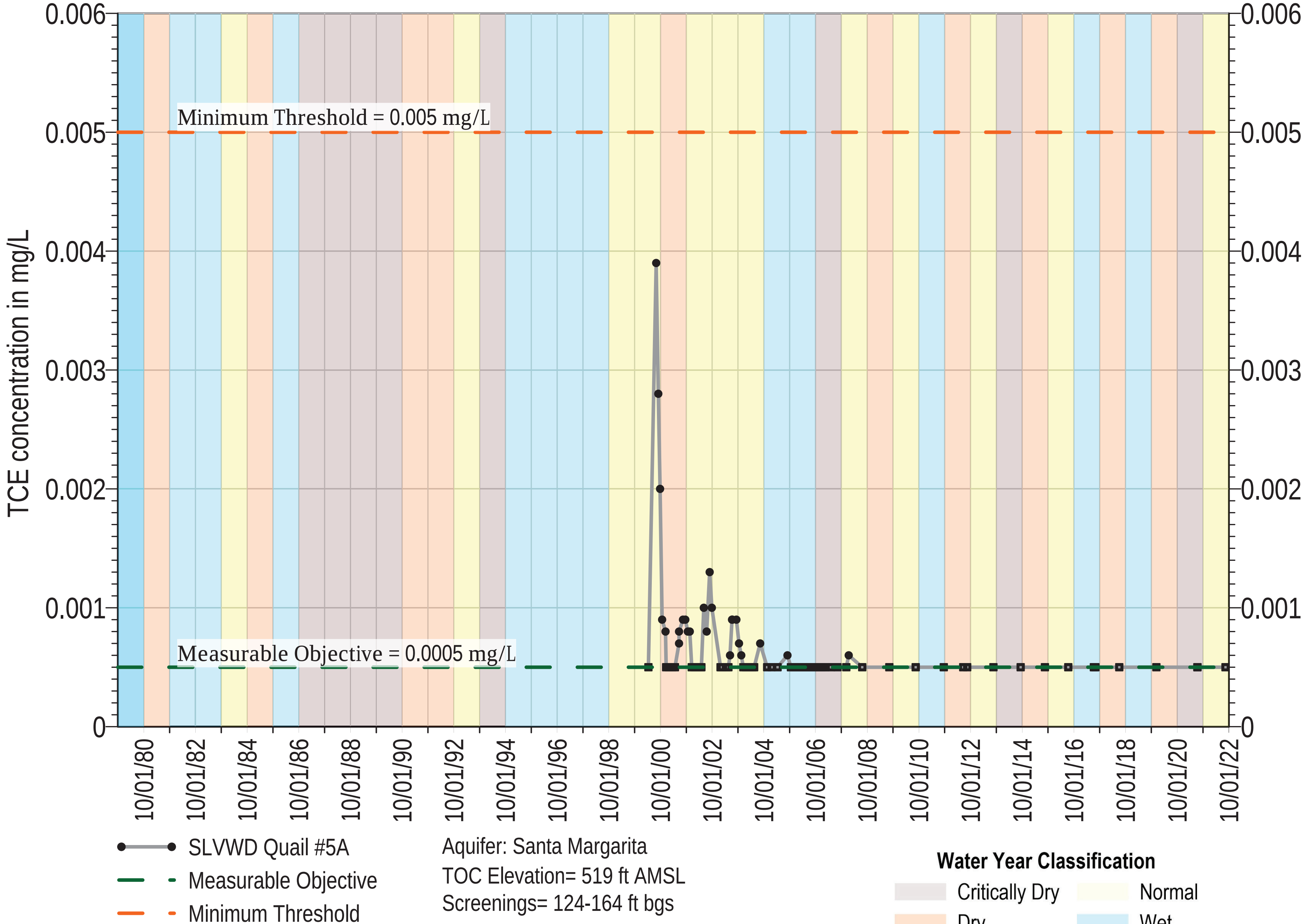

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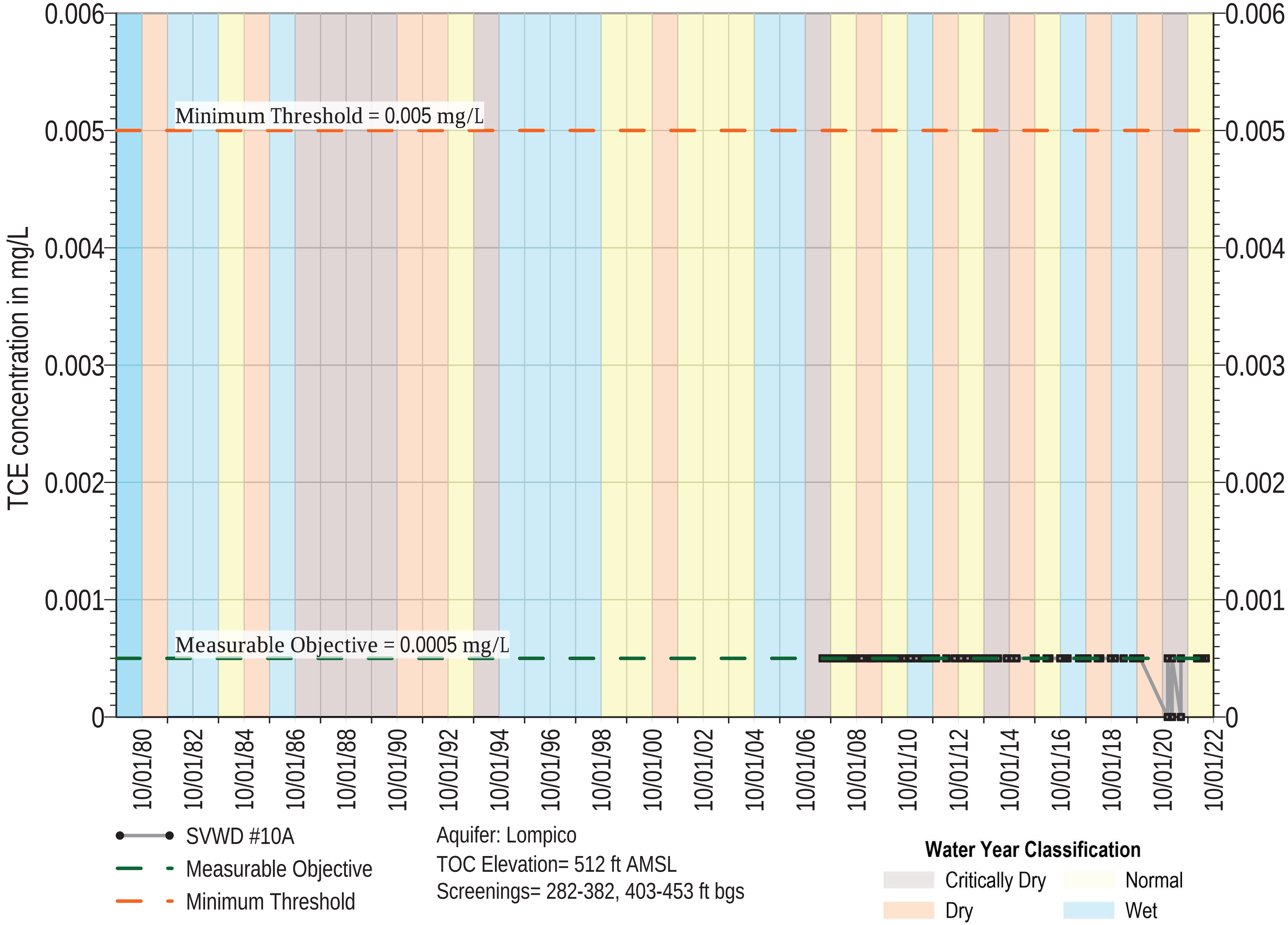

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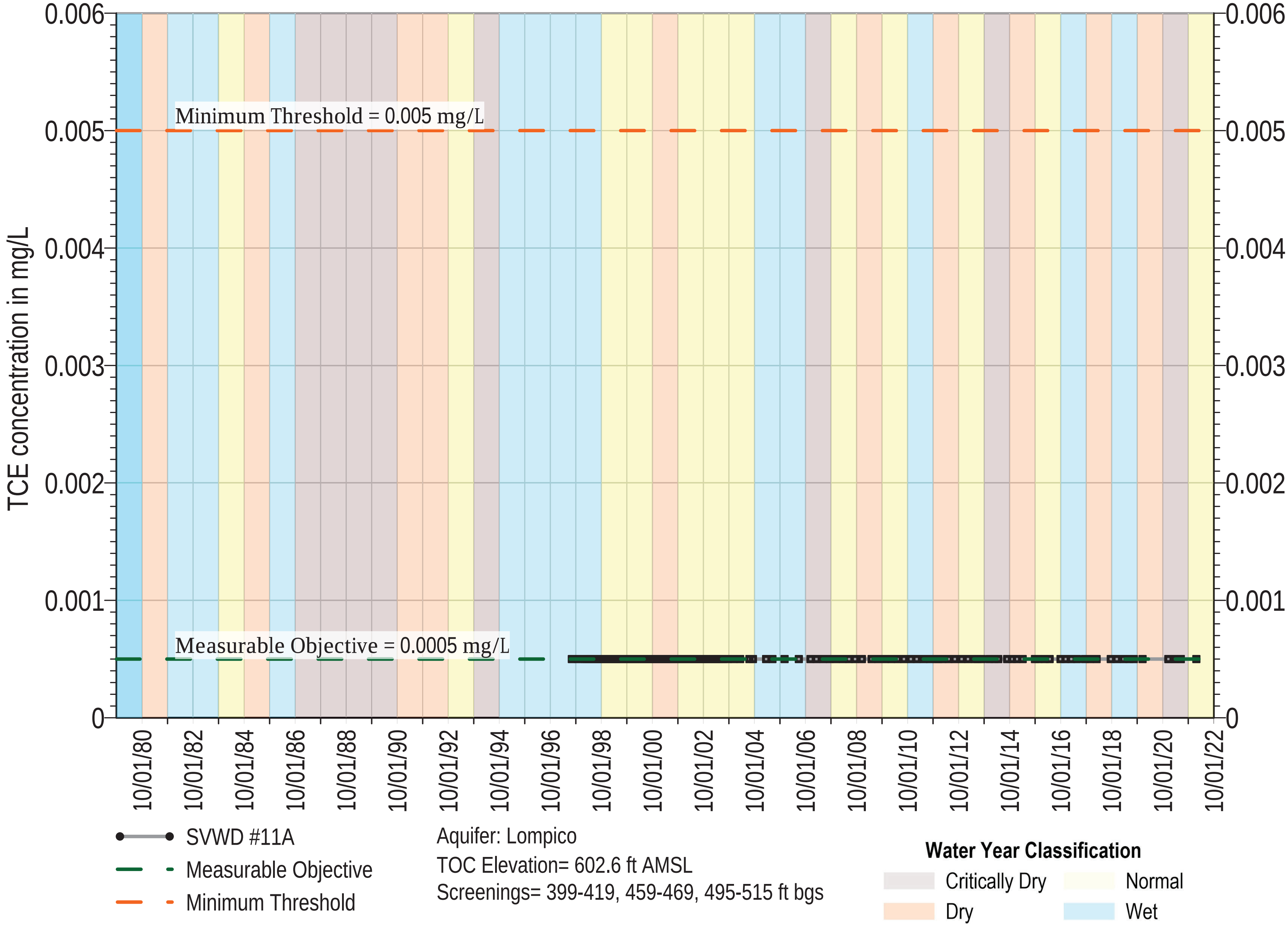

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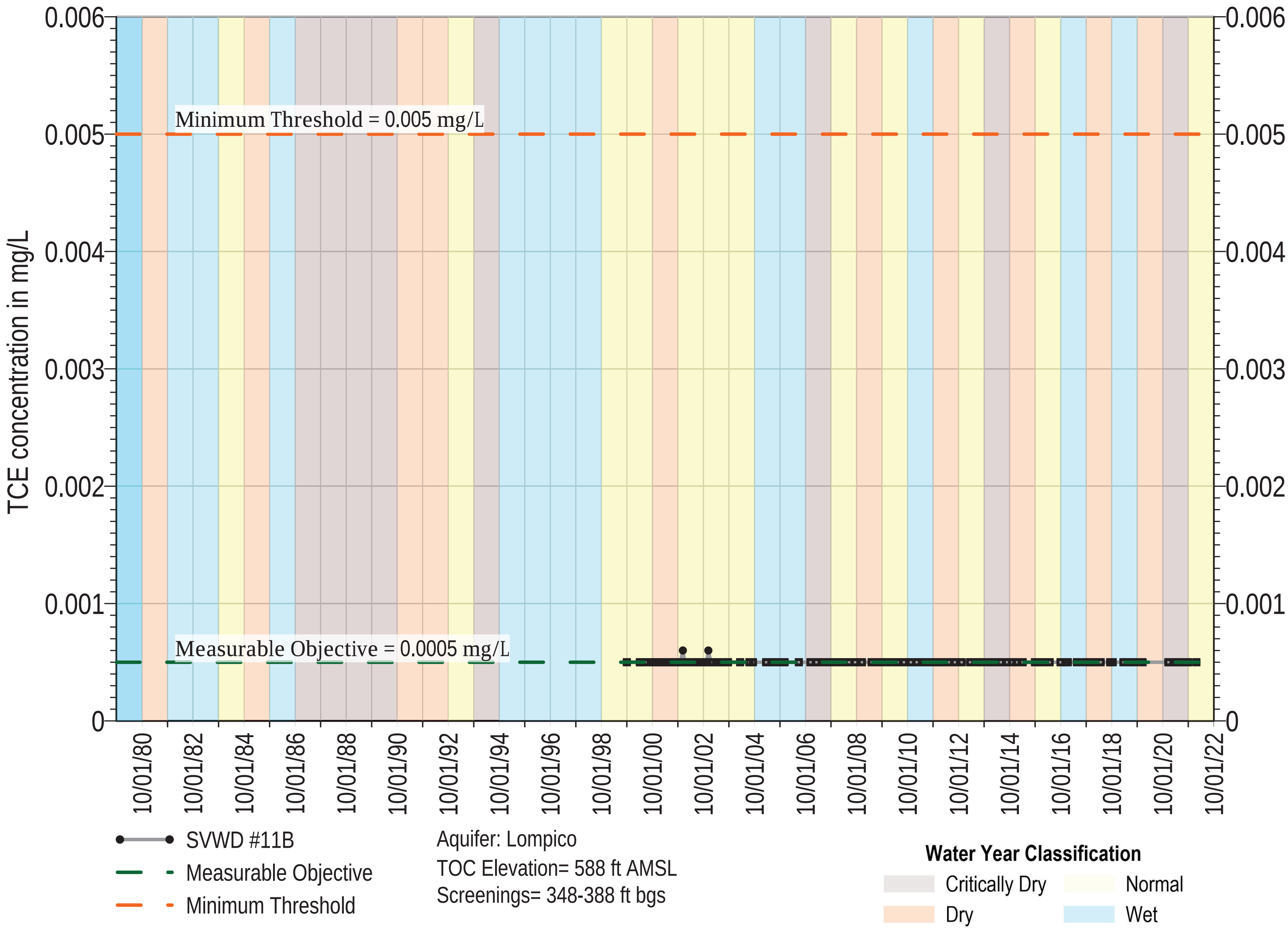

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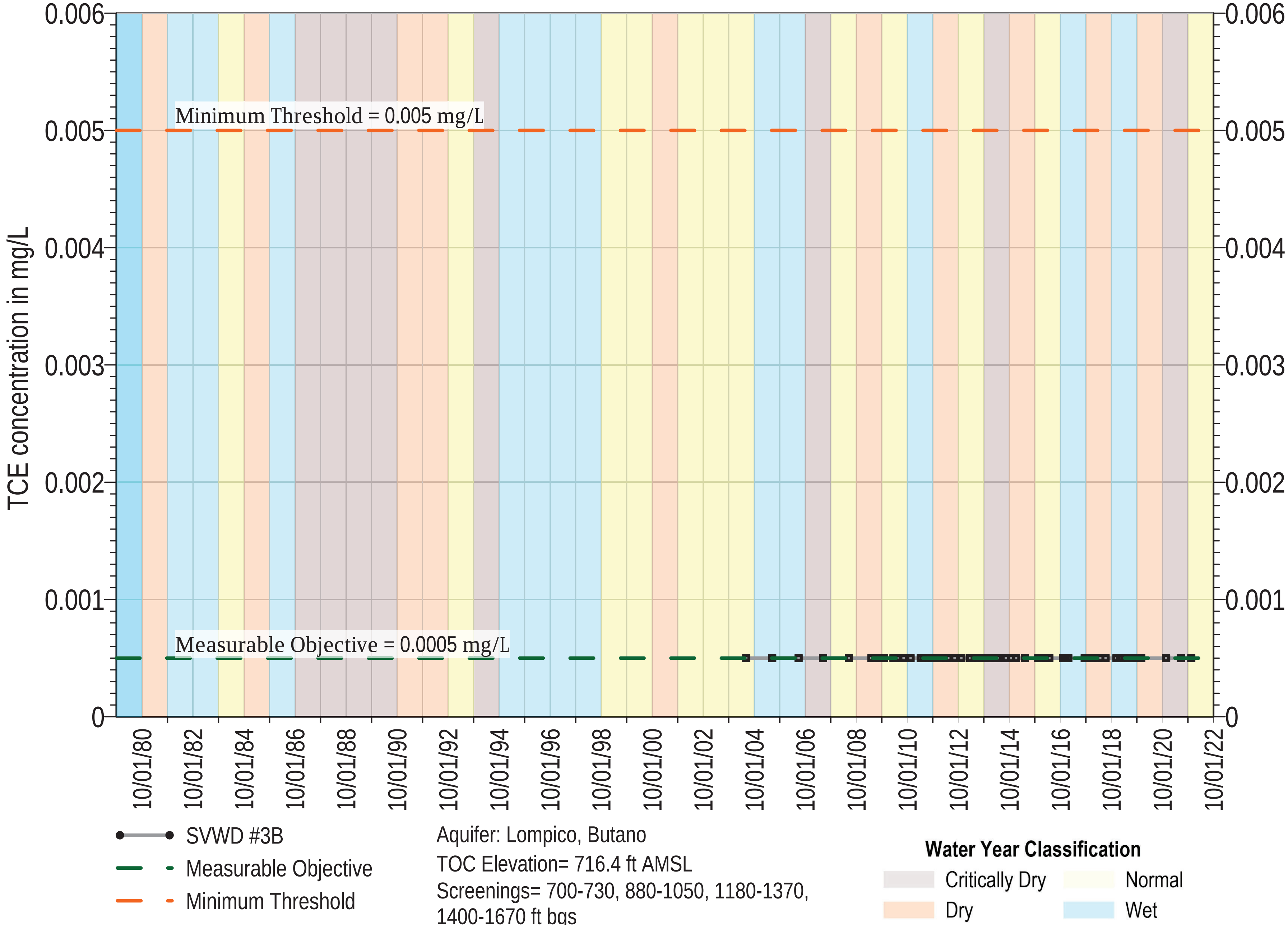

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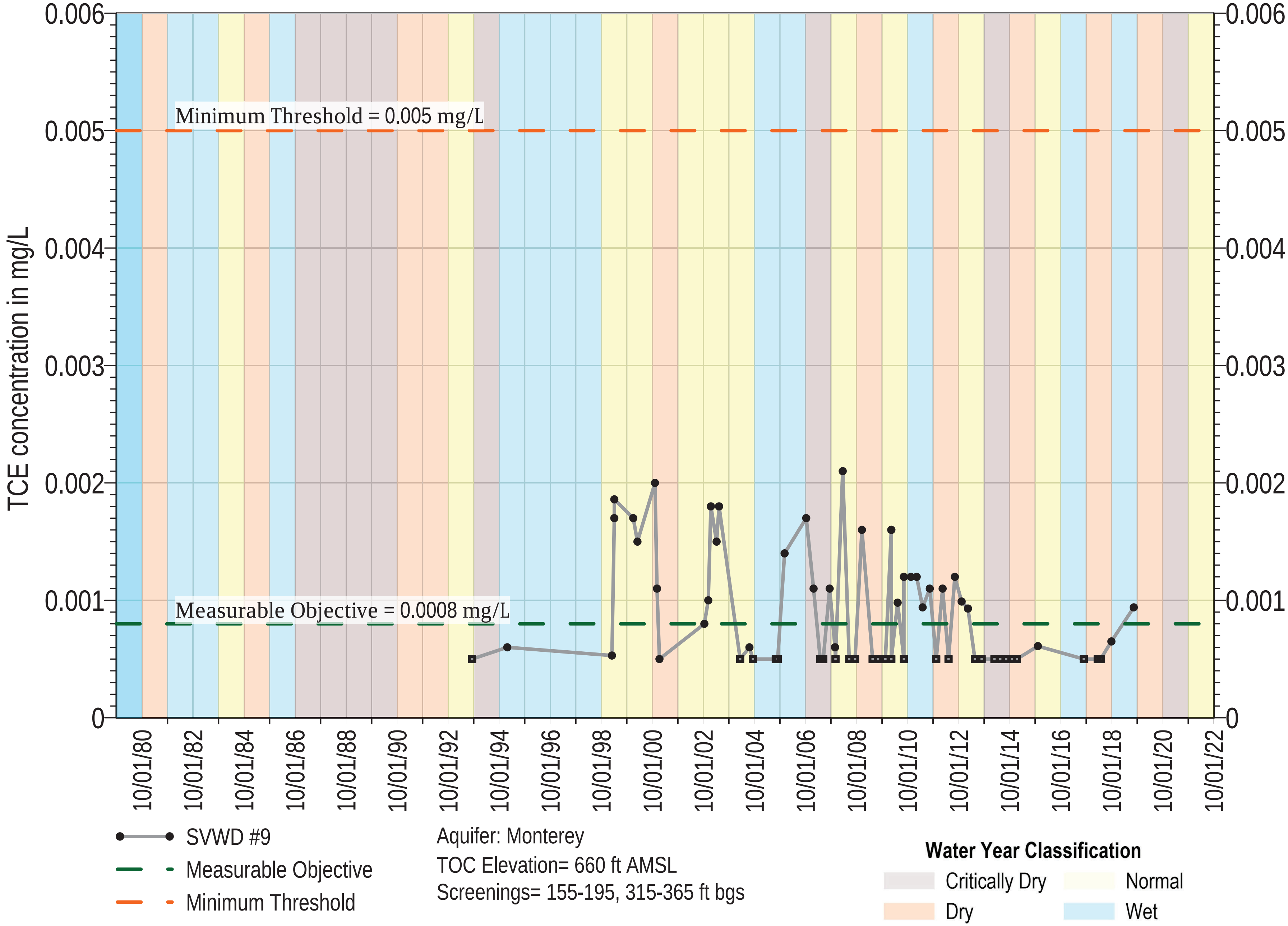

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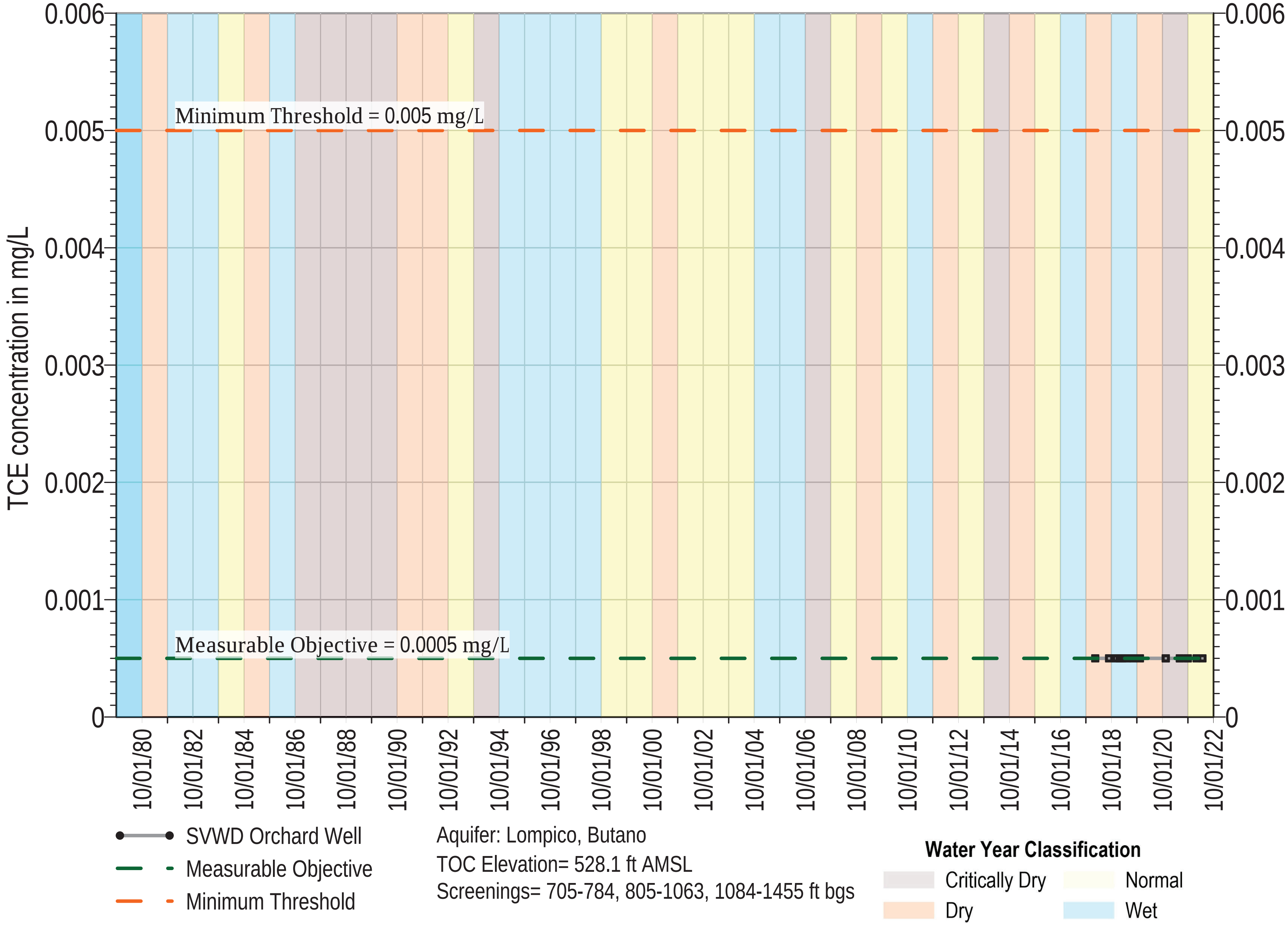

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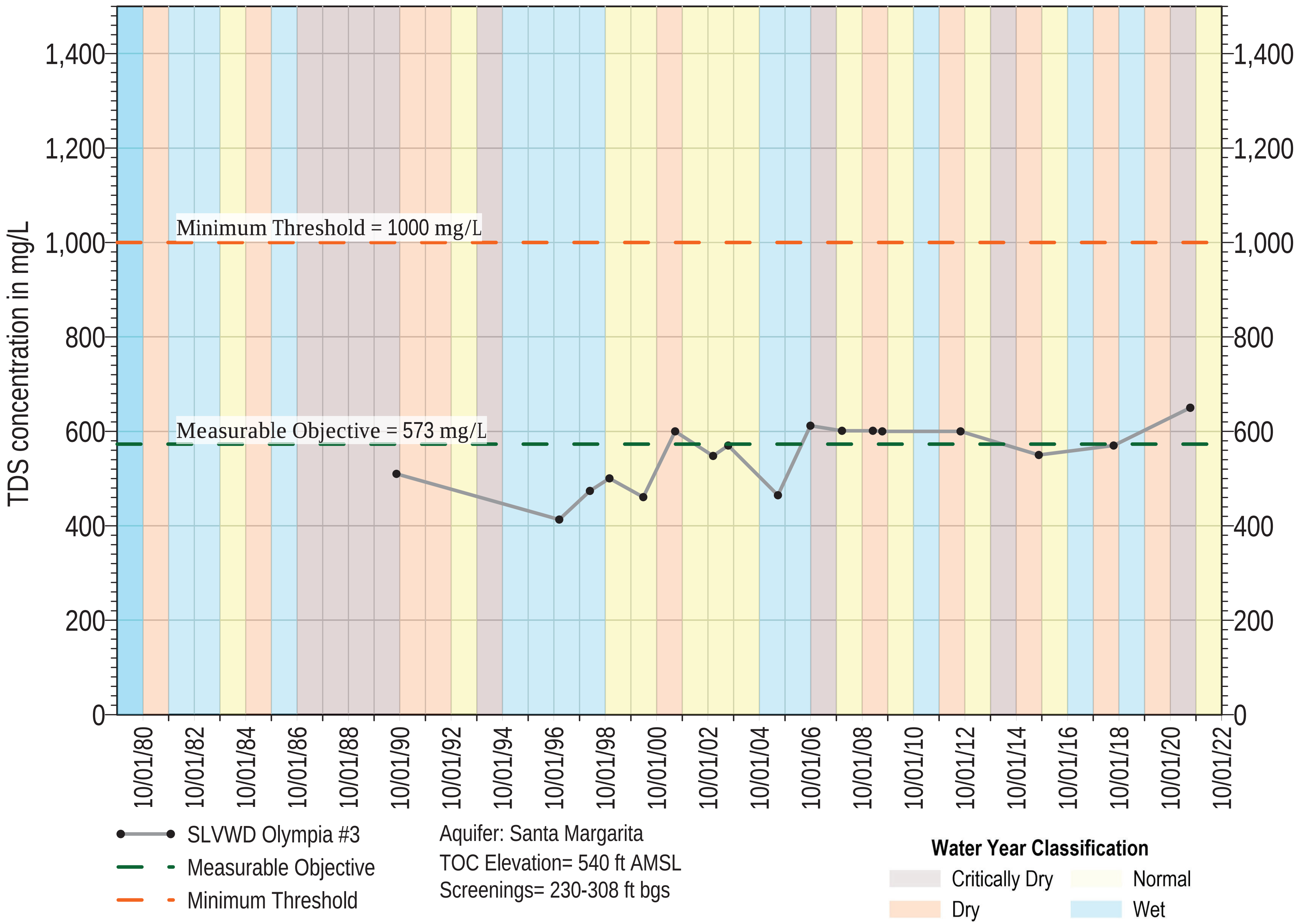
TDS



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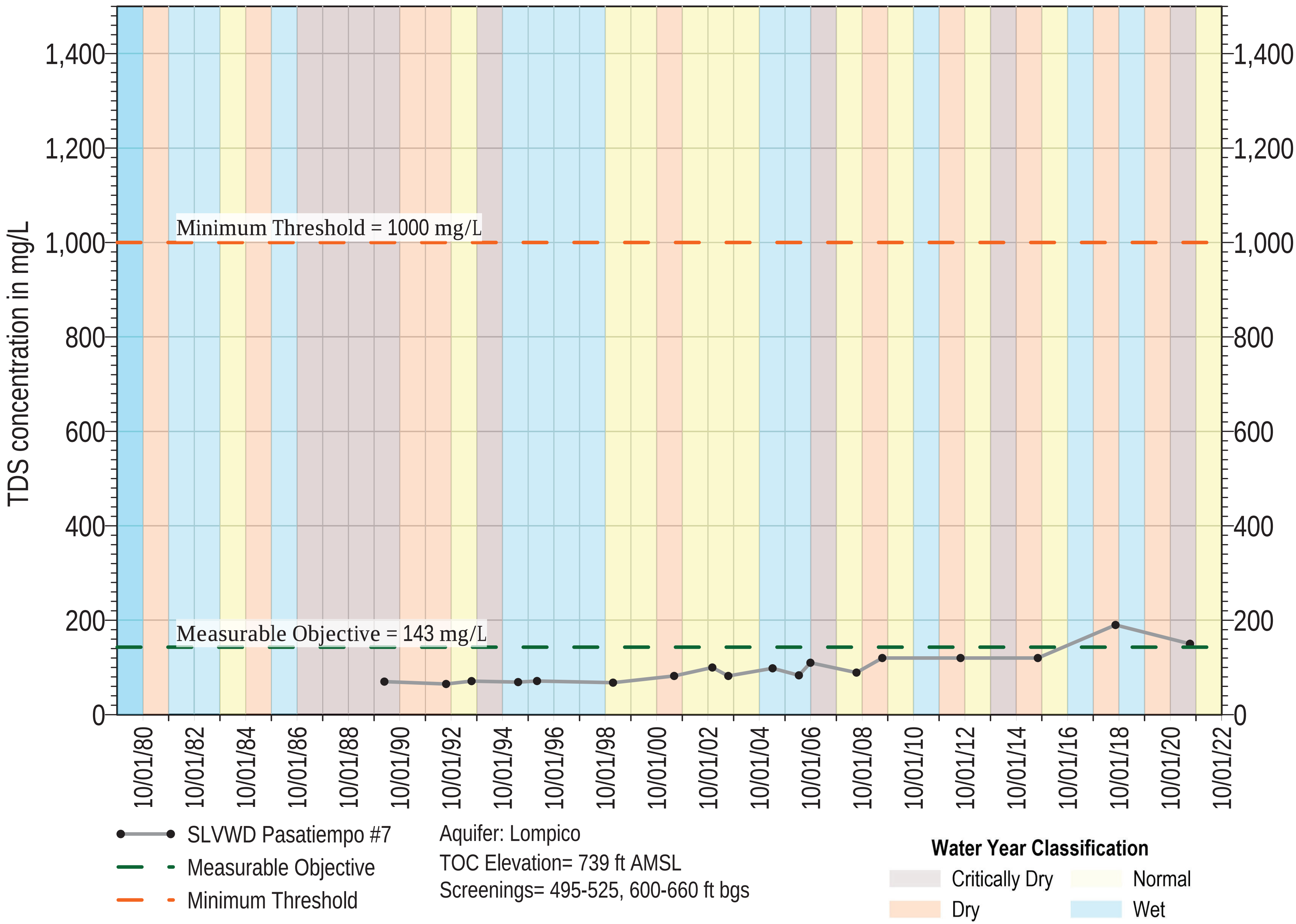

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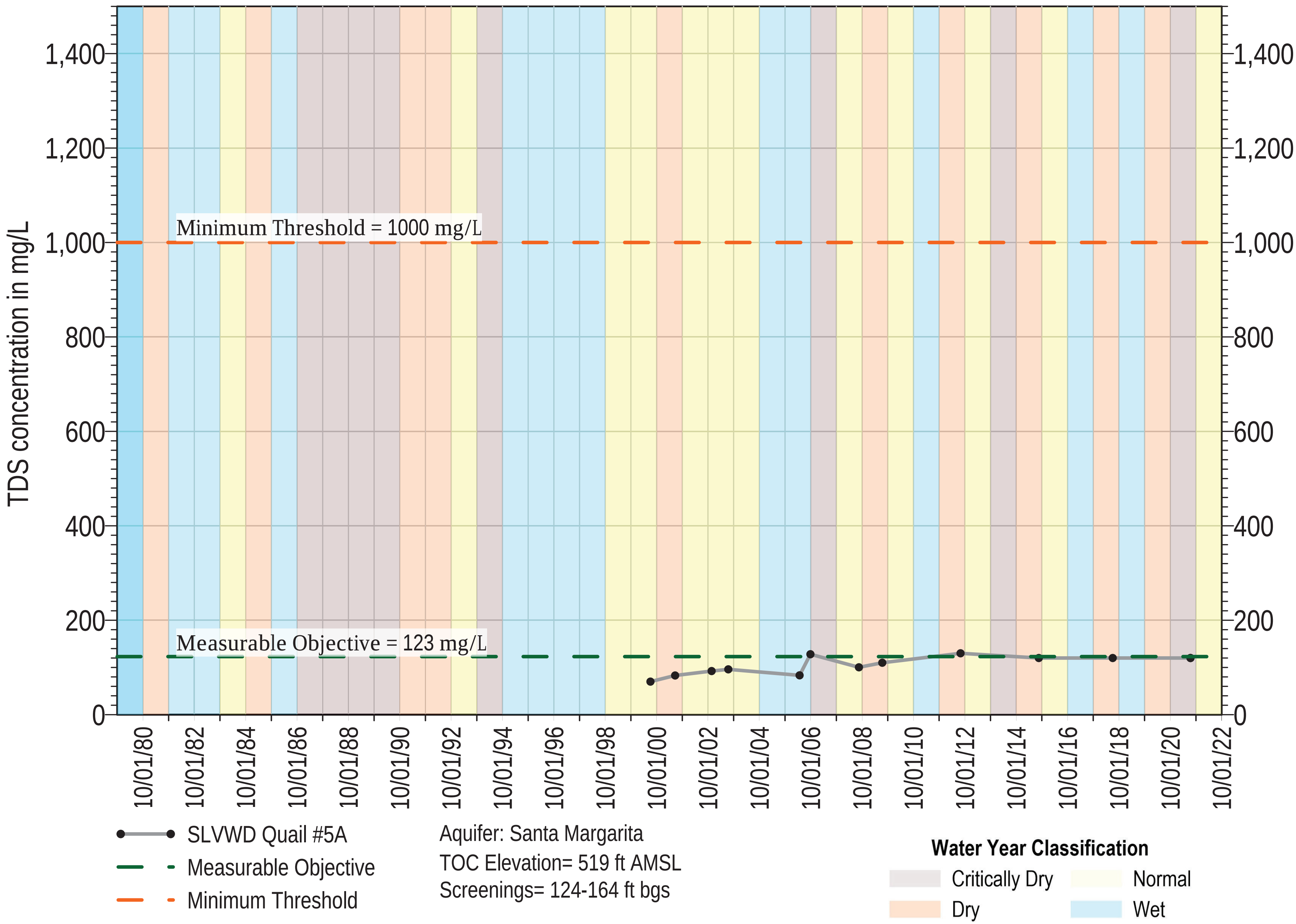

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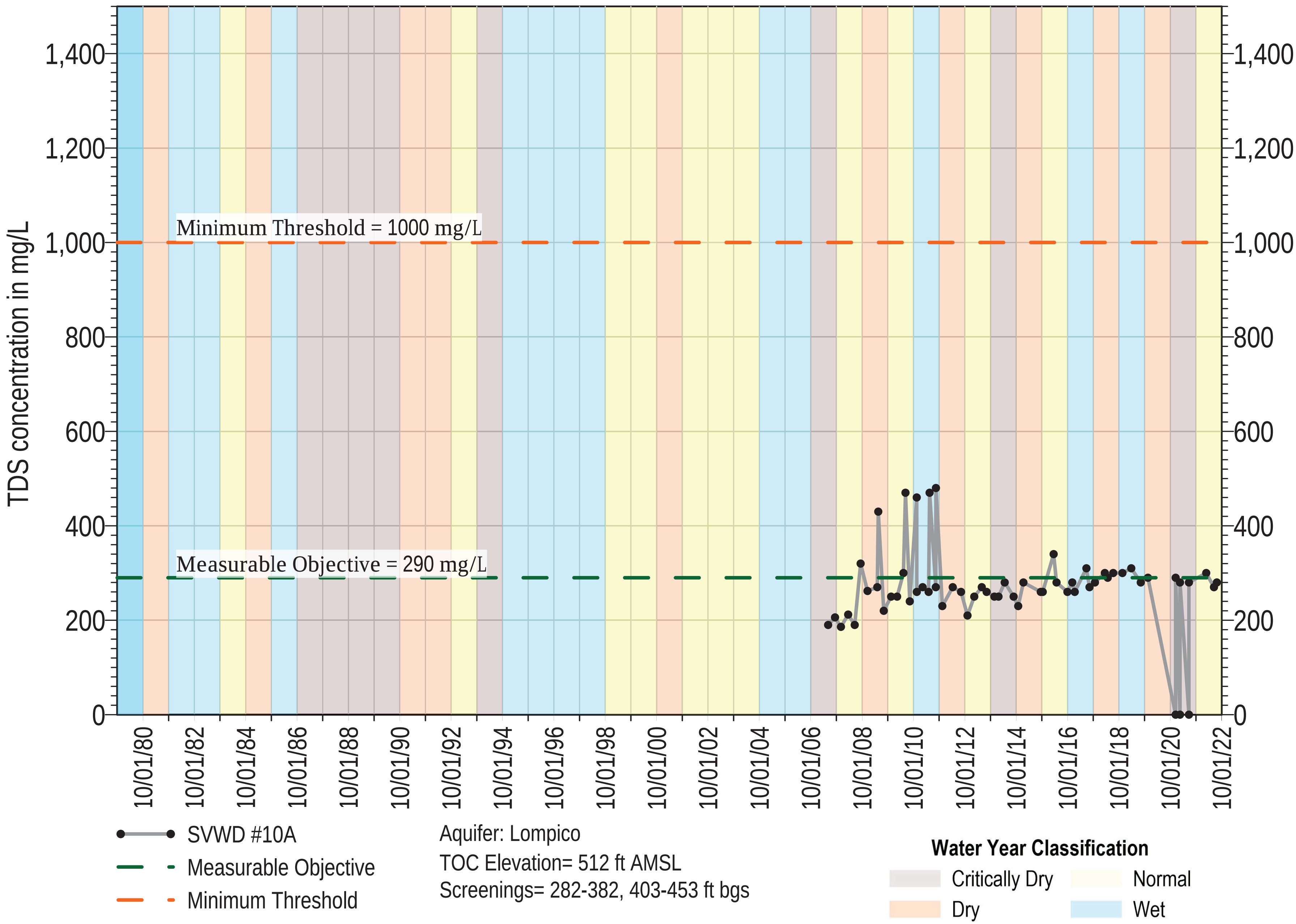

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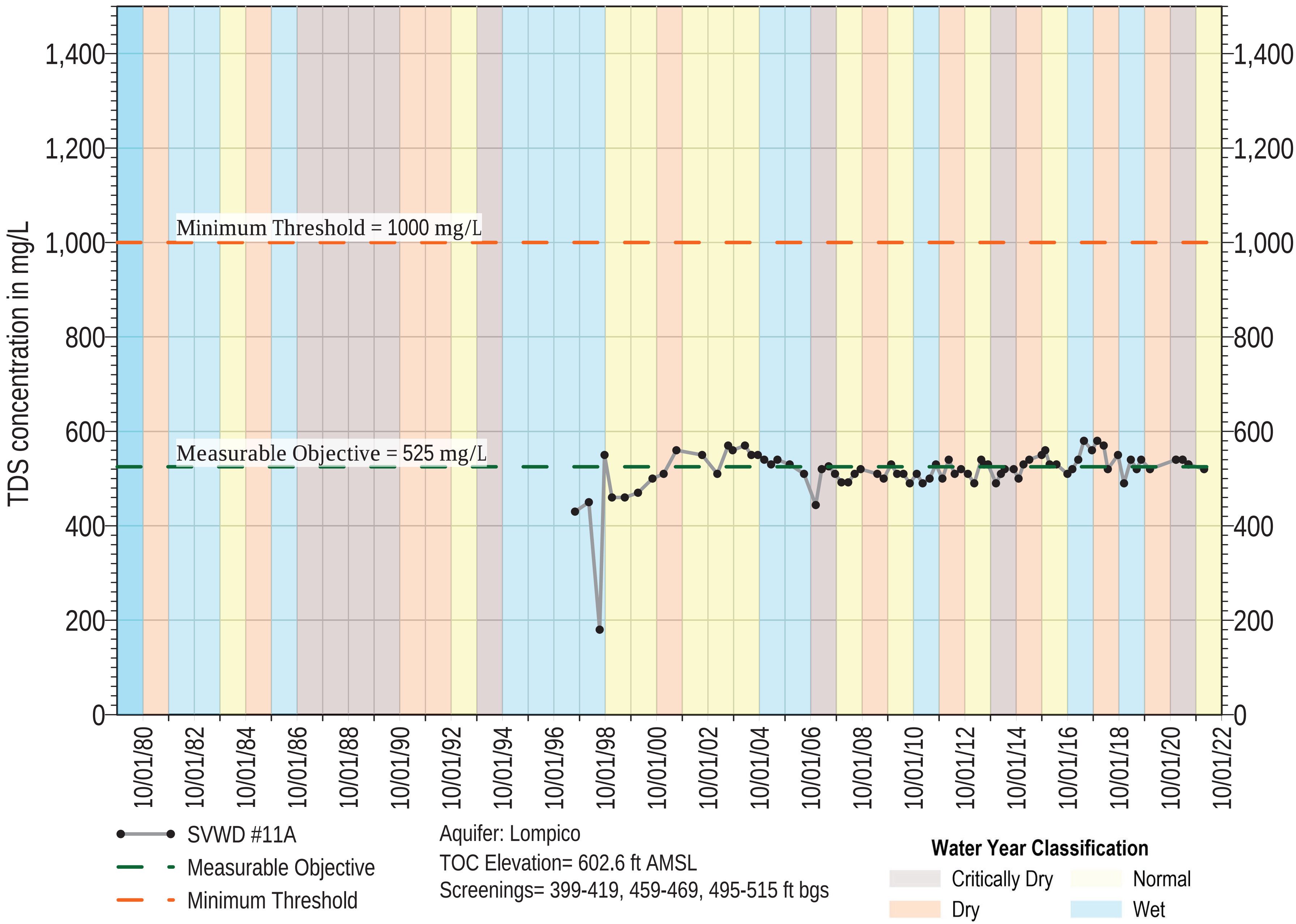

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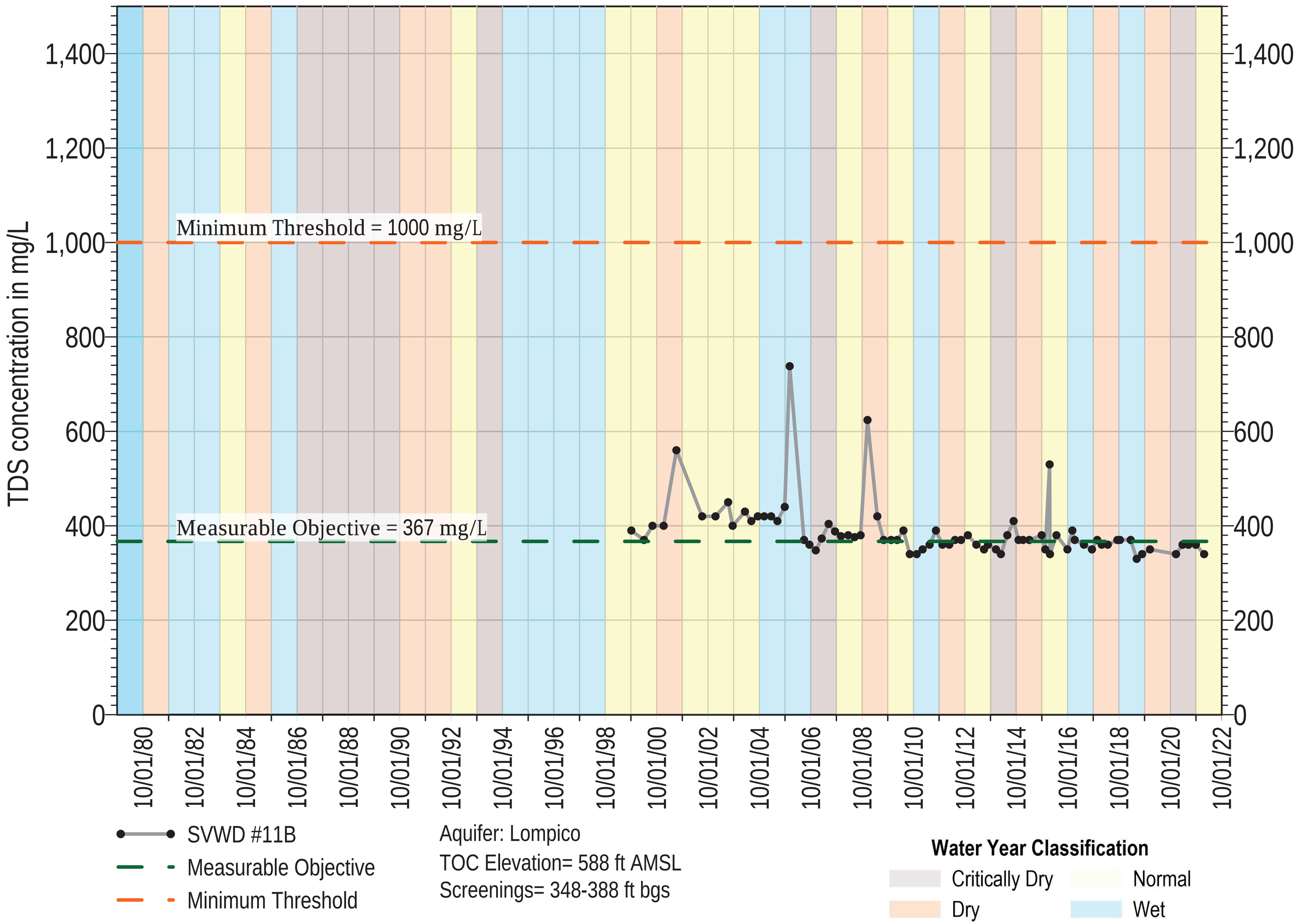

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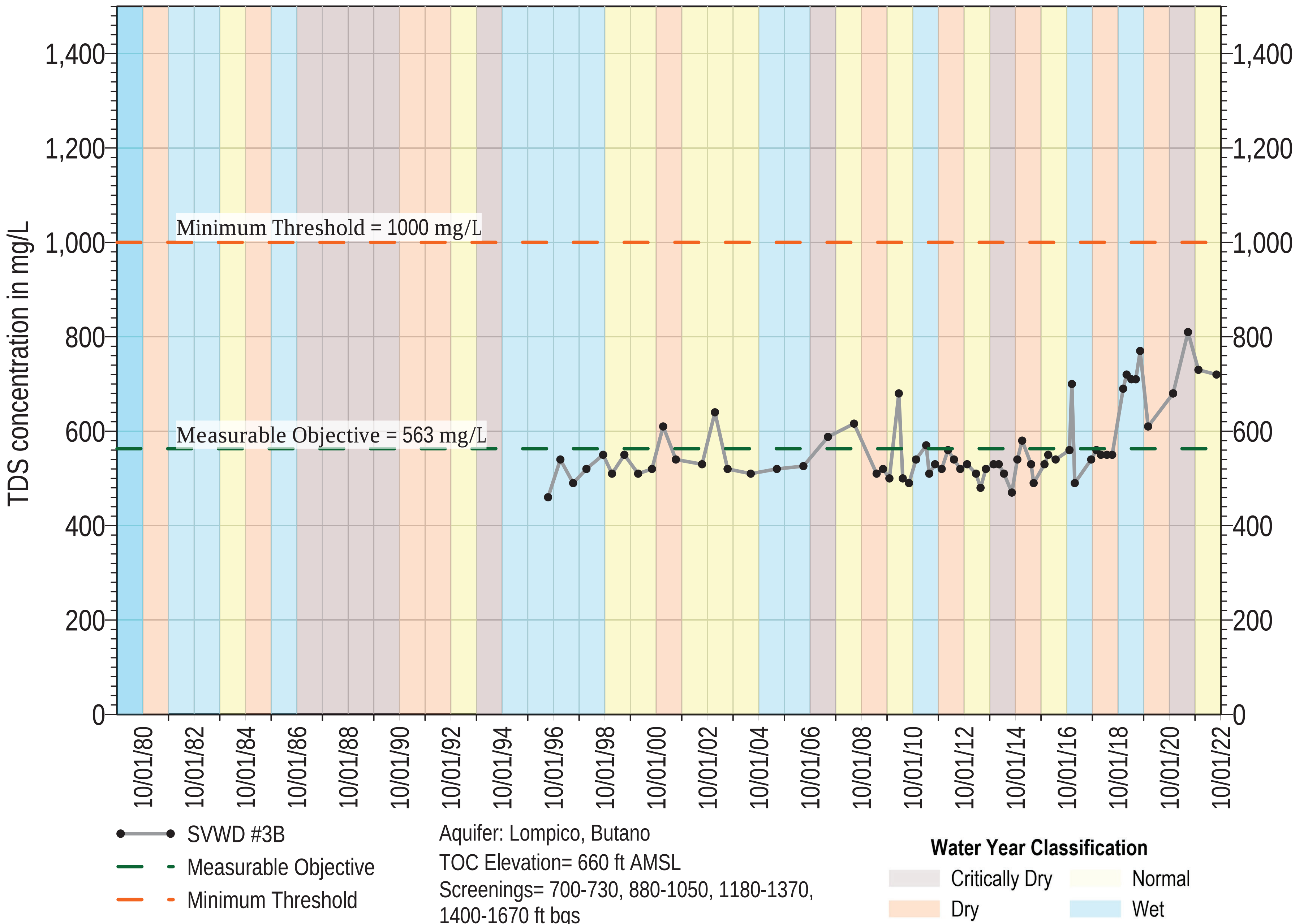

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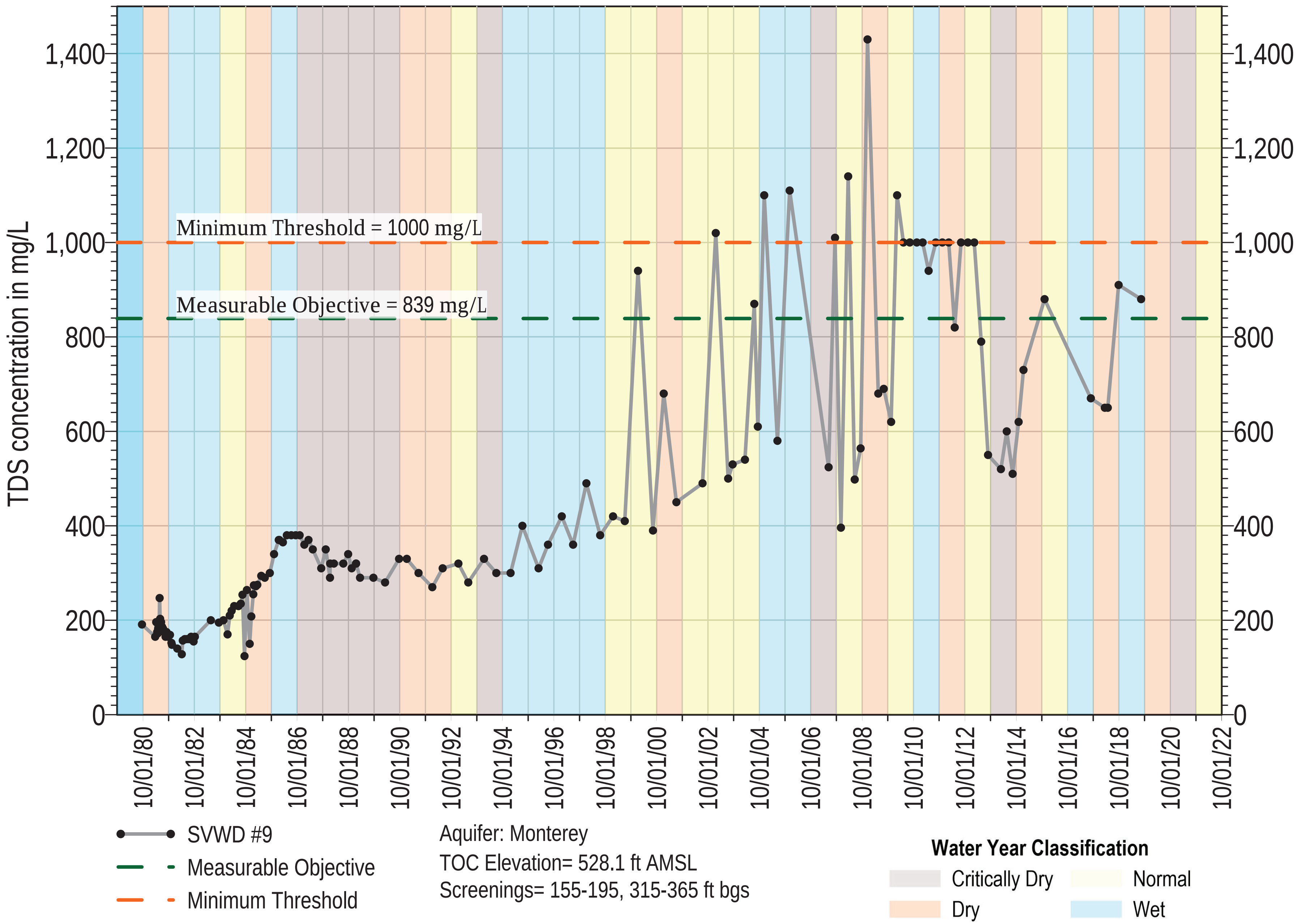

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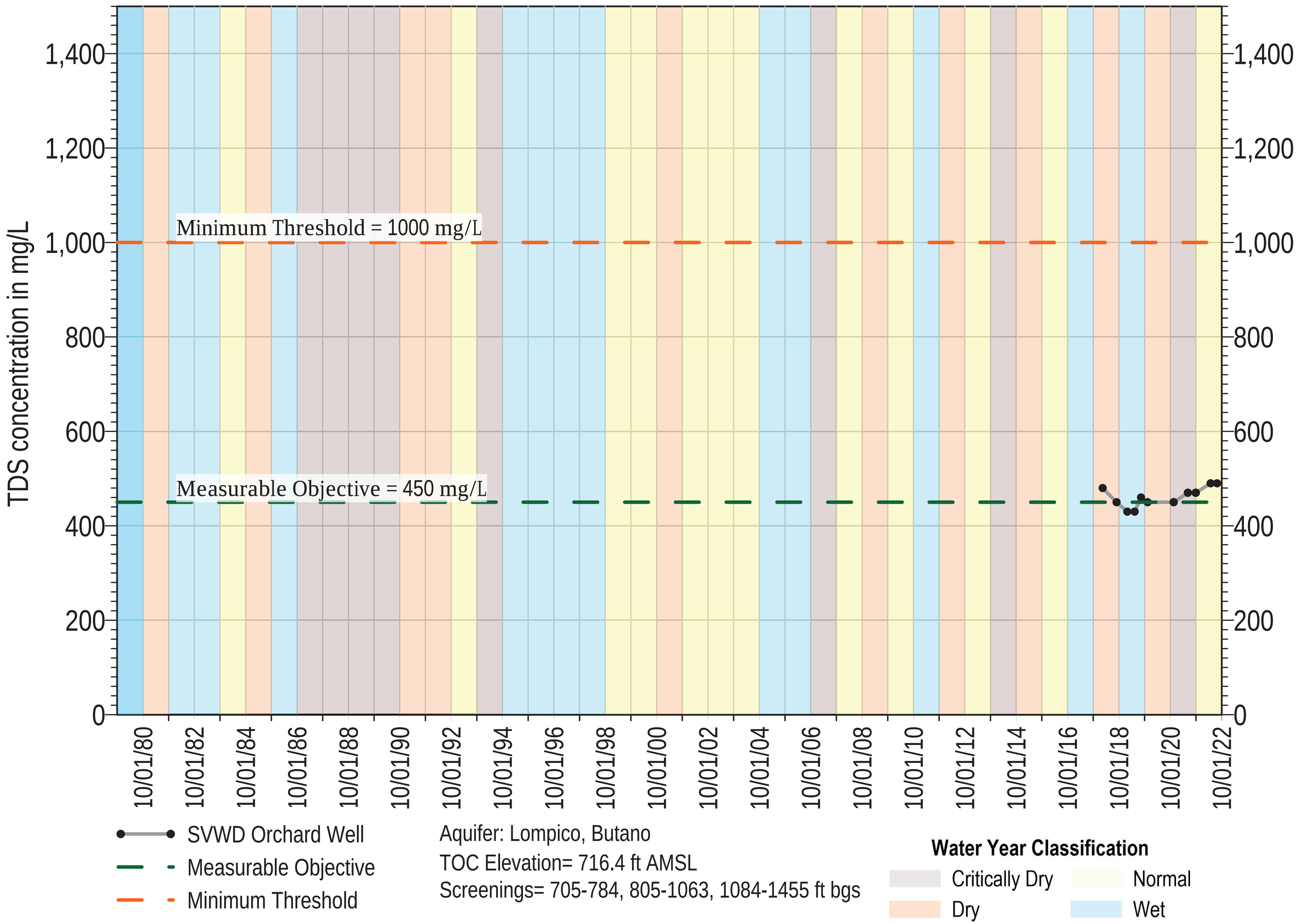

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